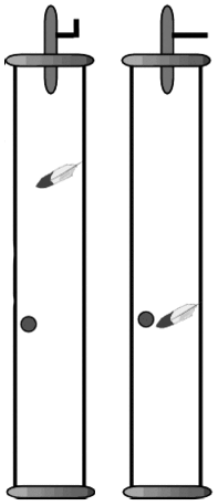
Chapter Two

Motion

After reading this chapter students will be able to —

- explain rest and motion
- find out the difference among different types of motion
- explain scalar and vector quantities
- analyze the relation among the quantities regarding motion.
- explain the motion of freely falling bodies.
- analyze the relations among the quantities regarding motion with the help of graph.
- realize the effects of motion in our life.

It is our common experience that a body having a higher mass falls down much faster than a body having a mass lower than that. But Galileo proved it wrong. His first law of falling bodies states that all bodies irrespective of their masses will reach the ground at the same time from the same height if there is no resistance of the air. Sir Issac Newton proved this law true by conducting an experiment with a gold coin and a feather in an air tight jar.



Multiple Choice Questions

294 Multiple Choice Questions ■ 178 General MCQ ■ 52 Multiple Completion Based ■ 64 Situation Set Based ■ 18 Board questions ■ 94 Cadet College questions

Textual Creative MCQs with Answers

Tutor: Read all the relevant information attentively. It will enhance your ability in answering similar but more important questions.

1. What is the unit of acceleration?

ⓐ ms^{-1} ⓑ ms^{-2}
ⓒ Ns ⓓ $kgNs^{-2}$

Ans: ⓑ

More information relating to this question:

- Acceleration means the rise in velocity with time
- Unit of speed or velocity is ms^{-1}.
- Unit of acceleration is ms^{-2}.
- Unit of impulse of force is Ns.

2. What type of motion does the hands of a clock have?

ⓐ linear motion ⓑ elliptical motion
ⓒ periodic motion ⓓ vibratory motion

Ans: ⓒ

More information regarding this question:

- If the motion of a moving particle is such that it passes through a definite point along the path of its motion in the same direction in a definite time interval, this type of motion is called periodic motion.
- The examples of periodic motion are the motion of the hands of a clock, the motion of the earth round the sun, etc.

3. The distance traveled in a given time by a freely falling body from rest will be—

ⓐ proportional to the time
ⓑ proportional to the square of that time
ⓒ inversely proportional to that time
ⓓ inversely proportional to the square of that time

Ans: ⓑ

More information relating to this question:

- The acceleration in case of a freely falling body is uniform.
- Acceleration due to gravity does not depend on the mass of a falling body.
- A falling body reaches the ground due to the effect of gravity.

4. A body moves with a uniform acceleration a starting from rest. What will be the traveled distance of the body at a given time?

i. $s = \frac{(u + v)t}{2}$ ii. $s = ut + \frac{1}{2} at^2$

iii. $s^2 = u^2 + 2at$

Which one of the following is correct?

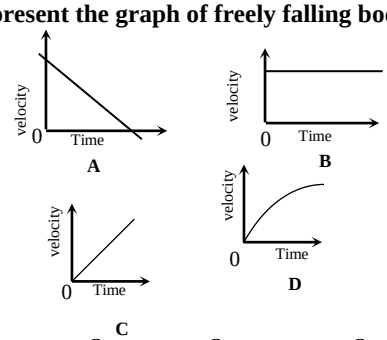
ⓐ i ⓑ ii ⓒ ii & iii ⓓ i, ii & iii

Ans: ⓓ

More information regarding this question:

- There are four equations regarding motion.
- The equations regarding motion apply when a body moves straight with uniform acceleration.

5. Which one of the velocity- time graph below does represent the graph of freely falling body?



ⓐ A ⓑ B ⓒ C ⓓ D

Ans: ⓒ

More information relating to this question:

- The velocity of a body moving with non uniform acceleration depends on time.
- The rise in velocity of a moving body will remain the same only when the body moves with uniform acceleration.
- In case of uniform acceleration, the velocity-time graph is a straight line.

Board Exam MCQs with Answers

Board Exam questions are very important for the exam preparation. So practice these questions again and again properly.

6. What is the change in distance of an object called? *[Rajshahi Board 2015]*
ⓐ Velocity ⓑ distance
ⓒ acceleration ⓓ speed **d**

7. The velocity of a car reduces from 30 ms^{-1} With constant deceleration to 10 ms^{-1} after 5s. What is the acceleration of the car? *[Rajshahi Board 2015]*
ⓐ – 8 ms^{-2} ⓑ 8 ms^{-2}
ⓒ – 4 ms^{-2} ⓓ 4 ms^{-2} **c**

8. How many equations are there of speed? *[Dhaka Board 2015]*
ⓐ 2 ⓑ 3 ⓒ 4 ⓓ 5 **c**

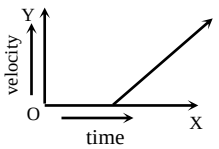
9. What will be the displacement if $\frac{1}{4}$ th distance is covered of a circle of radius 10m? *[Comilla Board 2015]*
ⓐ 7. 854 m ⓑ 7.071 m
ⓒ 5m ⓓ 2.5m **b**

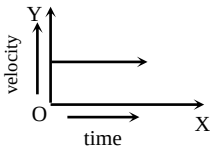
10. Which one of the following is used to measure velocity? *[Comilla Board 2015]*
ⓐ Nanometer ⓑ speedometer
ⓒ Hydrometer ⓓ Barometer. **b**

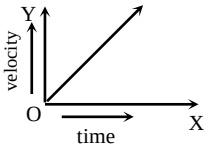
11. The velocity of a car increases at a constant rate from 15 ms^{-1} to 75 ms^{-1} in 10 s. What is the acceleration of the car? *[Sylhet Board 2015]*
ⓐ 2 ms^{-2} ⓑ 3 ms^{-2}
ⓒ 6 ms^{-2} ⓓ 5 ms^{-2} **c**

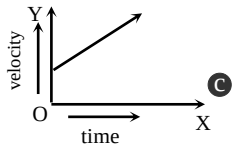
12. Which one of the following is the fundamental unit of acceleration? *[Sylhet Board 2015]*
ⓐ LT^2 ⓑ LT^{-1}
ⓒ MLT^2 ⓓ LT^{-2} **d**

13. Which diagram represents the path of an object from rest to continuous acceleration? *[Sylhet Board 2015]*
Answer – Diagram Based

ⓐ 

ⓑ 

ⓒ 

ⓓ 

c

14. If a box is pushed, the speed it gains without flipping over—*[Jessore Board 2015]*
ⓐ Oscillatory motion ⓑ Linear motion
ⓒ Periodic motion ⓓ Rotatory motion **b**

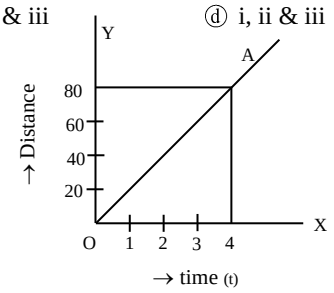
15. At what velocity will a body hit the ground when it is dropped from a height of 75 m? [g = 9.8 ms^{-1}] *[Jessore Board 2015]*
ⓐ 38.3 ms^{-1} ⓑ 75 ms^{-1}
ⓒ 735 ms^{-1} ⓓ 1470 ms^{-1} **a**

16. What is the dimension of momentum?
ⓐ MLT^{-1} ⓑ ML^2T^{-1}
ⓒ MLT^{-2} ⓓ MLT^{-3} **a**

17. What is the motion of the simple pendulum? *[Barisal Board 2015]*
ⓐ Straight line ⓑ Parabola
ⓒ Circular ⓓ Vibrating **d**

18. An object is falling from the top of a house which height is 50m. What will be its velocity when it touches the earth surface? *[Barisal Board 2015]*
ⓐ 21.1 ms^{-1} ⓑ 23.3 ms^{-1}
ⓒ 30.0 ms^{-1} ⓓ 31.3 ms^{-1} **d**

19. Circular motion is — *[Sylhet Board 2015]*
i. Motion of a pendulum
ii. The motion of the cylinder of a petrol engine
iii. Motion of Vibrating tuning fork
Which one of the following is correct?
ⓐ i & ii ⓑ i & iii
ⓒ ii & iii ⓓ i, ii & iii **d**



Answer 20 and 21 using the above diagram :
In figure, the kinetic condition of the thing's mass is 100 gm.

20. What is the kinetic Energy of the object at point A? *[Dhaka Board 2015]*
ⓐ 10 J ⓑ 20 J ⓒ 30 J ⓓ 40 J **b**

21. The object's — *[Dhaka Board 2015]*
i. Constant velocity
ii. constant acceleration
iii. The force applied is constant
Which one of the following is correct?
ⓐ i & ii ⓑ i & iii
ⓒ ii & iii ⓓ i, ii & iii **c**

The time and the corresponding velocity of a car is given on the following table —

Time (s)	0	10	20	30	40
Velocity ms^{-1}	0	5	10	10	5

On the basis of the above stem answer question numbers 22 and 23 :

22. What is the displacement of the car after 10 second? *[Dinajpur Board 2015]*
ⓐ 50 m ⓑ 25 m ⓒ 5 m ⓓ 2 m **b**

23. Which one of the following is correct about the nature of motion of the car after every 10 second from rest position? *[Dinajpur Board 2015]*
ⓐ Uniform acceleration, uniform velocity and uniform retardation
ⓑ Uniform velocity, uniform acceleration and uniform velocity
ⓒ Uniform velocity, uniform acceleration and uniform retardation
ⓓ Uniform acceleration, uniform retardation and uniform velocity. **b**

Cadet Colleges MCQs with Answers

Cadet Colleges questions are also important for your excellent preparation. It will help you to give a clear idea about the question as well as chapterwise exclusive questions and answers. So, practice them with proper attention.

24. What does the tangent drawn at point of the velocity– time graph indicate? *[Mymensingh Girls' Cadet-2015]*
ⓐ displacement ⓑ retardation
ⓒ acceleration ⓓ velocity **c**

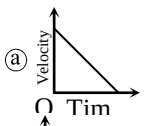
The velocity of a car decreases at a uniform rate from 20m/s and 4 m/s in 4 sec.

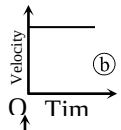
25. What is the acceleration of the car? *[Mymensingh Girls' Cadet-2015]*
ⓐ 4 m/s^2 ⓑ –4 m/s^2
ⓒ 16 m/s^2 ⓓ –16 m/s^2 **b**

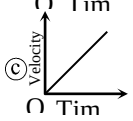
26. The car– *[Mymensingh Girls' Cadet-2015]*
i. will stop after running another 4 sec in case of the prevailing velocity
ii. covers 48m at the given time
iii. has an average velocity of 12 m/s
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **c**

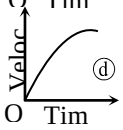
27. Two friends are sitting face to face in a compartment of a running train. What is one's position with respect to an static reference object? *[Mymensingh Girls' Cadet-2015]*
ⓐ Relative rest ⓑ relative motion
ⓒ absolute rest ⓓ absolute motion **b**

28. Which one of the velocity – time graph below does represent the graph of freely falling body? *[Rajshahi Cadet-2015]*

ⓐ 

ⓑ 

ⓒ 

ⓓ 

c

29. Periodic motion applies to *[Rajshahi Cadet-2015]*
i. circular movement
ii. elliptical movement
iii. stright line movement
Which one is correct?
ⓐ i & ii ⓑ i & iii
ⓒ ii & iii ⓓ i, ii & iii **d**

30. A force of 5 N is applied on a body of mass 5 kg, its acceleration will be
ⓐ 0.5 ms^{-2} ⓑ 10 ms^{-2}
ⓒ 100 ms^{-2} ⓓ 1 ms^{-2} **d**

31. In case of floatation- *[Rajshahi Cadet-2015]*
i. $(m \times g) > (F_2 - F_1)$
ii. $(m \times g) < (F_2 - F_1)$
iii. $(m \times g) = (F_2 - F_1)$
Which one is correct?
ⓐ i & ii ⓑ i & iii
ⓒ ii & iii ⓓ i, ii & ii **c**

The velocity of a car after every five seconds is given in the table below. *[Pabna Cadet-2015]*

Time(s)	0	5	10	15	20	25	30	35	40
Velocity (m/s)	0	10	20	30	30	30	30	15	0

Now answer the questions no 32, 33 & 34.

32. In 20s the distance traveled by this car is– *[Pabna Cadet-2015]*
ⓐ 200 m ⓑ 250 m
ⓒ 375 m ⓓ 255 m **c**

33. The total distance traveled by this car is– *[Pabna Cadet-2015]*
ⓐ 375 m ⓑ 775 m ⓒ 825 m ⓓ 925 m **c**

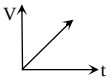
34. By analysis the velocity of this car, it can be understand that *[Pabna Cadet-2015]*
i. At first the car moves with uniform acceleration
ii. Then some time it moves with uniform velocity and then retardation occur
iii. Form first to last the car moves with uniform acceleration
Which one is correct?
ⓐ i & iii ⓑ i & ii ⓒ ii & iii ⓓ ii **b**

From the following stem, answer the next two questions. *[Pabna Cadet-2015]*
A car is moving with a velocity of 60 Kmh^{-1}. It is accelerated by 3 ms^{-2} in 4 sec.

35. What is the final velocity of the car? *[Pabna Cadet-2015]*
ⓐ 14.18 ms^{-1} ⓑ 24.29 ms^{-1}
ⓒ 26.76 ms^{-1} ⓓ 28.67 ms^{-1} **d**

36. How far will it travel during the period of acceleration? *[Pabna Cadet-2015]*
ⓐ 60.79 m ⓑ 90.68 m
ⓒ 80.58 m ⓓ 75 m **b**

37. Which type of motion represent the figure? *[Pabna Cadet-2015]*

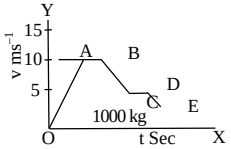


ⓐ Uniform acceleration
ⓑ Non uniform acceleration
ⓒ Uniform velocity
ⓓ Non uniform Velocity **a**

38. What type of motion does the hands of a clock have? *[Joypurhat Girls' Cadet-2015]*
ⓐ Linear motion ⓑ Elliptical motion
ⓒ Periodic motion ⓓ Vibratory motion **c**

39. The distance traveled in a given time by a freely falling body from rest will be *[Joypurhat Girls' Cadet-2015]*
ⓐ Proportional of the time
ⓑ Proportional to the square of that time
ⓒ Inversely proportional to that time
ⓓ Inversely proportional to the square of that time **b**

Answer the question 40 and 41 according to the following graph *[Joypurhat Girls' Cadet-2015]*



40. At which part of the graph velocity increases in proportion to time? *[Joypurhat Girls' Cadet-2015]*
ⓐ part OA ⓑ part AB
ⓒ part CD ⓓ part DE **a**

41. What is the maximum kinetic energy? *[Joypurhat Girls' Cadet-2015]*
ⓐ 1.25×10^5 J ⓑ 5×10^4 J
ⓒ 1.25×10^4 J ⓓ 6.2×10^3 J **b**

42. A man clapped standing on one of the banks of a river. Echo is heard after 1.5s due to the reflection of the sound from another bank. If the velocity of sound at that time is 340 ms^{-1}, what is the breadth of the river? *[Joypurhat Girls' Cadet-2015]*
ⓐ 243 m ⓑ 255 m
ⓒ 257 m ⓓ 260 **b**

43. What will be the distance covered by a body in case it takes a full rotation around a circular field having radius, r? *[Rangpur Cadet-2015]*
ⓐ 0 ⓑ πr
ⓒ $2\pi r$ ⓓ πr^2 **c**

44. A running car gains an acceleration of $2ms^{-2}$ from rest with a speed of $20ms^{-1}$. What time does the car take to gain this level of speed? *[Rangpur Cadet-2015]*
ⓐ 20s ⓑ 15s
ⓒ 10s ⓓ 5s **c**

45. What type of motion does the hand of a clock have? *[Comilla Cadet-2015]*
ⓐ Linear motion ⓑ Elliptical motion
ⓒ Periodic motion ⓓ Vibratory motion **c**

46. The distance traveled in a given time by a freely falling body from rest will be– *[Comilla Cadet-2015]*
ⓐ Proportional of the time
ⓑ Proportional to the square of that time
ⓒ Inversely proportional to that time
ⓓ Inversely proportional to the square of that time **b**

47. The acceleration of a moving body can be found from: *[Comilla Cadet-2015]*
ⓐ area under velocity-time graph
ⓑ area under distance-time graph
ⓒ slope of the velocity-time graph
ⓓ slope of the distance-time graph **c**

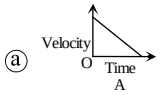
48. Starting from rest the velocity of a freely falling body is *[Comilla Cadet-2015]*
ⓐ Inversely proportional to the time of fall
ⓑ Directly proportional to the time of fall
ⓒ Inversely proportional to the square of the time of fall
ⓓ Directly proportional to the square of the time of fall **d**

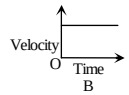
49. If the distance between the earth and moon is doubled then the gravitational force will become– *[Comilla Cadet-2015]*
i. half ii. double
iii. one fourth
Which one of the following is correct?
ⓐ i ⓑ ii
ⓒ iii ⓓ i, ii & iii **c**

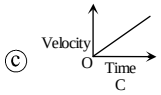
50. Which is the velocity gradient? *[Comilla Cadet-2015]*
ⓐ The derivative of acceleration with respect to distance
ⓑ The derivative of velocity with respect to distance
ⓒ The derivative of displacement with respect to distance
ⓓ The derivative of force with respect to distance **b**

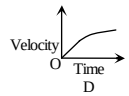
51. The tendency or property of a body to maintain its present state forever is called what? *[Comilla Cadet-2015]*
ⓐ force ⓑ acceleration
ⓒ inertia ⓓ velocity **c**

52. Which one of the velocity-time graph below does represent the graph of freely falling body? *[Feni Girls' Cadet-2015]*

ⓐ 

ⓑ 

ⓒ 

ⓓ 

c

53. With what velocity will a bus starting from rest and traveling with uniform acceleration 10 ms^{-2} cross a milepost at a distance of 125 m? *[Feni Girls' Cadet-2015]*
ⓐ 50 ms^{-1} ⓑ 75 ms^{-1}
ⓒ 80 ms^{-1} ⓓ 100 ms^{-1} **a**

54. Example of vibratory motion is– *[Feni Girls' Cadet-2015]*
i. heads of a clock
ii. motion of tuning fork
iii. motion of string of guiter
Which one of the following is correct?
ⓐ i & ii ⓑ iii
ⓒ ii & iii ⓓ ii **c**

55. Which type of velocity do we find of sound on moon? *[Feni Girls' Cadet-2015]*
ⓐ Maximum ⓑ Minimum
ⓒ Zero ⓓ 332 ms^{-1} **c**

56. What is the aceeleration due to gravity in the direction of vertically upward? *[Faujdarhat Cadet-2015]*
ⓐ 0 ms^{-2} ⓑ 9.8 ms^{-1}
ⓒ –9.8 ms^{-2} ⓓ 9.8 ms^{-2} **c**

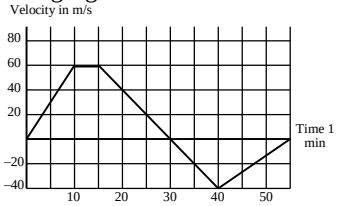
57. What is the final velocity of a body moving against gravity when it attains the maximum height? *[Faujdarhat Cadet-2015]*
ⓐ Zero ⓑ $\frac{U^2}{2g}$ ⓒ h/t ⓓ 2gh **a**

Read the following stem and answer the question 58. *[Faujdarhat Cadet-2015]*
During a 40 Km race the time taken by the runner was recorded at 8 K m intervals and the result are shown in the table below.

Distance/Km	0	8.0	16.0	24.0	32.0	40
Time/hours	0	0.70	1.42	2.13	2.80	4.25

58. What is the velocity of the runner after traveling 16 Km? *[Faujdarhat Cadet-2015]*
ⓐ 11.43 ⓑ 11.11 ⓒ 11.26 ⓓ 9.41 **c**

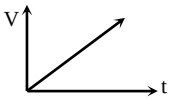
See the following figure and answer next two questions



59. The above graph represents– *[Sylhet Cadet-2015]*
ⓐ uniform velocity
ⓑ non uniform velocity
ⓒ uniform acceleration
ⓓ non uniform acceleration **b**

60. If a car follows the graph then the car will– *[Sylhet Cadet-2015]*
i. suddenly stop in its way of motion
ii. move with an uniform velocity for a certain time
iii. run in opposite direction in a particular time
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **d**

61. Which type of motion represents the figure? *[Jhenidah Cadet-2015]*



ⓐ Uniform acceleration ⓑ Non uniform acceleration
ⓒ Uniform velocity ⓓ Non uniform velocity **a**

The velocity of a car after every five seconds is given in that table below. *[Jhenidah Cadet-2015]*

Times (S)	0	5	10	15	20	25	30	35	40
Velocity	0	10	20	30	30	30	30	15	0

Now answer the questions no 62, 63 & 64.

62. In 20s the distance traveled by this car is– *[Jhenidah Cadet-2015]*
ⓐ 200 m ⓑ 250m
ⓒ 375m ⓓ 255m **c**

63. The total distance traveled by this car is– *[Jhenidah Cadet-2015]*
ⓐ 375m ⓑ 775m
ⓒ 825m ⓓ 925m **c**

64. By analysis the velocity from above table of this car, it can be understand that *[Jhenidah Cadet-2015]*
i. At first the car moves with uniform acceleration
ii. Then some time it moves with uniform velocity and then retardation occur
iii. From first to last the car moves with uniform acceleration
Which one of the following is correct?
ⓐ i& ii ⓑ i& iii
ⓒ ii& iii ⓓ i ,ii &iii **b**

65. Which two quantities have same unit and dimension? *[Barisal Cadet-2015]*
ⓐ Energy and work
ⓑ Mass and weight
ⓒ Acceleration and velocity
ⓓ Displacement and velocity **a**

66. A car starts to move with initial velocity of $5ms^{-1}$ and after 10s becomes $45ms^{-1}$. What is the displacement of the car during this time? *[Barisal Cadet-2015]*
ⓐ 100 m ⓑ 200 m
ⓒ 400 m ⓓ 250 m **d**

Answer the questions (67 & 68) according to the following chart for a moving car with 10 ms^{-1} initial velocity. *[Barisal Cadet-2015]*

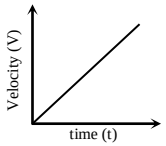
Time interval, t (s)	0-5	6-10	11-15	16-20
Acceleration, a (ms^{-2})	0	3	2	–1

67. What is the value of velocity after 10 sec? *[Barisal Cadet-2015]*
ⓐ 10 ms^{-1} ⓑ 20 ms^{-1}
ⓒ 25ms^{-1} ⓓ 30ms^{-1} **c**

68. At which time interval is the displacement of the car maximum? *[Barisal Cadet-2015]*
ⓐ 0-5 sec ⓑ 6-10 sec
ⓒ 11-15 sec ⓓ 16-20 sec **d**

69. Which is the dimension of pressure? *[Barisal Cadet-2015]*
ⓐ $[MLT^{-1}]$ ⓑ $[MLT^{-2}]$
ⓒ $[ML^{-1}T^{-2}]$ ⓓ $[ML^{-3}]$ **c**

70.



[Mirzapur Cadet-2014]

This graphs represents—
i. non-uniform acceleration
ii. Uniform acceleration
iii. rate of change of velocity is constant
Which one of the following is correct?
ⓐ i ⓑ ii
ⓒ iii ⓓ ii & iii **d**

71. An object moving at the speed of 20m/s loses its speed by 3 m/s. How far does travel before it stops? *[Mirzapur Cadet-2014]*
ⓐ 66m ⓑ 66.67m
ⓒ 69m ⓓ 70m **b**

72. Motion of rocket is the example of — *[Mirzapur Cadet-2014]*
ⓐ Law of conservation of momentum
ⓑ Newton's 1st law
ⓒ Law of motion
ⓓ Newton's 2nd law **a**

Now In the table below, the change of velocity with time of a car is shown --- *[Mymensingh Girls' Cadet-2014]*

Time (s)	0	5	10	15	20	25	30	35
Velocity (m/s)	0	1	2	3	3	3	3	1

answer the question number 73 & 74.

73. IN case the anlaysis of the car It starts the jounery.
ⓐ With uniform acceleration
ⓑ 1st uniform acceleration then. uniform velocity
ⓒ Whole times with uniform acceleration
ⓓ 1st retardation then uniform acceleration **b**

74. What is the traveled distance of the car in 15s?
ⓐ 12.5m ⓑ 17.5m ⓒ 20.5m ⓓ 22.5m **d**

75. If a bus at rest suddenly starts moving, the passengers will? *[Mymensingh Girls' Cadet-2014]*
ⓐ Lean forwards ⓑ lean backwards
ⓒ Remain stationary ⓓ Keep running **b**

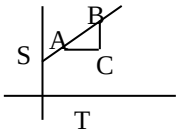
76. Which type of motion does the hand of a clock have? *[Rajshahi Cadet-2014]*
ⓐ Linear motion ⓑ Elliptical motion
ⓒ Periodic motion ⓓ Vibratory motion **c**

A car having velocity 54kmh^{-1} is accelerated during time 5 seconds and final velocity rises up to 35ms^{-1}. Now answer the question no. 77 & 78.

77. What was the accerleration? *[Pabna Cadet-2014]*
ⓐ $5ms^{-2}$ ⓑ $-4ms^{-2}$
ⓒ $-5ms^{-2}$ ⓓ $4ms^{-2}$ **d**

78. What will be the displacement? *[Pabna Cadet-2014]*
ⓐ 122m ⓑ 123m
ⓒ 124m ⓓ 125m **d**

79. Which one is correct in case of g? *[Pabna Cadet-2014]*
i. Standard value is $9.80665ms^{-2}$
ii. Standard value is taken at 45°
iii. Standard value is taken at sea level
Which one of the following is correct?
ⓐ i, ii & iii ⓑ i & ii
ⓒ ii & iii ⓓ i & iii **a**



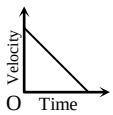
80. Figure shows a S-T graph. So, which one is correct? *[Pabna Cadet-2014]*
i. It is for uniform velocity
ii. It is for non uniform velocity
iii. Its slope is AC/BC
Which one of the following is correct?
ⓐ i ⓑ i & ii
ⓒ ii & iii ⓓ i & iii **a**

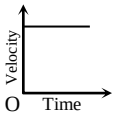
81. In Vacuum all freely falling object *[Pabna Cadet-2014]*
i. Have the same speed
ii. Have the same velocity
iii. Have the save acceleration
Which one of the following is correct?
ⓐ i ⓑ i & ii
ⓒ ii & iii ⓓ i, ii & iii **d**

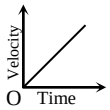
82. The distance traveled in a given time by a freely falling body from rest will be— *[Joypurhat Girls' Cadet-2014]*
ⓐ Proportional of the time
ⓑ Proportional to the square of that time
ⓒ Inversely proportional to that time
ⓓ Inversely propritonal to the square of that time **b**

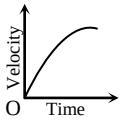
83. A body moves with a uniform acceleration a starting from rest. What will be the traveled distance of the body at a given time? *[Joypurhat Girls' Cadet-2014]*
i. $s = \frac{(u + v)t}{2}$ ii. $s = ut + \frac{1}{2}at^2$
iii. $s^2 = u^2 + 2at$
Which one of the following is correct?
ⓐ i ⓑ i & ii
ⓒ ii & iii ⓓ i, ii & iii **b**

84. Which one of the velocity time graph below does represent the graph of freely falling body? *[Joypurhat Girls' Cadet-2014]*

ⓐ 

ⓑ 

ⓒ 

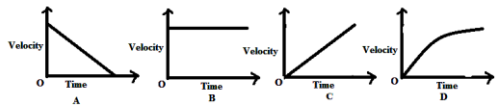
ⓓ 

c

85. The tendency or property of a body to maintain its present state for ever is called what? *[Joypurhat Girls' Cadet-2014]*
ⓐ force ⓑ acceleration
ⓒ inertia ⓓ velocity **c**

86. A train starting from rest moves with uniform acceleration of $10ms^{-1}$. What will be its velocity while crossing a post at a distance of 125m? *[Rangpur Cadet-2014]*
ⓐ $55ms^{-1}$ ⓑ $56ms^{-1}$ ⓒ $60ms^{-1}$ ⓓ $50ms^{-1}$ **d**

87. Which one of the velocity-time graph below does represent the graph of freely falling body? *[Rangpur Cadet-2014]*

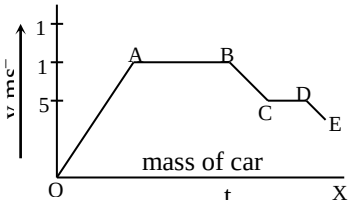


ⓐ A ⓑ B ⓒ C ⓓ D **c**

88. Example of vibratory motion is— *[Rangpur Cadet-2014]*
i. heads of a clock.
ii. motion of tuning fork.
iii. motion of string of guiter.
Which of the following is correct?
ⓐ i & ii ⓑ iii ⓒ ii & iii ⓓ ii **c**

89. Which type of velocity do we find of sound on moon? *[Rangpur Cadet-2014]*
ⓐ Maximum ⓑ Minimum
ⓒ Zero ⓓ $332ms^{-1}$ **c**

Answer the question 90 and 91 according to the following graph



90. At which part of the graph velocity increases in proportion to time? *[Comilla Cadet-2014]*
ⓐ part OA ⓑ part AB
ⓒ part CD ⓓ part DE **a**

91. Velocity of a car increases iniformly at the rate of $5ms^{-1}$ and after 10s becomes $45ms^{-1}$. Find the accerlaration of the car. *[Comilla Cadet-2014]*
ⓐ $2ms^{-2}$ ⓑ $4ms^{-2}$ ⓒ $10ms^{-2}$ ⓓ $8ms^{-2}$ **b**

A car is moving with a velocity, of $54kmh^{-1}$. It is accelerated by $4ms^{-2}$ for 5s.

92. What is the final velocity of the car? *[Comilla Cadet-2014]*
ⓐ $88ms^{-1}$ ⓑ $20ms^{-1}$
ⓒ $35ms^{-1}$ ⓓ $55ms^{-1}$ **c**

93. How far will it travel during the period of acceleration? *[Comilla Cadet-2014]*
ⓐ 12.5m ⓑ 125m ⓒ 15m ⓓ 12m **b**

From the following stem, answer the next two question. *[Feni Girls' Cadet-2014]*
A car is moving with a velocity of 60 Kmh^{-1}. It is accerlerated by $3ms^{-2}$ for 4 sec.

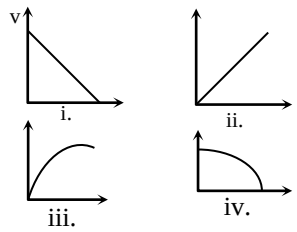
94. What is the final velocity of the car?
ⓐ $14.18\ ms^{-1}$ ⓑ $24.29\ ms^{-1}$
ⓒ $26.76\ ms^{1}$ ⓓ $28.67\ ms^{-1}$ **d**

95. How far will it travel during the period of accerleration?
ⓐ 60.79 m ⓑ 90.68 m
ⓒ 80.58 m ⓓ 75 m **b**

96. A bullet is fixed upward from a gun and the gun moves backward this phenomenon can be explained by the law of— *[Faujdarhat Cadet-2014]*
i. Newton's first law of motion
ii. Law of conservation of momentum
iii. Laws of falling body
Which one of the following is correct?
ⓐ i ⓑ ii
ⓒ i & ii ⓓ ii & iii **b**

97. If a simple pendulum is taken to the center of the earth— *[Faujdarhat Cadet-2014]*
i. It will move slowly
ii. Its time period be infinity
iii. Its motion will be harmonic
Which one of the following is correct?
ⓐ i ⓑ ii
ⓒ i & ii ⓓ ii & iii **b**

See the following figure and answer 98 and 99. *[Faujdarhat Cadet-2014]*



98. Which one shows the object slowing down with a non uniform acceleration?
ⓐ i ⓑ ii ⓒ iii ⓓ iv **c**

99. What information would you expect to find from above graph?
i. speed ii. acceleration
iii. displacement
Which one of the following is correct?
ⓐ i & ii ⓑ i & iii
ⓒ ii & iii ⓓ i, ii & iii **d**

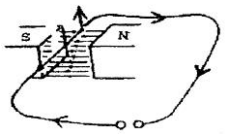
100. Which graph shows how the countr rate for radioactive substance varies with time? *[Faujdarhat Cadet-2014]*

ⓐ  ⓑ 

ⓒ  ⓓ  **d**

101. A body drops from the roof of a building 50 m high. With what velocity will it strike the ground? *[Sylhet Cadet-2014]*
ⓐ 28.3 ms^{-1} ⓑ 29.3ms^{-1}
ⓒ 30.3 ms^{-1} ⓓ 31.3ms^{-1} **d**

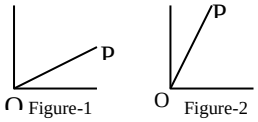
102. The motion of a marble is example of— *[Sylhet Cadet-2014]*
i. sliding friction ii. rolling fricition
iii. easy pulling
Which one of the following is correct?
ⓐ i & ii ⓑ i & iii ⓒ ii & iii ⓓ i, ii & iii **a**



103. The above figure follows— *[Sylhet Cadet-2014]*
ⓐ magnetic effect of current
ⓑ heating effect of current
ⓒ lighting effect of current
ⓓ magnetic induced current **a**

104. The velocity of sound— *[Sylhet Cadet-2014]*
i. increases when temperature increases
ii. decreases when the humidity of air increases
iii. is the highest in the solid medium
Which one of the following is correct?
ⓐ i & ii ⓑ i & iii
ⓒ ii & iii ⓓ i, ii & iii **b**

Observe the followng figure and answer next two questions. *[Sylhet Cadet-2014]*



105. If X-axis represents voltage and Y axis represents current, then the slope of OP and O_1P_1 represent—
ⓐ resistance ⓑ conductance
ⓒ potential difference ⓓ electromagnetic force **b**

106. From OP and O_1P_1 lines, O_1P_1 will give—
i. more conductance
ii. less conductance
iii. equal conductance
Which one of the following is correct?
ⓐ i ⓑ ii
ⓒ iii ⓓ i & ii **a**

107. The things depend of fundamental unit— *[Jhenidah Cadet-2014]*
i. Volume
ii. Time
iii. Displacement in unit time
Which one is correct?
ⓐ i & ii ⓑ ii & iii
ⓒ i & iii ⓓ i, ii & iii **c**

Read the followng passage and answer the question number 108 & 109. *[Jhenidah Cadet-2014]*
A train starting from rest moves with uniform acceleration of $10ms^{-2}$. It was corssing a post at a distance of 125m.

108. What was the time taken by the train to pass 125m? *[Jhenidah Cadet-2014]*
ⓐ $5\sqrt{10}$ ⓑ $10\sqrt{5}$
ⓒ 5 ⓓ 15 **c**

109. What will be its velocity while crossing a post at that distance? *[Jhenidah Cadet-2014]*
ⓐ 5 m/s ⓑ 50 m/s
ⓒ 25 m/s ⓓ 30 m/s **b**

The velocity of a car after every five seconds is given in the table below. *[Barisal Cadet-2014]*

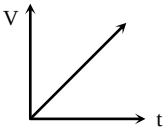
Time (s)	0	5	10	15	20	25	30	35	40
Velocity(m/s)	0	10	20	30	30	30	30	15	0

110. In 20s the distance traveled by this car is— *[Barisal Cadet-2014]*
ⓐ 200m ⓑ 250m
ⓒ 375m ⓓ 255m **c**

111. The total distance traveled by this car is— *[Barisal Cadet-2014]*
ⓐ 375m ⓑ 775m
ⓒ 825m ⓓ 925m **c**

112. By analysis the velocity of this car, it can be understand that— *[Barisal Cadet-2014]*
i. At first the car moves with uniform acceleration
ii. Then some time it moves with uniform velocity and then retardation occur
iii. From first to last the car moves with uniform acceleration
Which one of the following is correct?
ⓐ i & iii ⓑ i & ii
ⓒ ii & iii ⓓ ii **b**

113. Whcih type of motion represent the figure? *[Barisal Cadet-2014]*

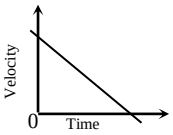


ⓐ Uniform acceleration
ⓑ Non uniform acceleration
ⓒ Uniform velocity
ⓓ Non uniform velocity **a**

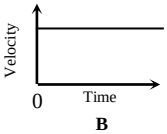
114. Which one is greasy material? *[Barisal Cadet-2014]*
ⓐ Petrol ⓑ Diesel
ⓒ Gas ⓓ Mobil **d**

115. A body falls from a certain height. When it touches the ground— *[Barisal Cadet-2014]*
ⓐ Potential energy become zero
ⓑ Kinetic energy become zero
ⓒ Potential and kinetic energy become zero
ⓓ None **a**

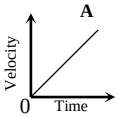
116. Which one of the velocity-time graph below does represent the graph of freely falling body– *[Comilla Cadet-2014]*

ⓐ 

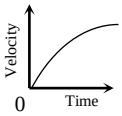
A

ⓑ 

B

ⓒ 

C

ⓓ 

D **c**

117. What is the final velocity of a body moving against gravity when it attains the maximum height? *[Faujdarhat Cadet-2014]*
ⓐ Zero ⓑ $\frac{U^2}{2g}$ ⓒ h/t ⓓ 2gh **a**

Topicwise MCQs with Answers

Pay your earnest attention to the topic-related information for making your concept clear

★★★ 2.1 Rest and Motion

TOP TIPS

- The fixed object with respect to which we find out the position, rest and motion of another object is called reference frame.
- The particular point considered for finding out the position of a place or an object is called reference point.
- A body is said to be static or at rest with respect to its surroundings when it does not change its position with time.
- A body is said to be in motion with respect to its surroundings when it changes its position with time.
- Change of position with time is called motion.

▶ General Creative MCQs with Answers

118. What is the fixed object called with respect to which the position, rest and motion of another object is found out? *(Knowledge)*
ⓐ reference object ⓑ reference frame
ⓒ reference area ⓓ reference axis **b**

119. What is the phenomenon of changing the position of an object with time called? *(Knowledge)*
ⓐ rest ⓑ motion
ⓒ speed ⓓ displacement **b**

120. What is the phenomenon of a body's remaining static with respect to its surroundings called? *(Knowledge)*
ⓐ rest ⓑ motion
ⓒ distance ⓓ displacement **a**

121. Two friends are sitting face to face in a compartment of a running train. What is one's position with respect to another called? *(Comprehension)*
ⓐ relative rest ⓑ relative motion
ⓒ absolute rest ⓓ absolute motion **a**

122. What is the movement of an object with respect to an absolutely static reference object? *(Knowledge)*
ⓐ relative rest ⓑ relative motion
ⓒ absolute rest ⓓ absolute motion **d**

▶ Multiple Completion-Based Creative MCQs with Answers

123. In all cases in the universe,— *(Higher Order Thinking)*
i. motion is absolute.
ii. motion is relative.
iii. rest is relative.
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **c**

124. In the universe, there is nothing to be— *(Higher Order Thinking)*
i. absolute rest ii. absolute motion
iii. relative motion
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **a**

125. In case of two friends sitting face to face in a compartment of a running train— *(Comprehension)*
i. One is said to be in rest with respect to another.
ii. They both are said to be in motion with respect to those who are standing by the trac.
iii. Their motion is relative with respect to the earth.
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii ⓒ ii and iii ⓓ i, ii and iii **d**

126. Reference frame tells us— *(Comprehension)*
i. the position of a body
ii. whether a body is in rest
iii. whether a body is in motion
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii ⓒ ii and iii ⓓ i, ii and iii **d**

127. The study of motion reveals that— *(Application)*
i. the earth can be said to have absolute motion
ii. the students in a class can be said to be in rest with respect to the teacher
iii. a stream can be said to be in motion with respect to its banks
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii ⓒ ii and iii ⓓ i, ii and iii **c**

★★★ 2.2 Types of Motion

TOP TIPS

- The motion of a body along a straight line is called linear motion.
- The motion of a body around a particular point or an axis keeping the distance of the particles of the body unchanged is called rotational motion.
- The motion of a body along a straight line in such a way that each of the particles of the body travels the same distance at the same time in the same direction is called rectilinear motion.
- The motion of a moving particle in such a way that it passes through a definite point along the path in the same direction in a definite time interval is called periodic motion.
- The motion that a body, while executing periodic motion moves in a definite direction for one half of its time period and exactly for the other half in the opposite direction is called vibratory motion.

▶ General Creative MCQs with Answers

128. What form of motion of a body belongs to when the body is restricted on a straight line? *(Knowledge)*
ⓐ linear motion ⓑ rotational motion
ⓒ rectilinear motion ⓓ periodic motion **a**

129. Which one of the following is an example of linear motion? *(Comprehension)*
ⓐ An electric fan moves.
ⓑ The second-hand of a clock ticks.
ⓒ A train runs without taking any turn.
ⓓ A tuning fork vibrates. **c**

130. What motion belongs to circular movement? *(Comprehension)*
ⓐ periodic motion ⓑ vibratory motion
ⓒ rectilinear motion ⓓ rotational motion **d**

131. In what call do all the particles of a body cover equal distance at equal time? *(Comprehension)*
ⓐ linear motion ⓑ rectilinear motion
ⓒ periodic motion ⓓ vibratory motion **b**

132. What form of motion does the piston of a petrol engine belong to? *(Comprehension)*
ⓐ periodic motion ⓑ linear motion
ⓒ rotational motion ⓓ vibratory motion **a**

133. Which one of the following will be an example of vibrating motion? *(Application)*
ⓐ the falling of a river into a sea
ⓑ the tuning of a string
ⓒ cycling
ⓓ pushing a coin from one end of a table to the other end **b**

134. What form of motion do the hands of a clock belong to? *(Comprehension)*
ⓐ vibratory motion ⓑ linear motion
ⓒ rotational motion ⓓ periodic motion **c**

135. What form of motion, do you think the functioning of our heart belong to? *(Higher Order Thinking)*
ⓐ vibratory motion ⓑ rectilinear motion
ⓒ rotational motion ⓓ periodic motion **d**

136. What form of motion can be rectilinear in nature? *(Application)*
ⓐ periodic motion ⓑ vibratory motion
ⓒ linear motion ⓓ rotational motion **b**

137. Suppose, your doctor is examining your pulse. What form of motion does your pulse belong to? *(Higher Order Thinking)*
ⓐ periodic motion ⓑ rotational motion
ⓒ linear motion ⓓ rectilinear motion **a**

138. What form of motion does musical scale commonly refer to? *(Application)*
ⓐ periodic motion ⓑ rotational motion
ⓒ rectilinear motion ⓓ vibratory motion **d**

139. Suppose, you're jogging by a circular wall. What form of motion is it? *(Application)*
ⓐ periodic motion ⓑ rotational motion
ⓒ rectilinear motion ⓓ vibratory motion **b**

140. We see, rain water falls from roofs through plastic pipes. What form of motion do you find in this phenomena? *(Application)*
ⓐ linear motion ⓑ rectilinear motion
ⓒ rotational motion ⓓ libratory motion **a**

141. What form of motion does the dripping of an intervinous infusion refer to? *(Higher Order Thinking)*
ⓐ linear motion ⓑ rectilinear motion
ⓒ periodic motion ⓓ vibratory motion **c**

142. Which one of the following is the most appropriate example of rotational motion in practice? *(Application)*
ⓐ digital camera ⓑ close circuit camera
ⓒ computer monitor ⓓ CPU of a computer **b**

▶ Multiple Completion-Based Creative MCQs with Answers

143. It is periodic motion which can be— *(Comprehension)*
i. circular
ii. linear
iii. rectilinear
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **b**

144. Periodic motion applies to— *(Application)*
i. circular movement
ii. elliptical movement
iii. rectilinear movement
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii ⓒ ii and iii ⓓ i, ii and iii **d**

145. Elliptical movement does not apply in cases of— *(Higher Order Thnking)*
i. vibratory motion
ii. rotational motion
iii. periodic motion
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii ⓒ ii and iii ⓓ i, ii and iii **a**

146. Periodic motion includes— *(Higher Order Thinking)*
i. normal heart-beat
ii. normal blinking
iii. normal breathing
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii ⓒ ii and iii ⓓ i, ii and iii **b**

147. Natural instances not referring to linear motion— *(Higher Order Thinking)*
i. radiation of light in vacuum
ii. movement of our limbs and organs
iii. frequency of sound
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii ⓒ ii and iii ⓓ i, ii and iii **c**

▶ Situation Set Based Creative MCQs with Answers

Read the following extract and answer the question numbers 148 – 149:
Ani's mother has been suffering from dehydration. Doctor has dispensed her interveinous infusion 20 drops per minute.

148. What form of motion does the infusion indicate? *(Application)*
ⓐ vibratory motion ⓑ periodic motion
ⓒ rotational motion ⓓ rectilinear motion **b**

149. We experience this form of motion when we— *(Higher Order Thinking)*
i. tell what time it is
ii. check a car-engine
iii. talk over a cellphone
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii ⓒ ii and iii ⓓ i, ii and iii **a**

Read the following extract and answer the question numbers 150 – 151:
Teacher says, "The motion of the hands of a clock belongs to two forms of motion"

150. What forms of motion does teacher mean? *(Application)*
ⓐ linear and rotational motion
ⓑ rectilinear and periodic motion
ⓒ rotational and periodic motion
ⓓ periodic and vibratory motion **c**

151. The natural forms of motion that does not apply to any of the forms meant by teacher— *(Higher Order Thinking)*
i. wave and storm
ii. tide and ebb
iii. tsunami and cyclone
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii ⓒ ii and iii ⓓ i, ii and iii **b**

Read the following extract and answer the question numbers 152 – 153:
Mr. Ahmed has been suffering from chest pain. He sees his doctor who advises him to have an MRI of his lungs and an ECG of his heart. He again sees the doctor with the reports. The doctor tells him that he has got no problem with his lungs but his heart- bearts are abnormal.

152. The forms of motion that applies to an ECG— *(Application)*
i. periodic motion ii. vibratory motion
iii. rectilinear motion
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii ⓒ ii and iii ⓓ i, ii and iii **a**

153. What form of motion will the flow of blood belong to if it passes through a straight vein or a straight artery having the same distance at a same time-interval? *(Higher Order Thinking)*
ⓐ linear motion ⓑ rectilinear motion
ⓒ rofational motion ⓓ vibratory motion **b**

★★★ 2.3 Scalar and Vector Quantities

TOP TIPS

- In respect to direction, quantities are of two categories- (i) non-directional or scalar quantity and (ii) directional or vector quantity.
- Physical quantities which can be expressed by only magnitude and no direction are scalar quantities; e.g. length, mass, speed, work, energy, time, temperature, etc.
- Physical quantities having both magnitude and direction are vector quantities; e.g. displacement, velocity, acceleration, force, electric intensity, etc.

▶ General Creative MCQs with Answers

154. Which of the following quantities has magnitude but not direction? *(Comprehension)*
ⓐ speed ⓑ displacement
ⓒ velocity ⓓ magnetic induction **a**

155. Which of the following quantities has both magnitude and direction? *(Comprehension)*
ⓐ Electric current ⓑ Electric potential
ⓒ density ⓓ area **d**

156. Which one of the following is a scalar quantity?
ⓐ weight ⓑ momentum
ⓒ distance ⓓ displacement **c**

157. Which one of the following is a vector quantity? *(Comprehension)*
ⓐ impulse of force ⓑ impulsive force
ⓒ electric flux ⓓ magnetic flux **a**

158. Which one of the following is a scalar quantity? *(Comprehension)*
ⓐ buoyancy ⓑ specific gravity
ⓒ electric current ⓓ efficiency **d**

159. Which one of the following units refers to a scalar quantity? *(Higher Order Thinking)*
ⓐ newton ⓑ ampere
ⓒ ohm ⓓ newton meter **b**

160. Which one of the following units refers to a vector quantity? *(Higher Order Thinking)*
ⓐ kelvin ⓑ joule
ⓒ candela ⓓ mole **c**

161. Which one of the following symbols refers to a scaler quantity? *(Higher Order Thinking)*
ⓐ K ⓑ Ω ⓒ N ⓓ F **a**

162. Which one of the following symbols refers to a vector quantity? *(Higher Order Thinking)*
ⓐ t ⓑ d ⓒ λ ⓓ a **d**

163. Which one of the following symbols is a vector quantity? *(Higher Order Thinking)*
ⓐ π ⓑ Ω ⓒ t ⓓ T **b**

▶ Multiple Completion-Based Creative MCQs with Answers

164. A vector quantity is represented by— *(Comprehension)*
i. $\vec{A}$
ii. $|\vec{A}|$
iii. [A]
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii ⓒ ii and iii ⓓ i, ii and iii **a**

165. In case of $\vec{A}$,— *(Comprehension)*
i. The length of the straight line represents magnitude
ii. The arrow head represents forward/backword direction
iii. The arrow-head represents upward/downward direction
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii ⓒ ii and iii ⓓ i, ii and iii **d**

166. Force— *(Comprehension)*
i. is a vector quantity
ii. does not depend on any fundamental quantity
iii. is changed without any change in its direction
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii ⓒ ii and iii ⓓ i, ii and iii **b**

167. In case of quantities— *(Comprehension)*
i. all the fundamental quantities are scalers
ii. scalers are not essential for determing vectors
iii. units of a scaler and a vector may resemble
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **b**

168. Vectors—
i. depend on direction for magnitudes
ii. may be equal or opposite
iii. may be either polar or axial
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **c**

▶ Situation Set Based Creative MCQs with Answers

Read the following equation and answer the question numbers 169 & 170:
$a = MLT^{-2}$

169. How many scalers does the equation consist of? *(Application)*
ⓐ 6 ⓑ 5
ⓒ 4 ⓓ 3 **d**

170. Equations representing vectors— *(Higher Order Thinking)*
i. $L = M + V \times V.C$
ii. $F = M \times A$
iii. $V = \sqrt{PR}$
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **c**

★★★ 2.4 Different Quantities Related to Motion

TOP TIPS

- Distance moved in a specified direction is called displacement.
- The rate of change of distance moved with time is called speed.
- Average speed = Total distance ÷ Time (taken by the object to cover the distance)
- If a body travels equal distance in equal time- interval, the speed of the body is called uniform speed.
- The speed of a body at a certain moment is called instantaneous speed.
- The rate of change of distance moved with time in a specific direction is called velocity. It is also termed as the rate of change of displacement.
- When there is no increase or decrease in the rate of change of distance moved with time in a specific direction, the velocity (of that body) is called uniform velocity.
- The dimensions of speed and velocity are the same (LT^{-1}).
- The units of speed and velocity are the same (ms^{-1})
- When the velocity of a body changes over time, the body is said to be acceleration. In other words, the rate of change of velocity with time is called acceleration.
- The dimension of acceleration is LT^{-2}.
- The unit of acceleration is ms^{-2}.
- If the rate of change of velocity with time is cosntant, it is called uniform acceleration.

▶ General Creative MCQs with Answers

171. What is the change of the position of a body in a particular direction called? *(Knowledge)*
ⓐ displacement ⓑ distance
ⓒ speed ⓓ velocity **a**

172. What is the change of the position of a body irrespective of direction called? *(Knowledge)*
ⓐ displacement ⓑ distance
ⓒ speed ⓓ velocity **b**

173. Which of the following notations represents acceleration? *(Knowledge)*
ⓐ ms^{-1} ⓑ m^2s^{-2}
ⓒ ms^{-2} ⓓ ms^2 **c**

174. What does meter represent? *(Knowledge)*
ⓐ speed ⓑ velocity
ⓒ deceleration ⓓ displacement **d**

175. What is the displacement of the second-hand of a watch in a minute (or in 60 seconds)? *(Comprehension)*
ⓐ 0 ⓑ π
ⓒ 2π ⓓ 2πr **a**

176. Suppose, you have a chronograph watch. What will be the displacement of the month-hand of the watch from January 2015 to January 2016? *(Application)*
ⓐ πd ⓑ 0 ⓒ πr ⓓ $\frac{4}{3}r$ **b**

177. Suppose, you have a chronograph watch. What will be the displacement of the day-hand of the watch from this Monday? *(Application)*
ⓐ πr ⓑ 2πr ⓒ 0 ⓓ $\pi\frac{r}{2}$ **c**

178. Suppose, you have a chronograph watch. What will be the displacement of the date-hand of the watch from 31st March to 31st May? *(Application)*
ⓐ π ⓑ πr
ⓒ 2πr ⓓ 0 **d**

179. Suppose, a moving body covers a distance, d at time, t. What will be its speed? *(Knowledge)*
ⓐ d/t ⓑ d × t
ⓒ t/d ⓓ d/t^2 **a**

180. Which one of the following is the dimensional expression of velocity? *(Knowledge)*
ⓐ $(LT)^{-1}$ ⓑ LT^{-1}
ⓒ LT^2 ⓓ LT^{-2} **b**

181. What unit of speed can we learn from a speedometer? *(Knowledge)*
ⓐ ms^{-1} ⓑ cms^{-1}
ⓒ Kmh^{-1} ⓓ mh^{-1} **c**

182. Suppose, a moving body travels a distance of 5 meters in each second till it reaches its destination. What should the phenomenon be termed? *(Comprehension)*
ⓐ instantaneous velocity ⓑ average velocity
ⓒ non uniform velocity ⓓ uniform velocity **d**

183. What is the marginal magnitude of time in case of instantaneous speed? *(Comprehension)*
ⓐ almost zero (≈0) ⓑ exactly zero (0)
ⓒ infinity (α) ⓓ greater than one (>1) **a**

184. Suppose a body is moving toward north-east. If it travels 20 meters in 6 seconds, what's the velocity of the body? *(Application)*
ⓐ 120 ms^{-1} ⓑ 3.333ms^{-1}
ⓒ 0.3ms^{-1} ⓓ 20.6ms^{-1} **b**

185. What quantities have the same dimension? *(Knowledge)*
ⓐ speed and retardation
ⓑ speed and deceleration
ⓒ speed and velocity
ⓓ velocity and acceleration **c**

186. What is the velocity of sound in the air at a temperature of 0°C? *(Comprehension)*
ⓐ 233ms^{-1} ⓑ 223ms^{-1}
ⓒ 323ms^{-1} ⓓ 332ms^{-1} **d**

187. Which of the following pairs of quantities has the same unit? *(Knowledge)*
ⓐ speed and velocity
ⓑ speed and retardation
ⓒ velocity and acceleration
ⓓ velocity and deceleration **a**

188. Which of the following equations is correct? *(Comprehension)*
ⓐ $a = \frac{u + v}{t}$ ⓑ $a = \frac{v - u}{t}$
ⓒ $u = v + at$ ⓓ $s = \left(\frac{u - v}{2}\right) t$ **b**

189. Which of the following relations is correct? *(Comprehension)*
ⓐ acceleration = displacement × time
ⓑ acceleration = displacement × $time^2$
ⓒ acceleration = displacement ÷ $time^2$
ⓓ acceleration = $time^2$ ÷ displacement **c**

190. Which one of the following is the dimensional expression of acceleration? *(Knowledge)*
ⓐ LT^{-1} ⓑ $L^{-2}T$ ⓒ $(LT)^{-2}$ ⓓ LT^{-2} **d**

191. What does it take place when the rate of velocity decreases with time? *(Knowledge)*
ⓐ retardation ⓑ radiation
ⓒ induction ⓓ conduction **a**

192. What is the rate of change of velocity of a body falling freely to the ground? *(Knowledge)*
ⓐ an increase by 8.9 ms^{-1}
ⓑ an increase by 9.8 ms^{-1}
ⓒ a decrease by 8.9 ms^{-1}
ⓓ a decrease by 9.8 ms^{-1} **b**

193. Suppose, a moving body has an initial velocity of $5ms^{-1}$. After 20 seconds, the velocity reaches a level of 45 ms^{-1}. What will be the acceleration of the body? *(Application)*
ⓐ 0.5 ms^{-2} ⓑ 3 ms^{-2}
ⓒ 2ms^{-2} ⓓ 2.5 ms^{-2} **c**

194. A car reaches a velocity of $60ms^{-1}$ from 15 ms^{-1}. What time does the car take in gaining an acceleration $9ms^{-2}$? *(Application)*
ⓐ 20 sec ⓑ 15 sec
ⓒ 10 sec ⓓ 5 sec **d**

195. The velocity of a car falls from $30ms^{-1}$ to 10 ms^{-1}. What time does the car to have a deceleration of 5 ms^{-2}? *(Application)*
ⓐ 4 sec ⓑ 8 sec ⓒ 12 sec ⓓ 16 sec **a**

196. A man runs $1\frac{1}{2}$ times along a circular field of a radius of 7 m. What will be his displacement? *(Application)*
ⓐ 0m ⓑ 14m
ⓒ 44m ⓓ 66m **b**

197. What will be the distance covered by a body in case it takes a full rotation around a circular field having radius, r? *(Application)*
ⓐ 0 ⓑ πr
ⓒ 2πr ⓓ πr^2 **c**

198. What does the tangent drawn at a point of the velocity-time graph indicate? *(Comprehension)*
ⓐ displacement ⓑ deceleration
ⓒ acceleration ⓓ velocity **d**

▶ Multiple Completion-Based Creative MCQs with Answers

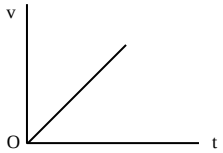
199. Displacement is different from distance because— *(Comprehension)*
i. it has its own magnitude
ii. it has its own direction
iii. it depends on time
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **a**

200. The pains of quantities to which same unit applies— *(Comprehension)*
i. work and force ii. heat and temperature
iii. speed and velocity
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **b**

201. In case of an average velocity of 50 Km/h,— *(Application)*
i. initial velocity may exceed 50Km/h.
ii. the body will cover 75Km in one and a half hour.
iii. time needed for reaching the destination partly depends on acceleration.
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **c**

▶ Situation Set Based Creative MCQs with Answers

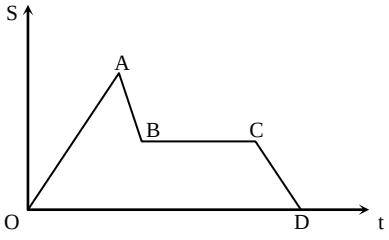
Take a look to the figure below and answer the question numbers 202 & 203:



202. What does the upward line actually consist of? *(Application)*
ⓐ direction and time ⓑ displacement and time
ⓒ displacement and direction
ⓓ speed and direction **d**

203. The upward time reveals that— *(Higher Order Thinking)*
i. a higher displacement takes place in each consecutive second.
ii. acceleration can be determined by using the formula, $a = \frac{v - u}{t}$.
iii. velocity can be determined by using the formula, $v^2 = u^2 + 2as$.
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **a**

Take a look to the figure below and answer the question numbers 204 – 205:



204. Which line refers to zero acceleration? *(Application)*
ⓐ OA ⓑ AB ⓒ BC ⓓ CD **c**

205. Lines refering to retardation— *(Application)*
i. AB
ii. DC
iii. CD
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **b**

Read the following extract and answer the question numbers 206 – 207:
The velocity of a car decreases at a uniform rate from $20ms^{-1}$ to $4ms^{-1}$ in 4 sec.

206. What is the acceleration of the car? *(Application)*
ⓐ $4ms^{-2}$ ⓑ $-4ms^{-2}$ ⓒ $4ms^{-1}$ ⓓ $-4ms^{-1}$ **b**

207. The car— *(Higher Order Thinking)*
i. will stop after running another 4 sec in case of the prevailing velocity
ii. covers 48 m at the given time
iii. has an average velocity of $12ms^{-1}$
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **d**

★★★ 2.5 Equations of Motion : Relation among Different Quantities Belonging to Motion

TOP TIPS

- u = initial velocity, v = final velocity, s = displacement, t = time, a = acceleration.
- (i) $v = u + at$ (ii) $s = ut + \frac{1}{2}at^2$ (iii) $s = \left(\frac{u + v}{2}\right)t$ (iv) $v^2 = u^2 + 2as$

▶ General Creative MCQs with Answers

208. How many quantities does each of the equations of motion consist of? *(Knowledge)*
ⓐ 3 ⓑ 4 ⓒ 5 ⓓ 6 **b**

209. What is the relation between velocity and time in case of uniform acceleration? *(Comprehension)*
ⓐ proportional
ⓑ inversely proportional
ⓒ proportional to the square root of each-other
ⓓ proportional to the cube root of each-other **a**

210. Which of the following relations is correct? *(Comprehension)*
ⓐ $v = ut + at^2$ ⓑ $v = u + at$
ⓒ $s = vt + \frac{1}{2}ut^2$ ⓓ $s = \sqrt{\frac{u - v}{t}}$ **b**

211. Which of the following equations does not give any direct idea about displacement? *(Comprehension)*
ⓐ $s = ut + \frac{1}{2}at^2$ ⓑ $s = \left(\frac{u + v}{2}\right)t$
ⓒ $v = u + at$ ⓓ $v^2 = u^2 + 2as$ **c**

212. Which of the following relations applies to a body running at uniform acceleration? *(Application)*
ⓐ $s \propto t$ ⓑ $s \propto \sqrt{u}$
ⓒ $u \propto \sqrt{t}$ ⓓ $t \propto \sqrt{u}$ **a**

213. Which of the following relations applies to a body running at uniform acceleration? *(Application)*
ⓐ $s \propto t$ ⓑ $s \propto t^2$ ⓒ $s \propto \sqrt{t}$ ⓓ $s \propto \sqrt{vt}$ **b**

214. A running car gains an acceleration of $2ms^{-2}$ with a speed of $20ms^{-1}$. What time does the car take to gain this level of acceleration? *(Application)*
ⓐ 20s ⓑ 15s ⓒ 10s ⓓ 5s **c**

215. A train is running at a velocity of $20ms^{-1}$. What will be its acceleration in 10 sec? *(Application)*
ⓐ $5\ ms^{-2}$ ⓑ $4ms^{-2}$ ⓒ $3ms^{-2}$ ⓓ $2ms^{-2}$ **d**

216. The velocity of a car falls from $54ms^{-1}$ to $34ms^{-1}$ in a period of 20 sec. What retardation does the car gain? *(Application)*
ⓐ $1ms^{-2}$ ⓑ $2ms^{-2}$ ⓒ $3ms^{-2}$ ⓓ $4ms^{-2}$ **a**

217. What will be the final velocity of a body starting with a velocity of $72ms^{-1}$ if it gains an acceleration of $1.5\ ms^{-2}$ in 4 sec? *(Application)*
ⓐ $76\ ms^{-1}$ ⓑ $78\ ms^{-1}$
ⓒ $80\ ms^{-}$ ⓓ $80\ ms^{-1}$ **b**

▶ Multiple Completion-Based Creative MCQs with Answers

218. The equation, $s = ut + \frac{1}{2}at^2$ applies in case of— *(Higher Order Thinking)*

i. uniform acceleration
ii. straight movement of the body
iii. unknonw final velocity

Which one of the following is correct?

ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **d**

219. Equations belonging to motion— *(Application)*

i. $T = \frac{1}{n}$ ii. $S = \left(\frac{u + v}{2}\right)t$
iii. $v = u + at$

Which one of the following is correct?

ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **c**

220. If a body runs with an initial velocity of $54ms^{-1}$ for 5 sec and gains an acceleration of $4ms^{-2}$— *(Higher Order Thinking)*

i. the final velocity of the body is 65 ms^{-1}
ii. the distance covered by the body is 275m
iii. the body having a mass of 0.5 kg applies a force of 2 newton

Which one of the following is correct?

ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **d**

221. In case of acceleration due to gravity, — *(Application)*

i. 'g' is the applicable symbol
ii. the value of g depends on both mass and radius of the earth
iii. the applicable dimension is MLT^{-2}

Which one of the following is correct?

ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **a**

222. Starting from rest, a particle advances along a straight line with a uniform acceleration of $5ms^{-2}$. The phenomena relating to this information—

i. the particle will take a time of 3 sec to reach a velocity of 15 ms^{-1}
ii. in this time, it will cover a displacement of 22.5 m will reach the level of $20ms^{-1}$ in the 4^{th} sec.
iii. the velocity

Which one of the following is correct?

ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **d**

▶ Situation Set Based Creative MCQs with Answers

Read the following extract and answer the question number 223 & 224:

Asif is driving his car with a velocity of $54Kmh^{-1}$ in the highway. The car gains an acceleration of $4ms^{-2}$ for 15 sec as the highway was free.

223. How far does Asif advance during the period of acceleration? *(Application)*

ⓐ 575m ⓑ 675m
ⓒ 475m ⓓ 375m **b**

224. The passage also states that— *(Higher Order Thinking)*

i. Asif is likely to fall victim to an accident if he drives his car in any of the roads of Dhaka city.
ii. the final velocity of the car is $75ms^{-1}$
iii. Asif will cover a distance of 100km in an hour if he drives the car at a higher acceleration of $5ms^{-1}$

Which one of the following is correct?

ⓐ i and ii ⓑ i and iii ⓒ ii and iii ⓓ i, ii and iii **a**

Read the following extract and answer the question numbes 225 & 226:

It has been drizzling for two days. There has been a low presure in the Bay of Bengal. The people living in the coastal areas get restless hearing the latest weather forecast that a huge cyclone is going to hit the coast with a velocity of 110 kmh^{-1} in the next 12 hours.

225. What distance is the cyclone advancing from? *(application)*

ⓐ 1230 km ⓑ 1320 km
ⓒ 1100 km ⓓ 1200 km **b**

226. The cyclone may have— *(Higher Order Thinking)*

i. taken more hours to hit the coast if the velocity decreases
ii. gained an acceleration of $72kmh^{-1}$ at the 12^{th} hour
iii. gained a final velocity higher than the velocity of a jet plane

Which one of the following is correct?

ⓐ i and ii ⓑ i and iii ⓒ ii and iii ⓓ i, ii and iii **d**

★★★ 2.6 Motion of Falling Bodies

TOP TIPS

- Gravitation refers to the force of attraction between any two bodies or particles in the universe.
- Gravity refers to the force of attraction of the earth on a body.
- The force of gravity causes acceleration which is called 'acceleration due to gravity'.
- Acceleration due to gravity' refers to the rate of increase of velocity of a freely falling body on earth.
- Acceleration due to gravity is represented by the letter 'g'.
- Since the value of 'g' is different at different places on the surface of the earth, its value at sea level altitude 45° is accepted as the standard value ($g = 9.80665\ ms^{-2}$).
- The Galilean laws of falling bodies: (i) All bodies falling from rest and also from the some height without any resistance travels equal distance in equal time. (ii) The velocity (v) acquired by a freely falling body from rest is directly proportional to the given time (t); that is, $v \propto t$. (iii) The distance (h) travelled by a freely falling body from rest is directly proportional to the square of the given time (t). That is, $h \propto t^2$.
- Equations of freely falling body: (i) $v = u + gt$ (ii) $h = \left(\frac{u + v}{2}\right)t$ (iii) $h = ut + \frac{1}{2}gt^2$ (iv) $v^2 = u^2 + 2gh$

▶ General Creative MCQs with Answers

227. What is the exact value of 'g'? *(Knowledge)*

ⓐ $9.08665ms^{-2}$ ⓑ $9.08656ms^{-2}$
ⓒ $9.80665ms^{-2}$ ⓓ $9.80566ms^{-2}$ **c**

228. Who first propounded laws of falling bodies? *(Knowledge)*

ⓐ Thales ⓑ Archimedes
ⓒ Newton ⓓ Galileo **d**

229. What is the main theme of the Newtonian 2nd law of motion?
ⓐ Force is proportional to accelration.
ⓑ Force is proportional to time.
ⓒ Force is proportional to displacement.
ⓓ Force is proportional to constants. **a**

230. What is the dimension of acceleration due to gravity? *(Knowledge)*
ⓐ LT^{-1} ⓑ $(LT)^2$
ⓒ LT^{-2} ⓓ MLT^{-2} **c**

231. What is the symbolic expression of the second law of falling bodies? *(Knowledge)*
ⓐ $h \alpha t^2$ ⓑ $v \alpha t$
ⓒ $h \alpha t^{-2}$ ⓓ $v \alpha t^{-1}$ **b**

232. What is the symbolic expression of the third law of falling bodies? *(Knowledge)*
ⓐ $v \alpha t$ ⓑ $v \alpha t^2$
ⓒ $h \alpha t$ ⓓ $h \alpha t^2$ **d**

233. Which formula is suitable for determining the distance travelled by a falling body in case of absence of acceleration due to gravity? *(Comprehension)*
ⓐ $v = u + gt$ ⓑ $h = \left(\frac{u+v}{2}\right)t$
ⓒ $h = ut + \frac{1}{2}gt^2$ ⓓ $v^2 = u^2 + 2gh$ **b**

234. How can we find out the acceleration due to gravity at any place on earth? *(Application)*
ⓐ dividing the product of G and M by the square of R
ⓑ dividing the product of M and R by the square of G
ⓒ dividing G by the square root of R
ⓓ dividing R by the square root of G **a**

235. Which of the following letters represents gravitational constant? *(Knowledge)*
ⓐ R ⓑ M
ⓒ G ⓓ g **c**

236. What does R stand for in the equation, $g = \frac{GM}{R^2}$? *(Knowledge)*
ⓐ mass of the earth ⓑ diameter of the earth
ⓒ gravitational force ⓓ radius of the earth **d**

237. Where will acceleration due to gravity be of the highest magnitude? *(Knowledge)*
ⓐ on the surface of the earth
ⓑ in the core of the earth
ⓒ on the peak of a mountain
ⓓ under the surface of the earth **a**

238. In what area/region does 'g' have the lowest value? *(Knowledge)*
ⓐ in the south pole ⓑ in the north pole
ⓒ at the equator ⓓ at the tropic of cancer **c**

239. Where does the earth have the largest radius? *(Knowledge)*
ⓐ in the south pole ⓑ in the north pole
ⓒ in the tropical zone ⓓ in the equator **d**

240. What sea- level altitude does the standard value of 'g' belong to? *(Knowledge)*
ⓐ 40° ⓑ 45° ⓒ 60° ⓓ 75° **b**

241. What is the standard value of 'g'? *(Knowledge)*
ⓐ $9.80665\ ms^{-2}$ ⓑ $9.79 ms^{-2}$
ⓒ $9.82 ms^{-2}$ ⓓ $9.8076 ms^{-2}$ **a**

242. What will happen if a five taka note and a five taka coin are dropped from the same height? *(Comprehension)*
ⓐ The note will reach the ground before the coin.
ⓑ The coin will reach the ground before the note.
ⓒ Both the note and the coin will reach the ground at the same time.
ⓓ the note will never reach the ground. **b**

243. What does not have any influence on acceleration due to gravity? *(Comprehension)*
ⓐ mass of the earth ⓑ radius of the earth
ⓒ mass of the body ⓓ volume of the body **d**

244. An object falls to the ground with a velocity of $31.3 ms^{-1}$ in case it is dropped from the roof of a building. If $g = 9.8 ms^{-2}$, what is the height of the roof from the ground? *(Application)*
ⓐ almost 30 m ⓑ almost 40 m
ⓒ almost 50 m ⓓ almost 60 m **c**

245. If a body is dropped from a height of 40 m, what will be its velocity at the moment of touching the ground? *(Application)*
ⓐ $28 ms^{-1}$ ⓑ $28.5 ms^{-1}$
ⓒ $29 ms^{-1}$ ⓓ $29.5 ms^{-1}$ **a**

246. What is the rate of increase in velocity in case of a freely falling body? *(Comprehension)*
ⓐ $0.98\ ms^{-1}$ ⓑ $9.81\ ms^{-1}$
ⓒ 9.8×10^{-2} ⓓ $0.98 \times 10^{-2} ms^{-1}$ **b**

247. Which of the following equations applies to a body falling with velocity v in time t? *(Knowledge)*
ⓐ $v \alpha t^2$ ⓑ $v \alpha t^{-2}$
ⓒ $v \alpha t$ ⓓ $v \alpha t^{-1}$ **c**

248. What is the final velocity of a body thrown upward at its highest height? *(Comprehension)*
ⓐ 0 ⓑ $9.8\ ms^{-1}$
ⓒ $\frac{1}{9.8}\ ms^{-1}$ ⓓ $9.8 \times 10^{-2}\ ms^{-1}$ **a**

249. What time a body will take to reach the ground if it is thrown upward with a velocity equal to the magnitude of 'g'? *(Application)*
ⓐ 0.1 s ⓑ 1 s ⓒ 0.2 s ⓓ 2 s **d**

250. Suppose, you have thrown a stone 50m upward that has fallen to the ground in 6 seconds. What has been the velocity of the body? *(Application)*
ⓐ $16.76\ ms^{-1}$ ⓑ $16.67\ ms^{-1}$
ⓒ $17.66 ms^{-1}$ ⓓ $17.76 ms^{-1}$ **b**

251. What distance will a falling body cover in 5 seconds if it covers 3m in 1 second?
ⓐ 15 m ⓑ 30 m
ⓒ 45 m ⓓ 75 m **d**

▶ Multiple Completion-Based Creative MCQs with Answers

252. The magnitude of 'g' depends on— *(Application)*
i. the product of the mass of the earth and gravitational constant
ii. the radius of the earth
iii. the time taken by the body in its course of falling freely
Which one of the following is correct?
ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **a**

253. In case of falling bodies— *(Application)*

i. $v \alpha t$
ii. $a \alpha t^2$
iii. $h \alpha t^2$

Which one of the following is correct?

ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **b**

254. Suppose, you are dropping a few objects of different masses from the roof of your house. You will find that— *(Application)*

i. the objects do not strike the ground simultaneously.
ii. the height of the roof is proportional to the square of the time taken by an object to strike the ground.
iii. the velocity of each of the objects is proportional to the time it takes to strike the ground.

Which one of the following is correct?

ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **d**

255. Due to acceleration due to gravity, an object falling from a height of 500m— *(Higher Order Thinking)*

i. gains a velocity of 39.2 ms^{-1} in 4 sec.
ii. strikes the ground in 25.5 sec.
iii. covers a distance of 78.4 m in 4 sec.

Which one of the following is correct?

ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **d**

▶ Situation Set Based Creative MCQs with Answers

Read the following extract and answer the question numbers 256 & 257:

Rafiq throws a ball straight upward at a velocity of 29.4 ms^{-1}. Rasman ran to catch the ball 8 sec. later but the ball has already fallen to the ground.

256. What height does the ball reach? *(Application)*

ⓐ 44.1 m ⓑ 41.4 m
ⓒ 45.1 m ⓓ 41.5 m **a**

257. If the incident takes place in a polar region— *(Higher Order Thinking)*

i. the ball will take a time less than 8 sec to strike the ground.
ii. the ball will gain maximum acceleration.
iii. Rasman will nto be able to catch the ball even if he runs with the same velocity.

Which one of the following is correct?

ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **d**

★★★ 2.7 Motion and Graph

TOP TIPS

- Along with the passage of time, change takes place in the position of a moving body.
- The distance travelled by a moving body depends on Time.
- The slope of the tangent drawn at any point of the distance-time graph refers to the velocity of the body at that point.
- The slope of the tangent drown at any point of the velocity time graph refers to the acceleration of the body at that point.

▶ General Creative MCQs with Answers

258. What does the tangent belonging to the distance time graph reveal? *(Knowledge)*

ⓐ speed ⓑ velocity
ⓒ displacement ⓓ acceleration **b**

259. What does the tangent belonging to the velocity time graph reveal? *(Knowledge)*

ⓐ acceleration ⓑ speed
ⓒ velocity ⓓ displacement **a**

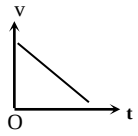
260. What is the shape of the distance time graph in case of constant displacement over time? *(Comprehension)*

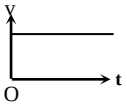
ⓐ vertical
ⓑ horizontal
ⓒ upward making 45° angle with the X-axis
ⓓ upward making 30° angle with the Y-axis **b**

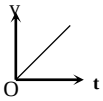
261. What angle does the distance-time graph make at its origin in case of equal distance travelled in each equal time interval? *(Comprehension)*

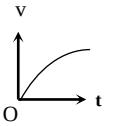
ⓐ 15° ⓑ 30°
ⓒ 45° ⓓ 60° **c**

262. Which of the following figures applies to a freely falling body?

ⓐ 

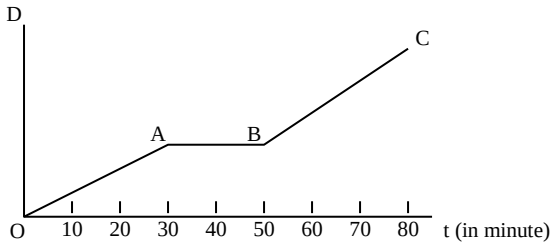
ⓑ 

ⓒ 

ⓓ 

c

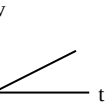
263.

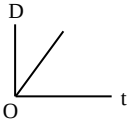


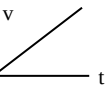
If OABC is the pathway of a bus, for what time did the passengers fall victim to standstill traffic jam? *(Higher Order Thinking)*

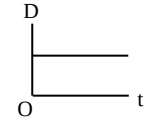
ⓐ 20 minutes ⓑ 25 minutes
ⓒ 30 minutes ⓓ 35 minutes **b**

264. Which of the following graphs represents uniforms velocity? *(Application)*

ⓐ 

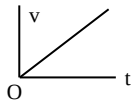
ⓑ 

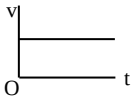
ⓒ 

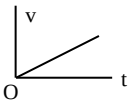
ⓓ 

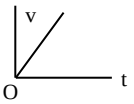
c

265. Which of the following figures represent uniform acceleration? *(Application)*

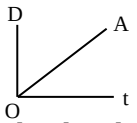
ⓐ 

ⓑ 

ⓒ 

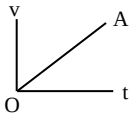
ⓓ 

a

266. 

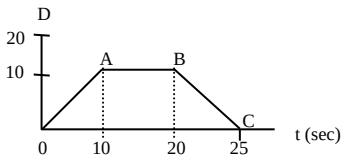
What does the line OA refer to? *(Higher Order Thinking)*

ⓐ uniform acceleration ⓑ non inform acceleration
ⓒ non uniform velocity ⓓ uniform velocity **d**

267. 

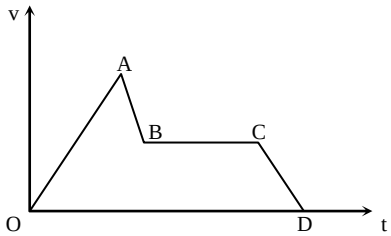
What does the line OA refer to? *(Higher Order Thinking)*

ⓐ uniform velocity
ⓑ uniform acceleration
ⓒ non-uniform velocity
ⓓ non uniform acceleration **b**

268. 

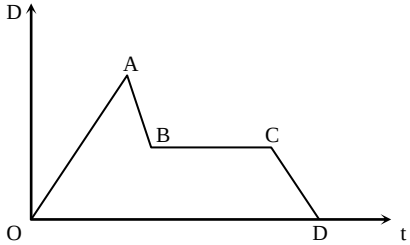
What is the length of the pathway OABC? *(Application)*

ⓐ 55 meter ⓑ 225 meter
ⓒ 250 meter ⓓ 150 meter **c**

269. 

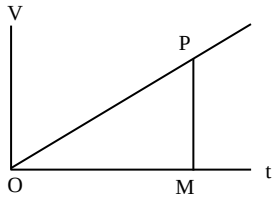
Which line in the figure reveals uniform acceleration? *(Application)*

ⓐ OA ⓑ AB
ⓒ BC ⓓ CD **a**

270. 

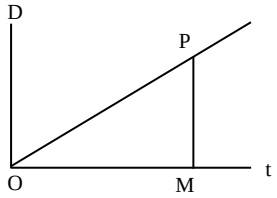
Which line belongs to zero velocity? *(Application)*

ⓐ OA ⓑ AB ⓒ BC ⓓ CD **c**

271. 

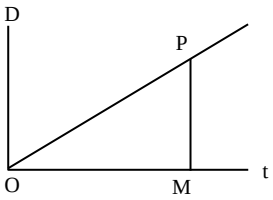
What is the slope of the time OP? *(Application)*

ⓐ $\frac{OM}{PM}$ ⓑ $\frac{PM}{OM}$
ⓒ $\frac{OP}{OM}$ ⓓ $\frac{OP}{PM}$ **b**

272. 

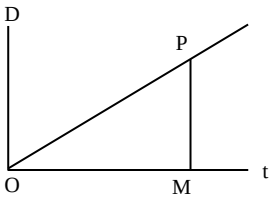
If ∠POM = 45°, ∠PMO = ? *(Application)*

ⓐ 60° ⓑ 80°
ⓒ 90° ⓓ 70° **c**

273. 

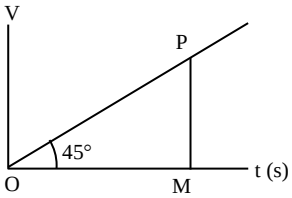
If line OP refers to uniform velocity, what is the magnitude of ∠OPM? *(Higher Order Thinking)*

ⓐ 30° ⓑ 45°
ⓒ 60° ⓓ 75° **b**

274. 

If line OP refers to uniform velocity, ∠POM + ∠OPM = ? *(Higher Order Thinking)*

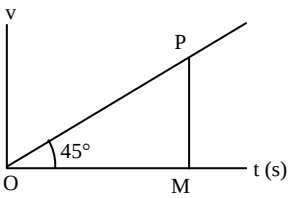
ⓐ 30° ⓑ 60°
ⓒ 90° ⓓ 120° **c**

275. 

How can you determine acceleration? *(Application)*

ⓐ dividing OP by OM
ⓑ dividing OP by PM
ⓒ dividing PM by OP
ⓓ dividing PM by OM **d**

276.

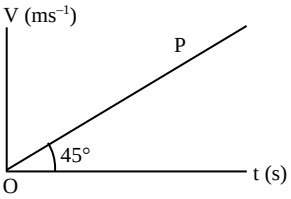


What is the dimension of each of the points of the line OP? *(Higher Order Thinking)*

ⓐ $(LT)^{-2}$ ⓑ LT^{-2}

ⓒ $(LT)^{2}$ ⓓ MLT^{-2} **b**

277.

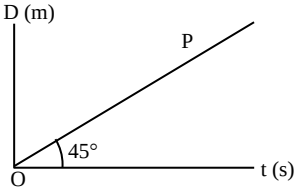


What is the unit of the quantity represented by each of the points of line OP? *(Higher Order Thinking)*

ⓐ Newton ⓑ Newton meter

ⓒ ms^{-2} ⓓ ms^{-1} **c**

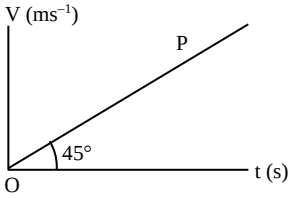
278.



What is the dimension of each of the points of the line, OP? *(Higher Order Thinking)*

ⓐ LT ⓑ LT^{-1} ⓒ LT^{2} ⓓ LT^{-2} **b**

279.

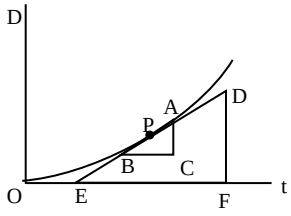


What is the unit of the quantity at each of the points of the line, OP? *(Higher Order Thinking)*

ⓐ N ⓑ N – M ⓒ ms^{-1} ⓓ ms^{-2} **d**

▶ Multiple Completion-Based Creative MCQs with Answers

280.



The figure states that— *(Higher Order Thinking)*

i. velocity is not uniform

ii. $\frac{AB}{BC} = \frac{DF}{EF}$

iii. $\angle ACB = \angle DFE$

Which one of the following is correct?

ⓐ i and ii ⓑ i and iii

ⓒ ii and iii ⓓ i, ii and iii **d**

281. In case of graphical illustration of velocity and acceleration,— *(Application)*

i. The horizontal axis represents time

ii. the vertical axis represents either velocity acceleration

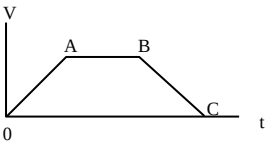
iii. the slope of the line originated from the vertex reveals the magnitude of velocity or acceleration

Which one of the following is correct?

ⓐ i and ii ⓑ i and iii

ⓒ ii and iii ⓓ i, ii and iii **d**

282.



Pathway OABC includes— *(Application)*

i. positive acceleration

ii. zero acceleration

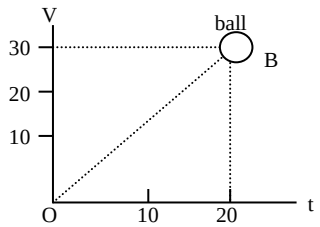
iii. negative acceleration

Which one of the following is correct?

ⓐ i and ii ⓑ i and iii

ⓒ ii and iii ⓓ i, ii and iii **d**

283.



The figure reveals that— *(Application)*

i. acceleration gained by the ball is $1.5ms^{-2}$.

ii. the ball takes 3 seconds to stricke the ground.

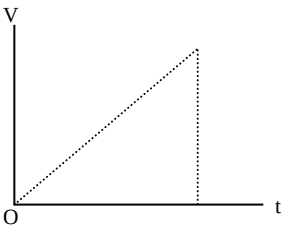
iii. $\angle BOC > \angle OBC$.

Which one of the following is correct?

ⓐ i and ii ⓑ i and iii

ⓒ ii and iii ⓓ i, ii and iii **a**

284.



Formula applicable to the figure — *(Higher Order Thinking)*

i. $F = m \times a$.

ii. $S = v \times t$.

iii. $h = ut + \frac{1}{2}gt^2$.

Which one of the following is correct?

ⓐ i and ii ⓑ i and iii

ⓒ ii and iii ⓓ i, ii and iii **c**

▶ Situation Set Based Creative MCQs with Answers

Take a look to the following extract and answer question numbers 285 & 286:

time(s)	0	5	10	15	20	25	30	35	40
velocity (ms^{-1})	0	10	20	30	30	30	30	15	0

285. What distance will the body travel in 20s? *(Application)*

ⓐ 200 m ⓑ 250 m
ⓒ 300 m ⓓ 350 m **c**

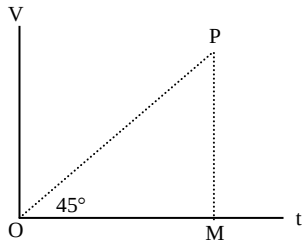
286. The table states that—

i. the body has an average velocity of 4.125 ms^{-1}
ii. it gains uniform velocity upto the 15th sec
iii. it starts retarding just after the 15th sec

Which one of the following is correct?

ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **a**

Look at the figure below and answer the question number 287 & 288:



287. What is the magnitude of ∠OPM? *(Application)*

ⓐ 30° ⓑ 45°
ⓒ 60° ⓓ 75° **b**

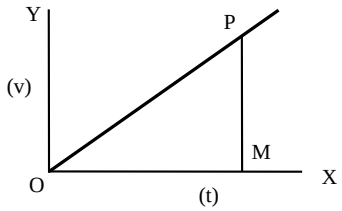
288. Line OP indicates that— *(Higher Order Thinking)*

i. line OV is parallel to line PM
ii. PM can either be greater or less than OM
iii. acceleration has neither increased nor decreased

Which one of the following is correct?

ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **d**

Look at the figure below and answer the question number 289 & 290:



289. Which angle must be equal to ∠ABC? *(Higher Order Thinking)*

ⓐ ∠ACB ⓑ ∠EDF ⓒ ∠DEF ⓓ ∠CAD **c**

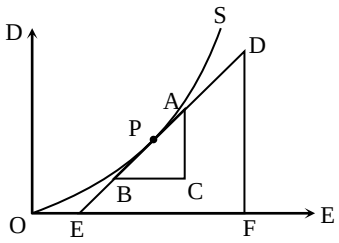
290. Line OS reveals that— *(Application)*

i. the body gains more velocity in part PS than in part OP
ii. velocity at point P is the quotient of AC by BC
iii. the tangent at print P makes an obtuse angle with the horizontal axis

Which one of the following is correct?

ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **a**

Look at the figure below and answer the question numbers 291 & 292:



291. Which two angles must be equal? *(Higher Order Thinking)*

ⓐ ∠DEF and ∠ABC ⓑ ∠DFE and ∠ACB
ⓒ ∠EDF and ∠BAC ⓓ ∠EDF and ∠AEF **b**

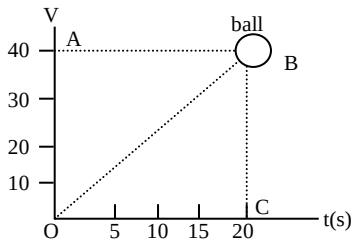
292. Line ED reveals that— *(Higher Order Thinking)*

i. ∠EAC > ∠DAC
ii. $\frac{AC}{AB} = \frac{DF}{EF}$
iii. the unit of quantity at point D is ms^{-1} in case ED is the distance time graph

Which one of the following is correct?

ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **d**

Look at the figure below and answer the question numbers 293 and 294:



293. How many right angled toriangles are there in the fig? *(Higher Order Thinking)*

ⓐ only one ⓑ two
ⓒ three ⓓ four **d**

294. The purpose of drawing the perpendicular BC— *(Higher Order Thinking)*

i. finding out the acceleration of the body at the 20th second
ii. finding out the time the body takes to strike the ground
iii. finding out the distance travelled by the body at each time interval

Which one of the following is correct?

ⓐ i and ii ⓑ i and iii
ⓒ ii and iii ⓓ i, ii and iii **d**

Creative Essay-Type Questions and Answers

41 Creative Questions ■ 1 Textual questions ■ 6 Board questions ■ 19 Cadet College questions ■ 4 Classwork ■ 6 Additional questions ■ 5 Questions with hints

Textual Creative Essay type Questions with Answers

The practice of these questions will guide you in writing about different questions corresponding to the topics in this chapter.

Ques. ▶1 Rajib with his family members started for visiting Jaflong in Sylhet by a microbus. He recorded the magnitude of velocity i.e. speed of the car from the speedometer after every 5 min throughout the jounry. The magnitude of velocity he got per hour was 18, 36, 54, 45, 54, 36 and 18 kilometer.

a. What is instantaneous speed? 1
b. Explain the acceleration of an object moving with uniform velocity? 2
c. Find the distance traveled by the car in first 5 min. 3
d. Draw and explain the velocity-time graph by the collected data 4

Answer to the question no. 1

a Instantaneous speed refers to the speed of a moving body at a certain time (e.g. a certain minute).

b The rate of change of velocity along with each unit of time is called acceleration. If the body moves with a uniform velocity, it clearly indicates that no change takes place in velocity. That is, acceleration is zero.

Symbolically, $v - u = 0$

$$\therefore v = u$$

Also, $a = \frac{v - u}{t} = \frac{0}{t} = 0$

c The stem states that,

time, $t = 5 \text{ min} = 5 \times 60 \text{ sec} = 300 \text{ sec}$

Initial velocity, $u = 0 \text{ ms}^{-1}$

Velocity gained in the first time – interval of 5 mins, $v = 18\text{kmh}^{-1}$

$$= \frac{18 \times 1000 \text{ m}}{60 \times 60 \text{ sec}} = 5 \text{ ms}^{-1}$$

In the distance travelled in the first 5 mins. is s,

$$s = \left(\frac{u + v}{2}\right)t$$

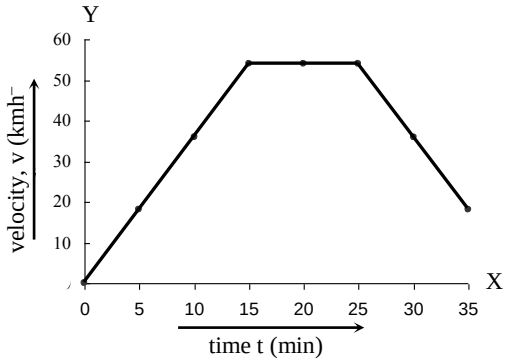
$$= \left(\frac{0\text{ms}^{-1} + \text{ms}^{-1}}{2}\right) 300 \text{ sec}$$

$$= \frac{5\text{ms}^{-1}}{2} \times 300 \text{ sec}$$

$$= 5 \text{ ms}^{-1} \times 150 \text{ sec}$$

$$= 750 \text{ m.}$$

d The velocity time graph with the collected data will be as follows:

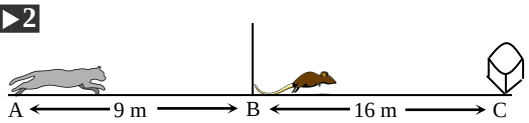


The velocity of the microbus per hour was 18,36, 54, 45, 54, 36 and 18 kilometer.
In 5th, 10th and 15th minutes, the bus gained uniform velocity (18 – 0 = 18, 36 – 18 = 18, 54 – 36 = 18).
From 15th to 20th min velocity falls at 45 kmh^{-1}.
By the next 5 mins, it increases at 54 kmh^{-1}.
In the next two intervals (25th – 30th min and 30th – 35th min) velocity further falls at 36 kmh^{-1} and 18 kmh^{-1}. That is, the microbus has a deceleration for the last 10 minutes; evidently. This declaration is also uniform (54 – 36 = 18, 36 – 18 = 18).

Board Exam Creative Questions with Answers

Board Exam questions are very important for the exam preparation. So practice these questions again and again properly.

Ques. ▶2



A rat moves from B at a velocity of 0·4 ms^{-1} to collect a piece of bread. A cat noticed the rat from A and moves in a forward direction in the same path with an acceleration of 0.02 ms^{-2} to collect the bread.

[Dhaka Board-2015]

a. What is a prime number? 1
b. There is no change in acceleration without change in velocity –Explain. 2
c. What velocity is required for the cat to reach B?3
d. Explain by mathematical explanation whether it is possible for the rat to collect the bread before the cat. 4

Answer to the question no. 2

a The physical quantities which do not need the help of other quantities to be fully expressed are called fundamental quantities.

b The rate of change of velocity that is, the change of velocity per unit time is called acceleration.

That is, acceleration, $a = \frac{\text{change of velocity}}{\text{time}} = \frac{\Delta v}{\Delta t}$

If the change of velocity, $\Delta v = 0$

then acceleration, $a = \frac{0}{\Delta t} = 0$

Therefore, if there is no change of velocity, there is no acceleration.

c Given that,
Initial velocity of cat, $u = 0ms^{-1}$
Displacement from A to B, $s = 9m$
Acceleration of cat, $a = 0.02ms^{-2}$
We have to find the velocity of cat at B that is the final velocity, $v = ?$
We know that, $v^2 = u^2 + 2as$
or, $v = (0ms^{-1})^2 + 2 \times 0.02ms^{-2} \times 9m$
or, $v = 0.36m^2s^{-2}$
$\therefore v = \sqrt{0.36\ m^2s^{-2}} = 0.6ms^{-1}$ **(Ans.)**

d Uniform velocity of mouse, $v + 0.4ms^{-1}$
and displacement, $s_1 = 16m$
So, if the mouse requires t_1 time to reach point c, $s_1 = vt_1$
or, $t_1 = s_1/v$
$= 16m/0.4ms^{-1}$
$= 40$ sec.
Let, the time required by the mouse to reach point C be t_2 then the displacement of the cat, $s_2 = 9m + 16m = 25m$
Initial velocity, $u = 0ms^{-1}$
Acceleration, $a = 0.02ms^{-2}$
$\therefore S_2 = ut_2 + \frac{1}{2}at_2^2 = 0 \times t_2 + \frac{1}{2}at_2^2 = \frac{1}{2}at_2^2$
or, $t_2^2 = \frac{2S_2}{a}$
$\therefore t_2 = \sqrt{\frac{2S_2}{a}} = \sqrt{\frac{2 \times 25m}{0.02ms^{-2}}} = 50$ seconds
Since, 50sec > 40 sec
So, $t_2 > t_1$
So, the mouse will reach the point C before the cat, So the mouse will be able to take the bread before the cat reaches there.

Ques. ▶3 Two cars, each of similar mass, M, start their journey at $6ms^{-1}$ and $9ms^{-1}$ and reach their destination. They have an acceleration of $5ms^{-2}$ and $3ms^{-2}$ respectively. *[Rasjhahi Board-2015]*

a. What is electromagnetic force? 1
b. Explain why the velocity of an object changes as it falls downward from a state of rest. 2
c. At what time did the two cars reach their destination? 3
d. Explain in terms of mathematical explanation, the change in kinetic energy of the two cars. 4

Answer to the question no. 3

a If two electric charges are in relative motion they apply electric and magnetic force on each other. The electric and magnetic field together create the electromagnetic force.

b If an object falls from rest uner the influence of gravitational force then an acceleration, $g = 9.8ms^{-2}$ is created on the body. That is, the velocity of the freely falling body increases by $9.8ms^{-1}$. That is why it is said that the velocity of a falling object is changed due to gravity.

c Here, Mass of both cars = M
Initial velocity of 1st car, $u_1 = 6ms^{-1}$
Initial velocity of 2nd car, $u_2 = 9ms^{-1}$
Acceleration of 1st car, $a_1 = 5ms^{-2}$
Acceleration of 2nd car, $a_2 = 3ms^{-2}$
Let, the two cars reach the destination at a distance of 5 metres in t seconds.
In case of 1st car,
$S = u_1t + \frac{1}{2}a_1t^2$
Or, $S = 6t + \frac{1}{2}5t^2$ ..... (i)
In case of 2nd car,
$S = u_2t + \frac{1}{2}a_2t^2$
Or, $S = 9t + \frac{1}{2}.3t^2$ ..... (ii)
From equation (i) and (ii) we get—
$6t + \frac{1}{2}5t^2 = 9t + \frac{3}{2}t^2$
Or, $6 + \frac{5}{2}t = 9 + \frac{3}{2}t$
Or, $\frac{5}{2}t - \frac{3}{2}t = 9 - 6$
Or, $\frac{5-3}{2}t = 3$
Or, $t = 3$
$\therefore t = 3s$
$\therefore$ The cars reached the destination in 3 seconds.

d From C we get,
Time spent, $t = 3s$
If velocity of 1st car after 3 seconds is v_1 then
$v_1 = u_1 = a_1t$
$= 6ms^{-1} = (5ms^{-2} \times 3s)$
$= 21ms^{-1}$
If the velocity of 2nd car after 3seconds is $v_2 = u_2 + a_2t$
$= 9ms^{-1} + (3ms^{-2} \times 3s)$
$= 18ms^{-1}$
Change of kinetic energy of 1st car $= \frac{1}{2}M(v_1^2 - u_1^2)$
$= \frac{1}{2}M\{(21ms^{-1}) - (6ms^{-1})^2\}$
$= \frac{1}{2}M\ (441m^2s^{-2} - 36m^2s^{-2})$

$= \textbf{Error!}J$
$= 202.5MJ$

Change of kinetic energy of 2nd car $= \frac{1}{2}M(v_2^2 - u_2^2)$

$= \frac{1}{2}M\{(18ms^{-1})^2 - (9ms^{-1})^2\}$

$= \frac{1}{2}M(324m^2s^{-2} - 81m^2s^{-2})$

$= \textbf{Error!}J$
$= 121.5J < 202.5MJ$

The change of kinetic energy is higher in 1st car than the 2nd car.

Ques. ▶4 The velocities at different time of a car on a plane road are given in the table below:

time t (min.)	0	5	10	15	20	25
velocity, v(ms^{-1})	2	4	6	6	4	0

[Dinajpur Board-2015]

a. What is called vector quantity? 1
b. Will your weight be equal in all the countries of the world?-Explain. 2
c. Find out th distance travelled in first 10 minutes by the car. 3
d. Drawing the velocity-time graph from the above table give your opinion about the velocity of the car. 4

Answer to the question no. 4

a The physical quantities which need both magnitude and direction to be fully expressed are called vector quantities.

b My weight will not be same in every country of the world. We know that, W = mg, here, m = mass of object and g = acceleration due to gravity. The mass of an object is a constant quantity; so the weight of an object is dependent on the acceleration due to gravity. Again, $g = \frac{GM}{R^2}$, here, G and M are constant, so the acceleration due to gravity depend on the distance of the object from the centre of the earth. So, it can be said that g is constant for a particular place but is varies from place to place. Since the value of g is not same in every country of the world so my weight is also not same.

c Here, Initial velocity, $v_0 = 2ms^{-1}$
Velocity after 10 minutes $v_{10} = 6ms^{-1}$
Time, t = 10min = 600s

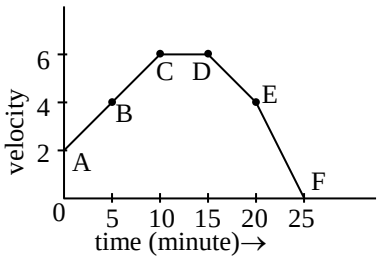
$$\text{Acceleration} = \frac{\text{Change of velocity}}{\text{time}}$$
$$= \frac{60 - 2}{600}\ ms^{-2}$$
$$= \frac{4}{600}ms^{-2}$$

We know, $S = v_0t + \frac{1}{2}at^2$

$= 2 \times 600 + \frac{1}{2} \times \frac{4}{600} \times (600)^2$
$= (1200 + 2 \times 600)m = 2400m$

So, the car traverses 2400m in the first 10 minutes.

d



From the graph it is seen that the initial velocity of the car is $2ms^{-1}$. To reach position C from A there was an uniform acceleration, $a = \frac{1}{150}ms^{-2}$ and the velocity at C is $6ms^{-1}$. In this time the car traverses, s = 2400m. The car reaches D from C in the next five minutes, in this state there was no acceleration and in this time the car traverses

$S_2 = vt = (6 \times 300)m = 1800m$

Here,
$v = 6ms^{-1}$
t = 5 min = 300 seconds

The car moves with uniform retardation from D to E. The velocity decreases to $4ms^{-1}$.

$\therefore$ retardation $= \frac{(4 - 6)\ ms^{-1}}{5\ min} = \frac{2ms^{-1}}{300s} = \frac{-1}{150}ms^{-2}$

The distance traversed in this time, $S_3 = v_0t + \frac{1}{2}at^2$

$= 6 \times 300 + \frac{1}{2} \times \left(-\frac{1}{150}\right) \times (300)^2$
$= (1800 - 300)m$
$= 1500m$

The car reaches position F from E with uniform retardation. The velocity of the car is $0ms^{-1}$ at F.

Therefore retardation, $a = \frac{(0 - 4)ms^{-1}}{5\ min} = -\frac{4}{300}ms^{-2}$
$= -\frac{1}{75}ms^{-2}$

The distance traversed by the car in this time,

$S_4 = v_0t + \frac{1}{2}at^2$

$= 4 \times 300 + \frac{1}{2} \times \left(-\frac{1}{75}\right) \times (300)^2$
$= (1200 - 600)m$
$= 600m$

So, the total distance traversed by the car,
$S = (2400 + 1800 + 1500 + 600)m$
$= 6300m$
$= 6.3km$

That is, the car traverses 6.3km distance in 25 minutes.

So, the average velocity of the car was—

$$\text{average velocity } \bar{v} = \frac{\text{Total distance traversed}}{\text{Total time}}$$
$$= \frac{6.3\ km}{25\ min} = 4.2\ ms^{-1}\ \textbf{(Ans.)}$$

Ques. ▶5 A bullet of log is shot from a pistol which weights 2kg. The bullet moves at a velocity of

500ms^{-1} upon release and the pistol moves backward at a velocity of 2.5ms^{-1}. The time of contact was 0.1see. *[Comilla Board-2015]*

a. What is a fundamental unit? 1
b. Why does an electronic fan rotate for sometime even after it is switched off? Explain. 2
c. Determine the weight of the pistol. 3
d. Explain with which law of Newton is the above mentioned incident similar. 4

Answer to the question no. 5

a The physical quantities which are independent, that is they do not depend on other quantities, rather other quantities depend on them, are called fundamental quantities.

b A fan keeps spinning even after the switch is turned off. The reason behind this is the fan's inertia of motion. Because of resistance from air a torque works on the opposite direction of the motion of the fan. The fan stops slowly due to this torque.

c Given that,
mass of gun, m = 2kg
We know, gravitational acceleration, g = 9.8ms^{-2}
We have to find the weight of the gun, w = ?
We know, w = mg
= 2kg × 9.8ms^{-2} = 19.6 N **(Ans.)**

d The phenomenon of stem follows Newton's third law.
Mass of bullet, m_1 = 10kg = 0.01kg
Initial velocity of bullet, u = 0ms^{-1}
Final velocity of bullet, v_1 = 500ms^{-1}
Time period, t = 0.1 sec

$\therefore$ acceleration of bullet, $a_1 = \frac{v_1 - u}{t}$

$= \frac{500 ms^{-1} - 0 ms^{-1}}{0.1 \text{ sec}}$

$= 5000 ms^{-2}$

The force acting on the bullet, $F_1 = m_1 a_1$
$= 0.1kg \times 5000 ms^{-2}$
$= 50N$

Mass of gun, m_2 = 2kg
Initial velocity of gun, u = 0ms^{-1}
Final velocity of gun, v_2 = 2.5ms^{-1}
Time period, t = 0.1 sec

Acceleration of the gun, $a_2 = \frac{v_2 - u}{t} = \frac{2.5 - 0 ms^{-2}}{0.1 \text{ sec}}$
$= 25 ms^{-2}$

The force applied on the gun, $F_2 = m_2 a_2 = 2kg \times 25 ms^{-2}$
$= 50N$

Since the action and reaction force are equal it is clear that the incident of the stem follows Newton's third law of motion.

Ques. ▶6 Rafique collected the velocity of his father's car while going to his school by looking at the speedometer after every 10s and listed his recordings in the following table.

Time t(s)	0	10	20	30	40	50	60
Velocity v (ms^{-1})	0	20	40	60	80	100	120

[Sylhet Board-2015]

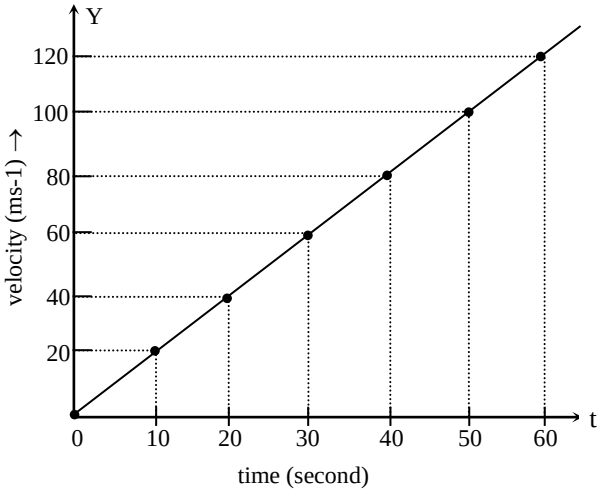
a. What is instant speed? 1
b. Why is a vibrating tuning fork's speed called. 2
c. Draw a velocity time graph from Rafiques collection. 3
d. Determine the constant acceleration from the graph– explain in terms of mathematical ideas. 4

Answer to the question no. 6

a When a body traverses a distance in a very short interval of time then the ratio of the distance travelled and that time interval is called the instantaneous speed of the body.

b We know, if a body in periodic motion travels in a direction for one half of its time period and in the other direction for exactly the other half of its time period it is called vibratory motion. During the vibration of tuning forks their sides move in one direction for half of its time period and in the opposite direction for other half of its time period. So, according to the definition of vibratory motion the motion of a tuning fork is a vibratory motion.

c From the data collected by Rafiq the velocity vs time graph is given below. The length of one smallest squares is taken as two units along t (time) axis. The length of one smallest square is considered as four units along the v (velocity) axis.



d Firstly, t = 10 sec as time period,
Initial velocity, u = 0ms^{-1} and final velocity, v = 20ms^{-1}
$\therefore$ the average acceleration for the first 10 seconds,

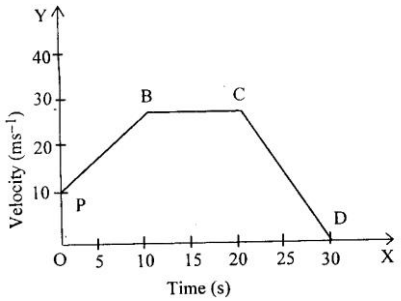
$a = \frac{v - u}{t}$

$= \frac{20 ms^{-1} - 0 ms^{-1}}{10 \text{ sec}}$

$= \frac{20 ms^{-1}}{10 \text{ sec}} = 2 ms^{-2}$

Therefore the average acceleration in the first 10 seconds is 2ms^{-2}.

Ques. ▶7



In the figure there showed the speed of a car with 300kg mass. *[Barisal Board-2015]*

a. What is Retardation? 1
b. What do you mean by the acceleration of a body is $10ms^{-2}$ towards East? 2
c. Calculate the distance travelled of the first 15 second of the car. 3
d. Campare the highest and lowest kinetic energy of the car. 4

Answer to the questions no. 7

a The rate of decrease of velocity with time is called retardation

b The acceleration of a body is $10ms^{-2}$ towards east means that the velocity of the body increases by $10ms^{-1}$ in 1 second towards east.

c For the first 10sec,
initial relocity $u = 10ms^{-1}$
final velocity, $v = 30\ ms^{-1}$
time, $t = 10$ sec
$\therefore$ The distance transversed during the first 10 sec, $s_1 = \frac{u+v}{2}t$

$$= \frac{10ms^{-1} + 30\ ms^{-1}}{2} \times 10sec$$
$$= 200\ m$$

For the next 5sec,
uniform velocity, $v = 30\ ms^{-1}$
time, $t = 5$ sec
$\therefore$ The distance transrersed during the next 5 sec, $S_2 = vt$
$= 30\ ms^{-1} \times 5\ sec = 150\ m$
Therefore the distance transversed by the car during the first 15 second, $s = s_1 + s_2 = 200m + 150\ m = 350\ m$ **(Ans.)**

d According to the stem,
mass of the car, $m = 300$ kg
Maximum velocity of the car, $v_{max} = 30\ ms^{-1}$
$\therefore$ The maximum kinetic energy of the car, $E_{max} = \frac{1}{2}mv^2_{max}$

$$= \frac{1}{2} \times 300kg \times (30ms^{-1})^2$$
$$= 135000\ J$$

According to the stem,
Miximum velocity of the car, $v_{min} = 0\ ms^{-1}$
$\therefore$ The minimum kinetic energy of the car, $E_{min} = \frac{1}{2}mv_{min}^2$

$$= \frac{1}{2} \times 300kg \times (0ms^{-1})^2$$
$$= 0\ J$$

Therefore the difference between the maximum and minimum kinetic energy
$= E_{max} - E_{min}$
$=13500J - 0J$
$= 135000J$

Cadet Colleges Creative Questions with Answers

Cadet Colleges questions are also important for your excellent preparation. It will help you to give a clear idea about the question as well as chapterwise exclusive questions and answers. So, practice them with proper attention.

Ques. ▶8 Kamal with his family members started for visiting Jaflong in Sylhet by microbus. He recorded the magnitude of velocity i.e. speed of the car from the speedimeter after every 5 min throughout the journey. The magnitude of velocity, he got per hour was 18, 36, 54, 36 and 18 kilometer. *[Mirzapur Cadet-2015]*

a. What is instantaneous speed? 1
b. Explain the acceleration of an object moving with uniform velocity. 2
c. Find the distance traveled by the car in first 5 min. 3
d. Draw and explain the velocity time graph by the collected data. 4

Answer to the question no. 8

a The speed of a moving body at any instant is called instantaneous speed.

b The rate of change of non-uniform velocity of an object with time is called its acceleration. If the initial velocity of the object is u and final velocity is v after time t then —
Change in velocity in time $t = v - u$
$\therefore$ Change in velocity in unit time $= \frac{v-u}{t}$
$\therefore$ Rate of change of velocity = acceleration, $a = \frac{v-u}{t}$

But in uniform velocity means velocity does not change over time. So $v = u$
$\therefore$ Acceleration $= \frac{v-u}{t} = \frac{v-v}{t} = 0$
$\therefore$ An object moving with uniform velocity have zero acceleration.

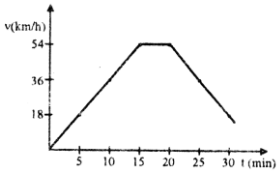
c For the first 5 minutes the reading from speedometer was 18 km/ hour

$$= \frac{18}{60}km/min = 0.3\ km/min$$

$\therefore$ In the first 5 minutes the distance they travel $s = v.t$
$= 0.3 \times 5 = 1.5$ km.

d Here from the curve, we can notice that for first 15 minutes the car ran on uniform accelration. The first five minutes the velocity is 18 km/hour = 0.3 km/min. For the second five minutes velocity is 36 km/ hour = 0.6 km/min. So the acceleration—

$a = \frac{0.6 - 0.3}{5} = 0.06 \text{km min}^{-2}$



and continues next five minutes with same acceleration.

After passing 15 minutes of the journey the car achieve uniform velocity and run in 54 km h^{-1} = 1.2 km min^{-1}. Then for the next 10 minutes the car declerates at the same rate (a = −0.06 km min^{-2}) and achieve 0.3 km min^{-1} after half an hour of travelling.

Ques. ▶9 When a rat was 15 m ahead of a cat. The cat started running to catch the rat with a uniform acceleration of 2 ms^{-2}. The rat was running with a uniform velocity of 14 ms^{-1}. *[Rajshahi Cadet-2015]*

a. What is uniform velocity? 1
b. Friction is a necessary evil- give argument in favor of it. 2
c. Find out the time when the velocity of the cat will be equal to that of the rat. 3
d. Will the cat be able to catch the rat? Represent logical analysis in favor of your answer. 4

Answer to the question no. 9

a If the magnitude and direction of the velocity of a moving body remains unchanged, then the velocity of the body as called uniform or equal velocity. The velocity of sound is a good example of natural phenomenon of uniform velocity.

b Friction has both advantage and disadvantages. Due to friction, it is possible to construct buildings or to stop a moving body once it is in motion. On the other hand, moving body wears out because of excess friction. The energy wasted for friction converts to heat energy. So in an engine controlled machine, excess friction can overheat engine or parts of it. But we cannot discard friction totally. We need to increase or decrease friction by some process in our daily life. For this reason friction is called necessary evil.

c Let after t seconds from starting, the velocities of cat and rat are equal. The rat was running at a uniform velocity. So after t second the velocity of rat is v = 14ms^{-1}.

Here initial velocity of cat u = 0 ms^{-1}

Acceleration a = 2ms^{-2}.

Velocity of cat after t second,

$v' = u + at$

$= 0 + 2t = 2t$

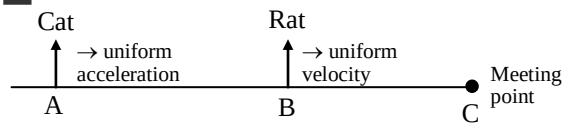
According to the question, the cat will catch the rat when $v' = v$.

$\Rightarrow 2t = 14$

$\Rightarrow t = 7s$

∴ After 7 seconds from starting the velocities of cat and rat are equal.

d



The cat will be able to catch the rat.

Because cat was running with uniform acceleration of 2 ms^{-2} while the poor rate was running with uniform velocity (no acceleration).So, cat's velocity increased every second and gradually came closer to rat.

t, time letter the rat will be caught.

Mathematically−

cat's running distance

$AC = ut + \frac{1}{2}at^2$

$= 0 + \frac{1}{2}.2t^2 = t^2$

rat's running distance BC = vt = 14t and AB = 15m.

∴ AB + BC = AC

$14t + 15 = t^2$

$\Rightarrow t^2 - 14t - 15 = 0$

$\Rightarrow t^2 - 15t + t - 15 = 0$

$\Rightarrow t(t - 15) + 1(t - 15) = 0$

$\Rightarrow (t - 15)(t + 1) = 0$

∴ t = 15s.

Since, there in a real value of time can be found to catch the rat, the cat will be able to catch the rat.

Ques. ▶10 Mr. Ruhan started from his house to the office by a jeep. The distance between the house and office is 3 km. Starting from rest the car moves with uniform acceleration and it crosses 1st kilometer in 4 minutes. Then the car moves with uniform velocity. *[Pabna Cadet-2015]*

a. Draw a velocity vs. time graph in which a body moves with uniform retardation. 1
b. State the laws of falling bodies. 2
c. Find out the total time taken by Mr. Ruhan to reaches his office? 3
d. In 6 minutes Mr. Ruhan crosses 66.67% of the total distance. Verify this statement mathematically according to stem. 4

Answer to the question no. 10

a

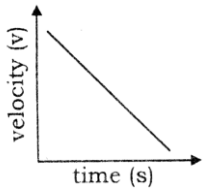


Figure: velocity vs time graph for uniform retardation.

b Laws of falling bodies are :

First law : All bodies falling form rest and from the same height without any resistance traverse equal distance in equal time.

Second law: The velocity (v), acquired by a freely falling body form rest in a given time (t) is directly proportional to time that is, $v \propto t$.

Third law: The distance (h) traversed by a freely falling body form rest in a given time (t) is directly proportional to the square of the time, that is $h \propto r^2$.

c For first 1 Kilometer with uniform acceleration
distance s = 1 km = 1000 m
$\therefore$ time t = 4 min = 240s

now $s = \frac{u + v}{2} . t_1$

$\Rightarrow = \frac{1000}{240} \times 2 = O + v$

$\Rightarrow v = \frac{25}{3}$ ms^{-1} = final velocity

$\therefore$ time taken for rest of (3 – 1) = 2 km = 2000 m is t_2

$= \frac{s}{v} = \frac{2000}{\frac{25}{3}} = 240$ s = 4 min

total time needed $t_1 + t_2$ = 4 min + 4 min = 8 min

d 66.67% of the total distance 3 km $= \frac{66.67}{100} \times 3000$
= 2000 m
First 1000 m is reached in 4 min
Then to cross 66.67% of 6 km, the rest (2000 – 1000) m
= 1000 must be reached in 2 minutes = 120 s
In this 120s distance reached s = vt
$= \frac{25}{3} \times 120$
= 1000 m
$\therefore$ 66.67% of total distance can be reached in 6 minutes.

Ques. ▶11 A body of mass 950 kg is moving with the velocity of 50 km/h meets with another body of mass 700 kg. Which is coming from the opposite side with the velocity of 65 km/h and collide each other. After the collision they become a single body.

[Joypurhat Girls' Cadet-2015]

a. What is called non-contact force? 1
b. What is meant by momentum? 2
c. Calculate the velocity of the combined body? 3
d. Does the above stimulus support the principal of conservation of momentum? Give your opinion with mathematically. 4

Answer to the question no. 11

a The force which acts without direct contact between two bodies is called non-contact force.

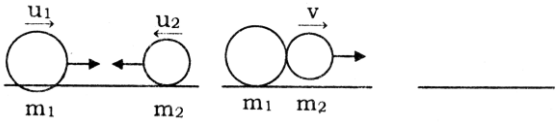
b Momentum is a measure of how difficult it is to stop something that is moving. Momentum is related to the force. This relation is obtained quantitatively in Newton's second law of motion.
Momentum is the product of the mass and velocity of a moving body.
Let, the mass of a body = m
Velocity = v
$\therefore$ Momentum = mv
Momentum is a vector quantity. Its direction is in the direction of velocity. It is observed from equation that the momentum of a body will be large if the body has a large mass and moving faster.

Unit: The unit of momentum is, unit of mass × unit of velocity, i.e. kg × ms^{-1} or kg ms^{-1}. If a body of 1 kg moves with a velocity of 1 ms^{-1}, its momentum will be 1 kg ms$^{-1+.}$

c According to, conservation of momentum
$m_1u_1 + m_2u_2 = (m_1 + m_2)v$
$\Rightarrow$ (950 × 13.89) + 700(−18.056)
= v(950 + 700)
$\Rightarrow v = \frac{13195.5 - 12.638.5}{1650}$
= 0.337 ms^{-1}
Since final velocity is of positive sign so combined body will move in the direction of first body.

Given,
a body of mass,
m_1 = 950kg
velocity u_1 = 50 kmh^{-1}
$= \frac{50 \times 1000}{60 \times 60}$
= 13.89 ms^{-1}
another body of mass m_2 = 700 kg
$\therefore$ velocity u_2 = 65 kmh^{-1}
$= -\frac{65 \times 1000}{60 \times 60}$
= − 18.056 ms^{-1}
[since opposite direction so negative sign]
Final velocity, v = ?

d According to the law of conservation of momentum, if there is no external force acting on two or more bodies then the momentum will not change and the bodies will move along the same straight line.

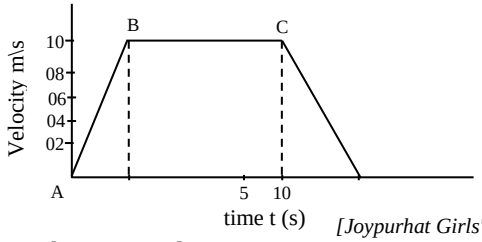


We know, momentum of a body = mass of that body × velocity of that body.

Momentum before collision:
Pass of first body m_1 = 950 kg
Velocity of first body u_1 = 13.89 ms^{-1}
Mass of second body m_2 = 700 kg
Velocity of second body u_2 = −18.056 ms^{-1} [due to its opposite direction]
$\therefore$ Momentum before collision $m_1u_1 + m_2u_2$
= (950 × 13.89) − (700 × 18.056)
= 556.03 kg ms^{-1}

Momentum after collision:
Mass of combined body m = $m_1 + m_2$ = 950 + 700
= 1650 kg
Velocity of combined body v = $m_1 + m_2$ = 950 + 700
= 1650 kg
$\therefore$ Momentum after collision mv = 1650 × 0.337
= 556.05 kg ms^{-1}

Ques. ▶12



[Joypurhat Girls' Cadet-2015]

a. What is retardation? 1

b. The acceleration of a body is 5 ms^{-2} What does it mean? 2
c. Calculate the acceleration from the graph. 3
d. Explain mathematically total distance from A to C. 4

Answer to the question no. 12

a The rate of decrease of velocity of a body with time is called negative acceleration or retardation.

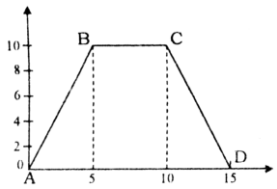
b The acceleration of a body is $5ms^{-2}$ in a straight line means the velocity of the body increases by 5 ms^{-1} in 1 second. Acceleration is a vector quantity. So, it demands to be measured in a straight line.

c Acceleration from A to B = $\frac{\text{change of velocity}}{\text{time}}$

$= \frac{10}{5} = 2\ ms^{-2}$

Acceleration from B to C = $\frac{\text{change of velocity}}{\text{time}}$

$= \frac{0}{5} = 0\ ms^{-2}$



If at 15s velocity is at point D.

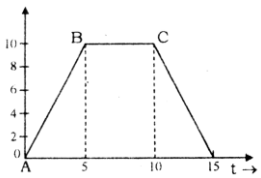
$\therefore$ Acceleration from C to D = $\frac{\text{change of velocity}}{\text{time}}$

$= \frac{-10}{5}$ [decrease of velocity]

$\therefore$ Average acceleration for whole path a = $\frac{2+0-2}{3}$

$= 0\ ms^{-2}$

d



From A to B, the body is in uniform acceleration and it initial velocity is zero, final velocity 10 ms^{-1}

$\therefore v = u + at$

$\Rightarrow 10 = 0 + a.5$

$\Rightarrow a = \frac{10}{5} = 2\ ms^{-2}$

$\therefore$ Distance $S = ut + \frac{1}{2}at^2 = 0 + \frac{1}{2}.2.(5)^2 = 25m$

From B to C, the body is in uniform velocity and the velocity is 10 ms^{-1}

$\therefore$ Distance $S = vt = 10 \times 5 = 50$ m.

$\therefore$ Distance from A to C = (25 + 50)m = 75m.

Ques. ▶13 A car is moving with velocity 72km/h. Suddenly driver of the car observed a child just ahead at a distance 11m.The driver immediately applies break and the car stops only 1m ahead of the children. *[Rangpur Cadet-2015]*

a. Define uniform velocity. 1
b. "Acceleration due to gravity does not depend on mass". Explain it. 2
c. After applying break, find out the acceleration of the car. 3
d. If the acceleration remains same but the initial velocity of the car becomes 108 km/h, is it possible to save the child? Why explain it. 4

Answer to the question no. 13

a If the magnitude and the direction of the velocity of a moving body remain unchanged, then the velocity of the body is called uniform velocity.

b We know that, the equation for gravitational force,

$F = G\frac{Mm}{R^2}$

Where M = mass of earth
m = mass of the object
g = acceleration due to gravity
G=universal gravitational constant.

We know gravitational force,F acted on a body of mass, m is mg and $F=mg= G\frac{Mm}{R^2}$

$mg = G\frac{Mm}{R^2}$ [F = mg]

$\Rightarrow g = G\frac{M}{R^2}$ ..... (1)

We can see there is no m in the equation (1). So, we can say acceleration due to gravity does not depend on mass.

c Here,
Initial velocity, u = 72 km/h
$= 20\ ms^{-1}$
Final velocity, $V = 0\ ms^{-1}$
distance, S = 11 m
acceleration, a = ?

We know that,

$V^2 = u^2 + 2aS$

$\Rightarrow O = u^2 + 2aS$

$\Rightarrow 2aS = -u^2$

$\Rightarrow a = \frac{-u^2}{2S}$

$= \frac{-(20)^2}{2 \times 11}\ ms^{-2}$

$= -18.18\ ms^{-2}$

After applying break, the acceleration of the car is = − 18.18 ms^{-2}.

d If the acceleration remains same but the initial velocity of the car becomes 180 km/h or 50 ms^{-1}. Then the distance travelled by the car is S_1.

We know that,

$V^2 = u^2 + 2aS$

$\Rightarrow 2aS = -u^2$

$\Rightarrow S = \frac{-u^2}{2a}$

$= \frac{-(50)^2}{2(-18.18)}$m

= 68.76m.

So, the car will ran over the child. And it is not possible to save the car in this condition.

Ques. ▶14

Time	Velocity (kmh^{-1})
0	0
8	14.4
16	28.8
24	43.2
32	57.6
40	72.0

[Comilla Cadet-2015]

a. What is rectilinear motion? 1
b. Why the drivers wear seat for safety during car driving? 2
c. Find the acceleration of the car in 24 s. 3
d. The acceleration of the car in every will be same or not? Explain mathematically. 4

Answer to the question no. 14

a Rectilinear Motion : A continuous change of position of a body so that every particle of the body follows a straight line path is called rectilinear motion.

b When a driver driving a car, he has the same velocity as the car. But when the car stops, the driver wants to keep the previous velocity due to inertia. Cars usually stop slowly. Buy when it is needed to break hard and will be injured badly. To avoid this, drivers wear seat belts which keeps them in the seat and saves them from getting injured.

c Here,

The initial velocity of the car, u = O ms^{-1}

The final velocity of the car, v = 43.2 ms^{-1}

The time spent, t = 24 s

The acceleration = ?

$$a = \frac{v-u}{t} = \left(\frac{43.2-0}{24}\right) ms^{-2}$$

$= 1.8\ ms^{-2}$

∴ The acceleration will be 1.8 ms^{-2}

d From the chart above, we can write acceleration after

8s is $= \frac{14.4-0}{8} = 1.8\ ms^{-2}$

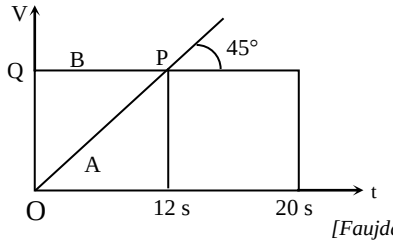
acceleration after 16s is $= \frac{28.8-0}{24} = 1.8\ ms^{-2}$

acceleration after 24s is $= \frac{43.2-0}{24} = 1.8\ ms^{-2}$

After 32 and 40 second, acceleration is also 1.8 ms^{-2}

So, mathematically, the acceleration of the car is every time will be same.

Ques. ▶15 The motion of Car A moving from rest and another car B moving with velocity is shown by following graph.



[Faujdarhat Cadet-2015]

a. Define instantaneous acceleration. 1
b. No rest or no motion is absolute. Explain it. 2
c. Find out the distance travelled by the car B. 3
d. Under the condition the distance traveled by the car A equals to the same of the car B. Analyze it mathematically. 4

Answer to the question no. 15

a The acceleration of a moving particle at any instant is called instantaneous acceleration.

b Actually whether an object is at rest or not depends on the reference object. If the reference frame is actually in rest, the object will be actually in rest with respect to that frame. This type of rest is called absolute rest. A body is said to be in absolutely rest when it is in rest with respect to an absolutely rest object.

Similarly absolute motion of a body is its motion with respect to a reference object absolutely at rest. But in this universe it is not possible to get a reference object, which is at absolute rest. Since the earth is continuously moving round the sun, while the sun itself is moving round the sun, while the sun itself is moving along the galaxy with its planets and satellites. Thus when we say that a body is at rest or in motion, we mean it is to be so with respect to a body apparently at rest. So we can say that in this universe all rest and all motion are relative. No rest or no motion is absolute.

c Car-B is moving with a constant velocity and Car-A is moving with a constant acceleration, a.

For Car-A, distance upto t = 12 sec. at Point-P

$S_1 = ut + \frac{1}{2} at^2$

$= 0 + t + \frac{1}{2} \times 1 \times (12)^2$

$= 72$ m

$a = \frac{\Delta v}{\Delta t} = \tan\theta$

$= \tan 45° = 1$

and u = 0

Velocity at point P

$v^2 = u^2 + 2as$

$\Rightarrow v^2 = 9 + 2 \times 1 \times 72$

$\Rightarrow v^2\ 144$

∴ v = 12 ms^{-1}

So, the unoform velocity of B at point P is = 12 ms^{-1}

Total distance travel by the Car-B

$S_2 = vt = 12 \times 20 = 240$m **(Ans.)**

d Let, t time letter both car's distance will be same.
Total distance travelled by Car-A

$$S_A\ 0 + t + \frac{1}{2}\ at^2$$

total distance travelled by Car-B

$$S_B = vt$$
$$= 12\ t$$

$\because S_A = S_B$

$\Rightarrow \frac{1}{2}\ at^2 = 12t$

$\Rightarrow \frac{1}{2} \times 1 \times t^2 = 12t \ \ [\Rightarrow a = 1]$

$\Rightarrow t^2 = 24t$

$\therefore t = 24$ sec

After 24 sec. both car will travel some distance.

Ques. ▶16 A bullet of mass 10gm was fired from an efficient hunters gun of 6kg mass at a velocity of 300ms^{-1} and during firing back ward reaction of gun was created. *[Mirzapur Cadet-2014]*

a. What is momentum? 1
b. Explain how the concept of inertia is obtained from New tons first law of motion. 2
c. Calculate the back ward velocity of the gun. 3
d. Does this even obey the conservation principle of momentum? Explain with mathematical analysis. 4

Answer to the question no. 16

a Momentum is the product of the mass and velocity of a moving body.

b From Newton's first law of motion we observe that a body cannot change its state on its own. If the body is at rest, it tends to remain at rest forever and if it's in motion it tends to keep on motion with uniform speed for all time. This property of a body is termed as inertia. Thus from the Newton's first law of motion we get the concept of inertia.

c Let velocity of bullet is positive. From the law of conservation of momentum.
We know,

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$
or, $0 + 0 = (10 \times 10^{-3})$ kg $\times$ 300 ms^{-1} + 6 kg $\times$ v_2
or, $v_2 = \frac{10^{-2}\text{kg} \times 300\ \text{ms-1}}{6\text{kg}}$
or, $v_2 = -0.5\text{ms}^{-1}$

Here,
mass of the bullet, m, = l0g
$= (10 \times l0^{-3})$kg
mass of the rifle, $m_2 = 6$ kg
initial velocity of the bullet,
$U_1 = 0$ ms^{-1}
initial velocity of the rifle, $u_2 = 0$ ms^{-1}
final velocity of the bullet, $V_1 = 300$ ms^{-1}
final velocity of the rifle, v_2 = ?

So, the rifle's velocity is negative therefore the velocity of the rifle is opposite to the velocity of the bullet.

d This event obey the conservation principle of momentum. According to the law of conservation, if there is no external force acting on two or more bodies then the momentum will not change and the bodies will move along the same straight line.
We know, momentum of a body = mass of that body $\times$ velocity of that body.

Momentum before the shot : Mass of the gun = 6kg, Velocity of the gun = 0 ms^{-1}.

$\therefore$ Momentum of the gun = 6×0 = 0 kgms^{-1}
Mass of the bul let = 10 gm = 0.01 kg
Velocity of the bullet, v = 0 ms^{-1}.

$\therefore$ Momentum of the bullet = 0.01 × 0 = 0 kgms^{-1}

The total momentum before the gun shot = 0 kg ms^{-1}.

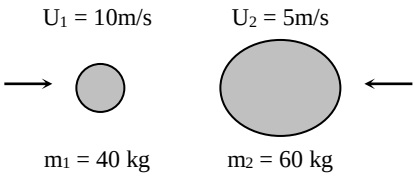
Momentum after the shot: Mass of the gun = 6 kg, velocity = -0.5 ms^{-1}
[From question c the backward velocity of the gun = 0.5 ms^{-1}]

$\therefore$ Momentum of the gun = 6 x (- 0.5) = - 3 kg ms^{-1} mass of the bullet = 10 gm = 0.01 kg; velocity = 300 ms^{-1}.

$\therefore$ Momentum of the bullet = (0.01 x 300) = 3 kg ms^{-1}

$\therefore$ Total momentum after the gun shot = -3 + 3 = 0 kg ms^{-1} So, the momentum after and before the gun shot is equal. Therefore the conservation of momentum is maintained.

Ques. ▶17 The picture of two bodies moving in a straight line and having collisions



[Mymensingh Girls' Cadet-2014]

a. What is impulse force? 1
b. 'Displacement is proportional to the square of the duration of time' How? 2
c. Determine the cobined velocity of the two bodies after the collision. 3
d. In the above mentioned event the kinetic energy is not conserved. 4

Answer to the question no. 17

a The product of force and time is defined as impulse of force.

b We know, from the equation of motion,

$s = ut + \frac{1}{2}\ at^2$ where, s = displacement, u = initial velocity a = acceleration and t = time.

If, u = 0 then we get, $s = \frac{1}{2}at^2 \rightarrow (1)$ consider,a is uniform acceleration, then a will be constant. From formula (1) we get,

$s \propto t^2$, It means- "Displacement is proportional to the square of the duration of time".

c Given that,

$m_1 = 40$ kg

$u_1 = 10$ ms^{-1}

$m_2 = 60$ ms^{-1}

$U_2 = 5$ ms~

v = combined velocity = ?

According to the conservation of momentum,

$m_1u_1 + m_2u_2 = v(m_1 + m_2)$

$40 \times 10 + 60 \times 5 = v(40 + 60)$

or, $v = \frac{400 + 300}{100} = 7\text{ms}^{-1}$

So, the combined velocity of the two bodies after the collision will be 7 ms^{-1}.

d In the above mentioned event kinetic energy is not conserved.

Proof: Mass of $m_1 = 40$ kg and velocity, $u_1 = 10$ ms^{-1}

$\therefore$ Kinetic energy of m_1 is $= \frac{1}{2} m_1u_1^2$

$= \frac{1}{2} \times 40 \times (10)^2$

$= 2000$ J

Again mass of $m_2 = 60$ kg and velocity, $u_2 = 5$ ms^{-1}

$\therefore$ Kinetic energy of m_2 is $= \frac{1}{2} m_2u_2^2$

$= \frac{1}{2} 60 \times (5)^2 = 750$ J

Before collision, total kinetic energy

$E_1 = (2000 + 750)$ J $= 2750$ J

After collision the combined velocity is, $v = 7$ ms^{-1} and combined mass, $m = (40 + 60)$ kg $= 100$ kg

$\therefore$ After collision total kinetic energy

$E_2 = \frac{1}{2} mv^2$

$= \frac{1}{2} \times 100 \times (7)^2$

$= 2450$ J.

Here, $E_1 \neq E_2$.

So, due to collision the kinetic energy of these two cars was not conserved.

Ques. ▶18 A truck driver of mass 105kg was driving his truck with velocity 60m/s. He saw a boy 40m away from him. He breaks the car and stops 1m ahead of the boy. *[Mymensingh Girls' Cadet-2014]*

a. What is instantaneous speed? 1

b. What do you mean by uniform acceleration? 2

c. Calculate the force from above stem. 3

d. Will the driver save the boy if he breaks the car with 45ms^{-2}? Explain mathematically. 4

Answer to the question no. 18

a the speed of a moving particle at any instant is called instantaneous speed.

b If the rate of increase of velocity of a moving body in a particular direction is maintained constantly all the time, then the acceleration is said to be uniform. An example of uniform acceleration is the acceleration of a freely falling body due to gravity. The acceleration of a freely falling body is 9.8 ms^{-2}, that is, its velocity increases by 9.8 ms^{-1} for each successive seconds. In the case of uniform acceleration if we draw a graph of velocity-time then we will find a straight line.

c Here,

Initial velocity, $u = 60$ ms^{-1}

final velocity, $v = 0$ ms^{-1}

distance, $s = (40 - 1)$ m $= 39$ m

Acceleration, a = ?

Force, F = ?

Mass, m= 105 kg

We know, $v^2 = u^2 + 2as$

$v = u + gt$

or, $v = gt$

or, $t = \frac{v}{g}$

or, $t = \frac{59.8}{9.8}$ s.

$\therefore t = 6.1$ s.

here,

$u = 0$

$g = 9.8$ ms^{-2}

$v = 59.8$ ms^{-1}

or, $a = \frac{v^2 - u^2}{2s}$

$= \frac{(60)^2}{2 \times 39}$ ms^{-2}

or, $a = 46.153$ ms^2

$F = ma = (105 \times 46.153)$ N

$= 4846.065$ N

d The accident can be avoided, if the bus is stopped exact 40 m away from the passenger.

Here, initial velocity, $u = 60$ m/s

Final velocity, $v = 0$ ms^{-1}

acceleration, $a = -45$ms^{-2}

distance, s = ?

We know, $v^2 = u^2 + 2as$

or, $s = \frac{v^2 - u^2}{2a}$

$= \frac{02 - (60)^2}{2(-45\text{ ms}^{-2})}$

$\therefore s = 40$m

It means the bus will be stopped at 40 m. So the accident can be avoided.

Ques. ▶19 A body is thrown from the top of a tower of 180m height. At the same time another body is thrown vertically upward with a velocity of 60ms^{-1}. *[Rangpur Cadet-2014]*

a. What is called gravitational acceleration? 1

b. If a piece of stone and paper are dropped from the same height, which will reach the ground first? Explain. 2

c. How long will the falling body to reach the ground? 3

d. "Two bodies will meet at a particular time"- Explain with mathematical logic when they will meet. 4

Answer to the question no. 19

a The rate of increase of velocity of a freely falling body on earth due to force of gravity is called gravitational acceleration.

b A piece of stone and a piece of paper are dropped from the same height, it is seen that the stone reaches the ground first. Since the acceleration due to gravity does not dropped on the mass of the body, the acceleration of the stone and that of the paper would be the same. So they should reach at the same time on the earth, but due to the resistance of air two bodies reach at different time on the earth. If there is no resistance of the air, they would fall at the same time.

c Let the required time for the body to reach the ground be't[1] initial velocity 'u' and final velocity V. We know in case of falling bodies,

$v^2 = u^2 + 2gh$
$= 0 + 2 \times 9.8 \times 180\ m^2 s^{-2}$
or, $v^2 = 3528\ m^2 s^{-2}$
$\therefore v^2 = 59.4\ ms^{-1}$

From the passage,
v = ?
u = 0
$g = 9.8\ ms^{-2}$
h = height of the tower
= 180 m

Again, we know,
So, it will take 6.1 second to reach the ground.

d Let the falling body be 'A' and the body thrown up be 'B'.
Let, after throwing B upwards they will meet each other in position h and will take time t.
In the case of A,

$\text{Height} = u_1 t + \frac{1}{2} gt^2$

or, $(180 - h) = 0 + \frac{1}{2} gt^2$

or, $180 - h = \frac{1}{2} gt^2$ .....(i)

In the case of B,

$\text{Height} = u_2 t - \frac{1}{2} gt^2$

or, $h = u_2 t - \frac{1}{2} gt^2$.....(ii)

By adding equation (i) and (ii) we get,

$180 - h + h = \frac{1}{2} gt^2 + u_2 t - \frac{1}{2} gt^2$

or, $180 = u_2 t$
or, $u_2 t = 180$
or, $60\ m\ s^{-1} \times t = 180$ [$\because u_2 = 60\ m\ s^{-1}$]
or, $t = \frac{180\ m}{60\ ms^{-1}}$
$\therefore t = 3s$
Now putting the value of in equation (i)

$180 - h = \frac{1}{2} \times 9.8\ m\ s^{-2} \times (3s)^2$

or, $180 - h = 44.1$
or, h = (180-44.1) m
$\therefore$ h = 135.9 m
$\therefore$ After throwing B upward, they will meet each other 135.9 m up from the ground in 3s.

Ques. ▶20 The distance between point A and B is 45 m. Particle P started from A moving with uniform velocity of $40ms^{-1}$ while particle Q started from B moving with initial velocity $16ms^{-1}$ and uniform acceleration of $6ms^{-2}$. *[Rangpur Cadet-2014]*

a. What is uniform acceleration? 1
b. Is it possible to have acceleration if the body moves at uniform speed? Explain. 2
c. How much distance the Q particle will pass in 6s?3
d. Can P & Q meet together at any point after start moving? Explain mathematically.

Answer to the question no. 20

a If the rate of increase of velocity of a moving body in a particular direction is maintained constant all the time then it is called uniform acceleration.

b The body that is moving with a uniform speed does not have acceleration. Acceleration is the rate of change of velocity. So if the velocity of a body changes in time to time then it has acceleration. But when a body is moving with a uniform speed the magnitude of velocity does not change. So there is no change in velocity which means there is no acceleration.

c From equation of motion we know,

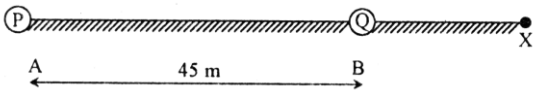
$S = ut + \frac{1}{2} at2$

$- (16 \times 6) + \frac{1}{2} \{6 \times (6)^2\}$
$= (96 + 108)m$
$= 204$

From the passage we get,
initial velocity, u = $16\ ms^{-1}$ uniform acceleration,
$a = 6\ ms^{-2}$
time, t = 6 s
distance, S = ?

So, Q particle will pass 204 m in 6 s.

d Let, P and Q will meet in x after time t.
final velocity $v = 40\ ms^{-1}$



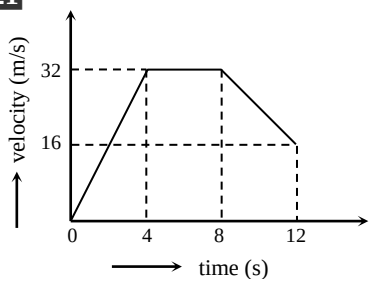
$\therefore$ Distance travelled by P in time t = vt
$\therefore$ Ax = 40 t
Again, In the case of Q,
initial velocity, $v = 16\ ms^{-1}$; uniform acceleration, a = $6\ ms^{-2}$

$\therefore$ Distance travelled by Q in time t, $Bx = ut + \frac{1}{2} at^2 =$

$16t = \frac{1}{2} 6 \times t^2 = 16t + 3t^2$

Now, Ax = AB + Bx
or, $40t = 45 + 16t + 3t^2$
or, $3t^2 - 24t + 45 = 0$
or, $t^2 - 5t - 3t + 15 = 0$
or, $t(t - 5) - 3(t - 5) = 0$
or, $(t - 5)(t - 3) = 0$
Either, $t - 5 = 0$ or, $t - 3 = 0$
$\therefore t = 5$ or, $t = 3$
Here both of the magnitude of t are real. So they will meet twice in the way.

Ques. ▶21



[Feni Girls' Cadet-2014]

a. State the Third law of falling bodies. 1
b. Is the acceleration due to gravity depend on mass of the body? 2
c. Calculate the distance traversed in first 4 second. 3
d. By explaining the graph, calculate the total distance. 4

Answer to the question no. 21

a The distance (h) by a freely falling body from rest in a given time (t) is directly proportional to the square of the time that is, $h \propto t^2$.

b The rate of increase of velocity of a freely falling body on earth due to force of gravity is called the acceleration due to gravity. The acceleration due to gravity is represented by the letter g.

The quantities of magnitude of 'g' any place on earth is

$$g = \frac{GM}{R^2} \quad \text{.....(i)}$$

Here, M = mass of the earth

G = a universal constant, which is called gravitational constant

R = Radius of the earth

So, from equation (i) we can see there is no mass of the body. From above discussion we can say that acceleration due to gravity does not depend on mass of the body.

c Here,

velocity, $v = 32\ ms^{-1}$

time, $t = 4$ sec

initial velocity, $u = 0$

acceleration, $a = \frac{32}{4} = 8\ ms^{-1}$

$$\therefore S = ut + \frac{1}{2}at^2 = \left(0 + eq\ \frac{1}{2} 8 \times 16\right) ms^{-2}$$

$$= 64m.$$

So, the distance transversed in first 4 second is 64 m.

d In this graph time t was put in x axis and velocity v was put in y-axis. The graph is velocity - time graph from which we can calculate the total distance easily.

Here the body starts moving from rest, that is why it starts from O in the graph, and in 4 sec it's velocity increases.

Here, acceleration, $a_1 = 8\ ms^{-1}$. So, the distance travelled in first 4 second in, S, = u, $t_1 + \frac{1}{2} a_1 t_1^2 = 64$ m.

Next 4 second it moved with uniform velocity. So, distance, $S_2 = v \times t = 32 \times 4 = 128$ m. In last 4 second its velocity decreased.

So, retardation, $a_2 = \frac{16}{4} = 4\ ms^{-1}$

Here, $u_2 = 32 ms^{-1}$

time, $t_2 = 4$ second

So, distance, $S_3 = u_2 t_2 + \frac{1}{2} a_2 t_2^2$

$$= 32 \times 4 + \frac{1}{2} 4 \times 16$$

$$= 128 + 32 = 160m$$

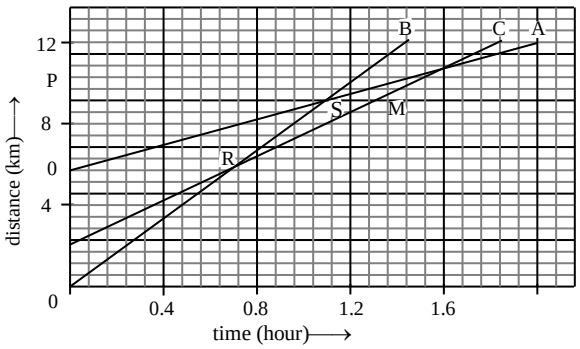
So, total distance, $S = S_1 + S_2 + S_3$

$$= (64 + 128 + 160)\ m$$

$$= 352m.$$

So, the total distance S = 352 m.

Ques. ▶22



[Faujdarhat Cadet-2014]

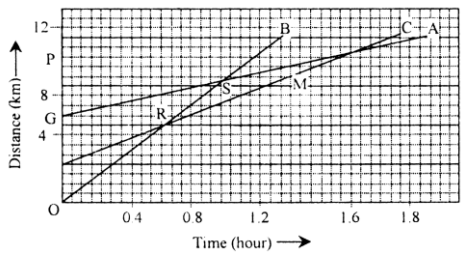
a. Define instantaneous speed. 1
b. No rest or no motion is absolute. Explain it. 2
c. How far has C travelled when B passes A? 3
d. Which of the three is travelling the fastest? Analyze mathematically. 4

Answer to the question no. 22

a The speed of a moving particle at any instant is called instantaneous speed,

b Actually whether an object is at rest or not depends on the reference object. If the reference frame is actually in rest, the object will be actually in rest with respect to that frame. This type of rest is called absolute rest. A body is said to be in absolutely rest when it is in rest with respect to an absolutely rest object. Similarly absolute motion of a body is its motion with respect to a reference object absolutely at rest. But in this universe it is not possible to get a reference object, which is at absolute rest. Since the earth is continuously moving round the sun, while the sun itself is moving along the galaxy with it's planets and satellites. Thus when we say that a body is at rest or in motion, we mean it is to be so with respect to a body apparently at rest. So we can say that in this universe all rest and all motion are relative. No rest or no motion is absolute.

c



From the graph we can see that B passes A in S position. From the graph, in 5 position time is $\left(\frac{14 \times 0.4}{5}\right)$ h = 1.12 hours. At that time the line of travel of C in y-axis is in 8 km.

So, C travels 8 km when B passes A.

d From the graph, A travels 12 km in (24 x 0.08) hour = 1.92 hours

B travels 12 km in (17 x 0.08) hour = 1.36 hours

C travels 12 km in (23 x 0.08) hour = 1.84 hours

So, if the velocity of A, B and C are V_A, V_B and V_c then we know, S = Vt

or, $V = \frac{S}{t}$

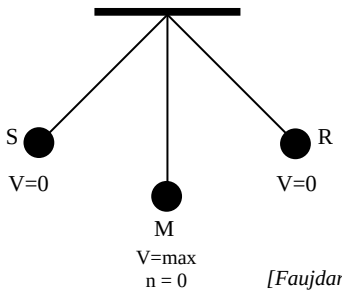
$\therefore$ In case of A, $V_a = \frac{12 \times 1000 \text{ m}}{1.92 \times 60 \times 60 \text{ s}} = 1.74 \text{ ms}^{-1}$

In case of B, $V_B = \frac{12 \times 1000 \text{ m}}{1.36 \times 60 \times 60 \text{ s}} = 2.45 \text{ ms}^{-1}$

In case of V, $V_c = \frac{12 \times 1000 \text{ m}}{1.84 \times 60 \times 60 \text{ s}} = 1.81 \text{ ms}^{-1}$

So, from the above discussion it is apparent that B is travelling the fastest.

Ques. ▶ 23 Energy changes which occur when we draw a pendulum bob of mass 50g to one side and allow it to oscillate in the following way. (h = 0.40m)



[Faujdarhat Cadet-2014]

a. Define periodic motion. 1

b. Why does the bob eventually come to rest? Explain. 2

c. Find out the maximum velocity of the bob. 3

d. What happens to its energy eventually? Is it a violation of law of conservation of energy? Analyze mathematically. 4

Answer to the question no. 23

a If the motion of a moving particle is such that it passes through a definite point along the path of its motion in the same direction in a definite interval of time, this type of motion is called periodic motion.

b The body eventually come to rest cause of balanced force. It is seen in figure that an object is suspended with a thread, The force of attraction of earth on the object i.e. the weight of the object W is acting vertically downward. The tension of the thread T is acting vertically upward. Here the two forces are equal is magnitude but opposite in direction thus cancelling each other's action and producing a balanced condition. Only the attractive force of the earth i.e. the force of gravity will act on the object if the thread is cut. Then the object will fall down with acceleration due to gravity. Here, the force of gravity or weight of the object is the unbalanced force. If the body is displaced slightly along one side, the tension of the thread T and the weight W will not be in a straight line. Then a resultant force will act on the body without creating balanced condition. Due to this, the body will oscillate. This is an example of unbalanced force.

c Here

u = 0 [bob state from rest]

g = 9.8

h = 0.40m

We know

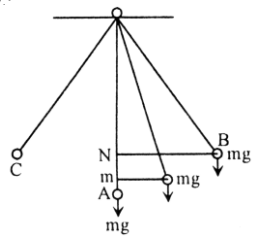
$v^2 = u^2 + 2gh$

or, $v = \sqrt{0 + 2 \times 9.8 \times 0.40} \text{ ms}^{-1}$

$= 2.8 \text{ms}^{-1}$

So, the maximum velocity is 2.8 ms^{-1}

d It does not viotat of law of conservation of energy. Let on be the pendulum. Its initial velocity become O for an instant at OB. So, at point B all of its energy is potential energy.



So to reach point B it travels AN length.

Total potential energy = mg × AN

$\therefore$ Total energy at B = potential energy + kinetic energy

= mg × AN + 0 = mg × AN

When bob returns but it reaches C and at that point it will

have both potential and kinetic energy.

$\therefore$ Potential energy it, C = mg × Am and

kinetic energy at, $C = \frac{1}{2} mv^2 = \frac{1}{2} M \times 2g \text{ mw}$

[$\because v^2 = O^2 + 2 \text{ gh} = 2g \times \text{mw}$]

= mg(mn) = mg(AN - AM)

$\therefore$ Total energy at, C = mg x AM + mg(AN – AM)

= mg x AN = total energy at B.

So, energy at any moment is constant in case of pendulum which is the law of conservation of energy.

Ques. ▶24 Ratul travels 500 m in 2 minutes and Rumi travels 750 m distance in 5 minutes. Both of them are traveling with the uniform speed and they are travelling in a straight line. *[Sylhet Cadet-2014]*

a. What is instantaneous speed? 1
b. Explain any two laws of falling body. 2
c. Find the minimum speed from the above data? 3
d. Generate data for both persons of their speed for 5-second interval. Putting this data in line curves predict about the speed of Ratul and Rumi by analysing the slope of the lines. 4

Answer to the question no. 24

a The speed of a moving particle at any instant is called instantaneous speed.

b Second and third law of falling body is explained below : Second law : The velocity (V), acquired by a freely falling body from rest in a given time (t) in directly proportional to time. That is $V \propto t$. Third law : The distance (h) traversed by a freely falling body from rest in a given time (t) is directly proportional to the square of the time. That is, $h \propto t2$.

c We know,

$V = \frac{S}{t}$ where, V = velocity/speed, S = distance, t = time.

In the case of Ratul,

$V = \frac{500\ m}{2 \times 60\ s}$ | From the stem, S = 500 m
$= 4.17\ ms^{-1}$ | t = 2 min = 2 × 60s

In case of Rumi,

$V = \frac{750\ m}{5 \times 60\ s}$ | From the stem, S = 750 m
$= 2.33\ ms^{-1}$ | t = 5 min = 5 × 60s

So, the minimum speed is 2.33 ms^{-1}.

Ques. ▶25 A bullet of 5g was shot from a gun with velocity of 400ms^{-1}. The backward velocity of gun was 2ms^{-1}. *[Jhenidah Cadet-2014]*

a. What is force? 1
b. What do you know about fundamental force? 2
c. Calculate the mass of the gun? 3
d. Why did the gun give backward velocity- Explain. 4

Answer to the question no. 25

a A meaningful or expressive change in the position of any object over time with respect to fixed reference is called motion.

b The rate of increase of velocity of a freely falling body on earth due to force of gravity is called the acceleration due to the gravity. The acceleration due to gravity is represented by the letter g. The quantities of magnitude of'g' at any place on earth is

$g = \frac{GM}{R^2}$ .....(i)

Here, M = mass of the earth
G = a universal constant, which is called gravitational constant
R = Radius of the earth

c Given that,
Initial velocity of the bullet, u = 300 ms^{-1}
Final velocity of the bullet, v= $\left(\frac{1}{2} \times 300\right)$ 17 x 300J ms^{-1}
$= 200\ ms^{-1}$
Traveled distance, s = 5 cm = 0.05 m
Acceleration, a = ?
We know, Opposite force = mass of the body × acceleration working on the body
Here, mass of the bullet = 10 gm = 0.01 kg, Now,
$V^2 = u^2 + 2as$
or, $2as = v^2 - u^2$
or, $a = \frac{v^2 - u^2}{2s}$
or, $a = \frac{(300)^2 - (200)^2}{2 \times 0.058}\ ms^{-1}$
$= -5x\ I0^5 ms^{-2}$
∴ Acceleration of the bullet is = $-5 \times I0^5\ ms^{-2}$
So opposite force, = (0.01 kg × 5 × 10^5) N
= 5x 10^3N

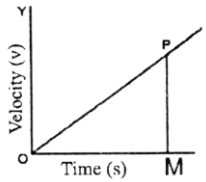
d In first case,
Let, initial velocity, u = 300 ms^{-1}
Final velocity, v = $\left(300 \times \frac{2}{3}\right) ms^{-1} = 200\ ms^{-1}$
distance, s, = 5 cm = 0.05 m
Let, retardation is a
We know,
$v^2 = u^2 - 2a S_1$
or, $S2 = \frac{u_2 - v_2}{2a}$
$= \frac{(200)^2}{2 \times 5 \times 10^3}$ m
= 0.04m
So, the total distance is, (0.05 + 0.04) m
= 0.09 m. The bullet can enter 0.09 m of wood.

Ques. ▶26 Mr. Hasan started from his house to the office by a car. The distance between the house and office is 3km. Starting from rest the car moves with uniform acceleration and it corsses 1st kilometer in 4 minutes. *[Barisal Cadet-2014]*

a. Draw a velocity vs. time graph in which a body moves with uniform retardation. 1
b. State the laws of falling bodies. 2
c. Find out the total time taken by Mr. Hasan to reaches his office? 3
d. In 6 minutes Mr. Hasan crosses 66.67% of the total distance Verify this statement mathematically according to stem. 4

Answer to the question no. 26

a



b **First Law** : All bodies falling from rest and from the same height without any resistance traverse equal distance in equal time.
Second Law : The velocity (y), acquired by a freely falling body from rest in a given time (t) is directly proportional to time that is, $v \alpha t$.
Third Law ; The distance (h) traversed by a freely falling body from rest in a given time (t) is directly proportional to the square of the time, that is, $h \propto t^2$.

c In case of uniform acceleration we know,

$v = \frac{S}{t}$ Here, V = velocity, S = distance, t = time

From the stem, S = 1 km = 1000 m
t = 4 minutes = 4 × 60 s = 240 s

$\therefore v = \frac{1000\ m}{240\ s} = 4.17\ ms^{-1}$

Again,

$v = \frac{S}{t}$

or, $t = \frac{S}{V}$

Here,
$V = 4.17\ ms^{-1}$
S = 3 km = 3000m
T = time = ?

or, $t = \frac{3000m}{4.17\ ms^{-1}}$

$\therefore$ t = 720 s
= 12 min

It takes 12 minutes to reach Mr. Hanan's office.

d The cars moves in uniform acceleration. So, here,

velocity = $\frac{distance}{time}$

From the stem, the car travels 1 km in 4 minutes.
So, in 6 minutes Mr Hasan crosses.

$v = \frac{S}{t}$

or, S = Vt
=1501.2 m
= 1.5 km

Here,
$V = 4.17\ ms^{-1}$
t = time, 6 min = $6 \times 60_s$
$= 360_s$
S = distance = ?

Now, in 6 minutes Mr.. Hasan Crosses 1.5 km which is half of the total distance.
So, the statement — " In 6 minutes Mr Hasan corsses 66.67% of the total distance" in not correct.

Creative Essay type Questions with Answers Based on Classwork

Classworks promote higher thinking and to-the-point answering. Practise the questions attentively.

Ques. ▶27 $S = \left(\frac{u + v}{2}\right)t$

and $a = \frac{v - u}{t}$

a. What is measured along the vertical axis in obtaining the magnitude of acceleration? 1
b. Why does acceleration due to gravity differ from region to region? 2
c. Show how can you apply the stem mentioned equations in reaching the equation, $S = ut + \frac{1}{2}at^2$. 3
d. Examine whether an equation excluding time can be represented with the use of the stem mentioned equations. 4

Answer to the question no. 27

a In obtaining the magnitude of acceleration, velocity is measured along the vertical axis.

b The earth is not perfectly round and so the radius of the earth differs from region to region. The polar regions are a bit compressed and so the value of R is comparatively low there. Since R is an influential determinant of acceleration due to gravity (g), it (g) is not the same in all the regions in the earth. The higher the value of R is, the lower will be the value of 'g' and vice-versa.

c Given, $a = \frac{v - u}{t}$

or, v – u = at
$\therefore$ v = u + at

Again,

$s = \left(\frac{u + v}{2}\right)t$

or, $s = \left(\frac{u + u + at}{2}\right)t$ [Putting the value of v]

or, $s = \left(\frac{2u + at}{2}\right)t$

or, $s = \left(\frac{2u}{2}\right)t + \left(\frac{at}{2}\right)t$

or, $s = ut + \frac{1}{2} \times at \times t$

$\therefore s = ut + \frac{1}{2}at^2$

d Given, $a = \frac{v - u}{t}$

or, at = v – u

$\therefore t = \frac{v - u}{a}$

Again, $s = \left(\frac{u + v}{2}\right)t$

or, $s = \left(\frac{u + v}{2}\right)\left(\frac{v - u}{a}\right)$ [Putting the value of t]

or, $s = \frac{(v + u)(v - u)}{2a}$

or, $s = \frac{v^2 - u^2}{2a}$

or, $v^2 - u^2 = 2aS$

$\therefore v^2 = u^2 + 2as$

Evidently, this equation of motion does not include 't'.

Ques. ▶28

t(s)	s(m)
0	0
12	6
24	12
36	18
48	24
60	30

a. What is the relation among time, distance and velocity? 1
b. The body covers 6m in 12 sec. It would take for less time if it were a freely falling body. Why? 2
c. Draw a time-distance graph representing the table and find the distance travelled by the body in 32 s. 3
d. Analyze the graph to clarify whether the body is advancing with uniform velocity. 4

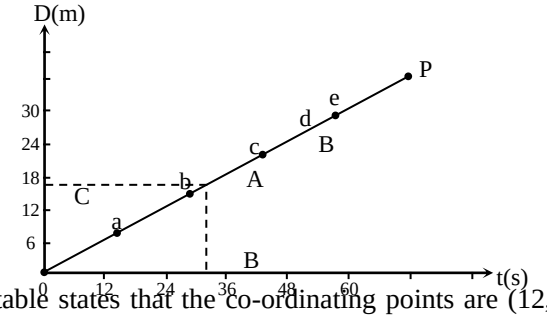
Answer to the question no. 28

a Distance is the product of velocity and time.

Symbolically, $S = v \times t$; That is, $V = \frac{S}{t}$ and $t = \frac{S}{v}$.

b The table illustrates that the body is moving upward. If it were moving downward, it would take for less time than 12 sec (to travel 6m) because of the force of acceleration due to gravity acting on the body downward.

c Let us draw a time-distance graph representing the table.



The table states that the co-ordinating points are (12, 6), (24, 12), (36, 18), (48, 24) and (60, 30) Which have been represented by a, b, c, d and e.
These points make the straight line OP originating from point O.
In case of 32 seconds, the measurement in the vertical axis is 16 when we draw the co-ordinating lines AB and AC.

d The graph (drawn by plotting the time-distance co-ordinating points) clarifies that the body is advancing with uniform velocity. At each of the co-ordinating points a, b, c, d and e, velocity neither increases nor decreases but remains the same.

At point a, $v = \frac{d}{t} = \frac{6m}{12s} = 0.5\ ms^{-1}$

At " b, $v = \frac{12m}{24s} = 0.5 ms^{-1}$

Similar are the cases with points c, d and e. Furthermore, according to the lines AB and AC,

$v = \frac{AB}{AC} = \frac{OC}{OB} = \frac{16m}{325} = 0.5 ms^{-1}$

Lastly, $\angle AOB = \angle AOC = 45°$

Beyond doubt, the body is advancing with uniform velocity.

Ques. ▶29

t(s)	v(ms^{-1})
0	0
5	2.5
10	5.0
15	7.5
20	10.0
25	12.5
30	15.0

a. What is velocity? 1
b. In what way is force a vector quantity? 2
c. Draw a time velocity graph using the stem. 3
d. The body is advancing not with uniform velocity but with uniform acceleration. Elucidate the statement. 4

Answer to the question no. 29

a Velocity refers to the rate of change of position along with direction.

b Force is a vector quantity because it has definite direction and it is a derivative fundamental of quantities.

Force = mass × acceleration

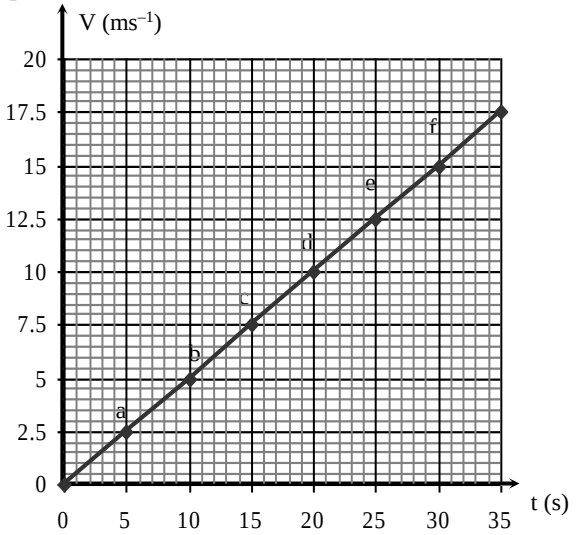
$= \text{mass} \times \frac{\text{velocity}}{\text{time}}$

$= \text{mass} \times \frac{\text{distance}}{\text{time}} \times \frac{1}{\text{time}}$

$= M \times \frac{L}{T} \times \frac{l}{T} = MLT^{-2}$

We see, force is a multidimensional quanity which further means that it is a vector quantity.

c Time and velocity have been taken along x and y axes respectively. The co-ordinating points have been denoted by a, b, c, d, e and f. These points form the straight line OP originating from the vertex. Each of the points of OP stands for acceleration.



d To elucidate the statement that the body is advancing not with uniform velocity but with uniform acceleration, let us consider three points, b, c and d.

At point b, acceleration = $\frac{\text{velocity}}{\text{time}} = \frac{5ms^{-1}}{10s} = 0.5ms^{-2}$

" " c, " = $\frac{7.5\ ms^{-1}}{15s} = 0.5\ ms^{-2}$

" " d, " = $\frac{10\ ms^{-1}}{20s} = 0.5\ ms^{-2}$

Now let us find displacements in each equal time interval (5s).

Distance travelled in 5s = $v \times t = 2.5\ ms^{-1} \times 5s$
= 12.5 m

" " " $10s = 5ms^{-1} \times 10s = 50$ m

" " " $15s = 7.5\ ms^{-1} \times 15s$
= 112.5 m

Now, the difference of distance in 1st 5s = 50m – 12.5m
= 37.5 m

" " " " " 2nd 5s = 112.5m–50m
= 62.5m

So the rate of change in distance travelled at each equal time interval is not the same; that is, velocity is not uniform.

Ques. ▶30 Raihan took a 1m long flat plank and made an end of the plank high by placing it on a brick. He then held a marble at the upper end of the plank and started the stopwatch. He stopped the stopwatch just at the moment the marble stroke the ground. The reading of the stopwatch was 0.5s.

a. What is the simplest formula for finding out displacement? 1
b. Why is the length of the plank a scaler quantity but the velocity of the marble a vector quantity? 2
c. Find out average velocity and acceleration of the marble if the reading of the stop watch is 0.5 sec. 3
d. If the marble was dropped from a height equal to the length of the plank, it would take less time than even half a second to strike the ground. Do you believe the logic? Give reasons supporting your view. 4

Answer to the question no. 30

a The simplest formula for finding out displacement is: $s = v \times t$.

b The length of the plank is a scaler quantity becuase length is a fundamental quantity which does not belong to direction. On the other hand, the velocity of the marble is a vector quantity because this derived quantity belongs to a definite direction. Velocity may differ depending on different direction.

c According to the passage, s = 1m and t = 0.5 s

$\therefore$ Average velocity = $\frac{s}{t} = \frac{1m}{0.5s} = 2ms^{-1}$

Now, $s = ut + \frac{1}{2}at^2$

or, $2m = 0 \times 0.5s + \frac{1}{2}a \times (0.5s)^2$

or, $2m = 0 + \frac{a \times 0.25s^2}{2}$

or, $\frac{a \times 0.25s^2}{2} = 2m$

or, $a \times 0.25s^2 = 2 \times 2m$

or, $a = \frac{4m}{0.25s^2}$

$\therefore a = 16ms^{-2}$

Acceleration = $16ms^{-2}$

d Yes, I believe that the marble would take less than even half a second to strike the ground if it was dropped from a height equal to the length of the plank. It applies the formula of motion of freely falling bodies.

Here, height = the length of the plank = 1m

initial velocity, u = 0

gravitational constant, $g = 9.8ms^{-2}$

t = ?

We know, $h = ut + \frac{1}{2}gt^2$

$\therefore 1m = 0 \times t + \frac{1}{2} \times 9.8\ ms^{-1} \times t^2$

or, $1m = 0 + 4.9ms^{-2} \times t^2$

or, $t^2 = \frac{1m}{4.9\ ms^{-2}}$

or, $t = \sqrt{\frac{1m}{4.9ms^{-2}}}$

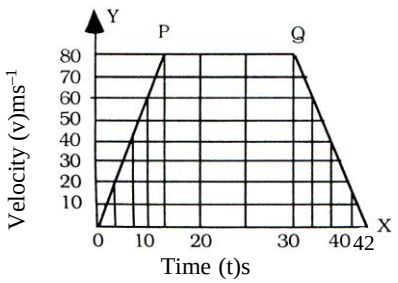
$\therefore$ t = 0.2 s.

Evidently, 0.2 s is far less than half a second.

Additional Creative Questions with Answers

Practice this part very well. Try to answer the questions all by yourself first. Read the answer and make sure your answer has been resembling with it.

Ques. ▶31 The following figure shows the time velocity graph of a helicopter having a mass of 5×10^6kg.



a. What do the lines OP and QX stand for? 1
b. If the helicopter flies at a uniform velocity, it will gain no acceleration. Why? 2
c. Find out the highest kinetic energy that the helicopter may have. 3
d. Analyze the trend of change in acceleration during the journey of the helicopter. 4

Answer to the question no. 31

a The lines OP and QX stand for acceleration and retardation respectively.

b Acceleration means change of velocity; the value of v (final velocity) must be more or less than that of u(initial velocity). In case of uniform velocity, v is equal but neither more nor less than u. This is why no acceleration takes place.

$a = \frac{v-u}{t} = \frac{v-v}{t} = \frac{0}{t} = 0 \quad [\because v = u]$

This is the case with the acceleration of the helicopter if it flies at a uniform velocity.

c Given, mass of the helicopter, $m = 5 \times 10^6$Kg.
The figure states that the higehest velocity of the helicopter, $v = 80ms^{-1}$.
$E_{kmax} = ?$

We know, $E_{kmax} = \frac{1}{2}mv^2_{max}$

$= \frac{1}{2} \times 5 \times 10^6 Kg \times (80ms^{-1})^2$

$= \frac{1}{2} \times 5 \times 10^6 Kg \times 80ms^{-1} \times 80ms^{-1}$

$= \frac{1}{2} \times 5 \times 10^6 Kg \times 80 \times 80ms^{-2}$

$= 5 \times 10^6 \times 80 \times 40$ joule

$= 5 \times 3200 \times 10^6$ joule

$= 16000 \times 10^6$ joule

$= 1.6 \times 10^4 \times 10^6$ joule

$= 1.6 \times 10^{10}$ joule. **(Ans.)**

d Line OP:
$u = 0\ ms^{-1}$
$v = 80ms^{-1}$
$t = 12$ s

$\therefore a = \frac{v-u}{t} = \frac{80-0}{12}ms^{-2} = \frac{80}{12}ms^{-2} = 6.67\ ms^{-2}$.

Line PQ:
$u = 80ms^{-1}$, $v = 80ms^{-1}$, $t = 30s - 12s = 18s$

$\therefore a = \frac{v-u}{t} = \frac{80-80}{18}\ ms^{-2} = \frac{0}{18}ms^{-2} = 0\ ms^{-2}$

Line QX:
$u = 80ms^{-1}$
$v = 0\ ms^{-1}$
$t = 42s - 30s = 12s$

$\therefore a = \frac{v-u}{t} = \frac{0-80}{12}ms^{-2} = -\frac{80}{12}ms^{-2}$

$= -6.67ms^{-2}$

The helicopter gains acceleration for 12 seconds and no acceleration for 18 seconds while it decelerates for the last 12 seconds during its journey.

Ques. ▶32 The distance between two cities is AB Km. An inter-city train starts from A and travels the first half of AB at a velocity of 30 Kmh^{-1} and the second half of AB at a velocity of 40 Kmh^{-1}. When it starts from B, it travels the first half of AB at a velocity of 30 Kmh^{-1} and the second half at a velocity of 40 Kmh^{-1}.

a. What is uniform velocity? 1

b. Uniform velocity does not mean uniform acceleration. Why? 2

c. Find out the average velocity of the train during its journey from B to A. 3

d. Will the average velocity of the train during its jurney from A to B different from that during its journey from B to A? Give argument in favour of your answer. 4

Answer to the question no. 32

a If the magnitude and direction of the velocity of a moving body remains unchanged, the velocity of the body is called uniform velocity.

b Uniform velocity belongs to time-distance graph while uniform acceleration belongs to time-velocity graph. A body may travel equal distance in each equal time interval; still it may not gain the same velocity at each equal time interval. Even though same velocity applies, acceleration differs in moving bodies and freely falling bodies.

c According to the stem, the time taken by the train (from B to A) to travel the first half $\left(\frac{AB}{2}\text{ km}\right)$ at a velocity of 30 Km/h^{-1} = s ÷ v

$= \frac{AB}{2}Km \div 30\ Kmh^{-1}$

$= \frac{AB}{2} \times \frac{1h}{30}$

$= \frac{AB}{60}h.$

Now, the time taken by the train to travel the second half $\left(\text{also } \frac{AB}{2}\text{ Km}\right)$ at a velocity of $40kmh^{-1}$

$= s \div v = \frac{AB}{2}\text{ Km} \div 40Kmh^{-1}$

$= \frac{AB\ Km}{2} \times \frac{1h}{40Km}$

$= \frac{AB}{80}h.$

So, average velocity $= \frac{\text{total displacement}}{\text{total time}}$

$= \frac{AB\ Km}{\frac{AB}{60}h + \frac{AB}{80}h}$

$= \frac{AB\ Km}{\left(\frac{4AB + 3AB}{240}\right)h}$

$= \frac{AB\ Km}{\frac{(7\ AB)h}{240}}$

$= AB\ Km \times \frac{240}{(7\ AB)\ h}$

$= \frac{240\ Km}{7\ h}$

$= 34.29\ Kmh^{-1}$ **(Ans.)**

d Yes, the avarage velocity of the train during its journey from A to B will differ from that from B to A. We have just found out that the average velocity of the train during its journey from B to A is 34.29Kmh^{-1}.
Now, let us suppose, the train takes 2t hours when it travels from A to B.
That is, it travels half the time (t) hours at velocity 30 Kmh^{-1} and another half (t) hours at velocity 40 Kmh^{-1}.
$\therefore$ Displacement at first half = v × t = 30Kmh^{-1} × to h
= 30 tKm
" " another " = 40 tKmh^{-1} × to h
= 40t Km
$\therefore$ Total displacement = 30t Km + 40t Km = 70tKm
Average velocity (from A to B) = $\frac{70t\ Km}{2t\ hour}$
= $\frac{70\ Km}{2\ hour}$ = 35Kmh^{-1}
Clear, this velocity is higher than 34.29 Kmh^{-1}.

Ques. ▶33 A car was running at a velocity of 54 Kmh^{-1}. The driver saw a pedestrain from a distance of 46m and he instantly pressed the brake. As the car stopped, the distance between the car and the pedestrain was only 1m.

a. What form of quantity is velocity? 1
b. In what way this form of quantity is different from the other one? 2
c. Apply the relevant formula for determining the acceleration of the car. 3
d. Represent the situation regarding the pedestrian's narrow escape from being stricken by the car. 4

Answer to the question no. 33

a Velocity is a vector quantity.

b There are two forms of quantities scales and vectors. Like other vectors, velocity is also different from scalers such as length and mass. The difference lies not in magnitude but in direction. Scalers have magnitude only but vectors have both magnitude and direction. Inspire of having same magnitude, speed is a scaler quantity because it does not have definite direction; but velocity is a vector quantity because it has a definite direction.

c The passage states that—
u = 54 Kmh^{-1}
= $\frac{54 \times 1000}{1 \times 60 \times 60}$ ms^{-1}
= 3 × 5 ms^{-1} = 15ms^{-1}.
v = 0
s = 46m – 1m = 45m
Now, a = ?
We know, $v^2 = u^2 + 2as$
or, $u^2 + 2as = v^2$
or, $(15ms^{-1})^2 + 2 \times a \times 45m = 0^2$
or, $15ms^{-1} \times 15\ ms^{-1} + 2 \times a \times 45m = 0$
or, $2 \times a \times 45m = -(15ms^{-1} \times 15ms^{-1})$
or, $a = -\frac{15\ ms^{-1} \times 15\ ms^{-1}}{2 \times 45\ m}$
$\therefore$ a = –2.5 ms^{-2}
The car gets a retardation (negative acceleration) of 2.5ms^{-2}; i.e. the velocity of the car decease by 2.5 m at each second.

d That the pedestrain had a narrow escape from a violent accident which might have caused his death jointly belong to displacement, Velocity and acceleration of the car. Here narrow escape means no distance between the car and the pedestrain; it alternatively means that the car had a displacement of 46m.
We have already found in ans (c) that u = 15 ms^{-1}.
v = 0, s = 46 m; now we need to find out the acceleration (negative) to know how the pedestrain was saved.
We know, $u^2 + 2as = v^2$
or, $(15\ ms^{-1})^2 + 2 \times a \times 46m = 0^2$
or, $2 \times a \times 46m = -(15ms^{-1} \times 15ms^{-1})$
or, $a = -\frac{15\ ms^{-1} \times 15\ ms^{-1}}{2 \times 46\ m}$
$\therefore$ a = –2.446 ms^{-2}.
As the car was retarding by 2.446 m every second, it stopped just by the pedestrain and so he had a narrow escape from being stricken by the car.

Ques. ▶34 A plane, while touching the runway had a velocity of 125ms^{-1}. The velocity started falling and the plane stopped at a certain moment. Here is the time-velocity table of the plane:

t (s)	1	2	4	6	8	10
v(ms^{-1})	125	100	75	50	2.5	0

a. What was the velocity of the plane when the passangers were getting down from it? 1
b. Why are the passangers of a plane advised to wear parachutte in case of emergency? 2
c. Find out how far the plane advanced from the moment of touching the runway till getting stopped. 3
d. Prove that the retardation line will not be a single straight line but downward slopping. 4

Answer to the question no. 34

a The velocity of the plane was o ms^{-1} when the passangers were getting down from it.

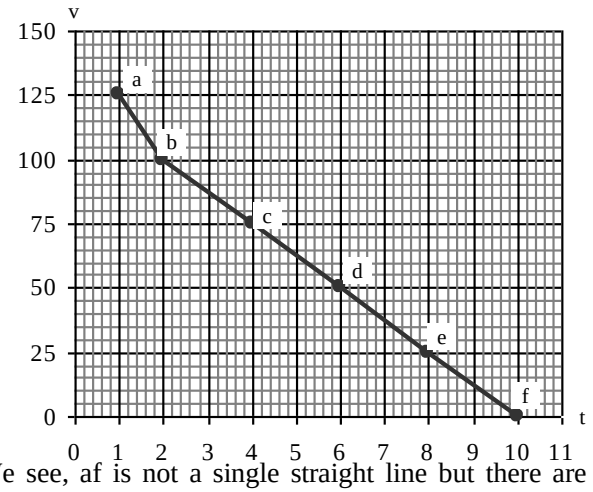
b If a passanger jumps from a plane (through a window), he is likely to die before or after reaching the ground. He may also fall into a sea or some other risky place. That he will fall down straight very quickly is subject to acceleration due to gravity, 9.8ms^{-2}. Parachutte works against it also adds a high friction of air and so a passanger can fly and get down at a place as safe as possible. This is why the passangers of a plane are advised to wear parachutte in case of emergency.

c The table states that—
The initial velocity of the plane, u = 125 ms^{-1}
" final " " " " , v = 0 ms^{-1}
time, t = 10 sec.
∴ Distance covered by the plane in this time (10s)

$$= \left(\frac{u + v}{2}\right)t = \left(\frac{125ms^{-1} + 0\ ms^{-1}}{2}\right)10s$$
$$= \frac{125ms^{-1}}{2} \times 10s$$
$$= 125ms^{-1} \times 5s$$
$$= 625m$$

That is, the plane advanced 625 m from the moment of touching the runway till getting stopped.

d A plane starts reducing its velocity from a certain height, lands in the runway at a lower velocity and stops within a few seconds. This trend is retardation.
The stem reveals the time – velocity co-ordinating points (1, 125), (2, 100), (4, 75), (6, 50), (8, 25) and (10, 0). Let us indicate the points to be a, b, c, d, e and f. we find the following figure by plotting these points on a sheet of graph paper.



We see, af is not a single straight line but there are two straight lines– ab and bf.

Evidently, both ab and bf are downward slopping.

Ques. ▶35 A train leaves platform A and reaches a velocity of 25 Kmh^{-1} at the 20th minute. It then runs with zero acceleration for the next 30 minutes and stops at platform B in 10 minutes.

a. What is the formula for displacement in case initial velocity, acceleration and time are given? 1
b. Why is time measured along the horizontal axis while measuring velocity and acceleration? 2
c. Find the distance travelled by the train in the first phase of its journey. 3
d. The train decelerates twice it accelerates. Illustrate the statement. 4

Answer to the question no. 35

a In case initial velocity, acceleration and time are given, the formula for displacement is: $s = ut + \frac{1}{2}at^2$.

b While measuring velocity and acceleration, time is measured along the horizontal axis because time is a fundamental quantity while velocity and acceleration are derived quantities. Both velocity and acceleration depends on time But it is not that time-velocity graph or time-distance graph can not be drawn if time is taken along the vertical axis.

c The passage states that,
u = 0

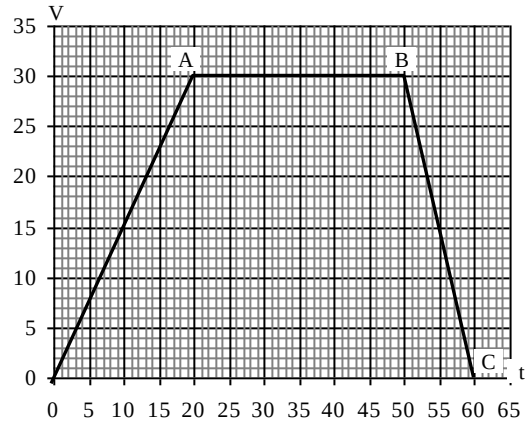
$$v = 25\ Kmh^{-1} = \frac{25 \times 1000}{60 \times 60}\ ms^{-1} = \frac{125}{18}ms^{-1}$$
$$= 6.95\ ms^{-1}$$

t = 20 min = 20 × 60 = 1200 sec. (because the first phase of the journey goes on for 20 min)

$$\therefore\ s = \frac{u + v}{2} \times t = \frac{0 + 6.95\ ms^{-1}}{2} \times 1200\ sec$$
$$= 3.48\ ms^{-1} \times 1200\ sec$$
$$= 4176\ m.$$

∴ The train covers a distance of 4176 m in the first phase of its journey.

d The illustration of the statement that the train decelerates twice than it accelerates can be done by drawing a time velcoity graph as par the stem states.



Line OA stands for positive acceleration, line AB for zero acceleration (no rise or fall of velocity from 20th to 50th min) and line BC for negative acceleration (deceleration).

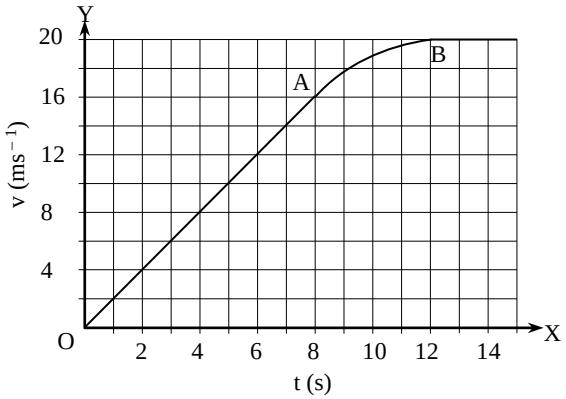
$$\text{Acceleration (OA line)} = \frac{v}{t} = \frac{25\ Kmh^{-1}}{20\ min} = \frac{25\ Kmh^{-1}}{20\ \frac{1}{60}h}$$
$$= 25Kmh^{-1} \times 3h = 75Kmh^{-2}$$

$$\text{Deceleration (BC line)} = \frac{25\ Kmh^{-1}}{10\ min} = \frac{25\ Kmh^{-1}}{10 \times \frac{1}{60}h}$$
$$= 25Kmh^{-1} \times 6h = 150Kmh^{-2}$$

Evidently, $150Kmh^{-2} = 75Kmh^{-2} \times 2$

The illustration is done.

Ques. ▶36



a. What does velocity refer to? 1
b. Acceleration due to gravity on the surface of the earth is 9.8 ms^{-2}. What does it mean? 2
c. Find out the acceleration gained and distance covered by the body considering line OA. 3
d. When the car was running at its highest velocity, the driver sees a dog 8.4m ahead. He instantaneously presses the brake that causes a retardation of 25 ms^{-2}. Do you think the dog will stay safe? Argue in favour of your answer. 4

Answer to the question no. 36

a Velocity is a vector quantity which refers to a certain displacement (with direction) travelled by a moving body a certain time.

b The rate of increase of velocity of a freely falling body on earth due to the force of gravity is called acceleration due to gravity. It is a unique natural instance of uniform acceleration. 'Acceleration due to gravity on the surface of the earth 9.8 ms^{-2}" means that when a body is falling toward the surface of the earth, its velocity rises by 9.8meter every second.

c The figure states that–
$u = 0$
v at point A = 16 ms^{-1}
$t = 8$ s

$$\therefore a = \frac{v-u}{t} = \frac{16\ ms^{-1} - 0}{8\ s} = \frac{16\ ms^{-1}}{8s} = 2ms^{-2}.$$

$$\text{and } s = ut + \frac{1}{2}at^2$$

$$= 0 \times t + \frac{1}{2} \times 2ms^{-2} \times (8s)^2$$

$$= 0 + \frac{1}{2} \times 2\ ms^{-2} \times 8s \times 8s$$

$$= 1ms^{-2} \times 64s^2$$

$$= 64m.$$

d When the driver presses the brake, the distance between the car and the dog is 8.4 m. The car is running at its highest velocity, 20ms^{-1}.
That is, $u = 20\ ms^{-1}$
$a = -25\ ms^{-2}$ (retardation)
$v = 0$
If the car travels a distance less than 8.4m, the dog will stay safe.
So, we need to find out the distance travelled by the car with the above – stated magnitudes of u, a and v.
We know, $v^2 = u^2 + 2as$

$$\text{or, } 0^2 = (20\ ms^{-1})^2 + 2 \times (-25ms^{-2}) \times s$$

$$\text{or, } 0 = 20ms^{-1} \times 20ms^{-1} - 50ms^{-2} \times s$$

$$\text{or, } 50ms^{-2} \times s = 20ms^{-1} \times 20ms^{-1}$$

$$\text{or, } s = \frac{20ms^{-1} \times 20ms^{-1}}{50\ ms^{-2}} = \frac{8\ m^2s^{-2}}{1\ ms^{-2}}$$

$$\therefore s = 8m$$

Certainly, $s < 8.4$.
So the dog will stay safe having a narrow escape of a distance (from the car) of only 0.4m (=8.4m – 8m)

Creative Questions with hints

Answer these questions yourself. See the Super Tips which will help you to answer the questions easily.

Ques. ▶37 When a rat was 15m ahead of a cat, the cat started running to catch the rat with the a uniform acceleration of 2ms^{-2}. The rat was running with a uniform velocity of 14ms^{-1}.

a. What is uniform velocity? 1
b. Why does the value of 'g' differ from region to region? 2
c. Find out the time when the velocity of the cat will be equal to that of the rat. 3
d. Will the cat be able to catch the rat? Represent logical analysis in favour of your answer. 4

Answer to the question no. 37

a When a moving body travels equal distance in each equal time-interval at a certain direction, the phenomenon is called uniform velocity.

b The earth is not perfectly round and so the radius of the earth differs from region to region. The polar regions are a bit compressed and so the value of R is comparatively low there. Since R is an influential determinant of acceleration due to gravity (g), it (g) is not the same in all the regions in the earth. The higher the value of R is, the lower will be the value of 'g' and vice versa.

Super tips: *For Application and Higher Order Thinking —*

c Apply the formula $v = u + at$ for finding out the time when the cat can catch the rat, ($v = 14\ ms^{-1}$, $u = 0$, $a = 2ms^{-2}$, $t = ?$)

d Yes, the cat will be able to catch the rat.
Distance travelled by the cat at time,

$$s = ut + \frac{1}{2}at^2 \ (u = 0,\ a = 2ms^{-2})$$

$$= 0 \times t + \frac{1}{2} \times 2\ ms^{-2}\ t = t^2$$

Now, Distance travelled by the cat = Distance travelled by the rat + 15m
That is, $t^2 = 14t + 15$
Therefore, t = 15 s
Finally, $s = ut + \frac{1}{2}at^2$ (u = 0, t = 15 sec, a = $2ms^{-2}$)

$\therefore$ s = 225 m

That cat will catch the rat when they both reach at a distance of 225m.

Ques. ▶38 Here is a table representing time and velocity of a bike.

t(s)	0	5	10	15	20	25	30	35	40	45	50
v(ms^{-1})	0	10	30	45	60	40	30	20	15	10	0

a. What does the graph derived from time and velocity represent? 1
b. The table represents non-uniform velocity. How? 2
c. Find out the distance traveled by the bike in the first 30 seconds. 3
d. The first phase of deceleration was twice the first phase of acceleration. Verify the statement graphically and mathematically. 4

Answer to the question no. 38

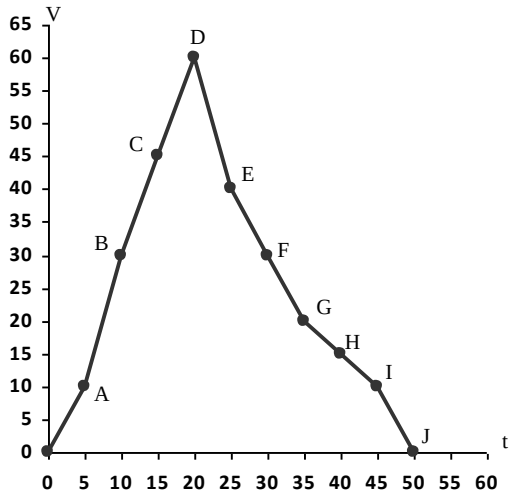
a the graph derived from time and velocity represents acceleration.

b The table represents non-uniform velocity in the way that the velocity at different equal time intervals are not equal. Time interval is 5 sec in each step but both rise and fall of velocity do not take place at the same rate. For example, (10 – 0) ms^{-1} = 10 ms^{-1}, (30 – 10)ms^{-1} = 20ms^{-1}, (45 – 30) ms^{-1} = 15 ms^{-1} Which are different.

Super tips: *For Application and Higher Order Thinking —*

c S = 5s × 10ms^{-1} + 5s × 20ms^{-1} + 5s × 15ms^{-1} + 5s × 15ms^{-1} + 5s × 20ms^{-1} + 5s × 10ms^{-1}
= 50m + 100m + 75m + 75m + 100m + 50m = 450m

d Let us draw a time-velocity graph with a view to verifying the given statement.



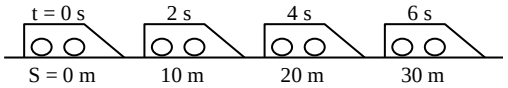
The graph states that line OA stands for the first phase acceleration and line DE stands for the first – phase deceleration.

As per line OA, acceleration $= \frac{v}{t} = \frac{(10-0)\ ms^{-1}}{(5-0)\ s}$
$= \frac{10ms^{-1}}{5s} = 2ms^{-2}$

As per line DE, deceleration $= \frac{v}{t} = \frac{(60-40)ms^{-1}}{(25-20)s}$
$= \frac{20ms^{-1}}{5s} = 4ms^{-2}$

$\therefore$ It is verified that the first-phase of deceleration was twice the first-phase of acceleration.

Ques. ▶39 Here is a figure of a motor car travelling different distances at different times along a bridge.



a. What ratio does speed refer to? 1
b. Comment on the velocity of the car. 2
c. Draw the time velocity graph of the car. 3
d. Suppose the car falls down into the river at a distance of 50m from the bridge. The car will gain a velocity six times higher than the velocity it gains while running along the bridge. Scrutinize the fact. 4

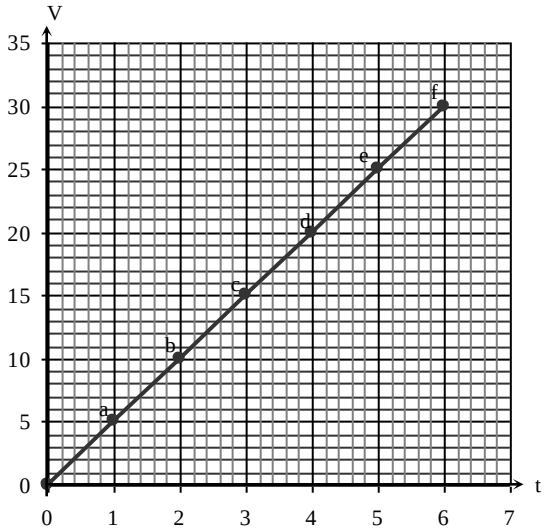
Answer to the question no. 39

a Speed refers to distance – time ratio.

b The car goes 10m in the first 2 seconds, 10m in the second 2 seconds and 10m in the third 2 seconds. In this way, the car gains a uniform velocity of 5ms^{-1} (= 10m ÷ 2s). If we divide the total distance (30m) by total time taken (6s), the result is same (5ms^{-1}).

Super tips: *For Application and Higher Order Thinking —*

c Let us measure time along the horizantal axis and velocity along the vertical axis.



The car goes 5 m in 1s, 10m in 2s, 15m in 3 s, 20m in 4s, 25 m in 5s and 30m in 6s. So the co-ordinating points are (1, 5), (2, 10), (3, 15), (4, 20), (5, 25 and (6, 30) which has been represented by a, b c, d, e and *f*. By joining these points, we get the straight line OP. This line makes 45° angle with either the horizontal axis or the vertical axis. It is because of uniform velocity. Since there is no rise or fall in the rate of velocity, no acceleration is taking place.

d The situation reveals that h = 50m
As the car falls into the river,

$v^2 = u^2 + 2gh$

or, $v^2 = (5ms^{-1})^2 + 2 \times 9.8ms^{-2} \times 50m$

or, $v^2 = 25m^2s^{-2} + 980m^2s^{-2}$

or, $v^2 = 1005m^2s^{-2}$

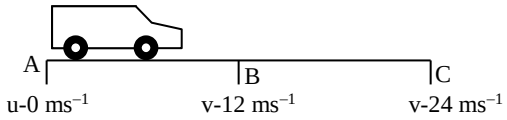
or, $v = \sqrt{1005\ m^2s^{-2}}$

$\therefore v = 31.70\ ms^{-1}$.

Clear, $31.70ms^{-1} > (5ms^{-1} \times 6)$.

The fact behind it is that the car had an acceleration of $2.5ms^{-2}$ when it was running along the bridge but it gained acceleration due to gravity by $9.8\ ms^{-2}$ when it was falling down.

Ques. ▶40



a. What is the dimension of deceleration? 1
b. Explain whether the car will gain acceleration if it runs at uniform velocity. 2
c. Find out the distance from A to B. 3
d. Can the car reach point C from B at the same time it reaches point B from A? Establish your answer. 4

Answer to the question no. 40

a The dimension of deceleration is LT^{-2}.

b No, the car will not gain acceleration if it runs at uniform velocity. Acceleration means rise or fall in the rate of velocity. If velcoity is uniform (if it neither rises nor falls over time), there will be no acceleration. The same is the case with the stem- mentioned car.

Super tips: *For Application and Higher Order Thinking —*

c Apply formula v = u + at to determind the value of 'a'.

Next, $s = ut + \frac{1}{2}at^2$

$\therefore$ Distance from A to B = $0 \times t + \frac{1}{2} \times$ (value of 'a') $\times (6\ s)^2$

d Here, $v = 24ms^{-1}$
$u = 12ms^{-1}$
First find 'a' and then s.
Compare them with a and s of ans. (C)

Ques. ▶41 The following table shows different velocity of a car at different times:

t(s)	0	5	10	15	20	25
v(ms^{-1})	0	10	20	20	15	0

a. What is the dimension of speed? 1
b. Why can velocity be never negative in case of a moving body while acceleration can be negative? 2
c. Find out the distance the car travelled with uniform velocity. 3
d. Is the distance travelled at the last 5 seconds equal to that at the first 5 seconds? Elucidate your view. 4

Answer to the question no. 41

a The dimension of speed is LT^{-1}.

b Acceleration can either be positive (rise in the rate of velocity) or be negative (full in the rate of velocity). Negative acceleration does not mean motionlessness but retardation. However, velocity can never be negative in case of a moving body because the body either travels a distance in a time unit or gets stopped (meaning that it reaches zero velocity).

Super tips: *For Application and Higher Order Thinking —*

c The table reveals that the car travels 10s of time at uniform velocity.
Time interval = (5 – 0) sec = 5 sec
and (10 – 5) sec = 5 sec.
rise of velocity in both the intervals = (10 – 0) ms^{-1}
= $10ms^{-1}$
and (20 – 10) $ms^{-1} = 10ms^{-1}$.
$\therefore s = 10ms^{-1} \times 5s + 10ms^{-1} \times 5s$
= 50m + 50m = 100m

d No, the distance travelled at the last 5s is not equal to that at the first 5s.
For the last 5s:

$a = \frac{v-u}{t} = \frac{0-15}{5} = \frac{-15}{5} ms^{-2} = -3ms^{-2}$.

$\therefore s = ut + \frac{1}{2}at^2 = 15ms^{-1} \times 5s + \frac{1}{2} \times (-3ms^{-2})(5s)^2$

$= \left\{15 \times 5 + \frac{1}{2} \times (-3) \times 5^2\right\} m$

$= \left(75 - \frac{3 \times 25}{2}\right) m = \left(75 - \frac{75}{2}\right) m$

= (75 – 37.5)m = 37.5 m
For the first 5s:
s = vt = (10 × 5)m = 50m
Evidently, the car runs 12.5m (=50m – 37.5m) more in the first 5 sec than it runs in the last 5 sec.

Knowledge and Comprehensive type Questions and Answers

You can get common the knowledge and comprehensive type questions in exam. So read these questions again and again.

Knowledge Based Question-Answers

Ques-1. What is non-uniform velocity?
Ans: Non-uniform velocity refers to the unequal change of displacement over time and/or a change in direction of a moving body.

Ques-2. What is absolute motion?
Ans: Absolute motion of a body refers to its motion with respect to a reference object which is absolutely at rest.

Ques-3. What is the most glowing natural example of uniform acceleration?
Ans: The most glowing natural example of uniform acceleration is the acceleration of a freely falling body (acceleration due to gravity).

Ques-4. What is called reference frame?
Ans: Reference frame is an object or a state with respect to which the position, rest or motion of other surrounding objects are determined.

Ques-5. When is the motion of a body called rotational motion?
Ans: The motion of a body is called rotational motion when it rotates around a particular point or axis keeping the distance of its particles unchanged.

Ques-6. When is the motion of a body called periodic motion?
Ans: When the motion of a moving particle is such that it passes through a definite point along the path of its motion in the same direction in a defniite time-interval, it is called periodic motion.

Ques-7. How is a vector quantity represented?
Ans: A vector quantity is represented by an arrow over the symbol of the physical quantity. For example, $\vec{v}$ or $\vec{A}$.

Ques-8. When does average velocity apply?
Ans: Average velocity applies when a body does not move with uniform velocity but non-uniform velcoity.

Ques-9. When does non-uniform acceleration take place?
Ans: Non-uniform acceleration takes place when the rate of velocity (in case of increase or decrease) differents at different but equal time intervals toward a certain direction.

Ques-10. What is gravitation?
Ans: Gravitation is the force of attraction between any two bodies or particles in the universe.

Ques-11. What is gravity?
Ans: Gravity is the force of attraction of the earth on any other body.

Ques-12. What does the slope of the tangent drawn at any point of a time-velocity graph stand for?
Ans: The slope of the tangent drawn at any point of a time-velocity graph stands for acceleration.

Comprehension Based Questions-Answers

Ques-1. All the examples of periodic motion are not rotational motion. Why?
Ans: Rotational motion means the rotation of a body around a particular point or axis keeping the distance of its particles unchanged.
On the other hand, when the motion of a moving particle is such that it passes through a definite point along the path of its motion in the same direction in a definite time-interval, it is called periodic motion. In this way, the motion of the hands of a clock belongs to both rotational and periodic motion. But the motion of a simple pendulum is not rotational although it is periodic; it is rather an example of linear motion.

Ques-2. All rest and all motion in the universe are not absolute but relative. In what way is it true?
Ans: There is nothing to be absolute rest or absolute motion in the universe. When a body is in rest or in motion depends on the reference object. Absolute motion of a body is its motion with respect to a reference object absolutely at rest but there is no such reference object in the universe.
The earth is moving around the sun while the sun itself is moving along the galaxy with its planets and satellites. In this way, no rest or no motion is absolute.

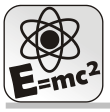
Ques-3. In what sense vibratory motion is positively related to periodic motion?
Ans: When the motion of a moving particle is such that it passes through a definite point along the path of its motion in the same direction in a definite time interval, it is called periodic motion. Vibratory motion is positively related to periodic motion in the sense that a body executes periodic motion in a definite direction for one-half of its time period and exactly for the other half in the opposite direction in case of vibratory motion.

Ques-4. In what way are x ms^{-1} and x ms^{-2} different?
Ans: x ms^{-1} stands for velocity (or speed) and x ms^{-2} stands for acceleration (or retardation). In case of velocity, x ms^{-1} means that a body travels a distance

of x meter in a second irrespective of any direction. In case of speed, same thing applies along a definite direction. On the other hand, x ms^{-2} means that a body gains a rise (acceleration) or fall (retardation) of velocity by x meter per second. x ms^{-2} belongs to a definite direction in cases of either acceleration or retardation.

Ques-5. A car is running along a straight line at a certan speed. A man is also running along a straight line at a certain speed. Rectilinear motion applies to the car but not to the man. Why is it so?

Ans: When a body moves along a straight line in such a way that each particle of the body travels the same distance at the same time in the same direction, the motion of the body is called rectilinear motion. Both the car and the man are running along the same direction at their own speed; yet the motion of the car but not of the man is rectilinear because the man is not a machine. It is not that each of his steps will be of same distance. He may move his head or hands in the way he wishes and so each particle of his body cannot travel the same distance at the same time. This is why rectilinear motion applies to the car but not to the man.



Necessary Equations I

Get all the equations (formula) by heart in order that you can solve the relevant mathematical problems as well as other creative questions.

	Formula	**Information**	**Unit**
1	$a = \frac{v - u}{t}$	u = initial velocity v = final velocity a = acceleration t = time	u = v = ms^{-1} a = ms^{-2} t = s
2	$v = u + at$	u = initial velocity v = final Velocity a = acceleration t = time	u = v = ms^{-1} a = ms^{-2} t = s
3	$s = ut + \frac{1}{2}at^2$	s = displacement	s = m
4	$v^2 = u^2 + 2as$	s = displacement	s = m
5	$v = \frac{s}{t}$	s = displacement t = time v = velocity	s = m t = s v = ms^{-1}
6	$s = \left(\frac{u + v}{2}\right)t$	u = initial velocity v = final velocity t = time s = displacement	u = ms^{-1} v = ms^{-1} t = s s = m
7		g = gravitational constant or acceleration due to gravity	g = ms^{-2}
8	$v = u + gt$	h = altitude from ground	h = m
9	$h = \left(\frac{u + v}{2}\right)t$	u = initial velocity v = final velocity	u = ms^{-1} v = ms^{-1}
10	$h = ut + \frac{1}{2}gt^2$	u = initial velocity g = acceleration due to gravity	u = ms^{-1} g = ms^{-2}
11	$v^2 = u^2 = 2gh$	u = initial velocity v = final velocity	u = ms^{-1} v = ms^{-1}

Important Mathematical Problems with Solutions I

The practice of this part will enhance your skill in solving Application-Based and also Higher Order-Based Questions.

Ques-1. A car is running with a uniform velocity. Its velocity falls from $20ms^{-1}$ to $4ms^{-1}$ in 4 seconds. What form of acceleration of the car gain?

Ans: Given, $u = 20ms^{-1}$
$v = 4\ ms^{-1}$
$t = 4s$
$a = ?$

Let us apply the formula, $a = \frac{v - u}{t}$

So, $a = \frac{4ms^{-1} - 20ms^{-1}}{4s}$

or, $a = \frac{-16ms^{-1}}{4s}$

or, $a = -4\ ms^{-1} \times 1s^{-1}$

$\therefore a = -4ms^{-2}$

The magnitude is negative which means that the car gains a negative acceleration or a retardation of $4ms^{-2}$.

Ques-2. A moving body takes 7 seconds to gain a velocity of $31ms^{-1}$ from 3 ms^{-1}. Find out the acceleration of the body.

Ans: Given, $u = 3ms^{-1}$
$v = 31ms^{-1}$
$t = 7s$
$a = ?$

Let us apply the formula, $a = \frac{v - u}{t}$

So, $a = \frac{31\ ms^{-1} - 3ms^{-1}}{7s}$

or, $a = \frac{28\ ms^{-1}}{7s}$

or, $a = 4ms^{-1} \times 1s^{-1}$

$\therefore a = 4ms^{-2}$.

The body gains a positive acceleration of $4ms^{-2}$.

Ques-3. A train was running with a uniform acceleration of $4ms^{-2}$. It travelled a distance of 240 m in 10 seconds. What was the velocity of the train when it was passing the station?

Ans: Given, $a = 4ms^{-2}$
$s = 240m$
$t = 10s$
$u = ?$

Let us apply the formula, $s = ut + \frac{1}{2}at^2$

So, $ut + \frac{1}{2}at^2 = s$

or, $ut = s - \frac{1}{2}at^2$

or, $u = \frac{s - \frac{1}{2}at^2}{t}$

or, $u = \frac{240m - \frac{1}{2} \times 4ms^{-2} \times (10s)^2}{10s}$

or, $u = \frac{240m - 2ms^{-2} \times 100s^2}{10s}$

or, $u = \frac{240m - 200m}{10s}$

or, $u = \frac{40m}{10s}$

$\therefore u = 4ms^{-1}$.

When the train was passing the station, its velocity was $4ms^{-1}$.

Ques-4. It took 50s to stop a car running with a velocity of $36Kmh^{-1}$ by pressing the brake. What acceleration did the car gain? What distance did the car travel by this time?

Ans: Given, $u = 36\ Kmh^{-1}$

$= \frac{36 \times 1000}{1 \times 60 \times 60}\ ms^{-1}$

$= 10\ ms^{-1}$.

$v = 0\ ms^{-1}$
$t = 50s$
$a = ?$
$s = ?$

Ans.

We know, $a = \frac{v - u}{t}$

or, $a = \frac{0ms^{-1} - 10ms^{-1}}{50s}$

or, $a = -\frac{10\ ms^{-1}}{50s}$

or, $a = -0.2ms^{-2}$.

The car had a negative acceleration of $0.2ms^{-2}$.

Now let's apply the formula, $s = ut + \frac{1}{2}at^2$

So, $s = 10ms^{-1} \times 50s + \frac{1}{2} \times (-0.2\ ms^{-2}) \times (50s)^2$

or, $s = 500m + \frac{1}{2}(-0.2\ ms^{-2}) \times (50 \times 50)s^2$

or, $s = 500m - 0.1ms^{-2} \times 2500s^2$

or, $s = 500m - 250m$

$\therefore s = 250m$

The car travelled 250m by this time (50s).

Ques-5. A plane advances a distance of 1Km with a uniform velocity of $10ms^{21}$ in the runway before take-off. what time will the plane take to leave the runway?

Ans: Given, $u = 0ms^{-1}$
$s = 1Km = 1000m$
$a = 10ms^{-2}$
$t = ?$

Let us apply the formula, $s = ut + \frac{1}{2}at^2$.

We can also write:

$ut + \frac{1}{2}at^2 = s$

or, $0\ ms^{-1} \times t + \frac{1}{2} \times 10ms^{-2}(t^2) = 1000m$

or, $0 + 5ms^{-2}(t^2) = 1000m$

or, $t^2 \times 5ms^{-2} = 1000m$

or, $t^2 = \frac{1000m}{5\ ms^{-2}}$

or, $t^2 = 200s^2$

or, $t = \sqrt{200s^2}$

$\therefore t = 14.14s$

The plane will take 14.14s to leave the runway.

Ques-6. An accelerator can make an acceleration of $2ms^{-2}$. A car goes 50 m gaining a velocity of $20ms^{-1}$ after the driver has pressed the accelerator. What was the velocity of the car at the moment when the accelerator was pressed?

Ans: Given, $v = 20ms^{-1}$
$s = 50m$
$a = 2ms^{-2}$
$u = ?$

We know, $v^2 = u^2 + 2as$

or, $u^2 + 2as = v^2$

or, $u^2 = v^2 - 2as$

or, $u^2 = (20ms^{-1})^2 - 2 \times 2ms^{-2} \times 50m$

or, $u^2 = 400m^2s^{-2} - 200m^2s^{-2}$

or, $u^2 = 200m^2s^{-2}$

or, $u = \sqrt{200m^2s^{-2}}$

$\therefore u = 14.14\ ms^{-1}$.

The velocity of the car was $14.14ms^{-1}$ at the moment when the accelerator was pressed.

Ques-7. A train was running at a velocity of 72 Kmh^{-1}. It was stopped in a minute by using emergency brake for the reason of avoiding an unexpected situation. What was the distance travelled by the train by this time?

Ans: Given, $u = 72Kmh^{-1} = \frac{72 \times 1000}{1 \times 60 \times 60}ms^{-1}$
$= 20ms^{-1}$
$v = 0\ ms^{-1}$
$t = 1\ min = 60\ sec$
$s = ?$

Let us first find out the deceleration (a) of the train as it was going to stop.

We know, $a = \frac{v - u}{t}$

or, $a = \frac{0 - 20ms^{-1}}{60\ s}$

or, $a = -\frac{1}{3}ms^{-2}$

$\therefore a = -0.33ms^{-2}$

Now, $s = ut + \frac{1}{2}at^2$

or, $s = 20ms^{-1} \times 60s + \frac{1}{2} \times (-0.33ms^{-2}) \times (60s)^2$

or, $s = 1200m - \frac{1}{2} \times 0.33\ ms^{-2} \times 3600s^2$

or, $s = 1200m - 0.33\ ms^{-2} \times 1800s^2$

or, $s = 1200m - 594\ m$

$\therefore s = 606m$

The distance travelled by the train by this time was 606 m.

Ques-8. A car running with a velocity of $20ms^{-1}$ travels 147 m in 6s. Find out the acceleration and also the final velocity of the car.

Ans: Given, $u = 20ms^{-1}$
$t = 6s$
$s = 147\ m$
$a = ?$
$v = ?$

For finding out acceleration, Let us apply the formula, $s = ut + \frac{1}{2}at^2$

That is, $147m = 20ms^{-1} \times 6s + \frac{1}{2} \times a \times (6s)^2$

or, $20ms^{-1} \times 6s + \frac{1}{2} \times a \times (6s)^2 = 147m$

or, $120m + \frac{1}{2} \times a \times 36s^2 = 147\ m$

or, $120m + a \times 18s^2 = 147m$

or, $a \times 18s^2 = 147m - 120m$

or, $a = \frac{27m}{18s^2}$

or, $a = \frac{3}{2}ms^{-2}$

$\therefore a = 1.5\ ms^{-2}$

Acceleration gained by the car is $1.5\ ms^{-2}$.

For finding out final velocity, let us apply the formula, $v = u + at$

So, $v = 20ms^{-1} + 1.5\ ms^{-2} \times 6s$

or, $v = 20ms^{-1} + 9ms^{-1}$

$\therefore v = 29\ ms^{-1}$.

The final velocity gained by the car is $29ms^{-1}$.

Ques-9. A car travels a distance of 3Km with uniform velocity. It travels one-third of the path in 6 minute. What time the car will take to travel the remaining distance?

Ans: $\frac{1}{3}$ of 3 Km = 1Km

In case of the first phase (1Km):

$u_1 = 0ms^{-1}$

$s_1 = 1Km = 1000m$

$t_1 = 6$ minute $= 6 \times 60s = 360s$

Let us first find out the acceleration for this phase.

We know, $s = ut + \frac{1}{2}at^2$

That is, $s_1 = u_1t_1 + \frac{1}{2}at_1^2$

or, $1000m = 0 \times t + \frac{1}{2} \times a \times (360s)^2$

or, $1000m = 0 + \frac{1}{2} \times a \times 360 \times 360s^2$

or, $a \times 180 \times 360s^2 = 1000m$

or, $a = \frac{1000m}{180 \times 360s^2}$

or, $a = \frac{5m}{9 \times 36s^2}$

or, $a = \frac{5m}{324s^2}$

or, $a = 10^{-3} \times 15.432\ ms^{-2}$.

Let us now find out the final velocity of the car applying the formula, $v = u + at$.

So, $v = 0 + 10^{-3} \times 15.432ms^{-2} \times 360s$

$\therefore\ v = 5.56\ ms^{-1}$.

In the second phase:

The car travels 2 Km, i.e, $s_2 = 2Km$

$v = 5.56ms^{-1}$

$t_2 = ?$

Applying

$S = vt$

or, $t_2 = \frac{s}{v} = \frac{2Km}{5.56ms^{-1}} = \frac{2 \times 1000m}{5.56\ ms^{-1}}$

$\therefore\ t_2 = 359.71s = 5.995$ min

$= 6$min (approx).

The car takes around 6 minutes to travel the remaining 2 Km.

Ques-10. A 100m long train passes a 300m long platform. The train enters the platform with a velocity of $40ms^{-1}$ and leaves the platform with a velocity of $50ms^{-1}$. What acceleration does the train gain?

Ans: Given, $u = 40ms^{-1}$

$v = 50ms^{-1}$

s = length of the train + length of the platform = 100m + 300m = 400m

a = ?

Applying the formula, $v^2 = u^2 + 2as$

or, $u^2 + 2as = v^2$

or, $2as = v^2 - u^2$

or, $a = \frac{v^2 - u^2}{2s}$

or, $a = \frac{(50ms^{-1})^2 - (40ms^{-1})^2}{2 \times 400m}$

or, $a = \frac{2500m^2s^{-2} - 1600m^2s^{-2}}{800m}$

or, $a = \frac{900m^2s^{-2}}{800m}$

or, $a = \frac{9}{8}ms^{-2}$

$\therefore\ a = 1.125ms^{-2}$.

The train gains an acceleration of 1.125 ms^{-2}.

Ques-11. Two cars A and B start racing with velocities of $4ms^{-1}$ and $7ms^{-1}$ respectively. They gain accelerations of 0.5 ms^{-2} and $0.4ms^{-2}$ respectively. Both the cars reach the ending line at the same time. What time does the race continue?

Ans: Given $u_A = 4ms^{-1}$

$u_B = 7ms^{-1}$

$a_A = 0.5ms^{-2}$

$a_B = 0.4ms^{-2}$

$t = ?$

Let us suppose, both the cars travels the distance, s at time, t.

Now, $s_A = u_At + \frac{1}{2}a_At^2$

and $s_B = u_Bt + \frac{1}{2}a_Bt^2$

As both the cars travels the same distance at the same time,

$s_A = s_B$

or, $u_At + \frac{1}{2}a_At^2 = u_Bt + \frac{1}{2}a_Bt^2$

or, $\frac{1}{2}a_At^2 - \frac{1}{2}a_Bt^2 = u_Bt - u_At$

or, $\frac{1}{2}t^2(a_A - a_B) = t(u_B - u_A)$

or, $t^2(a_A - a_B) = 2t(u_B - u_A)$

or, $t(a_A - a_B) = 2(u_B - u_A)$

or, $t = \frac{2(u_B - u_A)}{a_A - a_B}$

or, $t = \frac{2(7ms^{-1} - 4ms^{-1})}{(0.5\ ms^{-2} - 0.4ms^{-2})}$

or, $t = \frac{2 \times 3ms^{-1}}{0.1ms^{-2}}$

or, $t = \frac{6ms^{-1}}{0.1ms^{-2}}$

$\therefore\ t = 60sec = 1$ minute

The race continues for 1 minute.

Ques-12. A body passes a point A and continues moving with uniform acceleration. It gains a velocity of 1.5ms^{-1} before the end of the 5th second. At the end of the 6th second, the body stops and starts going backward. At what distance the body stops from point A when it stops?

Ans: Let us suppose, the initial velocity of the body at point A is u and the body has a uniform acceleration, a.

During the first phase,

$v = 1.5\ ms^{-1}$

$t = 5s$

$s = ?$

We know, $v = u + at$

or, $1.5 = u + a \times 5$

or, $u + 5a = 1.5$ ..... (i)

During the second pahse,

$v = 0\ ms^{-1}$

$t = 6\ s$

$s = ?$

Hence, $0 = u + a \times 6$

or, $u + 6a = 0$ ..... (ii)

Subtracting eq. (i) from eq. (ii),

$(u + 6a) - (u + 5a) = 0 - 1.5$

or, $u + 6a - u - 5a = -1.5$

or, $a = -1.5\ ms^{-2}$

Putting the value of 'a' in eq. (ii).

$u + 6(-1.5) = 0$

or, $u - 9 = 0$

$\therefore u = 9ms^{-1}$.

Finally, $s = ut + \frac{1}{2}at^2$

or, $s = 9ms^{-1} \times 6s + \frac{1}{2}(-1.5ms^{-2})\ (6s)^2$

or, $s = 54m - \frac{1}{2} \times 1.5ms^{-2} \times 36s^2$

or, $s = 54m - 1.5ms^{-2} \times 18s^2$

or, $s = 54m - 27m$

$\therefore s = 27m$.

The body stops at a distance of 27m from the point A when it stops.

Ques-13. Prove that a body will strike the ground in a second if it is thrown straight upward with an initial velocity of half the magnitude of 'g'.

Ans: According to the statement, $u = \frac{g}{2}$

and h = 0(because the body comes back to the ground)

In case of a body thrown upward,

$h = ut - \frac{1}{2}gt^2$

or, $ut - \frac{1}{2}gt^2 = h$

or, $t\left(u - \frac{1}{2}gt\right) = 0$

or, $t\left(\frac{1}{2}g - \frac{1}{2} \times g \times t\right) = 0$

or, $\frac{1}{2}gt\ (1 - t) = 0$

or, $1 - t = 0$

or, $-t = -1$

$\therefore t = 1$ sec.

It is proved that the body will strike the ground in a second if it is thrown straight upward with a velocity of half the magnitude of g.

Ques-14. What height will a body thrown straight upward with a velocity of 25ms^{-1} reach? What time will the body take to reach this height?

Ans: Given, $u = 25ms^{-1}$, $v = 0$

gravitational constant, $g = 9.8ms^{-2}$ (known)

$h = ?$

$t = ?$

We know, $v^2 = u^2 - 2gh$

or, $-2gh = v^2 - u^2$

or, $h = -\left(\frac{v^2 - u^2}{2g}\right)$

or, $h = -\left\{\frac{0^2 - (25ms^{-1})^2}{2 \times 9.8ms^{-2}}\right\}$

or, $h = -\frac{(-25ms^{-1} \times 25ms^{-1})}{2 \times 9.8ms^{-2}}$

or, $h = \frac{625m^2s^{-2}}{19.6ms^{-2}}$

or, $h = 31.89m$.

The body reaches a height of 31.89m

Again, $v = u - gt$

or, $gt = u - v$

or, $t = \frac{25ms^{-1} - 0ms^{-1}}{9.8ms^{-2}}$

or, $t = \frac{25ms^{-1}}{9.8ms^{-2}}$

$\therefore t = 2.55s$

The body takes 2.55 second to reach the height of 31.89m.

Ques-15. A body having a mass of 20gm is dropped from a certain height. What distance will the body travel in 5 sec?

Ans: Given, m = 20gm which has no influence on distance (height)

$t = 5$ sec

$g = 9.8ms^{-2}$ (universal gravitation)

$u = 0ms^{-1}$

$h = ?$

In case of a freely falling body,

$h = ut + \frac{1}{2}gt^2$

or, $h = 0 \times 5sec. + \frac{1}{2} \times 9.8\ ms^{-2} \times (5s)^2$

or, $h = 0 + 4.9ms^{-2} \times 25s^2$

$\therefore h = 122.5m$

The body travels 122.5m in 5 sec.

Super Tips at a glance

Have you thought of the questions while reading the chapter? If not, look at the questions below and find out the answers.

1. The velocity of train is uniformly at the rate of 25ms^{-1}leaving station in 20s. The velocity of this train remains 30s till pressing the break of the train and stops it in auniform declaration. If total inception of the train is 60s then what will be the acceleration and traveled distance of the train in 1st 30 sec.
2. The intercity teesta express train is crossing the half way with the velocity of 30kmh^{-1}. Then the rest of the way it crosses with the velocity of 60kmh^{-1}. Now what is the average velocity of that train during traveling from Dhaka to jamalpur?
3. Rafee travels by riding bicycle with the speed of 4ms^{-1} and crosses 50m distance in 10s. How long distance will rafee cross after crossing 50m distance in next 2s?
4. A car starts moving from its constant position with the uniform acceleration of 2ms^{-2}. Another car starts moving also from 20m back of the same road with the uniform speed of 20ms$^{-1.}$ What will be the actual time of that two car after starting journey for getting uniform speed between them?
5. A cat starts running from 15m distance to catch a rat form its constant position with the velocity of 2ms^{-2}. The cat is running in uniform speed. After how long and where will the cat be able to catch the rat?
6. A car was running with the speed of 30ms$^{-1.}$ The speed of this car is decreased uniformly 10ms^{-1} in 5sec after holding the break of that car. What is the travelled distance of that car?
7. The driver of the car named cholonketi sees a pedestrian in 46m distance when he drives his car with the velocity of 54kmh^{-1} and holds the break instantly. For this reason the pedestrian stops near the distance of 1m only. What is the acceleration of that car?
8. The list of velocity and time of a car has been given below:

Time(s)	0	5	10	15	25	30	35	40
Velocity (ms^{-1})	0	19	20	30	30	30	15	0

   How long distance will the car cross in 1st 20sec?
9. The velocity of 10ms^{-1} speed running car is 30ms^{-1} in 5s. What is the acceleration of the car?
10. How is crossed distance determined from the graph of velocity vs. time?
11. A running car of uniform acceleration cross 1km distance in 4 min. How long does this car need to cross 3km distance?
12. Teacher crosses the 1st km in 4 min. later he crosses the 2nd km in 3 min. Determine the crossed distance of teacher.
13. A car runs atuniform acceleration of 2ms^{-2} in 15sec from it's constant place. Later it crosses at constant velocity of 30ms^{-1} in 10sec. After 5sec from the time of tanning break the car starts moving again. What will be the travelled distance of that car?
14. Describe how the crossed distance is determined by the axis of time and the graph of velocity as well as time?
15. From a constant place Rahim starts his journey and crosses the distance at the uniform acceleration of 400m. How long distance has Rahim crossed in half of time?
16. From a constant place Rahim starts his journey and crosses the distance at the uniform acceleration of 400m. Now, show that Rahim spends 70.7% of time for crossing half distance.
17. Determine the crossed distance of a falling object from the upward in 10 sec?
18. Show that, the speed of a falling object from upward increases after each second at the velocity of 9.8ms^{-1}
19. Determine that, after how long a car will cross 65m distance by running with the uniform acceleration of 16ms^{-1}.
20. Form the graph of velocity vs time determine the travelled distance of car that travels at the uniform acceleration of 16ms^{-1} in 6sec.
21. Two cars start moving with the velocity of 4ms^{-1} and 7ms^{-1} and their acceleration are 0.5ms^{-2} as well as 0.4ms^{-2} respectively. Determine the actual travelled time of that two cars.
22. Two cars start moving with the velocity of 4ms^{-1} and 7ms^{-1} and their acceleration are 0.5ms^{-2} as well as 0.4ms^{-2} respectively. Determine the actual ratio of that two cars by determining travelled distance of that two cars in 30sec.
23. If a train moves from its constant place at the acceleration of 6ms^{-2}; when the velocity of the train will be equal with another train which moves at the acceleration of 60ms^{-1} from 600m front side of the way?
24. A train starts moving at the acceleration of 6ms^{-2} from its constant place. At the same time a car starts running also form 900m distance of the road with the acceleration of 60ms^{-1}. After moving how long the train will able to cross the car; determine it?
25. Determine the acquired velocity of a car after starting its running at the acceleration of 3ms^{-2} in 7sec from its constant place.

26. Form the graph of velocity vs time analyze the logic of the technique of determining the crossed distance of travelling route of a car.
27. A car runs in uniform acceleration in 10min and acquired a velocity by crossing 3km. Now, what will be the actual time to cross 1km distance with that acquired velocity?
28. Describe the speed of a car from a constant place according to the graph of velocity vs time.

In this part important information of the chpater, at which it is needed to cast a look before exam or you must remember, such subject matters have been mentioned here at a glance. So that you can keep the important information in mind easily; specially you can make you self-confident revising these in a quick view.

- **Reference Frame:** The fixed object with respect to which we find out the position, rest and motion of another object is called reference frame.
- **Rest:** A body is said to be static or at rest with respect to its surroundings when it does not change its position with time and this unchanged position is called rest.
- **Motion:** A body is said to be in motion with respect to its surroundings when it changes its position with time and this changed position is called motion.
- **Absolute Motion:** The motion of a body in respect to the things with absolute motion is called absolute motion.
- **Scalar Motion:** The motion which can be expressed by magnitude only is called scalar motion.
- **Scalar Quantity:** Physical quantities which can be fully expressed by magnitude only are called scalar quantities.
- **Vector Quantity:** Physical quantity which needs both magnitude and direction to be expressed fully is called vector quantity.
- **Displacement:** The change of position or distance in a definite direction is called displacement.
- **Velocity:** The rate of change of position in a definite direction or in other words the rate of change of displacement is called velocity.
- **Speed:** The quantity by which we can measure how fast a body moves or distance travels, is called speed.
- **Uniform Speed:** If the magnitude of speed does not change during the motion of the body, that is if the body travels equal distance in equal interval of time, then the speed of the body is called uniform speed.
- **Non-uniform Speed:** If the body does not travel equal distance in equal interval of time then the speed is called non uniform speed.
- **Acceleration:** The rate of change of velocity with time that is the change of velocity in unit time is known as acceleration.
- **Retardation:** The negative acceleration is called retardation or deceleration.
- **Uniform Acceleration:** If the rate of increase of velocity of a moving body in a particular direction is maintained constant all the time then it is called uniform acceleration.
- **Non-uniform Acceleration:** If the rate of increase of velocity changes with time then it is called non-uniform velocity.
- **Gravity:** If earth is one of the two bodies, then the force of attractions is called gravity that is the attraction of the earth on any other body is called gravity.
- **Gravitational Attraction:** The attraction between the earth and any other body of it is called gravitational attraction.
- **Laws of falling bodies:**

  Galilio discovered three laws regarding to falling bodies. These are called laws of falling bodies.

  First Law: All bodies falling from rest and from the same height without any resistance traverse equal distance in equal time.

  Second Law: The velocity (v), acquired by freely falling body from rest in a given time (t) is directly proportional to time that is, $v \propto t$.

  Third Law: The distance (h) traverse by a freely falling body from rest in a given time (t) is directed proportional to the square of the time, that is, $h \propto t^2$.

Suggestion: Highway Ensuring a Brilliant Result

It is not that you will find all the questions common but the practice of these questions will guide you in solving different and difficult question patterns.

Suggestion Multiple Choice Creative Questions

	Question Number
★★★	2, 4, 8, 12, 18, 20, 25, 29, 32, 38, 44, 50, 55, 57, 60, 68, 72, 76, 79, 80, 85, 87, 88, 90, 95, 98, 100, 110, 125, 130, 135, 140, 145, 148, 150, 154, 158, 160, 162, 165, 168, 170, 175, 180, 185, 188, 191, 193, 195, 197, 199, 200, 206, 209, 212, 214, 216, 220, 225, 230, 236, 240, 245, 250, 256, 258, 262, 265, 270, 275, 278, 280, 285, 288, 290, 292, 294.
★★	180, 188, 193, 197, 199, 200, 206, 212, 214, 220, 225, 230, 256, 262, 270, 280, 285, 288, 290, 292, 293

Suggestion Essay-Type Creative Questions

Question types	Question Number
Knowledge Based	Practice part 1, 3, 5, 7, 9, 12, 13, 17, 19, 21, 23, 25, 27, 29, 32, 34, 36, 38, 40 and **SURE 12** part 2, 4, 6, 8, 10, 12
Comprehension Based	Practice part 2, 4, 6, 8, 10, 11, 14, 15, 16, 18, 20, 22, 24, 26, 28, 30, 31, 33, 35, 37, 39 and **SURE 12** part 1, 3, 4, 5
Application Based	1. An inter-city train travels half the distance from Dhaka to Dinajpur at a velocity of 30Kmh^{-1} and the other half at that of 35Kmh^{-1}. What is the average velocity of the train during its journey? If the railroad is 300Km long, what time does the train take to reach Dinajpur? What acceleration does the train gain during its journey? 2. Car- A starts running with a uniform acceleration of 2ms^{-2}. Car-B is 84m behind car A and it (B) starts running at the same direction with a uniform velocity of 20ms^{-1}. What time will car-A take to gain this velocity (20ms^{-1})? 3. How can you find out the distance travelled by a moving body from time- velocity graph? 4. Rahim travels 400m with a uniform acceleration of 2ms^{-2}. What distance does he travel in half the time he takes to travel 400m? 5. Find out the distance travelled by a freely falling body in half a minute.
Higher Order-Based	1. Illustrate the fact that acceleration due to gravity but not the mass of a body influence the time a freely falling body takes to strike the ground. 2. Establish the third law of falling bodies by means of the second law. 3. A time-velocity graph illustrates not only acceleration but also definite direction. Examine the statement drawing four time-velocity graphs. 4. No motion in the universe is absolute. Do you agree? Support your answer. 5. Do the activities of the lung and the heart belong to vibratory motion? Scrutinize the fact.