CAPSTONE

# Mathematics: Arithmetic

# Lecture 08

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| ◆ Speed<br>◆ Train<br>◆ Boat | ◆ Work<br>◆ Pipe<br>◆ Age |

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**Train**

**Important:**

➔ The length of the two trains are always added.

➔ The distance travelled by the train to clear a platform or a bridge is equal to the sum of the length of the train and the platform or the bridge.

➔ When the two train move in opposite directions, they cross each other at a speed equal to the sum of their speeds.

➔ When two trains move in the same direction, they cross each other at a speed equal to the difference between their speeds.

➔ A train said to have crossed an object (stationary or moving) only when the last coach of the train crosses the said object completely [i.e. total length of train ($^{L}$train) crosses total length of the object ($^{L}$object)].

➔ Distance covered = Speed × Time

➔ Time taken = Distance covered ÷ Speed

➔ To convert 1 km/h into m/sec, the multiplying factor is $\frac{5}{18}$.

**Shortcut Formula:**

➔ Crossing time = $\frac{\text{length of train + length of object}}{\text{speed of train}}$

**Time, Speed & Distance**

**Important Formula:**

i. Speed = $\frac{\text{Distance}}{\text{Time}}$

ii. 1 km/hr = $\frac{5}{18}$ m/s

iii. 1 m/s = $\frac{18}{5}$ km/hr

iv. Suppose, a man covers a distance at x kmph and an equal distance at y kmph, then the average speed will be $\frac{2xy}{x+y}$

**Relative Speed:**

➔ Two bodies are moving in <u>opposite directions</u> at speed $v_1$ & $v_2$ respectively. The relative speed is defined as, $v_r = v_1 + v_2$.

➔ Two bodies are moving in same directions at speed $v_1$ & $v_2$ respectively. The relative speed is defined as, $v_r = |v_1 - v_2|$.

**Boats and Stream:**

Let, U = velocity of the boat in still water.

V = velocity of the stream

**Upstream:**

While moving in upstream, distance covered, $S = (U - V)T$

**Downstream:**

In case of downstream, distance covered, $S = (U + V)T$

If the speed downstream is a km/hr and the speed upstream is b km/hr, then:

Speed in still water $= \frac{1}{2}(a + b)$ km/hr

Rate of stream $= \frac{1}{2}(a - b)$ km/hr

**Practice Test**

1. John walks 10 miles at an average rate of 2 miles per hour and returns on a bicycle at average rate of 10 miles per hour. How long (to the nearest hour) does the entire trip take him?

A. 3 B. 4 C. 5 D. 6 E. 7

2. In a kilometer race, A beats B by 100 m and B beats C by 150 m. In the same race, by how many meters does A beat C?

A. 235 m B. 225 m C. 240 m D. 250 m E. None of these

3. A motorist travels to a place 150 km away at an average speed of 50 km and returns at 30 km per hour. What is his average speed for the whole journey in km per hour?

A. 35 B. 37 C. 37.5 D. 40 E. 42.5

4. A culprit was spotted by a police man from a distance of 250 meter. When the policeman started running forwards the culprit at a speed of 10 km/hr the culprit also fled. If his speed was 8 km/hr, find how far the culprit had run before he was over powered?

A. 1.5 km B. 15 km C. 2.5 km D. 2 km E. None of these

5. Asif riding his bike at 24 km/h reaches his office 5 minutes late. If he would have reached the office 4 minutes earlier than the scheduled time by travelling 25% faster, how far is his office from his house in kms? [BBA 16-17]

A. 18 B. 24 C. 36 D. 40 E. None of these

6. Fahim and Rishad both started at the same time from point A to point B at speeds of 52 kmph and 39 kmph respectively on the same road. As soon as Fahim reaches point B, he turns back, starts toward point A on the same road, and meets Rishad on the way. How far from point B to the two of them meet, if the distance between the points is 70 km?

A. 20 B. 30 C. 10 D. 25 E. 15

7. In a race, the speeds of A and B are in the ratio of 3:4. A takes 30 minutes more than B takes to reach the destination. What is the time taken by A to reach the destination in hours? [December 2017]

A. 1 B. 1.5 C. 2 D. 3 E. None of these

8. A jogger running at 9 kmph alongside a railway track is 240 meters ahead of the engine of 120 metres long train running at 45 kmph in the same direction in how much time will the train pass the jogger? [June'17]

A. 3.6 sec B. 18 sec C. 36 sec D. 72 sec E. None of these

9. Train Karnafuli starts from Chittagong at 6 am and reaches Dhaka at 4 pm. Train Paharika starts from Dhaka at 7 am and reaches Chittagong at 7:30 pm. At what time will the train cross each other's? [June 2018]

A. 11 am B. 11:40 am C. 12 pm D. 12:45 pm E. None of these

10. Arif starts walking from his home at 10 am for station A at 4 km per hour. At 1 pm his brother leaves for the same destination at 20 km per hour. At what time will his brother meet?

A. 1:45 pm B. 2:00 pm C. 2:15 pm D. 2:30 pm E. None of these

11. A car travelling at a certain constant speed takes 2 second longer to travel 1 km than it would take to travel 1 km at 75 km/hr. At what speed, in km/hr is the car travelling? [June 2016]

A. 60 B. 62 C. 70 D. 72 E. None of these

12. Anis drove at an average speed of 20 km/hr for some time and then at an average speed of 60 km/hr for the rest of the journey. If his average speed for the entire trip was 30 km/hr, for what fraction of the total time did he drive at 20 km/hr? [December 2015]

A. $\frac{4}{5}$ B. $\frac{3}{4}$ C. $\frac{2}{3}$ D. $\frac{1}{2}$ E. None of these

13. A person covers a certain distance at a certain speed. If he decreases his speed by 20%, then he takes 10 minutes more to cover the distance. Find the time taken by him to cover the distance at original speed. [June'15]

A. 64 B. 60 C. 48 D. 40 E. None of these

14. Two boats on the opposite shores of a river start moving towards each other. When they pass each other they are 750 yards from one shoreline. They each continue to the opposite shore, immediately turn around and start back. When they meet again they are 250 yards from the other shoreline. Each boat maintains a constant speed throughout. How wide is the river? [BBA 13-14]

A. 2400 yards B. 3000 yards C. 2000 yards D. 4000 yards E. None of these

15. Two stations P and Q are 110 km apart on a straight track. One train starts from P at 7 am and travel toward Q at 20 kmph. Another train starts from Q at 8 am and travel toward P at a speed of 25 kmph. What time will they meet?

A. 8 am B. 10 am C. 12 am D. 11 am E. None of these

16. How long does a train 110 meters long running at the speed of 72 km/hr take to cross a bridge 132 meters in length?

A. 9.8 sec B. 12.1 sec C. 12.42 sec D. 14.3 sec E. 11.3 sec

17. A train 110 metres long is running with a speed of 60 km/hr. In what time will it pass a man who is running at 6 km/hr in the direction opposite to that in which the train is going?

A. 5 B. 4 C. 7 D. 8 E. 6

18. Two train are moving in opposite direction at 60 km/hr and 90 km/hr. Their lengths are 1.10 km and 0.9 km respectively. The time taken by the slower train to cross the faster train in seconds is -

A. 36 B. 45 C. 40 D. 48 E. 49

19. A train is travelling at 48 kmph. It crosses another train having half of its length, travelling in a opposite direction at 42 kmph in 12 seconds. It also passes a railway platform in 45 seconds. What is the length of the platform?

A. 200 meter B. 250 meter C. 400 meter D. 450 meter E. 300 meter

20. A train has a length of 150 metres. It is passing a man who is moving at 2 km/hr in the same direction of the train, in 3 seconds. Find out the speed of the train.

A. 18.2 km/hr B. 15.2 km/hr C. 150 km/hr D. 152 km/hr E. 182 km/hr

21. If a man goes 18 km downstream in 4 hours and return against the stream in 12 hours, then the speed of the stream in km/hr is:

A. 3 B. 1.5 C. 1.75 D. 2 E. 1

22. A man rowed 3 miles upstream in 90 minutes if the river flowed with a current of 2 miles per hour, how long did the man's return trip take?

A. 20 B. 30 C. 40 D. 50 E. 35

23. Azam can swim 10 km upstream and 25 km downstream in 12 hours. He can also swim 15 km upstream and 50 km downstream in 20 hours. How many hours will it take for him to cover 17.5 km in downstream if the rate of current increase by 40%? [June 2018]

A. 4.5 hours B. 4 hours C. 3.5 hours D. 3 hours E. None of these

24. A certain river has a current of 4 miles per hour. A boat takes twice as long as to travel upstream between two points as it down stream between the same two points. What is the speed of the boat in still water?

A. 6 mph B. 8 mph C. 12 mph D. 1.2 mph E. 10 mph

25. A boat traveled a total of 600 miles in two days. If the distance it traveled on the first day was 150 miles less than twice the distance it traveled on the second day, what was the distance, in miles that it traveled on the second day?

A. 250 B. 275 C. 350 D. 375 E. 450

**Home Task**

1. A 50 meter long train passes over a bridge at the speed of 30 km/hr. If it taken 36 seconds to cross the bridge. What is the length of the bridge?

A. 200 meters B. 250 meters C. 300 meters D. 350 meters E. 240 meters

2. A man standing on a railway bridge which is 180 m long. He finds that a train crossed the bridge in 20 seconds and crosses him in 8 sec. Found the length of the train and its speed.

A. 5 m/s, 30 m B. 10 m/s, 100 m C. 15 m/s, 120 m D. 20 m/s, 300 m E. 25 m/s, 150 m

3. A man can row at 5 km/ hr in still water. If the velocity of the current is 1 km/hr and it takes him 1 hour to row to a place and come back, how far is the place?

A. 2.2 km B. 2.4 km C. 4.5 km D. 5.2 km E. 3 km

4. A certain river has a current of 3 miles per hour. A boat takes twice as long travel upstream between two points as it does to travel downstream between the same two points. What is the speed of the boat in still water?

A. 3 mph B. 6 mph C. 8 mph D. 9 mph E. 12 mph

5. A boat sails M miles upstream at the rate of R miles per hour. If the rate of the stream is S miles per hour, how long will it take the boat to return to its starting point?

A. $\frac{M}{R+2S}$ B. $\frac{M}{R+S}$ C. $\frac{M+R}{S}$ D. MR − S E. None of these

6. A train can travel 50% faster than a car. Both start from point A at the same time and reach point B, 75 km away from A at the same time. On the way however the train had lost about 12.5 minutes while stopping at the station. What is the speed of the car?

A. 120 km/hr B. 110 km/hr C. 100 km/hr D. 80 km/hr E. None of these

7. A ferry can travel twice as fast when empty as when it is full. If travels 20 mile with full load, spends 1 hour for unloading and returns to its original port empty. It took 11 hours to complete the journey. What is the speed when the ferry is empty?

A. 5 B. 6 C. 6.5 D. 5.5 E. 8

8. A train leaving Dhaka at 6 am reaches Mymensing at 10 am and another train leaving Mymensing at 7 am reaches Dhaka at 12 noon. At what time the two trains running in opposite direction should meet?

A. 7:40 am B. 8:40 am C. 9:20 am D. 9:40 am E. 8:20 am

9. A car average as 25 miles per gallon of gasoline when driven in the city and 40 miles per gallon when driven on the highway. According to these rates, which of the following is closest to the number of miles per gallon that the car average when it is driven 10 miles in the city and then 50 miles on the highway?

A. 64 B. 36 C. 12 D. 29 E. None of these

10. P starts jogging from point X to point Y. 30 minutes later his friend R who jogs 1 km/hr slower than twice P's rate starts from the same point and follow the same path, if R overtakes P in 2 hour, how many kilometers will R have covered?

A. 2.2 km B. 3.3 km C. 4 km D. 6 km E. 9 km

11. A car goes 15 km on a gallon of octane when it is driven at 50 km/hr. When the car is driven 60 km/hr, it only goes 80% as far. How many gallons of octane are needed to travel 200 km if half the distance is travelled at 50 km/hr and the rest at 60 km/hr?

A. 15 B. 16.67 C. 10.60 D. 14 E. 50

12. On a track for remote controlled racing cars, racing car A complete the track in 55 seconds, while racing car B complete it in 35 seconds. If they both start at the same time, after how many seconds will they be side by side again? [December 2015]

A. 275 B. 325 C. 385 D. 425 E. None of these

13. Two trains running in opposite directions cross a man standing on the platform in 27 seconds and 17 seconds respectively and they cross each other in 23 seconds. The ratio of their speeds is:

A. 2:3 B. 1:3 C. 3:1 D. 3:2 E. None of these

14. A train when moves at an average speed of 75 km/hr, reaches its destination on time. When its average speed becomes 50 km/hr, it takes 1 more hour to reach its destination. Find the length of the journey in km. [December 2017]

A. 150 B. 180 C. 200 D. 240 E. None of these

15. Train Green Arrow leaves station A for station B everyday at 7 pm. On a certain day, it was delayed by 2 hours. To cover up the time it increased its average speed by 20% but still arrived at station B 1 hour later than the scheduled time. What is the usual duration of the train's journey from station A to station B? [June 2018]

A. 6 hours B. 6.5 hours C. 8 hours D. 8.5 hours E. None of these

16. In a swimming competition, Saju beat Sajib by 60 seconds. If the rate of Saju's swimming is 69 meters/minute and that of Sajib's 66 meters/minutes, how long has it taken Sajib to complete the competition? [June 2018]

A. 20 min B. 21 min C. 22 min D. 23 min E. None of these

17. Two cars are travelling on a highway in the same direction. If car A travelling at a rate of 55 mph is 18 miles ahead of car B, which is travelling at 45 mph, how much time will it take for car A to double the distance between itself and car B?

A. 1 hr 48 mins B. 3 hrs C. 3 hrs and 36 mis D. 4 hrs E. 4 hrs and 18 min

18. A boat traveled upstream a certain distance and then travelled downstream, a distance which is not the same distance. If the time travelled in both the cases is t hrs, and the speed of the boat is x miles/hr, what is the total distance travelled by the boat?

A. xt mile B. $\frac{3x}{2t}$ mile C. 2xt mile D. $\frac{t}{3x}$ mile E. 3xt mile

19. A boat travelled upstream 90 miles at an average speed of $(v - 3)$ mile per hour and then travelled the same distance downstream at an average speed of $(v + 3)$ mile per hours. If the trip upstream took a half hour longer than the trip downstream, then how many hours did it take the boat travel downstream?

A. 2.5 B. 2.4 C. 2.3 D. 2.2 E. 2.1

20. A river boat leaves Silver Town and travels upstream to Gold Town at an average speed of 6 kilometers per hour. If return by the same route at an average speed of 9 kilometer per hour. What is the average speed for the round trip in kilometers per hour?

A. 7 B. 7.1 C. 7.2 D. 7.5 E. 8

21. A man can row at the rate of 4 km/hr in still water. If the time taken to row a certain distance upstream is 3 times as much as to row the same distance downstream, find the speed of the current.

A. 15 B. 6 C. 20 D. 2 E. 17

22. A train having a length of 270 metre is running at the speed of 120 kmph. If crosses another train running in opposite direction at the speed of 80 kmph in 9 seconds. What is the length of the other train?

A. 270 m B. 350 m C. 250 m D. 230 m E. 240 m

23. A train travels at an average speed of 90 km/hr without any stoppage. However its average speed decrease to 60 km/hr on account of stoppage. On an average, how minute per hour does the train stop?

A. 12 minute B. 18 minute C. 20 minute D. 24 minute E. 30 minute

24. A train travels from city A to city B. The average speed of the train is 60 miles/hr and it travels the first quarter of the trip at a speed of 90 km/hr. What is the speed of the train in the remaining trip?

A. 30 B. 45 C. 54 D. 72 E. 90

25. Two train fast and slow are going from city A to city B at the same time. When the fast train has covered $\frac{2}{3}$ of the distance, the slow train is 180 km away from city B, when the fast has arrived in city B, the slow train has covered $\frac{6}{7}$ of the distance. How long is the distance between A and B?

A. 210 km B. 315 km C. 420 km D. 490 km E. 560 km