

Bangladesh Power Development Board (BPDB) – 2023

Post: Assistant Engineer (Civil)

Date: 24-02-2023; Friday; Time: 03:30 PM – 04:30 PM

Exam Taker: BUET

Time: 1 hour

Full Marks: 100

Non-Technical Part– 40×1 = 40

1. Who is Chief Executive Officer (CEO) of Tesla Inc.? **Ans: Elon Musk.**
2. Which is not Space Agency? a) NASA b) SPACE c) ROSCOMOS d) JAXA. **Ans: SAPCE**
3. Who invented DC current? **Ans: Thomas Alva Edison.**
4. What was the magnitude of the earthquake in Turkey? **Ans: 7.8**
5. What is the capital of Ukrain? **Ans: Kyiv.**
6. What is the name of the currency of Sri Lanka? **Ans: Rupee.**
7. Where will the Summer Olympics 2024 be held? **Ans: France.**
8. Who is the president of China? **Ans: Xi Jinping.**
9. ChatGPT means – **Ans: a chatbot.**
10. GDP means – **Ans: Gross Domestic Products.**
11. Who is not a famous Artist? a) Salauddin b) Shahabuddin c) Joynul Abedin d) Kamrul Hasan.
12. Which is the largest District? a) Chittagong b) Sylhet c) Rangamati d) Dhaka. **Ans: Rangamati.**
13. The largest coalmine situated at – **Ans: Dinajpur.**
14. Who is the 1st Prime minister of Bangladesh? **Ans: Tajuddin Ahmed.**
15. How many sectors there were during liberation war? **Ans: 11.**
16. ECNEC is under – **Ans: Cabinet Ministry.**
17. Dahagram situated at – **Ans: Lalmonirhat.**
18. When did "Digital Security Act" passed? **Ans: 2018.**
19. The Smart Bangladesh means – **Ans: smart citizen, smart society, smart economy, and smart government.**
20. Padma Bridge connects – **Ans: Lauhojang, Zazira, Shibchar.**
21. BPDP is looking ____ some energetic engineers. **Ans: for.**
22. Children give promises to care ____ their parent's. **Ans: of.**
23. Correct spelling – **Ans: Extraterrestrial.**
24. 'To blow out some steam' phrase means – **Ans: to do something that helps one to get rid of strong feelings.**
25. In 'Omnipotent' word, omni means – **Ans: all.**
26. Opposite of stiff – **Ans: flexible.**
27. I dislike him because he is lazy, which clause is this? **Ans:**
28. The idea of a balanced diet is very difficult to ____ to anyone who knows nothing about food values. **Ans: put across.**
29. I would ____ left the job than the other. **Ans: rather.**
30. The clerks of office is out and ____ loafer. **Ans: out.**
31. সংবিধান শব্দের সন্ধি বিচ্ছেদ কোনটি? **উত্তরঃ সম্ + বিধান।**
32. যখন পড়বে না মোর "পায়ের চিহ্ন" - কোন কারকে কোন বিভক্তি? **উত্তরঃ করণকারকে যষ্ঠ।**
33. মুখরা রমণী বশীকরণ কোন ধরনের রচনা? **উত্তরঃ অনূদিত নাটক।**
34. শুদ্ধ বানান কোনটি? **উত্তরঃ জিগীষা**
35. ব্রহ্মপুত্র শব্দের সঠিক যুক্তবর্ণ কোনটি? **উত্তরঃ হ্রস্ব**

36. শশাঙ্ক এর সমার্থক শব্দ কোনটি? **উত্তরঃ চাঁদ।**
37. রক্তাক্ত প্রান্তর নাটকের পটভূমি কি ছিল? **উত্তরঃ পানিপথের ৩য় যুদ্ধ।**
38. রোস্টোরী কোন ভাষার শব্দ? **উত্তরঃ ফরাসি।**
39. 'ভালো ছেলেরা শিক্ষকের আদেশ পালন করে' কোন ধরনের বাক্য? **উত্তরঃ সরল বাক্য।**
40. সমাস ভাষাকে - **উত্তরঃ সংক্ষেপ করে।**

Technical Part – 6×10 = 60

1. (a) Fill in the gaps with appropriate words.
- Void ratio of soft clay is 1.5, porosity is _____.
 - The angle of internal friction of a soil is 30° , coefficient of active earth pressure is _____.
 - The N_c value for deep foundation is _____.
 - The unconfined compressive strengths of soft clay in undisturbed sample and remoulded state are 50 kN/m^2 and 25 kN/m^2 , sensitivity of the soft clay is _____.

(b) A dry sand was tested in direct shear apparatus under normal load of 36 kg, sample was failed under load of 58 lb. The sample size was 2 inch in height and 2 inch in width. Calculate the angle of internal friction of the sand.

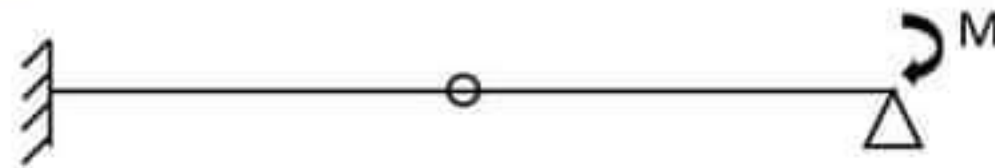
(c) A moist soil having volume of 0.2 ft^3 and weighs 25 lb. The oven dry weight is 20 lb. Calculate bulk unit weight, dry unit weight and water content of the soil.

2. Calculate the fineness modulus (FM), coefficient of uniformity (C_u) and percent of fine (silt and clay) of the sample.

Sieve size	#4	#8	#16	#30	#40	#50	#100	#200	Pan
% Retained	0	1	4	12	23	30	20	6	4

3. (a) The depth of equivalent constant stress of a singly reinforced rectangular beam, $a = 3.5''$ and effective depth is $16.5''$. The ratio of depth of rectangular stress block, β_1 is assumed as 0.85. Comment whether the beam is tension-controlled or compression-controlled. The value of $\frac{c}{d_t}$ is 0.60 (compression zone) and 0.375 (tension zone).

(b) Draw the bending moment diagram of the beam having span of $2L$. A concentric moment, M is applied at end point.



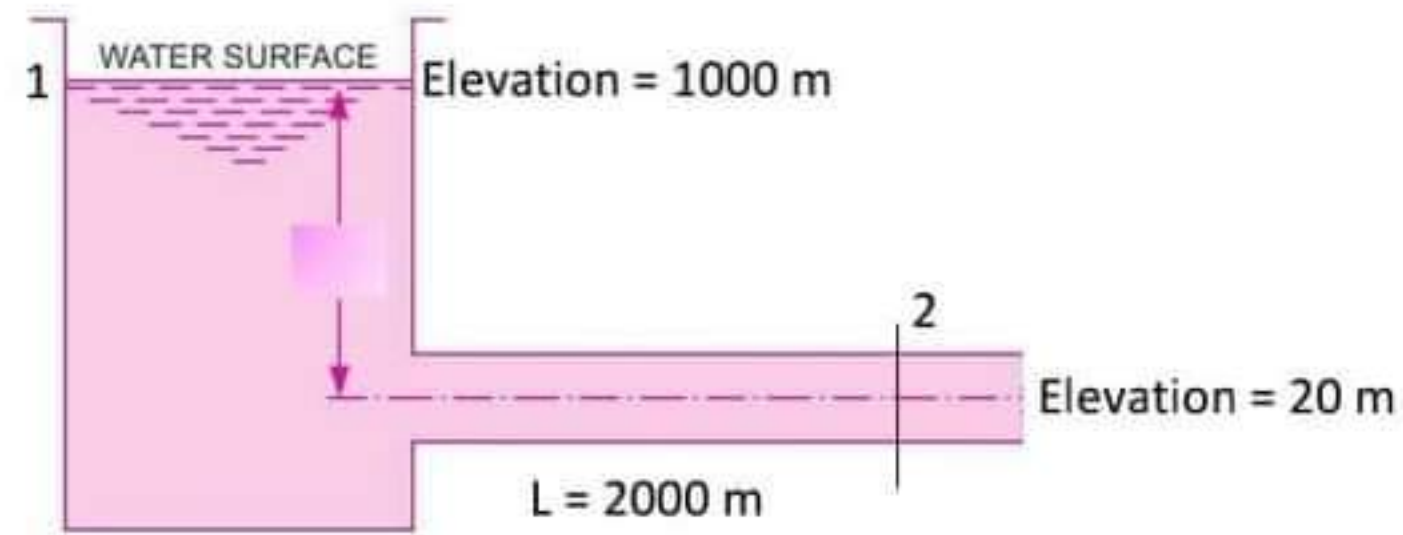
4. (a) The BOD_5 of a water sample is 125 mg/L in 20°C . The reaction rate constant at 20°C is 0.22 day^{-1} . Calculate the ultimate BOD.

(b) A horizontal flow grit chamber is used to pretreat wastewater with flow rate $26.5 \text{ ft}^3/\text{s}$. The chamber is 5.9 feet in deep and width is 15 times of length. What is the width of chamber if average approach velocity is 1.15 ft/s .

5. (a) A driver moving at a speed of 65 mph on 3% downgrade section of a highway sights an overturning truck 800 feet away on the highway and applied the brake. The coefficient of friction is 0.29, acceleration due to gravity is 32.2 ft/s^2 . What would be the final distance between the two stopped vehicles?

(b) Calculation of ESAL.

6. (a) The water flows from a thermal power plant through a pipe having diameter of 20 cm. Flow velocity is 1.0 m/s and friction coefficient of the pipe is 0.015. Find the pressure at point 2.



- (b) Water flows in a rectangular channel having a width of 3m, longitudinal slope is 0.001 and manning's coefficient is 0.20. If flow depth is 1m, calculate the flow rate if it is uniform flow.

5(a)

A driver moving at a speed of 65 mph on a 3% downgrade of a highway sights an overturning truck 800 ft away on the highway and applied the brake. The coefficient of friction is 0.29, accelerating due to gravity is 32.2 ft/s². What would be the final distance between the two stopped vehicles.

Solution: Co-efficient friction, $f = \frac{a}{g}$

Stopping sight distance (SSD)

$$= 1.47ut + \frac{u^2}{30 \left(\frac{a}{g} \pm 4 \right)}$$

$$= 1.47ut + \frac{u^2}{30 \left(f \pm \frac{g}{100} \right)}$$

$$= 1.47 \times 65 \times 2.5 + \frac{65^2}{30 \left(0.29 - \frac{3}{100} \right)}$$

$$= 238.875 + 541.667$$

$$= 780.542 \text{ ft.}$$

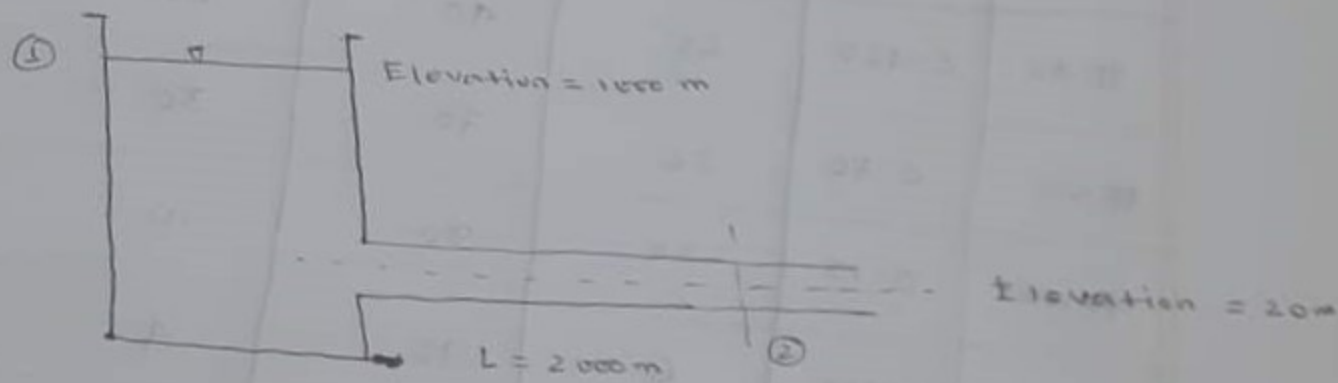
∴ Final distance between two stopped

$$\text{Vehicle} = (800 - 780.542) \text{ ft}$$

$$= 19.46 \text{ ft.}$$

(Ans)

6(a) The water flows from a thermal power plant through a pipe having diameter of 20cm. Flow velocity is 1.0 m/s and friction coefficient of the pipe is 0.015. Find the pressure at point 2.



Applying Bernoulli's energy equation between ① and ②

$$0 + 0 + Z_1 = \frac{P_2}{\gamma} + Z_2 + \frac{V_2^2}{2g} + \text{losses}$$

$$\Rightarrow 1000 = \frac{P_2}{\gamma} + 20 + \frac{V_2^2}{2g} + 0.50 \frac{V_2^2}{2g} + \frac{4 + L V^2}{2g d}$$

$$\Rightarrow 1000 = \frac{P_2}{\gamma} + 20 + \frac{1^2}{2 \times 9.81} + 0.50 \times \frac{1^2}{2 \times 9.81} + \frac{4 \times 0.015 \times 2000 \times 1^2}{2 \times 9.81 \times \frac{20}{100}}$$

$$\Rightarrow 1000 = \frac{P_2}{\gamma} + 20 + 0.0764526 + 20.58104$$

$$\therefore P_2 = 9313.05 \text{ KN/m}^2 \text{ (Ans)}$$

Q2 Calculate the Fineness modulus (FM), coefficient of Uniformity (C_u) and Percent of fine (silt and clay)

Sieve No	Sieve opening (mm)	% Retained	Cumulative % Retained	Cumulative % finer
#4	4.75	0	0	100
#3	2.36	1	1	99
#16	1.18	4	5	95
#30	0.60	12	17	83
#40	0.425	23	40	60
#50	0.30	30	70	30
#100	0.15	20	90	10
#200	0.075	6	96	4
Pan		4	100	0

$$\therefore \text{Fineness modulus, (FM)} = \frac{0 + 1 + 5 + 17 + 70 + 90}{100}$$

$$= 1.83 \text{ (Ans)}$$

$$\therefore \text{Uniformity coefficient, } C_u = \frac{D_{60}}{D_{10}} = \frac{0.425}{0.15}$$

$$= 2.83 \text{ (Ans)}$$

$$\therefore \% \text{ of silt and clay} = (4 - 0) = 4\% \text{ (Ans)}$$

* Sample question:

Calculate ESAL for 20 years following the data below considering 4th degree estimation of axle load.

[BPDB-23]

Axle Load	Number of axle Vehicle per day
16 K	50
18 K	48
22 K	36
24 K	55
28 K	60
30 K	38

sol^m we know,

$$SSD = 1.42uf + \frac{u^2}{30A(f-m)}$$

$$= 1.42 \times 65 \times \frac{2.5}{2.5} + \frac{65^2}{30(0.29-0.03)}$$

$$= 258.54 \text{ ft}$$

Here,

$$f = 0.29$$

$$u = 65 \text{ mph}$$

$$m = 0.03$$

$$A = 2.5 \text{ sec}$$

∴ Final distance between two stopped vehicles
 $= (800 - 258.54) = 541.46 \text{ ft}$

* 5.6) Calculate BSAL for 20 years following the data below. Considering 4th degree estimation of axle load.

Axle load	No's of vehicle today
16	50
18	48
22	36
24	55
28	60
30	38

sol^m BSAL for 20 years

$$= \sum N_i \times \left(\frac{\text{Axle load}}{\text{Standard load}} \right)^4$$

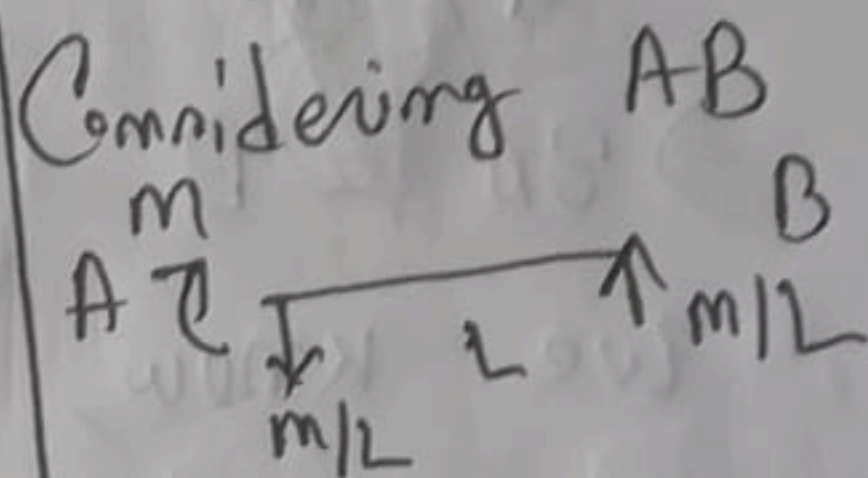
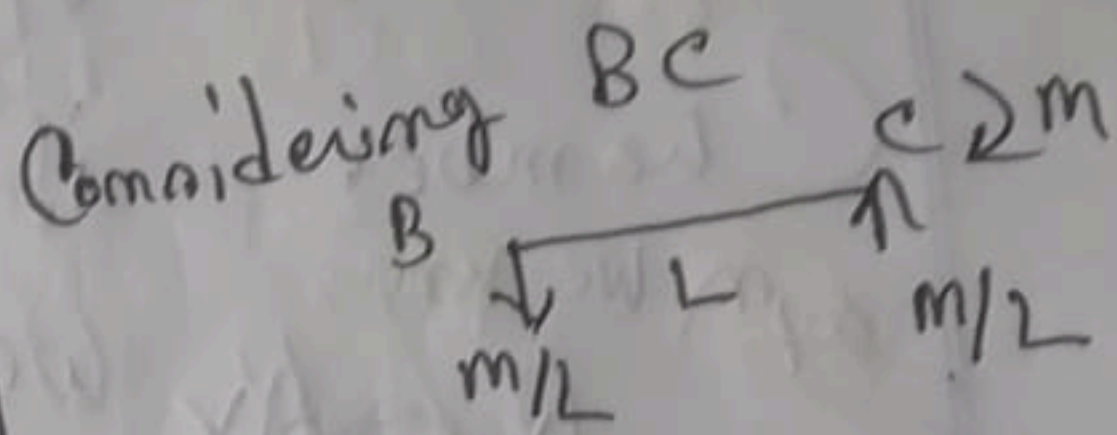
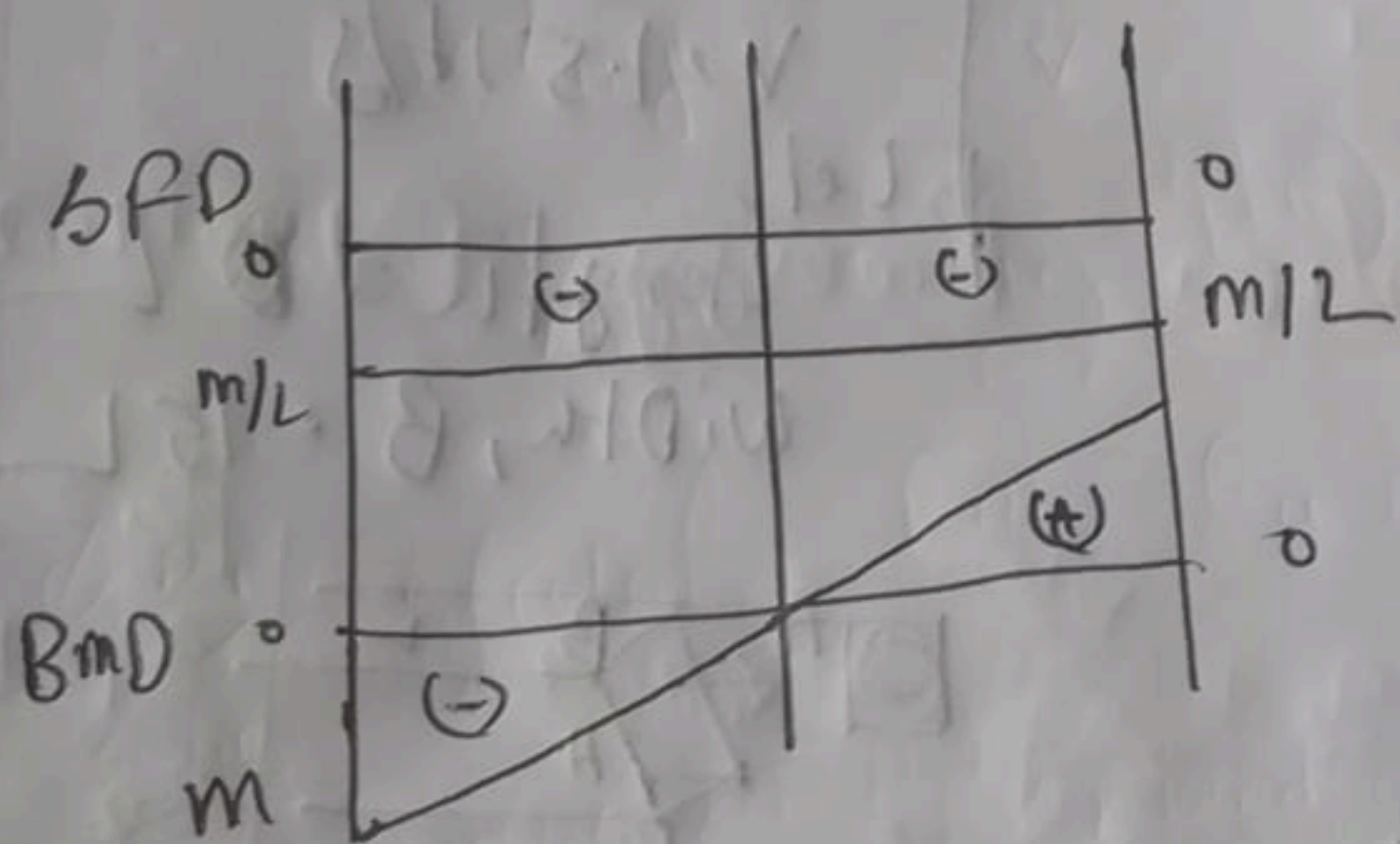
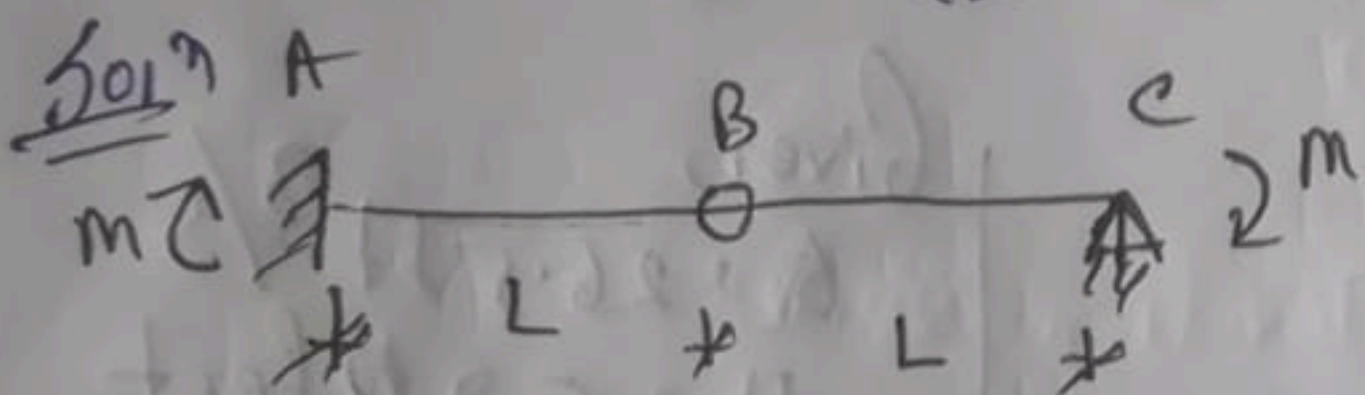
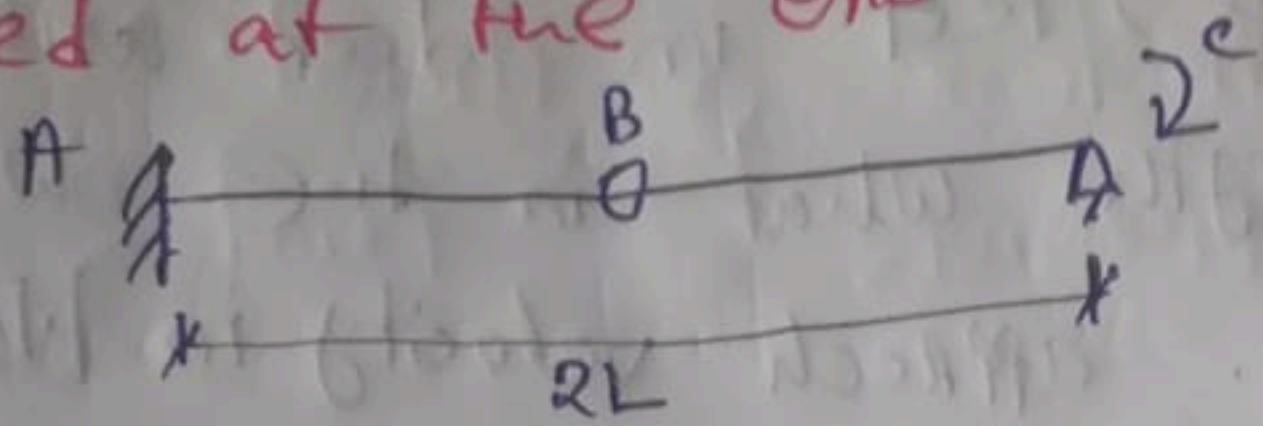
$$= \left[50 \times \left(\frac{16}{18} \right)^4 + 48 \times \left(\frac{18}{18} \right)^4 + 36 \times \left(\frac{22}{18} \right)^4 + 55 \times \left(\frac{24}{18} \right)^4 + 60 \times \left(\frac{28}{18} \right)^4 + 38 \times \left(\frac{30}{18} \right)^4 \right]$$

$$\times 365 \times 20$$

$$= 2138661.21$$

Ans

2(b) Draw the bending moment Diagram of the beam having span of $2L$. A Concentric moment m is applied at the end point.



Last \downarrow support or member
 $3m = 3 \times 2 \rightarrow$ no. of members
 $= 6$

no. of reaction, $n = 5 < 6$

\therefore So the beam is unstable.

So SFD, BMD Diagram will be straight line.

Q-a. The BOD_5 of a waste water sample is 125 mg/L in 20°C . The reaction rate constant at 20°C is 0.22 day^{-1} .

Calculate ultimate BOD?

Solⁿ We know,

$$BOD_5 = BOD_u (1 - e^{-kT})$$

$$\Rightarrow BOD_u = \frac{125}{1 - e^{-0.22 \times 5}}$$

$$= 182.32 \text{ mg/L}$$

$$\begin{aligned} BOD_5 &= 125 \text{ mg/L} \\ k &= 0.22 \text{ day}^{-1} \\ T &= 5 \text{ days} \end{aligned}$$

6.6 Water flows in a rectangular channel having a width of 3m. Longitudinal slope 0.001 and manning's coefficient is 0.2. If flow depth is 1m. Calculate the flow rate if it is uniform.

How.

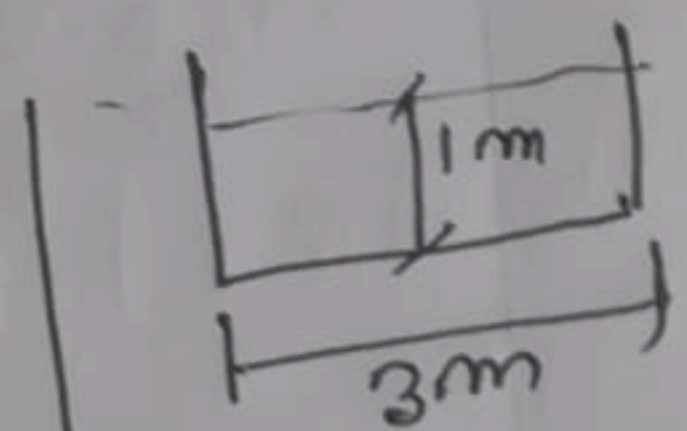
Solⁿ. we know,

$$Q = AV$$

$$= BH \times \frac{1}{n} R^{2/3} S^{1/2}$$

$$= 3 \times 1 \times \frac{1}{0.2} \times (0.6)^{2/3} \times (0.001)^{1/2}$$

$$= 0.34 \text{ m}^3/\text{s}$$



Here,
 $H = 1 \text{ m}$; $B = 3 \text{ m}$
 $S = 0.001$; $n = 0.2$
 $Q = ?$

$$A = 3 \times 1 = 3 \text{ m}^2$$

$$P = 3 + 1 + 1 = 5 \text{ m}$$

$$\therefore R = \frac{3}{5} = 0.6$$

4.6) A Horizontal flow ~~grip~~ chamber is used to pretreat waste water with flow rate $26.5 \text{ ft}^3/\text{s}$. The chamber is 5.9 feet in depth and width is 15 times of length. what is the width of chamber if Avg. approach velocity is 1.5 ft/s .

Solⁿ We know, $Q = AV$
 $\Rightarrow 30 = B \times H$

We know,

$$Q = AV$$

$$\Rightarrow 26.5 = B \times H \times 1.5$$

$$\Rightarrow B = \frac{26.5}{1.5 \times 5.9}$$

$$= 2.99 \approx 3 \text{ ft}$$

$$\therefore \text{Length} = 15B = 15 \times 3 = 25 \text{ ft}$$

Given,
 $Q = 26.5 \text{ ft}^3/\text{s}$
 $H = 5.9 \text{ feet}$
 $V = 1.5 \text{ ft/s}$

Let,

$$\text{Length} = L$$

$$\text{width, } B = 15L$$



5(a) A driver moving at a speed of 65 mph on 2% downgrade section of a highway sights an overtaking truck 800 feet away on the highway and applied the brake. $t = 20.29$, $a = 32.2 \text{ ft/s}^2$. what would be the final distance between two stopped vehicles?