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Time: 90 Minutes **PST-2018: Mock Paper** Maximum Marks: 50

**Read the following instructions carefully**

- (1) This question paper contains MCQ and numerical type questions divided into two sections:
  - (i) Section I – Question number 01 to 10 (10 Questions) will carry one mark each.
  - (ii) Section II – Question number 11 to 30 (20 Questions) will carry two mark each.
- (2) Answer all the questions.
- (3) Question must be answered on special machine gradable Objective Response Sheet (ORS) by darkening the appropriate bubble (marked A, B, C, D) using black ink ball pen against the question number on the ORS. Each question has only one correct answer.
- (4) Wrong answer carries negative marks. For one mark, there is one-third negative mark. For, two mark two-third negative mark. No negative marking for numerical type questions.
- (5) More than one answer bubbled against the question will be deemed as an incorrect response.
- (6) Write your registration number and other details at the specified locations on the ORS.
- (7) Calculator is allowed in the examination hall but the programmable calculator is not permitted.
- (8) Charts, graph sheets or tables are not allowed.
- (9) Choose the closest numerical answer among the choice given.
- (10) Use the blank pages given at the end of the question paper for rough use.
- (11) Cellphones, mobile phones are prohibited in the examination hall.
- (12) This question paper contains 12 printed pages including pages for rough work.
- (13) Please check all pages and report if there is any discrepancy.

**Candidate Name:** \_\_\_\_\_

**Registration Number:** \_\_\_\_\_

**Branch:** **CE**

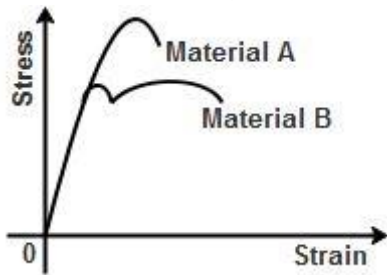
**Paper Code: 103**

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## SECTION-A

[Q-1] The stress-strain diagram for two materials A and B is shown below:



The following statements are made based on this diagram:

[GATE-2000]

(I) Material A is more brittle than material B.

(II) The ultimate strength of material B is more than that of A.

With reference to the above statements, which of the following applies?

- (a) Both the statements are false
- (b) Both the statements are true
- (c) I is true but II is false
- (d) I is false but II is true

[Q-2] The type of surveying in which the curvature of the earth is taken into account is called

(a) Geodetic surveying

(b) Plane surveying

(c) Preliminary surveying

(d) Topographical surveying

[GATE-2008]

[Q-3] Bull's trench kiln is used in the manufacturing of.....

[GATE-2016]

- (a) lime
- (b) cement
- (c) bricks
- (d) none of these

[Q-4] The order and degree of the differential equation  $\frac{d^3y}{dx^3} + 4\sqrt{\left(\frac{dy}{dx}\right)^3 + y^2} = 0$  are respectively?

- (a) 3 and 2
- (b) 2 and 3
- (c) 3 and 3
- (d) 3 and 1

[GATE-2010]

[Q-5] Cost of 3 cricket balls = cost of 2 pairs of leg pads.

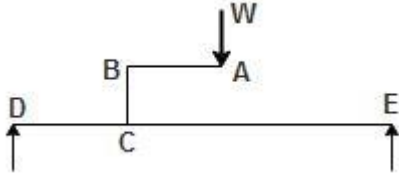
Cost of 3 pairs of leg pads = cost of 2 pairs of gloves.

Cost of 3 pairs of gloves = cost of 2 cricket bats.

If a cricket bat costs Rs. 54, what is the cost of a cricket ball?

- (a) Rs. 12
- (b) Rs. 14
- (c) Rs. 16
- (d) Rs. 18

[Q-6] For the loading given in the figure below, two statements (I and II) are made



(I) Member AB carries shear force and bending moment.

(II) Member BC carries axial load and shear force

Which of these statement is true?

[GATE-2002]

- (a) Statement I is true but II is false      (b) Statement I is false but II is true  
 (c) Both the statement I and II are true      (d) Both the statement I and II are false

[Q-7] During a levelling work along a falling gradient using a Dumpy level and a staff of 3 m length, following successive readings were taken: 1.785, 2.935, 0.360, 1.320. What will be the correct order of booking these four readings in a level book?(BS: Back sight, IS: Intermediate sight, FS: Force sight)

[GATE-2006]

- (a) BS, FS, BS, FS      (b) BS, IS, FS, FS      (c) BS, IS, IS, FS      (d) BS, IS, BS, FS

[Q-8] The compound which is largely responsible for initial setting and early strength gain of Ordinary Portland cement is.....

[GATE-2016]

- (a)  $C_3A$       (b)  $C_3S$       (c)  $C_2S$       (d)  $C_4AF$

[Q-9] Match List-I with List-II and select the correct answer using the codes given below the lists:

List-I

- A. Singular matrix  
 B. Non-square matrix  
 C. Real symmetric  
 D. Orthogonal matrix

List-II

1. Determinant is not defined  
 2. Determinant is always one  
 3. Determinant is zero  
 4. Eigen value are always real  
 5. Eigen value are not defined

**Codes:**    A    B    C    D

[GATE-2006]

- (a)    3    1    4    2  
 (b)    2    3    4    1  
 (c)    3    2    5    4  
 (d)    3    4    2    1

[Q-10] A can do a piece of work in 10 days and B can do the same work in 20 days. With the help of C, they finish the work in 5 days. How long will it take for C alone to finish the work?

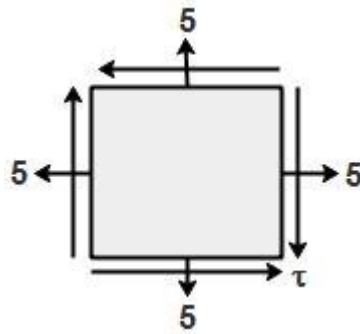
- (a) 20 days      (b) 10 days      (c) 35 days      (d) 15 days

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## SECTION-B

**[Q-11]** For the stress state (in MPa) shown in the figure, the major principal stress is 10 MPa.



The shear stress  $\tau$  is...

**[GATE-2016]**

- (a) 10.0 MPa (b) 5.0 MPa (c) 2.5 MPa (d) 0.0 MPa

**[Q-12]** The following measurements were made during testing a levelling instrument.

Instrument at	Staff reading at	
	$P_1$	$Q_1$
P	2.800 m	1.700 m
Q	2.700 m	1.800 m

$P_1$  is close to P and  $Q_1$  is close to Q. if the reduced level of station P is 100.000 m, the reduced level of station Q is.....

**[GATE-2007]**

- (a) 99.000 m (b) 100.000 m (c) 101.000 m (d) 102.000 m

**[Q-13]** As per indian standards for bricks, minimum acceptable compressive strength of any class of burnt clay bricks in dry state is.....

**[GATE-2016]**

- (a) 10.0 MPa (b) 0.75 MPa (c) 5.0 MPa (d) 3.5 MPa

**[Q-14]** The rank of the matrix  $\begin{bmatrix} 6 & 0 & 4 & 4 \\ -2 & 14 & 8 & 18 \\ 14 & -14 & 0 & -10 \end{bmatrix}$  is.....

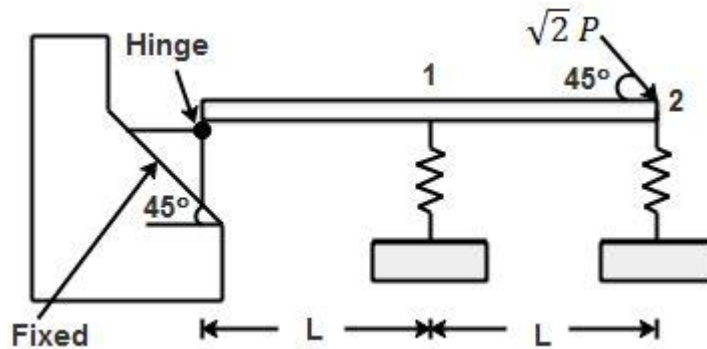
**[GATE-2014]**

**[Q-15]** 5 skilled workers can build a wall in 20 days; 8 semiskilled workers can build a wall in 25 days; 10 unskilled workers can build a wall in 30 days. If a team has 2 skilled, 6 semiskilled and 5 unskilled workers, how long will it take to build the wall?

- (a) 20 days (b) 18 days (c) 16 days (d) 15 days

**[GATE-2010]**

**[Q-16]** A rigid beam is hinged at one end and supported on linear elastic springs (both having a stiffness of 'K') at points '1' and '2', and an inclined load acts at '2', as shown.

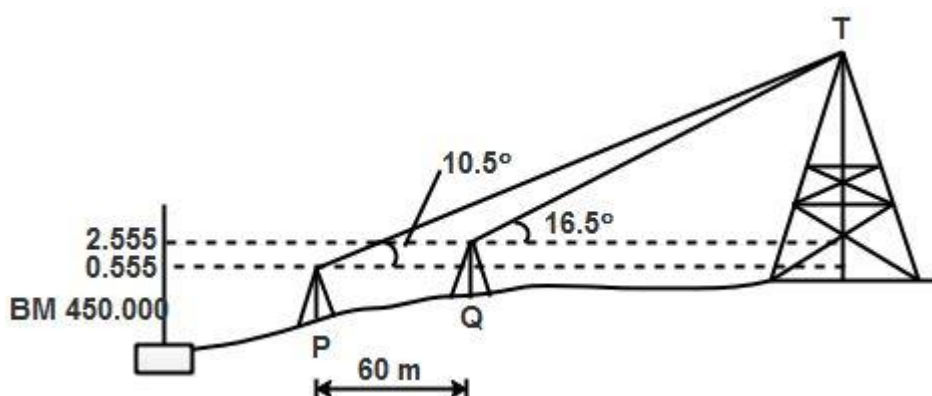


Which of the following options represents the deflections  $\delta_1$  and  $\delta_2$  at points '1' and '2'?

[GATE-2011]

- (a)  $\delta_1 = \frac{2}{5} \left( \frac{2P}{k} \right)$  and  $\delta_2 = \frac{4}{5} \left( \frac{2P}{k} \right)$       (b)  $\delta_1 = \frac{2}{5} \left( \frac{P}{k} \right)$  and  $\delta_2 = \frac{4}{5} \left( \frac{P}{k} \right)$   
 (c)  $\delta_1 = \frac{2}{5} \left( \frac{P}{\sqrt{2}k} \right)$  and  $\delta_2 = \frac{4}{5} \left( \frac{2P}{\sqrt{2}k} \right)$       (d)  $\delta_1 = \frac{2}{5} \left( \frac{\sqrt{2}P}{k} \right)$  and  $\delta_2 = \frac{4}{5} \left( \frac{\sqrt{2}P}{k} \right)$

**[Q-17]** The vertical angles subtended by the top of a tower T at two instrument station set up at P and Q, are shown in the figure. The two stations are in line with the tower and spaced at a distance of 60 m. readings taken from these two stations on a leveling staff placed at the benchmark (BM = 450.000 m) are also shown in the figure. The reduced level of the top of the tower T (expressed in m) is.....



[GATE-2016]



**[Q-18]** Group I gives a list of test method and test apparatus for evaluating some of the properties of Ordinary Portland Cement (OPC) and concrete. Group II gives the list of these properties.

Group-I

- P. Le Chatter test  
 Q. Vee-Bee test  
 R. Blaine air permeability of concrete  
 S. The vicat apparatus

Group-II

1. Soundness of OPC  
 2. Consistency and setting time of OPC  
 3. Consistency or workability of concrete  
 4. Fineness of OPC

The correct match of the items in Group I with the items in Group II is.....

- (a) P-1, Q-3, R-4, S-2    (b) P-2, Q-3, R-1, S-4  
 (c) P-4, Q-2, R-4, S-1    (d) P-1, Q-4, R-2, S-3

[GATE-2017]

**[Q-19]** The  $\lim_{x \rightarrow 0} \frac{\sin\left[\frac{2}{3}x\right]}{x}$  is.....

- (a) 2/3    (b) 1    (c) 3/2    (d)  $\infty$

[GATE-2010]

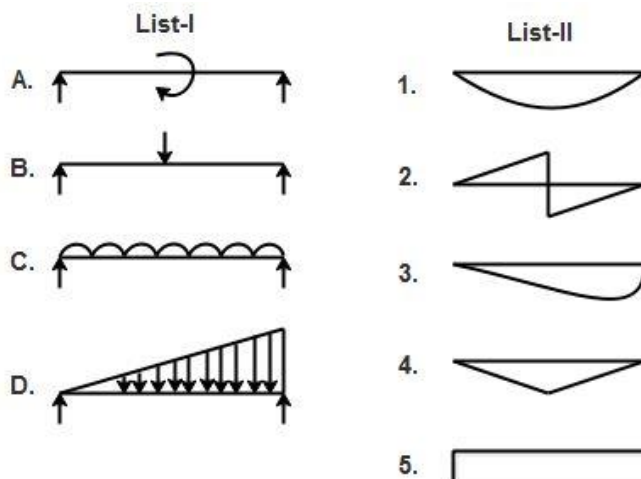
**[Q-20]** A container originally contains 10 litres of pure spirit. From this container 1 litre of spirit is replaced with 1 litre of water. Subsequently, 1 litre of the mixture is again replaced with 1 litre of water and this process is repeated one more time. How much spirit is now left in the container?

- (a) 7.58 litres    (b) 7.84 litres    (c) 7 litres    (d) 7.29 litres

[GATE-2011]

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**[Q-21]** List-I shows different loads acting on a beam and List-II shows different bending moment distributions. Match the load with the corresponding bending moment diagram.



- Codes:    A    B    C    D            A    B    C    D
- (a)    4    2    1    3            (b)    5    4    1    3
- (c)    2    5    3    1            (d)    2    4    1    3

[GATE-2003]

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**[Q-22]** Group-I lists tool/instrument while Group-II lists the method of surveying. Match the tool/instrument with the corresponding method of surveying.

Group-I				Group-II			
P. Alidade				1. Chain surveying			
Q. Arrow				2. Levelling			
R. Bubble tube				3. Plain table surveying			
S. Stadia hair				4. Theodolite surveying			

	P	Q	R	S
(a)	3	2	1	4
(b)	2	4	3	1
(c)	1	2	4	3
(d)	3	1	2	4

**[GATE-2014]**

**[Q-23]** Consider the following statements:

P. Walls of one brick thick are measured in square meters.

Q. Walls of one brick thick are measured in cubic meters.

R. No deduction in the brickwork quantity is made for opening in walls up to 0.1 m<sup>2</sup> area.

S. For the measurement of excavation from the borrow pit in a fairly uniform ground, deadman are left at suitable intervals.

**1** For the above statements, the correct option is... **[GATE-2017]**

- (a) P-false; Q-true; R-false; S-true  
 (b) P-false; Q-true; R-false; S-false  
 (c) P-true; Q-false; R-true; S-false  
 (d) P-true; Q-false; R-true; S-true

**[Q-24]** With initial condition  $x(1) = 0.5$ , the solution of the differential equation.  $t \frac{dx}{dt} + x = t$  is

- (a)  $x = t - \frac{1}{2}$  (b)  $x = t^2 - \frac{1}{2}$  (c)  $x = \frac{t^2}{2}$  (d)  $x = \frac{t}{2}$  **[GATE-2012]**

**[Q-25]** The salaries of A and B together amount to Rs. 2000. A spends 95% of his salary and B, 85% of his salary. If now, their savings are same, what is A's salary?

- (a) Rs. 1500 (b) Rs. 1250 (c) Rs. 750 (d) Rs. 1600

**[Q-26]** Creep strains are....

**[GATE-2013]**

- (a) caused due to dead load only
- (b) caused due to live load only
- (c) caused due to cyclic load only
- (d) independent of load

**[Q-27]** The length and bearings of a closed traverse PQRSP are given below.

Line	Length (m)	Bearing (WCB)
PQ	200	0°
QR	1000	45°
RS	907	180°
SP	?	?

The missing length and bearing, respectively of the line SP are

**[GATE-2008]**

- (a) 207 m and 270°
- (b) 707 m and 270°
- (c) 707 m and 180°
- (d) 907 m and 270°

**[Q-28]** A firm is selling its product at Rs. 60/unit. The total cost of production is Rs. 100 and the firm is earning a total profit of Rs. 500, later the total cost increased by 30%. By what percentage the price should be increased to maintain the same profit level...

- (a) 5
- (b) 15
- (c) 10
- (d) 30

**[GATE-2013]**

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**[Q-29]** The composition of an air-entrained concrete is given below:

Water	:	184 kg/m <sup>3</sup>
Ordinary Portland cement (OPC)	:	368 kg/m <sup>3</sup>
Sand	:	606 kg/m <sup>3</sup>
Coarse aggregate	:	1155 kg/m <sup>3</sup>

Assume the specific gravity of OPC, sand and coarse aggregate to be 3.14, 2.67 and 2.74 respectively. The air content is.....liters/m<sup>3</sup>.

**[GATE-2015]**

**[Q-30]** A mixture contains alcohol and water in the ratio of 12 : 5. On adding 14 litres of water, the ratio of alcohol to water becomes 4 : 3. The quantity of alcohol in the mixture is....



## ANSWER KEY

Q.	ANS	Q.	ANS	Q.	ANS	Q.	ANS
Q-1	[C]	Q-9	[A]	Q-17	476.911m	Q-25	[A]
Q-2	[A]	Q-10	[A]	Q-18	[A]	Q-26	[A]
Q-3	[C]	Q-11	[B]	Q-19	[A]	Q-27	[B]
Q-4	[A]	Q-12	[C]	Q-20	[D]	Q-28	[A]
Q-5	[C]	Q-13	[D]	Q-21	[D]	Q-29	50.3
Q-6	[A]	Q-14	2	Q-22	[D]	Q-30	42 L
Q-7	[A]	Q-15	[D]	Q-23	[D]	-	-
Q-8	[B]	Q-16	[B]	Q-24	[D]	-	-

## SOLUTION



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[Q-4]  $\frac{d^3y}{dx^3} + 4\sqrt{\left(\frac{dy}{dx}\right)^3 + y^2} = 0$  Removing radicals we get  $\left(\frac{d^3y}{dx^3}\right)^2 = 16\left[\left(\frac{dy}{dx}\right)^3 + y^2\right]$

1" The order is 3 since highest differential is  $\frac{d^3y}{dx^3}$  with Prime Features

The degree is 2 since power of highest differential is 2.

[Q-5]  $3G = 54 \times 2 = 108 \Rightarrow G = 36$

$3P = 36 \times 2 = 72 \Rightarrow P = 24$

$3C = 24 \times 2 = 48 \Rightarrow C = 16$

Cost of a cricket ball = Rs. 16

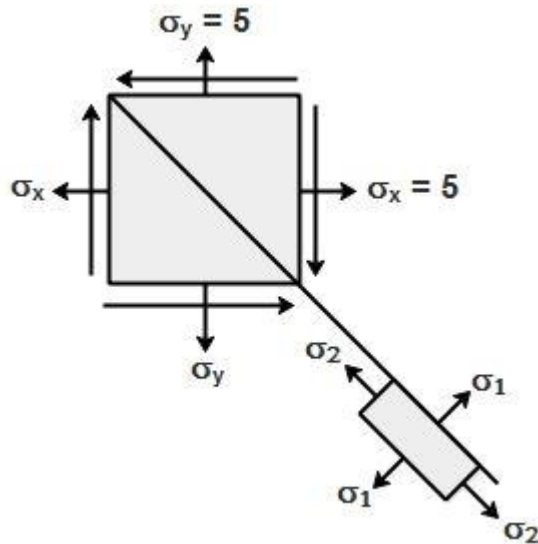
[Q-10]  $\frac{1}{5} - \frac{1}{10} - \frac{1}{20} = \frac{1}{20}$

This is C's one day work so 20 days are required for C alone to finish task

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[Q-11]



$$\begin{aligned}\sigma_x + \sigma_y &= \sigma_1 + \sigma_2 \\ \Rightarrow 5 + 5 &= 10 + \sigma_2 \\ \Rightarrow \sigma_2 &= 0\end{aligned}$$

$$\text{Now, } \sigma_{1/2} = \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

$$\therefore \sigma_1 = \frac{5+5}{2} + \sqrt{\left(\frac{5-5}{2}\right)^2 + \tau_{xy}^2}$$

$$\Rightarrow 10 = 5 + \tau_{xy}$$

$$\therefore \tau_{xy} = 5 \text{ MPa}$$

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[Q-12]  $h = \frac{\text{Difference of staff reading at } P_1 \text{ and } Q_1 \text{ when instrument is at } P + \text{Difference of staff reading at } P_1 \text{ and } Q_1 \text{ when instrument is at } Q}{2}$

$$h = \frac{(2.800 - 1.700) + (2.700 - 1.800)}{2}$$

$$h = 1$$

Reduced level of station

Q = Reduced level of P + h

$$= 100.000 + 1 = 101.000 \text{ m}$$

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$$[Q-14] \begin{bmatrix} 6 & 0 & 4 & 4 \\ -2 & 14 & 8 & 18 \\ 14 & -14 & 0 & -10 \end{bmatrix}$$

$$R_3 \rightarrow R_3 - 2R_1 + R_2$$

$$\begin{bmatrix} 6 & 0 & 4 & 4 \\ -2 & 14 & 8 & 18 \\ 14 - 2(6) + (-2) & -14 - 2(0) + (14) & 0 - 2(4) + 8 & -10 - 2(4) + (18) \end{bmatrix}$$

$$\begin{bmatrix} 6 & 0 & 4 & 4 \\ -2 & 14 & 8 & 18 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

Determinant of matrix  $\begin{bmatrix} 6 & 0 \\ -2 & 14 \end{bmatrix}$  is not zero

So, Rank is 2



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[Q-15] Per day work or rate of 5 skilled workers =  $\frac{1}{20}$

Per day work or rate of one skill worker =  $\frac{1}{5 \times 20} = \frac{1}{100}$

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Similarly per day work or rate 8 semiskilled workers =  $\frac{1}{25}$

Per day work or rate of one semi-skill worker =  $\frac{1}{8 \times 25} = \frac{1}{200}$

And per day work or rate of 10 unskilled workers =  $\frac{1}{30}$

Per day work or rate of one un-skill worker =  $\frac{1}{10 \times 30} = \frac{1}{300}$

Thus total per day work of 2 skilled, 6 semiskilled and 5 unskilled workers

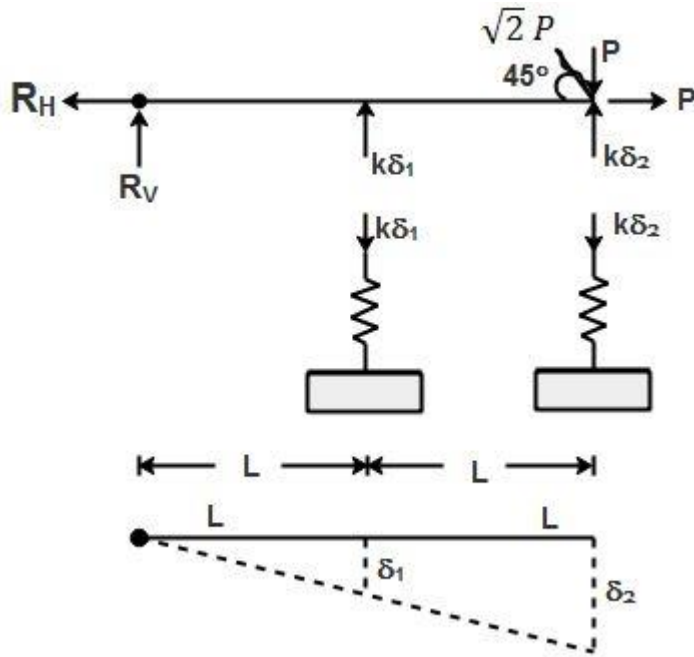
$$= \frac{2}{100} + \frac{6}{200} + \frac{5}{300} = \frac{12+18+10}{600} = \frac{40}{600} = \frac{1}{15} \text{ Thus time to complete the work is 15 days.}$$

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[Q-16] The free diagram of the beam is shown below



From similar triangles, we get

$$\frac{L}{\delta_1} = \frac{2L}{\delta_2} \Rightarrow \delta_2 = 2\delta_1 \dots\dots\dots(i)$$

Taking moments about hinge, we get

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$$P \times 2L - k\delta_2 \times 2L - k\delta_1 \times L = 0$$

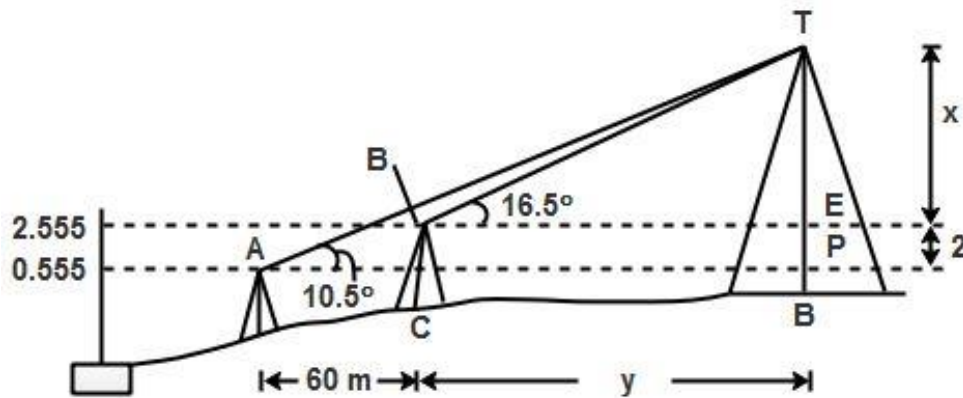
$$\Rightarrow 2P - k(2\delta_2 + \delta_1) = 0 \quad [\text{From (i)}]$$

$$\Rightarrow 2P - k(4\delta_1 + \delta_1) = 0$$

$$\Rightarrow \delta_1 = \frac{2P}{5k}$$

$$\text{From (i), we get } \delta_2 = 2 \times \frac{2P}{5k} = \frac{4P}{5k}$$

[Q-17]

In  $\triangle BET$ ,

$$\tan 16.5^\circ = \frac{x}{y}$$

$$\Rightarrow y = 3.3759x \quad \dots\dots(i)$$

$$\tan 10.5 = \frac{x+2}{60+y} \quad \dots\dots(ii)$$

Put value of  $y$  in eq.(ii)

$$0.1853 = \frac{x+2}{60+3.3759x}$$

$$11.1203 + 0.6255x = x + 2$$

$$x = 24.3568 \text{ m}$$

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So, the reduced level of tower

$$\begin{aligned} T &= 450.000 + 2.555 + 24.356 \\ &= 476.911 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{[Q-19]} \quad \lim_{x \rightarrow 0} \frac{\sin\left[\frac{2}{3}x\right]}{x} &= \lim_{\frac{2}{3}x \rightarrow 0} \frac{\sin\left(\frac{2}{3}x\right)}{\frac{2}{3}x} \cdot \frac{2}{3} \\ &= (1) \left(\frac{2}{3}\right) = \frac{2}{3} \end{aligned}$$

**[Q-20]** Every time if we take 1 litre of mixture out and replaced with water, content of pure spirit will keep on reducing by 10 %.

So, final quantity of spirit after 3 such operations are

$$10 \times 0.9 \times 0.9 \times 0.9 = 7.29 \text{ litres}$$

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**[Q-24]** The given differential equation is  $t \frac{dx}{dt} + x = t$  with initial condition  $x(1) = \frac{1}{2}$  which is same as  $\frac{dx}{dt} + \frac{x}{t} = 1$

Which is a linear differential equation

$$\frac{dx}{dt} + Px = Q \text{ where } P = \frac{1}{t} \text{ and } Q = 1$$

Integrating factor

$$= e^{\int P dt} = e^{\int \frac{1}{t} dt}$$

$$= e^{\log_e t} = t$$

Solution is  $x \cdot (IF) = \int Q \cdot (IF) dt + C$

$$x \cdot t = \int 1 \cdot t \cdot dt + C$$

$$xt = \frac{t^2}{2} + C$$

$$x = \frac{t}{2} + \frac{C}{t}$$

Put  $x(1) = \frac{1}{2}$

$$\Rightarrow \frac{1}{2} + \frac{C}{1} = \frac{1}{2}$$

$$\Rightarrow C = 0$$

So,  $x = \frac{t}{2}$  is the solution

**[Q-25]** Let A's salary = x, then B's = (2000 - x)

5% of A = 15% of B, i.e.

$$\frac{5}{100} x = \frac{15}{100} (2000 - x) \text{ or } x = 1500$$

**[Q-27]** For a closed travers sum of latitudes and departures should be zero respectively i.e.

$$\sum L = 0$$

$$\Rightarrow 200 \cos 0^\circ + 1000 \cos 45^\circ + 907 \cos 180^\circ + L \cos \theta = 0$$

$$\Rightarrow L \cos \theta = -0.10678 \quad \dots\dots\dots(i)$$

$$\sum D = 0$$

$$\Rightarrow 200 \sin 0^\circ + 1000 \sin 45^\circ + 907 \sin 180^\circ + L \sin \theta = 0$$

$$\Rightarrow L \sin \theta = -707.10678 \quad \dots\dots\dots(ii)$$

Diving (ii) by (i), we get

$$\tan \theta = 6622.09$$

$$\Rightarrow \theta = 270^\circ$$

$$\therefore L = \frac{-707.10678}{\sin 270^\circ} = 707.10678 \text{ m}$$

[Q-29] Let the total volume of air-entrained concrete is unity.

$$\frac{M_C}{\rho_C} + \frac{M_{FA}}{\rho_{FA}} + \frac{M_{CA}}{\rho_{CA}} + V_W + V_{Air} = 1.0$$

$$\frac{368}{3.14 \times 1000} + \frac{606}{2.67 \times 1000} + \frac{1155}{2.74 \times 1000} + \frac{184}{1000} + V_V = 1.0$$

$$0.11720 + 0.22697 + 0.42153 + 0.184 + V_V = 1.0$$

$$V_V = 0.0503$$

$$V_V = 0.0503 \times 1000$$

$$= 50.3 \text{ l/m}^3$$

[Q-30] Ratio of alcohol and water 12 : 5

Let their qualities be 12x and 5x respectively.

After adding the litres of water ratio becomes 4 : 3

$$\frac{12x}{5x+14} = \frac{4}{3}$$

$$x = \frac{7}{2}$$

Quantity of alcohol =  $12 \times \frac{7}{2} = 42 \text{ litres.}$



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