

# Assignment-7

AI24BTECH11036- Shreedhanvi Yadlapally

## I. MCQ - 2 MARKS

- 1) What should be the value of  $\lambda$  such that the function defined below is continuous at  $x = \frac{\pi}{2}$ ?

$$f(x) = \begin{cases} \frac{\lambda \cos x}{\frac{\pi}{2} - x} & \text{if } x \neq \pi/2 \\ 1 & \text{if } x = \pi/2 \end{cases}$$

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- a) 0                                      b)  $\frac{2}{\pi}$                                       c) 1                                      d)  $\frac{\pi}{2}$

- 2) What is the value of the definite integral,  $\int_0^a \frac{\sqrt{x}}{\sqrt{x} + \sqrt{a-x}} dx$ ?

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- a) 0                                      b)  $a/2$                                       c)  $a$                                       d)  $2a$

- 3) If  $\mathbf{a}$  and  $\mathbf{b}$  are two arbitrary vectors with magnitudes  $a$  and  $b$ , respectively,  $|\mathbf{a} \times \mathbf{b}|^2$  will be equal to

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- a)  $a^2 b^2 - (\mathbf{a} \cdot \mathbf{b})^2$                                       b)  $ab - \mathbf{a} \cdot \mathbf{b}$                                       c)  $a^2 b^2 + (\mathbf{a} \cdot \mathbf{b})^2$                                       d)  $ab + \mathbf{a} \cdot \mathbf{b}$

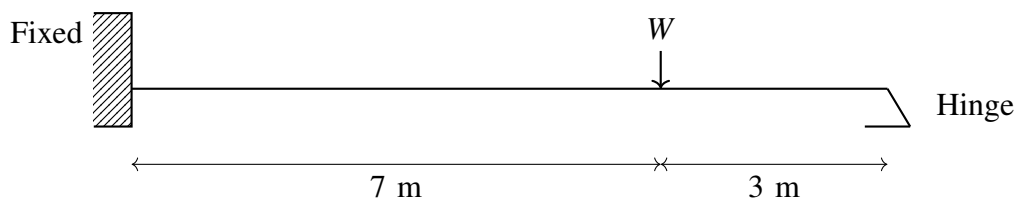
- 4) The solution of the differential equation  $\frac{dy}{dx} + \frac{y}{x} = x$ , with the condition that  $y = 1$  at  $x = 1$ , is

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- a)  $y = \frac{2}{3x^2} + \frac{x}{3}$                                       b)  $y = \frac{x}{2} + \frac{1}{2x}$                                       c)  $y = \frac{2}{3} + \frac{x}{3}$                                       d)  $y = \frac{2}{3x} + \frac{x^2}{3}$

- 5) The value of  $W$  that results in the collapse of the beam shown in the adjoining figure and having a plastic moment capacity of  $M_p$  is

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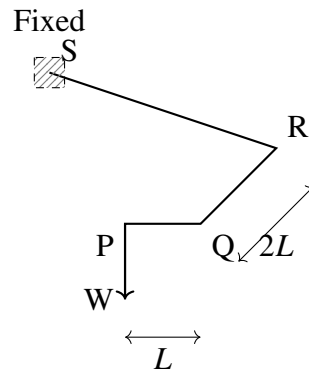


- a)  $(4/21)M_p$                                       b)  $(3/10)M_p$                                       c)  $(7/21)M_p$                                       d)  $(13/21)M_p$

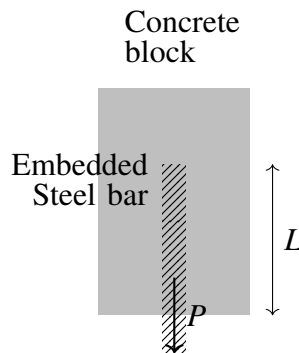
- 6) For the cantilever bracket, PQRS, loaded as shown in the adjoining figure ( $PQ=RS=L$ , and,  $QR=2L$ ), which of the following statements is **FALSE**?

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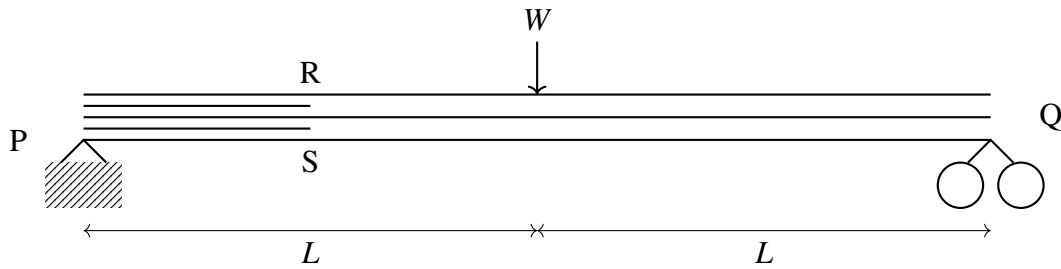
- a) The portion RS has a constant twisting moment with a value of  $2WL$ .  
 b) The portion QR has a varying twisting moment with a maximum value of  $WL$ .  
 c) The portion PQ has varying bending moment with a maximum value of  $WL$ .  
 d) The portion PQ has no twisting moment.



- 7) Consider a bar of diameter ' $D$ ' embedded in a large concrete block as shown in the adjoining figure, with a pull out force  $P$  being applied. Let  $\sigma_b$  and  $\sigma_{st}$  be the bond strength of the bar, respectively. If the block is held in position and it is assumed that the material of the block does not fail, which of the following options represents the maximum value of  $P$ ? 2011-CE

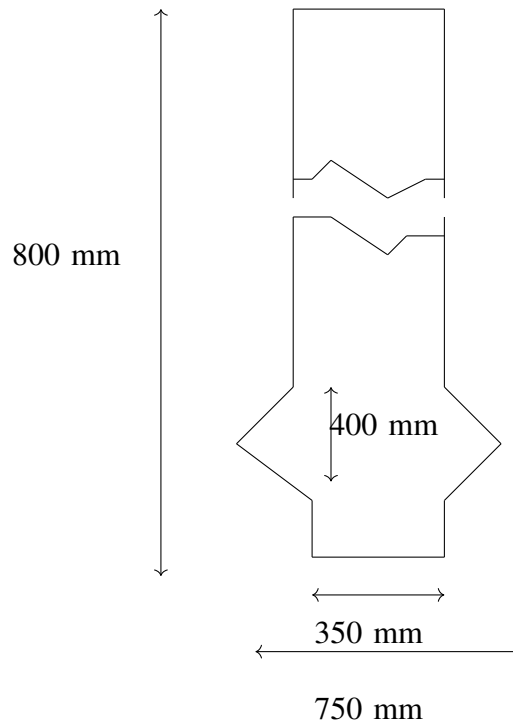


- a) Maximum of  $\left(\frac{\pi}{4}D^2\sigma_b\right)$  and  $(\pi DL\sigma_{st})$       c) Minimum of  $\left(\frac{\pi}{4}D^2\sigma_{st}\right)$  and  $(\pi DL\sigma_b)$   
 b) Maximum of  $\left(\frac{\pi}{4}D^2\sigma_{st}\right)$  and  $(\pi DL\sigma_b)$       d) Minimum  $\left(\frac{\pi}{4}D^2\sigma_b\right)$  and  $(\pi DL\sigma_{st})$
- 8) Consider two RCC beams P and Q, each having the section  $400 \text{ mm} \times 750 \text{ mm}$  (effective depth,  $d = 750 \text{ mm}$ ) made with concrete having  $\tau_{\text{cmax}} = 2.1 \text{ N/mm}^2$ . For the reinforcement provided and the grade of concrete used, it may be assumed that the  $\tau_c = 0.75 \text{ N/mm}^2$ . The design shear in beam P is 400 kN and in beam Q is 750 kN. Considering the provisions of IS 456-2000, which of the following statements is **TRUE**? 2011-CE
- a) Shear reinforcement should be designed for 175 kN for beam P and the section for beam Q should be revised.  
 b) Nominal shear reinforcement is required for beam P and the shear reinforcement should be designed for 120 kN for beam Q.  
 c) Shear reinforcement should be designed for 175 kN for beam P and the shear reinforcement should be designed for 525 kN for beam Q.  
 d) The sections for both beams P and Q need to be revised.
- 9) The adjoining figure shows a schematic representation of a steel plate girder to be used as a simply supported beam with a concentrated load. For stiffeners, PQ (running along the beam axis) and RS (running between the top and bottom flanges) which of the following pairs of statements will be **TRUE**? 2011-CE
- a) i) RS should be provided under the concentrated load only.  
 ii) PQ should be placed in the tension side of the flange



- b) i) RS helps to prevent local buckling of the web.  
 ii) PQ should be placed on the compression side of the flange.
- c) i) RS should be provided at supports.  
 ii) PQ should be placed along the neutral axis.
- d) i) RS should be provided away from points of action of concentrated loads.  
 ii) PQ should be provided on the compression side of the flange.
- 10) A singly under-reamed, 8-m long RCC pile (shown in the adjoining figure) weighing 20 kN with 350 mm shaft diameter and 750 mm under-ream diameter is installed within stiff, saturated silty clay (undrained shear strength is 50 kPa, adhesion factor is 0.3, and the applicable bearing capacity factor is 9) to counteract the impact of soil swelling on a structure constructed above. Neglecting suction and the contribution of the under-ream to the adhesive shaft capacity, what would be the estimated ultimate tensile capacity (rounded off to the nearest integer value of kN) of the pile?

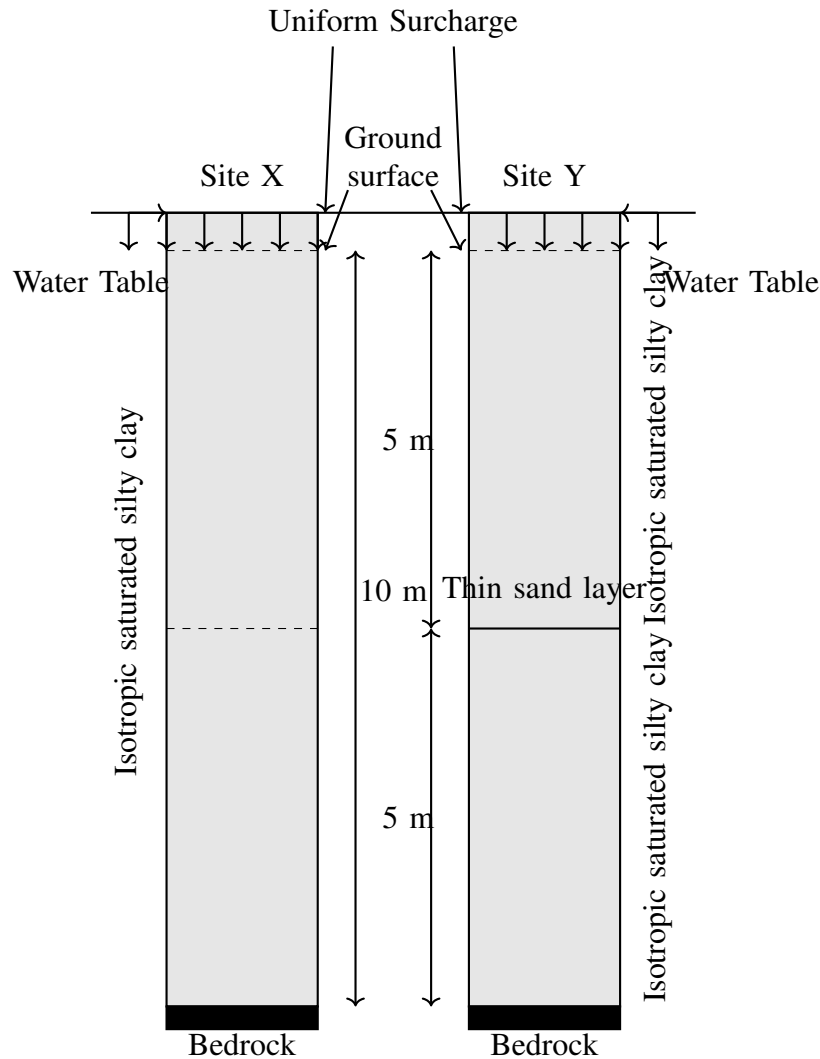
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- a) 132 kN                      b) 156 kN                      c) 287 kN                      d) 301 kN

- 11) Identical surcharges are placed at ground surface at site X and Y, with soil conditions shown alongside and water table at ground surface. The silty clay layers at X and Y are identical. The thin sand layer at Y is continuous and free-draining with a very large discharge capacity. If primary consolidation

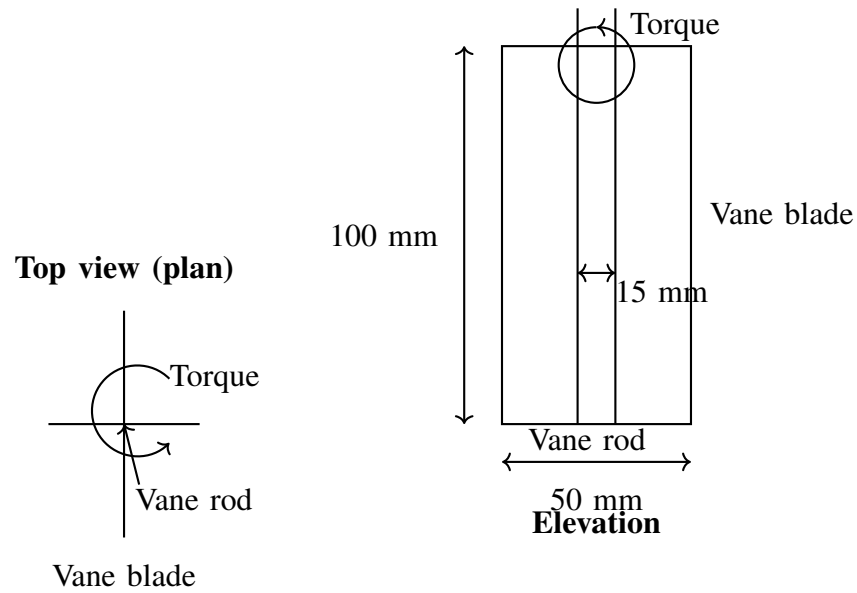
at X is estimated to complete in 36 months, what would be the corresponding time for completion of primary consolidation at Y?  
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- a) 2.25 months      b) 4.5 months      c) 9 months      d) 36 months

12) A field vane shear testing instrument (shown alongside) was inserted completely into a deposit of soft, saturated silty clay with the vane rod vertical such that the top of the blades were 500 mm below the ground surface. Upon application of a rapidly increasing torque about the vane rod, the soil was found to fail when the torque reached 4.6 Nm. Assuming mobilization of undrained shear strength on all failure surfaces to be negligible, what would be the peak undrained shear strength (rounded off to the nearest integere value of kPa) of the soil?  
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- a) 5 kPa      b) 10 kPa      c) 15 kPa      d) 20 kPa



- 13) A single pipe of length 1500 m and diameter 60 cm connects two reservoirs having a difference of 20 m in their water levels. The pipe is to be replaced by two pipes of the same length and equal diameter  $d$  to convey 25% more discharge under the same head loss. If the friction factor is assumed to be the same for all the pipes, the value of  $d$  is approximately equal to which of the following options? 2011-CE

a) 37.5 cm                      b) 40.0 cm                      c) 45.0 cm                      d) 50.0 cm