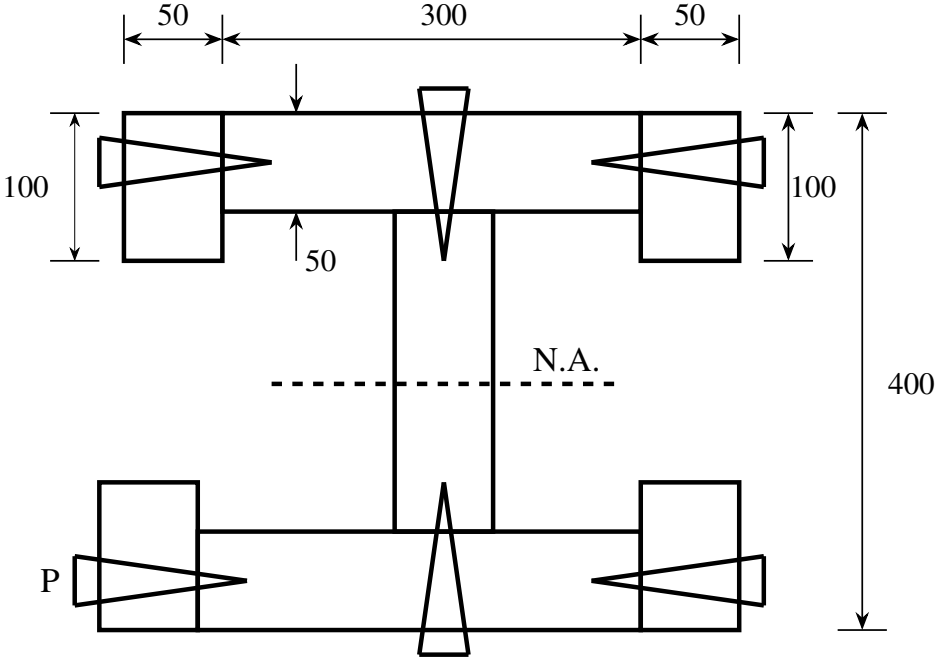
GateAssignment6

EE24BTECH11048-NITHIN.K

1 Q.26 to Q.55 carry two marks each

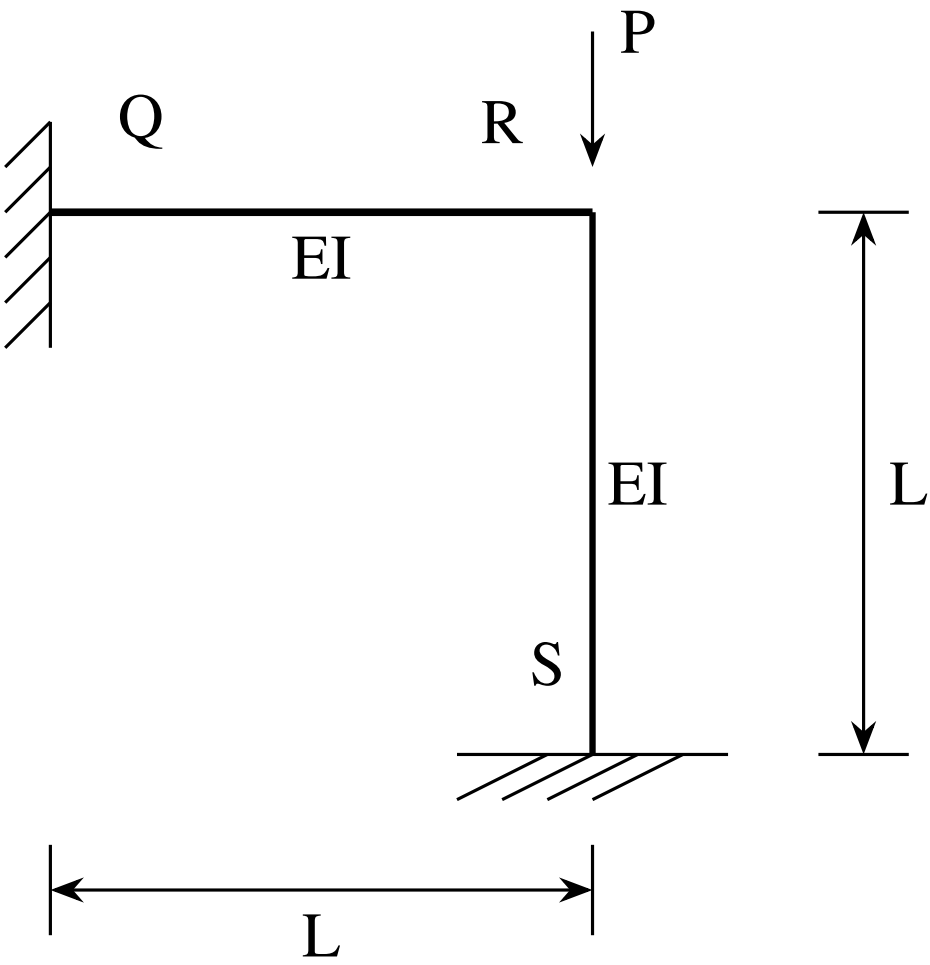
1) Consider two functions: $x = \psi \ln \phi$ and $y = \phi \ln \psi$. Which one of the following is the correct expression for $\frac{\partial \psi}{\partial x}$
   a) $\frac{x \ln \psi}{\ln \phi \ln \psi - 1}$
   b) $\frac{\ln \phi}{\ln \phi \ln \psi - 1}$
   c) $\frac{\ln \psi}{\ln \phi \ln \psi - 1}$
   d) $\frac{x \ln \phi}{\ln \phi \ln \psi - 1}$
2) The cross-section of a built-up wooden beam as shown in the figure (not drawn to scale) is subjected to a vertical shear force of 8 kN. The beam is symmetrical about the neutral axis (N.A.) shown, and the moment of inertia about N.A. is $1.5 \times 10^9 mm^4$. Considering that the nails at the location P are spaced longitudinally (alonf the length of the beam) at 60 mm, each of the nails at P will be subjected to the shear force of



a) 60 N

b) 120 N
c) 240 N
d) 480 N

3) The rigid-jointed plane frame QRS shown in the figure is subjected to a load P at the joint R. Let the axial deformation in the frame be neglected. If the support S undergoes a settlement of $\Delta = \frac{PL^3}{\beta EI}$, the vertical reaction at the support S will become zero when β is equal to



a) 0.1
b) 3.0
c) 7.5
d) 48.0

4) If the section shown in the figure turns from fully-elastic to fully-plastic, the depth of neutral axis (N.A.), $\bar{y}$, decreases by

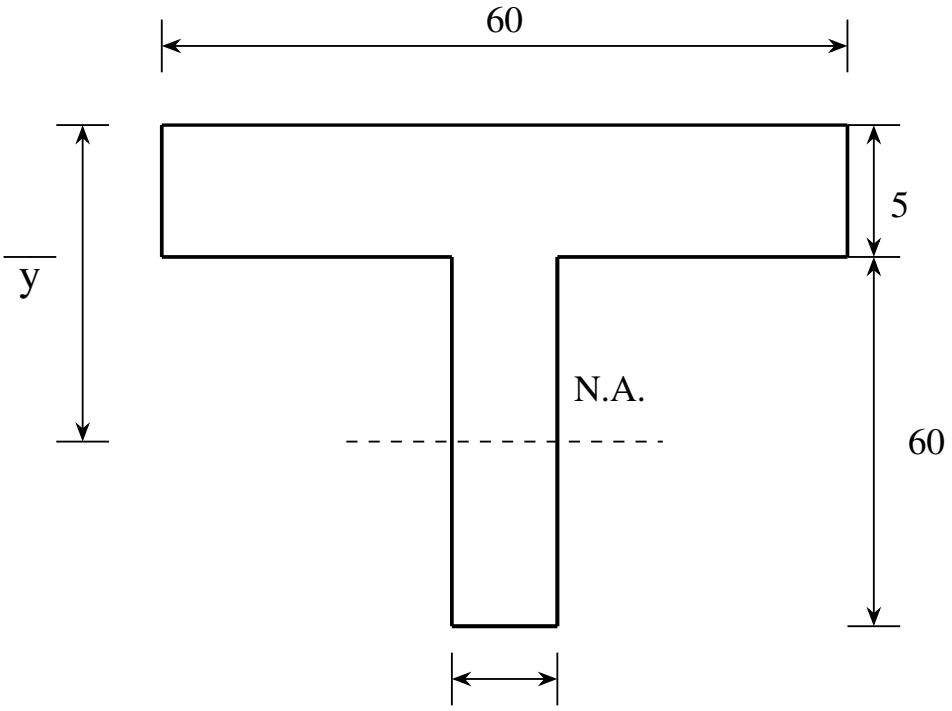


Figure not drawn to scale

All dimensions are in mm

a) 10.75 mm
b) 12.25 mm
c) 13.75 mm
d) 15.25 mm

5) Sedimentation basin in a water treatment plant is designed for a flow rate of 0.2 m^3/s. The basin is rectangular with a length of 32 m, width of 8 m, and depth of 4 m. Assume that the settling velocity of these particles is governed by the stokes law. Given: density of the particles = 2.5 g/cm^3; density of water = 1 g/cm^3; dynamic viscosity of water = 0.01 g/(cm.s); gravitational acceleration = 980 cm/s^2. If the incoming water contains particles of diameter 25 μm (spherical and uniform), the removal efficiency of these particles is

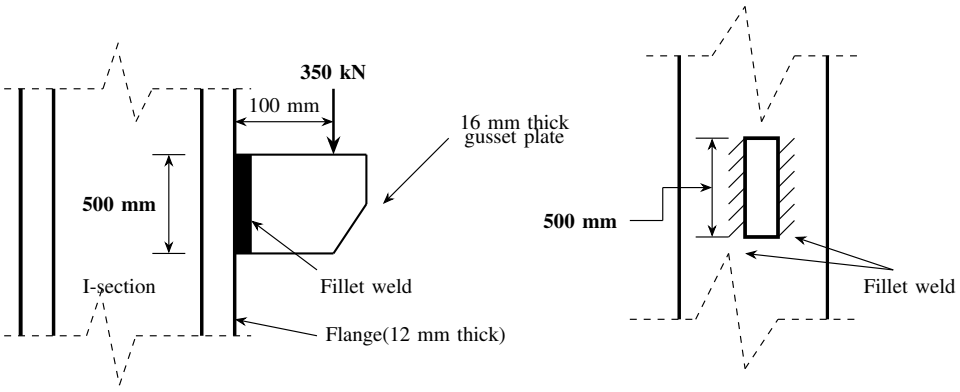
a) 51%

b) 65%
c) 78%
d) 100%

6) A survey line was measured to be 285.5 m with a tape having a nominal length of 30 m. On checking, the true length of the tape was found to be 0.05 m too short. If the line lay on a slope of 1 in 10. the reduced length (horizontal length) of the line for plotting of survey work would be

a) 283.6 m
b) 284.5 m
c) 285.0 m
d) 285.6 m

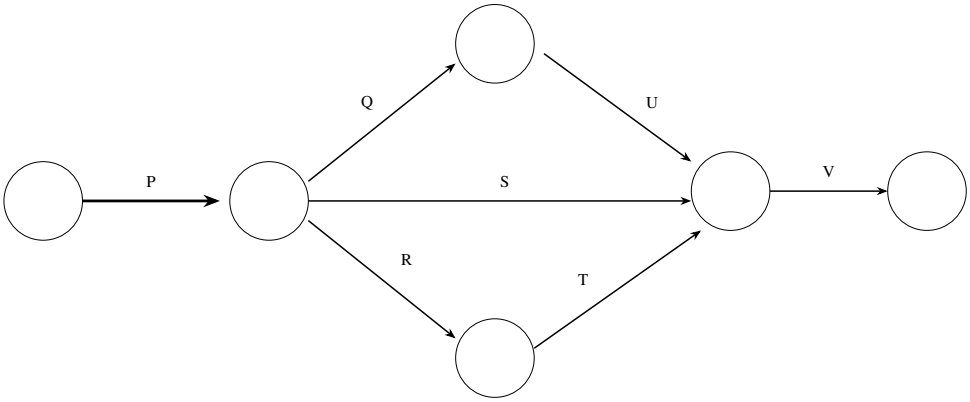
7) A 16 mm thick gusset plate is connected to the 12 mm thick flange plate of an I-section using fillet welds on both sides as shown in the figure (not drwan to scale). The gusset plate is subjected to a point load of 350 kN acting at a distance of 100 mm from the flange plate. Size of fillet weld is 10 mm.



(Front view) **(Side view)**

The maximum resultant stress (in MPa, round off to 1 decimal place) on the fillet weld along the vertical plane would be _____

8) The network of a small construction project awarded to a contractor is shown in the following figure. The normal duration, crash duration, normal cost, and crash cost of all the activities are shown in the table. The indirect cost incurred by the contractor is INR 5000 per day.

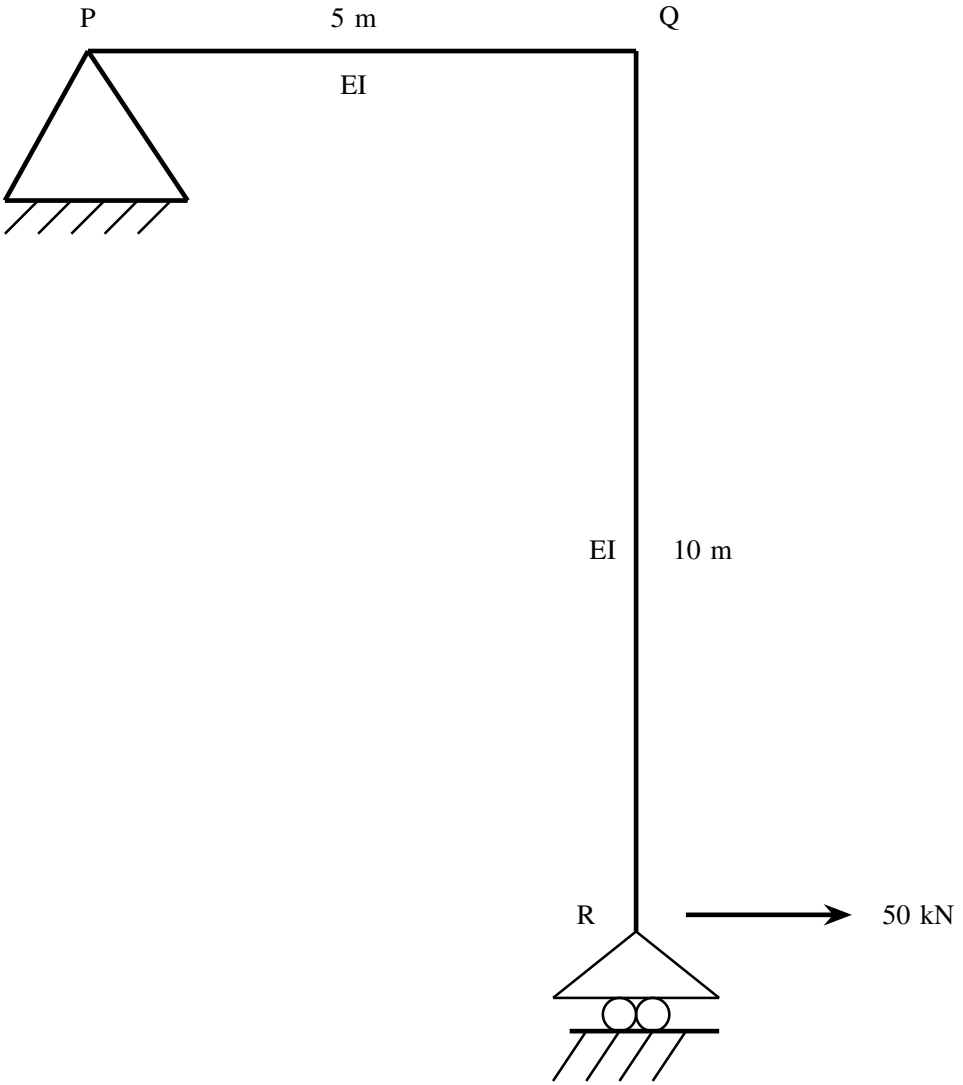


Activity	Normal Duration (days)	Crash Duration (days)	Normal Cost (INR)	Crash Cost (INR)
P	6	4	15000	25000
Q	5	2	6000	12000
R	5	3	8000	9500
S	6	3	7000	10000
T	3	2	6000	9000
U	2	1	4000	6000
V	4	2	20000	28000

If the project is targeted for completion in 16 days, the total cost (in INR) to be incurred by the contractor would be _____

9) A box measuring $50cm \times 50cm \times 50cm$ is filled to the top with dry carse aggregate of mass 187.5 kg. The water absorption and specifiv gravity of the aggregate are 0.5% and 2.5, respectively. The maximum quantity of water (in kg, round off to 2 decimal places) required to fill the box completely is _____

10) A portal frame shown in figure (not drawn to scale) has a hinge support at joint P and a roller support at joint R. A point load of 50 kN is acting at joint R in the horizontal direction. The flexural rigidity, EI, of each member is 10^6 kNm^2. Under the applied load, the horizontal dispalcement (in mm, round off to 1 decimal place) of joint R would be _____



11) A sample of air analysed at $0°C$ and 1 atm pressure is reported to contain 0.02 ppm (parts per million) of NO_2. Assume the gram molecular mass of NO_2 as 46 and its volume at $0°C$ and 1 atm pressure as 22.4 litres per mole. The equivalent NO_2 concentration (in microgram per cubic meter, round off to 2 decimal places) would be _____

12) A 0.80 m deep bed of sand filter (length 4 m and width 3 m) is made of uniform particles (diameter = 0.40 mm, specific gravity = 2.65, shape factor = 0.85) with bed porosity of 0.4. The bed has to be backwashed at a flow rate of 3.60 m^3/min. During backwashing, if the terminal settling velocity of sand particles is 0.05 m/s,

the expanded bed depth (in m, round off to 2 decimal places) is _____

13) A wasteland is to be disinfected with 35 mg/L of chlorine to obtain 99% kill of micro-organisms. The number of micro-organisms remaining alive (N_t) at time t, is modelled by $N_t = N_0 e^{-kt}$, where N_0 is number of micro-organisms at $t = 0$, and k is the rate of kill. The wastewater flow rate is 36 m^3/h, and $k = 0.23 min^{-1}$. If the depth and width of the chlorination tank are 1.5 m and 1.0 m, respectively, the length of the tank (in m, round off to 2 decimal places) is _____