2019-CE-27-39

EE24BTECH11001 - ADITYA TRIPATHY

1) A one-dimensional domain is discretized into N sub-domains of width Δx with node numbers $i = 0, 1, 2, 3, \cdots N$. If the time scale is discretized in steps of Δt , the forward time and centered-space finite difference approximation at i^{th} node and n^{th} time step, for the partial differential equaivalent $\frac{\partial v}{\partial t} = \beta \frac{\partial^2 v}{\partial x^2}$

$(2019 - CE)$

a) $\frac{v_i^{(n+1)} - v_i^{(n)}}{\Delta t} = \beta \left[\frac{v_{i+1}^{(n)} - 2v_i^{(n)} + v_{i-1}^{(n)}}{(\Delta x)^2} \right]$

b) $\frac{v_{i+1}^{(n+1)} - v_i^{(n)}}{\Delta t} = \beta \left[\frac{v_{i+1}^{(n)} - 2v_i^{(n)} + v_{i-1}^{(n)}}{2(\Delta x)} \right]$

c) $\frac{v_i^{(n)} - v_i^{(n-1)}}{\Delta t} = \beta \left[\frac{v_{i+1}^{(n)} - 2v_i^{(n)} + v_{i-1}^{(n)}}{(\Delta x)^2} \right]$

d) $\frac{v_i^{(n)} - v_i^{(n-1)}}{2\Delta t} = \beta \left[\frac{v_{i+1}^{(n)} - 2v_i^{(n)} + v_{i-1}^{(n)}}{2(\Delta x)} \right]$

2) A rectangular open channel has a width of $5m$ and a bed slope of 0.001. For a uniform flow of depth $2m$, the velocity is $2m/s$. The Manning's roughness coefficient for this channel is

$(2019 - CE)$

a) 0.002 b) 0.017 c) 0.033 d) 0.050

3) For the following statements:

P. The lateral stress in the soil while being tested in an oedometer is always at rest.

Q. For a perfectly rigid strip footing at deeper depths in a sand deposit, the vertical normal contact stress at the footing edge is greater that at its centre.

R. The corrections for overburden pressure and dilatency are not applied to measures SPT-N values in case of clay deposits.

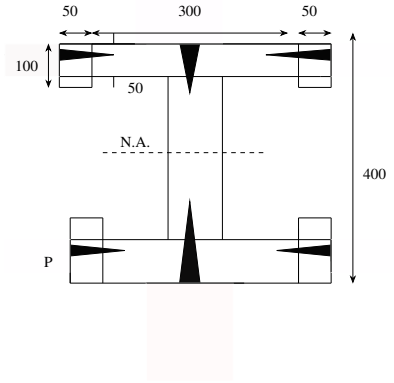
The corre combination of statements is $(2019 - CE)$

a) P-TRUE, Q-TRUE, R-TRUE
b) P-FALSE, Q-FALSE, R-TRUE
c) P-TRUE, Q-TRUE, R-FALSE
d) P-FALSE, Q-FALSE, R-FALSE

4) Consider two functions: $x = \Psi \ln \phi$ and $y = \phi \ln \Psi$. Which of the following is the correct expression for $\frac{\partial \Psi}{\partial x}$? $(2019 - CE)$

a) $\frac{x \ln \Psi}{\ln \phi \ln \Psi - 1}$ b) $\frac{x \ln \phi}{\ln \phi \ln \Psi - 1}$ c) $\frac{\ln \phi}{\ln \phi \ln \Psi - 1}$ d) $\frac{\ln \Psi}{\ln \phi \ln \Psi - 1}$

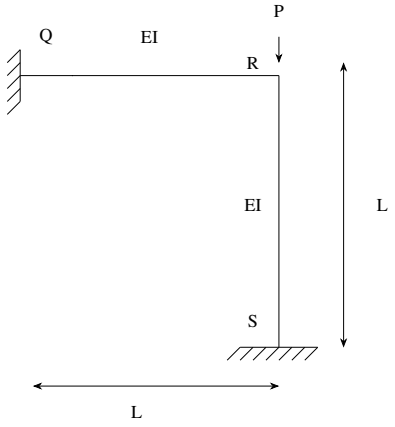
5) The cross-section of a built-up wooden beam as shown in the figure (not drawn to scale) is subjected to a vertical shear force of $8kN$. The beam is a symmetrical about the neutral axis ($N.A.$) shown, and the moment of inertia about ($N.A.$) is $1.5 \times 10^9 mm^4$. Considering that the nails at the location P are spaced longitudinally (along the lenghth of the beam) at $60mm$, each of the nails at P will be subjected to the shear force of



(2019 – *CE*)

a) 0.002 b) 0.017 c) 0.033 d) 0.050

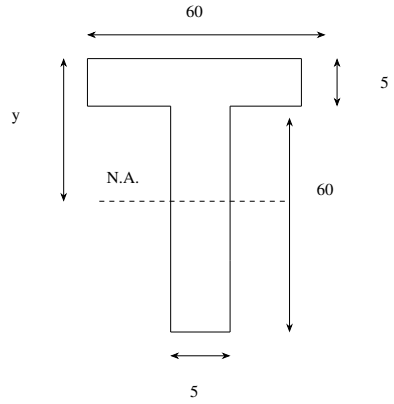
6) The rigid-jointed plane frame *QRS* shown in the figure is subjected to a load *P* at the joint *R*. Let the axial deformations in the frame be neglected. If the support *S* undergoes a settlement of $\Delta = \frac{PL^3}{\beta EI}$, the vertical reaction at the support *S* will become zero when β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



(2019 – *CE*)

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

7) If the section shown in the figure turns from fully-elastic to fully-plastic, the depth of neutral axis (N.A.), **y**, decreases by



(2019 – *CE*)

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

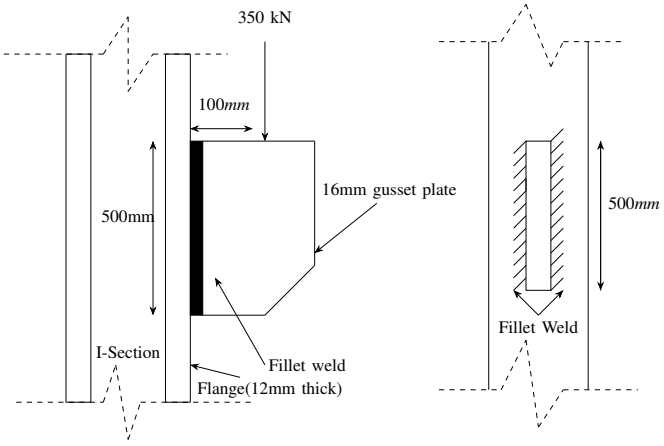
8) Sedimentation basin in a water treatment plant is designed for a new flow rate of $0.2m^3/s$. The basin is rectangular with a lenght of $32m$, width of $8m$, and depth of $4m$. Assume that the settling velocity of these particles is governed by Stoke's Law. Given: density of the particles = $2.5g/cm^3$, density of water = $1g/cm^3$, dynamic viscosity of water = $0.01g/cms$, gravitational acceleration = $980cm/s$. If the incoming water contains particles of diameter $25\mu m$ (spherical and uniform), the removal efficiency of these particles is $(2019-CE)$

a) 51% b) 65% c) 78% d) 100%

9) A survey line was measured to be $285.5m$ with a tape having a nominal length of 30m. On checking, the true length was found to be 0.05 too short. If the line lay on a slope of 1 in 10, the reduced length (horizontal) of the line for plotting of survey work would be $(2019-CE)$

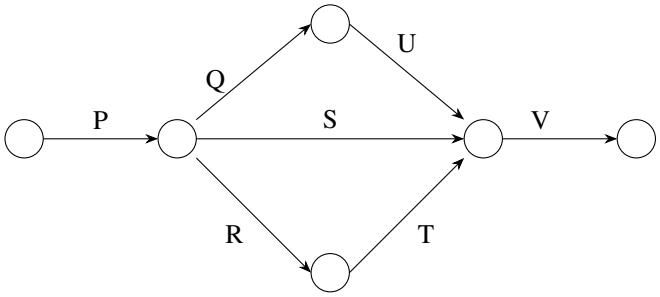
a) 283.6m b) 284.5m c) 285.0m d) 285.6m

10) A $16mm$ thick gusset is connected to the $12mm$ thick flange of an I-section using fillet welds on both sides as shown in the figure (not drawn to scale).The gusset plate is subjected to a point load of $350kN$ acting at a distance of $100mm$ from the flange plate. Size of the fillet weld is $10mm$. The maximum resultant stress (in MPa, round off to 1 decimal place) on the fillet weld along the vertical plane would be



$(2019-CE)$

11) 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 activities are shown in the table. The indirect cost incurred by the contractor is $INR5000$ per day.

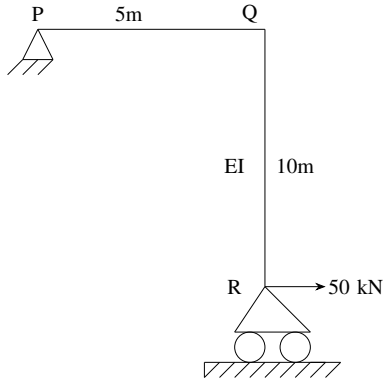


Activity	Normal Duration (days)	Crash Duration (days)	Normal Cost (INR)	Crash Cost (INR)
P	6	4	15000	25000
Q	5	2	6000	12000
R	5	3	8000	9500
S	6	3	7000	10000
T	3	2	6000	9000
U	2	1	4000	6000
V	4	2	20000	28000

If the project is tabulated for completion in 16 days, the total cost (in INR) to be incurred by the contractor would be (2019 – CE)

12) A box measuring $50cm \times 50cm \times 50cm$ is filled to the top with dry coarse aggregate of mass $187.5kg$. The water absorption and specific gravity of aggregate are 0.5% and 2.5 respectivley. The maximum quantity of water (in kg, round off to 2 decimal places) required to fill the box completely (2019 – CE)

13) A portal frame shown (not drawn to scale) has a hinge support at joint P and a roller support at joint R. A point load of $5kN$ is acting at joint R in the horizontal direction. The flexual rigidity, EI, of each member is $10^6 hN/m^2$. Under the applied load, the horizontal displacement (in mm, round off to 1 decimal place) of joint R would be



(2019 – CE)