2013-GATE-CE

AI24BTECH11016 - Jakkula Adishesh Balaji

1 27-39

1) Find the magnitude of the error (correct to two decimal places) in the estimation of following integral using Simpson's $\frac{1}{3}$ Rule. Take the step length as 1.
$\int_0^4 \left(x^4 + 10\right) dx$
2) The solution for $\int_0^{\frac{\pi}{6}} \cos^4 3\theta \sin^3 6\theta d\theta$ is:
   a) 0
   b) $\frac{1}{15}$
   c) 1
   d) $\frac{8}{3}$
3) Find the value of λ such that the function $f(x)$ is a valid probability density function.

$$f(x) = \begin{cases} \lambda (x-1)(2-x) & \text{if } 1 \geq x \geq 2 \\ 0 & \text{otherwise} \end{cases} \tag{3.1}$$

4) Laplace equation for water flow in soils is given below.

$$\frac{\partial^2 H}{\partial x^2} + \frac{\partial^2 H}{\partial y^2} + \frac{\partial^2 H}{\partial z^2} = 0 \tag{4.1}$$

   Head H does not vary in y and z directions.
   Boundary conditions are: at $x = 0$, $H = 5$;and $\frac{dH}{dx} = -1$.
   What is the value of H at $x = 1.2$?
5) All members in the rigid-jointed frame shown are prismatic and have the same flexural stiffness EI Find the magnitude of the bending moment at Q (i kNm) due to the given loading

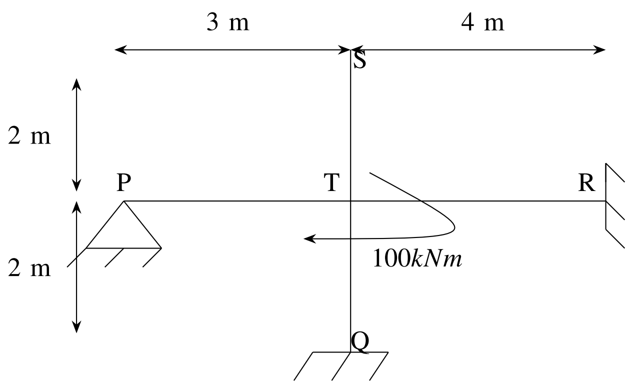

Fig. 5.1

6) A uniform beam ($EI = constant$) PQ in the form of a quarter-circle of radius R is fixed at end P and free at the end Q, where, a load W is applied as shown. The vertical downward displacement, $\delta_q = \beta\left(\frac{WR^3}{EI}\right)$. Find the value of β(correct to 4-decimal places).

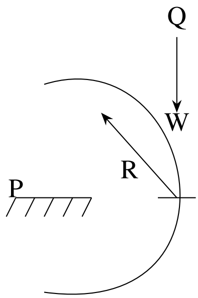

Fig. 6.1

7) A uniform beam weighing 1800N is supported at E and F by cable $ABCD$. Determine the tension (in N) in segment AB of this cable (correct to 1-decimal place). Assume the cables $ABCD$, BE and CF to be weightless

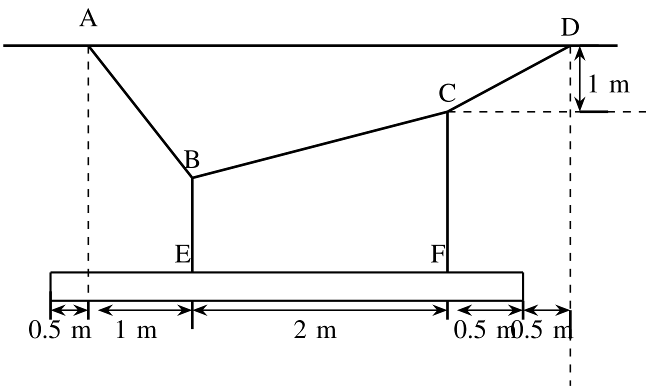

Fig. 7.1

8) Beam $PQRS$ has internal hinges in spans PQ and RS as shown. The beam may be subjected to a moving distributed vertical load of maximum intensity $4kN/m$ of any length anywhere on the beam. The maximum absolute value of the shear force (in kN) that can occur due to this loading just to the right of support Q shall be:

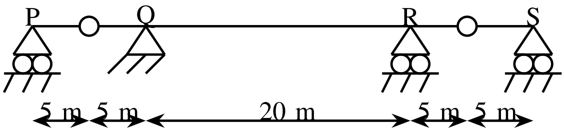

Fig. 8.1

a) 30
b) 40
c) 45
d) 55

9) A rectangular concrete beam 250mm wide and 600mm deep is pre-stressed by means of 16 high tensile wires, each of 7mm diameter, located at 200mm from the bottom face of the beam at a given section. If the effective pre-stress in the wires is 700MPa, what is the maximum sagging bending moment (in kNm) (correct to 1-decimal place) due to live load that this section of the beam can withstand without causing tensile stress at the bottom face of the beam? Neglect the effect of dead load of beam

10) The soil profile below a lake with water level at $elevation = 0m$ and lake bottom at $elevation = -10m$ is shown in the figure, where k is the permeability coefficient. A piezometer (stand pipe) installed in the sand layer shows a reading of $+10m$ elevation. Assume that the piezometric head is uniform in the sand layer. The quantity of water (in m^3/s) flowing into the lake from the sand layer through the silt layer per unit area of the lake bed is:

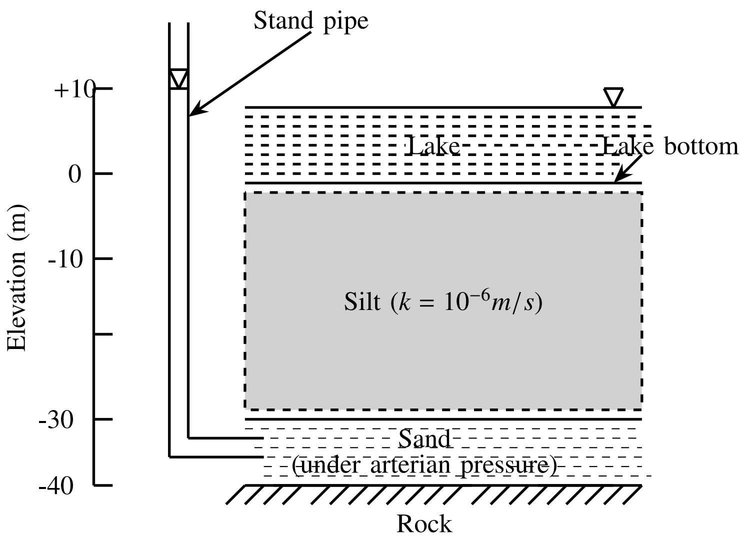

Fig. 10.1

a) 1.5×10^{-6}

b) 2.0×10^{-6}
c) 1.0×10^{-6}
d) 0.5×10^{-6}

11) The soil profile above the rock surface for a 25° infinite slope is shown in the figure, where s_u is the undrained shear strength and γ_t is total unit weight. The slip will occur at a depth of

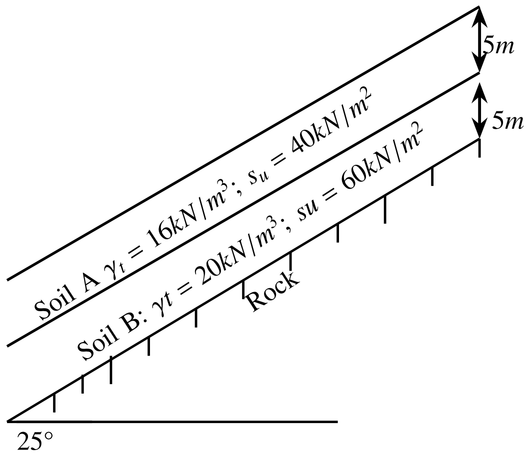

Fig. 11.1

a) $8.83m$
b) $9.79m$
c) $7.83m$
d) $6.53m$

12) Two different soil types (Soil 1 and Soil 2) are used as backfill behind a retaining wall as shown in the figure, where γ_t is total unit weight, and c' and ψ' are effective cohesion and effective angle of shearing resistance. The resultant active earth force per unit length (in kN/m) acting on the wall is:

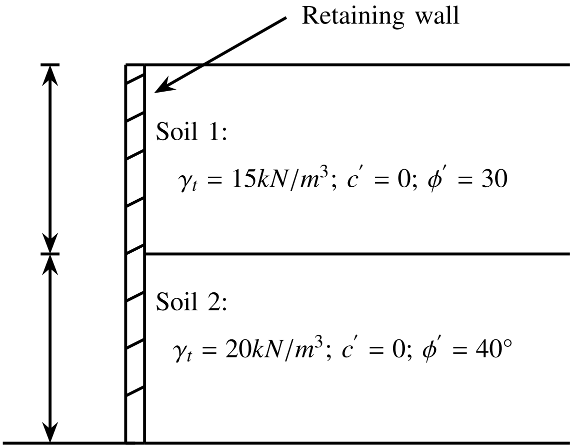

Fig. 12.1

a) 31.7
b) 35.2
c) 51.8
d) 57.0

13) A $2km$ long pipe of $0.2m$ diameter connects two reservoirs. The difference between water levels in the reservoirs is $8m$. The Darcy-Weisbach friction factor of the pipe is 0.04. Accounting for frictional, entry and exit losses, the velocity in the pipe (in m/s) is:

a) 0.63
b) 0.35
c) 2.52
d) 57.0