

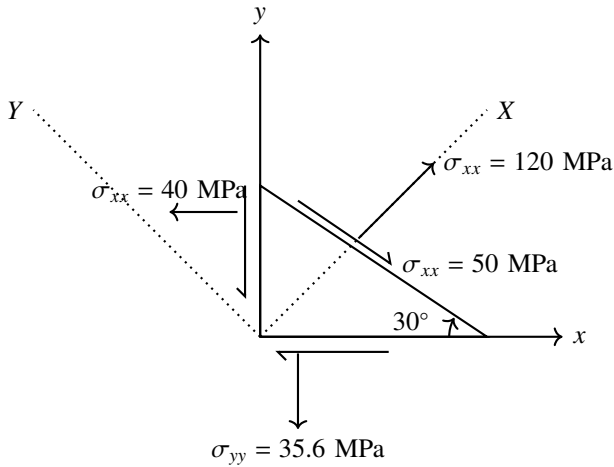
GATE 2021 CE(14-26)

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EE24BTECH11030 - J.KEDARANANDA

- 1) The shape of the most commonly designed highway vertical curve is
 - a) circular (single radius)
 - b) circular (multiple radii)
 - c) parabolic
 - d) spiral
- 2) A highway designed for 80 km/h speed has a horizontal curve section with radius 250 m. If the design lateral friction is assumed to develop fully, the required super elevation is
 - a) 0.02
 - b) 0.05
 - c) 0.07
 - d) 0.09
- 3) Which of the following is NOT a correct statement?
 - a) The first reading from a level station is a 'Fore Sight'.
 - b) Basic principle of surveying is to work from whole to parts.
 - c) Contours of different elevations may intersect each other in case of an overhanging cliff.
 - d) Planimeter is used for measuring 'area'.
- 4) Which of the following is/are correct statement(s)?
 - a) Back Bearing of a line is equal to Fore Bearing 180° .
 - b) If the whole circle bearing of a line is 270° , its reduced bearing is 90° NW.
 - c) The boundary of water of a calm water pond will represent contour line.
 - d) In the case of fixed hair stadia tachometry, the staff intercept will be larger, when the staff is held nearer to the observation point.
- 5) Consider the limit: $\left[\lim_{x \rightarrow 1} \left(\frac{1}{\ln x} - \frac{1}{x-1}\right)\right]$ The limit (correct up to one decimal place) is _____.
- 6) The volume determined from $\int \int \int_V 8xyz \, dV$ for $V = [2, 3] \times [1, 2] \times [0, 1]$ will be (in integer)_____
- 7) The state of stress in a deformable body is shown in the figure. Consider the transformation of the stress from the x-y coordinate system to the X-Y coordinate system. The angle θ , locating the X-axis, is assumed to be

positive when measured from the x-axis in the counter-clockwise direction.



The absolute magnitude of the shear stress component σ_{xy} (in MPa, round off to one decimal place) in the x-y coordinate system is _____

- 8) The equation of deformation is derived to be $y = x^2 - xL$ for a beam shown in the figure 8.

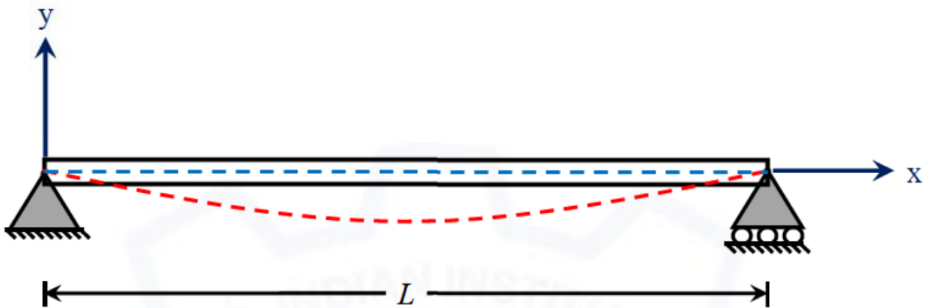
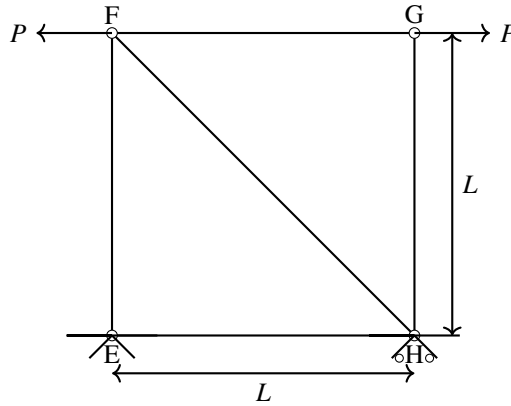


Fig. 8

The curvature of the beam at the mid-span (in units, in integer) will be _____

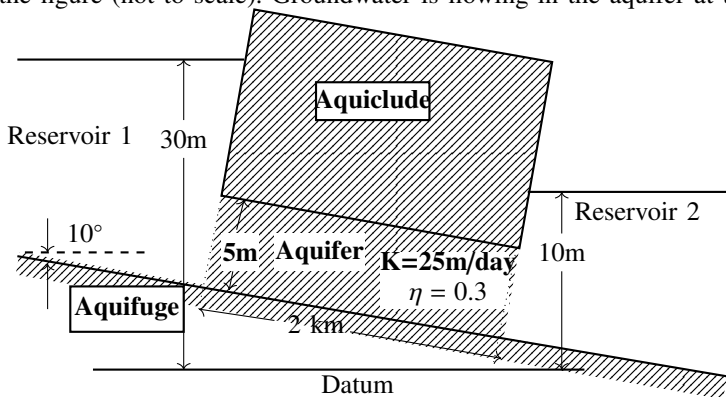
- 9) A truss EFGH is shown in the figure, in which all the members have the same axial rigidity R . In the figure, P is the magnitude of external horizontal forces acting at



joints F and G.

If $R = 500 \times 10^3$ kN, $P = 150$ kN, and $L = 3$ m, the magnitude of the horizontal displacement of joint G (in mm, round off to one decimal place) is _____

- 10) The cohesion (c), angle of internal friction (ϕ), and unit weight (σ) of a soil are 15 kPa, 20° , and 17.5 kN/m³, respectively. The maximum depth of unsupported excavation in the soil (in m, round off to two decimal places) is _____
- 11) Two reservoirs are connected through a homogeneous and isotropic aquifer having hydraulic conductivity (K) of 25 m/day and effective porosity (η) of 0.3 as shown in the figure (not to scale). Groundwater is flowing in the aquifer at the steady state.



If water in Reservoir 1 is contaminated, then the time (in days, round off to one decimal place) taken by the contaminated water to reach Reservoir 2 will be _____

- 12) A signalized intersection operates in two phases. The lost time is 3 seconds per phase. The maximum ratios of approach flow to saturation flow for the two phases are 0.37 and 0.40. The optimum cycle length using the Webster's method (in seconds, round off to one decimal place) is _____

13) The solution of the second-order differential equation

$$\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + y = 0$$

with boundary conditions $y(0) = 1$ and $y(1) = 3$ is

- a) $e^{-x} + (3e - 1)xe^{-x}$
- b) $e^{-x} - (3e - 1)xe^{-x}$
- c) $e^{-x} + \left[3 \sin\left(\frac{\pi x}{2}\right) - 1\right]xe^{-x}$
- d) $e^{-x} - \left[3 \sin\left(\frac{\pi x}{2}\right) - 1\right]xe^{-x}$