



# ACE

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Ph: 040-23234418, 040-23234419, 040-23234420, 040 - 24750437

**ESE- 2018 (Prelims) - Offline Test Series**

**Test-1**

**CIVIL ENGINEERING**

**SUBJECT: SOLID MECHANICS, CONSTRUCTION PRACTICE,  
PLANNING AND MANNAGEMENT  
SOLUTIONS**

**01. Ans: (b)**

**Sol:**

$$\frac{PL}{A_s E} = \frac{PL}{A_h E}$$

$$A_s = A_h$$

$$d^2 = D^2 - \left(\frac{D}{2}\right)^2 \Rightarrow d^2 = \frac{3D^2}{4}$$

$$d = \frac{\sqrt{3}}{2} D$$

**02. Ans: (a)**

**Sol:**

$$\delta_s = \delta_c$$

$$\Rightarrow \frac{\sigma_s}{E_s} = \frac{\sigma_c}{E_c} \quad (\because L_s = L_c)$$

$$\sigma_c = \frac{\sigma_s}{E_s} \times E_c$$

$$\sigma_c = \frac{\sigma_s}{2} = \frac{100}{2} = 50 \text{ MPa}$$

**03. Ans: (b)**

$$\text{Sol:} \quad \left(\frac{P}{100} \times 1000\right) = 2 \times 10^5 \times 0.75$$

$$10 P = 150000$$

$$P = 15 \text{ kN}$$

**04. Ans: (b)**

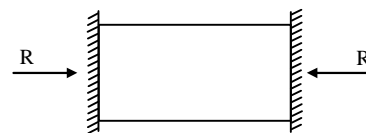
$$\text{Sol:} \quad \sigma = E (\alpha t) = 200 \times 10^3 \times 10^{-3} \times 30$$

$$\sigma = 6000 \text{ N/mm}^2 \text{ (compressive)}$$

Compressive force is exerted by the supports which prevents increase in length due to increase in temperature

**05. Ans: (c)**

**Sol:**



$$\text{act} = 0$$

$$\text{temp change} = \text{compressive reaction force}$$



$$L\alpha\Delta T = \frac{RL}{AE}$$

$$R = \alpha \cdot T \cdot AE$$

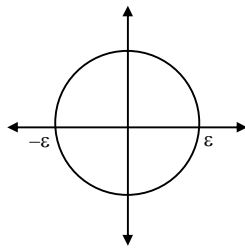
$$= 10 \times 10^{-6} \times 50 \times 20 \times 10^{-4} \times 200 \times 10^9$$

$$R = 200 \times 10^3 \text{ N}$$

$$R = 200 \text{ kN}$$

06. Ans: (b)

Sol:



07. Ans: (d)

Sol: For plastic deformation

$$\mu = 0.5$$

$$\epsilon_1 = \frac{\sigma_1}{E} - \frac{\mu\sigma_2}{E} - \frac{\mu\sigma_3}{E}$$

$$\epsilon_1 = \frac{30 - (0.5 \times 10) - (0.5 \times 5)}{E} = \frac{22.5}{E}$$

$$\epsilon_2 = \frac{\sigma_2}{E} - \frac{\mu\sigma_1}{E} - \frac{\mu\sigma_3}{E}$$

$$\epsilon_2 = \frac{10 - (0.5 \times 30) - (0.5 \times 5)}{E} = \frac{-7.5}{E}$$

$$\epsilon_3 = \frac{\sigma_3}{E} - \frac{\mu\sigma_1}{E} - \frac{\mu\sigma_2}{E}$$

$$\epsilon_3 = \frac{5 - (0.5 \times 30) - (0.5 \times 10)}{E} = \frac{-15}{E}$$

$$\therefore \epsilon_1 : \epsilon_2 : \epsilon_3 = 22.5 : -7.5 : -15$$

$$= 15 : -5 : -10$$

08. Ans: (c)

09. Ans: (b)

10. Ans: (b)

Sol:  $\delta = \frac{wL^3}{48EI}$

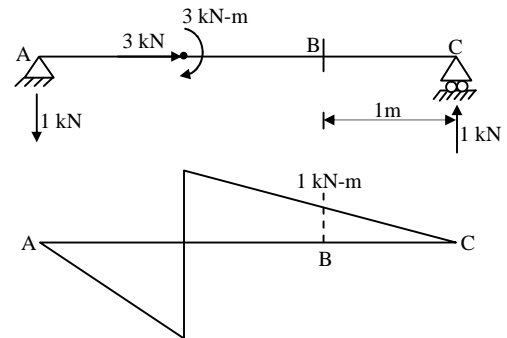
$$\delta \propto \frac{1}{I}$$

$$m \delta \times \frac{bd^3}{12} = \delta_2 \times \frac{b^3d}{12}$$

$$\delta_2 = \left(\frac{d}{b}\right)^2 \delta$$

11. Ans: (c)

Sol:



12. Ans: (b)

Sol:  $\sigma = \frac{M}{Z}$

$Z_{\text{squ}} > Z_{\text{curcular}}$  in case of bending

$$\therefore \sigma_{\text{circle}} > \sigma_{\text{square}}$$

Since 'I' (moment of inertial) will be different for square and circular section. Deformation will not be same.

# Pre GATE-2018

COMPUTER BASED TEST

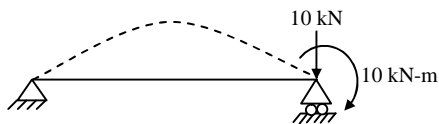
Date of Exam : 20<sup>th</sup> Jan 2018

Last Date To Apply : 05<sup>th</sup> Jan 2018

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13. Ans: (c)

Sol:



$$\Delta_c = \frac{10 \times 1^3}{3EI} + \frac{10 \times 3}{3EI} \times 1$$

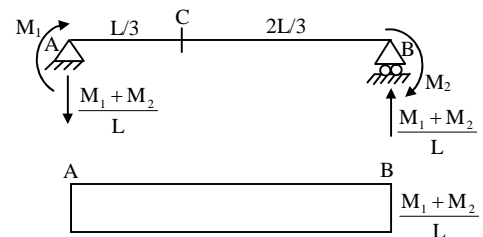
$$\Delta_c = \frac{40}{3EI}$$

14. Ans: (c)

Sol: Unit load method can be applied to plastic range also but  $d\theta$  will not be equal to  $\frac{M}{EI} dx$

15. Ans: (b)

Sol:



$\Rightarrow M_c = 0$  inflection point at C

$$\therefore M_1 - \left( \frac{M_1 + M_2}{L} \right) \frac{L}{3} = 0$$

$$\Rightarrow 3M_1 - (M_1 + M_2) = 0$$

$$\Rightarrow 2M_1 = M_2$$

$$\frac{M_2}{M_1} = 2$$



# ESE | GATE - 2019

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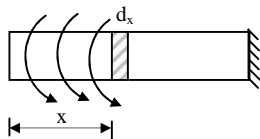
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16. Ans: (b)

Sol:



$$d\phi = \frac{Tdx}{GJ} \quad T = T_0x$$

$$d\phi = \frac{T_0x dx}{GJ}$$

$$\phi = \frac{1}{GJ} \int_0^L T_0x dx$$

$$\phi = \frac{T_0L^2}{2GJ}$$

17. Ans: (b)

Sol:

$$\tau = \frac{16T}{\pi d^3} \Rightarrow T = \frac{\pi}{16} \tau d^3$$

$$\theta = \frac{TL}{GJ} \Rightarrow L = \theta \times \frac{GJ}{T}$$

$$L = \frac{0.01 \times 0.84 \times 10^5 \times \frac{\pi}{32} (25)^4}{42 \times (25)^3 \times \frac{\pi}{16}}$$

$$L = 250 \text{ mm}$$

18. Ans: (d)

Sol:

$$Z_p \propto d^3$$

∴ Shaft B is 8 times stronger than A

19. Ans: (a)



20. Ans: (d)

Sol:  $B = b + 2mt$

$$= 200 + 2(10)20$$

$$= 200 + 400 = 600 \text{ mm}$$

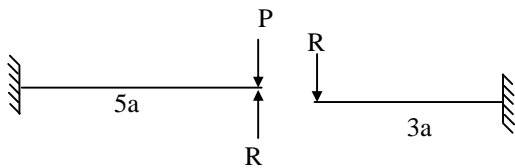
21. Ans: (a)

Sol:

$$\begin{aligned} \tau_{\max} &= \frac{16}{\pi d^3} \sqrt{T^2 + M^2} \\ &= \frac{16}{\pi 20^3} \sqrt{30^2 + 40^2} = \frac{1}{10\pi} \text{ kN/m}^2 \end{aligned}$$

22. Ans: (b)

Sol:



$$\frac{P(5a)^3}{3EI} - \frac{R(5a)^3}{3EI} = \frac{R(3a)^3}{3EI}$$

$$P \times 5^3 - 125R = 27R$$

$$P \times 125 = 152R$$

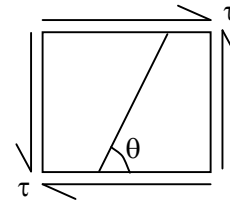
$$R = \frac{125P}{152} \quad \delta = \frac{125P(3a)^3}{152 \times 3EI} = \frac{1125Pa^3}{152EI}$$

23. Ans: (c)

Sol: Ductile material is weak in shear, so it fails in a plane where maximum shear stress occurs. Brittle material is weak in tension, so it fails in a plane where maximum tensile stress occurs.

**Torsion test:**

It is a case of pure shear.

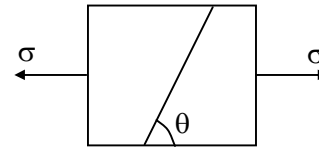


$\tau = \tau_{\max}$ , at  $\theta = 90^\circ$  (maximum shear stress which causes failure of ductile material)

$\sigma_1 = \sigma_{\max}$ , at  $\theta = 45^\circ$  (maximum normal stress which causes failure of brittle material)

**Tensile test:**

It is a case of uniaxial stress.



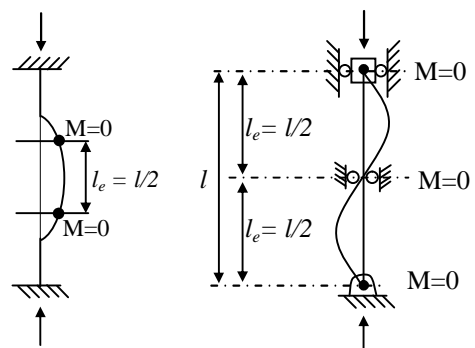
$\tau = \tau_{\max}$ , at  $\theta = 45^\circ$  (maximum shear stress which causes failure of ductile material)

$\sigma_1 = \sigma_{\max}$ , at  $\theta = 90^\circ$  (maximum normal stress which causes failure of brittle material)

So, from the given options, only option (C) is correct.

24. Ans: (d)

Sol:





$$(P_{cr1})_{\text{fixed-fixed}} = \frac{\pi^2 EI}{\ell_e^2} = \frac{\pi^2 EI}{\left(\frac{\ell}{2}\right)^2} = 4 \times \frac{\pi^2 EI}{\ell^2}$$

$$(P_{cr2})_{\text{pin-pin}} = \frac{\pi^2 EI}{\ell_e^2} = \frac{\pi^2 EI}{\left(\frac{\ell}{2}\right)^2} = 4 \times \frac{\pi^2 EI}{\ell^2}$$

$$\text{So, } \frac{P_{cr(1)}}{P_{cr(2)}} = 1$$

25. Ans: (c)

26. Ans: (b)

Sol: Length of rod- 5m, pitch of thread = 2.5 mm

Axial movement on both sides of screw

$$= \frac{2.5}{3} = 0.833 \text{ mm}$$

$$\text{Strain in each rod} = \frac{0.833}{5000} = 1.6 \times 10^{-4}$$

$$E = 200 \times 10^3 \text{ N/mm}^2$$

( $\sigma_1$ ) stress in each rod

$$= 0.16 \times 10^{-3} \times 200 \times 10^3$$

$$= 33.33 \text{ N/mm}^2$$

$$A = \frac{\pi}{4} \times (30)^2 = 225\pi \text{ mm}^2$$

$$T = 225\pi \times 33.33 = 7500 \pi \text{ N} = 7.5\pi \text{ kN}$$

27. Ans: (a)

Sol:

$$EI \frac{dy}{dx} = \frac{-w}{24l} (L-x)^4 + \frac{WL^3}{24}$$

Differentiation of slope = bending moment at X

$$EI \frac{d^2y}{dx^2} = \frac{-W}{24L} 4(1-x)^3(-1) + 0$$

$$EI \frac{d^3y}{dx^3} = \frac{W}{6L} 3(L-x)^2(-1)$$

$$EI \frac{d^3y}{dx^3} = \frac{-W}{2L} (L-x)^2$$

Shear force at distance x from fixed end A

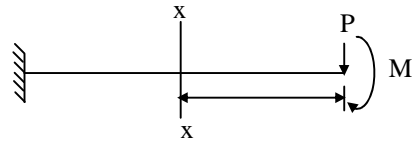
$$F = \frac{-W}{2L} (L-x)^2$$

$$\text{At } x = \frac{L}{2}$$

$$F = \frac{-W}{2L} \left(\frac{L}{2}\right)^2 = \frac{-WL}{8}$$

28. Ans: (d)

Sol:



$$M_x = P_x + M$$

$$\text{Strain energy } U = \int \frac{M_x^2 dx}{2EI}$$

$$= \int_0^L \frac{(Px + M)^2 dx}{2EI}$$

$$= \frac{1}{2EI} \int_0^L (P^2 x^2 + M^2 + 2PMx) dx$$

$$= \frac{1}{2EI} \left( P^2 \frac{x^3}{3} + M^2 x + 2PM \frac{x^2}{2} \right)_0^L$$

$$= \frac{P^2 L^3}{6EI} + \frac{M^2 L}{2EI} + \frac{PML^2}{2EI}$$

Principle of super position is applicable when there is a linear relationship between external loads and corresponding structural displacements.



29. Ans: (d)

Sol: Mile stone chart is modification of bar chart.

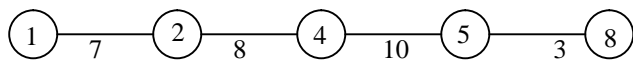
30. Ans: (a)

31. Ans: (b)

Sol: "Pipe laid" is completion of an activity i.e. an event.

32. Ans: (c)

Sol: Critical path for the given network is



∴ Project completion time = 28 weeks

33. Ans: (a)

Sol: Optimistic time occurs when conditions are better than normal

34. Ans: (b)

Sol: Standard deviation of the network ending

$$\text{event } (\sigma_{t_E}) = \sqrt{\sigma_1^2 + \sigma_2^2 + \dots + \sigma_n^2}$$

where,  $\sigma_1, \sigma_2, \dots, \sigma_n$  are the standard deviations of each of the activities.

$$\sigma_{11-12} = \frac{8-4}{6} = 0.667$$

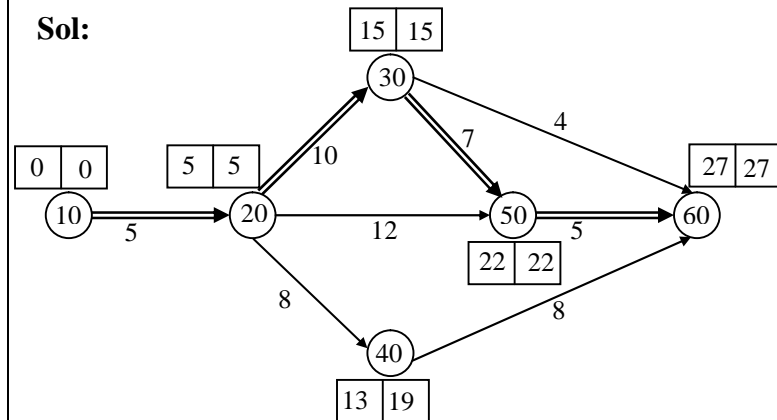
$$\sigma_{12-13} = \frac{11-5}{6} = 1$$

$$\sigma_{13-14} = \frac{12-4}{6} = 1.337$$

$$\begin{aligned} (\sigma_{t_E}) &= \sqrt{(0.667)^2 + 1^2 + (1.337)^2} \\ &= 1.795 \end{aligned}$$

35. Ans: (c)

Sol:



Double line represents critical path

∴ Slack at event (40) = 19 – 13 = 6 days

36. Ans: (d)

Sol:

Another cause of rolling resistance is slippage between tyres and surface.

37. Ans: (c)

38. Ans: (b)

39. Ans: (c)

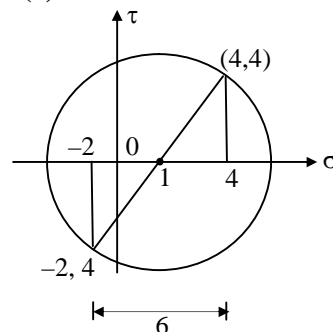
Sol:  $P = W \times \text{rolling resistance} \times \text{slope}$

$$100 = 10 \times R \times 4\%$$

$$R = 25 \text{ kgf/ton}$$

40. Ans: (c)

Sol:





Radius of Mohr's circle is maximum shear stress

$$\tau_{\max} = \sqrt{3^2 + 4^2} = 5 \text{ units}$$

(OR)

From Mohr's circle

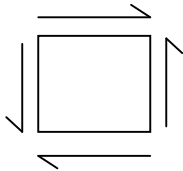
$$\sigma_x = 4, \quad \sigma_y = -2$$

$$\tau_{xy} = 4$$

$$\therefore \tau_{\max} = 5 \text{ units}$$

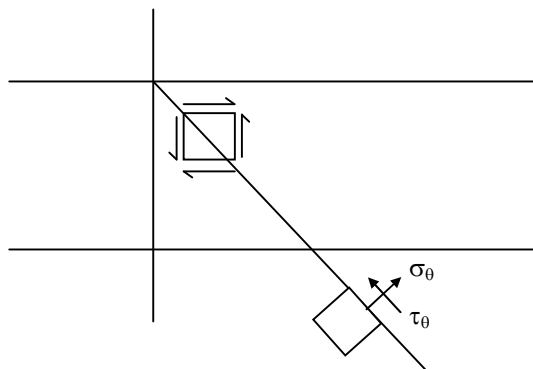
**41. Ans: (c)**

**Sol:** Material is subjected to pure shear



Normal stress

$$\sigma_{\theta} = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2} \cos 2\theta + \tau_{xy} \sin 2\theta$$



$$\sigma_{\theta} = \tau \sin 2\theta = \tau$$

$$\text{Shear stress } \tau_{\theta} = -\tau \cos 2\theta = 0$$

$$\therefore \text{Normal force } F_n = \sigma_{\theta} \frac{A}{\cos \theta} = \sqrt{2} \tau A$$

$$\therefore \text{Shear force } F_s = \tau_{\theta} \frac{A}{\cos \theta} = \tau_{\theta} \times \frac{A}{\frac{1}{\sqrt{2}}} = 0$$

**Another Method**

As this is pure shear condition, maximum principle plane will be at 45° to vertical and on maximum principal plane, shear stress will be zero.

In pure shear maximum principle stress is  $\tau$   
Normal force on the plane =  $\tau \times$  Area of plane

$$= \tau \times \frac{A}{\cos \theta} = \sqrt{2} \tau A$$

**42. Ans: (b)**

**Sol:** Power,  $P = \frac{2\pi NT}{60}$

$$P = 2\pi fT$$

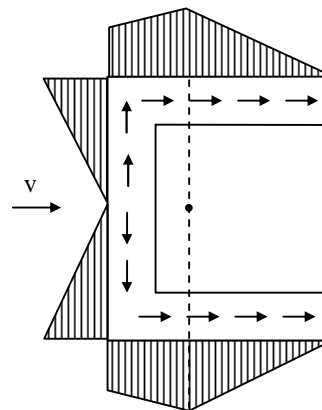
$$\left(\frac{N}{60} = f, f = \text{rotation per sec}\right)$$

$$50 \times 10^3 = 2\pi \times 10 \times T$$

$$T = \frac{2500}{\pi}$$

**43. Ans: (d)**

**Sol:**



At NA, shear stress should be maximum.




# GATE TOPPERS

**GATE 2017**

1 EC PRAMOD	1 ME SUDHEER	1 ME HASAN ASIF	1 EE SHYAM SINGH	1 CE ARJUN RAKESH	1 CS DEVAL N PATEL	1 IN NAVEEN	2 EC SREE KALYANI
2 CE PUNEET KHANNA	2 IN RAHUL MAHATO	2 IN SHEESHAM BANSAL	2 PI GALERY DINDYAL	3 EC KARUN	3 EE RAVI TEJA	3 ME PRADIP DOBADE	3 CS RAVI SHANKAR
3 CE ANKUR TEPAITHI	4 EC SONU SHARMA	4 EE SARFRAJ NAWAZ	4 CE CHIRAG MITTAL	4 ME GAUSH ALAM	4 IN MONTI	4 PI Sanghavi Adhikari	5 IN VRAJESH SHAH
5 PI ANKIT TIWARI	6 EC LAKSHI SAI LIPPU	6 CS MEGHASHAYAM	6 EE RAJASEKHAR REDDY	6 IN RAMESH KAMALLA	6 PI FARAZ KUMAR RANA	7 IN RANJAN MISHRA	8 ME DIVYANSHU JHA
8 PI Mansi Bhargava	9 EC Anand Upadhyay	9 CS Nihar Kumar Sanyal	9 ME CHIRAG KUMAR SIA	10 EC AMIT KAWAZ	10 ME ANURAG KUMAR	10 EE SURAJ DASH	10 IN VISHAKH SANKARANARAYANAN

# ESE TOPPERS

**ESE 2017**

 <b>CE</b> 	 <b>E&amp;T</b> 	 <b>EE</b> 	 <b>ME</b> 																														
<table border="1"> <tr> <td>1 CE NAMIT JAIN</td> <td>2 CE PRAVIND SINGH</td> </tr> <tr> <td>3 CE ANKIT</td> <td>6 CE RISHABH BHARGAVA</td> </tr> <tr> <td>8 CE ADITHYAN SINGH</td> <td>9 CE HIRANSHU GAUTAM</td> </tr> <tr> <td>10 CE AVUSHI DUBEY</td> <td>7 IN TOP 10 RANKS</td> </tr> </table>	1 CE NAMIT JAIN	2 CE PRAVIND SINGH	3 CE ANKIT	6 CE RISHABH BHARGAVA	8 CE ADITHYAN SINGH	9 CE HIRANSHU GAUTAM	10 CE AVUSHI DUBEY	7 IN TOP 10 RANKS	<table border="1"> <tr> <td>2 E&amp;T DIVYANSHU KUMARSHAW</td> <td>3 E&amp;T ANURAG KUMAR</td> </tr> <tr> <td>5 E&amp;T AMIT GAUTAM</td> <td>6 E&amp;T SARABANJAN MEGHA</td> </tr> <tr> <td>7 E&amp;T DEENDRAGAN DIXIT KUMAR</td> <td>8 E&amp;T DEEPAI GOYAL</td> </tr> <tr> <td>9 E&amp;T ADITHYAN PRASAD SINGH</td> <td>10 E&amp;T LIMESH</td> </tr> </table>	2 E&T DIVYANSHU KUMARSHAW	3 E&T ANURAG KUMAR	5 E&T AMIT GAUTAM	6 E&T SARABANJAN MEGHA	7 E&T DEENDRAGAN DIXIT KUMAR	8 E&T DEEPAI GOYAL	9 E&T ADITHYAN PRASAD SINGH	10 E&T LIMESH	<table border="1"> <tr> <td>2 EE PREETI KUMAR</td> <td>3 EE SANGHVI ANISH</td> </tr> <tr> <td>4 EE SARADIT KUMAR SINGH</td> <td>5 EE NIBEL KUMAR</td> </tr> <tr> <td>6 EE DUSHYANT SINGH</td> <td>8 EE AJAYCHANDRA GUPTA</td> </tr> <tr> <td>9 EE KIRAN BABU KONERU</td> <td></td> </tr> </table>	2 EE PREETI KUMAR	3 EE SANGHVI ANISH	4 EE SARADIT KUMAR SINGH	5 EE NIBEL KUMAR	6 EE DUSHYANT SINGH	8 EE AJAYCHANDRA GUPTA	9 EE KIRAN BABU KONERU		<table border="1"> <tr> <td>3 ME SAURABH</td> <td>4 ME AMIT KUMAR RAY</td> </tr> <tr> <td>6 ME ANJAN GUPTA</td> <td>7 ME DHRUV JHA</td> </tr> <tr> <td>9 ME ADITHYAN GUPTA</td> <td></td> </tr> </table>	3 ME SAURABH	4 ME AMIT KUMAR RAY	6 ME ANJAN GUPTA	7 ME DHRUV JHA	9 ME ADITHYAN GUPTA	
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 <b>7</b> All India 1 <sup>st</sup> Rank in ESE.	<b>8</b> IN TOP 10 RANKS and many more...	<b>7</b> IN TOP 10 RANKS	 <b>27</b> Ranks in Top 10 in ESE-2017																														



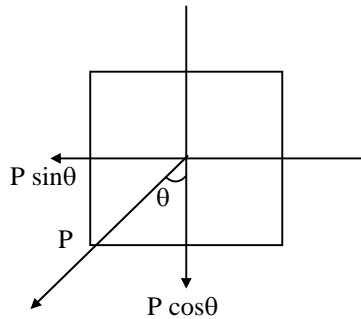
ACE

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44. Ans: (c)

Sol:



$$M_z = 50 \cos\theta(7)$$

$$M_y = 50 \sin\theta(7)$$

$$\tan\beta = \frac{M_y I_z}{M_z I_y}$$

$$\tan\beta = \frac{1}{\sqrt{3}} \cdot 3 = \sqrt{3}$$

$$\beta = 60^\circ$$

45. Ans: (c)

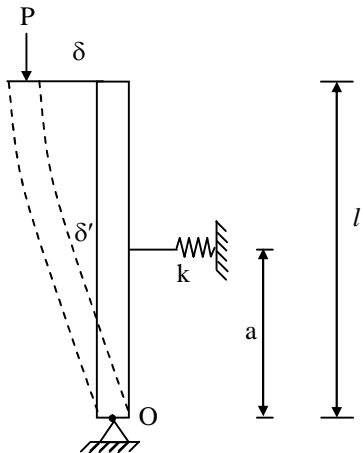
Sol: At neutral condition

$$M_o = M_R$$

$$P_{cr} \cdot \delta = F \cdot a$$

$$\Rightarrow F = k \cdot \delta'$$

$$P_{cr} \cdot \delta = k \cdot \delta' \cdot a$$

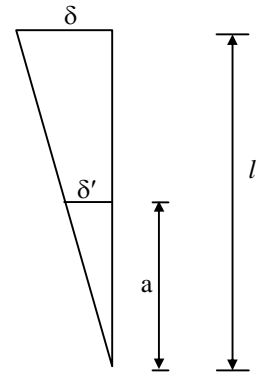


By similar triangle

$$\frac{\delta}{l} = \frac{\delta'}{a} \Rightarrow \delta' = \frac{\delta}{l} \cdot a$$

$$P_{cr} \cdot \delta = k \cdot \frac{\delta}{l} \cdot a^2$$

$$P_{cr} = k \cdot \frac{a^2}{l}$$



46. Ans: (a)

$$\text{Sol: } \tau_{\max} = \frac{16PR}{\pi d^3} \left[ 1 + \frac{d}{4R} \right]$$

$$\text{Spring index} = \frac{D}{d} = 10$$

$$D = 10 \times 10 = 100 \text{ mm}$$

$$R = 50 \text{ mm}$$

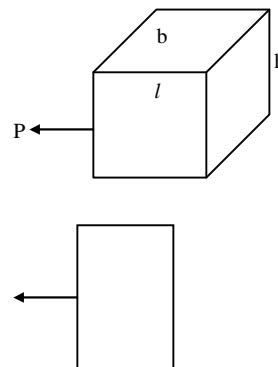
$$50 = \frac{16P[50]}{\pi(10)^3} \left[ 1 + \frac{10}{4 \times 50} \right]$$

$$P = 59.52 \pi \text{ N}$$

$$P \approx 60\pi \text{ N}$$

47. Ans: (a)

Sol:



$$\frac{\delta l}{l} = e$$



$$\delta l = (le)$$

Total length elongation after application of load

$$l' = l + le$$

$$l' = l(1 + e)$$

Change in breadth direction  $\Rightarrow b' = b - \mu be$

$$= b(1 - \mu e)$$

Similarly,

$$h' = h(1 - \mu e)$$

Total changed volume  $\Rightarrow l'b'h'$

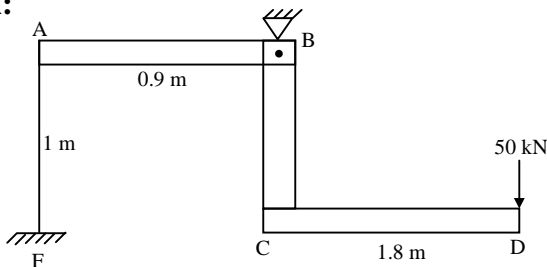
$$V' = l(1 + e) b(1 - \mu e) h(1 - \mu e)$$

$$= lbh(1 + e)(1 - \mu e)^2$$

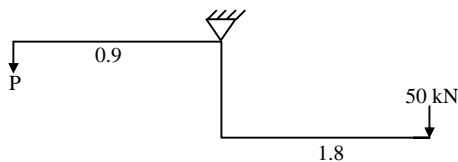
$$V' = V(1 + e)(1 - \mu e)^2$$

**48. Ans: (c)**

**Sol:**



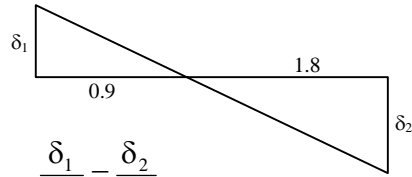
**FBD:**



$$P \times 0.9 = 50 \times 1.8$$

$$P = 100 \text{ kN}$$

$$\delta_{AF} \Rightarrow \frac{P\ell}{AE} = \frac{100 \times 1000 \times 1000}{100 \times 2 \times 10^5} = 5 \text{ mm}$$



$$\frac{\delta_1}{0.9} = \frac{\delta_2}{1.8}$$

$$\delta_2 = 10 \text{ mm}$$

**49. Ans: (c)**

**Sol:**  $M_Q = 0$

$$10 \times 12 \times 6 = W \times 4$$

$$W = 180 \text{ kN}$$

**50. Ans: (c)**

**51. Ans (c)**

**Sol:** Load carrying capacity of beam  $\propto Z$

$$\text{Where } Z = \text{section modulus} = \frac{I}{y_{\max}}$$

For vertical beam,  $b = 120 \text{ mm}$ ,  $d = 60 \text{ mm}$

$$Z_{\text{vertical}} = \frac{\left(\frac{bd^3}{12}\right)}{\frac{d}{2}} = \frac{bd^2}{6} = \frac{120 \times 60^2}{6}$$

For horizontal beam,  $b = 60 \text{ mm}$ ,

$$d = 120 \text{ mm}$$

$$Z_{\text{horizontal}} = \frac{bd^2}{6} = \frac{60 \times 120^2}{6}$$

$$\frac{Z_{\text{vertical}}}{Z_{\text{horizontal}}} = \frac{\left(\frac{120 \times 60^2}{6}\right)}{\left(\frac{60 \times 120^2}{6}\right)} = 0.5$$



52. Ans: (c)

$$\text{Sol: } y = \frac{3a^2 \times E_1 \times (2a + a/2) + 6a^2 \times 2E_1 \times a}{3a^2E_1 + 12E_1}$$

$$= \frac{3a^2E_1 \times 2.5a + 12a^3E_1}{15a^2E_1} = 1.3a$$

53. Ans: (c)

54. Ans: (c)

Sol:

We know that

$$\frac{E}{R} = \frac{M}{I} = \frac{f}{y}$$

$$f = \frac{M}{Z}$$

$$M = 20 \times 4 = 80 \text{ kN-m}$$

$$Z = \frac{\pi d^3}{32} = \frac{\pi}{32} (0.1)^3$$

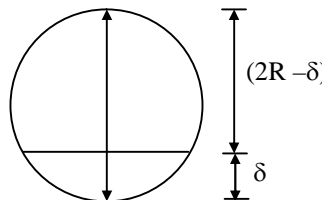
$$\therefore f = \frac{80 \times 32}{\pi (0.1)^3} = \frac{2560}{\pi} \times 10^3 \text{ kN/m}^2$$

55. Ans: (d)

56. Ans: (b)

Sol:

$$(2R - \delta)\delta = \frac{L^2}{4}$$



$$R = \left( \frac{L^2}{8\delta} \right) \rightarrow (1)$$

$$\frac{f}{y} = \frac{E}{R}$$

$$\frac{f}{y} \Rightarrow \frac{\epsilon E}{y} = \frac{E}{R}$$

$$\frac{\epsilon}{y} = \frac{1}{R}$$

$$\epsilon = \left( \frac{y}{R} \right)$$

$$\epsilon = \frac{8\delta y}{L^2}$$

$$\epsilon = \frac{8 \times 0.4 \times 1}{(400)^2} = 2 \times 10^{-5}$$

57. Ans: (d)

Sol: Modulus of elasticity is constant.

Modulus of elasticity is depends on the properties of material

58. Ans: (a)

Sol: Strain energy (U) =  $\frac{1}{2} P \cdot \delta$

$$= \frac{1}{2} \times 30 \times 10^3 \times 0.05 \times 10^{-3}$$

$$= 15 \times 0.05 = 0.75 \text{ N-m}$$

59. Ans: (c)

Sol: For two dimensional systems

As per maximum shear stress theory, failure occurs if

$$\frac{\sigma_1 - \sigma_2}{2} \geq \frac{\sigma_y}{2} \Rightarrow (\sigma_1 - \sigma_2) \geq \sigma_y$$



**60. Ans: (d)**

**Sol:** For No tension

$$e = \frac{Z}{A} = \frac{\frac{D^3}{6\sqrt{2}}}{D^2} = \frac{D}{6\sqrt{2}}$$

$$\left( \text{where } Z = \frac{I}{y_{\max}} = \frac{D^3}{6\sqrt{2}} \right)$$

**61. Ans: (b)**

**62. Ans: (b)**

**63. Ans: (a)**

**64. Ans: (c)**

**Sol:** Area under load deformation curve with elastic limit is modulus of resilience

**65. Ans: (a)**

**Sol:**  $P_{cr} = \frac{\pi^2 EI}{L^2}$

**66. Ans: (c)**

**67. Ans: (b)**

**68. Ans: (a)**

**69. Ans: (d)**

**Sol:** EPC contract doesn't involve detailed estimate. It is based on line estimate.

**70. Ans: (b)**

**71. Ans: (d)**

**Sol:** "Float is not associated with events"

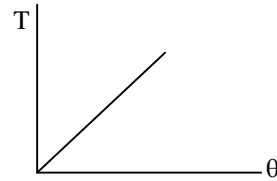
Assertion is wrong.

**72. Ans: (a)**

**73. Ans: (b)**

**74. Ans: (a)**

**Sol:**



Area under torque-rotation curve is strain energy

$$U = \frac{T\theta}{2}$$

$$\theta = \frac{TL}{GI_p}$$

$$\therefore U = \frac{T^2 L}{2GI_p}$$

**75. Ans: (a)**