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GATE • PSUs

PRODUCTION AND INDUSTRIAL ENGINEERING

Objective Practice Sets

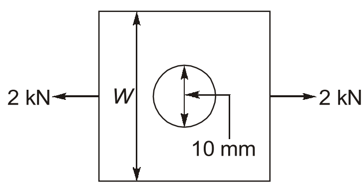
General Engineering : Volume II

Applied Mechanics

MADE EASY Publications

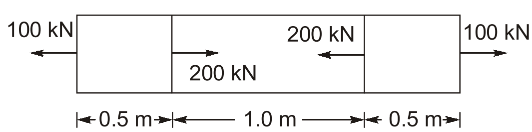
Applied Mechanics

Q.1 If permissible stress in plates of thickness 2 mm of joint through a pin as shown in the figure is 200 MPa, then the width w will be



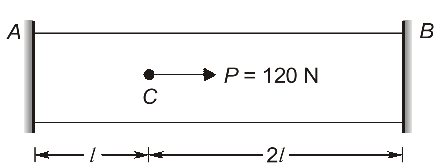
(a) 15 mm (b) 20 mm
(c) 18 mm (d) 25 mm

Q.2 A slender bar of 100 mm^2 cross-section is subjected to loading as shown in the figure below. If the modulus of elasticity is taken as 200×10^9 Pa, then the elongation produced in the bar will be



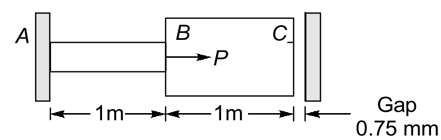
(a) 10 mm (b) 5 mm
(c) 1 mm (d) Nil

Q.3 A straight bar is fixed at edges A and B. Its elastic modulus is E and cross-section is A. There is a load P = 120 N acting at C. The reactions at the ends are



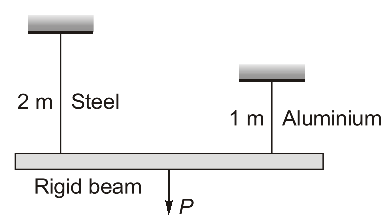
(a) 60 N at A, 60 N at B
(b) 30 N at A, 90 N at B
(c) 40 N at A, 80 N at B
(d) 80 N at A, 40 N at B

Q.4 In the arrangement as shown in the figure, the stepped steel bar ABC is loaded by a load P. The material has Young's modulus E = 200 GPa and the two portions AB and BC have area of cross section 1 cm^2 and 2 cm^2 respectively. The magnitude of load P required to fill up the gap of 0.75 mm is



(a) 10 kN (b) 15 kN
(c) 20 kN (d) 25 kN

Q.5 A rigid beam of negligible weight, is supported in a horizontal position by two rods of steel and aluminium, 2 m and 1 m long, having values of cross-sectional areas 100 mm^2 and 200 mm^2, and Young's modulus of 200 GPa and 100 GPa, respectively. A load P is applied as shown in the figure below :



If the rigid beam is to remain horizontal, then
(a) the force P must be applied at the centre of the beam
(b) the force on the steel rod should be twice the force on the aluminium rod
(c) the force on the aluminium rod should be twice the force on the steel-rod
(d) the forces on both the rods should be equal

Q.6 A copper rod of 2 cm diameter is completely encased in a steel tube of inner diameter 2 cm and outer diameter 4 cm. Under an axial load, the stress in the steel tube is 100 N/mm^2.
If $E_s = 2E_c$, then the stress in the copper rod is
(a) 50 N/mm^2 (b) 33.33 N/mm^2
(c) 100 N/mm^2 (d) 300 N/mm^2

Q.7 The resilience of steel can be found by integrating stress-strain curve up to the

Answers Applied Mechanics

1. (a)	2. (d)	3. (d)	4. (b)	5. (c)	6. (a)	7. (d)
8. (a)	9. (b)	10. (d)	11. (a)	12. (d)	13. (d)	14. (c)
15. (c)	16. (b)	17. (d)	18. (c)	19. (b)	20. (a)	21. (a)
22. (c)	23. (c)	24. (a)	25. (c)	26. (d)	27. (b)	28. (c)
29. (c)	30. (c)	31. (c)	32. (a)	33. (c)	34. (b)	35. (c)
36. (b)	37. (b)	38. (b)	39. (d)	40. (a)	41. (b)	42. (a)
43. (a)	44. (d)	45. (b)	46. (d)	47. (d)	48. (c)	49. (c)
50. (c)	51. (c)	52. (c)	53. (b)	54. (c)	55. (a)	56. (a)
57. (c)	58. (d)	59. (0.85)	60. (c)	61. (c)	62. (d)	63. (b)
64. (c)	65. (a)	66. (a)	67. (c)	68. (d)	69. (c)	70. (b)
71. (c)	72. (b)	73. (b)	74. (c)	75. (b)	76. (d)	77. (b)
78. (b)	79. (d)	80. (d)	81. (c)	82. (c)	83. (b)	84. (a)
85. (a)	86. (c)	87. (d)	88. (a)	89. (c)	90. (73.63)	91. (b)
92. (b)	93. (c)	94. (c)	95. (c)	96. (b)	97. (a)	98. (a)
99. (b)	100. (c)	101. (b)	102. (a)	103. (a)	104. (b)	105. (d)
106. (a)	107. (c)	108. (b)	109. (16.667)	110. (32.48)	111. (b)	112. (b)
113. (b)	114. (33.075)	115. (–0.64174)	116. (0.234375)	117. (52.02)	118. (190.8)	119. (14.5)
120. (76.95)	121. (d)	122. (c)	123. (c)	124. (150)	125. (2.778)	126. (264.6)
127. (a)	128. (b)	129. (d)	130. (d)	131. (1.9285)	132. (b)	133. (d)
134. (a)	135. (d)	136. (–180)	137. (d)	138. (c)	139. (200.1708)	140. (c)
141. (b)	142. (a)	143. (d)	144. (0.04321)	145. (10.667)	146. (c)	147. (57.83)
148. (1.25)	149. (a)	150. (2.515)	151. (d)	152. (a)	153. (a)	154. (a)
155. (b)	156. (b)	157. (a)	158. (c)	159. (a)	160. (c)	161. (a)
162. (6)	163. (1.28)	164. (0)	165. (b)	166. (a)	167. (a)	168. (480)
169. (40)	170. (266.67)	171. (d)	172. (893.33)	173. (1845.89)	174. (5.6655)	175. (133.33)
176. (75)	177. (–4.732)	178. (b)	179. (b)	180. (a)	181. (1)	182. (367.87)
183. (20)	184. (b)	185. (a)	186. (d)	187. (d)	188. (b)	189. (56.6)
190. (b)	191. (d)	192. (a)	193. (d)	194. (c)	195. (b)	196. (c)
197. (b)	198. (2.75)	199. (a)	200. (0.3)	201. (633.93)	202. (642.3)	203. (1.60)

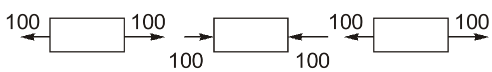
Explanations Applied Mechanics

1. (a)

$$A \times \sigma = F$$
$$(W - 10) \times 2 \times 200 = 2000$$
$$\therefore \quad W - 10 = 5$$
$$\therefore \quad W = 15 \text{ mm}$$

2. (d)

F.B.D.



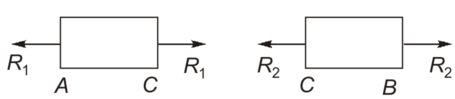
Total elongation, $\delta = \dfrac{PL}{AE}$

$$= \frac{1}{AE}(100 \times 0.5 - 100 \times 1 + 100 \times 0.5) = 0$$

3. (d)

$$R_A = 120 \times (BC/AB) = 80 \text{ N/mm}^2$$
$$R_B = 120 \times AC/AB = 40 \text{ N/mm}^2.$$

Free body diagrams,



$$R_1 - R_2 = 120 \quad \text{...(i)}$$

and $$(\delta l)_1 + (\delta l)_2 = 0$$

$$\frac{R_1 \times l}{A \times E} + \frac{R_2 \times 2l}{A \times E} = 0$$

$$\therefore \quad R_1 = -2R_2 \quad \text{...(ii)}$$

From Equation (i) and (ii), we get

$$R_2 = -40 \text{ N}$$

$R_2 = 40$ N (opposite direction to our assumption) and $R_1 = 80$ N.

4. (b)

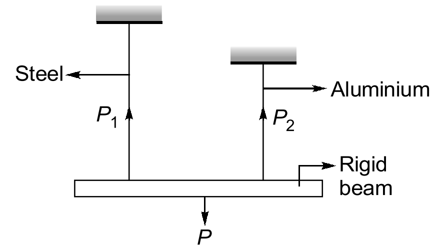
If BC is not touching the fixed end then there will be no stress in BC portion, So no force in BC section.

$$\frac{PL}{AE} = \delta l$$

$$\frac{P \times 1000}{(10)^2 \times 200 \times 10^3} = 0.75$$

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

5. (c)



If the rigid beam is to remain horizontal

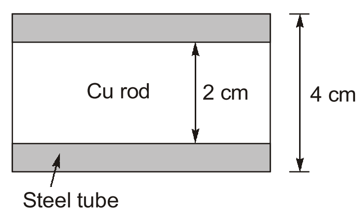
$$(\delta_L)_1 = (\delta_L)_2$$

$$\frac{P_1 L_1}{A_1 E_1} = \frac{P_2 L_2}{A_2 E_2}$$

$$\frac{P_1 \times 2000}{100 \times 200 \times 10^3} = \frac{P_2 \times (1000)}{200 \times 100 \times 10^3}$$

$$P_2 = 2P_1 \; [\text{i.e. } P_{Al} = 2\, P_{steel}]$$

6. (a)



Given:

$$\sigma_s = 100 \text{ MPa}$$
$$E_s = 2E_C$$
$$\delta_s = \delta_c$$

$$\frac{P_s L_s}{A_s E_s} = \frac{P_c L_c}{A_c E_c}$$

$$\frac{\sigma_s}{E_s} = \frac{\sigma_c}{E_c} \qquad [\because L_s = L_c]$$

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

$$\sigma_c = \frac{\sigma_s}{2}$$

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

7. (d)

The resilience of steel can be found by integrating stress-strain curve upto elastic point.