POSTAL Study Package

2021

Production and Industrial Engineering

Objective Practice Sets

General Engineering
Volume - II

Applied Mechanics

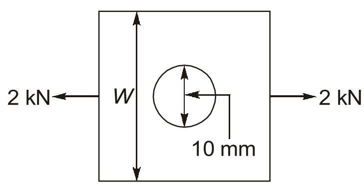
MADE EASY Publications

II VOLUME

General Engineering

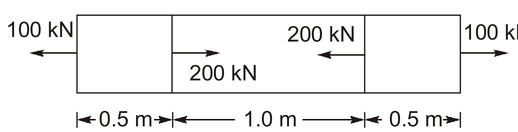
Applied Mechanics

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



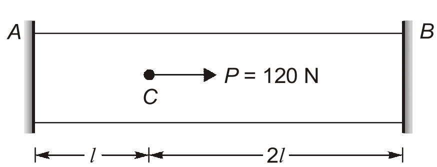
(a) 15 mm (b) 20 mm
(c) 18 mm (d) 25 mm

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



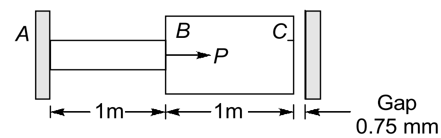
(a) 10 mm (b) 5 mm
(c) 1 mm (d) Nil

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



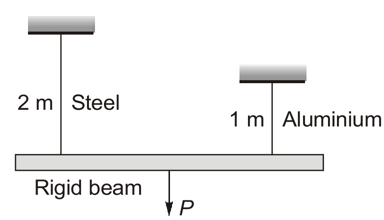
(a) 60 N at *A*, 60 N at *B*
(b) 30 N at *A*, 90 N at *B*
(c) 40 N at *A*, 80 N at *B*
(d) 80 N at *A*, 40 N at *B*

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

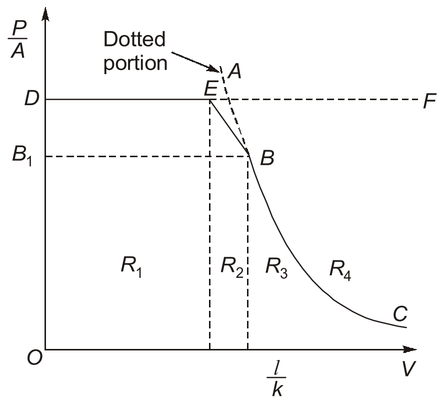
Q.5 A rigid beam of negligible weight, is supported in a horizontal position by two rods of steel and aluminium, 2 m and 1 m long, having values of cross-sectional areas 100 mm^2 and 200 mm^2, and Young's modulus of 200 GPa and 100 GPa, respectively. A load *P* is applied as shown in the figure below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



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



	List-I		List-II
A.	R_1	1.	Long, stable
B.	R_2	2.	Short
C.	R_3	3.	Medium
D.	R_4	4.	Long, unstable

Codes:

	A	B	C	D
(a)	2	4	3	1
(b)	2	3	1	4
(c)	1	2	4	3
(d)	2	1	3	4

Q.37 Match **List-I** (End conditions of columns) with **List-II** (Equivalent length in terms of length of hinged-hinged column) and select the correct answer using the codes given below the lists:

List-I

A. Both ends hinged
B. One end fixed and other end free
C. One end fixed and the other hinged
D. Both ends fixed

List-II

1. L 2. $L/\sqrt{2}$
3. $L/2$ 4. $2L$

Codes :

	A	B	C	D
(a)	1	3	4	2
(b)	1	4	2	3
(c)	3	1	2	4
(d)	3	1	4	2

Q.38 What is the expression for the crippling load for a column of length l with one end fixed and other end free?

(a) $P = \dfrac{2\pi^2 EI}{l^2}$ (b) $P = \dfrac{\pi^2 EI}{4l^2}$

(c) $P = \dfrac{4\pi^2 EI}{l^2}$ (d) $P = \dfrac{\pi^2 EI}{l^2}$

Q.39 For the case of a slender column of length L and flexural rigidity EI built in at its base and free at the top, the Euler's critical buckling load is

(a) $\dfrac{4\pi^2 EI}{L^2}$ (b) $\dfrac{2\pi^2 EI}{L^2}$

(c) $\dfrac{\pi^2 EI}{L^2}$ (d) $\dfrac{\pi^2 EI}{4L^2}$

Q.40 The end conditions of a column for which length of column is equal to the equivalent length are :

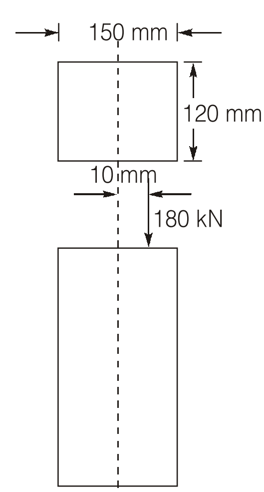
(a) Both the ends are hinged
(b) Both are ends are fixed
(c) One end fixed and other end free
(d) One end fixed and other end hinged

Q.41 Determine the ratio of the buckling strength of a solid steel column to that of a hollow column of the same material having the same area of cross section. The internal diameter of the hollow column is half of the external diameter. Both columns are of identical length and are pinned or hinged at the ends:

(a) $\dfrac{P_s}{P_h} = \dfrac{2}{5}$ (b) $\dfrac{P_s}{P_h} = \dfrac{3}{5}$

(c) $\dfrac{P_s}{P_h} = \dfrac{4}{5}$ (d) $\dfrac{P_s}{P_h} = 1$

Q.42 A rectangular strut is 150 mm wide and 120 mm thick. It carries a load of 180 kN at an eccentricity of 10 mm in a plane bisecting the thickness as shown in the figure:



The maximum intensity of stress in the section will be

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)

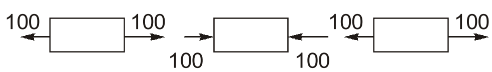
Explanations Applied Mechanics

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.



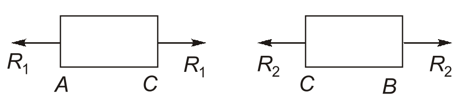
Total elongation, $\delta = \dfrac{PL}{AE}$

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

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,



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

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

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

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

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)

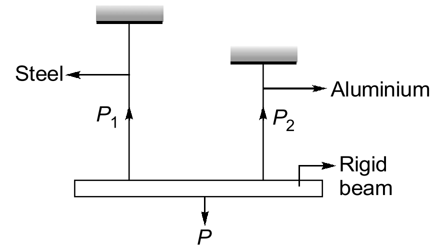
If BC is not touching the fixed end then there will be no stress in BC portion, So no force in BC section.

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

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

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

5. (c)



If the rigid beam is to remain horizontal

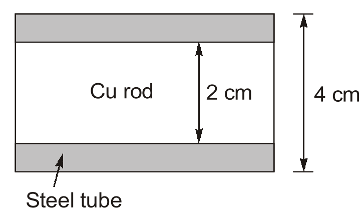
$$(\delta_L)_1 = (\delta_L)_2$$

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

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

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

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.