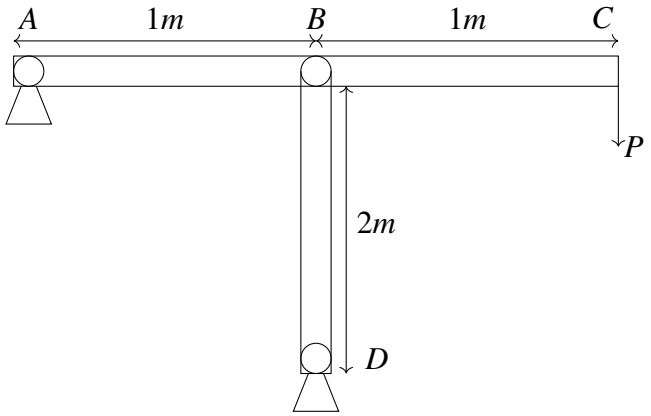
ae-2013-40 to 52

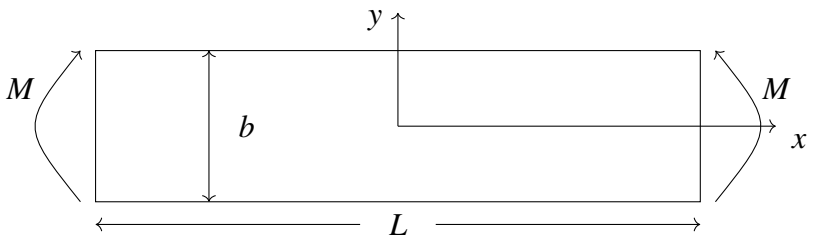
AI24BTECH11020 - Rishika

40) A horizontal rectangular plate $ABCD$ is hinged at points A, B and C. AC and BD are diagonals of the plate. Downward force P is applied at D. The upward reactions R_A, R_B and R_C at points A, B and C, respectively, are
   a) indeterminate
   b) $P, -P, P$
   c) $0, P, 0$
   d) $\frac{P}{3}, \frac{P}{3}, \frac{P}{3}$

41) In the steel structure(Young's modulus = $200GPa$) shown in the figure, all members have a circular cross-section of radius $10mm$. Column BD is pinned at B and D. The support at A is hinged. The minimum value of load at P at which the column BD may buckle in Newtons is approximately _____



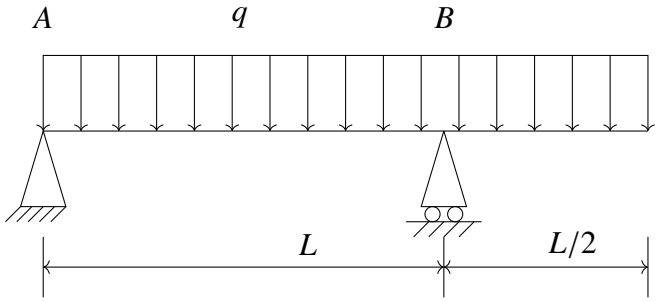
42) The thin rectangular plate has dimensions $L \times b \times t$. It develops a stress field corresponding to an applied bending moment M as shown in the figure. A valid Airy's stress function is



   a) $\frac{2M}{tb^3}x^3$
   b) $\frac{2M}{tb^3}y^3$
   c) $\frac{2M}{tb^3}\left(x^3 + y^3\right)$
   d) $\frac{2M}{tb^3}y^4$

43) A cantilever beam of negligible mass is $0.6m$ long. It has a rectangular cross-section of width $8mm$ and thickness $6mm$ and carries a tip of mass $1.4kg$. If the natural frequency of this system is $10rad/sec$, Young's modulus of the material of the beam in GPa is _____

44) A simply supported beam with overhang is loaded by uniformly distributed load of intensity q as shown in the figure. The bending moment at the mid-point of AB is



a) $\frac{qL^2}{16}$ sagging
b) $\frac{qL^2}{16}$ hogging
c) $\frac{3qL^2}{16}$ hogging
d) $\frac{3qL^2}{16}$ sagging

45) Thrust of liquid oxygen - liquid hydrogen rocket engine is $300kN$. The O/F ratio used is 5. If the fuel mass flow rate is $12.5kg/s$, the specific impulse of the rocket motor in Ns/kg is
a) 3800
b) 4000
c) 4200
d) 4400

46) In a 50% reaction axial compressor stage, the local blade velocity is $300m/s$ and the axial component of velocity is $100m/s$. If the absolute inlet flow angle $\alpha_1 = 45°$, the work per unit mass down on the fluid by the stage in KJ/kg is
a) 30
b) 40
c) 50
d) 60

47) Consider two rockets P and Q fired vertically up with identical specific impulse and a payload of $2kg$. Rocket P has 2 identical stages, and each stage has $200kg$ of propellant and $20kg$ of structural weight. Rocket Q has a single stage with $400kg$ of propellant and $40kg$ of structural weight. Neglecting drag and gravity effects, the ratio of the change in velocity of P to that attained by Q is
a) 1.13
b) 1.23
c) 1.33
d) 1.43

Common Data Questions

Common Data for Questions 48 *and* 49*:*

Data for an airplane are given as follows: weight $W = 30kN$,thrust available at sea-level $T_0 = 4000N$, wing planform area $S = 30m^2$, maximum lift coefficient $C_{Lmax} = 1.4$, and drag coefficient $C_D = 0.015 + 0.024C_L^2$.Assume air density at sea-level $\rho_\infty = 1.22kg/m^3$.

48) Stall speed of the airplane in m/s is
a) 17.36
b) 34.22
c) 45.52
d) 119.46

49) Minimum and maximum speed of the airplane inlevel flight condition at sea-level in m/s are respectively
   a) 17.36 and 180
   b) 17.36 and 34.22
   c) 34.22 and 119.46
   d) 17.36 and 119.46

Common Data for Questions 50 *and* 51*:*

An aircraft is flying at Mach number $M = 1.5$, where the ambient temperature is $250K$. The stagnation temperature of gases at the entry to the nozzel is $800K$. The nozzle is choked and always under expanded. Assume the molecular weight of the exhaust gases to be 29, the ratio of specific heats to be 1.4 and the universal gas constant is $8314J/Kmol - k$.

50) For which one of the nozzle exit Mach numbers given below is the propulsive efficiency highest?
   a) 1
   b) 1.5
   c) 2
   d) 2.5

51) For which one of the nozzle exit Mach numbers given below is the thrust highest?
   a) 1
   b) 1.5
   c) 2
   d) 2.5

Linked Answer Questions

Statement for Linked Answer Questions 52 *and* 53*:*

Circulation theory of lift is assumed for a thin symmetric airfoil at an angle of attack α. Free stream velocity is U.

52) If the circulation at the quarter chord $(c/4)$ of the airfoil is Γ_1, the normal velocity is zero at
   a) $\frac{c}{4}$
   b) $\frac{c}{2}$
   c) $\frac{3c}{4}$
   d) all points on the chord