

# 2007-ME-35 to 51

i

EE24BTECH11038 - MALAKALA BALA SUBRAHMANYA ARAVIND

- 35) A building has to be maintained at  $21^{\circ}$  (dry bulb) and  $14.5^{\circ}$  (wet bulb). The dew point temperature under these conditions is  $10.17^{\circ}$ . The outside temperature is  $-23^{\circ}$  (dry bulb) and the internal and external surface heat transfer coefficients are  $8 \text{ W/m}^2\text{K}$  and  $23 \text{ W/m}^2\text{K}$  respectively. If the building wall has a thermal conductivity of  $1.2 \text{ W/mK}$ , the minimum thickness (in m) of the wall required to prevent condensation is:
- a) 0.471
  - b) 0.407
  - c) 0.321
  - d) 0.125
- 36) Atmospheric air at a flow rate of  $3 \text{ Kg/s}$  (on dry basis), enters a cooling and dehumidifying coil with an enthalpy of  $85 \text{ kJ/kg}$  of dry air and a humidity ratio of  $19 \text{ grams/kg}$  of dry air. The air leaves the coil with an enthalpy of  $43 \text{ kJ/kg}$  of dry air and a humidity ratio of  $\text{grams/Kg}$  of dry air. If the condensate water leaves the coil with an enthalpy of  $67 \text{ kJ/kg}$ , the required cooling capacity of the coil in kW is:
- a) 75
  - b) 123.8
  - c) 128.2
  - d) 159.0
- 37) A heat transformer is a device that transfers a part of the heat, supplied to it at an intermediate temperature, to a high temperature reservoir while rejecting the remaining part to a low temperature heat sink. In such a heat transformer,  $100 \text{ kJ}$  of heat is supplied at  $350 \text{ K}$ . The maximum amount of heat in  $\text{kJ}$  that can be transferred to  $400 \text{ K}$ , when the rest is rejected to a heat sink at  $300 \text{ K}$  is:
- a) 12.5
  - b) 14.29
  - c) 33.33
  - d) 57.14
- 38) Which combination of the following statements is correct?  
The incorporation of reheater in a steam power plant:  
P: always increases the thermal efficiency of the plant.  
Q: always increases the dryness fraction of steam at condenser inlet.
- a) P only
  - b) Q only

- c) both P and Q only
- d) neither P nor Q

39) Which combination of the following statements is correct?

P: A gas cools upon expansion only when its Joule-Thomson coefficient is positive in the temperature range of expansion.

Q: For a system undergoing a process, its entropy remains constant only when the process is reversible.

R: The work done by a closed system in an adiabatic process is a point function.

S: A liquid expands upon freezing when the slope of its fusion curve on Pressure-Temperature diagram is negative.

- a) R and S
- b) P and Q
- c) Q, R and S
- d) P, Q and R

40) Which combination of the following statements about steady incompressible forced vortex flow is correct?

P: Shear stress is zero at all points in the flow.

Q: Vorticity is zero at all points in the flow.

R: Velocity is directly proportional to the radius from the center of the vortex.

S: Total mechanical energy per unit mass is constant in the entire flow field.

- a) P and Q
- b) R and S
- c) P and R
- d) P and S

41) Match the items in columns 1 and 2.

Column 1	Column 2
P: Centrifugal compressor	1: Axial flow
Q: Centrifugal pump	2: Surging
R: Pelton wheel	3: Priming
S: Kaplan turbine	4: Pure impulse

TABLE 41

- a) P-2,Q-3,R-4,S-1
- b) P-2,Q-3,R-1,S-4
- c) P-3,Q-4,R-1,S-2
- d) P-1,Q-2,R-3,S-4

42) A uniformly loaded propped cantilever beam and its free body diagram are shown below. The reactions are

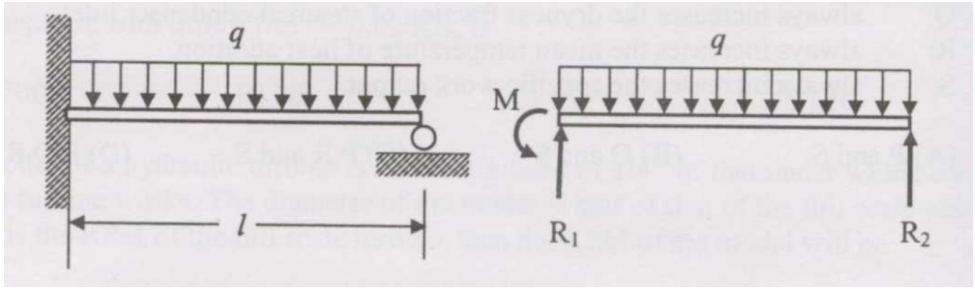


Fig. 42.1

- a)  $R_1 = \frac{5ql}{8}, R_2 = \frac{3ql}{8}, M = \frac{ql^2}{8}$   
 b)  $R_1 = \frac{3ql}{8}, R_2 = \frac{5ql}{8}, M = \frac{ql^2}{8}$   
 c)  $R_1 = \frac{5ql}{8}, R_2 = \frac{3ql}{8}, M = 0$   
 d)  $R_1 = \frac{3ql}{8}, R_2 = \frac{5ql}{8}, M = 0$

- 43) A block of mass  $M$  is released from point  $P$  on a rough inclined plane with inclination angle  $\theta$ , as shown in the figure below. The coefficient of friction is  $\mu$ . If  $\mu < \tan \theta$ , then the time taken by the block to reach another point  $Q$  on the inclined plane, where  $PQ = s$ , is:

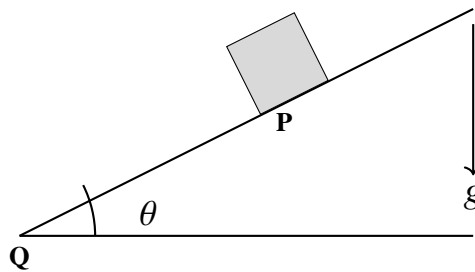


Fig. 43.1

- a) (A)  $\frac{2s}{\sqrt{g \cos \theta (\tan \theta - \mu)}}$   
 b) (B)  $\frac{2s}{\sqrt{g \cos \theta (\tan \theta + \mu)}}$   
 c) (C)  $\frac{2s}{\sqrt{g \sin \theta (\tan \theta - \mu)}}$   
 d) (D)  $\frac{2s}{\sqrt{g \sin \theta (\tan \theta + \mu)}}$

- 44) A  $200 \times 100 \times 50$  mm steel block is subjected to a hydrostatic pressure of 15 MPa. The Young's modulus and Poisson's ratio of the material are 200 GPa and 0.3, respectively. The change in the volume of the block in  $\text{mm}^3$  is:

- a) 85
- b) 90
- c) 100
- d) 110

45) A stepped steel shaft shown below is subjected to 10 Nm torque. If the modulus of rigidity is 80 GPa, the strain energy in the shaft in N mm is:

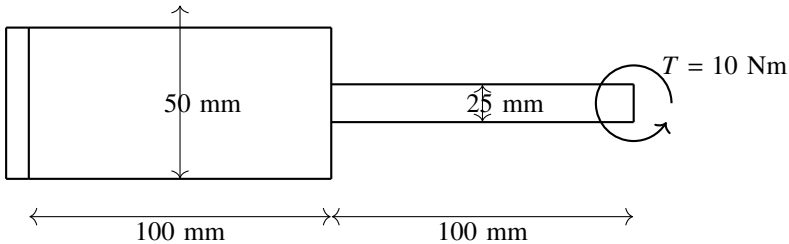


Fig. 45.1

- a) 4.12
- b) 3.46
- c) 1.73
- d) 0.86

46) A thin spherical pressure vessel of 200 mm diameter and 1 mm thickness is subjected to an internal pressure varying from 4 to 8 MPa. Assume that the yield, ultimate, and endurance strength of material are 600, 800 and 400 MPa respectively. The factor of safety as per Goodman's relation is:

- a) 2.0
- b) 1.6
- c) 1.4
- d) 1.2

47) A natural feed journal bearing of diameter 50 mm and length 50 mm operating at 20 revolutions/second carries a load of 2.0 kN. The lubricant used has a viscosity of 20 mPa s. The radial clearance is 50  $\mu\text{m}$ . The Sommerfeld number for the bearing is:

- a) 0.062
- b) 0.125
- c) 0.250
- d) 0.785

48) A bolted joint is shown below. The maximum shear stress, in MPa, in the bolts at A and B, respectively are:

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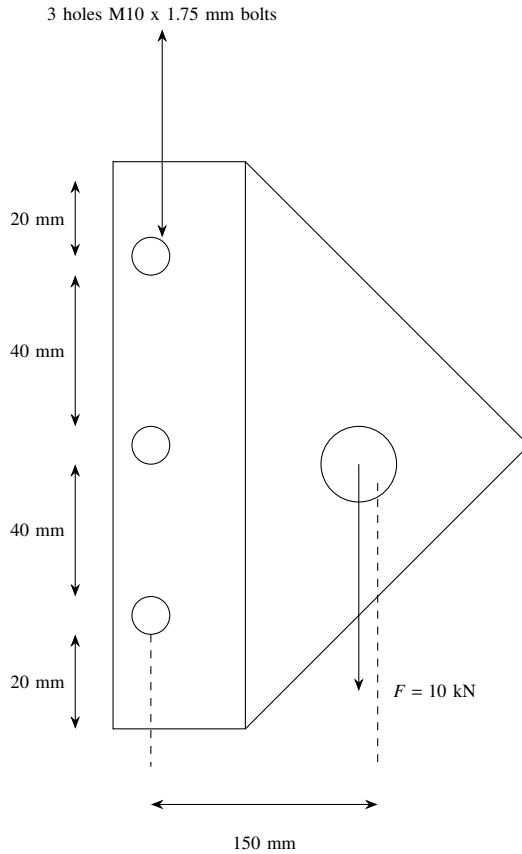


Fig. 48.1

- a) 242.6, 42.5
- b) 42.5, 242.6
- c) 42.5, 42.5
- d) 242.6, 242.6

49) A block-brake shown below has a face width of 300 mm and a mean coefficient of friction of 0.25. For an activating force of 400 N, the braking torque in Nm is:

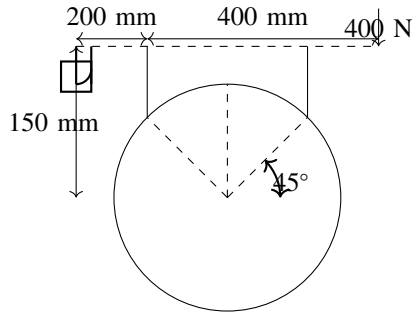


Fig. 49.1

- a) 30
- b) 40
- c) 45
- d) 60

50) The input link  $O_2P$  of a four-bar linkage is rotated at 2 rad/s in counterclockwise direction as shown below. The angular velocity of the coupler PQ in rad/s, at an instant when  $\angle O_4QP = 180^\circ$ , is:

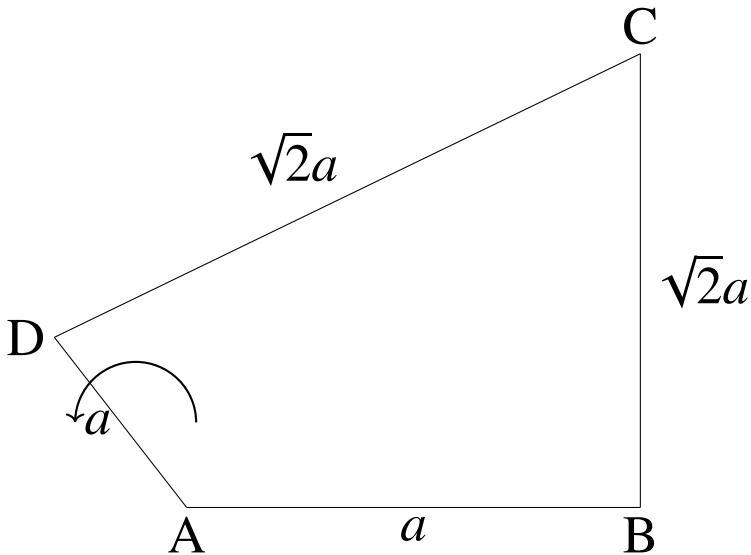


Fig. 50.1

- a) 4
- b)  $2\sqrt{2}$
- c) 1

d)  $\frac{1}{\sqrt{2}}$

51) The speed of an engine varies from 210 rad/s to 190 rad/s. During a cycle, the change in kinetic energy is found to be 400 Nm. The inertia of the flywheel in  $\text{kg } m^2$  is:

- a) 0.10
- b) 0.20
- c) 0.30
- d) 0.40