2020-Sep-3 Shift-2

AI24BTECH11002 - K. Akshay Teja

1) A building has to be maintained at $21°C$ (dry bulb) and $14°C$ (wet bulb). The dew point temperature under these condition is $10.17°C$. The outside temperature is $-23°C$ (dry bulb) and the internal and external surface heat transfer coefficients are 8 $\frac{W}{m^2}$K and 23 $\frac{W}{m^2}$K respectively, If the building wall has a thermal conductivity of 1.2 $\frac{W}{m}$K, the minimum thickness (in m) of the wall required to prevent condensation id

a) 0.471 b) 0.407 c) 0.321 d) 0.125

2) Atmospheric air at a flow rate of 3 $\frac{kg}{s}$ (on dry basis) enters a cooling and dehumidifying coil with an enthalpy of 85 $\frac{kJ}{kg}$ of dry air and a humidity ratio of 19 $\frac{grams}{kg}$ of dry air. The air leaves the coil with an enthalpy of 43 $\frac{kJ}{kg}$ of dry air and a humidity ratio of 8 $\frac{grams}{kg}$ of dry air. If the condensate water leaves the coil with an enthalpy of 67 $\frac{kJ}{kg}$, the required cooling capacity of the coil in kW is

a) 75.0 b) 123.8 c) 128.2 d) 159.0

3) 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 kJ of heat is supplied at 350 K. The maximum amount of heat in kJ that can be transferred to 400 K, when the rest is rejected to a heat sink at 300 K is

a) 12.50 b) 14.29 c) 33.33 d) 57.14

4) 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.
R: always increases the mean temperature of heat addition.
S: always increases the specific work output

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

5) Which combination of the following statements is correct?
P: A gas cools upon expansion only when its Joule-Thompson 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 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

6) 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: Velocity is zero at all points in the flow.
R: Velocity is proportional to the radius from the centre of the vortex.
S: Total mechanical energy per unit mass is constant in the entire flow field

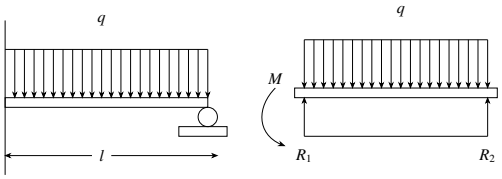
a) P and Q b) R and S c) P and R d) P and S

7) Match the items in columns I and II.

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

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

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

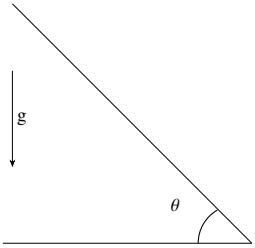


a) $R_1 = \frac{3}{8}ql, R_2 = \frac{5}{8}ql, M = \frac{1}{8}ql^2$
b) $R_1 = \frac{5}{8}ql, R_2 = \frac{3}{8}ql, M = \frac{1}{8}ql^2$
c) $R_1 = \frac{3}{8}ql, R_2 = \frac{5}{8}ql, M = 0$
d) $R_1 = \frac{5}{8}ql, R_2 = \frac{3}{8}ql, M = 0$

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

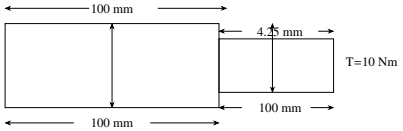
a) $\sqrt{\frac{2s}{g\cos\theta(\tan\theta-\mu)}}$
b) $\sqrt{\frac{2s}{g\cos\theta(\tan\theta+\mu)}}$
c) $\sqrt{\frac{2s}{g(1-\sin\theta(\tan\theta-\mu))}}$
d) $\sqrt{\frac{2s}{g(1-\sin\theta(\tan\theta+\mu))}}$

10) A 200 × 100 × 50 mm steel block is subjected to a hydrostatic pressure of 15 MPa. The Young's modulus and Poisson's ratio of the material is 200 GPa is 0.3 respectively. The change in volume of the block is in mm^3 is:



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

11) 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:



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

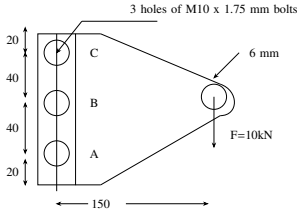
12) A thin spherical pressure vessel of 200 mm diameter and 1 mm thickness is subjected to an internal pressure varying from 4 to 8 MPa. Assume that the yield, ultimate, and endurance strength of material are 600, 800, and 400 MPa respectively. The factor of safety as per Goodman's relation is:

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

13) A natural feed journal bearing of diameter 50 mm and length 30 mm operating at 20 $\frac{revolution}{second}$ supports a load of 2.0 kN. The lubricant used has a viscosity of 20 mPa s. The radial clearance is 0.02 pm. The Sommerfeld number for the bearing is:

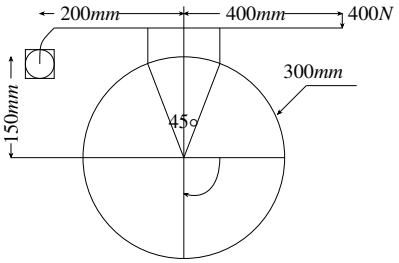
a) 0.062 b) 0.125 c) 0.250 d) 0.785

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



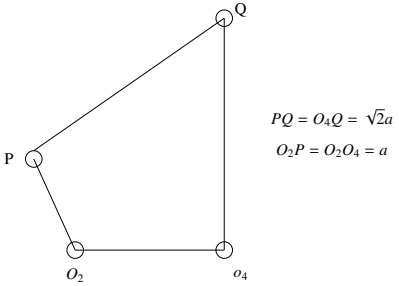
a) 242.6, 42.5 b) 42.5, 242.6 c) 42.5, 42.5 d) 242.6, 242.6

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



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

16) The input link O_2P of a four bar linkage is rotated at 2 $\frac{rad}{s}$ in a counterclockwise direction as shown below. The angular velocity of the coupler PQ in $\frac{rad}{s}$, at an instant when $\angle O_4O_2P = 180°$, is:



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

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

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