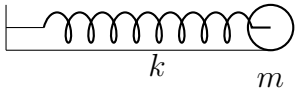
2011-ME-'40-52'

AI24BTECH11006 - Bugada Roopansha

40) A spherical steel ball of 12 mm diameter is initially at 1000 K. It is slowly cooled in a surrounding of 300 K. The heat transfer coefficient between the steel ball and the surrounding is $5\frac{W}{m^2K}$. The thermal conductivity of steel is $20\frac{W}{mK}$. The temperature difference between the centre and the surface of the steel ball is
   a) large because conduction resistance is far higher than the convective resistance.
   b) large because conduction resistance is far less than the convective resistance.
   c) small because conduction resistance is far higher than the convective resistance.
   d) small because conduction resistance is far less than the convective resistance.

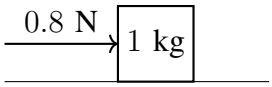
41) An ideal Brayton cycle, operating between the pressure limits of 1 bar and 6 bar, has minimum and maximum temperatures of 300 K and 1500 K. The ratio of specific heats of the working fluid is 1.4. The approximate final temperatures in Kelvin at the end of the compression and expansion processes are respectively
   a) 500 and 900
   b) 900 and 500
   c) 500 and 500
   d) 900 and 900

42) A disc of mass m is attached to a spring of stiffness k as shown in the figure. The disc rolls without slipping on a horizontal surface. The natural frequency of vibration of the system is



   a) $\frac{1}{2\pi}\sqrt{\frac{k}{m}}$
   b) $\frac{1}{2\pi}\sqrt{\frac{2k}{m}}$
   c) $\frac{1}{2\pi}\sqrt{\frac{2k}{3m}}$
   d) $\frac{1}{2\pi}\sqrt{\frac{3k}{2m}}$

43) A 1 kg block is resting on a surface with coefficient of friction $\mu = 0.1$. A force of 0.8 N is applied to the block as shown in the figure. The friction force is



   a) 0
   b) 0.8 N
   c) 0.98 N
   d) 1.2 N

44) Consider the following system of equations:

$$2x_1 + x_2 + x_3 = 0, x_2 - x_3 = 0 x_1 + x_2 = 0.$$

This system has
   a) a unique solution
   b) no solution
   c) an infinite number of solutions
   d) five solutions

45) A single-point cutting tool with $12°$ rake angle is used to machine a steel workpiece. The depth of cut, i.e., uncut thickness is 0.81 mm. The chip thickness under orthogonal machining conditions is 1.8 mm. The shear angle is approximately
   a) $22°$
   b) $26°$
   c) $56°$
   d) $76°$

46) Match the following non-traditional machining processes with the corresponding material removal mechanisms:

Machining Process	**Mechanism of Material Removal**
P. Chemical machining	1. Erosion
Q. Electrochemical machining	2. Corrosive reaction
R. Electrodischarge machining	3. Ion displacement
S. Ultrasonic machining	4. Fusion and vaporization

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

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

47) A cubic casting of 50 mm side undergoes volumetric solidification shrinkage and volumetric solid contraction of 4% and 6% respectively. No riser is used. Assume uniform cooling in all directions. The side of the cube after solidification and contraction is
a) 48.32 mm
b) 49.90 mm
c) 49.94 mm
d) 49.96 mm

Common Data for Questions 48 and 49:

In an experimental set-up, air flows between two stations P and Q adiabatically. The direction of flow depends on the pressure and temperature conditions maintained at P and Q. The conditions at station P are 150 kPa and 350 K. The temperature at station Q is 300 K. The following are the properties and relations pertaining to air:
Specific heat at constant pressure, $c_p = 1.005\frac{kJ}{kgK}$;
Specific heat at constant volume, $c_v = 0.718\frac{kJ}{kgK}$;
Characteristic gas constant, $R = 0.287\frac{kJ}{kgK}$.
Enthalpy, $h = c_pT$.
Internal energy, $u = c_vT$.

a) If the air has to flow from station P to station Q, the maximum possible value of pressure in kPa at station Q is close to
i) 50
ii) 87
iii) 128
iv) 150

b) If the pressure at station Q is 50 kPa, the change in entropy $(s_Q - s_P)$ in $\frac{kJ}{kgK}$ is
i) -0.155
ii) 0
iii) 0.160
iv) 0.355

Common Data for Questions 50 and 51:

One unit of product P_1 requires 3 kg of resource R_1, and 1 kg of resource R_2. One unit of product P_2 requires 2 kg of resource R_1, and 2 kg of resource R_2. The profits per unit by selling product P_1 and P_2 are Rs. 2000 and Rs. 3000 respectively. The manufacturer has 90 kg of resource R_1 and 100 kg of resource R_2.

48) The unit worth of resource R_2, i.e., the dual price of resource R_2 in Rs. per kg is
a) 0
b) 1350
c) 1500
d) 2000

49) The manufacturer can make a maximum profit of Rs.
a) 60000
b) 135000
c) 150000
d) 200000

Statement for Linked Answer Questions 52 and 53:

A triangular-shaped cantilever beam of uniform thickness is shown in the figure. The Young's modulus of the material of the beam is E. A concentrated load P is applied at the free end of the beam.

50) The area moment of inertia about the neutral axis of a cross-section at a distance x measured from the free end is
a) $\frac{bxt^3}{6l}$
b) $\frac{bxt^3}{12l}$
c) $\frac{bxt^3}{24l}$
d) $\frac{xt^3}{12}$