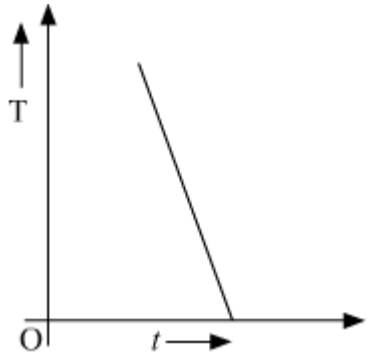
Thermal Properties of Matter

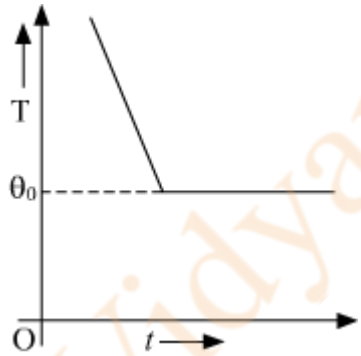
Q.No.1:
If a piece of metal is heated to temperature θ and then allowed to cool in a room which is at temperature θ_0, the graph between the temperature T of the metal and time t will be closest to:

JEE 2013

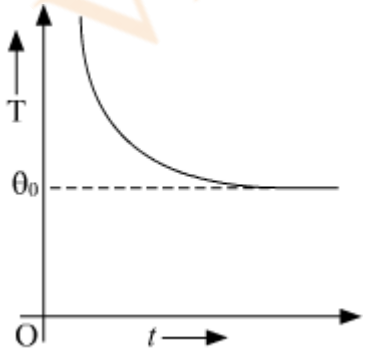
A.



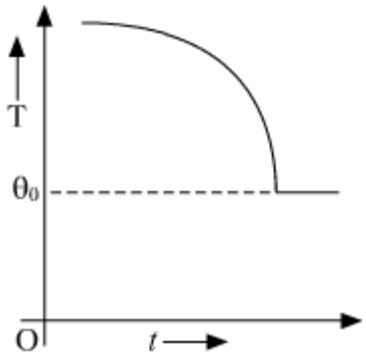
B.



C.



D.



Q.No.2: Three rods of copper, brass and steel are welded together to form a Y - shaped structure. Area of cross - section of each rod is 4 cm^2. The end of the copper rod is maintained at 100°C, whereas the ends of brass and steel are kept at 0°C. Lengths of the copper, brass and steel rods are 46, 13 and 12 cm, respectively. The rods are thermally insulated from the surroundings, except at the ends. Thermal conductivities of copper, brass and steel are 0.92, 0.26 and 0.12 CGS units, respectively. Rate of heat flow through the copper rod is

A. 4.8 cal/s

B. 6.0 cal/s

C. 1.2 cal/s

D. 2.4 cal/s

Q.No.3: A solid of constant heat capacity 1 J/°C is being heated keeping it in contact with reservoirs in two ways:
(i) Sequentially keeping in contact with 2 reservoirs such that each reservoir supplies same amount of heat.
(ii) Sequentially keeping in contact with 8 reservoirs such that each reservoir supplies same amount of heat.
In both the cases body is brought form initial temperature 100°C to final temperature 200°C. Entropy change of the body in the two cases respectively is: **JEE 2015**

A. ln2, 4ln2

B. ln2, ln2

C. ln2, 2ln2

D. 2ln2, 8ln2

Q.No.4: An external pressure P is applied on a cube at 0°C so that it is equally compressed from all sides. K is the bulk modulus of the material of the cube and α is its coefficient of linear expansion. Suppose we want to bring the cube to its original size by heating. The temperature should be raised by: **JEE 2017**

A. $3\,\mathrm{PK}\,\alpha$

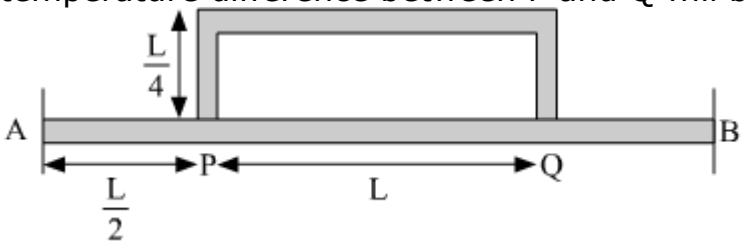
B. $\frac{\mathrm{P}}{3\alpha\mathrm{K}}$

C. $\frac{\mathrm{P}}{\alpha\mathrm{K}}$

D. $\frac{3\alpha}{\mathrm{PK}}$

Q.No.5: Temperature difference of 120°C is maintained between two ends of a uniform rod AB of length 2L. Another bent rod PQ, of same cross-section as AB and length $\frac{3\mathrm{L}}{2}$, is connected across AB (See figure). In steady state, temperature difference between P and Q will be close to:

JEE 2019



A. 45°C

B. 75°C

C. 60°C

D. 35°C

Q.No.6: A rod, of length L at room temperature and uniform area of cross section A, is made of a metal having a coefficient of linear expansion $\alpha\,/^{o}C$. It is observed that an external compressive force F, is applied to each of its ends, prevents any change in the length of the rod when its temperature rises by ΔTK. Young's modulus, Y, for this metal is:

JEE 2019

A. $\frac{F}{A\alpha\Delta T}$

B. $\frac{F}{A\alpha(\Delta T-273)}$

C. $\frac{F}{2A\alpha\Delta T}$

D. $\frac{2F}{A\alpha\Delta T}$

Q.No.7: A heat source at T = 10^3 K is connected to another heat reservoir at T = 10^2 K by a copper slab which is 1 m thick. Given that the thermal conductivity of copper is 0.1 $\mathrm{WK^{-1}\,m^{-1}}$, the energy flux through it in the steady state is:

JEE 2019

A. 90 $\mathrm{Wm^{-2}}$

B. 120 Wm^{-2}

C. 65 Wm^{-2}

D. 200 Wm^{-2}

Q.No.8: An unknown metal of mass 192 g heated to a temperature of 100°C was immersed into a brass calorimeter of mass 128 g containing 240 g of water at a temperature of 8.4°C. Calculate the specific heat of the unknown metal if water temperature stabilizes at 21.5°C. (Specific heat of brass is 394 J kg^{-1} K^{-1}) **JEE 2019**

A. 458 J kg^{-1} K^{-1}

B. 1232 J kg^{-1} K^{-1}

C. 916 J kg^{-1} K^{-1}

D. 654 J kg^{-1} K^{-1}

Q.No.9: Half mole of an ideal monoatomic gas is heated at constant pressure of 1 atm from 20°C to 90°C. Work done by gas is close to: (Gas constant R = 8.31 J/mol-K) **JEE 2019**

A. 581 J

B. 291 J

C. 146 J

D. 73 J

Q.No.10: Two kg of a monoatomic gas is at a pressure of 4×10^4 N/m^2. The density of the gas is 8 kg/m^3. What is the order of energy of the gas due to its thermal motion? **JEE 2019**

A. 10^3 J

B. 10^5 J

C. 10^4 J

D. 10^6 J