Physics English Classified MCQ
Heat
1992 - 2016

HEAT

01. Thermometry

(1) The sensitivity of a liquid – in glass thermometer can be increased by

A) increasing the length of the capillary of the thermometer.
B) increasing the internal radius of the capillary of the thermometer.
C) increasing the volume of the liquid bulb of the thermometer.

1) Only (A) is true
2) Only (B) is true
3) Only (C) is true
4) Only (A) and (B) are true.
5) Only (A) and (C) are true (1991)

(2) Once the necessary materials are provided which of the following thermometers is easiest to construct in a laboratory ?

1) Thermocouple
2) Alcohol in glass thermometer.
3) constant pressure gas thermometer
4) Mercury in glass thermometer.
5) constant volume gas thermometer. (1992)

(3) The mercury column of an uncelebrated thermometer stands at 12 cm when placed in steam, at 2cm when placed in melting ice and at 4 cm when placed in salt water. The approximate temperature of salt water is,

1) 2^0C 2) 20^0C 3) 33^0C 4) 40^0C 5) 80^0C (1993)

(4) The thermometric substance used in a thermometer must

1) remain a liquid over the entire range of temperature to be measured
2) have a property whose value increases linearly with temperature
3) have a property that varies with temperature
4) obeys Boyle's law
5) have a constant expansively (1994)

(5) The distance between any two consecutive degree marks of the scales of two mercury in glass thermometer P and Q are found to be 1 mm and 3mm respectively.

Consider the following deductions made above the thermometers

A) Thermometer Q has a smaller capillary bore radius than that of P
B) Thermometer Q has a larger mercury bulb than that of P
C) Readings taken with the thermometer Q is more accurate than those taken with P

Of the above statements

1) Only A is true
2) Only B is true
3) Only C is true
4) Only A and C are true
5) all A, B and C are true (1996)

(6) When a mercury –in-glass thermometer and a thermocouple were used to measure the temperature of a hot liquid. The thermocouple indicated a higher reading. The most appropriate reason for this is that ,

1) the thermocouple is more sensitive than the mercury thermometer
2) the thermocouple responds quicker than the mercury thermometer
3) the thermocouple absorbs more heat than the mercury thermometer to register a reading
4) the volume of the liquid is very small
5) specific heat capacity of mercury is smaller than those of the metals used in the thermocouple (1997)

(7) The mercury column rises in a mercury-in-glass thermometer when the temperature is raised. The most appropriate reason for this is,

1) mercury is a good conductor of heat
2) glass is a poor conductor of heat
3) glass expands when heated
4) glass expands less than mercury when heated
5) mercury expands uniformly with rise in temperature (2001)

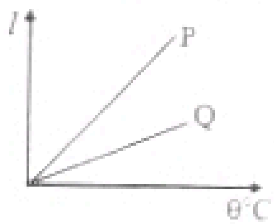
(8) Consider the following statements carefully,

A) Constant volume gas thermometer is not suitable for measuring rapidly changing temperatures because it is not an accurate thermometer.
B) Thermocouple is suitable for measuring rapidly changing temperatures because its heat capacity is large
C) Mercury-in glass thermometer is not suitable for measuring rapidly changing temperatures because its heat capacity is very small.

Of the above statements

1) Only (A) is true 2) Only (B) is true 3) Only (B) and (C) are true
4) Only (A) and (B) are true 5) all (A), (B) and (C) are true (2003)

(9) Graph shows the variation of the length (l) of the liquid column of a certain mercury–in–glass thermometer (P) and an alcohol–in–glass thermometer (Q) with temperature θ. A student draws the following general conclusions safely based only on the graph.



A) Mercury thermometers are more sensitive than alcohol thermometers.
B) Mercury thermometers are longer than alcohol thermometers.
C) Volume expansivity of mercury is grater than that of alcohol.

He can truly conclude,

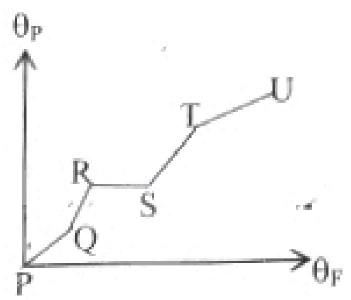
1) only (C) 2) only (A) and (B) 3) only (A) and (C)
4) all (A), (B) and (C) 5) none of (A), (B) and (C) (2006)

(10) Thermometer must possess good sensitivity as well as good accuracy. If the connection which of the following is true regarding a mercury–in–glass thermometer?

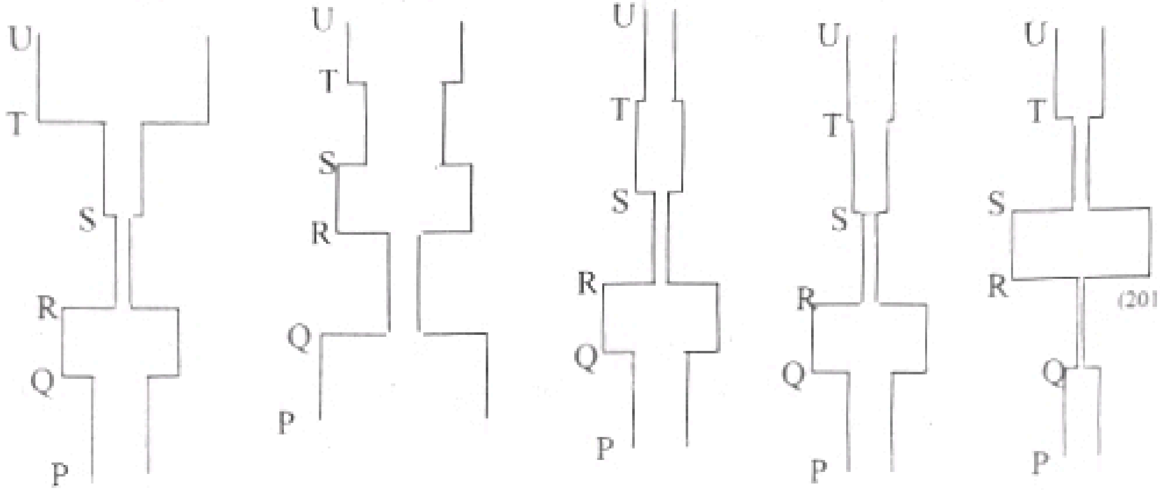
	To increase accuracy	To increase sensitivity
i)	Reduce the radius of the capillary	Increase the volume of mercury in the glass bulb
ii)	Increase the volume of mercury in the glass bulb	Reduce the radius of the capillary
iii)	Reduce the volume of the glass bulb	Reduce the radius of the capillary
iv)	Reduce the radius of the capillary	Reduce the volume of the glass bulb
v)	Reduce the volume of the glass bulb	Increase the volume of mercury in the glass bulb.

(2007)

(11) A mercury in glass thermometer made of a glass capillary of uneven bore radius when calibrated against a correct thermometer produces the curve shown in the figure. Here θ_P is the reading of the correct thermometer and θ_F is the corresponding reading of the uneven thermometer. Several students have deduced the shape of the bore of the capillary tube by considering the above curve a follows. Which of the following figures represents the best model for the shape ?



1) 2) 3) 4) 5)



(2011NS)

(12) Consider the following statements made about the capability of a given thermometer to produce an accurate value for a temperature measurements,

(A) In situation where quick changes of temperature with time have to be measure, the given thermometer must be a one having large variation of the thermometric properly with temperature.

(B) Thermal capacity of the thermometer must be negligible when compared to the thermal capacity of the environment of which the temperature is measured.

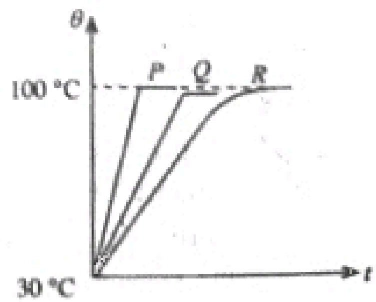
(C) Thermometer property must have a linear variation with the temperature

Of the above statements,

1) Only B is true
2) Only A and B are true
3) Only B and C are true
4) Only A and C are true
5) All A, B and C are true

(2012 N)

(13) Three different types of thermometers P, Q and R having a temperature range of 0 – 110 °C, and kept at room temperature of 30 °C were simultaneously dipped into a large oil bath, maintained at 100 °C at time t = 0, and their readings (θ) were recorded with time (t). Curves in figure show the variation of θ with t for three thermometers. Consider the following conclusions made about the thermometers after analyzing the three curves.



A) P is the most sensitive thermometer.
B) Thermometer P and R are accurate but not Q.
C) The scale of thermometer R is not linear.
Of the above conclusions,

1) only A is true. 2) only B is true. 3) only A and B are true
4) only B and C are true 5) all A, B and C are true (2014)

(14) Radii of capillary tubes of two mercury – in – glass thermometers A and B having equal volumes of mercury inside their bulbs are r and $\frac{r}{3}$ respectively. When the temperatures of the bulbs are increased by 1°C, the ratio $\frac{\text{Change in length of mercury column in A}}{\text{Change in length of mercury column in B}}$ is approximately (Neglect the expansion of glass)

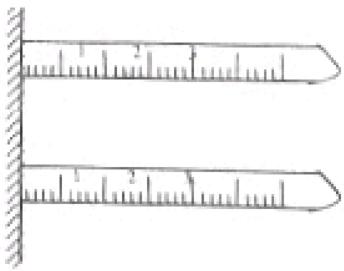
(1) $\frac{1}{9}$ (2) $\frac{1}{3}$ (3) 1 (4) 3 (5) 9 (2015)

(15) A certain liquid-in-glass thermometer with a uniform bore radius has been calibrated using the boiling point of water and the melting point of ice. Of the following properties, what is the most essential properly that a thermometric liquid used in this thermometer must posses?

1) High volume expansivity. 2) Uniform volume expansion.
3) High thermal conductivity. 4) Low specific heat capacity.
5) Low vapour pressure. (2016)

02. Expansion of solids

(1) Two meter rulers made of metal of linear expansivity $25 \times 10^{-6}\ {}^0C^{-1}$ are calibrated at 0^0C. One end of each of the meter rulers is fixed to a vertical wall and held side by side horizontally as shown in the figure. One of the meter rulers is maintained at 0^0C and the other at 100^0C which of the following two scale markings of meter rulers coincide with each other?

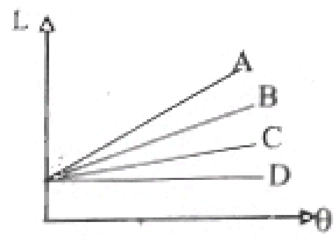


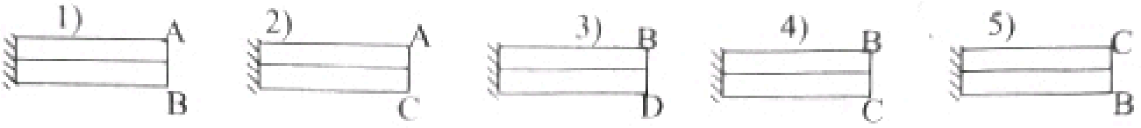
1) 25.0 cm and 25.1cm 2) 24.9 cm and 25.0 cm
3) 39.9 cm and 40.0 cm 4) 40.0 cm and 40.1 cm
5) 80.0 cm and 79.9 cm (1991)

(2) A spiral spring of length L, number of turns a and coil diameter d is heated from temperature $\theta_1 to \theta_2$. If the linear expansively of the material of the spring is α, the increase in length of the spring will be,

1) $L[1+\pi dn\alpha(\theta_2-\theta_1)]$ 2) $La(\theta_2-\theta_1)$ 3) $\pi dn\alpha(\theta_2-\theta_1)$
4) $L[1+\alpha(\theta_2-\theta_1)]$ 5) $2\pi dn\alpha(\theta_2-\theta_1)$ (1992)

(3) The graphs show the variation of length (L) with temperature (θ) of four metal strips A, B, C and D Five bimetallic strips ate made from pairs of these metal strips. Which bimetallic strip will bend upwards when one end is clamped and heated?





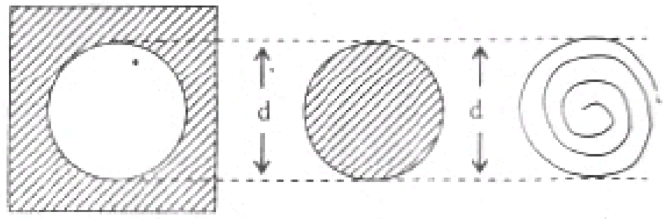
(1993)

(4) An aluminium plate 80 mm × 20 mm contains a rectangular hole with dimensions 20 mm × 5 mm. When the plate is heated uniformly its length increases by 0.002%. The length of the hole

1) increases by 4.0×10^{-4} mm
2) decreases by 4.0×10^{-4} mm
3) increases by 1.2×10^{-4} mm
4) decreases by 1.2×10^{-4} mm
5) remains the same

(1995)

(5) Figure A shows a circular hole of diameter d cut in a uniform aluminium sheet. Fig. B shows a uniform circular aluminium disc of diameter d. Fig. C shows a piece of uniform aluminimum wire bent to form a spiral, If $\Delta d_A, \Delta d_B, and \Delta d_C$ are the corresponding changes in d of A, B and C respectively for a given temperature change, then



(A) (B) (C)

1) $\Delta d_A = \Delta d_B < \Delta d_C$
2) $\Delta d_A = \Delta d_B > \Delta d_C$
3) $\Delta d_A < \Delta d_B < \Delta d_C$
4) $\Delta d_A = \Delta d_B = \Delta d_C$
5) $\Delta d_A < \Delta d_B > \Delta d_C$

(1996)

(6) If the fractional change in the volume of a solid when heated from 0^0C to 10^0C is 0.0027. the linear expansivity of the material of the solid is,

1) 0.00030C^{-1}
2) 0.00009$^0C^{-1}$
3) 0.003$^0C^{-1}$
4) 0.0027$^0C^{-1}$
5) 0.0009$^0C^{-1}$

(1998)

(7) The volume expansivity of a metal is equal to

1) its linear expansivity
2) twice its linear expansivity
3) three times its linear expansivity
4) half of its linear expansivity
5) one third of its linear expansivity

(2002)

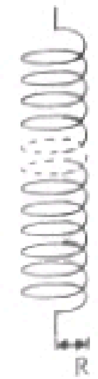
(8) A circular hole is made in a steel sheet of linear expansively 1.2×10^{-5} C^{-1}. When the temperature of the sheet is raised by 100^0C the area of the hole

1) is increased by a fraction of 2.4×10^{-3}
2) is decreased by a fraction of 2.4×10^{-3}
3) is increased by a fraction of 1.2×10^{-3}
4) is decreased by a fraction of 1.2 x 10-3
5) remains unchanged.

(2003)

(9) A coil of metal wire made of a material of linear expansivity 2×10^{-5} K^{-1} has n turns. When the temperature of the coil is increased by 1^0C while keeping its radius R (see figure) constant, the number of turns becomes n + 1. The value of n is,

1) 2.5×10^{9} 2) 10^{5} 3) 5×10^{4} 4) 2.5×10^{4} 5) $\sqrt{5}\times10^{4}$



(2004)

(10) Consider the following statements made about the linear expansivity of a material.

A) In SI unit is K^{-1}.

B) Its value changes when the temperature is measured in Celsius instead of Kelvin.

C) Its value changes when the temperature is measured in Fahrenheit instead of Kelvin

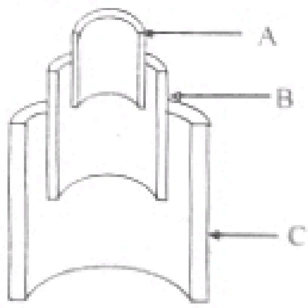
Of the above statements,

1) only (A) is true. 2) only (A) and (C) are true.
3) only (A) and (B) are true. 4) all (B) and (C) are true.
5) all (A), (B) and (C) are true. (2007)

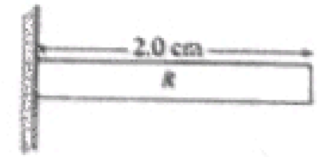
(11) Figure shows a cross – sectional view of three hollow cylinder *A*, *B* and *C* made from different materials, lead, brass and steel. They barely fit one another at room temperature. If the cylinders are heated the cylinder *C* falls off, while cylinder *A* becomes tightly wedged to cylinder *B*.

If $\propto_{lead} > \propto_{brass} > \propto_{steel}$ *A*, *B* and *C* cylinder are likely to be made of,

	A	B	C
1)	brass	lead	steel
2)	steel	lead	brass
3)	brass	steel	lead
4)	steel	brass	lead
5)	lead	brass	steel



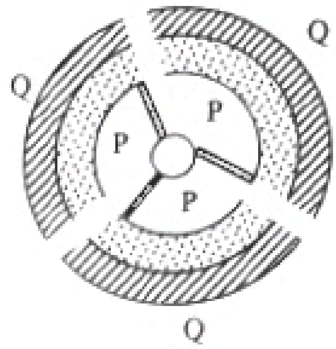
(12) In a certain experiment the unclamped end of an aluminium rod R of length 2.0 cm has to be moved at a constant speed of 100 nm s^{-1}. The rate at which the temperature of the rod be increased for this to happen is (linear expansivity for aluminium = 2.0×10^{-5} $°C^{-1}$)



1) 0.25 °C s^{-1} 2) 0.30 °C s^{-1} 3) 0.55 °C s^{-1}
4) 0.65 °C s^{-1} 5) 0.75 °C s^{-1}

(2009)

(13) The wheel shown in the figure is made of three bi - metal (P, Q) strips attached to the axis using radial metal parts. This can be setup to oscillate about an axis perpedicular to the plane of the wheel and passing through the centre. The wheel is designed such that the oscillating period of the wheel remains the same regardless of the changes of the surrounding temperature. Consider the following statments,



(A) The moment of inertia of the wheel should not change with the temperature

(B) The shape of the wheel should not change with temperature.

(C) The linear expansivity of metal P should be greater than that of Q.

Of the above statements,

(1) only (A) is true (2) only (B) is true (3) only (C) is true

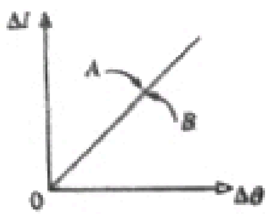
(4) only (A) and (B) are true (5) all (A), (B) and (C) are true.

(14) A simple pendulum is constructed by suspending a small metal bob with a fine wire of the same metal. The period of the pendulum at temperature θ_1 is T_1. When the pendulum operates at a higher temperature of θ_2 the period of the pendulum would be (Linear expansivity of the metal is α)

1) $T_1\sqrt{1+\alpha(\theta_2-\theta_1)}$ 2) $T_1\sqrt{\dfrac{1}{1+\alpha(\theta_2-\theta_1)}}$ 3) $\dfrac{T_1}{1+\alpha(\theta_2-\theta_1)}$

4) $[1+\alpha(\theta_2-\theta_1)]\dfrac{1}{T_1}$ 5) $T_1\sqrt{\alpha(\theta_2-\theta_1)}$ (2013)

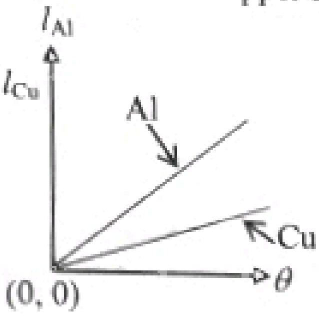
(15) When two metal rods A and B at room temperature are heated together and their expansions Δl, are plotted with the increase in temperature $\Delta\theta$, the two curves are found to coincide with each other as shown in figure.



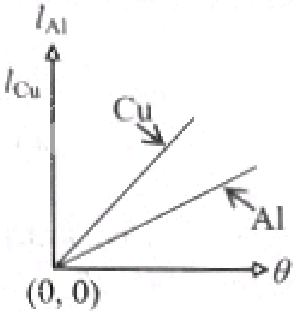
This could happen only if

1) the two rods are made of same material
2) length of A is same as the length of B.
3) linear expansivity of A is same as that of B.
4) the product linear expansivity x original length is same for both rods.
5) the two rods are heated together. (2014)

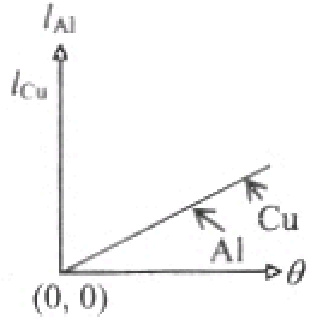
(16) l_{Al} and l_{Cu} respectively represent **fractional increase** in the original lengths of two rods of aluminium (Al) and copper (Cu) when their temperature is increased by an amount of θ °C from the room temperature. Which of the following graphs best represents the variations of l_{Al} and l_{Cu} with θ°C? (Linear expansivities of aluminium and copper are 2.3×10^{-5}°C^{-1} and 1.7×10^{-5}°C^{-1} respectively.)



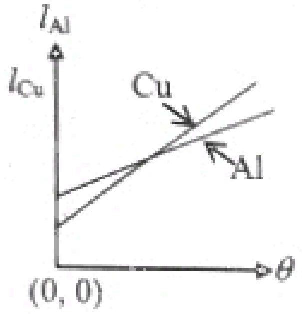
(1)



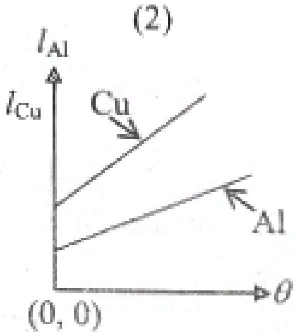
(2)



(3)



(4)

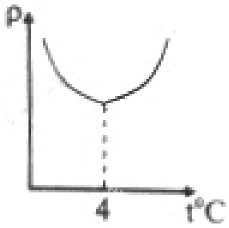


(5)

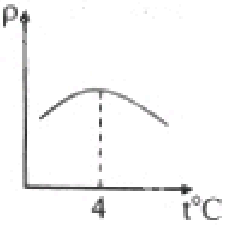
(2016)

03. Expansion of Liquids

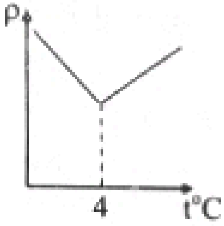
(1) Which of the following graphs best represents the variation of density (ρ) of water with temperature (t)



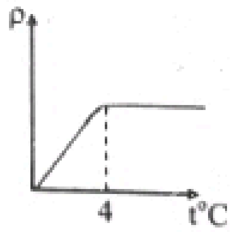
1)



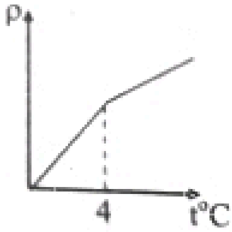
2)



3)



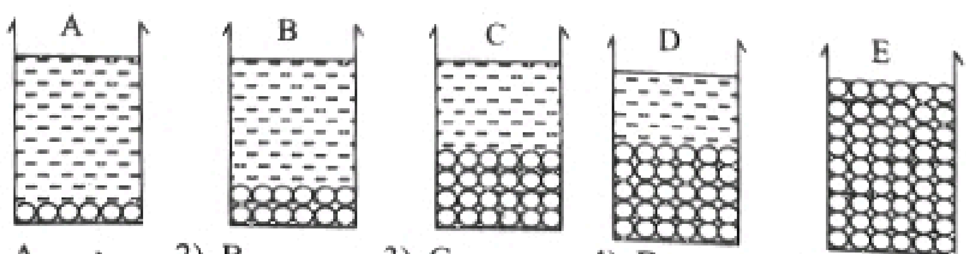
4)



5)

(1991)

(2) Five identical beakers A, B, C, D and E contain different amounts of lead shots and are filled with water to the same level as shown, In which beaker will the water level rise most when heated to about 85°C?



1) A 2) B 3) C 4) D 5) E

(1993)

(3) A uniform cylindrical vessel is filled with a liquid of volume expansivity γ to a height h_0. The liner expansivity of the material of the cylinder is α. If the temperature of the system is increased by θ, the new height h of the liquid level is given by,

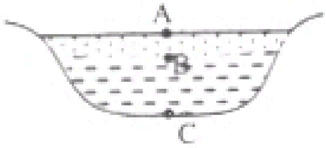
1) $h = h_0(1+\alpha\theta)$ 2) $h = h_0[1+(\gamma-3\alpha)\theta]$ 3) $h = \frac{h_0}{(1+2\gamma\theta)}(1+\lambda\gamma\theta)$

4) $h = h_0(1+\gamma\theta)$ 5) $h = h_0(1+2\alpha\theta)(1+\gamma\theta)$ (1994)

(4) A mercury – glass thermometer has a bulb of volume $0.5cm^3$ and a stem of internal cross- sectional area 4×10^{-4} cm^2. If the distance between the 0^0C and 100^0C marks of the thermometer is 20cm, the apparent volume expansivity of mercury in glass is approximately.

1) $8 \times 10^{-5}\ {}^0C^{-1}$ 2) $1.6 \times 10^{-5}\ {}^0C^{-1}$ 3) $8 \times 10^{-4}\ {}^0C^{-1}$
4) $1.6 \times 10^{-4}\ {}^0C^{-1}$ 5) $3.5 \times 10^{-5}\ {}^0C^{-1}$ (1997)

(5) During the formation of ice in a pond (see figure) due to cold weather, the possible temperatures at points A, B and C shown in the figure are

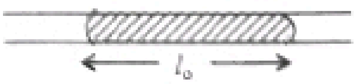


1) -5^0C 0^0C and 0^0C respectively
2) -5^0C 0^0C and 4^0C respectively
3) -5^0C 0^0C and 4^0C respectively
4) -5^0C 4^0C and 4^0C respectively
5) -5^0C 4^0C and 0^0C respectively (2002)

(6) A glass vessel of volume V is completely filled with a liquid of volume expansivity γ_1. The volume expansivity of glass is γ_g ($\gamma_1 > \gamma_g$) If the temperature of the glass vessel is increased by an amount θ the volume of liquid that expels from the vessel is,

1) $V(\gamma_1 - \gamma_g)\theta$ 2) $V(\gamma_1 + \gamma_g)\theta$ 3) $V\gamma_1\theta$
4) $V\gamma_g\theta$ 5) zero. (2005)

(7) A liquid of volume expansivity γ forms a liquid thread of length l_0 inside a tube made of a material of linear expansivity α as shown in the figure.

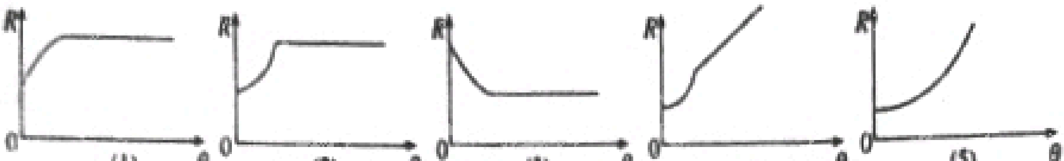


If the temperature is increased by an amount θ the length of the liquid thread will become,

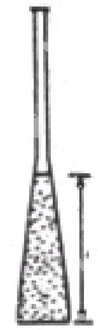
1) l_0 2) $l_0\frac{(1+\gamma\theta)}{(1+\alpha\theta)}$ 3) $l_0(1+\gamma\theta)(1+2\alpha\theta)$

4) $\frac{l_0(1+\gamma\theta)}{(1+2\alpha\theta)}$ 5) $l_0\frac{(1+\gamma\theta)}{(1+3\alpha\theta)}$ (2006)

(8) A glass container witha narrow area of cross – section as shown in figure is filled with a liquid to a height h. If the expansion of the container is negligible, the rate of change (R) of h with tempreture (B) is best represented by,



(1) (2) (3) (4) (5)



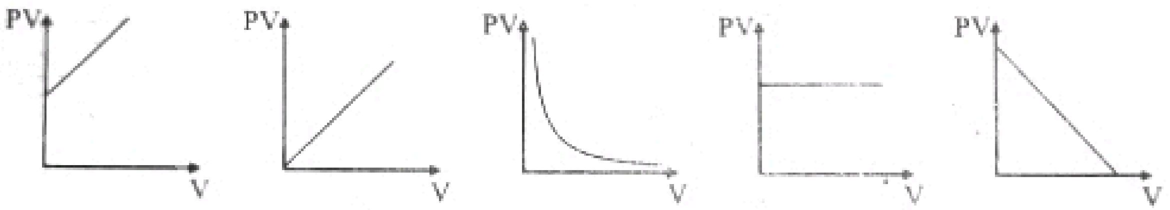
(2009)

04. Expansion of Gases

(1) A closed vessel contains an ideal gas at pressure P. The root mean square velocity of the gas molecules is proportional to

1) $P^{\frac{1}{3}}$ 2) $P^{\frac{1}{2}}$ 3) P 4) P^2 5) P^3 (1991)

(2) Which of the following graphs correctly represents Boyle's law?



1) 2) 3) 4) 5) (1991)

(3) A vessel with a small opening contains an ideal gas at 27^0C and at 1 atmosphere. To what temperature must this vessel be heated to drive out one fifth of the molecules originally present in the vessel?

1) 87^0C 2) 102^0C 3) 135^0C 4) 375^0C 5) 1227^0C (1991)

(4) The molecular weights of two ideal gases A and B in a mixture are M_1 and M_2 respectively. The ratio $\frac{\text{r.m.s. speed of gas A}}{\text{r.m.s. speed of gas B}}$ is equal to ,

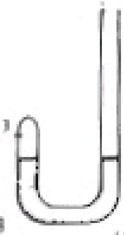
1) $\sqrt{\frac{M_1}{M_2}}$ 2) $\frac{M_1}{M_2}$ 3) $\sqrt{\frac{M_2}{M_1}}$ 4) $\frac{M_2}{M_1}$ 5) $\sqrt{M_1M_2}$ (1992)

(5) A closed container of volume V contains an ideal gas at pressure P_1 when a certain amount of the gas is now removed from this container its pressure becomes P_2 the percentage reduction of the mass to the gas in the container is,

1) $\frac{P_2}{P_1}\times100$ 2) $\frac{P_2}{P_1+P_2}\times100$ 3) $\frac{P_1}{P_1+P_2}\times100$

4) $\frac{P_1P_2}{P_1+P_2}\times100$ 5) $\frac{P_1-P_2}{P_1}\times100$ (1992)

(6) J – tube contains 3 cm^3 of dry air trapped by a mercury column. The levels of mercury are the same on both limbs as shown in the figure, more mercury is now poured into the open limb until the levels differ by 76cm. If the atmospheric pressure is 76cm of Hg what is the new volume of trapped air,



1) 0.25 cm^3 2) 0.5cm^3 3) 0.67 cm^3 4) 1.0 cm 5) 1.5 cm^3 (1993)

(7) A cylinder A contains an ideal gas at a pressure of 600kPa. An identical cylinder, B contains the same gas at a pressure of 200k Pa, and both cylinders are at the same temperature the ratio,

$\dfrac{\text{Density of the gas in A}}{\text{Density of the gas in B}}$ is equal to

1) $\dfrac{1}{\sqrt{2}}$ 2) 1 3) $\sqrt{2}$ 4) $\sqrt{3}$ 5) 3 (1994)

(8) A fixed mass of an ideal gas at pressure P is cooled at constant volume until the pressure becomes $\dfrac{P}{2}$. What will be the root mean square speed of the gas molecules if their r.m.s. speed was originally C?

1) $\dfrac{C}{4}$ 2) $\dfrac{C}{2}$ 3) $\dfrac{C}{\sqrt{2}}$ 4) $\sqrt{3}$ 5) 2C (1994)

(9) Which one of the following when doubled lead to the greatest increase in pressure of an ideal gas in a container?

1) number of molecules of the gas 2) root mean square speed of the molecules
3) Kelvin temperature of the gas 4) volume of the container
5) mass of the gas (1994)

(10) Neon and helium behave as ideal gases. The ratio of the kinetic energy of neon and helium atoms at the same temperature.

1) $\dfrac{1}{5}$ 2) $\dfrac{1}{2}$ 3) 1 4) 2 5) 5 (1995)

(11) The pressure of hydrogen gas (relative molecular mass = 2) in a container is 2 atmospheres. If helium gas (relative atomic mass – 4) is added to the container so that the pressure in the container becomes 3 atmospheres,

Then the ratio, $\dfrac{\text{mass of hydrogen}}{\text{mass of helium}}$ in the container is,

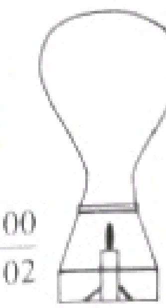
(Assume that the temperature remains constant)

1) 1 2) $\dfrac{1}{2}$ 3) 2 4) $\dfrac{1}{4}$ 5) 4 (1996)

(12) The average kinetic energy of a certain amount of an ideal gas K. When this gas is allowed to expand so that its volume doubles, the pressure of the gas is found to drop by a factor of three. The new average kinetic energy of the gas is,

1) $\dfrac{K}{6}$ 2) $\dfrac{2K}{3}$ 3) K 4) $\dfrac{3K}{2}$ 5) 5K (1996)

(13) A hot-air balloon of constant volume contains air at 100^0C (see the figure) When the temperature of the air inside the balloon is raised by 2^0C , the fraction of the air which escapes is approximately equal to (assume that the air behaves as an ideal gas and the pressure inside the balloon remains constant)



1) $\frac{2}{373}$ 2) $\frac{2}{375}$ 3) $\frac{2}{100}$ 4) $\frac{373}{375}$ 5) $\frac{100}{102}$

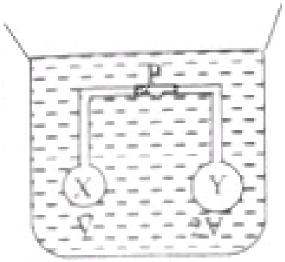
(1996)

(14) When the pressure of a given mass of an ideal gas is doubled while the volume is kept constant, the average translation Kinetic energy of a gas molecule will,

1) remain same 2) be halved 3) be doubled
4) be trebled 5) be quadrupled

(1997)

(15) Two bulbs X and Y of volume V and 2V immersed in a constant temperature bath contain two ideal gases having relative molecular masses 2 and 28 respectively. Two bulbs are connected by a narrow tube and the gases are separated by a small pellet of mercury (P) as shown in the diagram



The ratio $\frac{\text{mass of gas X}}{\text{mass of gas Y}}$ is,

1) $\frac{1}{28}$ 2) $\frac{1}{7}$ 3) 7 4) 14 5) 28

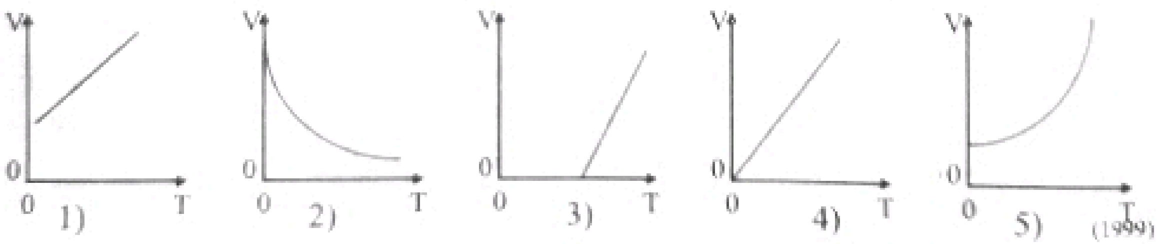
(1997)

(16) A closed cylinder contains a gas mixture of H_2, N_2 and O_2 at constant temperature. The pressure inside the cylinder increases most if M grams of ,

1) H_2 is added to the cylinder 2) N_2 is added to the cylinder
3) O_2 is added to the cylinder 4) a mixture of H_2 and N_2 added to the cylinder
5) a mixture of N_2 and O_2 is added to the cylinder.

(1998)

(17) Which of the following graphs best represents the variation of volume V of a fixed mass of an ideal gas at constant pressure, with its absolute temperature T ?



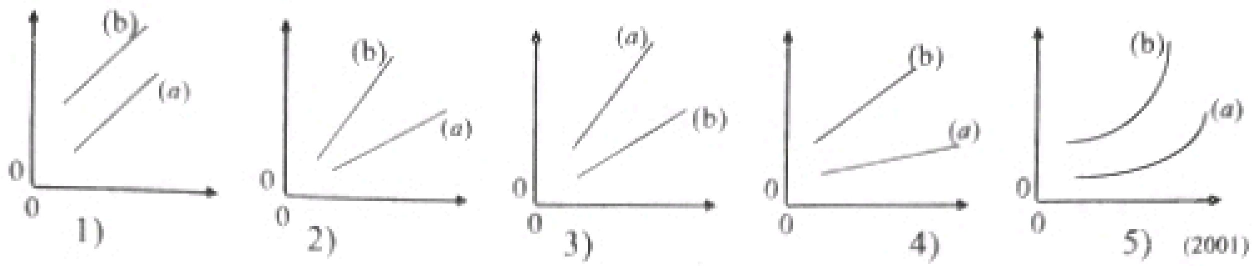
(1999)

(18) A tube of length l closed at one end is slowly lowered vertically into a liquid bath so that the open end first dips in the liquid. The air inside the tube does not escape. If the length of the air column inside the tube, becomes $\frac{l}{2}$ When the liquid meniscus inside the tube is at a depth H from the liquid surface of the bath, the atmospheric pressure expressed in terms of the height of the liquid column is,

1) $\frac{H}{2}$ 2) H 3) 2H 4) 3H 5) 4H

(1999)

(19) An ideal gas is kept inside a rigid container. Then another ideal gas is added into the container. The variations of pressure (P) inside the container with the absolute temperature (T) before adding the second gas (a) and after adding the second gas (b) are best represented by,

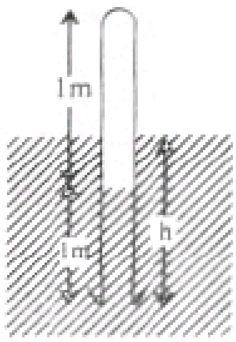


(2001)

(20) an ideal gas of volume $300cm^3$ at a pressure of 1 atmosphere and temperature of 27^0C is compressed to 5 atmospheres, and then heated to 127^0C at constant pressure. The new volume of the gas would be

1) $1500cm^3$ 2) $300cm^3$ 3) $80cm^3$ 4) $60cm^3$ 5) $45cm^3$ (2002)

(21) A uniform glass tube of length 2m with one end sealed contains air at atmospheric pressure. It is pressed vertically down into a mercury bath until the mercury rises halfway up in the glass tube as shown in the figure. If the atmospheric pressure is 76 Hg cm, then the depth h would be,

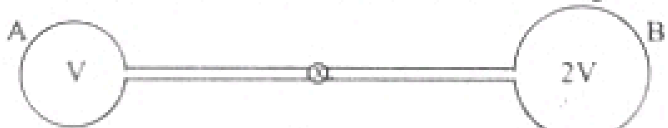


1) 124cm 2) 150 cm 3) 174cm
4) 176cm 5) 200cm (2002)

(22) At what temperature is the r.m.s. speed of nitrogen molecules equal to that of hydrogen molecules at 27^0C ? (A nitrogen molecule is 14 times as massive as a hydrogen molecule)

1) 6000^0C 2) 5200^0C 3) 3927^0C 4) 4900^0C 5) 3000^0C (2002)

(23) Two containers A and B of volumes V and 2V respectively, are connected by a narrow tube via a tap as shown in the figure. Initially, the tap is closed and A and B, each contains n moles of an ideal gas at same temperature. When the tap is opened and the steady state is reached the number of gas moles remaining in A is,



1) $\frac{n}{3}$ 2) $\frac{n}{2}$ 3) $\frac{2n}{3}$ 4) $\frac{3n}{4}$ 5) n (2003)

(24) When 1 g of each of the gases helium (relative atomic mass = 4) neon (relative atomic mass = 20) and argon (relative atomic mass = 40) are separately enclosed in the same container at the same temperature, the ratio of pressures exerted by the gases respectively is,

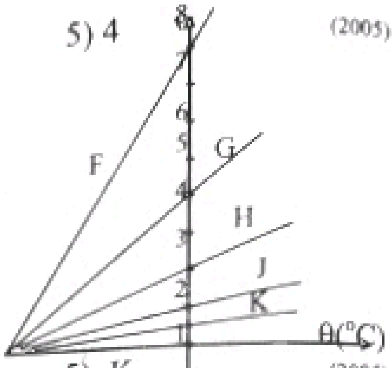
1) $\frac{1}{4}:\frac{1}{20}:\frac{1}{40}$ 2) 4 : 20 :40 3) $4^2 : 20^2 : 40^2$

4) $\frac{1}{4^2}:\frac{1}{20^2}:\frac{1}{40^2}$ 5) $\frac{1}{\sqrt{4}}:\frac{1}{\sqrt{20}}:\frac{1}{\sqrt{40}}$ (2004)

(25) Hygrogen gas is introduced into a container having Helium gas, until the pressure is doubled while keeping the colume and the temperature of the container constant. The ratio, $\frac{\text{number of Helium atoms}}{\text{number of Hydrogen molecules}}$ in the container is,

1) $\frac{1}{4}$ 2) $\frac{1}{2}$ 3) 1 4) 2 5) 4 (2005)

(26) The variation of the volume V with the temperature θ of an ideal gas of mass m at a constant pressure P is shown by the line H of the graph. The variation of V with θ of the same ideal gas of mass 2m at constant pressure $\frac{P}{2}$ is shown



1) F 2) G 3) H 4) J 5) K (2005)

(27) The oxygen molecule has 16 times the mass of the hydrogen molecule. At room temperature the ratio,

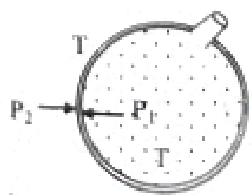
$\frac{\text{root mean square speed of oxygen molecules}}{\text{root mean square speed of hydrogen molecules}}$ is,

1) 16 2) 4 3) 2 4) $\frac{1}{4}$ 5) $\frac{1}{16}$ (2005)

(28) If two cylinders one containing argon gas and the other containing neon gas are kept at the same temperature, then.
1) the pressures of the gases must be equal.
2) the mean speed of the gas atoms of the two gases must be equal.
3) the gas atoms of the two gases must have the same root square speed.
4) the masses of the gas must be equal.
5) the gas atoms of the two gases must have the same mean translational kinetic energy.
(2006)

(29) Which of the following statement is true for a mixture of ideal at a given temperature?
1) All the gas molecules in the mixture have the same speed.
2) Molecules of each component of the gas mixture have the same average kinetic energy.
3) Lighter gas molecules have a lower average kinetic energy.
4) Heavier gas molecules have a lower average kinetic energy.
5) Root mean square velocities of gas molecules of each component of the gas mixture are the same.
(2007)

(30) Consider a rubber ballon filled with air. Inside and outside pressures of the balloon are P_1 and P_2 respectively, and temperatures on either side remain the same. Which of the following statements is true ?



1) $P_1 = P_2$ as the temperature on either side remain the same.
2) $P_1 > P_2$ due to higher mean speed of air molecules inside the balloon.
3) $P_1 > P_2$ due to higher mean kinetic energy of air molecules inside the balloon.
4) $P_1 > P_2$ due to higher rate of collisions of air molecules inside with the wall of the balloon.
5) $P_1 > P_2$ due to lower mean kinetic energy of air molecules inside the balloon.
(2008)

(31) The best vacuum that can be achieved in a laboratory has pressure of 10^{-13} Pa . The number of gas molecules presents in $1\ cm^3$ of such a vacuum at 300 K is (Take Boltzman constant $= \frac{4}{3} \times 10^{-23}\ J\ K^{-1}$)

1) 0 2) 5 3) 10 4) 25 5) 100 (2009)

(32) In order to double the root mean square speed of an ideal gas, the factor by which the absolute temperature of the gas to be increased is,

1) $\sqrt{2}$ 2) 2 3) 4 4) 8 5) 16 (2010)

(33) A fish in a lake releases an air bubble of volume $2.5 \times 10^{-7}\ m^3$. This bubble subsequently release a volume of $10^{-6}\ m^3$ air into the atmosphere. If the atmospheric pressure is 10^5 Pa and the density of water is $10^3\ kg\ m^{-3}$, depth of the position of the fish is, (neglect the effects of surface tension)

1) 30 m 2) 40 m 3) 50 m 4) 60 m 5) 80 m (2010)

(34) In an automobile engine, the gas (a mixture of air and petrol) in the cylinder is compressed to $\frac{1}{9}$ of its original volume. The initial pressure is 1.0 atm and the initial temperature is 27°C. If the pressure after compression is 21 atm, the temperature of the compressed gas is (Assume that the gas behaves as ideal).

1) 700°C 2) 523°C 3) 427°C 4) 327°C 5) 227°C (2011 NS)

(35) A vessel contains an ideal gas at 27°C . If the temperature of the gas is increased to 127°C, the ratio,

$\frac{\text{mean kinetic energy of the gas atoms at } 127°C}{\text{mean kinetic energy of the gas atoms at } 27°C}$ will become

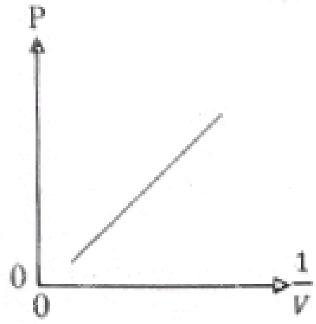
1) $\frac{127}{27}$ 2) $\frac{16}{9}$ 3) $\frac{4}{3}$ 4) $\frac{3}{4}$ 5) $\frac{27}{127}$ (2012 N)

(36) The atoms of an ideal gas have a certain mean kinetic energy at 10°C. Their mean kinetic energy will be twice at,

1) 20°C 2) 100°C 3) 293°C 4) 566°C 5) 600°C (2013)

(37) A student performed an experiment to verify the Boyle's Law using a constant mass m_0 of an ideal gas at the room temperature of 27 °C and obtained the graph given in the figure. Here P is the pressure and V is the volume of the gas.

He then removed a certain amount of gas from the volume V and repeated the experiment at a temperature 100 °C above the room temperature. If the new graph he obtained has the same gradient as the graph shown in the figure, the mass of the gas that he had removed is,



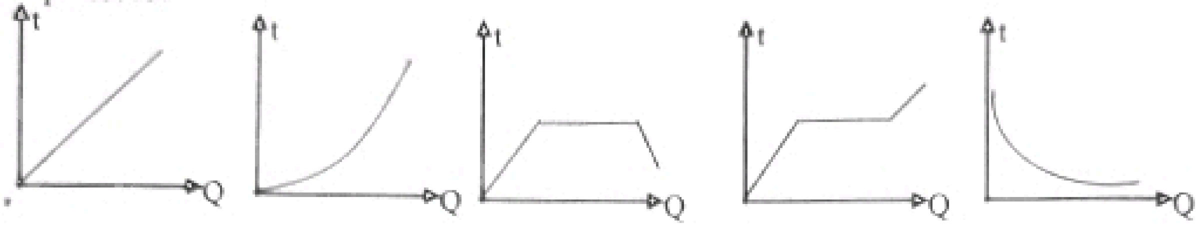
1) $\frac{27}{100}\ m_0$ 2) $\frac{73}{100}\ m_0$ 3) $\frac{1}{4}\ m_0$ 4) $\frac{1}{2}\ m_0$ 5) $\frac{3}{4}\ m_0$ (2016)

05. Calorimetry

(1) The ratio $\frac{\text{amount of heat required to raise the temperature of a body by } 1^0C}{\text{amount of heat required to raise the temperature of the same body by 1 K.}}$ takes the value,

1) 273 2) 1 3) $\frac{5}{9}$ 4) $\frac{100}{373}$ 5) $\frac{1}{273}$ (1991)

(2) Which of the following curves best represents the variation of temperature (t) with the heat supplied (Q) to a substance which undergoes a change of state at a given pressure?



1) 2) 3) 4) 5) (1991)

(3) In an experiment to find the specific latent heat (L) of ice using the method of mixtures a student dropped a large piece of wet ice without wiping out water on its surface in to a calorimeter containing water at room temperature. During the experiment he observed a layer of mist formed on the outer – surface of the colorimeter. He can expect a lower value for L

(A) as the ice cube was wet
(B) as the ice – piece takes a considerable time to melt
(C) due to the formation of mist

Of the above statements

1) Only (A) is true 2) Only (B) is true 3) Only (C) is true
4) Only (A) and (B) are true. 5) all (A),(B) and (C) are true (1991)

(4) Heat energy is supplied at the same rate to 100 g of paraffin and 100 g of water in two similar containers the temperature of paraffin rises faster. This is because the paraffin,

1) is more dense than water 2) is less dense than water
3) is a good conductor compared to water 4) has a smaller specific bar capacity
5) has a larger specific heat capacity. (1993)

(5) An immersion heater rated at 150W is embedded in al large block of ice at 0^0C. The specific latent heat of fusion of ice is $3 \times 10^5 J kg^{-1}$ how long does it take to melt 10 g of ice?

1) 2 s 2) 10 s 3) 20 s 4) 150 s 5) 4500 s (1993)

(6) The temperature of a hot liquid – wax in a container of negligible heat capacity falls at a rate 2 K per minute before it just begins to solidify. The temperature then remains steady for 10 min by which time the liquid has all solidified. The ratio $\frac{\text{specific latent heat of fusion of wax}}{\text{Specific heat capacity of liquid – wax}}$ is equal to

1) $\frac{1}{20}K$ 2) $\frac{1}{10}K$ 3) 1K 4) 10K 5) 20 K (1994)

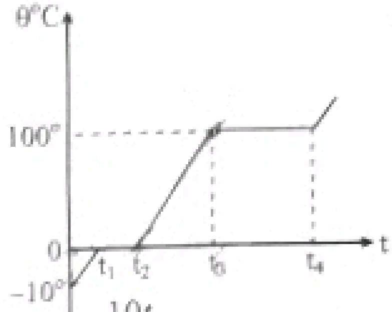
(7) When 10g of water at 100^0C is added to a certain amount of water at 30^0C the final temperature of the mixture is found to be 40^0C. Instead of 10 g of water 20 g of water at 100^0C is added, the final temperature of the mixture will become (neglect the heat capacity of the container and heat losses to the surroundings)

1) 45^0C 2) 47.5^0C 3) 50^0C 4) 52.5^0C 5) 55^0C (1995)

(8) 1 kg of water contained in a metal container of negligible heat capacity is heated with a 1 k W immersion heater, If the temperature rises from 25^0C to 45^0C in 100s. What is the average rate of heat loss to the surroundings from the container during this time? (Specific heat capacity of water is 4.2×10^3 $Jkg^{-1} K^{-1}$)

1) 40 W 2) 80 W 3) 160 W 4) 320 W 5) 640 W (1995)

Refer the graph given below to answer questions No 09 and 10



(9) Figure shows the variation of the temperature (θ) with time (t) of a certain amount of ice initially at -10^0C when heated at a constant rate.

The ratio $\dfrac{\text{Specific heat capacity of ice}}{\text{Specific heat capacity of water}}$ is,

1) $\dfrac{t_1}{(t_3-t_2)}$ 2) $\dfrac{10t_1}{(t_3-t_2)}$ 3) $\dfrac{t_3-t_2}{10t_1}$ 4) $\dfrac{t_3-t_2}{t_1}$ 5) $\dfrac{10t_1}{(t_3-t_1)}$ (1995)

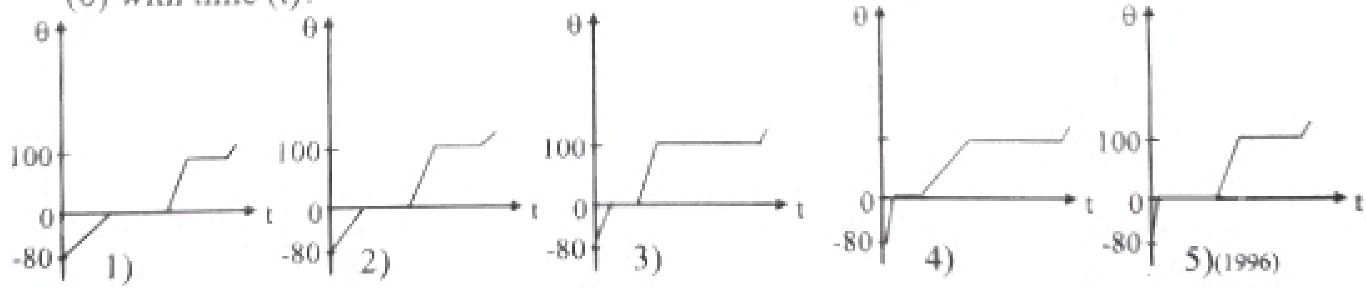
(10) In question No54 the ratio $\dfrac{\text{specific latent heat of fusion of ice}}{\text{Specific latent heat of vaporization of water}}$ is,

1) $\dfrac{t_4-t_3}{(t_2-t_1)}$ 2) $\dfrac{t_2}{t_4}$ 3) $\dfrac{t_2-t_1}{(t_4-t_3)}$ 4) $\dfrac{t_4-t_2}{(t_3-t_1)}$ 5) $\dfrac{t_3}{t_1}$ (1995)

(11) Assuming that no heat is lost to the surroundings, a final temperature of 50^0C could be obtained by mixing equal masses of,

1) ice at -5^0C and steam at 105^0C
2) ice at 0^0C and water at 100^0C
3) water at 0^0C and steam at 100^0C
4) ice at 0^0C and steam at 100^0C
5) water at 0^0C and water at 100^0C (1996)

(12) A certain quantity of crushed ice at 80^0C is heated at a constant rate until all the ice is converted into steam. Specific heat capacity of water is greater than that of ice. What of the following graphs best represents the variation of the temperature (θ) with time (t)?

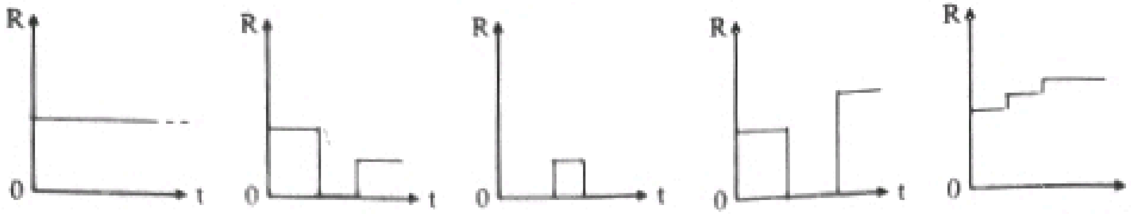


(1996)

(13) A lead bullet moving at a speed of 130 ms^{-1} is stopped inside a block of wood. The specific heat capacity of lead in 130 $kg^{-1}\,{}^0C$. If all the energy goes into heating the bullet, the increase in temperature of the bullet is,

1) 45^0C 2) 55^0C 3) 65^0C 4) 75^0C 5) 85^0C (1997)

(14) A metallic vessel containing a certain of water is heated uniformly at a constant rate. If the heat loss to the surroundings is neglected, then the rate of absorption of heat ® by the vessel when plotted against time (t) is represented by,



1) 2) 3) 4) 5) (1997)

(15) Equal amounts of heat was given to two liquids A and B of mass m and $\frac{m}{2}$ respectively. The liquid A has one half the specific heat capacity of the liquid B. If the increase in the temperature of liquids A and B are θ_A and θ_B respectively, then

1) $\theta_A = \theta_B$ 2) $\theta_A = \frac{\theta_B}{2}$ 3) $\theta_A = 2\theta_B$ 4) $\theta_A = \frac{\theta_B}{4}$ 5) $\theta_A = 4\theta_B$ (1998)

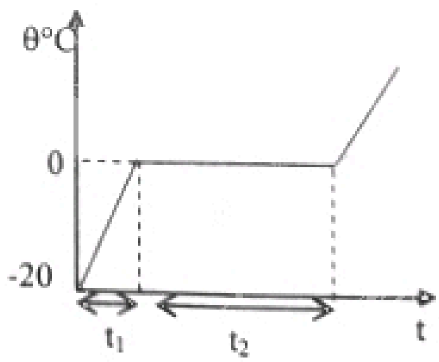
(16) At the atmospheric pressure the specific latent of fusion of ice and vaporization of water are 3×10^5 kg^{-1} and 20×10^5 Jkg^{-1} respectively. If the specific heat capacity of water is 4×10^3 $Jkg^{-1}\,^0C^{-1}$, the minimum amount of energy required to convert 1 kg of ice at 0^0C to steam at 100^0C under the atmospheric pressure is,

1) 27×10^5 J 2) 24×10^5 J 3) 23×10^5 J
4) 20×10 J 5) 7×10^3 J (2000)

(17) an electric heater is used to raise the temperature of water from 20^0C to 30^0C and supply hot water at a rate of 1 kg per minute. The minimum power of the heating element is (specific heat capacity of water = 4200 $Jkg^{-1}\,^0C^{-1}$)

1) 7W 2) 70W 3) 700W 4) 4200W 5) 8400W (2001)

(18) Heat is supplied at a constant rate to a certain amount of ice. The variation of temperature θ with time t is shown in the figure. If the specific heat capacity of ice is C and specific latent heat of fusion of ice is L, $\frac{t_2}{t_1}$ ratio is,



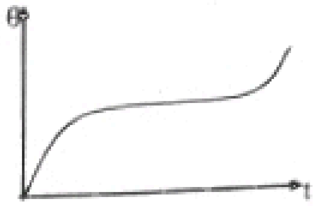
1) $\frac{L}{C}$ 2) $\frac{C}{L}$ 3) $\frac{20L}{C}$ 4) $\frac{L}{20C}$ 5) $\frac{LC}{20}$

(2001)

(19) 10 g of steam at 100^0 C is mixed with 10 g of ice at 0^0C . The final temperature of the mixture will most likely to be

1) 40^0C 2) less than 40^0C 3) 45^0C 4) 50^0C 5) greater than 50^0C (2002)

(20) When a certain amount of matter is heated at a constant rate, the variation of its temperature (θ) with time (t) is given by the curve shown in the figure. Consider the following statements made about the information that can be gathered from this curve about the matter.



(A) Matter shows a change of state with temperature
(B) Matter should have a large value for its specific latent heat of fusion/ vaporization
(C) Matter definitely has attained its boiling point.

Of the above statements

1) only (A) is true 2) Only (C) is true 3) only (A) and (B) are true
4) only (B) and (C) are true 5) all (A), (B) and (C) are true (2002)

(21) an electric water heater has to supply hot water at 40^0C at a constant rate of 1 kgs^{-1} from water at 30^0C . If the heat loss to surroundings is neglected, the minimum power of the heating element of the heater should be (specific heat capacity of water is 4200 J kg^{-1} $^0C^{-1}$)

1) 4.2×10^4W 2) 4.2×10^3 W 3) 1.2×10^4 W
4) 1.8×10^4W 5) 1.8×10^3 W (2003)

(22) A mass m_i of ice at 0^0C is added to a mass m_w of water at the room temperature of 30^0C , and the mixture is stirred until the ice is completely dissolved in water. If the minimum; temperature of the mixture is found to be 10^0C, the amount of heat absorbed by the mixture from the container and the environment is,
(Specific heat capacity of water = S_w, Latent heat of fusion of ice = L)

1) $m_1 \dfrac{(L+10S_w)}{20m_w S_w}$ 2) $m_i(L+10S_w)-20m_w S_w$

3) $10m_w S_w m_i(L+10S_w)$ 4) $m_i(L+10S_w)-10m_w S_w$

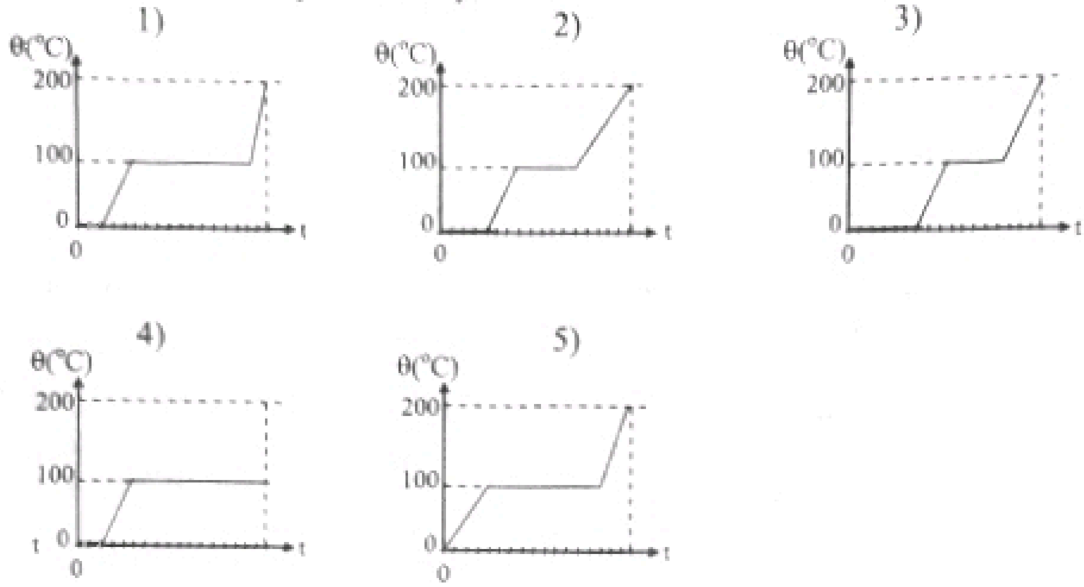
5) $20m_w S_w - m_i(L+10S_w)$ (2004)

(23) A metal block *X* of mass m at temperature 0°C is made to contact with another metal block *Y* of mass 2m at temperature 100°C. Heat transfer takes place between *X* and *Y* with no heat loss to the surrounding. The specific heat capacities of the *X* and *Y* metals are C_X and C_Y respectively. If the final equilibrium temperature of the metal blocks is 20°C then,

1) $C_X = 8\,C_Y$ 2) $C_X = 4C_Y$ 3) $C_X = 2C_Y$ 4) $C_X = \frac{1}{2}C_Y$ 5) $C_X = \frac{1}{4}\,C_Y$

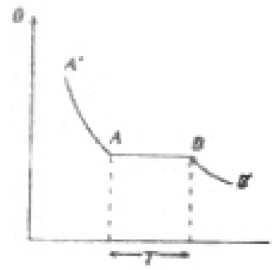
(2005)

(24) Crushed ice piece at 0°C are kept inside a thermally insulated closed container. Heat is supplied to the container at a constant rate and the pressure inside the container is kept constant. The variation of the temperature inside the container with time is best represented by,



(2005)

(25) Figure shows the cooling curve of liquid wax of mass m, specific heat capacity S_1 and intent heat of fusion L. The heat capacity of the container can be neglected.



Consider the following statements,

A) Gradient of the curve AA' at A is equal to the gradient of the curve BB' at B.

B) The rate of heat released to the surrounding during the time T is $\frac{mL}{T}$.

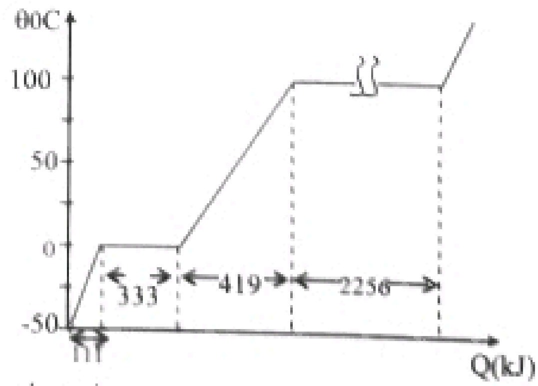
C) Gradient of the curve AA' at A = $\frac{1}{S_1}.\frac{L}{T}$.

Of the above statements,

1) only (A) is true.
2) only (A) and (B) are true.
3) only (B) and (C) are true.
4) all (A), (B) and (C) are true.
5) all (A), (B) and (C) are false

(2007)

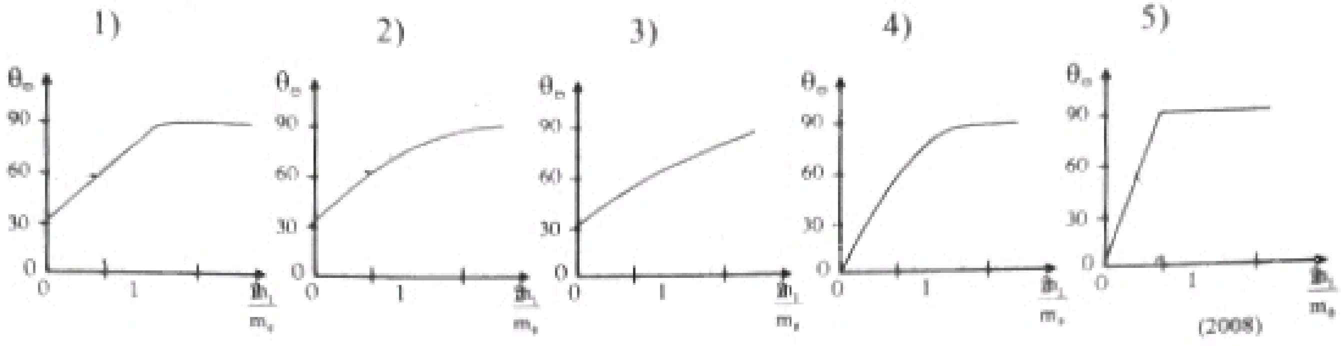
(26) The figure shows the amounts of heat Q (in kJ) absorbed by 1 kg of ice under each of the states when it is heated from temperature - 50°C to 100°C. Which of the following statements is incorrect ?



1) Specific latent heat of fusion of ice is 333×10^3 J kg^{-1}.
2) Specific latent heat of vaporization of water is 2256×10^3 J kg^{-1}.
3) Specific heat capacity of ice is 1110 J kg^{-1} °C^{-1}.
4) Specific heat capacity of ice is less than that of water
5) Specific heat capacity of water is 4190 J kg^{-1} °C^{-1}.

(2008)

(27) A vessel of negligible heat capacity contains water of mass m_0 at the room temperature of 30°C. When a mass m_1 of water at 100°C is added to the vessels, the maximum of the mixture becomes θ_m (neglect heat losses). The variation of θ_m with $\frac{m_1}{m_0}$ is best represented by,



(2008)

(28) Minimum amount of heat that is necessary to melt completely an ice cube of mass 30g at 0°C is (Specific intent heat of fusion of ice is 3.3×10^5 J kg^{-1})

1) 11 J 2) 990 J 3) 1 100 J 4) 9 900 J 5) 11 000 J (2009)

(29) SI unit of the quantity of heat is,

1) cal 2) W 3) K 4) J 5) cd (2010)

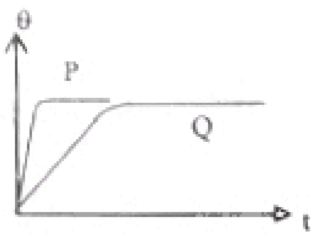
(30) An electric kettle requires 0.2 kWh to raise the temperature of 2 kg of water from 28 °C to the boiling point of 100 °C. If the specific heat capacity of water is 4200 J kg^{-1} K^{-1}, the efficiency with which the kettle works is

1) 42% 2) 54% 3) 60% 4) 72% 5) 84% (2010)

(31) A 110 W immersion heater is placed in a metal container of heat capacity 200 J K^{-1} containing 1kg of water. It is found that although the heater is kept switched on for a long time the temperature of water risk only up to 90°C. The temperature of water 10s after turning off the heater, is closest to, (specific heat capacity of water = 4200 J kg^{-1} K^{-1})

1) 89.50°C 2) 89.68°C 3) 89.70°C 4) 89.73°C 5) 89.75°C (2010)

(32) The variation of temperature (θ) with time(t) for two liquids P and Q of equal masses heated in identical manner are shown in the figure.

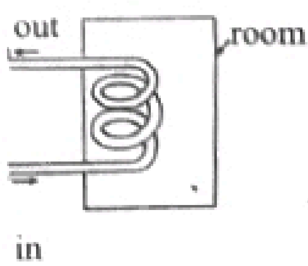


Consider the following statements,

a. Liquid Q is a better thermometric liquid than P to measure temperature variation in small quantities of liquids.

b. Liquid Q is more suitable than P to construct a constant temperature liquid bath.

c. Liquid Q is better than liquid P for heating air in an enclosed room by reading through a spiraled pipe as shown



Of the above statements,

1) only (A) is true 2) only (B) is true

3) Only (A) and (B) are true 4) only (B) and (C) are true

5) all (A), (B) and (C) are true (2010)

(33) Heat is supplied at a steady rate to a block of ice in a container at 0°C. After a time t, the block of ice has converted completely to steam at 100°C. (specific latent heat of fusion of ice = 3×10^5 J kg^{-1}, specific heat capacity of water = 4×10^3 J Kg^{-1} K^{-1}, specific latent heat vaporization of water = 2×10^6 J kg^{-1}, Neglect the heat capacity of the container and heat loss to the surroundings). At time $\frac{t}{2}$, the container has,

1) ice and water at 0°C.
2) water at 30°C
3) water at 50°C
4) water at 70°C
5) water and steam at 100°C

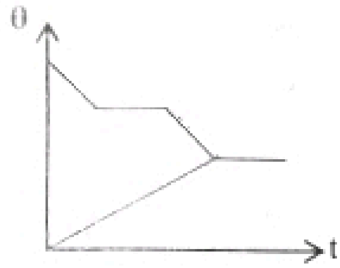
(2011 NS)

(34) The mass of body A is twice that of body B. The specific heat capacity of the material of body A is three times that of body B. They are supplied with equal amounts of heat. If the body A experiences a temperature change of ΔT, then body B will experience a temperature change of,

1) $\frac{\Delta T}{2}$
2) $\frac{2}{3}\Delta T$
3) ΔT
4) $\frac{3}{2}\Delta T$
5) 6T

(2012 N)

(35) Small amounts of water and ice of identical masses are placed in a thermally insulated container and allowed to come to thermal equilibrium. The variation of the temperature (θ) of water and ice are recorded with time (t) and are shown in the same graph. Which of the following conclusions can be drawn about the behaviour of water and ice from the given graph ?



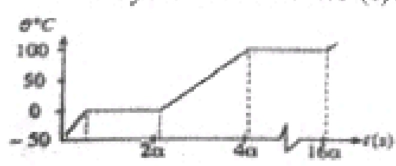
1) water has fully frozen and no ice has melted.
2) water has partly frozen and no ice has melted.
3) water has partly frozen and ice has fully melted.
4) water has fully frozen and ice has fully melted.
5) water has fully frozen and ice has partly melted.

(2012 N)

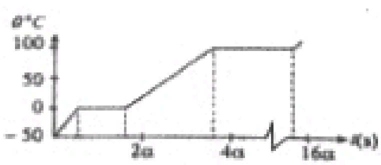
(36) A piece of ice of mass 0.1 kg at -50^0C is heated uniformly by providing heat energy at a constant rate of 10 W. If the specific heat capacity of ice is α, in SI units, the values of the other relevant quantities in terms of α can be given approximately as follows.

Specific heat capacity of water	=	2α
Latent heat of fusion of ice	=	160α
Latent heat of vaporization of water	=	1200α

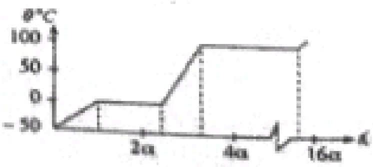
Which of the following graphs best represents the variation of the temperature (θ) of the system with time (t)?



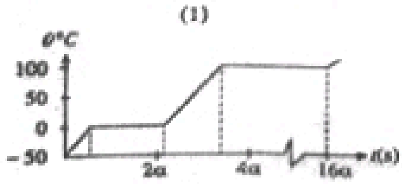
(1)



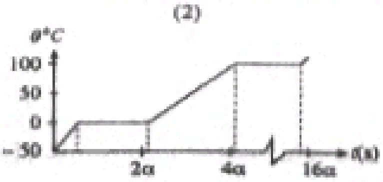
(2)



(3)



(4)



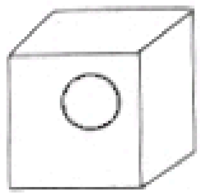
(5)

(2015)

37) During the recent hot season, the night time temperature of a certain room with closed windows in a house made of bricks was observed to be 35 °C. A person opened the windows of the room for a few minutes at night and allowed the room to be filled with cooler air at 27 °C which was present outside the house. Once the windows were closed again, he observed that the temperature of the room had returned almost to 35 °C in a quick time. Which of the following reasons he had proposed to explain the observed effect is most **unlikely** to be accepted?

1) Rapid movement of air molecules inside the room.
2) Collision of air molecules with the walls.
3) Low specific heat capacity of air.
4) Low thermal conductivity of air.
5) High specific heat capacity of brick walls. (2016)

38) A cube of ice of mass 1 kg at 0 °C has a small metal sphere trapped inside as shown in the figure. It was found that this ice cube requires 300 kJ of heat energy to completely melt and form water at 0°C. Specific latent heat of fusion of ice is 330 kJ/kg. The mass of the metal sphere in grams is approximately.



1) 30 2) 33 3) 91 4) 110 5) 333 (2016)

06. Thermodynamics

(1) Consider the following statements made about an ideal gas undergoing a process

(A) for a constant volume process $\Delta Q = \Delta U$
(B) for an isothermal process ΔU is always zero
(C) for an adiabatic compression $\Delta U > 0$

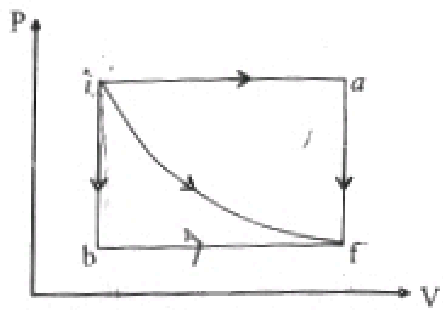
Of the above statements

1) Only A is true 2) Only A and B are true 3) Only B and C are true
4) Only A and C are true 5) all A, B and C are true (1997)

(2) In a certain process 500 J of heat is supplied to a system while 100 J of work is done on the system . As a result of this process the internal energy of the system will,

1) increase by 600 J 2) decrease by 600J 3) increase by 400J
4) decrease by 400 J 5) remain unchanged (1998)

(3) An ideal gas can be taken from an initial state i to a final state f by the processes $i \rightarrow f$ or $i \rightarrow a \rightarrow f$ or $i \rightarrow b \rightarrow f$ as shown on the P – V diagram Consider the following statements.



(A) Maximum work is done by the system during the process iaf

(B) the change in internal energy of the system is the same for all three processes

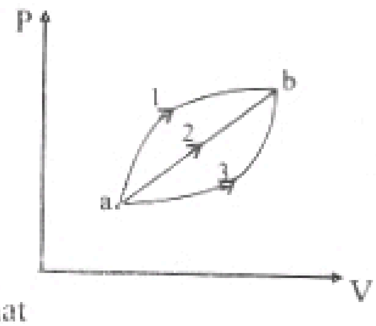
(C) the maximum heat absorption occurs during the process ibf

Of the above statement

1) Only (A) is true 2) Only (B) is true 3) Only (C) is true
4) only (A) and (B) are true 5) all (A), (B) and (C) are true

(1999)

(4) An ideal gas is taken from state 'a' to state 'b' to state 'b' separately along the three paths shown in the P-V diagram. If $U_b > U_a$ consider the following statements



(A) The work done by the gas is same for all three processes

(B) Heat is absorbed when the gas is taken along path 1 whereas heat is liberated when taken along path 3

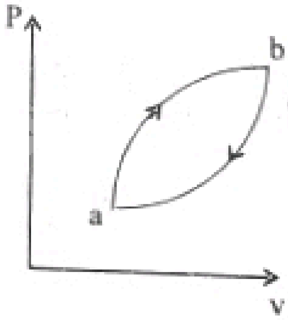
(C) The temperature of the gas at state b is higher than that at state a

Of the above statements

1) Only (A) is true 2) Only (B) is true 3) Only (C) is true
4) Only (A) and (B) are true 5) all (A), (B) and (C) are true

(2000)

(5) An ideal gas is taken through a cyclic process as shown in the p – v diagram. If $U_b > U_a$ consider the following statements



(A) The net work done by the gas is positive for the whole process

(B) Heat is absorbed along the path a- b whereas heat is liberated along the path b – a

(C) The temperature of the gas at the beginning of the process is same as that at the end of the process

Of the above statements

1) Only (A) is true 2) Only (A) and (B) are true
3) Only (A) and (C) are true 4) Only (B) and (C) are true
5) all (A), (B) and (C) are true

(2001)

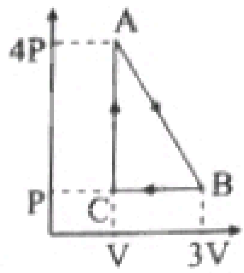
(6) In an adiabatic process always

1) no heat enters or leaves the system
2) no work is done on the system or by the system
3) the temperature of the system or by the system
4) the pressure of the system remains constant
5) the volume of the system remains constant

(2003)

(7) Work done during the cyclic thermodynamic process

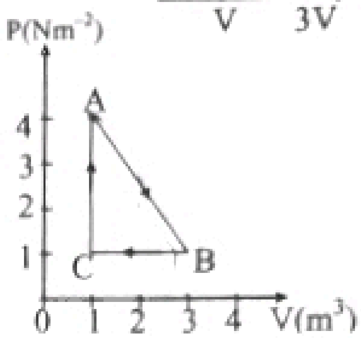
1) PV
2) 2PV
3) 3 PV
4) 4PV
5) 5 PV



(2004)

(8) Figure shows a *PV* diagram of a perfect gas subjected to a cyclic process *ABCA*. In this process,

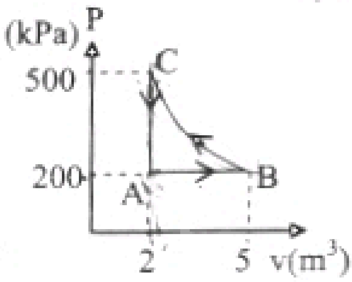
1) 3J of heat is absorbed by the system.
2) 3J of heat is removed from the system.
3) 6J of heat is absorbed by the system.
4) 6J of heat is removed from the system.
5) to heat to absorbed or removed from the system



(2005)

(9) An ideal gas undergoes the cyclic path *ABCA* in the *PV* diagram shown *BC* is an isothermical path. The work done by the gas during one cycle is nearly equal to,

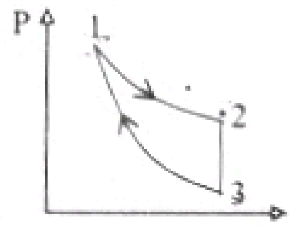
1) 600 kJ 2) 300 kJ 3) 0
4) – 300 kJ 5) – 600 kJ



(2006)

(10) An ideal gas in taken through a thermodynamic cycle as shown in the figure. Process 1 - 2 is isothermal and during the process 60 J of heat enters the system. Process 2 - 3 takes place at contant volume and during this process 40 J of heat leaves the system. The change in the internal energy in the process 3-1 is

1) -40 J 2) -20 J 3) 0 4) + 20J 5) + 40 J



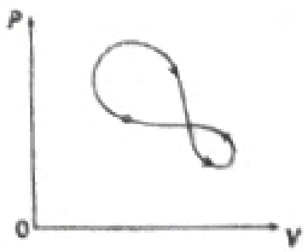
(2007)

(11) An ideal gas undergoes a cyclic process as shown in the figure. Consider the following statements.

(A) Over a complete cycle a net work is done by the gas.
(B) Over a complete cycle a net heat goes out of the gas.
(C) The temperature of the gas remains unchanged throughout the cycle

Of the above statements,

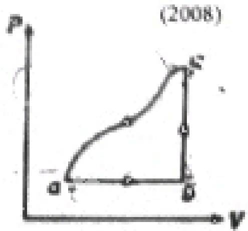
1) only (A) is true 2) only (B) is true.
3) only (A) and (B are true 4) only (B) and (C) are true.
5) all (A), (B) and (C) are true.



(2008)

(12) Figure shows a closed P – V cycle for an ideal gas. The change in internal energy along path *ca* is - 160 J.
The heat transferred to the gas is 200J along path ab, and 40J along bc. The work done by the gas along ab is,

1) 80 J 2) 100 J 3) 280 J 4) 320 J 5) 400 J



(2009)

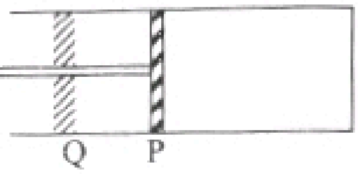
(13) Air is rapidly pumped into a tyre by a bicycle pump. Which of the following is true for air inside the pump during the pumping process ? (Here all the symbols have their usual meaning)

	ΔQ	ΔW	ΔU
1)	0	negative	positive
2)	positive	positive	positive
3)	0	positive	negative
4)	0	positive	positive
5)	negative	negative	positive

(2010)

(14) An ideal gas in a cylinder is expanded by moving the piston from P to Q.

(A) very slowly (B) very rapidly



Which of the following answers correctly represents the change in temperature ΔT. (+ or –) of quantities ΔQ, ΔU and ΔW for the two processes (A) and (B) ? (All symbols have their usual meaning)

	Process	ΔT	ΔQ	ΔU	ΔW
1)	(A)	0	+	0	+
	(B)	–	0	–	+
2)	(A)	0	+	0	+
	(B)	–	0	–	–
3)	(A)	–	+	–	+
	(B)	0	–	0	+
4)	(A)	0	+	0	+
	(B)	–	0	+	+
5)	(A)	+	+	+	+
	(B)	–	0	–	–

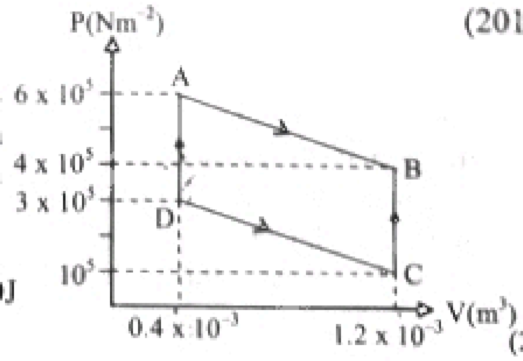
(2011 NS)

(15) Consider a process where air is quickly leaking out of a balloon. Which of the following is true for this process ?

	ΔQ	ΔW	ΔU
1)	+	+	+
2)	–	–	–
3)	0	0	0
4)	0	–	–
5)	0	+	–

(2012 N)

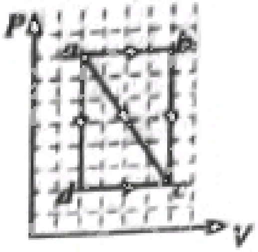
(16) A system undergoes a cyclic process according to the P – V diagram shown in figure. The work done by the system from A to B and from B to C, respectively are



1) 400J, 0 2) 400J, 360J 3) 480J, 360J 4) 480J, 0 5) 520J, 0

(2013)

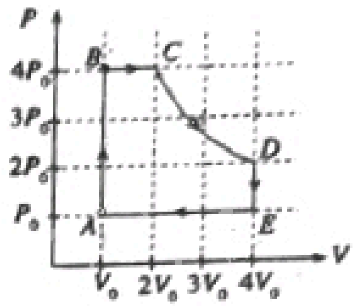
(17) An ideal gas can expand from state a to state c along three thermodynamic paths adc, ac and abc as given in the P – V diagram. Along which of the above paths would the highest exchange of heat occur?



1) Path adc
2) Path ac
3) Path abc
4) Path adc and ac equally
5) Path adc and abc equally

(2014)

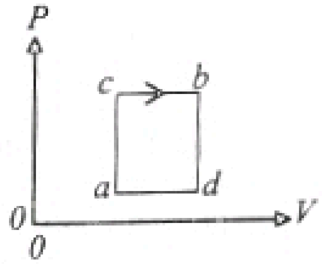
(18) A fixed mass of an ideal gas undergoes a cyclic process as shown in the P-V diagram. If the temperatures of the points A, B, C, D and E are T_A, T_B, T_C, T_D and T_E respectively, then"



1) $T_A > T_B > T_C > T_D > T_E$
2) $T_A = T_B < T_C < T_D = T_E$
3) $T_C = T_D > T_B = T_E > T_A$
4) $T_A = T_B > T_C > T_D = T_E$
5) $T_D = T_C > T_B > T_A = T_E$

(2015)

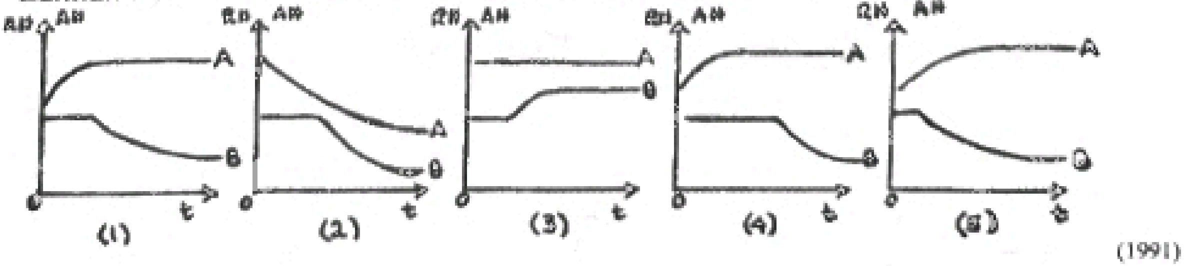
19) An ideal gas is taken from state *a* to state *b* through two paths *acb* and *adb* as shown in the *P* – *V* diagram. When going through path *acb*, 100 J of heat is absorbed and 50 J of work is done by the gas. If the work done by the gas, when taking the path *adb* is 10 J, the amount of heat absorbed by the gas during the path *adb* is,



1) 40 J
2) 50 J
3) –50 J
4) 60 J
5) – 60 J(2016)

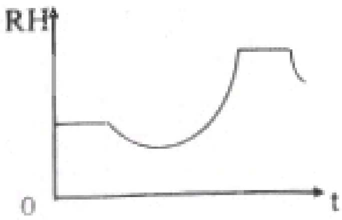
07. Hygrometry

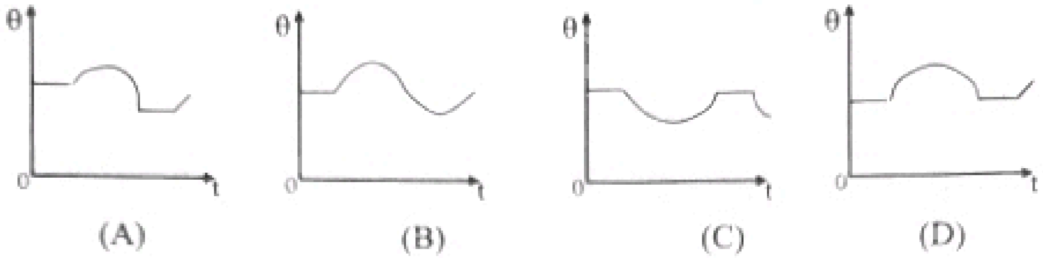
(1) which one of the following curves best represents the variation of the relative humidity RH with time t (i.e curve A) and the variation of the absolute humidity AH with time t. (i.e.. curve B) of air inside a closed empty refrigerator in a Sri Lankan home which is switched on for the first time ?



(1991)

(2) The graph shown represents the variation of the relative humidity (RH) of a closed room with time (t) of the day due to the change in temperature. Which of the following graphs correctly represents the variation of the temperature (θ) in side the room with the time,



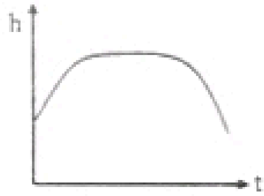


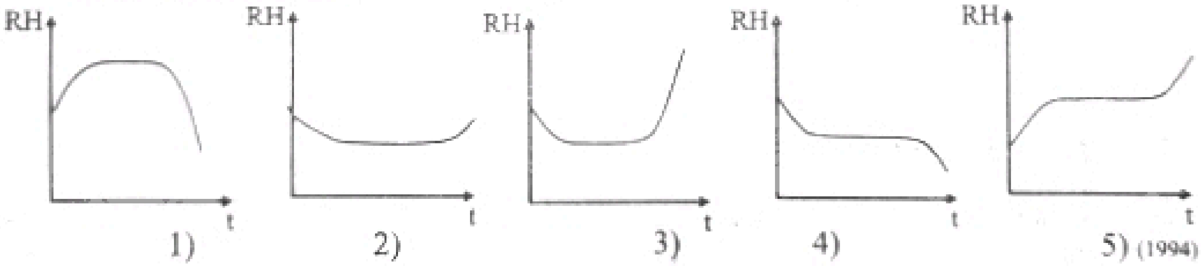
1) A Only 2) B Only 3) C Only 4) D Only 5) A and B Only (1992)

(3) A region with maximum relative humidity and minimum absolute humidity is most likely to by found in a place

1) just above the surface of boiling water
2) just above the surface of a block of ice kept in still air at 30^0C
3) Inside a closed room at dew point
4) inside a closed freezer at -10^0C
5) inside a crowded room with less ventilation (1993)

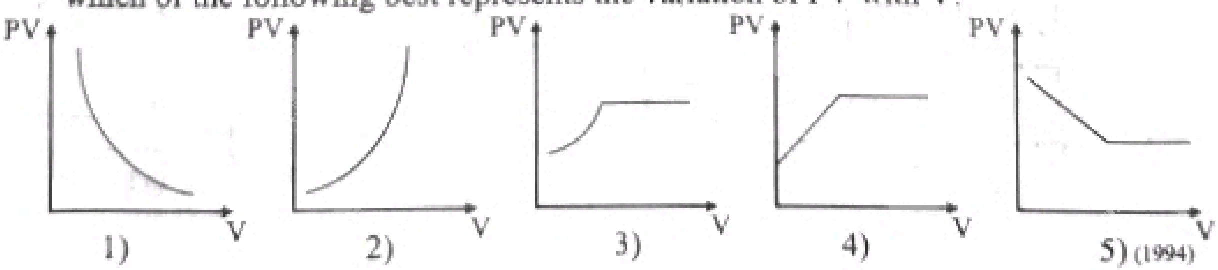
(4) Figure shows the variation of the difference between the dry and wet bulb thermometer readings with time kept at constant temperature. Which one of the following curves best represents the variation of the relative humidity (RH) inside the room with ?





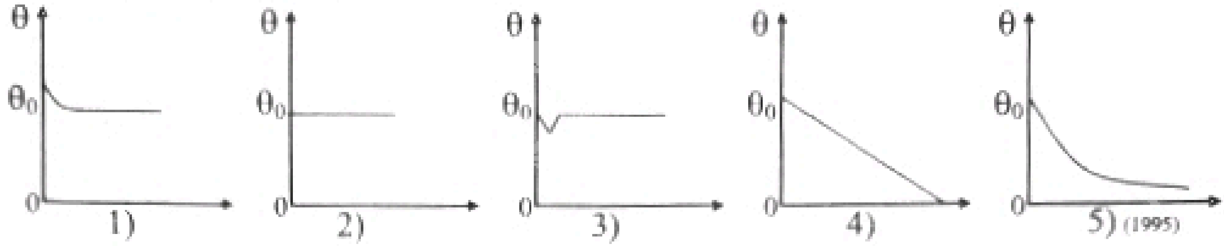
(1994)

(5) The total volume of a mixture of air and an unsaturated vapour is decreased at a constant temperature. If p is the total pressure and V is the volume of the mixture , which of the following best represents the variation of PV with V.



(1994)

(6) At time t = 0, the bulb of a sensitive mercury in glass thermometer is wrapped with a small piece of damped cloth which is at room temperature and left in still air in a room unsaturated with water vapour. If the temperature is θ_0 , which of the following curves best represents the variation of the variation of the thermometer reading (θ) with time (t)



(1995)

(7) large vessel of water is placed inside a closed room having a relative humidity of 50%. If the temperature remains constant, as time goes on,

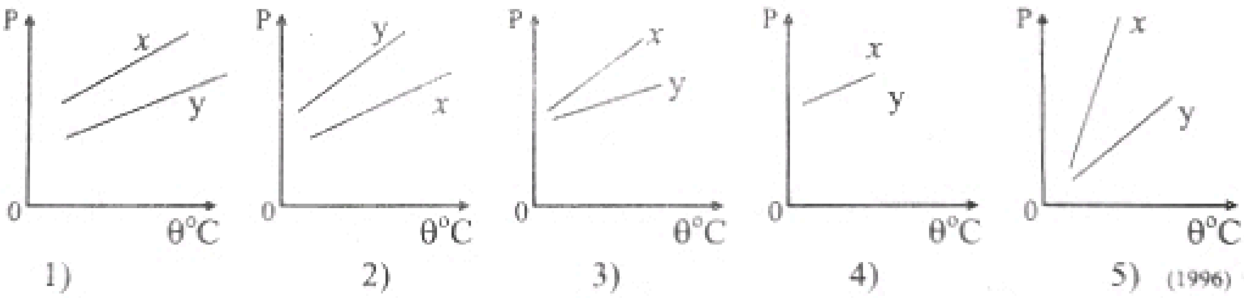
(A) absolute humidity inside the room will increase continuously
(B) relative humidity inside the room stays constant
(C) the dew point of the room becomes equal to the room temperature

Of the above statements

1) Only B is true   2) Only C is true   3) Only A and Bare true
4) Only B and C are true   5) all A, B and C are true   (1996)

(8) Two air samples, one dry and the other containing a little amount of water vapour (unsaturated) are used in an experiment to verify Charles law. If the masses of the two samples are the same which of the following pressure (P) versus temperature (θ) curves would you expect for the two samples?

Curve X represents the sample with water vapour
Curve Y represent the sample without water vapour



(1996)

(9) On a certain day, the dew point of a city X is twice that of a city Y, consider the following statements made above the two cities.

(A) The temperature of city Y should be twice that of X
(B) The relative humidity of city X should be twice that of Y
(C) The absolute of the city X at its dew point should be greater than that the city Y at is dew point.

Of the above statements,

1) Only A is true   2) Only C is true   3) Only B and C are true
4) Only A and C are true   5) all A, B and C are true   (1997)

(10) A vessel of volume V contains a mixture of an ideal gas and a saturated vapour. If the mixture is slowly compressed while keeping the temperature constant until the volume is reduced to $\frac{V}{2}$, then

1) the vapour pressure is reduced and the gas pressure is doubled
2) the vapour pressure is reduced and the gas pressure is doubled
3) the vapour pressure is doubled and the gas pressure remains constant
4) the vapour pressure is remains constant and the gas pressure doubled
5) both the vapour pressure and the gas pressure remains constant (1998)

(11) A closed room which is maintained at a constant temperature has a relative humidity of 50% . when the room is occupied by a few persons the relative humidity is found to be increased up to 70% . As a result the water vapour content inside the room is increased by,

1) 10% 2) 20% 3) 30% 4) 40% 5) 50% (1998)

(12) The saturated vapour pressure of water at 30^0C is 1.6×10^3 pa. The partial of water vapour on a day at 30^0C is 1.2×10^3 pa. The relative humidity on that day is,

1) 50% 2) 60% 3) 75% 4) 80% 5) 85% (1999)

(13) Dew cannot appear if

1) temperature is high, and relative humidity is 100%
2) temperature is low, and absolute humidity is equal to it s corresponding value at dew point.
3) temperature is high, and the absolute humidity is equal to its corresponding value at dew point.
4) temperature is below the dew point, and relative humidity is 100%
5) temperature is low, and the absolute humidity is less than the maximum possible value at that temperature. (2000)

(14) A liquid and its vapour are enclosed in a closed vessel. The volume of the vessel is expanded slowly at a constant temperature ensuring that some liquid is retained inside the vessel during the expansion. During the expansion

1) the vapour pressure increases linearly with the volume
2) the vapour pressure decreases linearly with the volume
3) the vapour pressure remains constant
4) the number of vapour molecules per unit volume increases
5) the kinetic energy of vapour molecules decreases (2000)

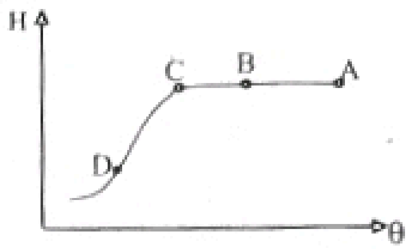
(15) Relative humidity inside a closed chamber can be increased by

(A) adding water vapour to the chamber
(B) by decreasing the temperature inside the chamber
(C) by decreasing the volume of the chamber

Of the above statements

1) Only (A) is true 2) Only (B) is true 3) Only (A) and (B) are true
4) Only (B) and (C) are true 5) all (A), (B) and (C) are true (2001)

(16) The curve shows the variation of the absolute humidity (H) of an isolated volume of atmosphere with temperature (θ) the relative humidity of the air volume corresponding to the



1) point A can be 100%
2) point B can be 100%
3) points A and C can be the same
4) point C can be less than 100%
5) point D can never be less than 100%

(2002)

(17) Consider the following statements made about the space just above a small block of ice placed in still air at a school laboratory, where room temperature and the relative humidity are 30^0C and 80% respectively.

(A) Absolute humidity of air in the space just above the ice block is higher than the absolute humidity of air away from the block

(B) Relative humidity of air in the space just above the ice block is higher than the relative humidity of air away from the block

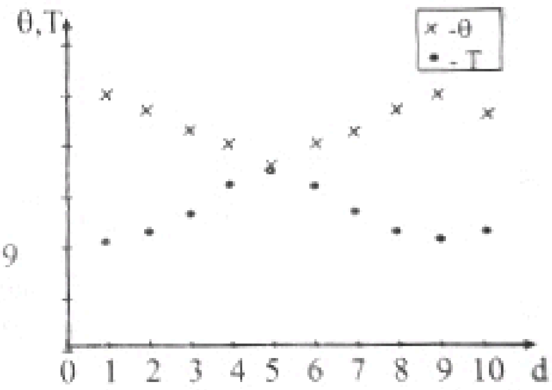
(C) Air in the space just above the ice block is drier than the air away from the block.

Of the above statements

1) Only (A) is true
2) Only(A) and (B) are true
3) Only (B) and (C) are true
4) Only (A) and (C) are true
5) all (A), (B) and (C) are true

(2003)

(18) The mean temperature (θ) and the dew point (T) of the atmosphere between 6.00 am and 8.00 a.m. in 10 consecutive days (d), 1-10 ,are shown in the figure. Consider the following statements made about the atmosphere.



(A) Relative humidity is maximum on day 9

(B) Day 6 has more water vapour in the atmosphere than on day 8.

(C) Mist is possible in none of the days

Of the above statements

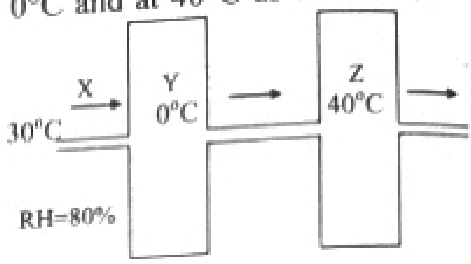
1) Only (B) is true
2) Only (A) and (B) are true
3) Only (B) and (C) are true
4) Only (A) and (C) are true
5) all (A), (B) and (C) are true

(2004)

(19) The concentration of water vapour inside a closed room at a certain temperature is 24.0 gm^{-3} and the relative humidity is 60%. If the air inside the room is made to saturate with water vapour at the same temperature the new water vapour concentration inside the room is,

1) 14.4 gm^{-3} 2) 24.0 gm^{-3} 3) 40.0 gm^{-3} 4) 60.0 gm^{-3} 5) 100.0 gm^{-3} (2005)

(20) Atmosphere air at 30°C and having 80% relative humidity is made to flow slowly through two large chambers. Y and Z maintained at 0°C and at 40°C as shown in figure.



Densities of saturated water vapour in the atmosphere at 0°C, 30°C and 40°C are 4.8 x 10^{-3} kg m^{-3}, 30 x 10^{-3} kg m^{-3} and 48 x 10^{-3} kg m^{-3} respectively. Which of the following tables correctly represents the relative humidities (RH), and the absolute humidities (AH) of air in the atmosphere (X) and in the chambers Y and Z?

1)

	X	Y	Z
RH	80	10	90
AH(kgm^{-3})	30×10^{-3}	4.8×10^{-3}	35×10^{-3}

2)

	X	Y	Z
RH	80	100	10
AH(kgm^{-3})	24×10^{-3}	4.8×10^{-3}	4.8×10^{-3}

3)

	X	Y	Z
RH	80	0	40
AH(kgm^{-3})	24×10^{-3}	4.8×10^{-3}	4.8×10^{-3}

4)

	X	Y	Z
RH	80	100	100
AH(kgm^{-3})	24×10^{-3}	4.8×10^{-3}	4.8×10^{-3}

5)

	X	Y	Z
RH	80	100	100
AH(kgm^{-3})	24×10^{-3}	4.8×10^{-3}	48×10^{-3}

(2006)

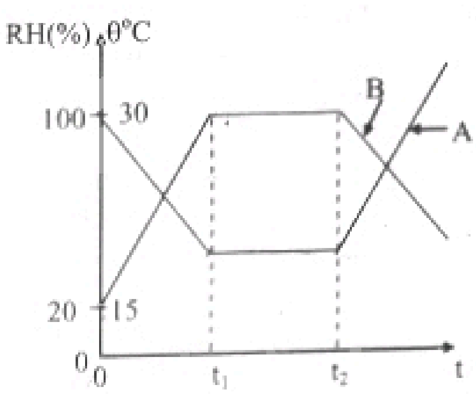
(21) A volume V_1 of air at 100% relative humidity is mixed with volume V_2 of completely dry air at the same temperature and pressure so that the final volume becomes $V_1 + V_2$. The relative humidity of the mixture is,

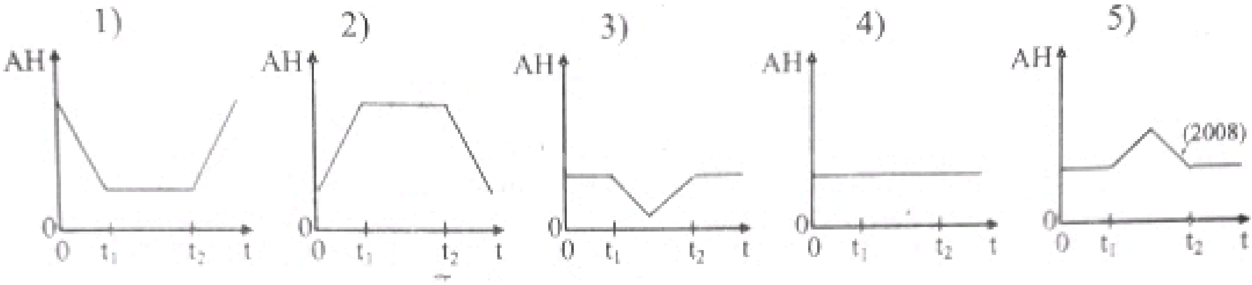
1) $\left(\frac{V_1}{V_2}\right)\times100\%$ 2) $\left(\frac{V_1 - V_2}{V_1 + V_2}\right)\times100\%$ 3) $\left(\frac{V_1}{V_1 + V_2}\right)\times100\%$

4) $\left(\frac{V_2}{V_1}\right)\times100\%$ 5) $\left(\frac{V_2}{V_1 + V_2}\right)\times100\%$

(2007)

(22) As shown in the figure the temperature (θ) of air inside a closed room is varied with time according to curve A. Its relative humidity (RH) is found to vary with time according to the curve (B). The corresponding variations of the absolute humidity (AH) of air inside the room with time (t) is correctly represented by,





(23) When a person wearing spectacles moves from room P to room Q he observed that a this film of water is deposited on the lenses. Consider the following that are given as necessary conditions for this to happen,
(A) Temperature of room P > Temperature of room Q
(B) Temperature of room Q > Temperature of room P
(C) Relative humidity of room P > Relative humidity of room Q
(D) Relative humidity of room Q > Relative humidity of room P
Which of the above conditions/s that should be satisfied for the above phenomenon to take place definitely.

1) (A) only
2) (B) only
3) (B) and (C) only.
4) (A) and (C) only
5) (B) and (D) only

(2009)

(24) Two empty boxes of volumes 0.1 m^3 and 0.3 m^3 filled with air at room temperature of 30 °C are sealed and stored in a refrigerator. A packet of moisture absorbing silica gel has been inserted into the 0.3 m^3 box just before sealing. Later it was found that the relative humidity of air inside the small box reached 100% at 15 °C and relative humidity of air inside the large box reached the 100% at 5°C. If the absolute humidites of air at the dew points of 5 °C and 15 °C are 6.8gm^{-3} and 12.7 g m^{-3} respectively. The amount of water vapour absorbed by the gel is,

(1) 1.77 g (2) 2.04 g (3) 3.81 g (4) 6.80 g (5) 12.70 g (2010)

(25) Water is found to condense on the outer surface of a cooled glass bottle of soft drink, when kept in the atmosphere. The total amount of water condensed before it reaches the atmosphere will not depend on,

1) initial temperature of the cooled bottle of soft drink.
2) thermal capacity of the bottle of soft drink.
3) rate of increase of temperature of the bottle of soft drink.
4) dew point of the atmosphere
5) the thermal conductivity of glass

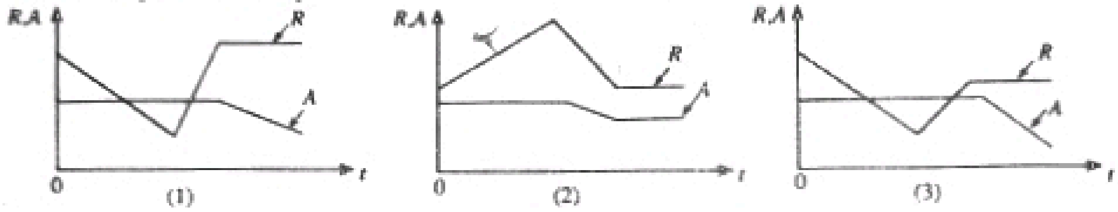
(2012 N)

(26) The initial relative humidity of a closed room of volume V at room temperature θ_0 is X%. The temperature and the relative humidity of the room are then reduced to θ_1 and Y% respectively using an air conditioner. If the absolute humidities of air at corresponding dew points of θ_0 and θ_1 are A_0 and A_1 respectively then the mass of water vapour that has been removed by the air conditioner is,

1) $\left(\frac{XA_0V - YA_1V}{100}\right)$ 2) $\left(\frac{XA_0}{Y} - \frac{YA_0}{Y}\right)100$ 3) $\left(\frac{X}{A_0Y} - \frac{Y}{A_1V}\right)\frac{1}{100}$

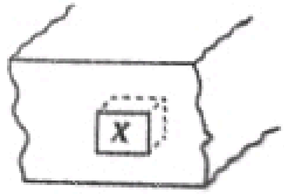
4) $\left(\frac{XV}{A_0} - \frac{YV}{A_1}\right)100$ 5) $\left(\frac{A_0V}{X} - \frac{A_1V}{Y}\right)100$ (2013)

(27) A certain volume of air, isolated from the atmosphere at 30°C, is first heated up to 80°C and then cooled down to 15°C at uniform a rates. Both heating and cooling are done at constant pressure. Dew point of the isolated air is 25°C. The variations of relative humidity (R) and absolute humidity (A) of the air volume with time (t) are best represented by



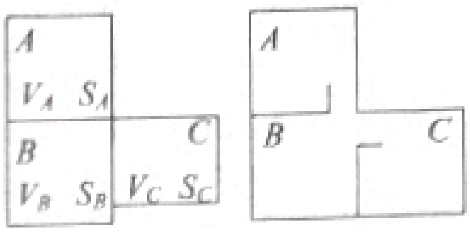
(2014)

(28) Figure shows a part of an outdoor brick – structure with a cubical – shrine (X) carved in as shown. The shrine is lime plastered and the front is sealed with a sheet of glass. It has been seen very often that water vapour condenses on the inner surface of the glass sheet, and it is found to happen mostly during the evenings. Which of the following deductions made by a student about this situation is most unlikely?



1) Although the shrine is sealed from the front side, water vapour can enter the shrine from the bulk of the brick structure.
2) Relative humidity at the vicinity of the inner surface of glass sheet varies during the course of the day.
3) Atmospheric temperature has no effect on the condensation of water vapour.
4) The bricks of the structure may have absorbed water during rainy seasons.
5) Condensation of water vapour can be reduced, if the walls of the shrine are water proofed and front sealed during a dry season. (2015)

(29) Absolute humidities of air inside three closed rooms A, B and C of volume V_A, V_B and V_C at atmospheric pressure are S_A, S_B and S_C respectively. [See figure (a)]. The dew point of air in room A is T_0. When the doors are opened as shown in figure (b) and the air in three rooms are allowed to mix, the common dew point of the three rooms will remain at T_0 if,

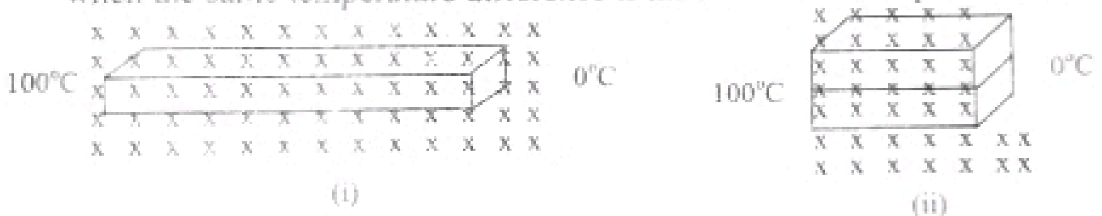


1) $S_A = \frac{V_B S_B + V_C S_C}{V_B + V_C}$ 2) $S_A = \frac{S_B + S_C}{2}$ 3) $V_A S_A = V_B S_B + V_C S_C$

4) $\frac{S_A}{V_A} = \frac{S_B}{V_B} + \frac{S_C}{V_C}$ 5) $S_A = \sqrt{S_B S_C}$ (2016)

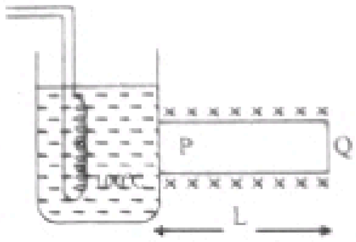
08. Conductivity

(1) Two well lagged identical rectangular metal beams are connected end to end as shown in figure (1). At steady state when a temperature difference of 100^0C is maintained across the ends, 10J of heat is found to flow through the beams in 2 minutes. If one beam is now placed on top of the other, with faces lagged as in figure (11), the time taken by the same amount of heat to flow through the beams when the same temperature difference is maintained at the open ends is,



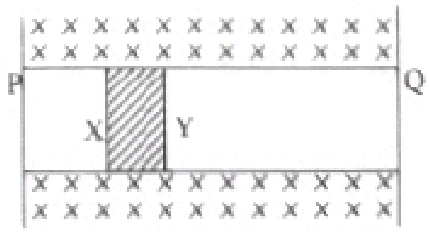
1) 0.25 min 2) 0.5 min 3) 1 min 4) 1.5 min 5) 2 min (1992)

(2) In the figure shown the immersion heater provides heat at the rate of W which maintains the temperature of the water in the reservoir at 100^0C. The rod PQ of length L and area of cross section A is lagged except its end Q and heat now through the rod under steady state condition. If K is the thermal conductivity of the material of the rod, then the minimum temperature to which the end Q can be lowered without altering the above mentioned conditions I,



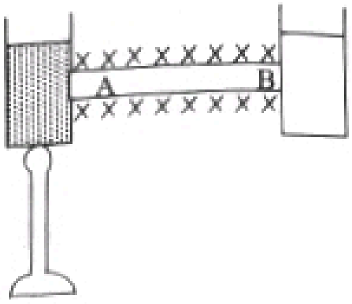
1) 0 2) $\frac{WL}{KA}$ 3) $100 - \frac{WL}{KA}$ 4) $\frac{100K}{LA}$ 5) $\frac{KA}{WL}$ (1993)

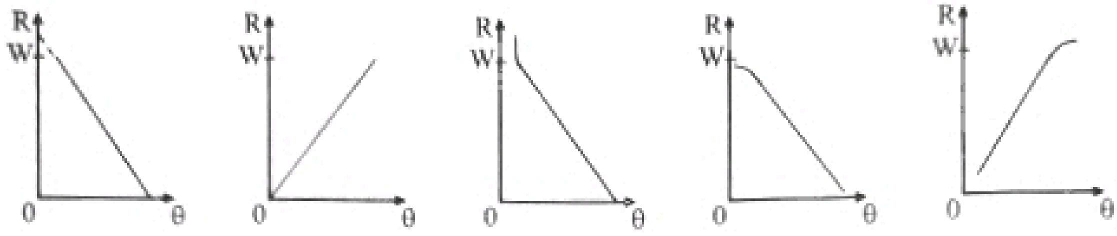
(3) A metal bar PQ encloses a section XY of another material as shown in the figure. The ends of the bar are maintained at different temperatures. The temperature difference between XY at the steady state is independent of



1) the temperature difference between P and Q
2) the material of the bar PQ
3) the length of XY
4) the material of XY
5) the position of XY along PQ (1994)

(4) End A of the well lagged uniform rod AB is kept in contact with a water reservoir which is supplied with heat at a constant rate (W). Temperature of the end B can be maintained at different values by adjusting the temperature θ of the adjoining reservoir. The rate of flow of heat (R) through the rod is measured under steady state conditions for different values of θ. Which of the following curves best represents the experimental data?



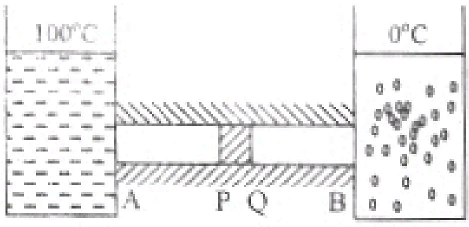


1) 2) 3) 4) 5) (1995)

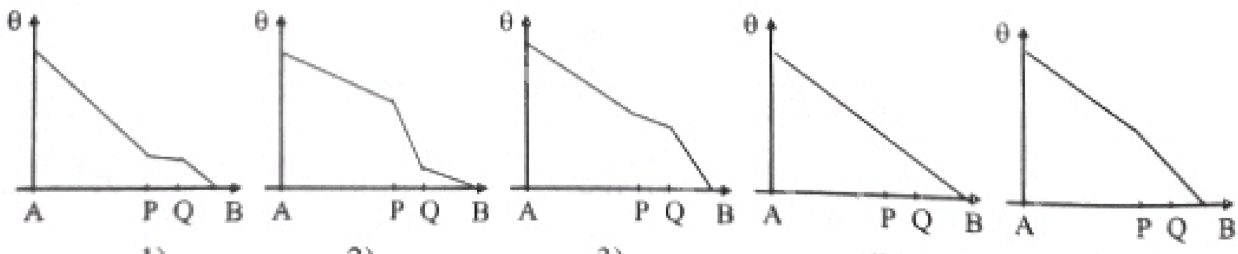
(5) A thin walled metal tank of surface area 4 m^2 is filled with water which is heated by a 1 kW immersion heater. The tank is covered with a 4 cm thick layer of insulation whose thermal conductivity is 0.2 W $m^{-1}K^{-1}$, In the steady state if the outer surface of the insulation is at 20^0C , the temperature of the water in the tank is (assume that there is no heat loss due to evaporation)

1) 35^0C 2) 50^0C 3) 60^0C 4) 70^0C 5) 80^0C (1996)

(6) The two ends of a well lagged uniform rod APQB are maintained at 100^0C and 0^0C as shown in the figure. The portion PQ of the rod is made of a different material, the thermal conductivity of which is smaller than that of the rest of the material, the thermal conductivity of which is smaller than

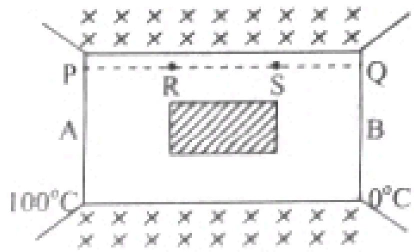


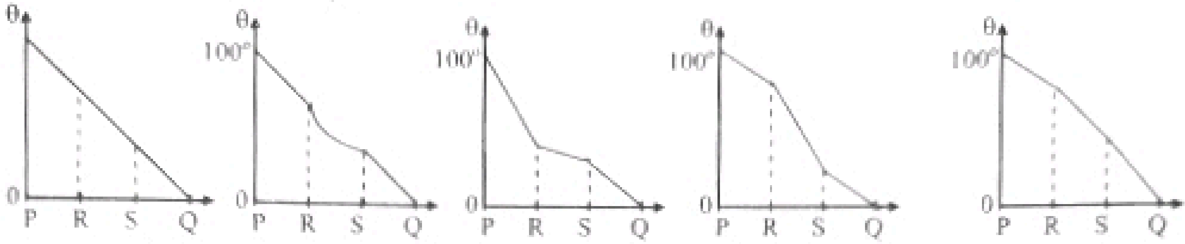
that of the rest of the material of the rod. Once the steady state is achieved, which of the following graphs best represents the variation of the temperature (θ) along the bar ?



1) 2) 3) 4) 5) (1997)

(7) As shown in the figure, a well lagged metal rod AB has a cylindrical cavity at its centre. The cavity is filled with a thermal insulating material, if the two ends A and B of the rod are maintained at the temperatures 100^0C and 0^0C respectively the variation of temperature (θ) along the dotted line PQ of the rod at steady state is best represented by,



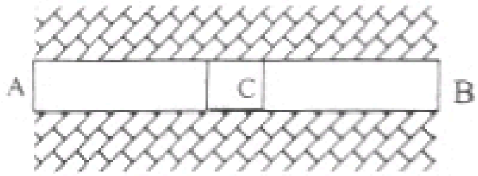


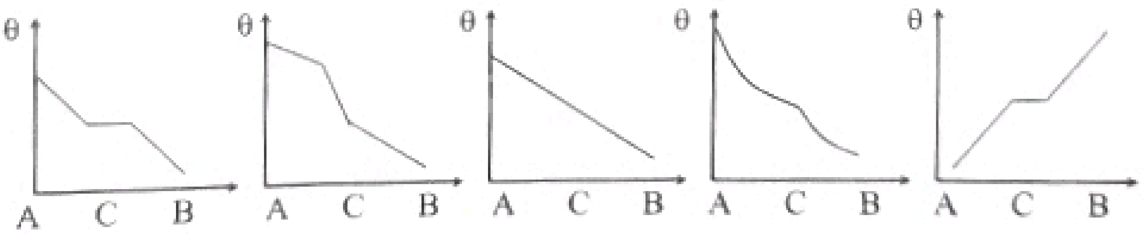
1) 2) 3) 4) 5) (1999)

(8) In an experiment to measure the thermal conductivity of a good conductor, a long bar of the material is normally used. The is to

1) obtain the steady-state condition
2) achieve a higher heat flow rate
3) obtain a practically measurable temperature difference along the bar
4) make lagging easy
5) ensure a parallel flow of heat along the bar. (2000)

(9) The rod AB is made by connecting two identical metal rods with a thin piece of a poorly conducting material C as shown in the figure. The rod is well lagged except at the two ends. If a steady heat flow in maintained from A to B, the variation of the temperature (θ) along the rod is best represented by,





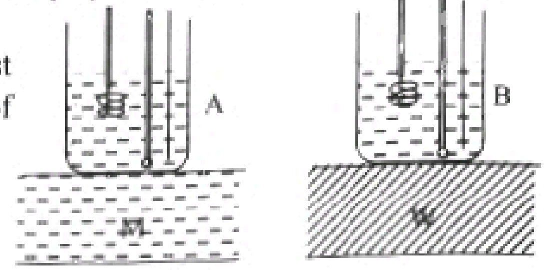
1) 2) 3) 4) 5) (2001)

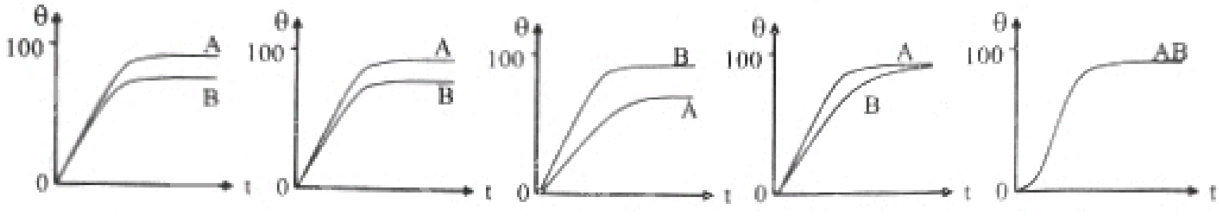
(10) When one touches a piece of metal in the environment one feels it to be colder than a piece of wood, because

1) the temperature of metal piece in the environment is generally lower than that of wood
2) metal pieces have a higher heat capacity
3) the temperature of wood is generally closer to the body temperature
4) metal has higher thermal conductivity than wood
5) surface emissivity of metal is higher than that of wood. (2002)

(11) Two identical thin metal cans A and B containing equal amounts of water are heated using two identical domestic electrical heaters. As shown in the figure, the cans A and B are kept on a large metal block (M) and a large wooden block (W) respectively.

Which of the following curves best represents the variation of temperature (θ) of water in A and B with time (t)?





1) 2) 3) 4) 5) (2003)

(12)

temperatures at the two ends of a composite cylindrical rod made of two similar pieces of different metals P and Q are maintained at 100^0C and 0^0C in two different situations (a) and (b) as shown in figures. The composite rod is well lagged, and the thermal conductivity of the metal P is twice that of Q. Consider the following statements made regarding the system at the steady state

(A) The temperature variation along the composite rod from hot end to cold end is the same in both situations (a) and (b)

(B) Temperature at the junction between tow metals of the composite rod is higher in the situation (a) than in (b)

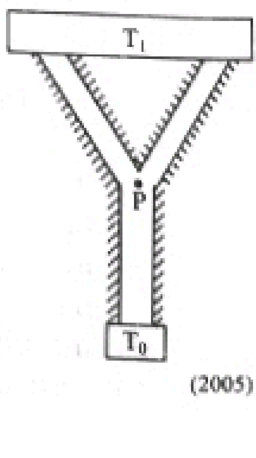
(C) The rates of flow of heat along the composite rod are the same in situations (a) and (b)

Of the above statements

1) Only (C) is true
2) Only (A) and (B) are true
3) Only (B) and (C) are true
4) Only (B) and (C) are true
5) all (A), (B) and (C) are true

(2004)

(13) A well lagged Y – shaped structure made of copper has three thin identical limbs. Free ends of two of the limbs are connected to a metal block which is maintained at temperature T_1 while the free end of the third limb is maintained at a temperature T_0. The steady state temperature of the junction *P* of the structure is,

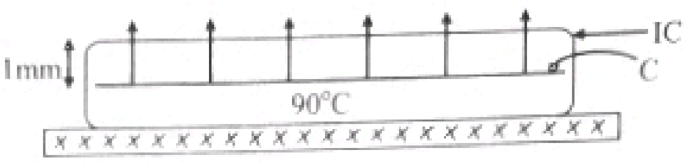


1) $\frac{T_0 + T_1}{2}$ 2) $\frac{3T_0 + T_1}{2}$ 3) $\frac{2T_0 + T_1}{3}$

4) $\frac{T_0 + 3T_1}{2}$ 5) $\frac{T_0 + 2T_1}{3}$

(2005)

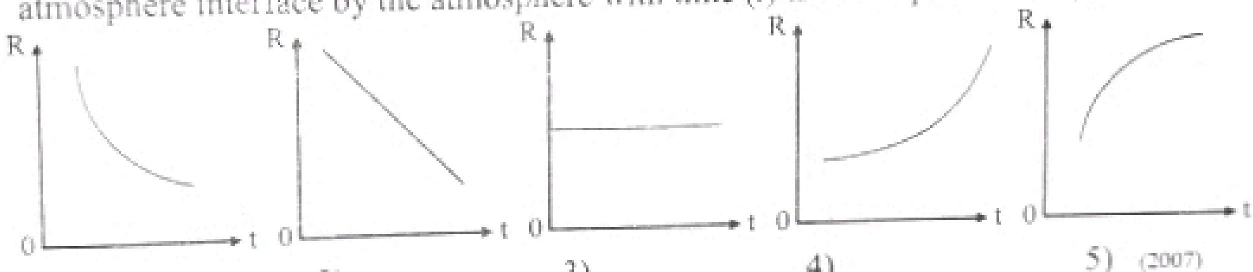
(14) The figure shows a cross section of an integrated circuit (IC) mounted on a circuit board. The core (C) of the *IC* (the electronic circuit) dissipates 60 W of power as heat.



The core is covered with a material of thermal conductivity 6 W m^{-1} K^{-1}. The direction of heat flow is shows by the arrows. The top surface of the *IC* is cooled by forced convection. The top surface has an area of 10 cm^2 and the distance from the core to the top surface is 1 mm. At what temperature the top surface be kept in order to maintain the core at 90°C ? (Assume that no heat flows through the bottom surface and the sides.)

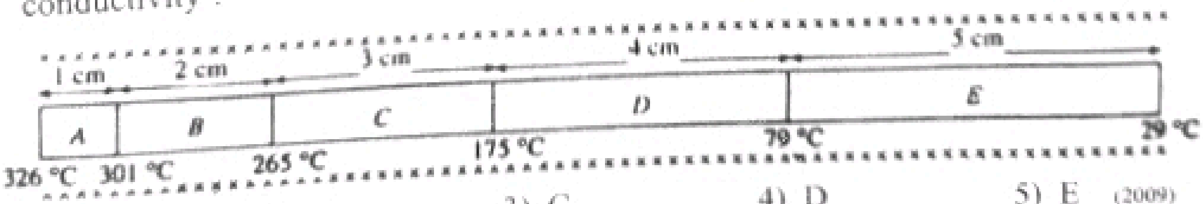
1) 70°C 2) 80°C 3) 89.9°C 4) 91°C 5) 100°C (2006)

(15) Consider a situation where a layer of ice is being formed on Arctic sea water due to a constant temperature difference between sea water and the atmosphere. The variation of the rate (*R*) at which the heat is extracted from a unit area of ice – atmosphere interface by the atmosphere with time (*t*) is best represented by.



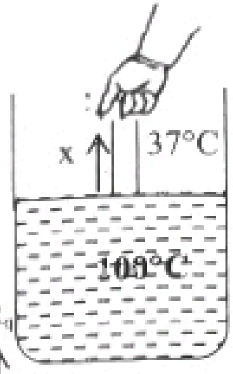
(2007)

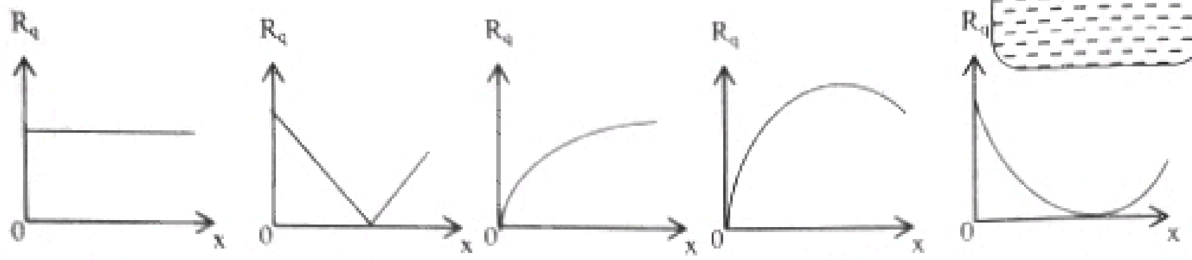
(16) Five cylindrical metal bars (A, B, C, D and E) are made from five different materials. All bars have the same cross sectional area but different lengths, and they are connected end to end as shown in figure. When the free ends are maintained as temperature 326 °C and 29 °C steady state temperatures at the interfaces are indicated in the figure. Assume that the system is fully lagged except its free ends, Which metal bar is made out of the material with the smallest thermal conductivity ?



1) A 2) B 3) C 4) D 5) E (2009)

(17) A metal rod is initially at 0°C . Now one end of this rod is immersed in boiling water and the other end is held by fingers as shown in the figure. The temperature of the fingers is 37°C. Which of the following curve correctly represents the variation of the rate of flow of heat (R_Q) along the rod with x at a certain instant?

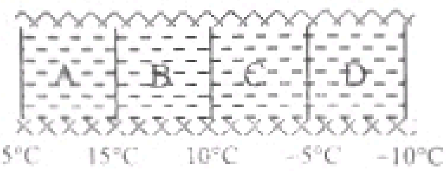




(1) (2) (3) (4) (5) (2010)

(18) The unit of thermal conductivity is,
1) $J\,m^{-1}\,K^{-1}$ 2) $W\,m^{-1}\,K^{-1}$ 3) $W\,m^{-2}\,K^{-1}$ 4) $J\,m^{-2}\,K^{-1}$ 5) $W\,m^{-2}\,K^{-2}$ (2011 NS)

(19) The figure idicates the face and interface temperatures of a lagged composite slab consisting of four materials A, B, C and D of identical thickness and surface area through which the heat transfer is steady. If k_A, k_B, k_C and k_D are the thermal conductivities of materials A, B, C and D respectively then,



1) $k_A > k_B > k_C > k_D$ 2) $k_A < k_B < k_C < k_D$ 3) $k_B = k_D > k_A > k_C$
4) $k_B = k_D < k_A < k_C$ 5) $k_B = k_D = k_A > k_C$ (2012 N)

(20) When a uniform rod of known length and area of cross-section was lagged, and the rate of flow of heart and the temperature gradient were measured, it was found that the value of the thermal conductivity calculated using those quantities, is smaller than the expected value of the thermal conductivity for the material of the rod. This could occur if

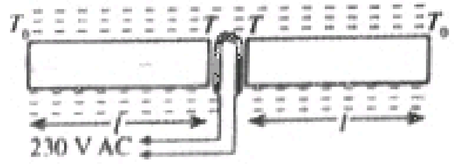
(A) the measured value of the rate of flow of heat through the rod is lower than the expected value.

(B) lagging of the rod is poor.

(C) the measured value of the temperature gradient is larger than the expected value.

Of the reasons given above,
1) only (A) is true 2) only (CB) is true 3) only (B) and (C) are true
4) only (A) and (C) are true 5) all (A), (B) and (C) are true (2013)

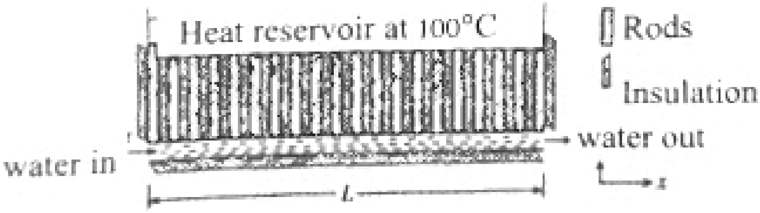
(21) Two ends of two identical metal rods of uniform cross seciton are placed very close to each other, and those ends are heated using an electric heating element which supplies heat at a constant rate of P (Watts), as shown in figure. The rods are thermally well insulated as shown and at the steady state, the temperature at free ends which are exposed to the surroundings is T_0 . Assume that the entire heat energy generated by the element is absorbed equally by the two rods. If l, A and k respectively are the length, cross sectional area and the thermal conductivity of a rod, what is the temperature T of the ends of rods close to the heating element at the steady state?

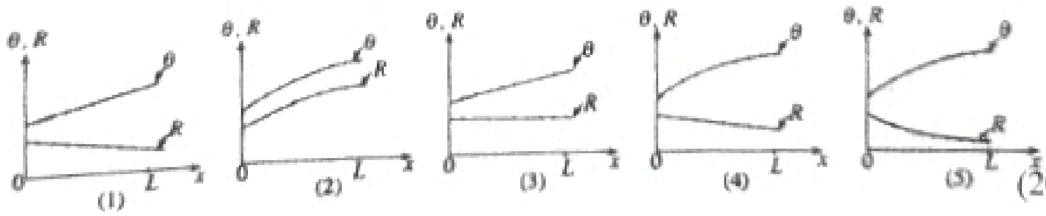


1) $T = T_0 + \frac{Pl}{kA}$ 2) $T = T_0 + \frac{Pl}{2kA}$ 3) $T = T_0 + \frac{2Pl}{kA}$

4) $T = 2T_0$ 5) $T = 2\left(T_0 + \frac{Pl}{kA}\right)$ (2014)

(22) Water flows at a uniform rate through a tube of length L, which is made of an insulating material. A large number of identical, uniform and insulated metal rods which are equally spaced as shown in the figure is connected between the tube and a large heat reservoir maintained at 100 ^{0}C to transfer heat from the reservoir to the water in the tube. If the inlet temperature of water is equal to the room temperature, which of the following graphs best represents the variation of the rate of flow of heat (R) through the rods and temperature (θ) of water along the length (x) of the tube at the steady state?





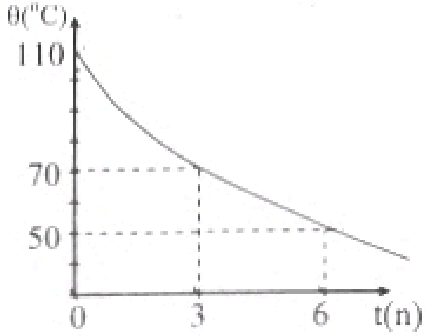
(2015)

09. Convection

(1) Two identical copper calorimeters of mass 100 g each contain 60 g of water and 140 g of another liquid respectively the specific heat capacity of copper is 400 J $kg^{-1}K^{-1}$ and that of water is 4200 J kg^{-1} K^{-1}. Under similar conditions, both calorimeters are found to take 40 minutes to cool from 67^0C to 27^0C, the specific heat capacity of the liquid is,

1) 600 J kg^{-1} K^{-1} 2) 1200 J kg^{-1} K^{-1} 3) 1800 J kg^{-1} K^{-1}
4) 2400 J kg^{-1} K^{-1} 5) 3000 J kg^{-1} K^{-1} (1994)

(2) The graph shows the cooling curve of a liquid which is kept in a room having a temperature of 30^0C Consider the following statements



(A) The rate of loss of heat from the liquid during the first 3 Minutes is twice that during the second 3 minutes

(B) The total loss of heat from the liquid during the first 3 minutes is twice that during the second 3 minutes

(C) the liquid may attain the room temperature after 9 minutes Of the above statements

1) Only A is true 2) Only C is true 5) all A, B and C are true
3) Only A and Bare true 4) Only A and B are true (1996)

(3) Under constant environmental conditions, the time taken by a liquid to cool from 65^0C to 55^0C in a room at 30^0C is 5.0 minutes. The time taken by the liquid to cool from 55^0C to 45^0C

1) 5.0 min 2) 6.5 min. 3) 7.5 min.
4) 8.0 min. 5) 10.0 min. (1999)

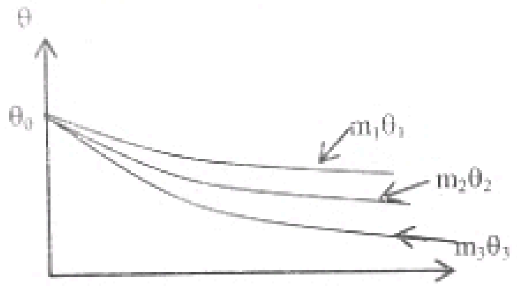
(4) A given mass of water is in a calorimeter. When a W heater is immersed in water, the temperature of water increases and comes to a steady value at 35^0C if a 180W heater is used, the steady temperature is 45^0C. What should be the room temperature?

1) 10^0C 2) 15^0C 3) 20^0C
4) 25^0C 5) 30^0C (2001)

(5) Two bodies having thermal capacities in the ratio 1:4 are heated to a few degrees above the room temperature and allowed to cool. If their rates of fall of temperatures are the same at a particular instant, then their rates of loss of heat would be in the ratio

1) 1:1 2) 1:2 3) 1:4 4) 2:1 5) 4:1 (2002)

(6) Three masses m_1, m_2 and m_3 of hot water at temperature θ_1, θ_2 and θ_3 respectively are added to three identical containers each having mass m of water to achieve the same final temperature θ_0. Then the containers are allowed to cool. The cooling curves for the three containers are shown in the figure. If the rate of loss of heat from each container is the same, then



1) $m_1 < m_2 < m_3$ and $\theta_1 < \theta_2 < \theta_3$
2) $m_1 < m_2 < m_3$ and $\theta_1 > \theta_2 > \theta_3$
3) $m_1 > m_2 > m_3$ and $\theta_1 < \theta_2 < \theta_3$
4) $m_1 > m_2 > m_3$ and $\theta_1 > \theta_2 > \theta_3$
5) $m_1 = m_2 = m_3$ and $\theta_1 = \theta_2 = \theta_3$ (2010)

ANSWERS

HEAT

01) Thermometry

(01)	3	(02)	1	(03)	2	(04)	3	(05)	3	(06)	4	(07)	4
(08)	5	(09)	5	(10)	3	(11)	3	(12)	1	(13)	2	(14)	1
(15)	2												

02) Expansion of solids

(01)	4	(02)	2	(03)	5	(04)	1	(05)	4	(06)	2
(07)	3	(08)	1	(09)	3	(10)	2	(11)	3	(12)	1
(13)	1	(14)	1	(15)	4	(16)	1				

03) Expansion of Liquids

(01)	2	(02)	1	(03)	3	(04)	4	(05)	2
(06)	1	(07)	4	(08)	2				

04) Expansion of Gases

(01)	2	(02)	4	(03)	2	(04)	3	(05)	5	(06)	5
(07)	5	(08)	3	(09)	2	(10)	3	(11)	1	(12)	2
(13)	2	(14)	3	(15)	1	(16)	1	(17)	4	(18)	2
(19)	2	(20)	3	(21)	4	(22)	All	(23)	3	(24)	1
(25)	3	(26)	1	(27)	4	(28)	5	(29)	2	(30)	4
(31)	4	(32)	3	(33)	1	(34)	3	(35)	3	(36)	3
(37)	3										

05) Calorimetry

(01)	2	(02)	4	(03)	5	(04)	4	(05)	3
(06)	5	(07)	2	(08)	All	(09)	2	(10)	3
(11)	5	(12)	4	(13)	3	(14)	4	(15)	1
(16)	1	(17)	3	(18)	4	(19)	5	(20)	1
(21)	1	(22)	2	(23)	1	(24)	1	(25)	3
(26)	3	(27)	2, 3	(28)	4	(29)	4	(30)	5
(31)	5	(32)	4	(33)	5	(34)	5	(35)	1
(36)	1	(37)	4	(38)	3				

06) Thermodynamic

(01)	5	(02)	1	(03)	4	(04)	3	(05)	5	(06)	1
(07)	3	(08)	1	(09)	4	(10)	5	(11)	1	(12)	1
(13)	1	(14)	1	(15)	5	(16)	1	(17)	3	(18)	3
(19)	4										

07) Hygrometry

(01)	1	(02)	5	(03)	4	(04)	3	(05)	4
(06)	3	(07)	2	(08)	1	(09)	2	(10)	4
(11)	4	(12)	3	(13)	5	(14)	3	(15)	5
(16)	5	(17)	3	(18)	1	(19)	3	(20)	2
(21)	3	(22)	4	(23)	2	(24)	1	(25)	5
(26)	1	(27)	1	(28)	3	(29)	1		

08) Conductivity

(01)	2	(02)	3	(03)	5	(04)	4	(05)	4
(06)	2	(07)	4	(08)	3	(09)	2	(10)	4
(11)	3	(12)	3	(13)	5	(14)	2	(15)	1
(16)	3	(17)	5	(18)	2	(19)	3	(20)	5
(21)	2	(22)	5						

09) Convection

(01)	3	(02)	3	(03)	3	(04)	4	(05)	3
(06)	3								