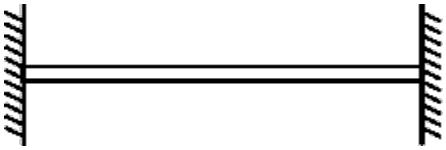
Q.1 An iron rod of length 1 m is fixed between two walls as shown in figure. Find thermal stress and thermal strain developed in the rod if it is heated by ΔT - 20°C.(Given: Coefficient of linear expansion of iron is $1.2 \times 10^{-5}\ °C^{-1}$. Young's modulus of iron is $2 \times 10^{11}\ \text{N}/m^2$).



(A) $4 \times 10^{7}\ \text{N}/m^2, 48 \times 10^{-5}$ **(B)** $48 \times 10^{6}\ \text{N}/m^2, 32 \times 10^{-4}$
(C) $32 \times 10^{7}\ \text{N}/m^2, 48 \times 10^{-4}$ **(D)** $48 \times \mathbf{10^{6}}\ \text{N}/\boldsymbol{m^2}, 24 \times \mathbf{10^{-5}}$

Q.2 A metal bar of length 1 m and area of cross-section 1 mm^2 is clamped between two rigid supports. For the material of rod, its Young's modulus is $Y = 10^{11}\ \text{N}/m^2$ and coefficient of linear expansion is $\alpha = 1.8 \times 10^{-5}\ °C^{-1}$. If the temperature of the rod is decreased by $\Delta T = 10°C$, the force exerted by the rod on the supports is

(A) 9 N **(B)** 6 N **(C)** 16 N **(D)** 18 N

Q.3 Statement 1: Heat capacity/Thermal capacity of a substance depends on mass of substance.
Statement 2: Specific heat capacity of a substance is independent of mass of substance.
(A) Statement 1 is correct, statement 2 is incorrect.
(B) Statement 1 is incorrect, statement 2 is correct.
(C) Both statements are correct.
(D) Both statements are incorrect.

Q.4 Two spheres A and B have diameters in the ratio 1 : 2, densities in the ration 2 : 1 and thermal capacities in the ratio 1 : 12. Find the ratio of their specific heat capacities.

(A) 1 : 6 **(B)** 1 : 12 **(C)** 1 : 3 **(D)** 1 : 4

Q.5 How much heat energy is released when 10 Kg of water at 100°C is brought to its freezing point? (Specific heat of water = 1 cal/g°C)

(A) 2100 kJ **(B)** 420 kJ **(C)** 4200 kJ **(D)** 8400 kJ

Q.6 Steam is passed into 56 g of water at 30°C till the temperature of mixture becomes 90°C. If the latent heat of steam is 536 cal/g, the mass of the mixture will be:
(Specific heat capacity of water is 1 cal/g°C)

(A) 80 g **(B)** 62.1 g **(C)** 60 g **(D)** 54 g

Q.7 2g bullet moving with a velocity of 210 m/s brought to a sudden stoppage by an obstacle. The total heat produced goes to the bullet. If the specific heat of the bullet is 0.03 cal/g°C the rise in its temperature will be

(A) 175°C **(B)** 180°C **(C)** 150°C **(D)** 125°C

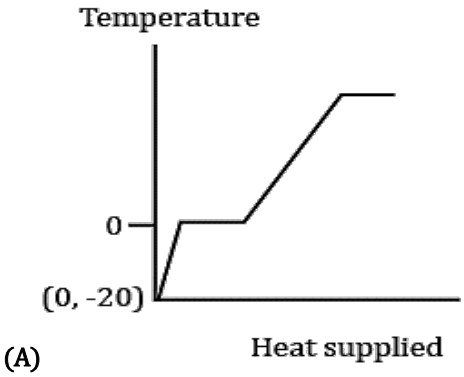
Q.8 A 10 kg iron bar (specific heat 0.11 cal/g°C) at 80°C is placed on the block of ice. How much ice melts?
(Take latent heat of fusion as 80 cal/g)

(A) 1 k g **(B)** 1.1 k g **(C)** 2.2 k g **(D)** 2 k g

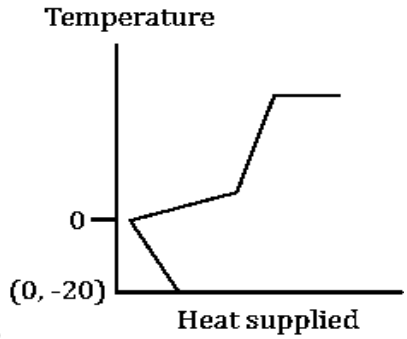
Q.9 Which one of the following would raise the temperature of 20 g of water at 30°C most when mixed with?(Specific heat of water = 1 cal/g°C)

(A) 20 g of water at 40°C **(B)** 40 g of water at 35°C
(C) 10 g of water at 50°C **(D)** 10 g of water at 80°C

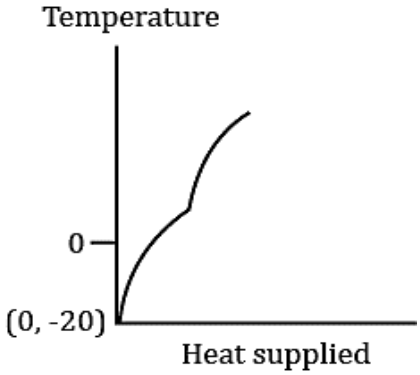
Q.10 A block of ice at temperature -20°C is slowly heated and converted to steam at 100°C. Which of the following diagrams is most appropriate?


Temperature
0
(0, -20)
Heat supplied

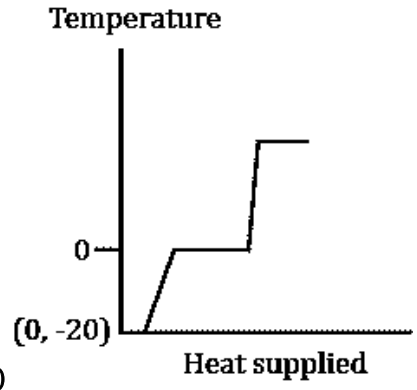
(A)


Temperature
0
(0, -20)
Heat supplied

(B)


Temperature
0
(0, -20)
Heat supplied

(C)


Temperature
0
(0, -20)
Heat supplied

(D)

WORK SHEET

Q.1 Snow is falling vertically at a constant speed of 8.0 m/s. At what angle from the vertical do the snowflakes appear to be falling as viewed by the driver of a car traveling on a straight level road with a speed of $8\sqrt{3}$ m/s?

(A) 30^o **(B)** 60^o **(C)** 75^o **(D)** 45^o

Q.2 The excess pressure inside one soap bubble is three times that inside a second soap bubble, then the ratio of their surface areas is:

(A) 1 : 9 **(B)** 1:3 **(C)** 3 : 1 **(D)** 1 : 27

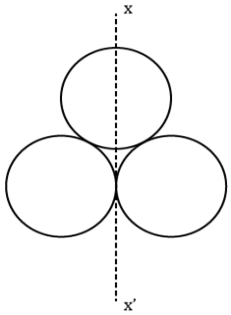
Q.3 A cubical block (side 2 m) of mass 20 kg slides on inclined plane lubricated with the oil of viscosity $\eta = 10^{-1}$ Poise with constant velocity of 10 m/s. Find out the thickness of the layer of liquid. $(g = 10\ m/s^2)$

(A) 4×10^{-3} m **(B)** 3×10^{-3} m **(C)** 2×10^{-3} m **(D)** 1×10^{-3} m

Q.4 Water rises in a capillary tube up to a height of 50 cm. The length of the water column when the capillary tube is tilted at an angle of 45^o is

(A) $\frac{50}{\sqrt{2}}$Cm **(B)** $50\sqrt{2}$ cm **(C)** zero **(D)** None of these

Q.5 Three identical spherical shell, each of mass m and radius r are placed as shown in figure. Consider an axis XX', which is touching to two shells and passing through diameter of third shell. Moment of inertia of the system consisting of these three spherical shells about XX' axis is



(A) $\frac{11}{5}$ mr^2 **(B)** $4\ mr^2$ **(C)** $\frac{16}{5}$ mr^2 **(D)** $3\ mr^2$

Q.6 A thin circular ring of mass M and radius r is rotating about its axis with a constant angular velocity ω. Two objects, each of mass m are attached gently to the opposite ends of a diameter of the ring. The ring now rotates with an angular velocity of

(A) $\frac{\omega M}{M+m}$ **(B)** $\frac{\omega(M-2m)}{M+m}$ **(C)** $\frac{\omega M}{M+2m}$ **(D)** $\frac{\omega(M+2m)}{M}$

Q.7 A small sphere initially at rest, falls in to a viscous liquid. Due to drag, heat is produced. Then the relation between rate of production of heat and the radius of the sphere at terminal velocity, is best represented by:

(A) $\propto r^2$ **(B)** $\propto r^5$ **(C)** $\propto r^6$ **(D)** $\propto r^3$

Q.8 If M is the mass of water that rises in a capillary tube of radius r, then mass of water which will rise in a capillary tube (of same material) of radius 2r is

(A) 2M **(B)** 4M **(C)** M/2 **(D)** M

Q.9 What should be the pressure inside a air bubble of radius 0.1 mm situated 1 m below the water surface? (Take surface tension of water $T = 7.2 \times 10^{-2}$ N/m) and $g = 10\ m/s^2$)

(A) 3.5×10^5Pa **(B)** $1.11 \times 10^5 Pa$ **(C)** $2.11 \times 10^5 Pa$ **(D)** $3 \times 10^5 Pa$

Q.10 Water rises to a height of 10 cm in a certain capillary tube. Another identical tube when dipped in mercury, the level of mercury is depressed by 3.42 cm. Density of mercury is 13.6 gm/cm^3. The angle of contact for water in contact with glass is 0^o and mercury in contact with glass is 135^o.

Then the ratio of surface tension of water to that of mercury is: (use $\frac{0.0342}{\sqrt{2}} = 0.024$)

(A) 0.33 **(B)** 0.25 **(C)** 0.75 **(D)** 0.15

Q.11 The specific heat capacity of a metal is 0.01 cal/g°C. If heat capacity of m kg of metal is 0.42 J/°C. Find the value of m.

(A) 10^{-2} **(B)** 10^{-1} **(C)** 1 **(D)** 10^{-3}

Q.12 If the ratio of radii of two spheres of same material is 1 : 4, then the ratio of their heat capacity will be

(A) 1/60 **(B)** 1/32 **(C)** ½ **(D)** ¼

Q.13 M kg of water at 20° C is brought to its boiling point. If the heat energy gained by M kg of water is 3360 kJ, find the value of M. (Specific heat of water = 4.2 kJ/kg°C)

(A) 5 **(B)** 8 **(C)** 10 **(D)** 12

Q.14 One gram of ice is mixed with one $gram$ of steam. After thermal equilibrium is reached, the temperature of the mixture is

(Latent heat of fusion of ice; $L_{ice} = 80\ cal/g$, latent heat of condensation of vapour; $L_v = 540\ cal/g$

(A) 100°C **(B)** 55°C **(C)** 50°C **(D)** 0°C

Q.15 Two liquid with masses $m_1 = 10$ kg and $m_2 = 20$ kg are thoroughly mixed. If their specific heats are $C_1 = 0.2$ cal/g $-^o$ C and $C_2 = 0.1$ cal/g $-^o$ C and their temperatures are 30°C and 40°C respectively, then the temperature of the mixture is

(A) 25°C **(B)** 35°C **(C)** 30°C **(D)** 28°C

Q.16 Two tanks A and B contain water at 30^oC and 80^oC respectively. Calculate the amount of wate rthat must be taken from tank A and B respectively in order to prepare 40 kg of water at 50°C:

(A) 24 kg, 16 kg **(B)** 16 kg, 24 kg **(C)** 20 kg, 20 kg **(D)** 30 kg, 10 kg

Q.17 A liquid of mass M and specific heat c is at temperature 2t. If another liquid of equal mass and thermal capacity 1.5 that of the first at a temperature of $\frac{t}{3}$ is added to it, the resultant temperature will be

(A) $\left(\frac{4}{3}\right)t$ **(B)** t **(C)** t/2 **(D)** 2t/3

Q.18 An experiment takes 10 min for an electric kettle to heat a certain quantity of water from 0°C to 100°C. If it takes 54 min to convert this water at 100°C into steam, then latent heat of steam is:

(A) 80 cal/gm **(B)** 540 cal/kg **(C)** 540 cal/gm **(D)** 80 cal/kg

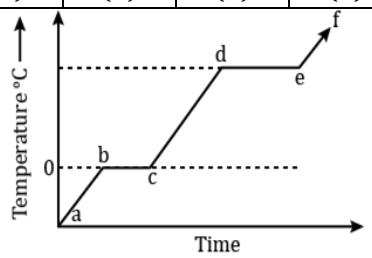
Q.19 A bullet of mass 10×10^{-3} kg20 10^{-3}kg moving with a speed of 20 ms^{-1} hits an ice block (0°C) of mass 990 g kept at rest on a frictionless floor and gets embedded in it. If ice takes 50% o fcc. E lost by the system; the amount of ice melted (in grams) approximately is

(Latent heat of ice = 80 cal/g)

(A) 6 **(B)** 3 **(C)** 6×10^{-3} **(D)** 3×10^{-3}

Q.20 The following figure represents the temperature versus time plot for a given amount of a substance when heat energy is supplied to it at a fixed rate and at a constant pressure. Which part of the plot represents phase change?

Q.	1	2	3	4	5	6	7	8	9	10
Sol.	(D)	(D)	(C)	(C)	(C)	(B)	(A)	(B)	(D)	(A)
WORK SHEET										
Q.	1	2	3	4	5	6	7	8	9	10
Sol.	(B)	(A)	(A)	(B)	(B)	(C)	(B)	(A)	(B)	(D)
Q.	11	12	13	14	15	16	17	18	19	20
Sol.	(A)	(A)	(C)	(A)	(B)	(A)	(B)	(C)	(D)	(D)



(A) a to b and e to f **(B)** b to c and c to d **(C)**d to e and e to f **(D**) b to c and d to e

ANSWER KEY