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DPP – 2 1 (Theometry & Calorimetry)

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Q 1. 1 kg of ice at 0ºC is mixed with 1.5 kg of water at 45ºC [latent heat of fusion = 80 cal/g]. Then-
(a) the temperature of the mixture of 0ºC
(b) mixture contains 156.25 g of ice
(c) mixture contains 843.75 g of ice
(d) the temperature of the mixture is 15ºC

Q 2. It takes 15 minutes to raise a certain amount of water 0ºC to boiling point using an electric heater. After this one hour and twenty minutes are required in the same conditions to convert all the water into vapour -
(a) latent heat of vaporization is 530 cal
(b) latent heat of vaporization is 533 cal
(c) mass of water is 1 kg
(d) latent heat of vaporization is 540 cal

Q 3. Steam at 100^0C passed into a calorimeter of water equivalent 10 g containing 94 gm of water and 10g of ice at 0^0C. The temperature of the calorimeter and contents rise by 5^0C. The amount of steam passed is
(a) 1g (b) 2g
(c) 3g (d) 4g

Q 4. An electrically heating coil is placed in a calorimeter containing 360g of H_2O at 10^0C. The coil consumes energy at the rate of 90W. The water equivalent of calorimeter and the coil is 40g. The temperature of water after 10 minutes will be
(a) 42.14^0C (b) 32.14^0C (c) 22.14^0C (d) 52.14^0C

Q 5. To raise the temperature of 100 g of ice at 0^0C to 10^0C by a heater of 420 W the time required is
(a) 90 min (b) 90 seconds (c) 21.2 min (d) 21.2 seconds

Q 6. A lump of 0.1 kg of ice at -10°C is put in 0.15 kg of water at 20°C. How much water will be found in the mixture when it has reached thermal equilibrium? (Specific heat of ice = 2.1 kJ/kg; Latent heat of ice = 336 kJ/kg)

Q 7. If water at 0°C, kept in a container with an open top, is placed in a large evacuated chamber,
(a) all the water will vaporize
(b) all the water will freeze

(c) part of the water will vaporize and the rest will freeze
(d) ice, water and water vapour will be formed and reach equilibrium at the triple point.

Q 8. A substance of mass M kg requires a power input of P watts to remain in the molten state at its melting point. When the power source is turned off, the sample completely solidifies in time t seconds. The specific latent heat of fusion of the substance is
(a) Pt (b) Pt/M (c) PtM (d) PM/t

Q 9. Heat is supplied to a certain homogenous sample of matter, at a uniform rate. Its temperature is plotted against time, as shown. Which of the following conclusions can be drawn?

(a) Its specific heat capacity is greater in the solid state than in the liquid state.
(b) Its specific heat capacity is greater in the liquid state than in the solid state.
(c) Its latent heat of vaporization is greater than its latent heat of fusion.
(d) Its latent heat of vaporization is smaller than its latent heat of fusion.

Q 10. When ice melts at zero degree Celsius
(a) its molecular kinetic energy increases
(b) its molecular potential energy increases
(c) its kinetic energy decreases
(d) None of these

Q 11. 100 gram water at 0^0C is placed in a large container in which there is no air. Some water converted to steam and rest converts in to ice. Find mass of ice formed ?
(a) 13g (b) 50g (c) 87g (d) 33g

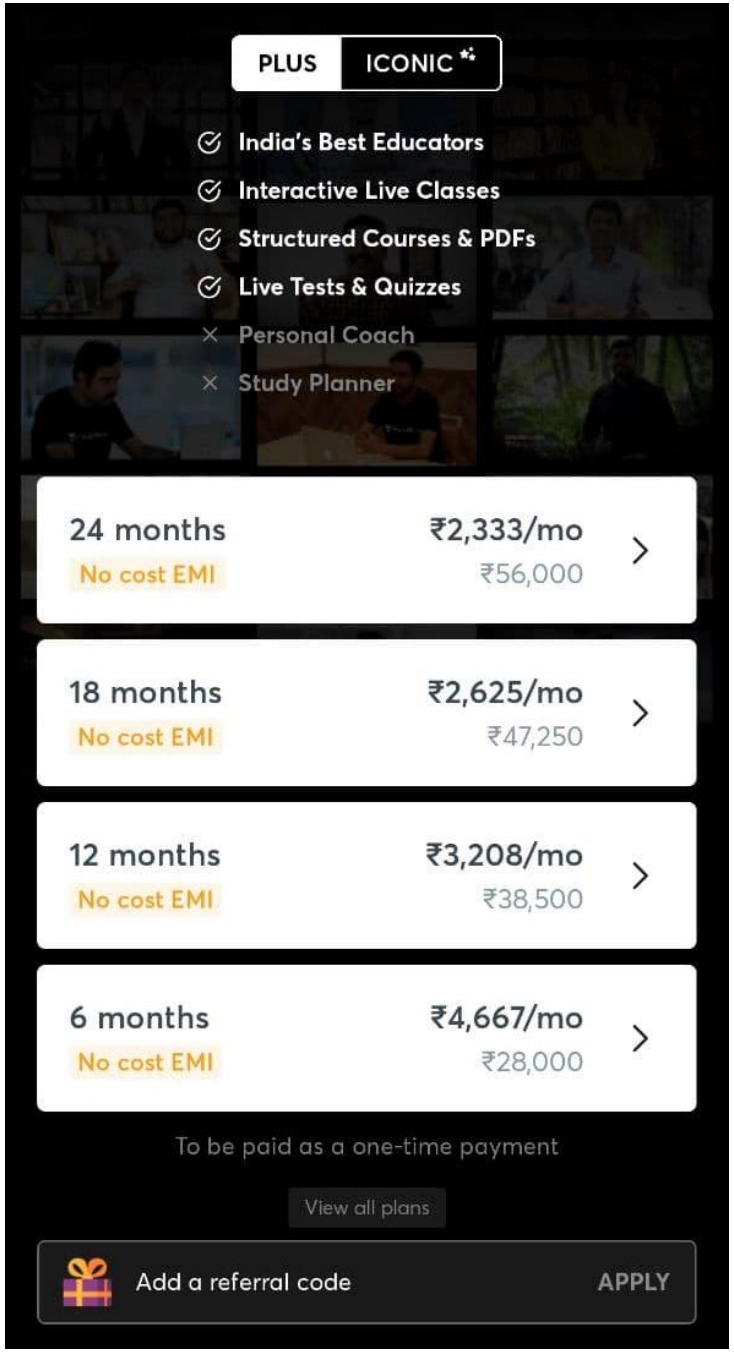
Q 12. mass of empty cylinder is 14 kg Mass of fully filled LPG cylinder is 30 kg and pressure inside it is P.. find pressure inside cylinder when mass of cylinder reduces to 22kg ?
(a) P (b) 2P (c) P/2 (d) P/3

Q 13. m_1 gm ice at 0°C, m_2 gm water at 50°C and m_3 gm steam at 100°C are mixed together then the correct alternative is –
(a) Temperature of mixture is 0°C if $m_1 \, ^3\frac{5}{8} m_2 + 8\, m_3$.
(b) Temperature of mixture is 100°C if $m_3 \, ^3\frac{5}{54} m_2 + \frac{m_1}{3}$
(c) Temperature of mixture is 50°C if $13\, m_1 = 59\, m_3$
(d) Temperature of mixture is 50°C if $18\, m_1 = 59\, m_3$

Q 14. A cube of iron (density = 8000 kg/m^3, specific heat capacity = 470 J/kg-K) is heated to a high temperature and is placed on a large block of ice at 0^{o}C. The cube melts the ice below it, displaces the water and sinks. In the final equilibrium position, its upper surface just goes inside the ice. Calculate the initial temperature in degree celcius of the cube. Neglect any loss of heat outside the ice and the cube. The density of ice = 900 kg/m^3 and the latent heat of fusion of ice = 3.36×10^5 J/kg.

Answer Key

Q.1 a,b	**Q.2 b**	**Q.3 b**	**Q.4 a**	**Q.5 b**
Q.6 181g	**Q.7 c**	**Q.8 b**	**Q.9 b,d**	**Q.10 b**
Q.11 c	**Q.12 a**	**Q.13 a,b,c**	**Q.14 080**	



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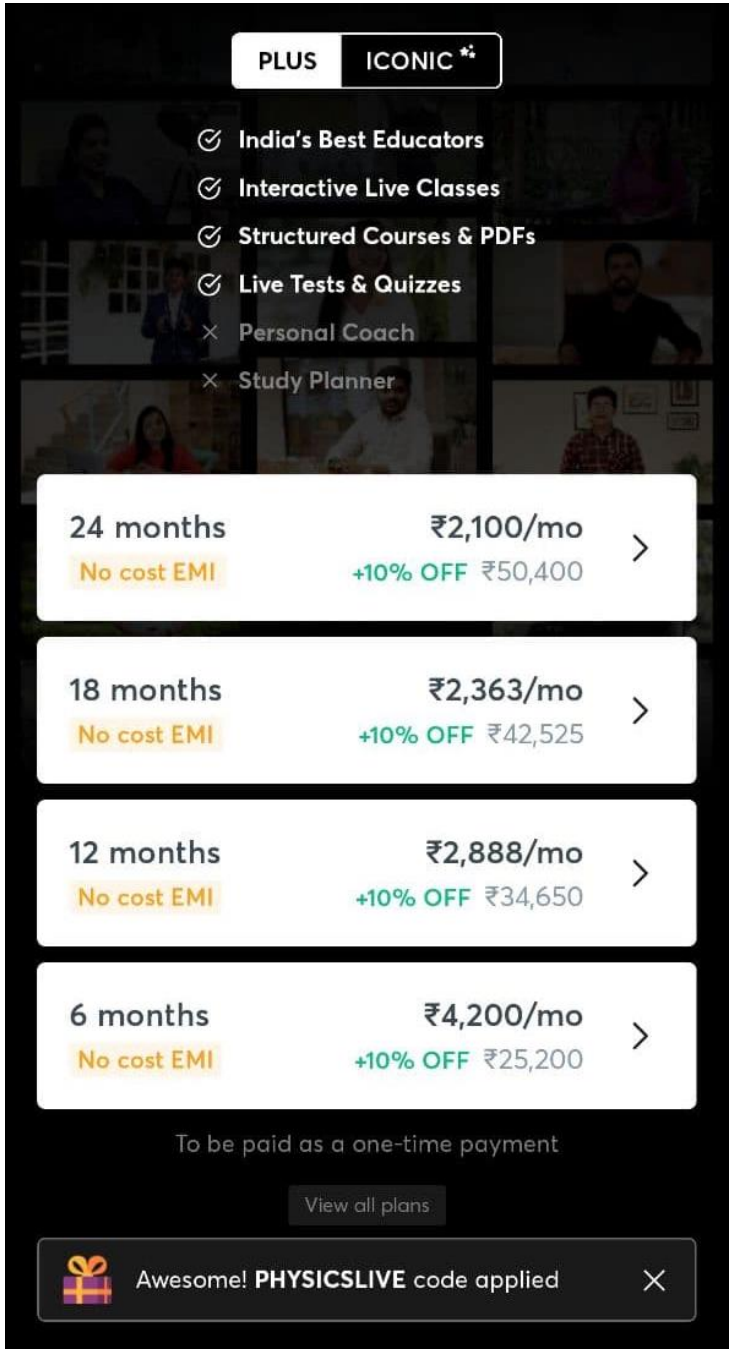


Written Solution

DPP-2 Calorimetry

By Physicsaholics Team

Solution:1

1 Kg ice at 0°C

+ 1.5 Kg water at 45°C

Let final temp is T. where $0 < T < 45°$.

Heat loosed by one part = Heat absorbed by other

$$1000 \times 80 + 1000 \times 1 (T - 0) = 1500 \times 1 \times (45 - T)$$

$$80 + 10T = 675 - 15T$$

$$25T = -175$$

$$T = -ve$$

$\Rightarrow$ ice will not melt Completely. final temp = 0

Heat loosed by 1.5 Kg water $= 1.5 \times 1000 \times 45$

$= 15 \times 4500$

mass of melted ice $= \frac{\Delta Q}{L} = \frac{15 \times 4500}{80}$

$= 843.7$ gm

mass of remaining ice $= 156.3$ gm

Ans.a,b

Solution:2

Heat required to increase temperature from 0°C to 100°C is $= m \times 1 \times 100 = P \times 15\ min$

↓ Power of heater

Heat required for vaporisation

$= mL = P \times (1hr\ 20\ min) = P \times 80\ min$

$\Rightarrow \frac{100}{L} = \frac{15}{80} \Rightarrow L = \frac{8000}{15} = \frac{1600}{3}\ Cal/Kg$

$= 533.3\ Cal/Kg$

Ans.b

(B)

Solution:3

Heat required to rise temp. of 10 g ice by 5°C

$= mL + ms\Delta T = 10 \times 80 + 10 \times 1 \times 5 = 850$ Cal

Heat required to rise temp. of 94 g water by 5°C

$= 94 \times 1 \times 5 = 470$ Cal

Heat required to rise temp. of Calorimeter

$=$ " " " " " of 10 gm water

$= 10 \times 1 \times 5 = 50$ Cal

total Heat required $= 1270$ Cal

Heat released by m gram steam

$= m \times 540 + m \times 1 \times 95$

$= 645\ m$

$645\ m = 1270$

$m = 2$ gram

Ans.b

Solution:4

Total water + water equivalent = 360 + 40
= 400 gram

Total Heat produced = 90 × 10 × 60
= 54000 J

$$\Delta Q = mS\Delta T$$

$$\Delta T = \frac{54000}{400 \times 4.2} = 32.14\,^{\circ}C$$

$$T_f = T_i + \Delta T = 10 + 32.14$$

$$\boxed{T_f = 42.14\,^{\circ}C}$$

Ans.a

Solution:5

Heat required to melt ice = 100×80

$= 8000$ Cal

" " " increase temp. = $100 \times 1 \times 10$

$= 1000$

Total Heat required = 9000 Cal

Heat produced by Heater = $420\,\Delta t = 9000 \times 4.2$

$\Delta t = 90$ Sec

Ans. (B)

Solution:6

Let m gram ice melts.

Heat supplied by first sample = Heat absorbed by other

$$.15 \times 4.2 \times 20 = .1 \times 2.1 \times 10 + m \times 336$$

$$12.6 = 2.1 + 336m$$

$$m = .031 \text{ kgram}$$

final mass of water $= .15 + .031$

$$= .181 \text{ Kg}$$

Ans.181g

Solution:7

When water is placed in large evacuated chamber, it starts conversion in to vapour by taking energy from rest water. Due to this some water converts in to ice

Ans. (c)

Solution:8

To remain in molten state

Power absorbed = Power radiated = P

Heat loss for solidification = ML = Pt

$$L = \frac{Pt}{M}$$

Ans. (B)

Solution:9

$$\Delta Q = ms\Delta T = Pt$$

$$\Rightarrow \frac{\Delta T}{t} = \frac{P}{ms}$$

high Slope $\Rightarrow$ low s

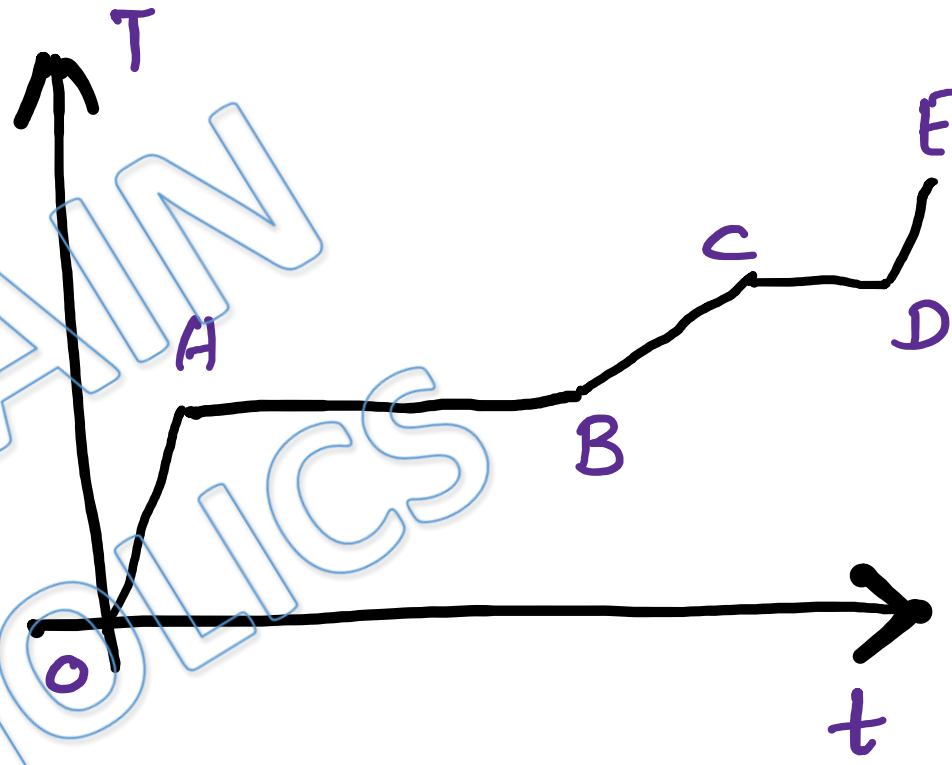
(B) is Correct

$$\Delta Q = mL = Pt$$

$$\Rightarrow L = \frac{Pt}{m}$$

high t $\Rightarrow$ high L.

(D) is Correct



Ans.b,d

Solution:10

When ice melts at zero degree Celsius its molecular potential energy increases

Ans.b

Solution:11

100 g water $\longrightarrow$ m g ice + (100 − m) vapour

$m \times 8\emptyset = (100 - m)540$

$8m = 54000 - 540m$

$62m = 5400$

$m = 87.09 gram$

Ans.c

Solution:12

L.P.G. Cylinder Contains liquid and it's vapour. Pressure inside cylinder is vapour pressure which depends on temperature only. pressure in cylinder remains constant until liquid

Ans.a

Solution:13

Heat released in lowering temp of water to $0^\circ C = m_2 \times 1 \times 50$

Heat released in lowering temp of steam to $0^\circ C = m_3 \times 540 + m_3 \times 1 \times 100 = 640 m_3$

Heat required to melt ice $= 80 m_1$

final temp will be $0^\circ C$ if

$$80 m_1 \geq 50 m_2 + 640 m_3$$

$$m_1 \geq \frac{5}{8} m_2 + 8 m_3$$

(A) is Correct

Heat absorbed by ice to increase temp to 100C

$= 80m_1 + 100 \times 1 \times m_1 = 180m_1$

Heat absorbed by water to increase temp to 100c

$= m_3 \times 1 \times (100 - 50) = 50m_3$

Heat released in condensing steam $= 540m_3$

final temp will be 100°c if

$540m_3 \geq 180m_1 + 50m_2$

$m_3 \geq \frac{m_1}{3} + \frac{5}{54} m_2$

(B) is correct

for final temp 50°C

$$80m_1 + 50\times1\times m_1 = 540m_3 + (100-50)\times1\times m_3$$

$$130\,m_1 = 590\,m_3$$

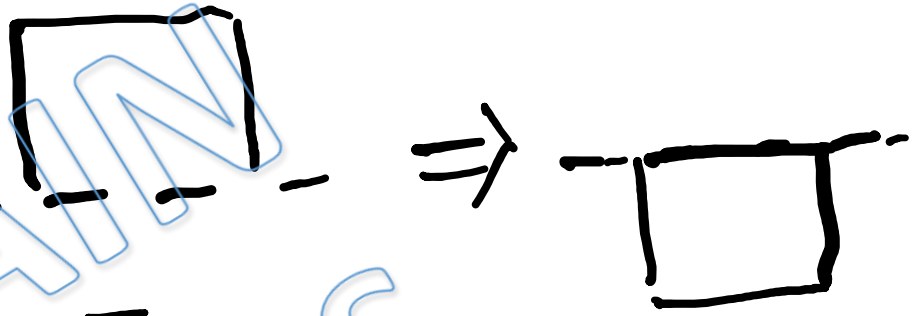
Ans. A,b,c

Solution:14

Let side of iron Cube is ℓ.

mass of iron Cube $= 8000\ell^3$

If initial temp. was T.



Heat loss by Cube $= 8000\ell^3 \times 470\,T$

mass of ice melted $= 900\ell^3$

Heat absorbed by ice $= 3.36 \times 10^5 \times 900\ell^3$

now $8000\ell^3 \times 470\,T = 3.36 \times 900 \times 10^5 \ell^3$

$T = 80$

Ans.080

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