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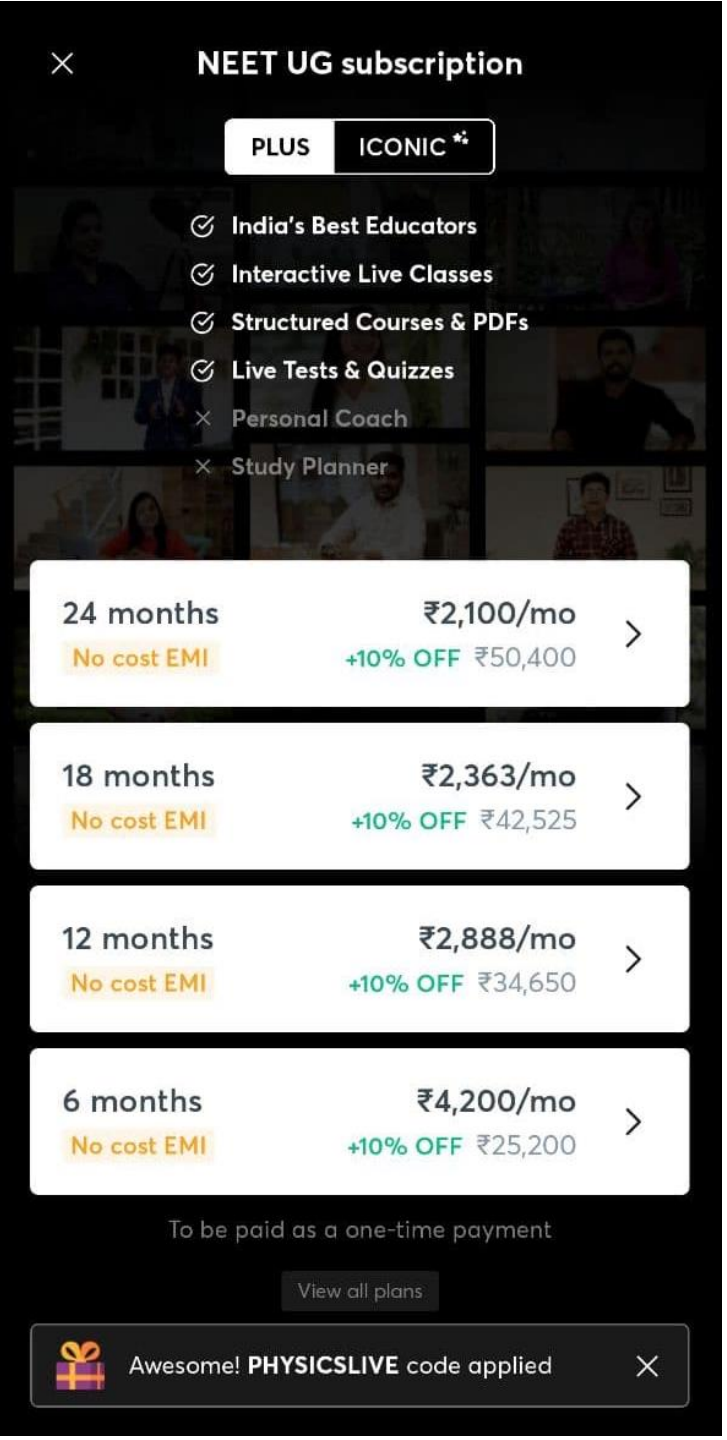

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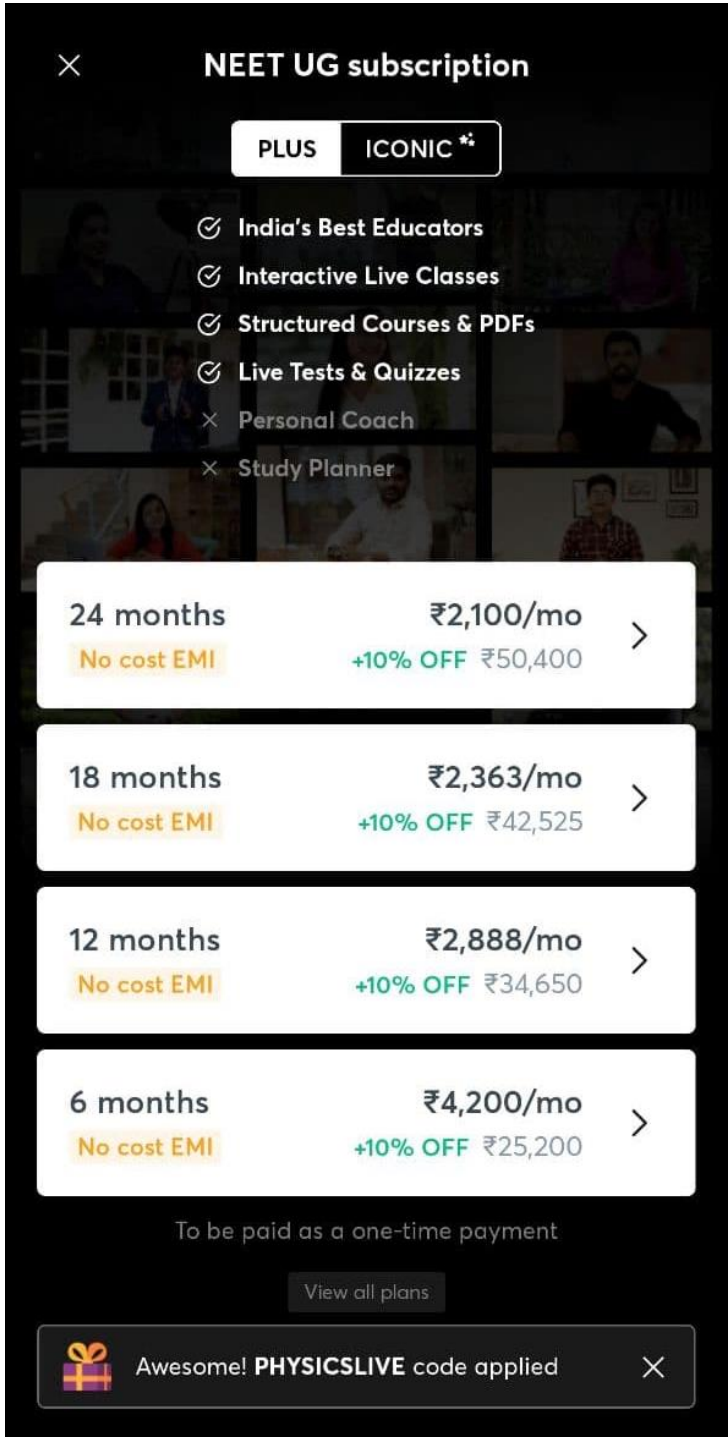

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JEE Main & Advanced, NSEP, INPhO, IPhO
Physics DPP

DPP- Thermometry & Calorimetry

By Physicsaholics Team

Q) The freezing point on a thermometer is marked as -20° and the boiling point as 130°. A temperature of human body (34°C) on this thermometer will be read as:

(a) 31° (b) 51° (c) 20° (d) none of these

Ans. a

Solution:

$$\frac{X - n_1}{n_2 - n_1} = \frac{C - 0}{100}$$

Here n_1 is freezing point & n_2 is boiling point in X thermometer

$$\Rightarrow \frac{X - (-20)}{130 - (-20)} = \frac{34}{100}$$

$$\Rightarrow \frac{X + 20}{150} = \frac{34}{100}$$

$$\Rightarrow \frac{X + 20}{3} = \frac{17}{2}$$

$$\Rightarrow X + 20 = 51$$

$$\Rightarrow X = 31$$

Q) In a temperature scale called Z , the boiling point of water is 65Z and freezing point is -14Z. Then the temperature T = - 98 Z corresponds on the Fahrenheit scale to

(a) – 191F

(*b*) -159 F

(c) 79 F

(*d*) none of these

Ans. b

Solution:

$$\frac{Z - n_1}{n_2 - n_1} = \frac{F - 32}{180}$$

$$\Rightarrow \frac{-98 - (-14)}{65 - (-14)} = \frac{F - 32}{180}$$

$$\Rightarrow \frac{-84}{79} = \frac{F - 32}{180}$$

$$\Rightarrow F = -159$$

(B)

Q) If a thermometer reads freezing point of water as 20^0 C and boiling point 150^0C . How much thermometer reads when the actual temperature is 60^0 C ?

(a) 98^0 C

(b) 110^0 C

(c) 40^0 C

(d) 60^0 C

Ans. a

Solution:

$$\frac{X - n_1}{n_2 - n_1} = \frac{C - 0}{180}$$

$$\Rightarrow \frac{X - 20}{150 - 20} = \frac{60}{100}$$

$$\Rightarrow \frac{X - 20}{130} = \frac{6}{10}$$

$$\Rightarrow X = 78 + 20$$

$$= 98$$

Q) A centigrade and a Fahrenheit therometers are dipped in boiling water. The water temperature is lowered until the Fahrenheit thermometer reads 140^0 C . The fall in temperature registered by centigrade thermometer is

(a) 80^0 C

(b) 40^0 C

(c) 50^0 C

(d) 90^0 C

Ans. b

Solution:

$$\frac{C-0}{100} = \frac{F-32}{180}$$

$$\Rightarrow \frac{C}{10\cancel{0}} = \frac{140-32}{18\cancel{0}}$$

$$\Rightarrow C = 60$$

Initial temperature in centigrade = 100

fall in temperature in Centigrade

$= 100 - 60 = 40$

(b)

Q) 100 gm of ice at 0ºC is mixed with 100 g of water at 100ºC. What will be the final temperature of the mixture ?

(A) 10ºC (B) 20ºC (C) 30ºC (D) 40ºC

Ans. a

Solution:

Let final temperature is $T^\circ C$

where $0 \leq T < 100$

Heat given by water = Heat taken by ice

$$\Rightarrow \quad 100 \times 1 \times (100 - T) = 100 \times 80 + 100 \times 1 \times (T - 0)$$

$$100 - T = 80 + T$$

$$2T = 20$$

$$T = 10^\circ C$$

(A)

Q) A lead bullet of 10g travelling at 300 m/s strikes against a block of wood and comes to rest. Assuming 50% of heat is absorbed by the bullet, the increase in its temperature is (specific heat of lead = 150 J/kg. K)

(a) 100^0C (b) 125^0C (c) 150^0C (d) 200^0C

Ans. c

Solution:

K.E. of bullet $= \frac{1}{2} \times .01 \times (300)^2$

$= 450\ J$

Heat absorbed by bullet $= \frac{450}{2}$

$= 225\ J$

$\Delta Q = m s \Delta T$

$225 = .01 \times 150\ \Delta T$

$\Delta T = \frac{2250}{15} = 150^\circ C$

(c)

Q) Equal masses of three liquids A, B and C have temperatures 10°C, 25°C and 40°C respectively. If A and B are mixed, the mixture has a temperature of 15°C. If B and C are mixed, the mixture has a temperature of 30°C. If A and C are mixed, the mixture will have a temperature of

(a) 16°C (b) 20°C (c) 25°C (d) 29°C

Ans. a

Solution:

Let s_1, s_2 & s_3 are specific heats of A, B & C.

When A & B are mixed

$$m s_1 (15-10) + m s_2 (15-25) = 0$$

$$\Rightarrow \quad 5 s_1 - 10 s_2 = 0 \Rightarrow s_1 = 2 s_2 \quad --(1)$$

When B & C are mixed

$$m s_2 (30-25) + m s_3 (30-40) = 0$$

$$\Rightarrow \quad 5 s_2 - 10 s_3 = 0 \Rightarrow s_2 = 2 s_3 \quad --(11)$$

When A & C are mixed, final temp. is T.

$$m\rho_1(T-10) + m\rho_3(T-40) = 0$$

$$\Rightarrow \frac{\rho_1}{\rho_3}(T-10) + T - 40 = 0$$

$$\Rightarrow \frac{\rho_1}{\rho_2} \times \frac{\rho_2}{\rho_3}(T-10) + T - 40 = 0$$

$$\Rightarrow 4T - 40 + T - 40 = 0$$

$$\Rightarrow 5T = 80 \Rightarrow T = 16^\circ C$$

(A)

Q) On increasing temperature of water from freezing point to boiling point its specific heat

(a) remains constant

(b) first increases then decreases

(c) first decreases then increases

(d) decreases throughout

Ans. c

Solution:

Specific Heat of water first decreases then increases on increasing its temperature from 0°C to 100°C. It is minimum near 38°C.

(c)

Q) Three different liquids with equal masses (m), specific heat as s_A, s_B and s_C & initial temperature as T_A, T_B & T_C are kept closed in a isolated container, then -

(a) final temperature of mixture will be $\frac{1}{3}(T_A + T_B + T_C)$ if $s_A = s_B = s_C$

(b) heat given by liquid A to liquid B & C will be $\frac{ms_A}{3}(2T_A - T_B - T_C)$ if $s_A = s_B = s_C$

(c) heat absorbed by liquid C will be $\frac{ms_C}{s_A+s_B+s_C}[s_A(T_A - T_C) + s_B(T_B - T_C)]$

(d) heat absorbed by liquid A is $\frac{ms_A}{3}(T_B + T_C - 2T_A)$ if $s_A = s_B = s_C$

Ans. a, b, c, d

Solution:

If $s_A = s_B = s_C = s$

$$ms(T - T_A) + ms(T - T_B) + ms(T - T_C) = 0$$

$$\Rightarrow \quad 3T = T_A + T_B + T_C$$

$$\Rightarrow \quad T = \frac{T_A + T_B + T_C}{3}$$

(A) is correct

Heat given by A

$$\Delta Q_A = m s_A (T_A - T)$$

$$= m s_A \left(T_A - \frac{T_A + T_B + T_C}{3} \right)$$

$$= \frac{m s_A}{3} (2T_A - T_B - T_C)$$

If $\rho_A \neq \rho_B \neq \rho_C$

$$m\rho_A(T-T_A) + m\rho_B(T-T_B) + m\rho_C(T-T_C) = 0$$

$$\Rightarrow \quad T = \frac{\rho_A T_A + \rho_B T_B + \rho_C T_C}{\rho_A + \rho_B + \rho_C}$$

Heat absorbed by C

$$\Delta Q_C = m\rho_C(T - T_C)$$

$$= m\rho_C\left[\frac{\rho_A T_A + \rho_B T_B + \rho_C T_C}{\rho_A + \rho_B + \rho_C} - T_C\right]$$

$$= -m\rho_C\left[\frac{\rho_A(T_A - T_C) + \rho_B(T_B - T_C)}{\rho_A + \rho_B + \rho_C}\right]$$

(c) is correct

Heat absorbed by A if $s_A = s_B = s_C = s$

$$\Delta Q_A = m s_A (T - T_A)$$

$$= m s_A \left[\frac{T_A + T_B + T_C}{3} - T_A \right]$$

$$= \frac{m s_A}{3} \left[T_B + T_C - 2 T_A \right]$$

(D) is correct

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Chalo Niklo