DPP – 2

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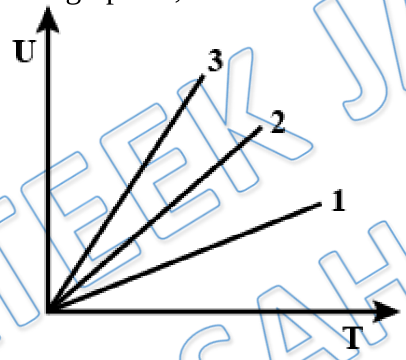
Q 1. The internal energy of an ideal gas depends upon
(a) Specific volume (b) Pressure
(c) Temperature (d) Density

Q 2. The internal energy of gases He, O_2 and NH_3 are plotted against the absolute temperature. The respective graphs 1, 2 and 3 are of



(a) He, O_2 and NH_3 (b) NH_3, He, and O_2
(c) NH_3, O_2 and He (d) O_2, He, and NH_3

Q 3. In changing the state of thermodynamics from A to B state, the heat required is Q and the work done by the system is W. The change in its internal energy is
(a) Q + W (b) $Q - W$
(c) Q (d) $\frac{Q-W}{2}$

Q 4. For a gaseous system find change in internal energy if the heat supplied to the system is 50 J and work done by the system is 16 J
(a) 66 J (b) 50 J
(c) 34 J (d) 16 J

Q 5. For a gaseous system, change in internal energy (ΔU) and work done on the system are respectively 17 J and 41 J. find heat supplied / evolved from the system.
(a) 24 J supplied to system (b) 24 J evolved from system
(c) 57 J supplied to system (d) 57 J evolved from system

Q 6. The first law of thermodynamics is concerned with the conservation of
(a) Momentum (b) Energy

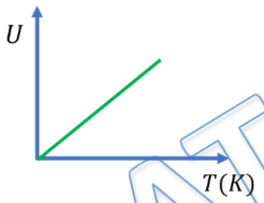
(c) Mass (d) Temperature

Q 7. The ratio of translational and rotational kinetic energies at 100 K temperature is 3: 2. Then the internal energy of one mole gas at that temperature is (R = 8.3 J/mol-K)(Neglecting all vibrational modes)
(a) 1175 J (b) 1037.5 J
(c) 2075 J (d) 4150 J

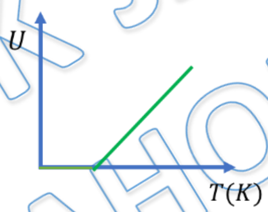
Q 8. Find total internal energy of 3 moles of hydrogen gas at temperature `T` (Neglecting all vibrational modes)
(a) 7.5 RT (b) 15 RT
(c) 75 RT (d) 5.5 RT

Q 9. A gas mixture consists of 2 moles of oxygen and 4 moles of Argon at temperature T. Neglecting all vibrational modes, the total internal energy of the system is: (Neglecting all vibrational modes)
(a) 4 RT (b) 9 RT
(c) 11 RT (d) 15 RT

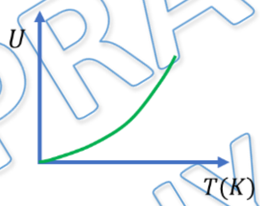
Q 10. Plot a graph between internal energy U and Temperature (T) of an ideal gas



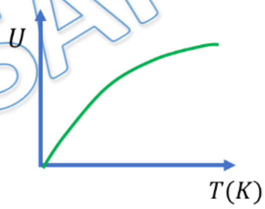
(a)



(b)



(c)



(d)

Q 11. Internal energy of n_1 moles of H_2 at temperature T is equal to the internal energy of n_2 moles of He at temperature 2T. Then the ratio $\frac{n_1}{n_2}$ is:
(a) 3/5 (b) 2/3
(c) 6/5 (d) 3/7

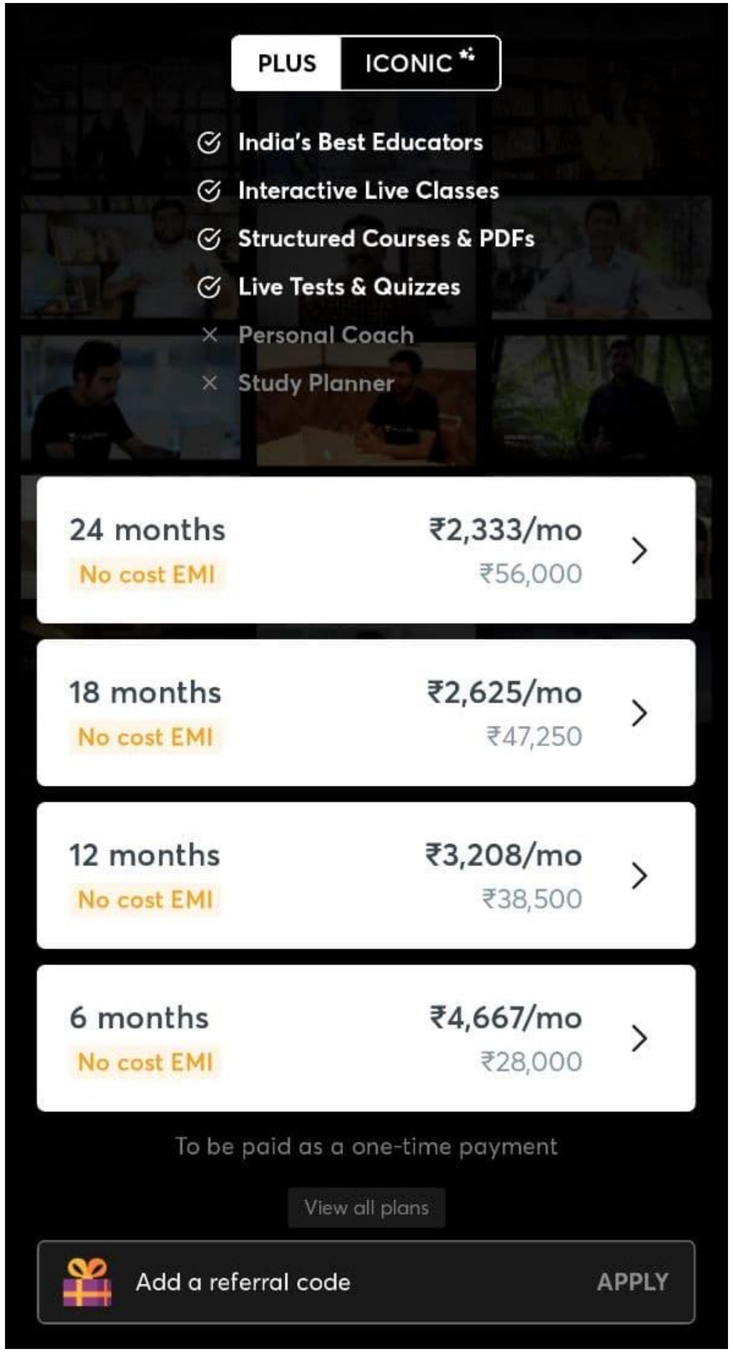
Q 12. If heat is supplied to an ideal gas in an isothermal process
(a) the internal energy of the gas will increase
(b) the gas will do positive work
(c) the gas will do negative work
(d) the given process is not possible

Q 13. Find the change in internal energy in joule when 20 gm of a gas is heated from 20°C to 30°C at constant volume ($C_V = 0.18\ Kcal/kg$-K)
(a) 72.8 J (b) 151.2 J

(c) 302 J (d) 450 J

Answer Key

Q.1 c	**Q.2 a**	**Q.3 b**	**Q.4 c**	**Q.5 b**
Q.6 b	**Q.7 c**	**Q.8 a**	**Q.9 c**	**Q.10 a**
Q.11 c	**Q.12 b**	**Q.13 b**		



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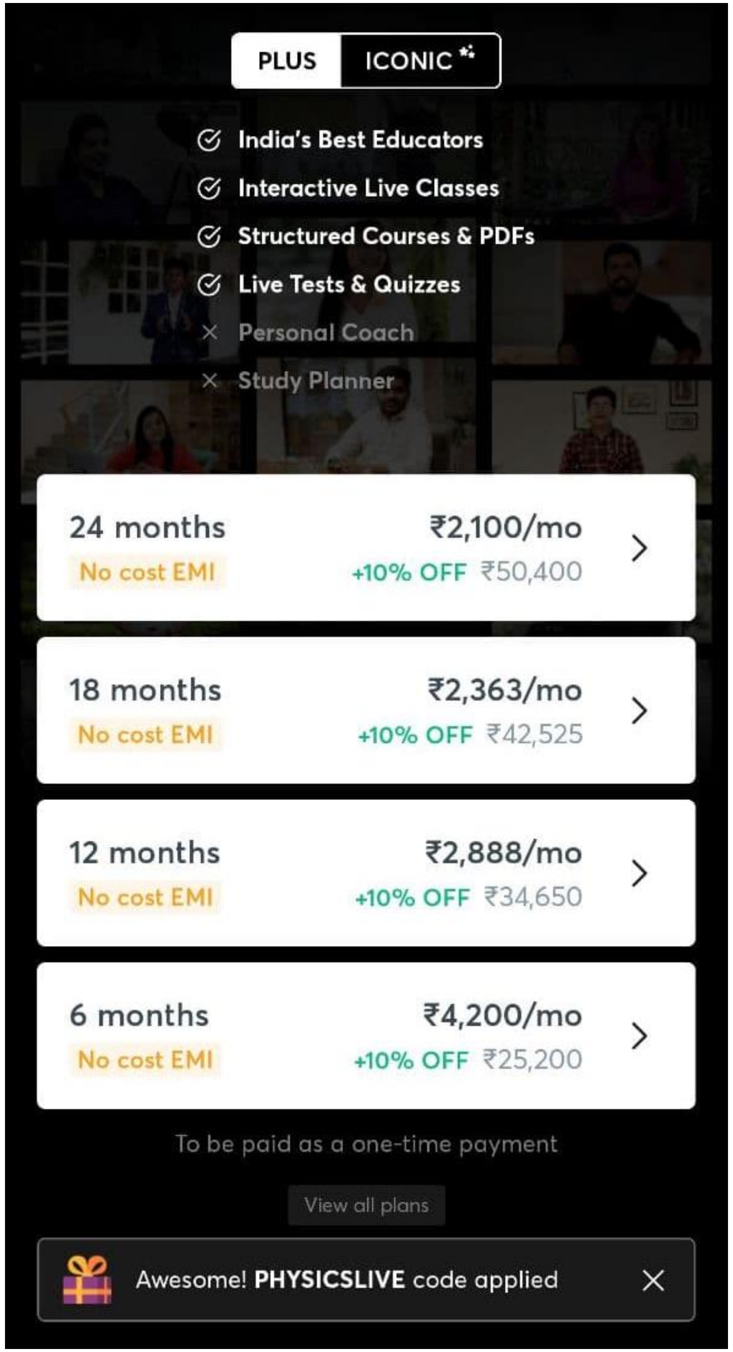

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NEET & JEE Main
Physics DPP- Solution

DPP- 2 Thermodynamics- Internal Energy & 1st Law of Thermodynamics

By Physicsaholics Team

Solution 1:

Internal energy is independent of volume and depends on the temperature only.

Ans. c

Solution 2:

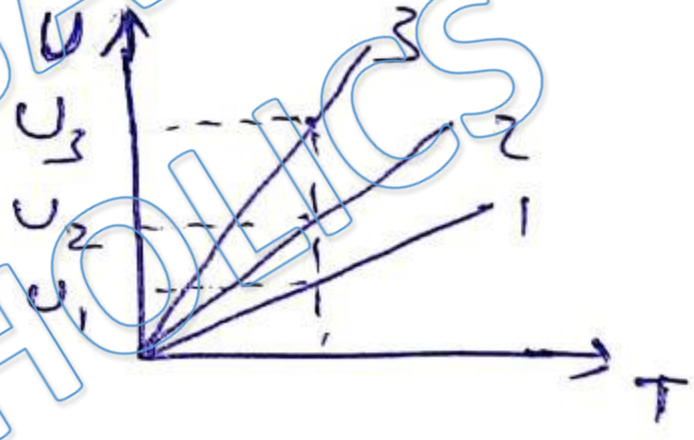
$$U = \frac{f}{2} nRT$$

when n & T are constant

$$U \propto f$$

here

$$f_{NH_3} > f_{O_2} > f_{He}$$



so; $U_{NH_3} > U_{O_2} > U_{He}$

& from graph $\Rightarrow U_3 > U_2 > U_1$

so; for internal Energy graph 1, 2, 3 are for He, O_2 & NH_3

Ans. a

Solution 3:

from first law of Thermodynamics

$$dQ = \Delta U + dW$$

$$dQ = Q$$

$$dW = W$$

then

$$Q = \Delta U + W$$

$$\boxed{\Delta U = Q - W}$$

Ans. b

Solution 4:

$$dQ = \Delta U + dW$$

heat supplied to the system $dQ = 50$ J

work done by the system $dW = 16$ J

So, $50 = \Delta U + 16$

$\Delta U = 34$ J

Ans. c

Solution 5:

$$dQ = \Delta U + dW$$

Change in internal energy $\Delta U = 17$ J

work done on the system $dW = -41$ J

So, $dQ = 17 - 41$

$$dQ = -24 \text{ J}$$

Ans. b

Solution 6:

It is concerned with the conservation law of energy.

Ans. b

Solution 7:

Translational Energy =

$$U_K = \frac{f_K}{2} nRT \quad \text{—(1)}$$

Rotational kinetic energy = U_R

$$U_R = \frac{f_R}{2} nRT$$

$$\frac{U_K}{U_R} = \frac{f_K}{f_R} = \frac{3}{2}$$

Means; $f_K = 3$

& $f_R = 2$

$$f = 2 + 3 = 5$$

$$U = \frac{f}{2} nRT$$

$$U = \frac{5}{2} \times 1 \times 8.3 \times 100$$

$$\boxed{U = 2075 \text{ J}}$$

Ans. c

Solution 8:

H_2 gas - diatomic

$f = 5$

$U = \frac{f}{2} nRT$

$U = \frac{5}{2} \times 3 \times RT$

$U = \frac{15}{2} RT$

$\boxed{U = 7.5\, RT}$

Ans. a

Solution 9:

O_2 gas 2 mole

$f = 5$

$U_1 = \frac{5}{2} \times 2 \times RT$

$U_1 = 5RT$

Argon gas 4 mole

$f = 3$

$U_2 = \frac{3}{2} \times 4 RT$

$U_2 = 6RT$

$U = U_1 + U_2$

$U = 5RT + 6RT$

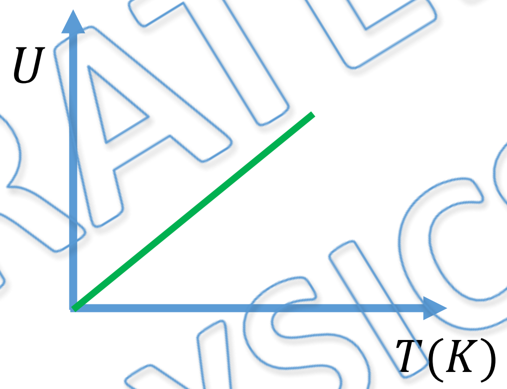
$\boxed{U = 11RT}$

Ans. c

Solution 10:

$$U = \frac{f}{2}nRT$$

$$U \propto T$$



Ans. a

Solution 11:

for H_2 at 'T' & Moles n_1

$$U_1 = \frac{5}{2} n_1 RT$$

for He at '2T' & Moles n_2

$$U_2 = \frac{3}{2} n_2 R (2T)$$

$$U_1 = U_2$$

$$\frac{5}{2} n_1 RT = \frac{3}{2} n_2 R (2T)$$

$$\frac{5}{2} n_1 = 3 n_2$$

$$\boxed{\frac{n_1}{n_2} = \frac{6}{5}}$$

Ans. c

Solution 12:

$$dQ = \Delta U + dW$$

$$\Delta U = dQ - dW$$

$$dQ = \Delta U + dW$$

$$\Delta U = 0 \quad (\because T = \text{constant})$$

$$\therefore dQ = dW$$

Heat is given to system $\Rightarrow dQ = +ve$

$\Rightarrow dW = +ve$

Ans. b

Solution 13:

at constant Volume

$\Delta U = nC_v \Delta T$

when C_v is in cal/mol-°C

and $\Delta U = mC_v \Delta T$

when C_v is in cal/kg-°C

given; $C_v = 0.18$ Kcal/kg-K

$m = 20$ gm $= 20 \times 10^{-3}$ kg

$\therefore \Delta U = (20 \times 10^{-3}) \times (0.18) \times 10$ Kcal

$\Delta U = 3.6 \times 10^{-3} \times 10$ Kcal

$\Delta U = 3.6 \times 10^{-2}$ Kcal

$\Delta U = 0.036$ Kcal

1 cal = 4.2 Joule

1 Kcal = 4200 Joule

$\therefore \Delta U = 0.036 \times 4200$

$\Delta U = 3.6 \times 42$

$\boxed{\Delta U = 151.2 \text{ J}}$ Ans.

Ans. b

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