AVIRAL CLASSES
CREATING SCHOLARS
FOR JEE (Main & advance), PMTs & FOUNDATION

DATE : 12.02.2017

FINAL TEST SERIES NEET -2017
TEST-05

BRANCH OFFICE-1 : HO : World Trade Tower, 99- Rajpur Road. Dehradun (U.K.)

BRANCH OFFICE-2 : GMS Road, Ballupur Chowk, Dehradun (U.K.)

PH: 0135-6557701 / 02 / 03, **MOB.:** 9045062312 / 14 / 15 / 16 / 17 / 18 / 20. **web: www.aviral.co.in**

[PHYSICS]

1. Given that,

$T_2 = 4°C = 277$ K, $T_1 = 303$ K

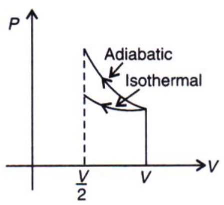
and $Q_2 = 600$ cal

Hence, $\frac{Q_1}{Q_2} = \frac{T_1}{T_2}$

or $\frac{Q_2 + W}{Q_2} = \frac{T_1}{T_2}$

$\therefore$ $W = 236.5\ W$

2.



As area under adiabatic curve > area under isothermal curve

Hence, $W_{\text{adiabatic}} > W_{\text{isothermal}}$

3. For a complex cycle,

$Q_{\text{cycle}} = W_{\text{cycle}}$

or, $400 + 100 + Q_{C\to A} = \frac{1}{2}(2\times10^{-3})(4\times10^{4})$

or, $500 + Q_{C\to A} = 40$

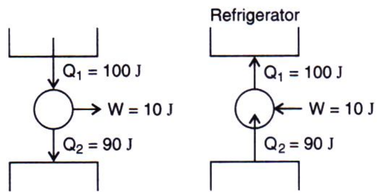
or, $Q_{C\to A} = -460$ J

Hence, $Q_{A\to C} = +460$ J

4. $\gamma = \frac{C_p}{C_v} = \frac{\left(\frac{n}{2}+1\right)R}{\left(\frac{1}{2}\right)R}$

$= \left(1+\frac{2}{n}\right)$

5.



It is clear from above figure that 90 J heat is absorbed at lower temperature.

6. $\Delta U = \left(\frac{f}{2}\right)nR(T_1 - T_2)$

$= \frac{5}{2}[P_1V_1 - P_2V_2]$

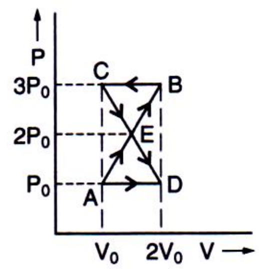
$= \frac{5}{2}[2\times10^3\times6 - 5\times10^3\times4]$

$= \frac{5}{2}[12-20]\times10^3$ J

$= -20 \times 10^3$ J

$= -20$ kJ

7. In a cyclic process work done is equal to the area under the cycle and is posiitve if the cycle is clockwise and negative if anticlockwise.



As is clear from figure,

W_{AEDA} = + area of $\Delta AED = +\frac{1}{2}P_0V_0$

W_{BCEB} = + area of $\Delta AED = -\frac{1}{2}P_0V_0$

The net work done by the system is

$W_{\text{net}} = W_{AEDA} + W_{BCEB} = +\frac{1}{2}P_0V_0 - \frac{1}{2}P_0V_0 =$ zero

8. First, isothermal expansion

$PV = P'(2V)$ (For isothermal process, PV= constant)

$$P'\frac{P}{2}$$

Then, adiabatic expansion

$P'(2V)^{\gamma} = P_f(16V)^{\gamma}$

(For adiabatic process, PV^{γ} = constant)

$$\frac{P}{2}(2V)^{5/3} = P_f(16V)^{5/3}$$

$$P_f = \frac{P}{2}\left(\frac{2V}{16V}\right)^{5/3} = \frac{P}{2}\left(\frac{1}{8}\right)^{5/3} = \frac{P}{2}\left(\frac{1}{2^3}\right)^{5/3}$$

$$= \frac{P}{2}\left(\frac{1}{2^5}\right) = \frac{P}{64}$$

9. $P \propto T^3$ or PT^{-3} = constant ....(1)

for an adiabatic process

$PT^{\gamma/1-\gamma}$ = constant

comparing (1) and (2), we get : ......(2)

$$\frac{\gamma}{1-\gamma} = -3 \quad \text{or} \quad \gamma = -3 + 3\gamma$$

$$\text{or} \quad 2\gamma = 3 \quad \text{or} \quad \gamma = \frac{3}{2}$$

As $\gamma = \frac{C_p}{C_v}$, $\quad\therefore\quad \frac{C_p}{C_v} = \frac{3}{2}$

Hence, correct answer is (c)

10. For an ideal gas

$C_p - C_v = R$

dividing by C_v on both sides, we get :

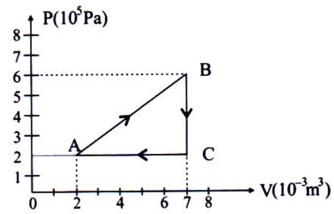
$$\frac{C_p}{C_v} - 1 = \frac{R}{C_v}$$

As $\gamma = \frac{C_p}{C_v}$

$$\therefore \quad \gamma - 1 = \frac{R}{C_v} \text{ or } C_v = \frac{R}{\gamma - 1}$$

Hence, correct answer is (a) :

11. In a cycle process, work done is equal to the area under the cycle and is positive if the cycle is clockwise and negative if the cycle is anticlockwise.



The network done by the gas is :

W = Area of the cycle $ABCA$

$$= \frac{1}{2} \times (7-2) \times 10^{-3} \times (6-2) \times 10^5$$

$$= \frac{1}{2} \times 5 \times 10^{-3} \times 4 \times 10^5$$

$= 10 \times 10^2$ J = 1000 J

Hence, correct answer is (a)

12. According to Stefan's law of Black Body Radiation

$Q = \sigma A t^4$

$$\therefore \quad T = \left(\frac{Q}{\sigma A}\right)^{1/4}$$

$$= \left(\frac{Q}{4\pi R^2 \sigma}\right)^{1/4}$$

13. Efficiency of Carnot engine,

$$\eta = 1 - \frac{T_2}{T_1}$$

$$\text{or} \quad \frac{T_2}{T_1} = 1 - \eta = 1 - \frac{40}{100} = \frac{3}{5}$$

$\therefore \quad T_1 = \frac{5}{3} \times T_2 = \frac{5}{2} \times 300 = 750\text{K}$

Increase in efficiency = 50% of 40% = 20%

$\therefore$ New efficiency, η' = 40% + 20% = 60%

$$\therefore \quad \frac{T_2}{T_1} = 1 - \frac{60}{100} = \frac{2}{5}$$

$$\therefore \quad T_1' = \frac{5}{2} \times T_2 = \frac{5}{2} \times 300 = 750\text{K}$$

Increase in temperature of source

= $T_1' - T_1$ = 750 – 500 = 250 K

14. Entropy is a measure of disorder. When water is converted to ice, disorder decreases, so entropy decreases.

15. According to first law of thermodynamics

$\Delta Q = \Delta U + \Delta W$ ......(i)

where,

ΔQ = Heat supplied to the system

ΔU = Increase in interal energy of the system

ΔW = Work done by the system

$\Delta Q = 0$

From equation (i), we get

$\Delta U = - \Delta W$

For an isothermal process

$\Delta U = 0$

From equation (i), we get

$\Delta Q = \Delta W$

Hence, option (c) is true.

16. Give that,

V_{rms} = 200 ms^{-1}, T_1 = 300 K, P_1 = 10^5 Nm^{-2}

$$\therefore \quad V_{\text{rms}} = \sqrt{\frac{3RT}{M}} T_2 = 400\text{K}, P_2 = 0.05 \times 10^5 \text{Nm}^{-2}$$

$$\text{or} \quad \frac{V_2}{V_1} = \sqrt{\frac{T_2}{T_1}}$$

$$\text{or} \quad V_2 = \sqrt{\frac{400}{300}} \times 200\text{ms}^{-1} = \frac{400}{\sqrt{3}}\text{ms}^{-1}$$

17. The mean free path λ is the average distance convered by a molecule between two successive collision and is given by

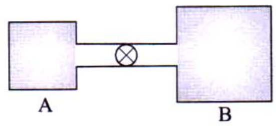
$$\lambda = \frac{1}{\sqrt{2}n\pi d^2}$$

where n is the number density and d is the diameter of the molecule.

$$\therefore \quad \lambda \propto \frac{1}{d^2}$$

18. According to ideal gas equation.

$PV = nRT$ ......(i)



Total number of mole of ideal gas in both containers,

$n = n_A + n_B$ ......(ii)

$$n = \frac{P_A V_A}{RT_A} + \frac{P_B V_B}{RT_B} \qquad \text{[using (i)]}$$

$$= \frac{5 \times 10^5 \times V}{R \times 300} + \frac{1 \times 10^5 \times 4V}{R \times 400} \qquad (\because V_B = 4V_A)$$

$$\therefore \quad n = \frac{2.67 \times 10^3 \times V}{R} \qquad \text{....(iii)}$$

Put (iii) in (ii) we get

$$n_B = \frac{2.67 \times 10^3 \times V}{R} - n_A \qquad \text{...(iv)}$$

It is given that the final pressure in both containers are same i.e., $P_A = P_B$

$$\text{or} \quad \frac{n_A \times R \times T_A}{V_A} = \frac{n_B \times R \times T_B}{V_B} \qquad \text{[using (i)]}$$

$$\frac{n_A \times R \times 300}{V} = \left(\frac{2.67 \times 10^3 \times V}{R} - n_A\right)\frac{R \times 400}{4V}$$

$$\text{or} \quad \frac{n_A \times R \times 300}{V} + \frac{n_A \times R \times 400}{4V} = 2.67 \times 10^5$$

$$\text{or} \quad n_A\left[\frac{300R}{V} + \frac{100R}{V}\right] = 2.67 \times 10^5$$

$$\therefore \quad n_A \frac{2.67 \times 10^5 \times V}{400R}$$

$$\text{or} \quad P_A = P_B = \frac{n_A \times R \times T_A}{V_A}$$

$$= \frac{2.67 \times 10^5 \times V \times R \times 300}{400R \times V} = 2 \times 10^5 Pa$$

19. As here volume of the gas remains constant, therefore, the amount of heat energy required to raise the temperature of the gas is :

$\Delta Q = nC_V\Delta T$

Here, number of moles, $n = \frac{1}{4}$

$C_v = \frac{3}{2}R$ ($\because$ He is a monoatomic gas)

$\Delta T = T_2 - T_1$

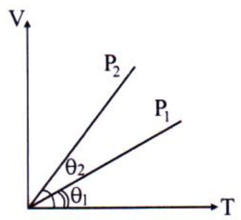
$\therefore \quad \Delta Q = \frac{1}{4}\left(\frac{3}{2}R\right)(T_2 - T_1)$

$= \frac{3}{8}N_a k_B(T_2 - T_1) \qquad \left[\because k_B = \frac{R}{N_a}\right]$

Hence, correct answer is (d).

20. According to ideal gas equation

$PV = nRT$ or $V = \frac{nRT}{P}$



For an isobaric process, P = constant and $V \propto T$. Therefore, $V - T$ graph is a straight line passing through origin. Slope of this line is inversely proportional to P.

In the given figure $(\text{slope})_2 > (\text{slope})_1$

$\therefore \quad P_2 < P_1$

21. $v_{\text{rms}} = \sqrt{\frac{3RT}{m}}$

$\vec{v} = \sqrt{\frac{8RT}{\pi m}} = \sqrt{\frac{2.5RT}{m}}$

and $v_p = \sqrt{\frac{2RT}{m}}$

From these expressions, we can see that $v_p < \vec{v} < v_{\text{rms}}$

Again, $v_{\text{rms}} = v_p\frac{\sqrt{3}}{2}$

and average kinetic energy of a gas molecule

$E_k = \frac{1}{2}mv_{\text{rms}}^2$

$E_k = \frac{1}{2}m\left(\sqrt{\frac{3}{2}}v\right)^2 = \frac{1}{2}m \times \frac{3}{2}v_p^2 = \frac{3}{4}mv_p^2$

22. C

23. Assuming the balloons have the same volume, as $PV = nRT$, if P, V and T are the same, n, the number of moles present will be the same, whether it is He or air. Hence, number of molecules per unit volume will be same in both the balloons

24. $P = \frac{1}{3}\frac{mv}{V}v_{\text{rms}}^2$

i.e., $P \propto m$

$\propto v_{\text{rms}}^2$

m is halved and v_{rms} is doubled. Hence P wil become two times.

[In the above equation m is the mass of one gas molecule and n is the total number of gas molecules.]

25. $v_{\text{rms}} \propto \sqrt{T}$

$\therefore \quad v_{\text{rms}} \propto \sqrt{273}$ and $2v_{\text{rms}} \propto \sqrt{T}$

$\therefore \quad 2 = \sqrt{\frac{T}{273}}$ or T = 4 × 273

$\therefore$ T = 1092 K = 1092 – 273 = 819ºC

26. $v_1^2 = \omega^2(a^2 - x_1^2)$

$v_2^2 = \omega^2(a^2 - x_2^2)$

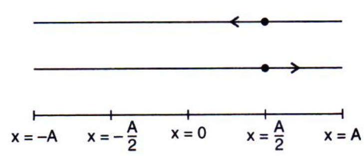
Hence, $\frac{v_1^2}{\omega^2} + x_1^2 = \frac{v_2^2}{\omega^2} + x_2^2$

or, $\frac{v_1^2 - v_2^2}{\omega^2} + x_2^2 - x_1^2$

or, $\omega = \sqrt{\frac{v_1^2 - v_2^2}{x_2^2 - x_1^2}}$

$\therefore \quad T = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{x_2^2 - x_1^2}{v_1^2 - v_2^2}}$

27.



The time taken by the particle to travel from x = 0 to $x = \frac{A}{2}$ is $\frac{T}{12}$

The time taken by the particle to travel from $x = A$ to $x = \frac{A}{2}$ is $\frac{T}{6}$

Time difference = $\frac{T}{6} + \frac{T}{6} = \frac{T}{3}$

Phase difference, $\phi = \frac{2\pi}{T} \times \text{Time difference}$

$$= \frac{2\pi}{T} \times \frac{T}{3} = \frac{2\pi}{3}$$

28. $T = 2\pi\sqrt{\frac{L}{g}}$

i.e., time period of a simple pendulum depends upon effective length and acceleration due to gravity, not on mass

So, $T = 2$ sec.

29. $y = r \sin \omega t$

$12.5 = 25 \sin \frac{2\pi}{3} \times t \qquad \left(\because \theta = \frac{2\pi}{T}\right)$

$\frac{\pi}{6} = \frac{2\pi}{3} t$

or $t = \frac{1}{4} \sec = 0.25 \sec$

$t' = 2t$

$= 2 \times 0.25 = .0.5$ sec

30. The coin will be just leaving the contact at the lowest position when

$m\omega^2 A \geq mg$

or $A \geq (g/\omega^2)$.

31. $y = \sin \omega t - \cos \omega t$

$\frac{dy}{dt} = \omega \cos \omega t + \omega \sin \omega t$

$\frac{d^2y}{dt^2} = -\omega^2 \sin \omega t + \omega^2 \cos \omega t$

or $a = -\omega^2(\sin \omega t - \cos \omega t)$

or $a = -\omega^2 y$

$\therefore$ $a \propto -y$

Which is the condition of simple harmonic motion.

32. $U = k\,|\,x\,|^3$

$F = -\frac{dU}{dx} = -3k\,|\,x\,|^2$ ....(i)

The equation of SHM is given as:

$x = a \sin \omega t$

and $\frac{d^2x}{dt^2} = -m\omega^2 x$ .....(ii)

Using eqn. (i) and (ii), we get

$3k|x^2| = m\omega^2 x$

or $\omega = \sqrt{\frac{3kx}{m}}$

$\therefore$ $T = 2\pi\sqrt{\frac{m}{3kx}} = 2\pi\sqrt{\frac{m}{3ka \sin \omega t}}$

$\therefore$ $T \propto \frac{1}{\sqrt{a}}$

33. $y = \frac{1 - \cos 2\omega t}{2}$

$\therefore$ Period, $T = \frac{2\pi}{2\omega} = \frac{\pi}{\omega}$

34. $T = 2\pi\sqrt{\frac{l}{g}}$

$\therefore$ $\frac{T_2}{T_1} - \sqrt{\frac{l_2}{l_1}} = \sqrt{\frac{1.21 l}{l}} = 1.1$

$T_2 = 1.1 T_1$

Hence, $\Delta T = \frac{T_2 - T_1}{T_1} \times 100 = 10\%$

35. $y = A \sin(\omega t + \phi)$

When time is counted from extreme position $y = A$ at $t = 0$, so that

$A = A \sin(0 + \phi)$, i.e., $\phi = (\pi/2)$

So, the equation of motion becomes:

$y = A \sin\left(\omega t + \frac{\pi}{2}\right) = A \cos \omega t$

Now, as here $y = (A/2)$, hence

$(A/2) = A \cos \omega t$, i.e., $\omega t = \cos^{-1}(1/2)$,

or $\frac{2\pi}{T} t = \frac{\pi}{3}$ or $t = \frac{T}{6}$