AVIRAL
JEE | NEET | FOUNDATIONS

WEEKLY TEST TYJ-02 TEST 16 RAJPUR ROAD SOLUTION Date 01-12-2019

[PHYSICS]

1. $\frac{C_{H_2}}{C_{O_2}} = \sqrt{\frac{32}{2}} = 4$

or $C_{H_2} = 4 \times C_{O_2} = 4 \times 400\ \text{m s}^{-1} = 1600\ \text{m s}^{-1}$

2. The kinetic energy of gas w.r.t. centre of mass of the system $\text{K.E.} = \frac{5}{2}nRT$

Kinetic energy of gas w.r.t. ground = Kinetic energy of centre of mass w.r.t. ground + Kinetic energy of gas w.r.t. centre of mass.

$$\text{K.E.} = \frac{1}{2}MV^2 + \frac{5}{2}nRT$$

3. Ideal gas equation $PV = \mu RT = \left(\frac{N}{N_A}\right)RT$ where N = Number of molecule, N_A = Avogadro number

$$\therefore \frac{N_1}{N_2} = \left(\frac{P_1}{P_2}\right)\left(\frac{V_1}{V_2}\right)\left(\frac{T_2}{T_1}\right) = \left(\frac{P}{2P}\right)\left(\frac{V}{V/4}\right)\left(\frac{2T}{T}\right) = \frac{4}{1}.$$

4. $C = \sqrt{\frac{3RT}{M}}$ or $T \propto M$

$\therefore \frac{T'}{T} = \frac{4}{2} = 2$ or $T' = 2T$

or $T = 2 \times 273\ \text{K} = 546\ \text{K}$

5. or $m \propto (1/P)$ or, $m_2 > m_1 \ \therefore P_2 < P_1$

6. Since the graph is a straight line,

so, $V = mT$ where m is the slope.

$= (nRT)/P$ [From equation of state]

7. Given:

Initial volume $V_1 = 3V$

Initial pressure $P_1 = 2$ atmosphere.

Final pressure

$$P_2 = 2P_1 = 2 \times 2 = 4 \text{ atmosphere}$$

According to the Boyle's law we have

$P_1V_1 = P_2V_2$ (where V_2 is the final volume of gas)

or $\quad 2 \times 3V = 4 \times V_2$ or $V_2 = 1.5\ V$

8. For a given pressure, V is small for T_1. Since $V \propto T$, therefore, $T_1 < T_2$.

9. When, the container stops, its total kinetic energy is transferred to gas molecules in the form of translational kinetic energy, thereby increasing the absolute temperature.

Assuming n = number of moles.

Given, m = molar mass of the gas.

If ΔT = change in absolute temperature.

Then, kinetic energy of molecules due to velocity v_0,

$$\Delta K_{\text{motion}} = \frac{1}{2}(mn)v_0^2 \qquad \text{(i)}$$

Increase in translational kinetic energy

$$\Delta K_{\text{translation}} = n\frac{3}{2}R(\Delta T) \qquad \text{(ii)}$$

According to kinetic theory Eqs. (i) and (ii) are equal

$$\Rightarrow \quad \frac{1}{2}(mn)v_0^2 = n\frac{3}{2}R(\Delta T)$$

$$(mn)v_0^2 = n3R(\Delta T)$$

$$\Rightarrow \quad \Delta T = \frac{(mn)v_0^2}{3nR} = \frac{mv_0^2}{3R}$$

10. $\frac{C_t}{C_0} = \sqrt{\frac{273+t}{273}}$

or $\quad 4 \times 273 - 273 = t$

or $\quad t = 3 \times 273 = 819°\text{C}$

11. 3 moles of H_2 are given.

12. $PV = \mu RT, PV = \frac{n}{N} \times hNT$ or $n = \frac{PV}{kT}$

13. For a constant value of density, pressure is more at T_1.

$\therefore \quad T_1 > T_2 \qquad [\because P \propto T]$

14.

15. Initial volume of gas = V_1

Final volume of gas = V_2

Initial temperature of gas $T_1 = 27°C = 300$ K

Final temperature of gas $T_2 = 54°C = 327$ K

Now from the Charles's law at constant pressure

$$\frac{V_1}{V_2} = \frac{T_1}{T_2} = \frac{300}{327} = \frac{100}{109}$$

16.

17. The given statement is zeroth law of thermodynamics. It was formulated by R. H. Fowler in 1931

18. The internal energy of ideal gas depends only upon temperature of gas not on other factors.

19. For monoatomic gas, $\frac{\Delta U}{Q} = \frac{1}{3}$ or, $\Delta U = \frac{Q}{3}$

From the first law of thermodynamics,

$$Q = \Delta U + W \quad \therefore \quad W = (2/3)Q$$

20. $\Delta U = nC_V\Delta T = n(5/2)R\Delta T$

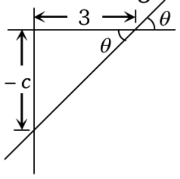
$\Delta Q = nC_P\Delta T = n(7/2)R\Delta T$

$W = \Delta Q - \Delta U = \frac{n7}{2}R\Delta T - \frac{n5}{2}R\Delta T = nR\Delta T$

$\frac{W}{\Delta U} = \frac{2}{7}$

[MATHEMATICS]

41. (a) Obviously $m = \tan\theta = \frac{-c}{3} \Rightarrow 3 = \frac{-c}{3} \Rightarrow c = -9$



Hence the required equation is $y = 3x - 9$.

42. (b) Slope $= \frac{-y'}{2a}$.

Hence equation is $y'x + 2ay = y'x' + 2ay'$.

43. (b) The line perpendicular to the line $x + y + 1 = 0$ is $y - x + \lambda = 0$. Also, it passes through the point (1, 2); $\therefore \lambda = -1$. Hence, required line is $y - x - 1 = 0$.

44. (b) Angle between both the lines is

$\tan^{-1} m \pm \tan^{-1} m = \tan^{-1}\frac{2m}{1-m^2}$ or $\tan^{-1} 0$

Therefore equation of lines are $y = 0$, $y = \frac{2mx}{1-m^2}$.

45. (a) Point of intersection $y = -\frac{21}{5}$ and $x = \frac{23}{5}$

$\therefore\ 3x + 4y = \frac{3(23) + 4(-21)}{5} = \frac{69-84}{5} = -3$.

Hence, required line is $3x + 4y + 3 = 0$.

46. (a) Intersection point on x-axis is $(2x_1, 0)$ and on y-axis is $(0, 2y_1)$. Thus equation of line passes through these points is $\frac{x}{x_1} + \frac{y}{y_1} = 2$.

47. (c) The point of intersection is (1, 1) Therefore the equation of the line passing through (1, 1) and $(\pi, 0)$ is

$y - 1 = \frac{-1}{\pi - 1}(x-1) \Rightarrow x - y = \pi(1-y)$.

48. (a) $x\cos\theta - y\sin\theta = a(\cos^4\theta - \sin^4\theta) = a\cos 2\theta$

49. (b) If the given lines represent the same line, then the length of the perpendiculars from the origin to the lines are equal, so that $\frac{c}{\sqrt{1+m^2}} = \frac{p}{\sqrt{\cos^2\alpha + \sin^2\alpha}}$

$\Rightarrow\ c = p\sqrt{1+m^2}$.

50. (c) Required equation is $y - 2 = \frac{5-2}{2-1}(x-1) \Rightarrow y - 3x + 1 = 0$.

51. (b) The equation of any line parallel to $2x + 6y + 7 = 0$ is $2x + 6y + k = 0$.

This meets the axes at $A\left(-\frac{k}{2}, 0\right)$ and $B\left(0, -\frac{k}{6}\right)$.

By hypothesis, $AB = 10$

$\Rightarrow \sqrt{\frac{k^2}{4} + \frac{k^2}{36}} = 10 \Rightarrow \sqrt{\frac{10k^2}{36}} = 10$

$\Rightarrow 10k^2 = 3600 \Rightarrow k = \pm 6\sqrt{10}$.

Hence there are two lines given by $2x + 6y \pm 6\sqrt{10} = 0$.

52. (d) The equation of a line passing through (2, 2) and perpendicular to $3x + y = 3$ is $y - 2 = \frac{1}{3}(x-2)$ or $x - 3y + 4 = 0$.

Putting $x = 0$ in this equation, we obtain $y = 4/3$.

So, y-intercept $= 4/3$.

53. (d) Given form is $3x + 3y + 7 = 0$

$\Rightarrow \frac{3}{\sqrt{3^2+3^2}}x + \frac{3}{\sqrt{3^2+3^2}}y + 7 = 0$

$\Rightarrow \frac{3}{3\sqrt{2}}x + \frac{3}{3\sqrt{2}}y = \frac{-7}{3\sqrt{2}}$, $\therefore\ p = \left|\frac{-7}{3\sqrt{2}}\right| = \frac{7}{3\sqrt{2}}$.

54. (a) Perpendicular to $\sqrt{3}\sin\theta + 2\cos\theta = \frac{4}{r}$ is

$\sqrt{3}\sin\left(\frac{\pi}{2}+\theta\right) + 2\cos\left(\frac{\pi}{2}+\theta\right) = \frac{k}{r}$

It is passing through $(-1, \pi/2)$

$\sqrt{3}\sin\pi + 2\cos\pi = \frac{k}{-1} \Rightarrow k = 2$

$\therefore\ \sqrt{3}\cos\theta - 2\sin\theta = \frac{2}{r} \Rightarrow 2 = \sqrt{3}r\cos\theta - 2r\sin\theta$.

55. (a) Equation of the line passing through $(-4,6)$ and $(8,8)$

is $y - 6 = \left(\frac{8-6}{8+4}\right)(x+4) \Rightarrow y - 6 = \frac{2}{12}(x+4)$

$\Rightarrow 6y - 36 = x + 4 \Rightarrow 6y - x - 40 = 0$ ......(i)

Now equation of any line perpendicular to it is

$6x + y + \lambda = 0$ ......(ii)

This line passes through the mid point of $(-4,6)$ and $(8,8)$ *i.e.,* $(2,7) \Rightarrow 6 \times 2 + 7 + \lambda = 0$

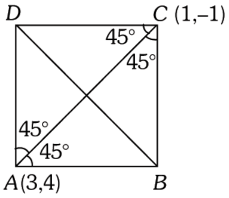
$\Rightarrow 19 + \lambda = 0 \Rightarrow \lambda = -19$

From (ii) the equation of required line is

$6x + y - 19 = 0$.

56. (c) Obviously, slope of $AC = 5/2$.

Let m be the slope of a line inclined at an angle of 45^o to AC, then $\tan 45^o = \pm \frac{m - \frac{5}{2}}{1 + m.\frac{5}{2}} \Rightarrow m = -\frac{7}{3}, \frac{3}{7}$.



Thus, let the slope of AB or DC be 3/7and that of AD or BC be $-\frac{7}{3}$. Then equation of AB is $3x - 7y + 19 = 0$.

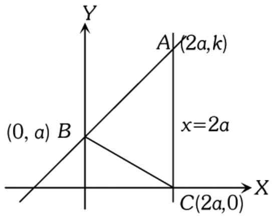
Also the equation of BC is $7x + 3y - 4 = 0$.

On solving these equations, we get, $B\left(-\frac{1}{2}, \frac{5}{2}\right)$.

Now let the coordinates of the vertex D be (h, k). Since the middle points of AC and BD are same, therefore $\frac{1}{2}\left(h - \frac{1}{2}\right) = \frac{1}{2}(3+1) \Rightarrow h = \frac{9}{2}$, $\frac{1}{2}\left(k + \frac{5}{2}\right) = \frac{1}{2}(4-1)$

$\Rightarrow k = \frac{1}{2}$. Hence, $D = \left(\frac{9}{2}, \frac{1}{2}\right)$.

57. (d) Obviously, other line AB will pass through $(0, a)$ and $(2a, k)$.



But as we are given $AB = AC$

$\Rightarrow k = \sqrt{4a^2 + (k-a)^2} \Rightarrow k = \frac{5a}{2}$

Hence the required equation is $3x - 4y + 4a = 0$.

58. (a) $ax + by + c = 0$ is always through $(1, -2)$.

$\therefore\ a - 2b + c = 0 \Rightarrow 2b = a + c$

Therefore, a, b and c are in A.P.

59. (d) Line joining point $(-1,3)$ and $(4,-2)$ is

$(y+1) = \frac{-5}{5}(x-3) \Rightarrow y + 1 = -1(x-3)$

$x + y = 2$ ..... (i)

If line (i) passes through point (p, q), then $p + q = 2$.

60. (c) $a_1 a_2 + b_1 b_2 = \frac{1}{ab'} + \frac{1}{a'b} = 0$

Therefore, the lines are perpendicular.