WEEKLY TEST TARGET - JEE- 02 TEST - 02
SOLUTION Date 14-07-2019

[PHYSICS]

1.

2. $F = \frac{1}{4\pi\varepsilon_0}.\frac{q_1q_2}{r^2}$; $\therefore$ unit of $\varepsilon_0 = \frac{(\text{coulomb}^2)}{(\text{newton} - \text{m}^2}$

3. Here, $\frac{2\pi}{\lambda}(ct - x)$ is dimensionless. Hence, $\frac{ct}{\lambda}$ is also dimensionless and unit of ct is same as that of x. Therefore, unit of λ is same as that of x. Also unit of y is same as that of A, which is also the unit of x.

4. We know that the units of physical quantities which can be expressed in terms of fundamental units are called derived units. Mass, length and time are fundamental units but volume is a derived unit (as $V = L^3$)

5.

6. $CR = \frac{q}{V} \times \frac{V}{I} = \frac{q}{q/t} = t$

$[CR] = [T]\,[M^0L^0T]$

7. $[a] = [PV^2]$

$= \left[\frac{FV^2}{A}\right] = \frac{[ML^{-2}T^6]}{[L^2]} = [MLT^{5-2}]$

8. $E = h\nu$ or $[h] = \left[\frac{E}{\nu}\right] = \frac{[ML^2T^{-2}]}{[T^{-1}]} = [ML^2T^{-1}]$

9. We know that dimension of velocity of light $[c] = [M^0LT^{-1}]$; dimension of gravitational constant $[G] = [M^1L^3T^{-2}]$ and dimension of Planck's constant $[h] = [M^1L^2T^{-2}]$. Solving the above three equations, we get; $[M] = [c^{1/2}G^{-1/2}h^{1/2}]$.

12. $\frac{\Delta V}{V} = 3 \times \frac{\Delta r}{r} = 3 \times \frac{1}{100} = \frac{3}{100} = 3\%$

13. Given length $(\ell) = 3.124$ m and breadth (b) = 3.002 m. We know that area of the sheet (A) = $\ell \times b = 3.124 \times 3.002 = 9.378248\ m^2$. Since, both length and breadth have four significant figures, therefore area of the sheet after rounding off to four significant is $9.378\ m^2$.

14. $\frac{[h]}{[I]} = \frac{[E\lambda]}{[CI]} = \frac{[ML^2T^{-2}][L]}{[LT^{-1}][ML^2]}$

$= [T^{-1}] = [\text{frequency}]$.

15. Unit of energy = $[F]^x\,[A]^y\,[T]^z$

$[M]^1\,[L]^2\,[T]^{-2} = [MLT^{-2}]^x\,[M^0LT^{-2}]^y\,[M^0L^0T^1]^z$

or $[M]^1\,[L]^2\,[T]^{-2} = M^xL^{x+y}T^{-2x-2y+z}$

For equality,

$x = 1,\ x + y = 2$ or $y = 1$

$-2x - 2y + z = -2$ or $z = 2$

$\therefore$ Unit of energy = $[F]^1\,[A]^1\,[T]^2$

16. $x^2 = 1 + t^2$

or $x = (1 + t^2)^{1/2}$

$$\frac{dx}{dt} = \frac{1}{2}(1+t^2)^{-1/2}.2t = t(1+t^2)^{-1/2}$$

$$\frac{d^2x}{dt^2} = t\left(-\frac{1}{2}\right)(1+t^2)^{-3/2}.2t(1+t^2)^{-1/2}$$

$$= \frac{1}{x} - \frac{t^2}{x^3}$$

17. $x = \frac{k}{b^2}(1-e^{-bt})$

$$\frac{dx}{dt} = \frac{k}{b}e^{-bt}, \quad \frac{d^2x}{dt^2} = -ke^{-bt}$$

18. $s_n = \frac{a}{2}(2n-1)$ and $s(n) = \frac{a}{2}n^2$

Hence, $\frac{s_n}{s(n)} = \frac{\frac{a}{2}(2n-1)}{\frac{a}{2}n^2} = \left[\frac{2}{n} - \frac{1}{n^2}\right]$

19. For no collision, the speed of car A may be reduced to v_B before the cars meet, i.e., final relative velocity of car A with respect to car B is zero, i.e., $V_r = 0$

Henc, u_r = initial relatie velocity = $V_A - V_B$

Relative acceleration = $a_r = u^2 + 2as$

Then using the equation, $v^2 = u^2 + 2as$

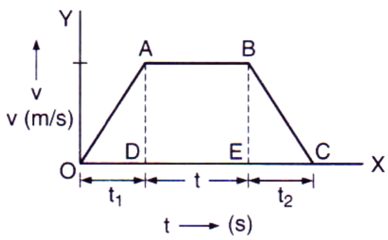
$$0 = (V_A - V_B)^2 - 2as' \quad \text{or} \quad s' = \frac{(V_A - V_B)^2}{2a}$$

For no collision, $s' \le s$, i.e., $\frac{(V_A - V_B)^2}{2a} \le s$

20.

21. In the portion OA, slope (= velocity) of the curve is +ve; at the point A, slope of the curve is zero; while in the portion AB, slope of the curve is – ve. Hence (v – t) curve will be as shown in option (b)

22. The velocity-time graph can be drawn as shown in following figure.



Magnitude of slope of OA = f and slope of $BC = \frac{f}{2}$

$$v = ft_1 = \frac{f}{2}t_2$$

$\therefore$ $t = 2t_1$

In the graph area of ΔOAD gives distances,

$$S = \frac{1}{2}ft_1^2 \qquad ....(i)$$

ARea of rectangle ABED gives distance travelled in time t

$S_2(ft_1)t$

Distance travelled in time $t_2 = S_3 = \frac{1}{2} f_2 (2t_1)^2$

Thus, $S_1 + S_2 + S_3 = 15$ S

$S + (ft_1)t + ft_1^2 = 15$ S

S + (ft)t + 2S = 15 S $\quad \left(S = \frac{1}{2} ft_1^2\right)$

$(ft_1)t = 12$ S ....(ii)

From eqns. (i) and (ii), we have

$$\frac{12S}{S} = \frac{(ft_1)t}{\frac{1}{2}(ft_1)t_1}$$

or $t_1 = \frac{t}{6}$

From eqn. (i), we get;

$\therefore$ $S = \frac{1}{2} f(t_1)^2$

or $S = \frac{1}{2} f\left(\frac{t}{6}\right)^2 = \frac{1}{72} ft^2$

23. Initial velocity of parachutist after bailing out, $u^2 = 2ah = 2 \times 9.8 \times 50 = 980$

When it reaches the ground,

$3^2 = u^2 - 2 \times 2 \times h_1$

or $h_1 = 242.75$ m

$\therefore$ Total height = 242.75 + 50 $\simeq$ 293 m

24. Equation of given curve is

$$\frac{v}{v_0} + \frac{x}{x_0} = 1$$

$\therefore$ $v = \left(1 - \frac{x}{x_0}\right) v_0$

$\therefore$ $a = \frac{dv}{dt} - \frac{v_0^2}{x_0}\left(\frac{dx}{dt}\right) = -\frac{v_0}{x_0}(v)$

or $a = -\frac{v_0^2}{x_0^2} x - \frac{v_0^2}{x_0}$

Which is straight line with positive slope and negative intercept.

25. $x = ae^{-\alpha t} + be^{\beta t}$

$$\frac{dx}{dt} = -a\alpha e^{-\alpha t} + b\beta e^{t}$$

$v = - a\alpha e^{-\alpha t} + b\beta e^{\beta t}$

For certain value of t velocity will increase.

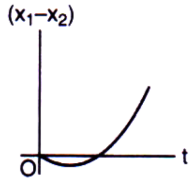
26. Here,

$x_2 = vt$

and $x_1 = \frac{at^2}{2}$

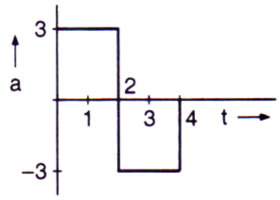
$$x_1 - x_2 = -\left(vt - \frac{at^2}{2}\right)$$

So, the graph would be like that shown in figure.



27. Velocity at 3s = total algebraic sum of area under the curve
or $v = 4 \times 2 - 4 \times 1$
$= 8 - 4 = 4\ ms^{-1}$.

28. Taking the motion from 0 to 2 is :
$u = 0$, $a = 3\ ms^{-2}$, $t = 2s$, $v = ?$
$v = u + at = 0 + 3 \times 2 = 6\ ms^{-1}$
Taking the motion from 2s to 4s:
$v = 6 + (-3)(2) = 0\ ms^{-1}$



Hence, graph (a) represents the correct option.

29.

30. Because the slope is the highest at C, $v = \frac{ds}{dt}$ is maximum.

[CHEMISTRY]

43.

$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_3$
1L of N_2 reacts with 3L of H_2 to form 2L of NH_3.
10 L of N_2 will react with 30 L H_2 to form 20 L NH_3.
Since actual yield is 50% of the expected yield,
therefore, NH_3 formed = 10 L
N_2 reacted = 5L and H_2 reacted = 15 L.
∴ **Mixture will contain 10 L NH_3, 25 L N_2 and 15 L H_2.**

44.

$\underset{1\ mol}{Mg_3(PO_4)_2} \equiv \underset{8\ mo!}{8O}$

∴ 0.25 mole of) atoms $= \frac{1}{8} \times 0.25$ mol of $Mg_3(PO_4)_2$
$= \mathbf{3.125 \times 10^{-2}}$ **mol**

45.

Number of electrons involved in the redox reaction is five.
Therefore, equivalent weight is **M/5**.

46.

Concentration of $Na_2CO_3 = \frac{25.3}{250} \times 1000 = 101.2\ g\ L^{-1}$
$= \frac{101.2}{106}\ mol\ L^{-1} = 0.9547\ mol\ L^{-1}$
∴ Conc. of Na^+ ion $= 2 \times 0.9547 = \mathbf{1.91M}$
Conc. of CO_3^{2-} ion $= \mathbf{0.955\ M}$

47.

$44\,g\ CO_2 = 1\ \text{mol} = 6.02 \times 10^{23}$ molecules

$48\,g\ O_2 = \frac{48}{32} = 1.5\ \text{mol} = 1.5 \times 6.02 \times 10^{23}$ molecules

$8\,g\ H_2 = \frac{8}{2} = 4\ \text{mol} = 4 \times 6.02 \times 10^{23}$ molecules

$64\,g\ SO_2 = \frac{64}{32} = 2\ \text{mol} = 2 \times 6.02 \times 10^{23}$ molecules

$\therefore$ $8\,g\ H_2$ has maximum number of molecules.

48.

Number of moles in 0.018 g water $= \frac{0.018}{18} = 1 \times 10^{-3}$ moles

$\therefore$ Number of molecules in 10^{-3} moles $= N_A \times 10^{-3}$.

$= 6.022 \times 10^{23} \times 10^{-3} = \mathbf{6.022 \times 10^{20}}$

49.

$$\underset{\substack{1\ \text{mol} \\ 100\ g}}{CaCO_3} + 2HCl \longrightarrow CaCl_2 + H_2O + \underset{\substack{1\ \text{mol} \\ 6.023 \times 10^{23} \\ \text{molecules}}}{CO_2}$$

Thus, 100 g of pure $CaCO_3$ gives 1 mol or 6.023×10^{23} molecules

1 mg or 10^{-3} g of pure $CaCO_3$ gives .

50.

$$\underset{\text{(Original)}}{M_1V_1} = \underset{\text{(Diluted)}}{M_2V_2}$$

$5 \times 1 = M_2 \times 10$

$M_2 = \frac{5}{10} = 0.5\ M = \mathbf{1N}$ [$\because H_2SO_4$ is a dibasic acid]

51.

$N_1V_1 = N_2V_2$

$0.5 \times 100 = 0.1 \times V_2$

$V_2 = \frac{0.5 \times 100}{0.1} = 500$ mL

Water to be added = 500 – 100 = **400 mL**

53.

54.

$$\underset{\substack{1\ \text{vol.} \\ 20\ \text{mL}}}{CH_4} + \underset{\substack{2\ \text{vol.} \\ 40\ \text{mL}}}{2O_2} \longrightarrow \underset{\substack{1\ \text{vol.} \\ 20\ \text{mL}}}{CO_2} + 2H_2O$$

Volume of oxygen left unused = 50 – 40 = 10 mL

On cooling, water vapours change to liquid

volume of gases after cooling = 10 mL O_2 + 20 mL CO_2

= **30 mL**

55.

$$MCO_3 \xrightarrow{\Delta} MO + CO_2$$
1 mol → 1 mol or 22400 mL of CO_2 at STP

448 *cc* of CO_2 is given by metal carbonate = 2 *g*

22400 *cc* of CO_2 is given by metal carbonate

$$= \frac{2}{448} \times 22400\ g = 100\ g$$

$\therefore$ Mol mass of $MCO_3 = 100$

or $M + 60 = 100$ or atomic mass of metal $= 100 - 60 = 40$

Eq. mass of metal $= \frac{40}{2} = \mathbf{20}$

56.

$$M_{mix} V_{mix} = M_1V_1 + M_2V_2$$

$$M_{mix} = \frac{M_1V_1 + M_2V_2}{V_{mix}}$$

$$= \frac{0.5 \times 750 + 2 \times 250}{(750 + 250)} = \frac{375 + 500}{1000} = \mathbf{0.875\ M}$$

57.

Let the formula of the hydrocarbon be C_xH_y. its combustion can be represented as :

$$\underset{1\ mol}{C_xH_y} + \underset{\left(x+\frac{y}{4}\right) mol}{\left(x + \frac{y}{4}\right) O_2} \longrightarrow \underset{x\ mol}{xCO_2} + \underset{\frac{y}{2}\ mol}{\frac{y}{2} H_2O}$$

Moles of H_2O produced $= \frac{0.72}{18} = 0.04$

Moles of CO_2 produced $= \frac{3.08}{44} = 0.07$

$\therefore x = 0.07$; $\frac{y}{2} = 0.04$ or $y = 0.08$

$$\frac{x}{y} = \frac{0.07}{0.08} = \frac{7}{8}$$

$\therefore$ Empirical formula of the hydrocarbon is $\mathbf{C_7H_8}$

88.

$$\overset{+6}{Cr_2}O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2\overset{+3}{Cr}{}^{3+} + 7H_2O$$

Reduction of $Cr_2O_7^{2-}$ in acidic medium to Cr^{3+}, requires six electrons.

$\therefore$ Eq. wt. of $K_2Cr_2O_7$ in acidic medium $= \frac{\text{Mol. wt.}}{6}$

59.

60.

In exponential notation, only the numerical portion gives the number of significant figures. Hence, 6.023×10^{23} has four significant figures.