WEEKLY TEST MEDICAL PLUS -02 TEST - 05 RAJPUR SOLUTION Date 21-07-2019

[PHYSICS]

1.

2. $F = \frac{1}{4\pi\varepsilon_0} . \frac{q_1 q_2}{r^2}$; $\quad \therefore$ unit of $\varepsilon_0 = \frac{(\text{coulomb}^2)}{(\text{newton} - m^2}$

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

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. $P = \dfrac{\sqrt{abc^2}}{d^3 e^{1/3}}$

$= \dfrac{\Delta P}{P} \times 100$

$= \left[\dfrac{1}{2} \times \dfrac{\Delta a}{a} + \dfrac{1}{2} \times \dfrac{\Delta b}{b} + \dfrac{\Delta c}{c} + 3 \times \dfrac{\Delta d}{d} + \dfrac{1}{3} \times \dfrac{\Delta e}{e}\right] \times 100$

$= \left[\dfrac{1}{2} \times 2\% + \dfrac{1}{2} \times 3\% + 2\% + 3 \times \% + \dfrac{1}{3} \times 6\%\right]$

= [1% + 1.5% + 2% + 3% + 2%]

The minimum amount of error is contributed by the measurement of a.

17. $y = \dfrac{a^4 b^2}{(cd^4)^{1/3}}$

Taking log on both sides,

$\log y = 4\log a + 2\log b - \dfrac{1}{3}\log c - \dfrac{4}{3}\log d$

Differentiating,

$\dfrac{\Delta y}{y} = 4\dfrac{\Delta a}{a} + 2\dfrac{\Delta b}{b} - \dfrac{1}{3}\dfrac{\Delta c}{c} - \dfrac{4}{3}\dfrac{\Delta d}{d}$

Percentage error in y,

$\dfrac{\Delta y}{y} \times 100 = 4\left(\dfrac{\Delta a}{a} \times 100\right) + 2\left(\dfrac{\Delta b}{b} \times 100\right) + \dfrac{1}{3}\left(\dfrac{\Delta c}{c} \times 100\right) + \dfrac{4}{3}\left(\dfrac{\Delta d}{d} \times 100\right)$

$= [4 \times 2\% + 2 \times 3\% + \dfrac{1}{3} \times 4\% + \dfrac{4}{3} \times \%] = 22\%$

18. $E = [ML^2T^{-2}]$, $G = [M^{-1}L^3T^{-2}]$, $I = [MLT^{-1}]$ and $M = [M]$

$\therefore$ Dimensions of $\dfrac{GIM^2}{E^2}$

$= \dfrac{[M^{-1}L^3T^{-2}][MLT^{-1}][M^2]}{[ML^2T^{-2}]} = [T]$

19. Let $v \propto \sigma^a \rho^b \lambda^c$

Equation dimensions on both sides,

$[M^0L^1T^{-1}] \propto [MT^{-2}]^a [ML^{-3}]^b [L]^c$

$\propto [M]^{a+b} [L]^{-3b+c} [T]^{-2a}$

Equation the powers of M, L, T on the both sides, we get;

a + b = 0

– 3b + c =1

– 2a = – 1

Solving, we get;

$a = \dfrac{1}{2}, b = -\dfrac{1}{2}, c = -\dfrac{1}{2}$

$\therefore$ $v \propto \sigma^{1/2} \rho^{-1/2} \lambda^{-1/2}$

$\therefore$ $v^2 \propto \dfrac{\sigma}{\rho\lambda}$

20. 1/8th of the circumference $= \dfrac{360^o}{8} = 45^o$

Change in velocity, $\sqrt{v^2 + v^2 - 2v^2 \cos 45^o} = 0.765v$

23. $[\text{Energy density}] = \left[\frac{\text{Work done}}{\text{Volume}}\right] = \frac{[MLT^{-2}.L]}{[L^3]}$

$[\text{Young's modulus}] = [Y] = \left[\frac{\text{Force}}{\text{Area}}\right] \times \frac{[\ell]}{\Delta\ell}$

$= \frac{[MLT^{-2}]}{[L^2]} \cdot \frac{[L]}{[L]} = [ML^{-1}T^{-2}]$

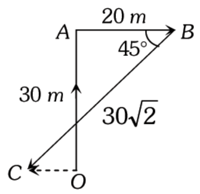
The dimensions of 1 and 4 are the same.

26. (a) $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k} \quad \therefore r = \sqrt{x^2 + y^2 + z^2}$

$r = \sqrt{6^2 + 8^2 + 10^2} = 10\sqrt{2}\ m$

27. (a) $\vec{r} = 20\hat{i} + 10\hat{j} \quad \therefore r = \sqrt{20^2 + 10^2} = 22.5\ m$

28. (c) From figure, $\overrightarrow{OA} = 0\hat{i} + 30\hat{j}$, $\overrightarrow{AB} = 20\hat{i} + 0\hat{j}$



$\overrightarrow{BC} = -30\sqrt{2}\cos 45^\circ\hat{i} - 30\sqrt{2}\sin 45^\circ\hat{j} = -30\hat{i} - 30\hat{j}$

$\therefore$ Net displacement, $\overrightarrow{OC} = \overrightarrow{OA} + \overrightarrow{AB} + \overrightarrow{BC} = -10\hat{i} + 0\hat{j}$

$|\overrightarrow{OC}| = 10\ m.$

29. (a) An aeroplane flies 400 *m* north and 300 *m* south so the net displacement is 100 *m* towards north.

Then it flies 1200 *m* upward so $r = \sqrt{(100)^2 + (1200)^2}$

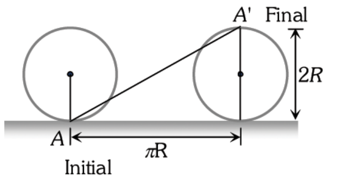
$= 1204\,m \simeq 1200\,m$

The option should be 1204 *m*, because this value mislead one into thinking that net displacement is in upward direction only.

30. (b) Total time of motion is 2 *min* 20 *sec* = 140 *sec*.

As time period of circular motion is 40 *sec* so in 140 *sec*. athlete will complete 3.5 revolution *i.e.*, He will be at diametrically opposite point *i.e.*, Displacement = 2*R*.

31. (c) Horizontal distance covered by the wheel in half revolution = πR.



So the displacement of the point which was initially in contact with ground = $AA' = \sqrt{(\pi R)^2 + (2R)^2}$

$= R\sqrt{\pi^2 + 4} = \sqrt{\pi^2 + 4}$ (As $R = 1m$)

32. (d) As the total distance is divided into two equal parts therefore distance averaged speed $= \frac{2v_1 v_2}{v_1 + v_2}$

33. (d) $\frac{v_A}{v_B} = \frac{\tan\theta_A}{\tan\theta_B} = \frac{\tan 30°}{\tan 60°} = \frac{1/\sqrt{3}}{\sqrt{3}} = \frac{1}{3}$

34. (b) Distance average speed $= \frac{2v_1 v_2}{v_1 + v_2} = \frac{2 \times 20 \times 30}{20 + 30}$

$= \frac{120}{5} = 24\ km/hr$

35. (b) Distance average speed $= \frac{2v_1 v_2}{v_1 + v_2} = \frac{2 \times 2.5 \times 4}{2.5 + 4}$

$= \frac{200}{65} = \frac{40}{13} km/hr$

36. (c) Distance average speed $= \frac{2v_1 v_2}{v_1 + v_2} = \frac{2 \times 30 \times 50}{30 + 50}$

$= \frac{75}{2} = 37.5\ km/hr$

37. (d) Average speed $= \frac{\text{Total distance}}{\text{Total time}} = \frac{x}{t_1 + t_2}$

$= \frac{x}{\frac{x/3}{v_1} + \frac{2x/3}{v_2}} = \frac{1}{\frac{1}{3 \times 20} + \frac{2}{3 \times 60}} = 36\ km/hr$

38. (a) Time average speed $= \frac{v_1 + v_2}{2} = \frac{80 + 40}{2} = 60 km/hr$.

39. (b) Distance travelled by train in first 1 *hour* is 60 *km* and distance in next 1/2 *hour* is 20 *km*.

So Average speed $= \frac{\text{Total distance}}{\text{Total time}} = \frac{60 + 20}{3/2}$

$= 53.33\ km/hour$

40. D

41. (c) Total distance to be covered for crossing the bridge

= length of train + length of bridge

$= 150m + 850m = 1000m$

Time $= \frac{\text{Distance}}{\text{Velocity}} = \frac{1000}{45 \times \frac{5}{18}} = 80\ sec$

42. (c) Displacement of the particle will be zero because it comes back to its starting point

$$\text{Average speed} = \frac{\text{Total distance}}{\text{Total time}} = \frac{30m}{10\ sec} = 3\ m/s$$

43. (d) Velocity of particle $= \dfrac{\text{Total diplacement}}{\text{Total time}}$

$$= \frac{\text{Diameter of circle}}{5} = \frac{2\times 10}{5} = 4\ m/s$$

44. (d) A man walks from his home to market with a speed of $5\ km/h$ .Distance $= 2.5\ km$ and time $= \dfrac{d}{v} = \dfrac{2.5}{5} = \dfrac{1}{2} hr$.

and he returns back with speed of $7.5\ km/h$ in rest of time of 10 *minutes*.

Distance $= 7.5 \times \dfrac{10}{60} = 1.25\ km$

So, Average speed $= \dfrac{\text{Total distance}}{\text{Total time}}$

$$= \frac{(2.5+1.25)km}{(40/60)hr} = \frac{45}{8} km/hr\ .$$

45. (b) $\dfrac{|\text{Average velocity}|}{|\text{Average speed}|} = \dfrac{|\text{displacement}|}{|\text{distance}|} \le 1$

because displacement will either be equal or less than distance. It can never be greater than distance.

[CHEMISTRY]

46. $\lambda = \dfrac{h}{\sqrt{2m(\text{KE Joules})}} = \dfrac{6.626\times 10^{-34}}{\sqrt{2\times 1\times 0.5}} = 6.626\times 10^{-34}\ \text{m}$

47. $\Delta V = \dfrac{\Delta P}{m} = \dfrac{1\times 10^{-18}\,\text{gcms}^{-1}}{9\times 10^{-28}\ \text{g}} = 1\times 10^{9}\ \text{cm s}^{-1}$

48. $\dfrac{E_2}{E_1} = \dfrac{\frac{1}{4}}{\frac{1}{1}} \Rightarrow \quad E_2 = -\dfrac{13.6\text{eV}}{4} = -3.4\ \text{eV}$

Excitation energy = – 3.4 – (–13.6) = 10.2 eV

49. Density of nucleus is 1.685×10^{14} g cm^{-3} in all caes. So, the ratio of densities of two nuclei will be 1 : 1

50. $\Delta x = \Delta P \quad \Rightarrow \quad (\Delta P)^2 = \dfrac{h}{4\pi} \Rightarrow \Delta P = \dfrac{1}{2}\sqrt{\dfrac{h}{\pi}}$

$$\Delta V = \frac{\Delta P}{m} = \frac{1}{2m}\sqrt{\frac{h}{\pi}}$$

51. $\dfrac{\Delta x_A . m_A \Delta_A}{\Delta_{x_B} . m_B \Delta v_B} = 1$

$$\frac{\Delta x_A}{\Delta x_B} = \frac{m_B \Delta v_B}{m_A \Delta v_A} = \frac{5}{1}\times\frac{0.02}{0.05} = 2$$

52 KE per atom $= \frac{(4.4\times10^{-19})-(4.0\times10^{-19})}{2} = 2.0\times10^{-20}$ J

53. $\frac{E_1}{E_2} = \frac{\frac{hc}{\lambda_1}}{\frac{hc}{\lambda_2}} = \frac{\lambda_2}{\lambda_1}$

$\Rightarrow \frac{\lambda_2}{\lambda_1} = \frac{25}{50} \quad \Rightarrow \quad \lambda_1 = 2\lambda_2$

54. Order of difference of energy $E_2 - E_1 > E_3 - E_2 > E_4 - E_3 > ....$
So, $E_6 - E_1 > E_5 - E_3 > E_5 - E_4 > E_6 - E_5$

55. $\Delta v = \frac{0.001}{100}\times300 = 3\times10^{-3}\ ms^{-1}$

$\Delta v = \frac{h}{4\pi m\Delta v} = \frac{6.6\times10^{-34}\ kg\ m^2s^{-1}}{4\times3.14\times(9.1\times10^{-31}\ kg)\times(3\times10^{-3}\ ms^{-1})}$

$= \frac{6.6}{4\times3.14\times9.1\times3}m = 0.01925\ m$

$= 1.925 \times 10^{-2}$ m

56. All have isotopic number = 1

57. $\bar{v} = \frac{1}{\lambda} = R\left(\frac{1}{2^2}-\frac{1}{\infty^2}\right) = \frac{R}{4}$

$\lambda = \frac{4}{R} = 4\times9.11\times10^{-8}\ m = 4\times9.11\times100\times10^{-10}\ m = 3644Å$

58. $\frac{1}{\lambda} = R\left(\frac{1}{2^2}-\frac{1}{3^2}\right)$, for the first spectral line

$= R\left(\frac{1}{4}-\frac{1}{9}\right) = R\times\frac{5}{36}cm^{-1}$

$\lambda = \frac{36}{5R}cm$

59. $\frac{m_A}{m_B} = \frac{1}{4}$

$\frac{\lambda_A}{\lambda_B} = \frac{\left(\frac{h}{mv}\right)_A}{\left(\frac{h}{mv}\right)_B} = \frac{m_B}{m_A} = 4$

$\lambda_A : \lambda_B = 4 : 1$

60. $\lambda = \frac{h}{mv}; KE = \frac{1}{2}mv^2 \quad \Rightarrow \quad KE = \frac{h^2}{2m\lambda^2}$

For h and λ being constant, $KE \propto \frac{1}{m}$

61. No. of spectral lines $\Sigma\Delta n = \Sigma(6 - 3)$ S3 = 3 + 2 + 1 = = 6. There is no line in Balmer series as the electron comes to 3r shell.

62. $E_n = \frac{E_1}{n^2} \Rightarrow E_1 = 2^2 \times (-328) = -4 \times 328 \text{ kJ mol}^{-1}$

Energy of 3rd shell, $E_3 = \frac{E_1}{9} = -\frac{4 \times 328}{9}$

$= -145.78 \text{ kJ mol}^{-1}$

63. $E = 1eV = 1.6 \times 10^{-19}$ J

$E = hv = \frac{hc}{\lambda} \quad \Rightarrow \quad \lambda = \frac{hc}{E}$

$\lambda = \frac{6.6 \times 10^{-34} \text{ Js} \times 3 \times 10^8 \text{ ms}^{-1}}{1.6 \times 10^{-19} \text{ J}} = 12.375 \times 10^{-7} \text{ m} = 12375 Å$

64. h and mvr have same units kg m^2s^{-1}.

65. $\frac{\text{Ionisation energy of } Li^{2+}}{\text{Ionisation energy of } Be^{3+}} = \frac{\text{Ionisation energy of H-atom} \times (3)^2}{\text{Ionisation energy of H-atom} \times (4)^2} = \frac{9}{16}$

66.

67. No. of revolutions of electron in nth shell in 1 second $= \frac{6.66 \times 10^{15} \times Z^2}{n^3}$

$= \frac{6.66 \times 10^{15} \times 4}{8}$

$= 3.33 \times 10^{15}$

68. New energy = – 13.6 + 12.1 = – 1.5 eV

$E_n = \frac{-13.6}{n^2} \quad \Rightarrow n^2 = \frac{-13.6}{-1.5} = 9 \quad \Rightarrow \quad n = 3$

Number of spectral lines in Balmer series for $3 \rightarrow 2$ transition would be one only

69.

70. $v = 3.29 \times 10^{15} Z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right) s^{-1} = 3.29 \times 10^{15} \times 1 \times \left(\frac{1}{1^2} - \frac{1}{4^2} \right) s^{-1}$

$= 3.29 \times 10^{15} \times \frac{15}{16} s^{-}K \approx 3.08 \times 10^{15} s^{-1}$

71.

72. $KE = \frac{1}{2}mv^2; KE = eV$

$\frac{1}{2}mv^2 = eV \quad \Rightarrow \quad v = \sqrt{\frac{2eV}{m}}$

73. $\frac{KE_1}{KE_2} = \frac{h(v_1 - v_0)}{h(v_2 - v_0)}; \frac{KE_1}{KE_2} = \frac{1}{x}$(given)

$\Rightarrow \quad \frac{v_1 - v_0}{v_2 - v_0} = \frac{1}{x} \quad \Rightarrow xv_1 - xv_0 = v_2 - v_0$

$\Rightarrow \quad xv_1 - v_2 = xv_0 - v_0 \quad \Rightarrow v_0 \frac{xv_1 - v_2}{x - 1}$

$\Rightarrow \quad xv_1 - v_2 = xv_0 - v_0 \quad \Rightarrow v_0 \frac{xv_1 - v_2}{x - 1}$

74. n^{th} shell has n wavelengths, i.e., $n\lambda = 2\pi r_3$

$$\lambda = \frac{2\pi r^3}{n} = \frac{2\pi}{3}\left(\frac{r_1 \times 3^2}{Z}\right) \qquad \left[\because r_n = \frac{r_1 \times n^2}{Z}\right]$$

$$= \frac{6\pi r_1}{Z}$$

75. Be has fully filled 2s sub-shell ($2s^2$) and, therefore, show little tendency to accept an electron.

80. All have 18 electrons.

86. The element is p-block
Its group = 10 + no. of electrons in $4s^2 4p^4$ = 10 + 6 = 16
Its period is four

89. The given element belongs to third period whose atomic number is = 15. Below this element in the periodic table should belong to 4^{th} period. Fourth period contains 18 elements. Thus atomic number of this element is 15 + 18 = 33.

90. The electronic configuration of M is
$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^5$