WEEKLY TEST MEDICAL PLUS -03 TEST - 03 RAJPUR SOLUTION Date 21-07-2019

[PHYSICS]

1.

2. $F = \frac{1}{4\pi\varepsilon_0} . \frac{q_1 q_2}{r^2}$; $\therefore$ 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 $[G] = [M^{1}L^{3}T^{-2}]$ 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 (ℓ) = 3.124 m and breadth (b) = 3.002 m. We know that area of the sheet (A) = $\ell \times b$ = 3.124× 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. $\frac{[h]}{[I]} = \frac{[E\lambda]}{[CI]} = \frac{[ML^2T^{-2}][L]}{[LT^{-1}][ML^2]}$
$= [T^{-1}]$ = [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. $P = \frac{\sqrt{abc^2}}{d^3 e^{1/3}}$

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

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

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

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

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

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

Taking log on both sides,

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

Differentiating,

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

Percentage error in y,

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

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

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

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

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

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;

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

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

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

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

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

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

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

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

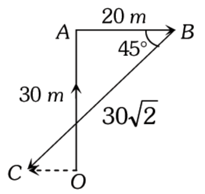
The dimensions of 1 and 4 are the same.

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, $\overrightarrow{OA} = 0\vec{i} + 30\vec{j}$, $\overrightarrow{AB} = 20\vec{i} + 0\vec{j}$



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

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

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

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 $r = \sqrt{(100)^2 + (1200)^2}$

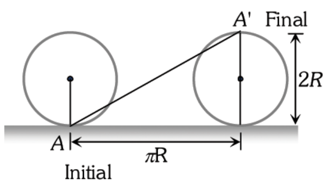
$= 1204\,m \simeq 1200\,m$

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 = $AA' = \sqrt{(\pi R)^2 + (2R)^2}$

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

32. (d) As the total distance is divided into two equal parts therefore distance averaged speed $= \frac{2v_1v_2}{v_1+v_2}$

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 $= \frac{2v_1v_2}{v_1+v_2} = \frac{2\times 20\times 30}{20+30}$

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

35. (b) Distance average speed $= \frac{2v_1v_2}{v_1+v_2} = \frac{2\times 2.5\times 4}{2.5+4}$

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

36. (c) Distance average speed $= \frac{2v_1v_2}{v_1+v_2} = \frac{2\times 30\times 50}{30+50}$

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

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

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

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

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

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

$= \frac{d}{v} = \frac{2.5}{5} = \frac{1}{2} hr$.

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

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

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

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

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

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

[CHEMISTRY]

46. (b) The number of electrons in an atom is equal to its atomic number *i.e.* number of protons.

47. (a) No. of protons = Atomic no. = 25 and no. of neutron = 55 – 25 = 30.

48. (a) Na^+ and Ne are isoelectronic which contain 10 electrons.

49. (a) One molecule of CO_2 have 22 electrons.

50. (c) Mass of an atom is due to nucleus (neutron + proton).

51. (c) Most probable radius = a_0 / Z

where a_0 = 52.9 pm. For helium ion, Z = 2.

$r_{\text{mp}} = \frac{52.9}{2} = 26.45\ pm$.

52. (c) Na^+ has 10 electron and Li^+ has 2 electron so these are different number of electron from each other.

53. (c) $P_{15} = 2, 8, 5$

54. (c) ${}^{16}_{8}O^{--}$ have more electrons than neutron $p = 8,\ e = 10,\ n = 8$.

55. (b) $^-CONH_2$ = 6 + 8 + 7 + 2 + 1 (from other atom to form covalent bond) = 24

56. (b) Complete $E.C. = [Ar]^{18} 3d^{10} 4s^2 4p^6$.

57. (c) Neutron in ${}^{12}_{6}C = 6$, , Neutrons in ${}^{28}_{14}Si = 14$

Ratio = 6 : 14 = 3 : 7.

58. D

59. (c) $H^- = 1s^2$ and $He^+ = 1s^2$.

60. (a) Number of unpaired electrons in inert gas is zero because they have full filled orbitals.

61. (a) In case of N^{3-}, $p = 7$ and $c = 10$

62. (c) Atomic number of chlorine 17 and in Cl^- ion total no. of electron =18.

63. C

64. (a) The central part consisting whole of the positive charge and most of the mass caused by nucleus, is extremely small in size compared to the size of the atom.

65. (b) According to the Bohr model atoms or ions contain one electron.

66. (c) α-particles pass through because most part of the atom is empty.

67. (b) An electron jumps from L to K shell energy is released.

68. D

69. B

70. (a) Increases due to absorption of energy and it shows absorption spectra.

71. A

72. (d) According to de-Broglie $\left(\lambda = \frac{h}{mv}\right)$.

73. (c) $\lambda = \frac{h}{mv} = \frac{6.625 \times 10^{-34}}{0.2\,kg \times \frac{5}{60 \times 60\,ms^{-1}}} = 10^{-30}\,m$.

74. (a) We know that the correct relationship between wavelength and momentum is $\lambda = \frac{h}{p}$. Which is given by de-Broglie.

75. Charge/mass for n = 0, for $\alpha = \frac{2}{4}$, for $p = \frac{1}{1}$, for $e^- = \frac{1}{1/1837}$

76.

77. A

78. A

79. D

80.

81. Charge/mass for n = 0, for $\alpha = \frac{2}{4}$, for $p = \frac{1}{1}$, for $e^- = \frac{1}{1/1837}$

82.

83.

84.

Species	$_{19}K^+$	$_{20}Ca^{2+}$	$_{21}Sc^{3+}$	$_{17}Cl^-$
No. of electrons	18	18	18	18

85. We know that, E = hv = hc/λ

$$E = E_1 + E_2 \Rightarrow \frac{hc}{\lambda} = \frac{hc}{\lambda_1} + \frac{hc}{\lambda_2}$$

$$\Rightarrow \frac{1}{\lambda} = \frac{1}{\lambda_1} + \frac{1}{\lambda_2} \Rightarrow \frac{1}{355} = \frac{1}{680} + \frac{1}{\lambda_2}$$

$$\therefore \lambda_2 = \frac{355 \times 680}{680 - 355} = 742.769K \approx 743 \text{ nm}$$

86. The energies of two photons are in the ratio 3 : 2, their wavelengths will be in the ratio of 2 : 3, because

$E \propto \frac{1}{\lambda}$ (according to Planck's quantum theory)

$\therefore \quad \frac{E_1}{E_2} = \frac{\lambda_2}{\lambda_1} \Rightarrow \lambda_1 : \lambda_2 = 2 : 3$

87. Smallest and largest amount of energy is eV and lit-atm.
1 cal = 4.184 J, 1 eV = 1.6×10^{-19} J, 1 J = 10^7 erg.
1 lit-amt = (1 L) × (1 atm)
= $(1 \times 10^{-3}\ m^3)(101.325 \times 10^3\ Pa)$ = 101.325 J

88. Work function = 4.0 eV = $4.0 \times 1.6 \times 10^{-19}$ J

$$= h\nu_0 = \frac{hc}{\lambda} = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{\lambda} \text{ or } \lambda = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{4.0 \times 1.6 \times 10^{-19}} = 330 \times 10^{-9} \text{ m}$$

89. Threshod frequency $\nu_0 = \frac{\text{work function}}{h}$

$$= \frac{3.3 \times 1.6 \times 10^{-19}\,J}{6.6 \times 10^{-34}\,Js} = 8 \times 10^{14}\ s^{-1}$$

90. de-Broglie wavelength $\lambda = \frac{h}{mv_{rms}}$, *rms* velocity of a gas particle at the given temperature (*T*) is given as

$$\frac{1}{2}mv_{rms}^2 = \frac{3}{2}kT \Rightarrow v_{rms} = \sqrt{\frac{3kT}{m}} \Rightarrow mv_{rms} = \sqrt{3mk\,T}$$

$$\therefore \lambda = \frac{h}{mv_{rms}} = \frac{h}{\sqrt{3mkT}}$$

$$\Rightarrow \frac{\lambda_H}{\lambda_{He}} = \sqrt{\frac{m_{He}T_{He}}{m_H T_H}} = \sqrt{\frac{4(273+127)}{2(273+27)}} = \sqrt{\frac{8}{3}}$$