PHYSICS

1. A particle has initial velocity = 10 m/s and has an acceleration of 2 m/s^2. After how much time will it have velocity equals to 60 m/s ?

Ans. 25 sec

Sol. $v = u + at$

$60 = 10 + 2t$

$t = 25$ sec.

2. An atom follows Bohr's model. If the radius of e^- in first orbit is 'a'. what is the de Broglie wave length of electron present in third orbit.

Ans. $\lambda_3 = 6\pi a$

Sol. $2\pi r = n\lambda$

$\lambda_3 = \frac{2\pi r_3}{3}$

$r_1 = a$

$\Rightarrow r_3 = 9a$

$\lambda_3 = 6\pi a$

3. Gravitational force acting on a body is 100 N on earth. What is the magnitude of gravitational force acting on it at height = $\left(\frac{1}{4}\right)^{th}$ of the radius of earth

Ans. 64 N

Sol. $g' = \frac{g}{\left(1+\frac{h}{Re}\right)^2} = \frac{g}{\left(1+\frac{1}{4}\right)^2} = \frac{16}{25} \times g$

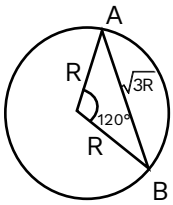
$mg = 100$

$mg' = \frac{16}{25} mg = \frac{16}{25} \times 100 = 64$ N

4. A particle moving in uniform circulation motion goes from A to B separated by an angle of 120° w.r.t. center of the circle. Find the magnitude of average velocity of particle from A to B.

Ans. $\frac{3\sqrt{3}v}{2\pi}$

Sol.



Average velocity = $\frac{\text{displacement}}{\text{time}} = \frac{\sqrt{3}R}{\left(\frac{2\pi R}{3v}\right)}$

5. A ring and a solid sphere of same mass has equal moment of inertia about an axis passing through their respective centre of mass. If the ratio of their radius is $\sqrt{\frac{2}{x}}$. Find x

Ans. 5

Sol. $mr_1^2 = \frac{2}{5}mr_2^2$

$\frac{r_1}{r_2} = \sqrt{\frac{2}{5}}$

$\Rightarrow$ $x = 5$

6. If for a given ideal gas rms velocity at 200K is v_0, find out rms velocity at 800K.

Ans. $2V_0$

Sol. $V_{rms} = \sqrt{\frac{3RT}{M}}$

$V \propto \sqrt{T}$

$\frac{V_{800}}{V_{200}} = \sqrt{\frac{800}{200}} = 2$

$V_{800} = 2V_0$

7. Electric energy density and magnetic energy density of an electromagnetic wave is given by :

Ans. $U_e = \frac{1}{2}\varepsilon_0 E_0^2$

$U_M = \frac{1}{2}\frac{B_0^2}{\mu_0}$

8. A body is kept in a surrounding of temperature $T_0 = 10°C$. If the temperature of the body decreases from 60° to 40° in 7 min, find out the temperature after next 7 min.

Ans. 28°C

Sol. $\frac{T_i - T_f}{t} = k\left(T_{avg} - T_0\right)$

$\frac{\frac{20}{7}}{\frac{40-T}{7}} = \frac{k(50-10)}{k\left(\frac{40+T}{2} - 10\right)}$

$\frac{1}{40-T} = \frac{2\times 2}{(40+T-20)}$

$20 + T = 160 - 4T$

$5T = 140$

$T = \frac{140}{5} = 28°C$

9. Potential energy of an electron is defined as $U = \frac{1}{2}m\omega^2x^2$ and follows Bohr's law. Radius of orbit as function of n depends on (ω is some constant and x is distance from centre)

Ans. $\sqrt{n}$

Sol. $mvx = \frac{nh}{2\pi}$

$mx^2\omega = \frac{nh}{2\pi}$

$x^2 = \frac{nh}{2\pi m\omega}$

$x \propto \sqrt{n}$

10. Which of the following statement is incorrect according to Kepler's law for a planet :
(1) Total energy of planet is constant (2) linear speed is constant
(3) areal velocity is constant (4) All of the above

Ans. (2)

11. In amplitude modulation with carrier frequency (A_c) and modulating frequency (A_m), modulation index 60%. If $A_c - A_m = 3V$ then $A_c + A_m$ is equal to.

Ans. 12V

Sol. $\frac{A_m}{A_c} = 0.6$

$\Rightarrow \frac{A_m + A_c}{A_m - A_c} = \frac{1.6}{-0.4}$

$\Rightarrow A_m + A_c = 12$

12. Find the ratio of speed of sound in H_2 and O_2 gas.

Ans. 4

Sol. $V \propto \frac{1}{\sqrt{M}}$

$\frac{V_{H_2}}{V_{O_2}} = \sqrt{\frac{32}{2}} = 4$

13. A body of mass 5 kg moving in circular motion completes one rotation in π s. If radius of circle is 2 m then find the centrifugal force.

Ans. 40 N

14. Find the time period of a dipole made of 2 particles of mass m, m/2 and charges q and – q placed in a uniform electric field.

Ans. $2\pi\sqrt{\frac{ml}{3qE}}$

15. **Assertion :** The phase difference of two light waves change if they travel through different media having same thickness but different indices of refraction.
Reason : The wavelength of waves are different in different media.

Ans. Both are correct and R is the correct explanation of A.

16. A proton is projected in a magnetic field of magnitude $\frac{2}{\pi}$ T. If angle between velocity of the particle and magnetic field is 60°. Kinetic energy of proton is 2eV (mass of proton = 1.6×10^{-27}kg, e = 1.6×10^{-19}C). The pitch of the path of proton is approximately.

Ans. 1mm

Sol. Pitch = $v_{||}T$

$K.E. = \frac{1}{2}mv^2 \Rightarrow v = \sqrt{\frac{4e}{m}}$

$T = \frac{2\pi m}{qB}$, $v_{||} = v\cos 60°$

$\text{Pitch} = \frac{2\pi m}{qB}\sqrt{\frac{4e}{m}} \times \frac{1}{2}$

$= \frac{2\pi m\pi}{e \times 2} \times \sqrt{\frac{e}{m}}$

$= \pi^2\sqrt{\frac{m}{e}}$

$= \pi^2\sqrt{\frac{1.6 \times 10^{-27}}{1.6 \times 10^{-19}}}$

$= \pi^2 \times 10^{-4}$ m

$\approx$ 1mm

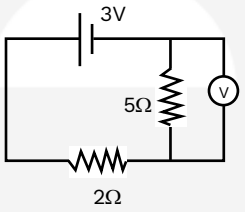
17. A capacitor of capacitance 150μF is connected with an AC source of emf $\varepsilon = 36\sin(120\pi t)$. Find the value of maximum current through the capacitor.

Ans. 2A

18. **Assertion (A) :** In forward biased p-n junction, diffusion current is from p-region to n-region.
Reason (R) : Diffusion takes place due to concentration gradient.

Ans. Both are correct and R is the correct explanation of A.

19. If potential difference across 5Ω resistance is 2V then find the internal resistance of voltmeter.



Sol. $i = \frac{1V}{2} = 0.5A$

$R_{eq} = \frac{\varepsilon}{i} = \frac{3}{0.5} = 6$

$\frac{5R}{5+R} + 2 = 6$

$R = 20\Omega$

20. Two different photosensitive materials having work function 4.1 eV and 5.1 eV respectively, are illuminated with light of sufficient energy to emit electron. If the graph of stopping potential vs. frequency is drawn for these two different photosensitive materials, the ratio of slope of graph for these two materials is:

Ans. 1 : 1

Sol. $eV_s = h\nu - \phi$

$V_s = \left(\frac{h}{e}\right)\nu - \phi$

21. An object A is released from a height h such that the ratio of its speed before striking the ground and after striking the ground is 4 : 1. If loss of kinetic energy is $\frac{x}{4}$%, than value of x is

Ans. 375

Sol. $\frac{x}{4} = \frac{\frac{1}{2}mu^2 - \frac{1}{2}mv^2}{\frac{1}{2}mu^2} \times 100$

$= \left(1 - \frac{v^2}{u^2}\right) \times 100$

$= \left(1 - \frac{1}{16}\right) \times 100 = \frac{15 \times 100}{16} = \frac{375}{4}$

22. **Assertion :** When toothpaste is pressed, it follows Pascal's law.
Reason : When pressure is applied on a fluid it is distributed uniformly throughout the fluid in all direction and on the wall of the container.

Ans. Both are correct and R is the correct explanation of A.