PART : PHYSICS

1. A ball is dropped from height R from the surface of earth, what will be the velocity of ball when it reaches to ground. (R is radius of earth.) g is acceleration due to gravity at surface of earth :

(1) $\sqrt{2gR}$ (2) $\sqrt{gR}$ (3) $\sqrt{\frac{gR}{2}}$ (4) $\sqrt{3gR}$

Ans. (2)

Sol. $\frac{GMm}{R+h} = \frac{1}{2}mv^2 - \frac{GMm}{R}$

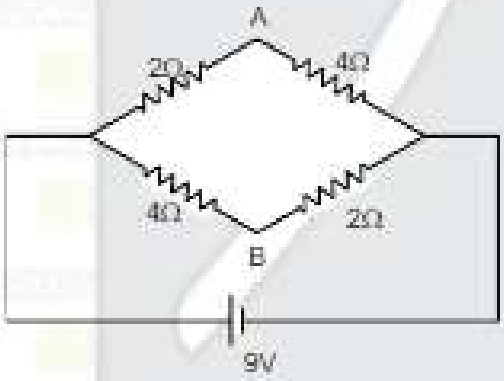
$h = R$

$\frac{1}{2}mv^2 = \frac{GMm}{R} - \frac{GMm}{2R}$

$\frac{1}{2}mv^2 = \frac{GMm}{2R}$

$v = \sqrt{\frac{GM}{R}} = \sqrt{\frac{gR^2}{R}} = \sqrt{gR}$

2.

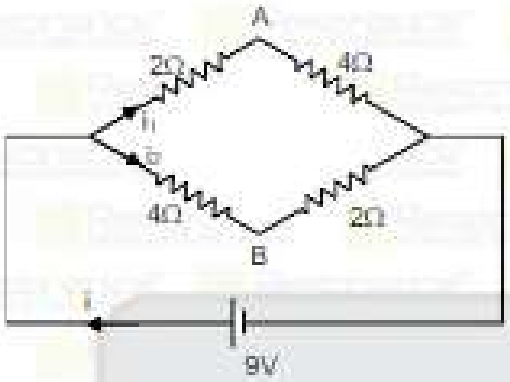


Find $V_A - V_B$

(1) 1 V (2) 2V (3) 3V (4) 4V

Ans. (3)

Sol.



$$i = \frac{9}{3} = 3A$$

$$i_1 = i_2 = \frac{i}{2} = 1.5\ A$$

$$V_A - V_B = 4i_2 - 2i_1 = 4 \times 1.5 - 2 \times 1.5 = 6 - 3$$

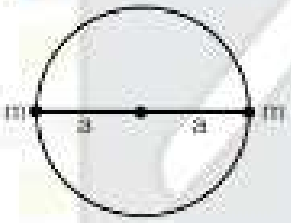
$$V_A - V_B = 3$$

3. Two particles each having mass m are revolving around a circle of radius a due to their mutual gravitation attraction. Find angular velocity of each mass.

(1) $\sqrt{\frac{Gm}{a^3}}$ (2) $\sqrt{\frac{Gm}{4a^3}}$ (3) $\sqrt{\frac{Gm}{2a^3}}$ (4) $\sqrt{\frac{2Gm}{a^3}}$

Ans. (2)

Sol.



For circular motion

$$\frac{Gm^2}{(2a)^2} = m\omega^2 a \Rightarrow \frac{Gm}{4a^3} = \omega^2 \quad \Rightarrow \omega = \sqrt{\frac{Gm}{4a^3}}$$

4. Position vector of a particle at time t is $\vec{r} = 6\hat{i} + 10t^2\hat{j} + 7\hat{k}$. Resultant force on the particle will be

(1) in x-y plane (2) along positive z-axis

(3) along positive y–axis (4) in y–z plane

Ans. (3)

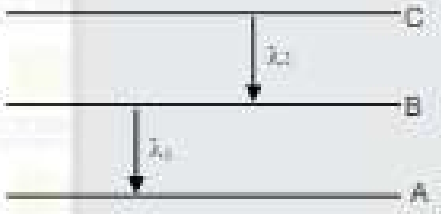
Sol. $\vec{r} = 6t\hat{i} + 10t^2\hat{j} + 7\hat{k}$

$$\vec{v} = \frac{d\vec{r}}{dt} = 6\hat{i} + 20t\hat{j}$$

$$\vec{a} = \frac{d\vec{v}}{dt} = 20\hat{j}$$

So force will be along positive y–axis

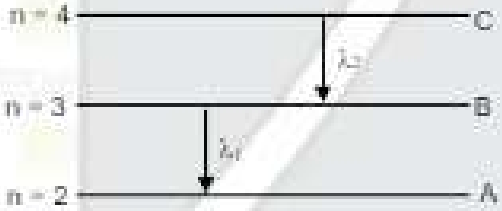
5. A, B & C are 1st, 2nd & 3rd excited states of hydrogen atom. Find $\frac{\lambda_1}{\lambda_2}$



(1) $\frac{7}{15}$ (2) $\frac{7}{20}$ (3) $\frac{7}{5}$ (4) $\frac{7}{3}$

Ans. (2)

Sol.



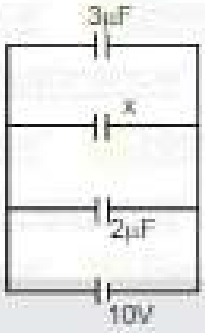
$$\frac{1}{\lambda_1} = R\left(\frac{1}{2^2} - \frac{1}{3^2}\right)$$

$$\Rightarrow \frac{1}{\lambda_1} = R\left(\frac{1}{4} - \frac{1}{9}\right) \quad \Rightarrow \frac{1}{\lambda_1} = R\left(\frac{9-4}{36}\right) \quad \Rightarrow \lambda_1 = \frac{36}{5R}$$

$$\& \ \frac{1}{\lambda_2} = R\left(\frac{1}{3^2} - \frac{1}{4^2}\right) = R\left(\frac{1}{9} - \frac{1}{16}\right) \Rightarrow \frac{1}{\lambda_2} = R\left(\frac{16-9}{144}\right) \Rightarrow \lambda_2 = \frac{144}{7R}$$

$$\text{So } \frac{\lambda_1}{\lambda_2} = \frac{36}{5R} \times \frac{7R}{144} = \frac{7}{20}$$

6. Total charge stored on all the three capacitors is 100 μC. Find x.



(1) 5μF (2) 10μF (3) 15μF (4) 4μF

Ans. **(1)**

Sol. $C_{eq} = 3 + 2 + x = 5 + x$

$Q = C_{eq}V = (5 + x)\,10 = 100$

$\Rightarrow 5 + x = 10$

$\Rightarrow x = 5$

7. A has half life of 5 years. Find the fraction of A that might have decayed after 15 years.

(1) 1/8 (2) 7/8 (3) 1/4 (4) 3/4

Ans. **(2)**

Sol. $N = \frac{N_0}{2^n}$

for n = 3

$N = \frac{1}{8}$

fraction left is $1 - \frac{1}{8} = \frac{7}{8}$

8. A Container contains H_2 gas & Ar gas mass ratio of both the gases in the container is 2 : 1 at same temperature 30°C. Find ratio of average kinetic energy per molecule of both the gases :

(1) 5/2 (2) 5/3 (3) 3/2 (4) 4/5

Ans. **(3)**

Sol. $\langle x \rangle = f/2\ kT$

So, $\frac{\langle K_{H_2} \rangle}{\langle K_{Ar} \rangle} = \frac{f_{H_2}}{f_{Ar}} = \frac{5}{3}$

9. In single slit diffraction experiment angular position of first minima is 30°. If wavelength used is 600 nm then find the slit width .

(1) 0.3 μm (2) 0.6 μF (3) 1.2 μm (4) 1.8 μm

Ans. (3)

Sol. $a\sin\theta = \lambda$

$a\sin30° = \lambda$

$a = 2\lambda$

$= 1200$ nm $= 1.2$ μm

10. Velocity of wave in water $v = \lambda^a g^b \rho^c$ find value a, b, c

(1) $\frac{1}{2}, \frac{1}{2}, 0$ (2) $0, \frac{1}{2}, \frac{1}{2}$ (3) 1, 1, 0 (4) 1, 0, $\frac{1}{2}$

Ans. (1)

Sol. $M^0L^1T^{-1} = L^aL^bT^{-2b}M^cL^{-3c}$

$M^0L^1T^{-1} = M^cT^{-2b}L^{a+b-3c}$

$C = 0$

$b = \pm 1/2$

$a + \frac{1}{2} + 0 = 1$

$a = \frac{1}{2}$

$V = \lambda^{1/2} g^{1/2} \rho^0$

11. A particle of mass 10 kg experiences a force $F = 5x$ along x-axis. Find work done by the force F on the particle from $x = 2$ to $x = 4$:

(1) 10J (2) 15 J (3) 30 J (4) 40 J

Ans. (3)

Sol. $w = \int F dx = \int_2^4 5x dx = 5\int_2^4 x dx$

$w = \frac{5}{2}\left[4^2 - 2^2\right] = \frac{5}{2}[16 - 4] \Rightarrow \quad w = 5/2 \times 12 = 30$ J

12. Minimum angle of deviation for equilateral prism of refractive index $n = \sqrt{2}$ will be :

(1) 60° (2) 40° (3) 30° (4) 15°

Ans. (3)

Sol. $\eta = \dfrac{\sin\left(\dfrac{A+\delta_{min}}{2}\right)}{\sin\dfrac{A}{2}}$

$\Rightarrow \sqrt{2} = \dfrac{\sin\dfrac{60+\delta_{min}}{2}}{\sin\dfrac{60}{2}}$

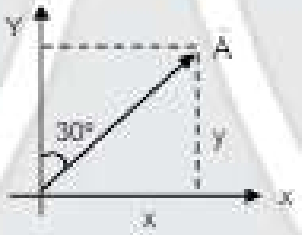
$\Rightarrow \sqrt{2}\sin 30^\circ = \sin\dfrac{60+\delta_{min}}{2}$

$\Rightarrow \dfrac{1}{\sqrt{2}} = \sin\dfrac{60+\delta_{min}}{2}$

$\Rightarrow 45^\circ = \dfrac{60+\delta_{min}}{2}$

$\delta_{min} = 30^\circ$

13. y-component of given position vector $\vec{A}$ is $2\sqrt{3}$ m. Then x component of position vector will be



(1) 2m (2) 4m (3) $\dfrac{2}{\sqrt{3}}$ (4) $\sqrt{3}$ m

Ans. (1)

Sol. $\tan 30^\circ = x/y$

$x = y \cdot \tan 30^\circ$

$= 2\sqrt{3}\,\dfrac{1}{\sqrt{3}} = 2m$

14. At a general point electric field intensity due to an electric dipole is proportional to.

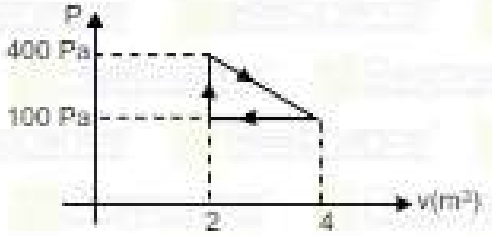
(1) $\dfrac{1}{r^3}$ (2) $\dfrac{1}{r_2}$ (3) $\dfrac{1}{\sqrt{r}}$ (4) $\dfrac{1}{r}$

Ans. (1)

Sol. At an angle θ

$E = \dfrac{kp}{r^3}\sqrt{1+3\cos^2\theta}$

15. Work done by gas in following cyclic process will be



(1) 100 J (2) 200 J (3) – 200 J (4) – 100 J

Ans. (2)

Sol. W = Area

$= \frac{1}{2} \times 2 \times 300 = 300$ J

16. De Broglie wavelength of an electron of kinetic energy E will be λ. then de-Broglie wavelength of the electron with kinetic energy E/4 will be:

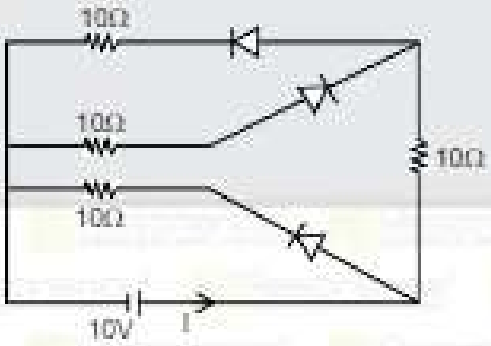
(1) $\lambda/2$ (2) 2λ (3) λ (4) 4λ

Ans. (2)

Sol. $\lambda = \frac{h}{\sqrt{2mE}}$

$\lambda' = \frac{h}{\sqrt{2m\frac{E}{4}}} = \frac{2h}{\sqrt{2mE}} = 2\lambda$

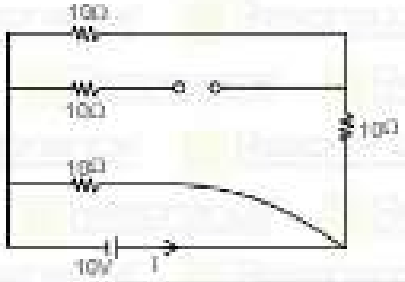
17. Current I through battery will be



(1) 0.5 A (2) 1 A (3) 1.5 A (4) 2 A

Ans. (3)

Sol.



$$Req = \frac{20\times10}{20+10} = \frac{200}{30} = \frac{20}{3}$$

$$I = \frac{10}{Req} = \frac{10\times3}{20} = 1.5\ A$$

18. A string is fixed at its both the ends. Linear mass density of the string is 20 gm/m. String vibrates in its 1st harmonic with frequency 50 Hz. Find speed of the wave on the string. Total mass of the string is 18 gm.

(1) 100 m/s (2) 90 m/s (3) 30 m/s (4) 60 m/s

Ans. **(2)**

Sol. $\mu = \frac{m}{\ell} \Rightarrow 20 = \frac{18}{\ell}$

$$\Rightarrow \ell = \frac{18}{20} = \frac{9}{10} = 0.9m$$

$$f = \frac{v}{2\ell} \Rightarrow V = 2f\ell = 2\times50\times0.9 = 90\ m/s$$

19. **In SHM**

Statement-1 : Direction of acceleration and displacement are always opposite to each other.

Statement-2 : Acceleration is minimum at extreme position.

Statement-3 : Velocity is maximum at mean position.

Statement-4 : Force is directly proportional to displacement.

Which of the above statement is/are correct:

(1) S_1S_2 (2) $S_1S_2S_4$ (3) $S_2S_3S_4$ (4) S_2S_4

Ans. **(2)**

20. Match the following:

(i) infrared	(1) 400 nm – 1 nm
(ii) microwave	(2) 0.1 m – 1mm
(iii) ultra violet	(3) 700 nm – 1mm
(iv) x-rays	(4) 1nm – 10^{-3} nm
(1) (i) → 3, (ii) → 2, (iii) → 1, (iv) → 4	(2) (i) → 1, (ii) → 2, (iii) → 4, (iv) → 3
(3) (i) → 3, (ii) → 1, (iii) → 2, (iv) → 4	(4) (i) → 1, (ii) → 2, (iii) → 3, (iv) → 4

Ans. **(1)**