A particle of mass 0.5 kg moving with speed 12 m/s collide with free end of spring as shown in figure. When compression in spring is 30 cm speed of particle is 6 m/s, then find spring constant of spring.
Ans. (4)

Sol. \[ \frac{1}{2} m \frac{V^2}{2} + \frac{1}{2} m \left( \frac{v^2}{4} \right) + \frac{1}{2} k(0.3)^2 \]
\[ \frac{1}{2} m \frac{3}{4} v^2 + \frac{1}{2} k(0.9) \]
\[ k = 600 \text{ N/m} \]

2. Difference of speed of light in two medium A & B is \( V_A - V_B = 2.6 \times 10^7 \text{ m/s} \). Refractive index of medium B is \( n_B = 1.37 \), then find refractive index of medium A. (Given \( C = 3 \times 10^8 \text{ m/s} \))

\( (1) \ 1.11 \quad (2) \ 1.22 \quad (3) \ 1.33 \quad (4) \ 1.44 \)

Ans. (4)

Sol.
\[ V = \frac{C}{n} \]
\[ V_A = \frac{C}{n_A} = \frac{3 \times 10^8}{1.22} \]
\[ V_A = V_B = 2.6 \times 10^7 \text{ m/s} \]
\[ V_A = V_B = 0.26 \times 10^8 \text{ m/s} \]
\[ V_A = V_B = 2.45 \times 10^8 \text{ m/s} \]
\[ n_A = \frac{V}{V_A} = \frac{3 \times 10^8}{2.45 \times 10^8} = 1.22 \]

3. A particle of 1/2 kilogram initially at rest. A force of \( 10\hat{i} + 5\hat{j} \)N is acting on it. Its position after 2 sec. is \( a_i = b_j \), then \( a/b \) will be:

\( (1) \ 2:3 \quad (2) \ 2:1 \quad (3) \ 1:2 \quad (4) \ 1:1 \)

Ans. (2)

Sol.
\[ \ddot{a} = \frac{F}{m} = 20\hat{i} + 10\hat{j} \text{ m/s}^2 \]
\[ s = \frac{1}{2} \cdot 20 \cdot 2^2 + \frac{1}{2} \cdot 10 \cdot 2^2 \text{ m} \]
\[ \frac{a}{b} = 2 \]

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4. Acceleration of gravity due to earth at height \( h = 2R \) from the surface of earth will be \( (R \text{ = radius of earth}) \)

\( (1) g/4 \quad (2) g/9 \quad (3) g/3 \quad (4) g/2 \)

Ans. (2)

Sol.
\[ g = \frac{GM}{(R+h)^2} \]

5. A force \( F = 3\hat{i} + 4\hat{j} + 2\hat{k} \) N is acting on a particle at \( 2\hat{i} + \hat{j} - 2\hat{k} \) m, find out torque of force about origin will be

\( (1) \ 10\hat{i} + 10\hat{j} - 5\hat{k} \text{ Nm} \quad (2) \ 10\hat{i} - 10\hat{j} + 5\hat{k} \text{ Nm} \quad (3) \ 10\hat{i} + 10\hat{j} + 5\hat{k} \text{ Nm} \quad (4) \ 10\hat{i} - 10\hat{j} - 5\hat{k} \text{ Nm} \)

Ans. (2)

Sol.
\[ \vec{t} = \vec{r} \times \vec{F} \]
\[ = \begin{vmatrix} i & j & k \\ 2 & 1 & 1 \\ 3 & 4 & 2 \end{vmatrix} \\ = i(2+6) - j(4+6) + k(8-3) \\ = 10\hat{i} - 10\hat{j} + 5\hat{k} \]

6. Choose correct option for non-zero vector \( \vec{A} \)

\[ \vec{A} = \begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix} \]

\[ \vec{A} = a_1(b_2c_3 - b_3c_2) - a_2(b_1c_3 - b_3c_1) + a_3(b_1c_2 - b_2c_1) \]

\( (1) \ a_1(b_2c_3 - b_3c_2) \quad (2) \ a_2(b_1c_3 - b_3c_1) \quad (3) \ a_3(b_1c_2 - b_2c_1) \quad (4) \ a_1(b_2c_3 - b_3c_2) + a_2(b_1c_3 - b_3c_1) + a_3(b_1c_2 - b_2c_1) \)

Ans. (4)
7. The angle between two unit vectors \( \vec{A} \) and \( \vec{B} \) is \( \theta \). Then choose correct option.

\[
(1) \quad \vec{A} \cdot \vec{B} = \vec{A} \cdot \vec{B} \cos \frac{\theta}{2} \\
(2) \quad \vec{A} \cdot \vec{B} = \vec{A} \cdot \vec{B} \tan \frac{\theta}{2} \\
(3) \quad \vec{A} \cdot \vec{B} = \vec{A} \cdot \vec{B} \cos \frac{\theta}{2} \\
(4) \quad \vec{A} \cdot \vec{B} = \vec{A} \cdot \vec{B} \tan \frac{\theta}{2}
\]

\[\text{Ans. (2)}\]

8. The element in AC circuit which produces only non-watt current is –

\[\text{(1) RC only} \quad \text{(2) RLC series} \quad \text{(3) Pure resistance} \quad \text{(4) Pure inductance}\]

\[\text{Ans. (4)}\]

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9. Find current through cell in the given circuit.

\[\text{Ans. (2)}\]

10. 50 gm steam of 100°C is converted to 20°C water. Then find heat released in joule during this process. (Latent heat of vaporisation 540 cal/g & specific heat of water is 1 cal/g°C)

\[\text{(1) } 13 \times 10^3 \text{ J} \quad \text{(2) } 13.2 \times 10^3 \text{ J} \quad \text{(3) } 30.2 \times 10^4 \text{ J} \quad \text{(4) } 13 \times 10^4 \text{ J}\]

\[\text{Ans. (4)}\]

11. In which cable signal of 100 Tera Hz will be transmitted.

\[\text{(1) Optical fibre} \quad \text{(2) Twisted pair} \quad \text{(3) coaxial cable} \quad \text{(4) Normal cable}\]

\[\text{Ans. (1)}\]

12. Intensities of two waves are I & 9I meets at points P & Q. If phase difference between two waves at point

\[\text{Ans. (1)}\]
P is $\frac{\pi}{2}$ and at point Q is $\pi$. Then ratio of intensity at P & Q is:

\[
\begin{align*}
(1) & \quad \frac{1}{2} \\
(2) & \quad \frac{3}{2} \\
(3) & \quad \frac{5}{2} \\
(4) & \quad \frac{4}{2}
\end{align*}
\]

Ans. (3)

---

13. Magnetic field B due to infinite log wire at distance r if current is constant in the wire is:

\[
\begin{align*}
(1) & \quad B \propto r \\
(2) & \quad B \propto \frac{1}{r} \\
(3) & \quad B \propto \frac{1}{r^2} \\
(4) & \quad B \propto \frac{1}{r^3}
\end{align*}
\]

Ans. (2)

Sol. \( B = \frac{\mu_0 I}{2\pi r} \)

14. A ball of radius r falling in a liquid its terminal velocity \( v \) will be:

\[
\begin{align*}
(1) & \quad V \propto r \\
(2) & \quad V \propto r^2 \\
(3) & \quad V \propto r^3 \\
(4) & \quad V \propto \frac{1}{r}
\end{align*}
\]

Ans. (2)

Sol. \( \frac{2 r^2}{9} (\rho_0 - \rho) g = v \)

15. Wavelength of emitted photon to ionise Li\(^+\) from ground state:

\[
\begin{align*}
(1) & \quad 101\text{Å} \\
(2) & \quad 120\text{Å} \\
(3) & \quad 130\text{Å} \\
(4) & \quad 150\text{Å}
\end{align*}
\]

Ans. (1)

Sol. \[
\lambda = \frac{1}{n^2} \cdot \frac{1}{\lambda} = \frac{1}{n^2} \cdot \frac{1}{\lambda} \]

\[
\lambda = \frac{1}{n^2} = \frac{911}{9} \quad \lambda = 101\text{Å}
\]

16. Find out the ratio of speed of electron moving in third orbit of hydrogen and He\(^+\) ion.

\[
\begin{align*}
(1) & \quad \frac{1}{2} \\
(2) & \quad \frac{3}{2} \\
(3) & \quad \frac{2}{1} \\
(4) & \quad \frac{2}{3}
\end{align*}
\]

Ans. (1)

Sol. \[
\frac{V_e}{V_{He^+}} = \frac{1}{n^2} = \frac{1}{2}
\]

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17. Why photodiode used in Revers Bias because –
   (1) Small change in majority charge carrier produces high value of current in reverse bias.
   (2) Small change in minority charge carrier produces high value of current in reverse bias.
   (3) Small change in majority charge carrier produces low value of current in reverse bias.
   (4) Small change in minority charge carrier produces low value of current in reverse bias.

   Ans. (2)

18. Choose correct option for relation between rms speed and most probable speed of oxygen
   (1) $V_{rms} = \sqrt{\frac{2}{3}} V_{mp}$
   (2) $V_{rms} = \sqrt{\frac{2}{3}} V_{mp}$
   (3) $V_{rms} = \sqrt{\frac{1}{2}} V_{mp}$
   (4) $V_{rms} = \sqrt{2} V_{mp}$

   Ans. (1)

   Sol. $V_{rms} = \frac{3RT}{M}$
       $V_{mp} = \frac{2RT}{M}$
       $\frac{V_{rms}}{V_{mp}} = \sqrt{\frac{3}{2}}$

19. In given circuit, equivalent capacitance between point A & B is
   (1) 4 \( \mu \)F
   (2) 2 \( \mu \)F
   (3) 6 \( \mu \)F
   (4) 8 \( \mu \)F

   Ans. (3)

   Sol. $C_{AB} = \frac{24\times8}{24+8} = 6 \mu F$

20. Electric field at distance L and 2L from uniformly charged large non conducting sheet of surface charge density $\sigma$ will be
   (1) $\frac{\sigma}{2\epsilon_0}$
   (2) $\frac{\sigma}{2\epsilon_0}$
   (3) $\frac{\sigma}{2\epsilon_0}$
   (4) $\frac{\sigma}{2\epsilon_0}$

   Ans. (2)

   Sol. $E = \frac{\sigma}{2\epsilon_0}$

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22. In a resistance 2A current produce 300 J heat in 15 sec. Then heat produce by 3 A current in 10 sec by same resistance is

(1) 300 J  (2) 250 J  (3) 450 J  (4) 350 J

Ans. (3)

Sol. \( H = I^2 R t \)

\[
\frac{H_2}{H_1} = \left( \frac{I_1}{I_2} \right)^2 = \left( \frac{2}{3} \right)^2 = \frac{4}{9} \times \frac{10}{15} = \frac{3}{2}
\]

\( H_2 = 450 J \)

23. Electric field for a electromagnetic wave is given by \( E = 45.7 \sin \left( \frac{\pi x}{4} \right) \) N/C, then intensity of electromagnetic wave is \( (c = 3 \times 10^8 \text{ m/s}) \)

(1) 2532.81  (2) 2032.81  (3) 2132.81  (4) 2232.81

Ans. (1)

Sol. \( I = \frac{1}{2} c E^2 C = \frac{1}{2} \times 8.85 \times 10^{-12} \times (45.7)^2 \times 3 \times 10^8 \)

= 2.77
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