Solution

PHY

JEE main - Physics

PHYSICS (Section-A)

1.

(b) $[ML^2T^{-2}]$

Explanation:

$[ML^2T^{-2}]$

2.

(b) 29 seconds

Explanation:

Displacement in first eight steps = 5 - 3 = 2 metre.
Since the last five steps covering 5-metre land the drunkard fell
into the pit, the displacement prior to this is (11 - 5) metre = 6 metre.
Time is taken for the first eight steps = 8 sec.
Time is taken to cover the first six metres of journey $= \frac{6}{2} \times 8 = 24\text{sec}$
Time is taken to cover last 5 metres = 5 sec.
Total time = 24 sec + 5 sec = 29 sec

3.

(c) (400, 100)

Explanation:

When the horizontal range is maximum, the maximum height attained is RJ4. Hence, coordinates of the point = (400, 100)

4.

(d) 100 dyne

Explanation:

100 dyne

5.

(d) 100%

Explanation:

Since, E = $\frac{1}{2}\frac{p^2}{m}$

So, $\left(\frac{p_2}{p_1}\right)^2 = \left(\frac{E_2}{E_1}\right)$

Here, E_1 = E, E_2= 4E

or, $p_2 = 2p_1$

$p_2 = p_1 + 100\%\ p_1$

Here, % change in momenta

$\frac{p_2-p_1}{p_1} = 100$

6.

(c) $\frac{4}{3}Ml^2$

Explanation:

Moment of inertia for the rod AB rotating about an axis through the mid-point of AB perpendicular to the plane of the paper is $\frac{Ml^2}{12}$.

$\therefore$ Through the axis through the centre of the square and parallel to this axis,

$I = I_0 + Md^2 = M\left(\frac{l^2}{12} + \frac{l^2}{4}\right) = \frac{Ml^2}{3}$

For all the four rods or for the whole square frame,

$I' = 4I = \frac{4}{3}Ml^2$

7.

(b) 4πRT

Explanation:

The T force point to the left and act all along the circular edge of the hemispherical film the magnitude of the force due to each surface of the film is the product of the T and the circumference (2πR) of the circle edge, T(2πR)

Total force = 2T(2πR)

= 4πRT

8.

(d) 1480 $Jkg^{-1} K^{-1}$

Explanation:

By using

Heat gained = heat lost

$\therefore 2 \times 4200 \times (60 - 55) = 1 \times S_{unknown} \times (55 - 30) + 200 \times (55 - 30)$

$8400 \times = 5 = 25 S_{unknown} + 5000$

$25 S_{unknown} = 37000$

$\therefore S_{unknown} = 1480 Jkg^{-1} K^{-1}$

9.

(d) $2P_1V_1$

Explanation:

Work done = $(\frac{1}{2}) \times 2P_1 \times 2V_1$

= $2P_1V_1$

10.

(b) 10 J

Explanation:

As we know that,

PE = $\frac{1}{2}m\omega^2x^2$

= 2.5 J

As x = $\frac{A}{2}$

$\frac{1}{2}m\omega^2\left(\frac{A}{2}\right)^2$ = 2.5

$\therefore \frac{1}{2}m\omega^2\frac{A^2}{4}$ = 2.5

$\frac{1}{2}m\omega^2A^2$ = 10 J

Therefore, total energy of system

= $\frac{1}{2}m\omega^2A^2$

= 10 J

11.

(b) $|V_A| = |V_B| > |V_C| = |V_D|$

Explanation:

Along the equatorial line, field and potential will be half that along the axial line.

$\therefore |V_A| = |V_B| > |V_C| = |V_D|$

12. **(a)** 25

Explanation:

Given that,

V = 5 Volt; I_g = 0.005 Amp;

R = 975 Ω

$R=\frac{V}{I_g}-G$ or $G=\frac{V}{I_g}-R$

$\therefore G=\frac{5}{0.005}-975=25\Omega$

13.

(d) $\chi_m=\mu_r-1$

Explanation:

Relationship between magnetic susceptibility χ_m and relative permeability μ_r is

$\mu_r=\chi_m+1$ or $\chi_m=\mu_r-1$

14.

(b) 30 πV

Explanation:

The current through the coil 1 is

$I_1 = I_0 \sin \omega t$

where I_0 is the peak value of current.

Magnetic flux linked with the coil 2 is

$\phi_2 = MI_1 = MI_0 \sin \omega t$

where M is the mutual inductance between the two coils.

The magnitude of induced emf in coil 2 is

$|e_2|=\frac{d\phi_2}{dt}=\frac{d}{dt}(MI_0\sin\omega t)=MI_0\omega\cos\omega t$

$\therefore$ Peak value of voltage induced in the coil 2 is

$=MI_0\omega=150\times10^{-3}\times2\times2\pi\times50=30\pi V$

15. **(a)** $\frac{V_0}{\sqrt{2}}$

Explanation:

$V_{rms}=\left[\frac{1}{T}\int_0^{T/2}V_0^2dt\right]^{1/2}=\left[\frac{V_0^2}{T}[t]_0^{T/2}\right]^{1/2}$

$=\left[\frac{V_0^2}{T}\left(\frac{T}{2}\right)\right]^{1/2}$

$V_{rms}=\frac{V_0}{\sqrt{2}}$

16.

(d) 10^6 V/s

Explanation:

$\frac{Q}{t}=\frac{CV}{t}$ or $I_d=\frac{CV}{t}$

or $\frac{V}{t}=\frac{I_d}{C}=\frac{10}{10^{-6}}$ = 10^6 V/s

17.

(c) $\lambda_{CM}=\frac{2\lambda_1\lambda_2}{\sqrt{\lambda_1^2+\lambda_2^2}}$

Explanation:

Momentum (p) of each electron $\frac{h}{\lambda_t}\hat{i}$ and $\frac{h}{\lambda_2}\hat{j}$

Velocity of centre of mass

$V_{cm}=\frac{h}{2m\lambda_i}\hat{i}+\frac{h}{2m\lambda_2}\hat{j}$ ($\because$ p = mv)

Velocity of 1 st particle about centre of mass

$V_{1cm} = \frac{h}{2\,m\lambda_1}\hat{i} - \frac{h}{2\,m\lambda_2}\hat{j}$

$\lambda_{cm} = \frac{h}{\sqrt{\frac{h^2}{4\lambda_1^2} + \frac{h^2}{4\lambda_2^2}}} = \frac{2\lambda_1\lambda_2}{\sqrt{\lambda_1^2+\lambda_2^2}} \quad \left(\because \lambda = \frac{h}{p}\right)$

18. **(a)** U = -2K

Explanation:

We know that, Kinetic energy,

K = $\frac{1}{2}mv^2 = \frac{e^2}{8\pi\varepsilon_0 r}$

and, Potential Energy,

U = $-\frac{e^2}{4\pi\varepsilon_0 r}$

Then,

K = $\frac{1}{2}mv^2$

$= \frac{e^2}{8\pi\varepsilon_0 r}$

$\Rightarrow$ U = -2K

19. **(a)** at high temperature and high pressure

Explanation:

Fusion occurs at high temperatures and high pressure when the fuel is highly dense.

20.

(d) 6533 $\overset{o}{A}$

Explanation:

As we know that,

$\lambda = \frac{hc}{E_g}$

$\because$ E_g = 1.9 eV

= 1.90 $\times$ 1.6 $\times$ 10^{-19} J

$\therefore \lambda = \frac{6.62\times10^{-34}\times3\times10^8}{1.90\times1.6\times10^{-19}}$

= 6533 $\overset{o}{A}$

PHYSICS (Section-B)

21. 3.6

Explanation:

Potential energy of charges Q_1 and Q_2 at 10 cm apart

$= \frac{1}{4\pi\varepsilon_0}\frac{12\times10^{-6}\times5\times10^{-6}}{0.1}$

$= \frac{9\times10^9\times60\times10^{-12}}{0.1}$

= 54 $\times$ 10^{-1} = 5.4 J

At 6 cm apart:

$PE = \frac{9\times10^9\times60\times10^{-12}}{0.06}$ = 9 J

$\therefore$ Work done = (9 - 5.4) J = 3.6 J

22. 2.0

Explanation:

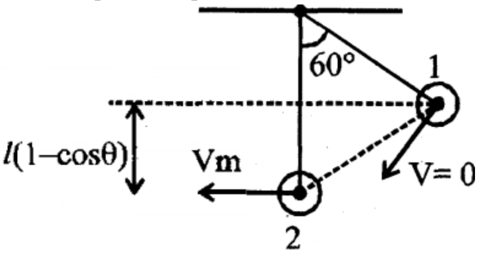
We know that orbital velocity is given as

$V = \sqrt{\frac{GM}{x}} \therefore V \propto \frac{1}{\sqrt{x}} \Rightarrow \frac{V_1}{V_2} = \sqrt{\frac{r_2}{r_1}} = \sqrt{\frac{800}{3200}} = \frac{1}{2}$

23. 5.0

Explanation:

At mean position, pendulum will have maximum velocity



So, By conservation of energy

$P_i + K_1 = P_2 + K_2$

mgl (1 - cosθ) + 0 = 0 + $\frac{1}{2}$m Vm^2

$V_m = \sqrt{2gl(1 - cos\theta)}$

$= \sqrt{2 \times 10 \times 2.5 \times (1 - \cos 60^{\circ})} = \sqrt{25}$ = 5 m/s.

24. 144.0

Explanation:

Given, Charge, q = 2 μC = 2 $\times$ 10^{-6} C

Magnetic field, B = 4 x 10^{-3} T

radius r = 3cm = 3 $\times$ 10^{-2}m

r = $\frac{mv}{qB} = \frac{\sqrt{2Km}}{qB}$, m = $\frac{r^2q^2B^2}{2K}$

Kinetic energy K = qV = 2 $\times$ 10^{-6} $\times$ 100

m = $\frac{(3\times10^{-2})^2\times(2\times10^{-6})^2\times(4\times10^{-3})^2}{2\times10^{-6}\times100}$ = 144 $\times$ 10^{-18}kg

25. 64

Explanation:

$P \propto AT^4$ and $A \propto r^2$

$\therefore P \propto r^2T^4$

Now, T' = 2T, r' = 2r

Hence, P' = 4 $\times$ 16P = 64 P.m