Solution

PHYSICS

NEET-UG - Physics

PHYSICS (Section-A)

1.

(d) $[M^{\circ}L^{\circ}T^{-1}]$

Explanation:

$[M^{\circ}L^{\circ}T^{-1}]$

2.

(d) 1 eluoj = 6.67×10^{-14} joule

Explanation:

1 Newton = $G\frac{1\text{kg}\times 1\text{kg}}{(1\text{km})^2}$

or G = 10^6 newton m^2 kg^{-2}

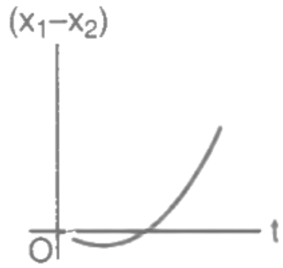
But G = $6.67 \times 10^{-11}\text{N} - \text{m}^2\text{kg}^{-2}$

$\therefore$ 1 notwen = 6.67×10^{-17} notwen

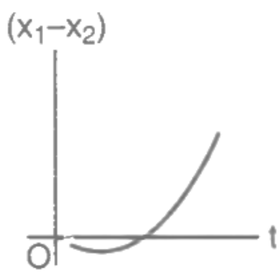
1 eluoj = 1 notwen $\times$ 1 km = 6.67×10^{-17} newton $\times 10^3$n

= 6.67×10^{-14} joule .

3. **(a)**



Explanation:



Here, x_2 = vt

and $x_1 = \frac{at^2}{2}$

x_1 - x_2 = $-\left(vt - \frac{at^2}{2}\right)$

So, the graph would be like that shown in Fig.

4.

(c) 30°

Explanation:

h = $\frac{u^2 \sin^2\theta}{2g} = \frac{(56)^2 \sin^2\theta}{19.6}$

$\sin^2\theta = \frac{40\times 19.6}{(56)^2} = \frac{1}{4}$

$\sin\theta = \frac{1}{2}$ or $\theta = 30^{\circ}$

5.

(d) 90

Explanation:

$(\vec{A}+\vec{B})\cdot(\vec{A}-\vec{B})=0$ (as A = B)

$\therefore(\vec{A}+\vec{B})$ is $\perp$ to $(\vec{A}-\vec{B})$.

6.

(b) Conservation of linear momentum

Explanation:

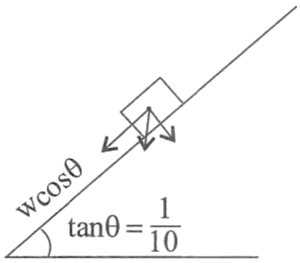
A jet engine works on the principle of conservation of linear momentum.

7. **(a)** 15 ms^{-1}

Explanation:

While moving downhill power

P = $\left(w\sin\theta+\frac{w}{20}\right)$ 10



P = $\left(\frac{w}{10}+\frac{w}{20}\right)$ 10 = $\frac{3w}{2}$

$\frac{\mathrm{P}}{2}=\frac{3\mathrm{w}}{4}=\left(\frac{\mathrm{w}}{10}-\frac{\mathrm{w}}{20}\right)\mathrm{V}$

$\frac{3}{4}=\frac{v}{20}\Rightarrow$ v = 15 m/s

$\therefore$ Speed of car while moving downhill v = 15 m/s

8.

(c) 1.2 kg

Explanation:

By law of conservation of momentum

$2u=2\frac{u}{4}+mv\Rightarrow\frac{3u}{2}=mv$

Now, $e=\frac{v-\frac{u}{4}}{u}\Rightarrow u=v-\frac{u}{4}\ [\because \mathrm{e}=1]\Rightarrow\frac{5\mathrm{u}}{4}=\mathrm{v}$

$\Rightarrow\frac{5\mathrm{mu}}{4}=\frac{3\mathrm{u}}{2}\Rightarrow\mathrm{m}\ =\frac{6}{5}=1.2\ \mathrm{kg}$

9.

(b) does not shift

Explanation:

No external horizontal force is applied,

$\therefore a_{CM}=0$

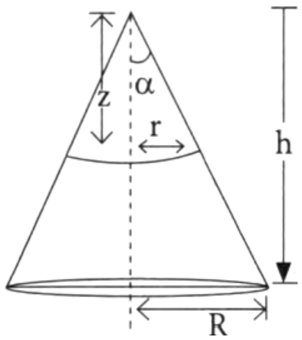
Since, $v_{CM}=0$, hence $\Delta x_{\mathrm{CM}}=0$

10.

(c) (0, 0, $\frac{h}{4}$)

Explanation:

As we know that,



dm = $\rho\pi r^2$ dz

tan $\alpha = \frac{r}{z} = \frac{R}{h}$

$\therefore$ r = $\frac{R}{h}$z

Now, z_{CM} = $\frac{\int zdm}{\int dm} = \frac{\int_0^h \rho\pi r^2 zdz}{\frac{1}{3}\pi R^2 h\rho}$

= $\frac{3}{R^2h}\int_0^h\left(\frac{R}{h}z\right)^2$ zdz

= $\frac{3}{hR^2}\left(\frac{R^2}{h^2}\right)\int_0^h$ z^3dz

= $\frac{3}{h^3}\left[\frac{z^4}{4}\right]_0^h = \frac{3h}{4}$

So that, the distance of centre of mass from base is, $h - \frac{3h}{4} = \frac{h}{4}$

Centre of mass has co-ordinates (0, 0, $\frac{h}{4}$)

11. **(a)** 17

Explanation:

$\omega = \frac{2\pi}{24 \times 3600}$

$g' = g - R_e\omega^2$ or 0 = g - $R_e\omega'^2$

or $\omega' = \sqrt{\frac{g}{R_e}} = \frac{2\pi}{84.6 \times 60}$

$\therefore \frac{\omega'}{\omega} = \frac{24 \times 3600}{84.6 \times 60}$ = 17

12.

(c) $AY\left(\frac{R-r}{r}\right)$

Explanation:

$Y = \frac{FL}{A\Delta L}$ or $F = \frac{YA\Delta L}{L}$

$\therefore \quad F = \frac{YA \times 2\pi(R-r)}{2\pi r} = \frac{YA(R-r)}{r}$

13.

(b) both when heated or cooled

Explanation:

Water has least volume at 4^oC. So, volume will increase when water is heated or cooled at 4^oC.

14.

(c) only ii

Explanation:

decreases with increasing pressure; The **melting point of ice** decreases when **pressure increases** because when **pressure** is **increased** volume is decreased and volume of water is less than **ice**.

15.

(b) Compressing the gas through adiabatic process will require more work to be done.

Explanation:

Work done = area under curve

While compressing the gas adiabatically, the area under the curve is more than that for isothermal compression.

16. **(a)** 6

Explanation:

Let C_p and C_v be the specific heat capacity of the gas at constant pressure and volume.

At constant pressure, heat required

$\Delta Q_1 = nC_p\Delta T$

$\Rightarrow 160 = nC_p \cdot 50$ ...(i)

At constant volume, heat required

$\Delta Q_2 = nC_v\Delta T$

$\Rightarrow 240 = nC_v \cdot 100$ ...(ii)

Dividing (i) by (ii), we get

$\frac{160}{240} = \frac{C_p}{C_v} \cdot \frac{50}{100} \Rightarrow \frac{C_p}{C_v} = \frac{4}{3}$

$\gamma = \frac{C_p}{C_v} = \frac{4}{3} = 1 + \frac{2}{f}$ (Here, f = degree of freedom)

$\Rightarrow f = 6$

17.

(b) π sec

Explanation:

Maximum speed $v_{\max} = \omega A$ ...(i)

Maximum acceleration, $a_{\max} = \omega^2 A$ ...(ii)

Dividing eqn. (i) by (ii), we get:

$\frac{a_{\max}}{v_{\max}} = \frac{\omega^2 A}{\omega A} = \omega = \frac{2\pi}{T}$

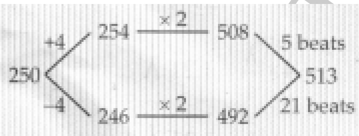
$\therefore T = 2\pi\left[\frac{v_{\max}}{a_{\max}}\right]$

$= 2\pi\left[\frac{30\text{cm sec}^{-1}}{60\text{cm sec}^{-2}}\right]$

$= \pi$ sec

18. **(a)** 254 Hz

Explanation:



Clearly, the unknown frequency 254 Hz satisfies the given conditions.

19.

(c) $\frac{3}{100}$ mm

Explanation:

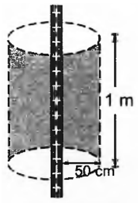
As we know,

Pressure amplitude, ΔP_0 = = aKB = S_0KB = $S_0 \times \frac{\omega}{V} \times \rho V^2$ [$\because$ K = $\frac{\omega}{V}, V = \sqrt{\frac{B}{\rho}}$]

$\Rightarrow S_0 = \frac{\Delta P_0}{\rho V\omega} \approx \frac{10}{1\times300\times1000}$ m = $\frac{1}{30}$ mm $\approx \frac{3}{100}$ mm

20. **(a)** $\frac{100Q}{\varepsilon_0}$

Explanation:



Charge per metre of the wire = 100 QC

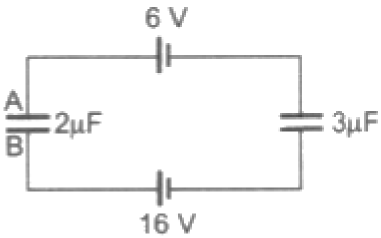
According to Gauss law, the total electric flux passing through the cylindrical surface is,

$\phi = \frac{q_{\text{enclosed}}}{\varepsilon_0} = \frac{100Q}{\varepsilon_0}$

21.

(b) - 6 V

Explanation:

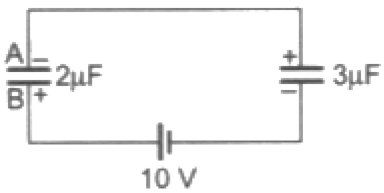


Here, 2 μF and 3 μE capacitors are connected in series. Their equivalent capacitance is,

$\frac{1}{C_S} = \frac{1}{2} + \frac{1}{3}$ or $C_S = \frac{6}{5}\mu\text{F}$

Net voltage, V = 16 V - 6 V = 10 V

The equivalent circuit diagram as shown in below figure.



Charge on each capacitor,

$q = C_S V = \frac{6}{5} \times 10 = 12\mu\text{C}$

The potential difference between A and B is = $-\frac{12\mu C}{2\mu F} = -6V$

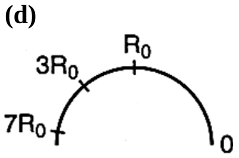
22. **(a)** unchanged

Explanation:

unchanged

23.

(d)



Explanation:

For full deflection $I_0 = \frac{E}{R_0}$

$\text{R} = \text{R}_0 \quad \text{I} = \frac{\text{I}_0}{2}$

$\Rightarrow$ Half deflection

$\text{R} = 3\text{R}_0 \quad I = \frac{I_0}{4}$

$\Rightarrow$ One fourth deflection

24.

(d) 6 J

Explanation:

Work done in turning the magnet of moment,

M = 2 × 10^4 JT^{-1} in a field B = 6 × 10^4 T

(H is not present in space) through an angle 60° is,

W = MB cos θ

$W = 2 \times 10^4 \times 6 \times 10^{-4} \times \cos 60^\circ$

W = 6 J

25.

(c) Only (B)

Explanation:

According to Curie's law intensity of the magnetisation,

$I = C\left(\frac{B}{T}\right) \propto \frac{1}{T}$

i.e., Paramagnetism is temperature-dependent.

26.

(b) only iii

Explanation:

By Lenz's law, the direction of induced current in the ring is such as to oppose the falling of A-pole of the magnet.

So, the direction of the induced current will be anticlockwise, because the induced current makes the ring a magnetic dipole, with its N -pole upward which opposes (repel) the A-pole of the falling magnet. Hence, the direction of the current in the ring will be anticlockwise.

27.

(b) both placing in a time-varying magnetic field and passing either a direct or alternating current through the plate are correct

Explanation:

When a metal plate is getting heated, it may be due to the passage of direct current, alternating current, or even induced current through the plate. As time-varying magnetic field produces induced current in the plate, so both placings in a time-varying magnetic field and passing either a direct or alternating current through the plate are correct.

28.

(b) $5\sqrt{3}$ amp

Explanation:

Given: I = 5 + 10 sin ωt,

$I_{\text{eff.}} = \left[\frac{\int_0^T I^2 dt}{\int_0^T dt}\right]^{1/2} = \left[\frac{1}{T}\int_0^T\right.$ (5 + 10 sin $\omega t)^2$ dt$]^{1/2}$

$= \left[\frac{1}{T}\int_0^T\right.$ (25 + 100 sin ωt + 100 $\sin^2$ $\omega t]^{1/2}$

But as, $\frac{1}{T}\int_0^T$ sin ωt dt = 0

and $\frac{1}{T}\int_0^T$ $\sin^2$ ωt dt = $\frac{1}{2}$

So, $I_{\text{eff.}}$ = [25 + $\frac{1}{2}\times$ 100$]^{1/2}$ = $5\sqrt{3}$ amp

29.

(d) J.C. Bose

Explanation:

J.C. Bose

30.

(b) $\sqrt{2}$

Explanation:

Given, A=30^o

$i_1 = 45^o$ and $r_2 = 0$ Since, $r_1 + r_2 = A$

$\therefore r_1 = A = 30^o$

Now, refractive index of the prism,

$\mu = \frac{\sin i_1}{\sin r_1} = \frac{\sin 45^\circ}{s}(\in 30^\circ) = \frac{\frac{1}{\sqrt{2}}}{\frac{1}{2}} = \sqrt{2}$

31.

(d) 420 nm

Explanation:

3rd Bright fringe $\times$ 700 nm = 5th Bright fringe $\times$ k

$\therefore\ \lambda = \frac{3\times700}{5}$ = 420 nm

32. **(a)** $K^{-1/2}$

Explanation:

Kinetic energy of a proton,

K = $\frac{1}{2}m_p v_p^2 = \frac{p^2}{2m_p}$

$\therefore \quad \lambda_1 = \frac{h}{p} = \frac{h}{\sqrt{2m_pK}}$

For photon,

K = hv_2 = $\frac{hc}{\lambda_2}$ or $\lambda_2 = \frac{hc}{K}$

$\therefore \quad \frac{\lambda_2}{\lambda_1} = \frac{hc}{K}\frac{\sqrt{2m_pK}}{h} = c\sqrt{\frac{2m_p}{K}}$

or $\frac{\lambda_2}{\lambda_1} \propto K^{-1/2}$

33.

(d) Photoelectric effect

Explanation:

Photoelectric effect

34.

(b) -4.36 $\times$ 10^{-18} J

Explanation:

As we know that,

P.E. = -2K.E.

Here, K.E. = -E = 13.6 eV

= 13.6 $\times$ 1.6 $\times$ 10^{-19} J

= 2.18 $\times$ 10^{-18} J

Hence, P.E. = -2 $\times$ 2.18 $\times$ 10^{-18} J

= -4.36 $\times$ 10^{-18} J

35.

(c) $x = n, y = n, K_{\text{Sr}} = 129\text{MeV}, K_{\text{Xe}} = 86\text{MeV}$

Explanation:

From conservation laws of mass number and atomic number, we can say that x = n, y = n

$\left(x =_0^1 n, y =_0^1 n\right)$

From conservation of momentum, $|P_{xe}| = |P_{sr}|$

From $K = \frac{P^2}{2m} \Rightarrow K \propto \frac{1}{m}$

$\frac{K_{sr}}{K_{xe}} = \frac{m_{xe}}{m_{sr}}$
∴ K_{sr} = 129 MeV, K_{xe} = 86 MeV

PHYSICS (Section-B)

36.
(b) 0.25
Explanation:
According to law of conservation of linear momentum
mv = 4mv' or v' = $\frac{v}{4}$
Coefficient of restitution e = $\frac{\text{velocity of separation}}{\text{velocity of approach}}$
= $\frac{\frac{v}{4}-0}{v-0} = \frac{1}{4}$ = 0.25

37.
(b) $\sqrt{\frac{4}{3}gh}$
Explanation:
As the body rolls the inclined plane, it loses potential energy. However, in rolling it acquires both linear and angular speeds and hence, gain in kinetic energy of translation and that of rotation. So by conservation of mechanical energy,
$Mgh = \frac{1}{2}Mv^2 + \frac{1}{2}I\omega^2$
But as in rolling, v = Rω
$\therefore \quad Mgh = \frac{1}{2}Mv^2\left[1 + \frac{I}{MR^2}\right]$
Let $1 + \frac{I}{MR^2} = \beta$
Let $Mgh = \frac{1}{2}\beta Mv^2$
Hence, $v = \sqrt{\frac{2gh}{\beta}}$
$v = \sqrt{\frac{2gh}{\beta}} = \sqrt{\frac{2gh}{1+\frac{I}{MR^2}}}$
For cylinder: $I = \frac{1}{2}MR^2$
$\therefore \quad v = \sqrt{\frac{2gh}{1+\frac{1}{2}}} = \sqrt{\frac{4gh}{3}}$

38. **(a)** About 3.1 $\times$ 10^{10} J
Explanation:
About 3.1 $\times$ 10^{10} J

39.
(c) $\frac{1}{2}\lambda_m$
Explanation:
Given: Temperature (T_1) = 1000 K;
The wavelength at maximum radiation λ = λ_m and
final temperature (T_2) = 2000 K.
Now from the Wein's displacement law λ_mT = constant.
Therefore when the temperature is doubled, the peak will shift to half the original value.

40. **(a)** Mechanical transverse waves can propagate through solids only.
Explanation:
Mechanical transverse waves can propagate through solids only as in transverse wave each element of the medium in subjected to shearing stress. Solids and strings have shear modulus, i.e., they sustain shearing stress and hence, transverse waves can propagate through them.
Longitudinal waves one mechanical waves, i.e. they require medium to propagate hence they can not propagate in a vacuum.

Longitudinal waves involve compressing stress and solids, as well as fluids, have bulk modulus that is they can sustain compressive stress. Hence, longitudinal waves can be propagated through solids and fluids both.

41.

(d) remains unchanged

Explanation:

remains unchanged

42.

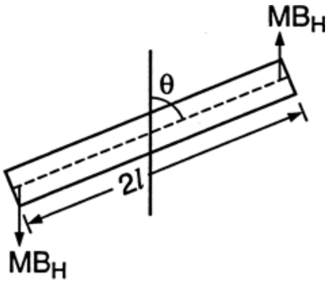
(c) contract

Explanation:

Treat the gas as a thick conductor carrying a uniform current. Apply Ampere's law to .find the magnetic field. Then apply the left-hand rule to find the direction of Ampere force.

43. **(a)** $\frac{MB_H\theta}{I}$

Explanation:



$\tau = -2mB_H I \sin\theta$

= -MB_H sinθ

If θ is small, $sin\theta \approx \theta$

$I\alpha = -MB_H\theta$

$|\alpha| = \frac{MB_H\theta}{I}$

44.

(b) 19 Hz and 170 V

Explanation:

Given,

V = 240 sin 120t V

Comparing with V = V_0 sin ωt

V_0 = 240 V

ω = 120 rad/s

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

$= \frac{240}{\sqrt{2}}$

= 169.7

$\approx$ 170 V

ω = 2πf

f = $\frac{\omega}{2\pi}$

$= \frac{120}{2\pi}$

= 19 Hz

45.

(b) decreases n^2 times

Explanation:

If power transmitted is P, the resistance of transmission line is r, current through-line is I = ($\frac{P}{V}$) then

Power loss = I^2r = $(\frac{P}{V})^2$r. As P and r is always constant, Power loss $\propto (\frac{1}{V^2})$ hence is V increases n times then loss decreases by n^2 times

46.

(b) two

Explanation:

two

47. **(a)** suffer total internal reflection in case (B) only

Explanation:

Velocity of light in medium

$V_{med} = \frac{3 \text{ cm}}{0.2 \text{ ns}} = \frac{3\times10^{-2} \text{ m}}{0.2\times10^{-9} \text{ s}} = 1.5 \times 10^8$ m/s

Refractive index of the medium

$\mu = \frac{V_{air}}{V_{med}} = \frac{3\times10^8}{1.5\times10^8 \text{ m/s}} = 2$

As $\mu = \frac{1}{\sin C}$ $\therefore \sin C = \frac{1}{\mu} = \frac{1}{2} = 30^o$

Condition of TIR is angle of incidence i must be greater than critical angle. Hence ray will suffer TIR in case of (B) $(\mathrm{i} = 40^\circ > 30^\circ)$ only.

48.

(c) $\frac{V}{2000}$ volt

Explanation:

$\lambda_e = \lambda_p$

or $\frac{h}{\sqrt{2m_eQ_eV}} = \frac{h}{\sqrt{2m_pQ_pV_p}}$

$\therefore m_eQ_eV = m_pQ_pV_p$

$\therefore V_p = \left(\frac{m_e}{m_p}\right)\left(\frac{Q_e}{Q_p}\right)V = \left(-\frac{1}{2000}\right)(1)\ V = \frac{V}{2000}$ volt

49.

(c) $\frac{nh}{2\pi}$

Explanation:

Angular momentum (mvr) of an electron in the nth orbit of a hydrogen atom is given by $\frac{nh}{2\pi}$

Thus, angular momentum is an integral multiple of $\frac{h}{2\pi}$ and is quantized.

50.

(d) 27×10^{13} J

Explanation:

Given that,

Here, Δm = 0.3% of 1 kg

$= \frac{0.3}{100}$ kg $= 3 \times 10^{-3}$ kg

$E = (\Delta m)c^2$

$= 3 \times 10^{-3} \times (3 \times 10^8)^2 = 27 \times 10^{13}$ J