Solution

PHYSICS

NEET-UG - Physics

PHYSICS (Section-A)

1.

(b) 2

Explanation:

2

2.

(b) $v^2 = K\lambda g$

Explanation:

$v^2 = K\lambda g$

3.

(b) 36 s

Explanation:

Let distance be S

$V_{\text{man}} = \frac{s}{90}$

$V_{\text{escalator}} = \frac{s}{60}$

V_{man} on moving escalator w.r.t ground $V_{\text{man}} + V_{\text{escalator}} = s\left(\frac{1}{90} + \frac{1}{60}\right) = \frac{s}{36}$

Time $= \frac{s}{v} = \frac{s}{\frac{s}{36}} = 36$

4.

(b) 0.5 K

Explanation:

Since the range is maximum, therefore $\theta = 45^{\circ}$. Hence, $v_x = v \cos 45^{\circ} = \frac{v}{\sqrt{2}}$. At the highest point, the net velocity of the projectile is, $v_x = v \cos 45^{\circ}$.

$\therefore \text{KE} = \frac{1}{2}mv_x^2 = \frac{1}{2}m\frac{v^2}{2} = \frac{K}{2} = 0.5\text{K}$.

5.

(c) 5 : 4

Explanation:

$H_{\max} = \frac{u^2 \sin^2\theta}{2g}$

$T = \frac{2u \sin\theta}{g}$

$\frac{H_{\max}}{T^2} = \frac{u^2 \sin^2\theta}{2g} \times \frac{g^2}{4u^2 \sin^2\theta} = \frac{g}{8} = \frac{10}{8} = \frac{5}{4}$.

6.

(d) 2.8 N

Explanation:

Limiting force of friction

= μR = μMg = 0.4 $\times$ 2 $\times$ 10 = 8 N

As external applied force = 2.8 N. Because it is less than the limiting friction, the actual force of friction is equal to external force of 2.8 N but in opposite direction.

7.

(c) 313.6 W

Explanation:

Given that,

m = 60 + 20 = 80 kg

h = 20 $\times$ 0.2 = 4 m

g = 9.8 ms^{-2}

f = 10 sec

Power,

P = $\frac{W}{t}$

= $\frac{mgh}{t}$

= $\frac{80 \times 9.8 \times 4}{10}$

= $\frac{3136}{10}$

= 313.6 W

8.

(d) 0.15 m

Explanation:

Loss of KE = Gain in elastic PE

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

or $0.5 \times (1.5)^2 = 50 \times x^2$

$\therefore \quad x^2 = \frac{0.5 \times (1.5)^2}{50} = \frac{(1.5)^2}{109}$

$\therefore \quad x = \frac{1.5}{10}$ = 0.15 m

9.

(c) The centre of mass of the body remains unchanged.

Explanation:

Centre of mass of body remains unchanged in rotational motion of rigid body.

10.

(c) $\frac{2V_0}{3}$

Explanation:

For sliding motion, $V = V_0 + at = V_0 - \mu gt$ ...(i)

as $a = -\frac{f}{M} = \frac{-\mu Mg}{M} = -\mu g$

It is worth noting here that when a body is given initial velocity V_0 on a rough surface, the velocity is reduced because sliding is opposed by friction. On the other hand, rolling is caused by friction. When the relation $V = R\omega$ is satisfied, pure rolling occurs.

Now, angular velocity of the body after t sec is,

$\omega = \omega_0 + \alpha t$

$= \alpha t \ (\because \omega_0 = 0)$ ...(ii)

Also, $\tau = I\alpha = fR = \mu MgR$

$\therefore \ \alpha = \frac{\mu MgR}{I}$ ...(iii)

From eq. (ii) and (iii)

$\omega = \frac{\mu MgR}{I}t$

For a sphere, $I = \frac{2}{5}MR^2$

$\therefore \ \omega = \frac{\mu MgR}{\frac{2}{5}MR^2}t = \frac{\mu gt}{\frac{2}{5}R}$

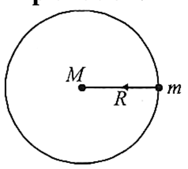
Hence, $R\omega = \frac{5}{2}\mu gt$

or $\mu gt = \frac{2}{5}R\omega = \frac{2}{5}V$

(For pure rolling, $V = R\omega$)

Putting in eq. (i), we have,
$V = V_0 - \frac{2}{5}V$
or $\frac{7}{5}V = V_0$
$V = \frac{5}{7}V_0$
V = V_0 + at = V_0 - μgt ...(i)
$\omega = \omega_0 + \alpha t = 0 + \alpha t$ ...(ii)
$\tau = I\alpha = \mu MgR$
$\therefore\ \alpha = \frac{\mu MgR}{I}$
For disc: $I = \frac{1}{2}MR^2$
$\therefore\ \alpha = \frac{\mu MgR}{\frac{1}{2}MR^2} = (4\mu g/R)$ ....(iii)
From eq. (ii) and (iii), $\omega = \frac{4\mu g}{R}t$
or $R\omega = 2\mu gt$
For pure rolling, $R\omega = V = 2\mu gt$
From eq. (i), $V = V_0 - \frac{V}{2}$
or $V = \frac{2}{3}V_0$

11.

(c) $T^2 \propto R$
Explanation:


According to the question, the mass density of a spherical galaxy varies as $\frac{k}{r}$.
Mass, $M = \int \rho dV$
$\Rightarrow M = \int_0^{r=R_0} \frac{k}{r} 4\pi r^2 dr \Rightarrow M = 4\pi k \int_0^{R_0} r dr$
or $M = \frac{4\pi k R_0^2}{2} = 2\pi k R^2$
$F_G = \frac{GMm}{R_0^2} = m\omega_0^2 R (= F_C)$
$\Rightarrow \frac{G\frac{4\pi kR^2}{2}}{R^2} = \omega_0^2 R \Rightarrow \omega_0 = \sqrt{\frac{2\pi KG}{R}} \left(\because \omega = \frac{2\pi}{T}\right)$
$\therefore T = \frac{2\pi}{\omega_0} = \frac{2\pi\sqrt{R}}{\sqrt{2\pi KG}} = \sqrt{\frac{2\pi R}{KG}} \Rightarrow T^2 = \frac{2\pi R}{KG}$
$\because 2\pi$, K and G are constants
$\therefore T^2 \propto R$

12. **(a)** $(\frac{1}{2})(EA\alpha t)(l\alpha t)$
Explanation:
Work done = Energy stored = $\frac{1}{2}\times$ Stress $\times$ Strain $\times$ Volume = $\frac{1}{2}\times$ (Eat) $\times$ (at) $\times$ Al

13.

(c) violet or indigo
Explanation:
According to Wien's law, higher the temperature of a star, the lower is the wavelength of maximum intensity radiation emitted from star hence violet or indigo has shortest wavelength. So stars appears as violet or indigo.

14.

(b) Cu
Explanation:
thermal resistance of Cu is lesser than the steel. So heat current is maximum in Cu.

15. **(a)** Only ii

Explanation:

Concept of entropy is associated with second law of thermodynamics.

16.

(b) $\frac{mv^2}{5R}$

Explanation:

$\frac{mv^2}{5R}$

17. **(a)** sinωt + cos ωt

Explanation:

A periodic function is one which repeats itself after a fixed internal of time. $e^{-\omega t}$, $\log_e(\omega t)$ and $e^{-\omega t}$ are either continuously increasing or decreasing.

sinωt + cos ωt

= sqrt(2) (sin ωt cos 45 + cos ωt sin 45)

= sqrt(2) sin(ωt + 45)

Hence, from the above equation we can say that it will repeat after fixed interval.

18.

(b) 5 f

Explanation:

The frequency obtained from a stretched wire = $\frac{n}{2l}\sqrt{\frac{T}{\mu}}$, where n is the harmonic, l = length of the wire, T is the tension and μ the mass per unit length.

The fundamental frequency, f = $\frac{1}{2l}\sqrt{\frac{T}{\mu}}$

If for the same wire, the tension is increased 25 times one gets a fundamental frequency 5 times the original frequency, i.e, 5 f

19.

(c) $\frac{\pi}{3}$

Explanation:

x = a sin $\left(\omega t+\frac{\pi}{6}\right)$

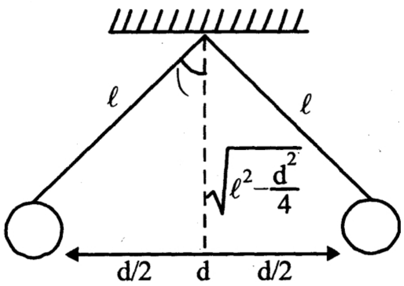
x' = a cos ωt = a sin $\left(\omega t+\frac{\pi}{2}\right)$

$\therefore$ Phase difference = ($\frac{\pi}{2}$) - ($\frac{\pi}{6}$) = ($\frac{\pi}{3}$)

20.

(d) d = $\left(\frac{q^2 l}{2\pi\varepsilon_0 mg}\right)^{\frac{1}{3}}$

Explanation:



T cos θ = mg ...(i)

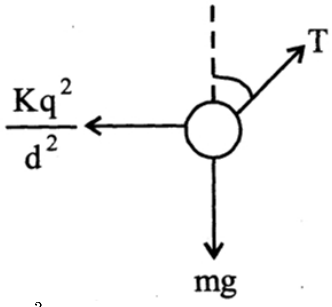
Force due to charges = $\frac{kq^2}{d^2}$

T sinθ = $\frac{kq^2}{d^2}$ ...(ii)

From (i) and (ii) we get

$\tan\theta = \frac{\frac{kq^2}{mg}}{m}$

as $\tan\theta \approx \sin\theta \approx \frac{d}{2\ell}$



$\frac{kq^2}{mgd^2} = \frac{d}{2\ell}$

$\Rightarrow d^3 = \frac{2kq^2\ell}{mg}$

$\Rightarrow d = \left(\frac{2kq^2\ell}{mg}\right)^{\frac{1}{3}} = \left(\frac{q^2\ell}{2\pi\varepsilon_0 mg}\right)^{\frac{1}{3}}$

21.

(d) -80 J/C

Explanation:

As we know, potential difference $V_A - V_O$ is

dV = -Edx

$\Rightarrow \int_{V_0}^{V_A} dV = -\int_0^2 30x^2 dx$

$V_A - V_O = -30 \times \left[\frac{x^3}{3}\right]_0^2$

$= -10 \times [2^3 - (0)^3]$

$= -10 \times 8 = -80$ J

22.

(b) 56%

Explanation:

Resistance, R = $\frac{\rho\ell}{A} = \frac{\rho\ell^2}{(\text{Vol.})}$ or $R \propto \ell^2$

or, $\frac{R_1}{R_2} = \frac{\ell_1^2}{\ell_2^2}$

As length increases 25%, if $\ell_1 = \ell$ then

$\ell_2 = \ell + \ell \times \frac{25}{100} = 1.25\ell$

$\therefore \frac{R}{R_2} = \frac{\ell^2}{(1.25\ell)^2}$ or, $R_2 = 1.5625$ R

$\therefore$ % increase in resistance R $\simeq$ 56%

23.

(b) 0.2 Am^2, 0.016 Nm

Explanation:

Magnetic moitient,

M = NIA

M = $1000 \times 1 \times 2 \times 10^{-4}$

M = 0.2 Am^2

Torque,

$\tau = MB\sin\theta$

$= 0.2 \times 0.16 \times \sin 30^o$

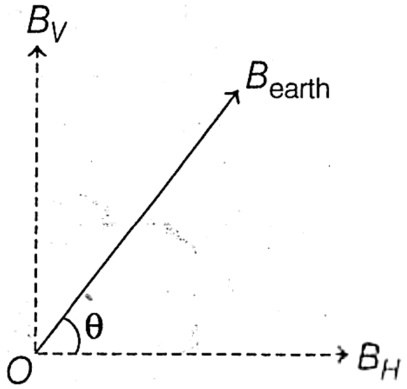
$= 0.032 \times \frac{1}{2}$
= 0.016 Nm

24.

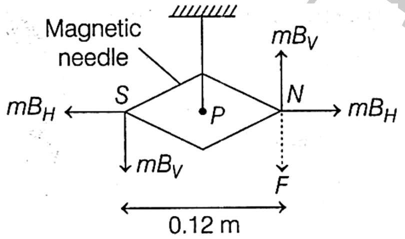
(c) high permeability and low hysteresis loss
Explanation:
high permeability and low hysteresis loss

25.

(b) 6.5×10^{-5} N
Explanation:
Without applied forces, (in equilibrium position) the needle will stay in the resultant magnetic field of the earth. Hence, the dip 'θ' at this place is 45^o (given).



We know that, horizontal and vertical components of earth's magnetic field (B_H and B_V) are related as
$\frac{B_V}{B_H} = \tan\theta$
Here, $\theta = 45^\circ$ and $B_H = 18 \times 10^{-6}$ T
$\Rightarrow B_V = B_H \tan 45^o$
$\Rightarrow B_V = B_H = 18 \times 10^{-6}$ T ($\because \tan 45^o = 1$)
Now, when the external force F is applied, so as to keep the needle stays in horizontal position is shown below,



Taking torque at point P, we get
$mB_V \times 2l = Fl$
$\therefore F = 2 \times mB_V$
Substituting the given values, we get
$= 2 \times 1.8 \times 18 \times 10^{-6}$
$= 6.48 \times 10^{-5} = 6.5 \times 10^{-5}$N

26.

(c) only iii
Explanation:
speed less than that of disc but in same direction

27.

(c) 2.5 s and 5.0 s
Explanation:

We have given, time period, 7 = 10s

∴ Angular velocity; $\omega = \frac{2\pi}{10} = \frac{\pi}{5}$

Magnetic flux, ϕ(t) = BA cos ωt

Emf induced, E = $\frac{-d\phi}{dt}$ = BAωsin ωt = BAωsin(ωt)

Induced emf, $|\varepsilon|$ is maximum when ωt = $\frac{\pi}{2}$

$\Rightarrow$ t = $\frac{\frac{\pi}{2}}{\frac{\pi}{5}}$ = 2.5 s

For induced emf to be minimum i.e zero

$\omega t = \pi$ $\Rightarrow$ t = $\frac{\pi}{\frac{\pi}{5}}$ = 5 s

∴ Induced emf is zero at t = 5 s

28. **(a)** increases

Explanation:

When the secondary coil circuit is open, the magnetic flux in the core is produced by the primary current only. Only when the secondary circuit is closed, the currents in the secondary coil also produce magnetic flux in the core but in the opposite direction. This decreases the core flux and hence reduces the back emf produced in the primary coil. The source emf is now in excess of the back emf; more current is drawn in the primary coil. Hence, the power factor is no longer zero. The power factor has increased or the phase difference is no longer 90°, i.e., phase difference has decreased. Thus, dynamic resistance has increased.

29.

(c) $\frac{kr}{2}$

Explanation:

$\oint \vec{E} \cdot \overrightarrow{dl} = -\frac{d\phi_B}{dt}$

or $E(2\pi r) = \frac{d}{dt}\left(kt \times \pi r^2\right)$

$\therefore \quad E = \frac{kr}{2}$

30.

(d) zero

Explanation:

In YDSE,

Path difference, Δx = dsinθ ...(i)

and phase difference, Δd = $\frac{2\pi}{\lambda}\Delta$x ...(ii)

For central maxima θ = 0

using equation (i) and (ii)

Δd = 0

31.

(b) 4

Explanation:

nth bright fringe of red light Coincides with (n+1)th bright fringe of green light

Distance of n^{th} bright fringe = x_n = $\left[\frac{(n\lambda D)}{(2d)}\right]$

$x_n = \left[\frac{(n\lambda_1 D)}{(2d)}\right]$,

Similarly $x_{(n+1)}$ = $\left[\frac{\{(n+1)\lambda_2 D\}}{(2d)}\right]$

x_n = x(n+1)

$\left[\frac{(n\lambda_1 D)}{(2d)}\right] = \left[\frac{\{(n+1)\lambda_2 D\}}{(2d)}\right]$

$\mathrm{n}\lambda_1 = (\mathrm{n}+1)\lambda_2$

$\left(\frac{\lambda_1}{\lambda_2}\right) = \left(\frac{(n+1)}{n}\right)$

$\left[\frac{(7500)}{(6000)}\right] = \left\{\frac{(n+1)}{n}\right\}$

$\frac{5}{4} = \left\{\frac{(n+1)}{n}\right\}$
n = 4

32.

(c) 15.1 volt

Explanation:

add explanation here

33.

(c) $\frac{-h}{|e|Et^2}$

Explanation:

Acceleration of electron in electric field, $a = \frac{eE}{m}$
Using equation
v = u + at $\Rightarrow v = 0 + \frac{eE}{m}t$
$\Rightarrow v = \frac{eEt}{m}$ ...(i)
De-broglie wavelength λ is given by
$\lambda = \frac{h}{mv} = \frac{h}{m\left(\frac{eEt}{m}\right)} \Rightarrow \lambda = \frac{h}{eEt}$ [using (i)]
Differentiating w.r.t. t
$\frac{d\lambda}{dt} = \frac{d\left(\frac{h}{eEt}\right)}{dt} \Rightarrow \frac{d\lambda}{dt} = \frac{-h}{eEt^2}$

34.

(b) Spectral lines

Explanation:

Bohr’s model explains the spectral lines of the hydrogen atomic emission spectrum. When the atom absorbs one or more quanta of energy, the electron moves from the ground state orbit to an excited state orbit that is further away. Energy levels are designated with the variable.

35.

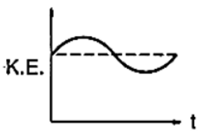
(c) 2×10^{11}

Explanation:

As we know that,
Power $= \frac{\text{Energy released per fission}}{\text{Time for one fission}}$
$P = \frac{E}{T}$
= Ef
where, f = frequency
= No. of fissions per second
$f = \frac{P}{E}$
= $\frac{6.4}{200 \times 10^6 \times 1.6 \times 10^{-19}}$
= $\frac{6.4}{200 \times 1.6 \times 10^{-13}}$
f = 2×10^{11} per second

PHYSICS (Section-B)

36.

(c) 

Explanation:

As the earth moves around the sun in its elliptical orbit, its KE is maximum when it is closest to the sun and minimum when it is farthest from the sun. As KE is never zero, during its motion.

37.

(b) will decrease approximately by 0.67%

Explanation:

Let R = radius of the sphere,
M = mass of the sphere,
V = volume of the sphere,
ω = angular velocity of the sphere and
L = angular momentum
then $L = I\omega$
But, $I = \frac{2}{5}MR^2$
$\therefore \quad L = \frac{2}{5}MR^2\omega$
Now, $V = \frac{4}{3}\pi R^3$
$\therefore \quad R = \left(\frac{3V}{4\pi}\right)^{1/3}$
Hence, $L = \frac{2}{5}M\left(\frac{3V}{4\pi}\right)^{2/3}\omega$
or $\omega = \frac{5}{2}\left(\frac{L}{M}\right)\left(\frac{4\pi}{3V}\right)^{2/3}$
$= \frac{5}{2}\left(\frac{L}{M}\right)\left(\frac{4\pi}{3}\right)^{2/3}(V)^{-2/3}$
L and M do not change with temperature.
$\therefore \quad \omega \propto V^{-2/3}$
or $\omega = KV^{-2/3}$
where K is a constant.
Now, $\log\omega = \log K - \frac{2}{3}\log V$
Differentiating, $\frac{d\omega}{\omega} = -\frac{2}{3}\frac{dV}{V}$
$\therefore \quad \frac{d\omega}{\omega} \times 100 = -\frac{2}{3}\left(\frac{dV}{V} \times 100\right)$
Now, $\frac{dV}{V} \times 100 = +1$
$\therefore \quad \frac{d\omega}{\omega} \times 100 = -\frac{2}{3} \times 1$ = -0.67%

38.

(c) 6.4 $\times$ 10^{10} Joules

Explanation:

The required energy for this work is $= \frac{GMm}{R}$
$= gR^2 \times \frac{m}{R}\left(\because g = \frac{GM}{R^2}\right)$
$= mgR$
$= 1000 \times 10 \times 6400 \times 10^3$
$= 64 \times 10^9\text{J} = 6.4 \times 10^{10}\text{J}$

39. **(a)** 75.23 cm

Explanation:

$\Delta L = \alpha L\left(\theta_2 - \theta_1\right)$ = 18 $\times$ 10^{-6} $\times$ 75.2 $\times$ 20 = 0.027 = 0.03
The correct value = 75.2 + 0.03 = 75.23 cm

40.

(b) Both air and water

Explanation:

Longitudinal waves like sound require a material medium.

41.

(b) 5000 Hz

Explanation:

Frequency of the echo detected by the driver is

$v' = \left(\frac{v+v_s}{v-v_s}\right)\nu = \left(\frac{330+220}{330-220}\right) \times$ 1000 Hz = 5000 Hz

42.

(c) 0, BIl

Explanation:

F = IBl sin θ

Since, PQ is || to the direction of magnetic field, θ = 0°

F_{PQ} = BIl sin 0° = 0

Since, QR is perpendicular to the direction of magnetic field,

θ = 90°

F_{QR} = BIl sin 90° = BIl

43.

(d) 0.8×10^7erg

Explanation:

W = $MB(\cos\theta_1 - \cos\theta_2)$

When the magnet is rotated from 0^o to 60^o, then work done is 0.8 J.

0.8 = $MB(\cos 0^\circ - \cos 60^\circ) = \frac{MB}{2}$

$\therefore$ MB = 1.6 N-M

In order to rotate the magnet through an angle of 30°, i.e., from 60° to 90°, the work done is,

$W' = MB(\cos 60^\circ - \cos 90^\circ) = MB\left(\frac{1}{2} - 0\right)$

$= \frac{MB}{2} = \frac{1.6}{2}$ = 0.8 J = 0.8 $\times$ 10^7 erg

44.

(c) Zero

Explanation:

When the wire is allowed to move with a constant velocity in the uniform magnetic field, there occurs no change in magnetic flux w.r.t. time, hence no emf is developed across the wire and no force is required to move it.

45.

(c) $(\frac{1}{R})\sqrt{\frac{L}{C}}$

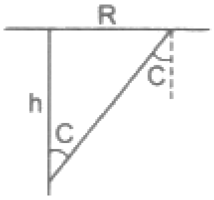
Explanation:

$(\frac{1}{R})\sqrt{\frac{L}{C}}$

46.

(b) $\frac{3}{\sqrt{7}}$ h

Explanation:



$\frac{\sin 90^\circ}{\sin C}$ = μ

sin C = $\frac{1}{\mu}$ or $\frac{R}{\sqrt{R^2+h^2}}$ = $\frac{3}{4}$

Squaring on both sides,

$16R^2 = 9R^2 + 9h^2$

$7R^2 = 9h^2$ or $R = \frac{3}{\sqrt{7}}h$

47.

(d) Total internal reflection

Explanation:

Critical angle will be,

$\sin^{-1}(1/4.5) = 41.8^o$

The angle of incidence inside the prism will be 45^o. This angle is more than the critical angle, hence the light ray will undergo total internal reflection.

48.

(c) $\frac{2E}{c}$

Explanation:

We have, $\frac{hc}{\lambda}$ = E and p = $\frac{h}{\lambda}$

For perfectly reflecting surface, momentum transferred = 2p = $2\frac{h}{\lambda} = \frac{2E}{c}$

49. **(a)** Balmer series is in the visible region (partly)

Explanation:

As Balmer series lies in the visible region (partly) of the electromagnetic spectrum corresponds to the emissions of photons by the electrons in excited states transitioning to the quantum level which is described by the principal quantum number (n) equal to 2.

50. **(a)** production of more neutrons during fission

Explanation:

Due to the production of neutrons, a chain of nuclear fission is established which continues until the whole of the source substance is consumed.