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Answer & Solutions

for

NEET 2022 (Re-Exam)

Physics

1. An energy of 484 J is spent in increasing the speed of a flywheel from 60 rpm to 360 rpm. The moment of inertia of the flywheel is

(1) 0.07 kg-m^2 (2) 0.7 kg-m^2

(3) 3.22 kg-m^2 (4) 30.8 kg-m^2

Sol. Answer (2)

$$\omega_i = 60rpm = 60\times\frac{2\pi}{60} = 2\pi\ rad/5$$

$$\omega_f = 360rpm = 360\times\frac{2\pi}{60} = 12\pi\ rad/5$$

Energy spent = $\Delta kE = \frac{1}{2}I\left(\omega_f{}^2 - \omega_i{}^2\right)$

$$486 = \frac{1}{2}\times I\times\left[(12\pi)^2 - (2\pi)^2\right]$$

$$I = \frac{2\times 486}{140\pi^2} \approx 0.7kg - m^2$$

2. Let R_1 be the radius of the second stationary and R_2 be the radius of the fourth stationary orbit of an electron in Bohr's model. The ratio $\frac{R_1}{R_2}$ is :

(1) 4 (2) 0.25

(3) 0.5 (4) 2

Sol. Answer (2)

$$R = 0.529\times\frac{n^2}{z}\overset{0}{A}$$

$$\frac{R_1}{R_2} = \frac{2^2}{4^2} = \frac{1}{4}$$

3. During a cloudy day, a primary and a secondary rainbow may be created, then the :

(1) secondary rainbow is due to single reflection and is formed above the primary one.

(2) primary rainbow is due to double internal reflection and is formed above the secondary one,

(3) primary rainbow is due to double internal reflection and is formed below the secondary one.

(4) secondary rainbow is due to double internal reflection and is formed above the primary one.

Sol. Answer (4)

Primary rainbow is formed due to 1st TIR while secondary rainbow is formed after 2nd TIR.

Secondary rainbow form above the primary rainbow

4. The reciprocal of resistance is :

(1) conductance (2) reactance

(3) mobility (4) conductivity

Sol. Answer (1)

5. Two copper vessels A and B have the same. base area but of different shapes. A take twice the volume of water as that B requires to fill upto a particular common height. Then the correct statement among the following is: ,

(1) Vessel B weighs twice that of A.

(2) Pressure on the base area of vessels A and B is same.

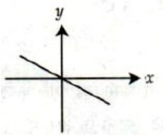
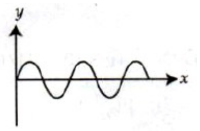
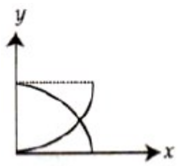
(3) Pressure on the base area of A and B is not same.

(4) Both vessels A and B weigh the same.

Sol. Answer (2)

Since water is filled upto same height so pressure at the bottom will be same.

6. Match List - I with List - II:

List - I (x-y graphs)	**List-II (Situations)**
(a) 	(i) Total mechanical energy is conserved
(b) 	(ii) Bob of a pendulum is oscillating under negligible air friction
(c) 	(iii) Restoring force of a spring
(d) 	(iv) Bob of a pendulum is oscillating along with air friction

Choose the correct answer from the options given below:

(1) (a) - (iii), (b) - (ii), (c) - (i), (d) - (iv)

(2) (a) - (iv), (b) - (ii), (c) - (iii), (d) - (i)

(3) (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)

(4) (a) - (i), (b) - (iv), (c) - (iii), (d) - (ii)

Sol. Answer (3)

Graph (a) represents damped oscillation

$a \longrightarrow$ (iv)

Graph (b) represents restoring force of spring

$F = -kx$

$b \longrightarrow$ (iii)

Graph (c) represents undamped oscillations

$c \longrightarrow$ (ii)

Graph (d) represents total mechanical energy conservation

$d \longrightarrow$ (i)

7. The distance covered by a body of mass 5 g having linear momentum 0.3 kg m/s in 5 s is:

(1) 0.3 m (2) 300 m

(3) 30 m (4) 3 m

Sol. Answer (2)

$P = mv$

$0.3 = \frac{5}{1000} \times v \Rightarrow v = 60\ m/s$

Distance travelled in 5s = 60 × 5

= 300 m

8. The distance between the two plates of a parallel plate capacitor is doubled and the area of each plate is halved. If C is its initial capacitance, its final capacitance is equal to:

(1) $\frac{C}{4}$ (2) 2 C

(3) $\frac{C}{2}$ (4) 4 C

Sol. Answer (1)

$C = \frac{A\varepsilon_0}{d}$

$C' = \frac{\frac{A}{2}\varepsilon_0}{2d} = \frac{C}{4}$

9. A closely packed coil having 1000 turns has an average radius of 62.8 cm. If current carried by

62.8 cm the wire of the coil is 1 A the value of magnetic field produced at the centre of the coil will be (permeability of free space = $4\pi \times 10^{-7}$ H/m) nearly .

(1) 10^{-3} T (2) 10^{-1} T

(3) 10^{-2} T (4) 10^{2} T

Sol. Answer (1)

$B = \frac{\mu_0 nI}{2R}$

$= \frac{4\pi \times 10^{-7} \times 1000 \times 1}{2 \times 62.8 \times 10^{-2}}$

$10^{-3} T$

10. The magnetic field of a plane electromagnetic wave is given by

$\vec{B} = 3 \times 10^{-5} \cos(1.6 \times 10^{3} x + 48 \times 10^{10} t)\hat{j}$,

then the associated electric field will be:

(1) $9\cos(1.6\times10^{3}x+48\times10^{10}t)\hat{k}\ V/m$

(2) $3\times10^{-8}\cos(1.6\times10^{3}x+48\times10^{10}t)\hat{i}\ V/m$

(3) $3\times10^{-8}\sin(1.6\times10^{3}x+48\times10^{10}t)\hat{i}\ V/m$

(4) $9\sin(1.6\times10^{3}x-48\times10^{10}t)\ \hat{k}\ V/m$

Sol. Answer (1)

$\frac{E_0}{B_0}=C\Rightarrow E_0=B_0C$

$= 3\times10^{-8}\times3\times10^{8}$

$= 9\ v/m$

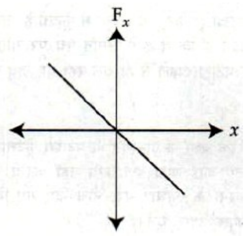
Phase of magnetic and electric field is same of travelling EM wave

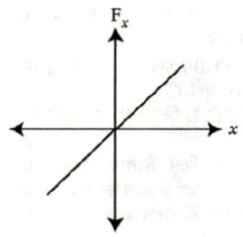
$\hat{E}=\hat{B}\times\hat{C}$

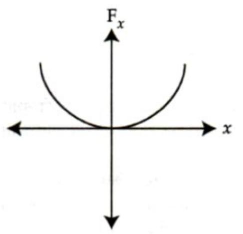
$=\hat{j}\times(-\hat{i})=\hat{k}$

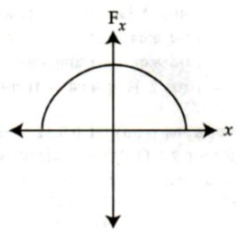
$\vec{E}=9\cos(1.6\times10^{3}x+48\times10^{10}t)\hat{k}\ v/m$

11. The restoring force of a spring with a block attached to the free end of the spring is represented by

(1)


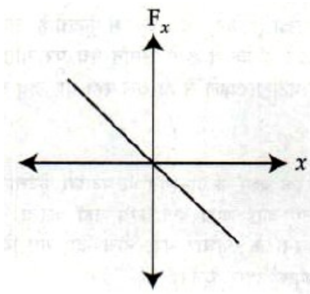
(2)


(3)


(4)


Sol. Answer (1)

$F = -kx$



12. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) :

When a fire cracker (rocket) explodes in mid air, its fragments fly in such a way that they continue moving in the same path, which the fire cracker would have followed, had it not exploded.

Reason (R) :

Explosion of cracker (rocket) occurs due to internal forces only and no external force acts for this explosion.

In the light of the above statements, choose the most appropriate answer from the options given below

(1) (A) is not correct but (R) is correct

(2) Both (A) and (R) are correct and (R) is the correct explanation of (A)

(3) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

(4) (A) is correct but (R) is not correct

Sol. Answer (1)

CoM of rocket follows the same path not the fragments. It is because the explosion takes place due to internal forces.

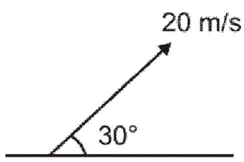
13. A cricket ball is thrown by a player at a speed of 20 m / s in a direction 30° above the horizontal. The maximum height attained by the ball during its motion is .

(g = 10 m/s^2)

(1) 25 m (2) 5 m

(3) 10 m (4) 20 m

Sol. Answer (2)



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

$= 5\ m$

14. Given below are two statements .

Statement I :

In an ac circuit, the current through a capacitor leads the voltage across it.

Statement II :

In a.c circuits containing pure capacitance only, the phase difference between the current and the voltage is π.

In the light of the above statements, choose the most appropriate answer from the options given below

(1) Statement I is incorrect but Statement II is correct

(2) Both Statement and Statement II are correct

(3) Both Statement I and Statement II are incorrect

(4) Statement I is correct but Statement II is incorrect

Sol. Answer (4)

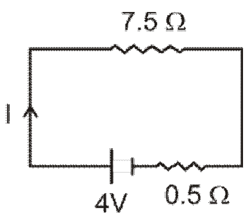
In AC circuit current through the capacitor leads the potential difference across it by a phase $\frac{\pi}{2}$.

15. A cell of emf 4 V and internal resistance 0.5 Ω is connected to a 7.5 Ω external resistance. The terminal potential difference of the cell is .

(1) 0.375 V (2) 3.75 V

(3) 4.25 V (4) 4 V

Sol. Answer (2)



$$I = \frac{4}{7.5 + 0.5}$$

$= 0.5\ A$

Terminal voltage = $E - ir$

= $4 - 0.5 \times 0.5$

= 3.75 V

16. An ideal gas follows a process described by the equation $PV^2 = C$ from the initial (P_1, V_1, T_1) to final (P_2, V_2, T_2) thermodynamic states, where C is a constant. Then :

(1) If $P_1 > P_2$ then $V_1 > V_2$

(2) If $P_1 > P_2$ then $T_1 < T_2$

(3) If $V_2 > V_1$ then $T_2 > T_1$

(4) If $V_2 > V_1$ then $T_2 < T_1$

Sol. Answer (4)

$$PV^2 = C \Rightarrow TV = \text{const and } \frac{T^2}{P} = \text{const}$$

$$P\uparrow \Rightarrow V\downarrow \qquad T\uparrow \Rightarrow V\downarrow \qquad T\uparrow = P\uparrow$$

$$P_1 > P_2 \Rightarrow V_2 > V_1 \quad V_2 > V_1 \Rightarrow T_1 > T_2 \quad P_1 > P_2 = T_1 > T_2$$

17. The shape of the magnetic field lines due to an infinite long, straight current carrying conductor is :

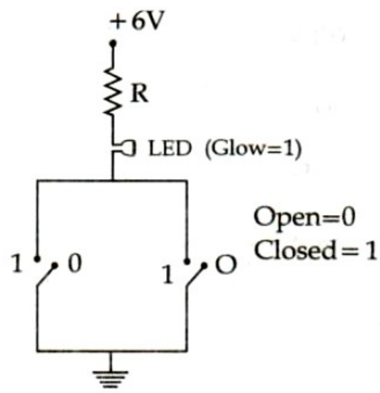
(1) a plane (2) a straight line

(3) circular (4) elliptical

Sol. Answer (3)

For infinite current carrying conductor MF lines are concentric circles.

18.



Identify the equivalent logic gate represented by the given circuit :

(1) NAND (2) OR

(3) NOR (4) AND

Sol. Answer (2)

When both inputs given as "O" means open circuit, no current flows throw LED means "O".

If the inputs given as 0, 1 & 1, 0 & 1, 1 current flows throw LED, it means "I".

Truth table same as "OR" gate.

19. The light rays having photons of energy 4.2 eV are falling on a metal surface having a work function of 2.2 eV. The stopping potential of the surface is :

(1) 6.4 V (2) 2 eV

(3) 2 V (4) 1.1 V

Sol. Answer (3)

Given $hv = 4.2\ eV$

$w = 2.2\ eV$

$V_s = ?$

By Einstein's equation

$$hv = w + eV_s$$

$$4.2eV = 2.2eV + e \times V_s$$

$$2eV = eV_s$$

$$2 \times 1.6 \times 10^{-19} = 1.6 \times 10^{-19} \times V_s$$

$$V_s = 2v$$

20. Identify the function which represents a non periodic motion.

(1) $\sin(\omega t + \pi/4)$ (2) $e^{-\omega t}$

(3) $\sin \omega t$ (4) $\sin \omega t + \cos \omega t$

Sol. Answer (2)

Periodic motion is represented by sin & cosine (harmonic functions) functions.

$e^{-\omega t}$ is not harmonic function

21. An inductor of inductance 2 mH is connected to a 220 V, 50 Hz a.c. source. Let the inductive reactance in the circuit is X_1. If a 220 V dc source replaces the ac source in the circuit, then the inductive reactance in the circuit is X_2. X_1 and X_2 respectively are

(1) 0.628 Ω, infinity (2) 6.28 Ω, zero

(3) 6.28 Ω, infinity (4) 0.628 Ω, zero

Sol. Answer (4)

Given $L = 2mH, \quad f = 50Hz$

when A. C. source is applied

$$X_1 = wL = 2\pi\ fL$$

$$= 2\pi \times 50 \times 2 \times 10^{-3}$$

$$= .628\ \Omega$$

when D. C. source is applied

$$X_2 = wL = 2\pi f\, L$$

$(\because f = 0)$

$$X_2 = 0$$

22. The ratio of the magnitude of the magnetic field and electric field intensity of a plane electromagnetic wave in free space of permeability μ_0 and permittivity ε_0 is (Given that C - velocity of light in free space)

(1) $\dfrac{\sqrt{\mu_0 \varepsilon_0}}{c}$ (2) c

(3) $\dfrac{1}{c}$ (4) $\dfrac{c}{\sqrt{\mu_0 \varepsilon_0}}$

Sol. Answer (3)

We know $|E| = C|B|$

$$\Rightarrow \frac{|B|}{|E|} = \frac{1}{C}.$$

23. The threshold frequency of a photoelectric metal is ν_0. If light of frequency 4 ν_0 is incident on this metal, then the maximum kinetic energy of emitted electrons will be

(1) 4 $h\nu_0$ (2) $h\nu_0$

(3) 2 $h\nu_0$ (4) 3 $h\nu_0$

Sol. Answer (4)

Given $v = 4v_0$

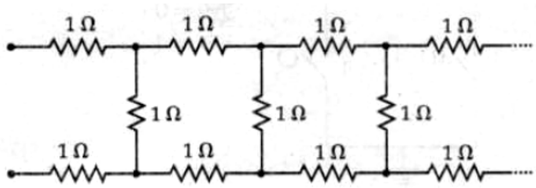
By photo electric equation

$$hv = hv_0 + K.E_{\max}$$

$$h \times 4v_0 = hv_0 + K.E_{\max}$$

$$K.E_{\max} = 3hv_0$$

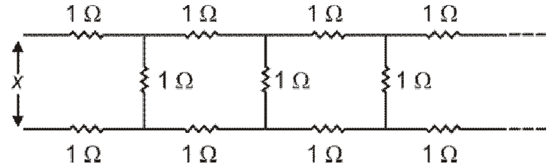
24. The equivalent resistance of the infinite network given below is :

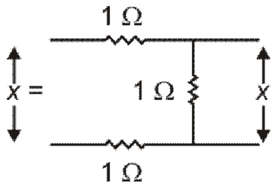


(1) $\left(1+\sqrt{5}\right)\Omega$ (2) 2 Ω

(3) $\left(1+\sqrt{2}\right)\Omega$ (4) $\left(1+\sqrt{3}\right)\Omega$

Sol. Answer (4)





By removing repeated part of *Ckt*

$\Rightarrow \dfrac{x \times 1}{x+1} + 2 = x$

$\Rightarrow x^2 - 2x - 2 = 0$

$\Rightarrow x = \dfrac{2 \pm 2\sqrt{3}}{2}$

$\Rightarrow x = 1 + \sqrt{3}$ (By neglecting –ve resistance)

25. If the screen is moved away from the plane of the slits in a Young's double slit experiment, then the :

(1) linear separation of the fringes decreases

(2) angular separation of the fringes increases

(3) angular separation of the fringes decreases

(4) linear separation of the fringes increases

Sol. Answer (4)

We know fringe width

$B = \dfrac{\lambda D}{d}.$

As D increases B increases.

i.e., Linear separation of fringes increases.

26. If $\vec{F} = 2\hat{i} + \hat{j} - \hat{k}$ and $\vec{r} = 3\hat{i} + 2\hat{j} - 2\hat{k}$, then the scalar and vector products of $\vec{F}$ and $\vec{r}$ have the magnitudes respectively as :

(1) 10, 2 (2) 5, $\sqrt{3}$

(3) 4, $\sqrt{5}$ (4) 10, $\sqrt{2}$

Sol. Answer (4)

Given $\vec{F} = 2\hat{i} + \hat{j} - \hat{k}$, $\vec{r} = 3\hat{i} + 2\hat{j} - 2\hat{k}$,

Scalar product = $\vec{F}.\vec{r}$

$= 2 \times 3 + 1 \times 2 + (-1) \times (-2)$

$= 6 + 2 + 2 = 10$

Vector product = $\vec{F} \times \vec{r}$

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 1 & -1 \\ 3 & 2 & -2 \end{vmatrix} = \hat{i}(-2+2) - \hat{j}(-4+3) + \hat{k}(4-3)$$

$\vec{F} \times \vec{r} = \hat{j} + \hat{k}$

$|\vec{F} \times \vec{r}| = \sqrt{2}$

27. Given below are two statements:

Statement I: The law of radioactive decay states that the number of nuclei undergoing the decay per unit time is inversely proportional to the total number of nuclei in the sample.

Statement II : The half life of a radionuclide is the sum of the life time of all nuclei, divided by the initial concentration of the nuclei at time $t = 0$.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Statement **I** is incorrect but Statement **II** is correct

(2) Both Statement **I** and Statement **II** are correct

(3) Both Statement **I** and Statement **II** are incorrect

(4) Statement **I** is correct but Statement **II** is incorrect

Sol. Answer (3)

According to Radioactive decay law,

$-\dfrac{dN}{dt} \propto N$ ($\Rightarrow$ Rate is directly proportional)

Half life is the duration in which half of the active nuclei decayed.

28. The physical quantity that has the same dimensional formula as pressure is:

(1) Coefficient of viscosity

(2) Force

(3) Momentum

(4) Young's modulus of elasticity

Sol. Answer (4)

Pressure = $\dfrac{F}{A}$

$[P] = \dfrac{MLT^{-2}}{L^2} = ML^{-1}T^{-2}$

Young's modulus Y = $\dfrac{\text{Stess}}{\text{Strain}}$

$$[Y] = \frac{\frac{F}{A}}{\frac{\Delta L}{L}} = \frac{MLT^{-2}}{L^2} = ML^{-1}T^{-2}$$

29. The effective capacitances of two capacitors are 3 μF and 16 μF, when they are connected in series and parallel respectively. The capacitance of two capacitors are:

(1) 1.2 μF, 1.8 μF

(2) 10 μF, 6 μF

(3) 8 μF, 8 μF

(4) 12 μF, 4 μF

Sol. Answer (4)

Let the capacitances are C_1 and C_2

In series C_{eff} = 3 μF

$$\Rightarrow \frac{C_1C_2}{C_1+C_2} = 3\mu F \quad ..... (i)$$

In parallel C_{eff} = 16 μF

$$\Rightarrow C_1 + C_2 = 16\ \mu F \quad ....(ii)$$

From (i) & (ii)

$$C_1C_2 = 48\ \mu F$$

$$(C_1 - C_2)^2 = (C_1 + C_2)^2 - 4C_1C_2$$

$$C_1 - C_2 = 8\ \mu F \quad ....(iii)$$

From (ii) & (iii)

$$C_1 = 12\ \mu F, C_2 = 4\ \mu F$$

30. After passing through a polariser a linearly polarised light of intensity I is incident on an analyser making an angle of 30° with that of the polariser. The intensity of light emitted from the analyser will be:

(1) $\frac{2I}{3}$ (2) $\frac{I}{2}$

(3) $\frac{I}{3}$ (4) $\frac{3I}{4}$

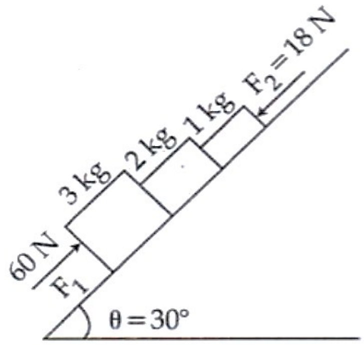
Sol. Answer (4)

By law of Malus, Intensity after analyser

$$I' = I\cos^2 30^\circ = I \times \frac{3}{4}$$

$$I' = \frac{3I}{4}$$

31. In the diagram shown, the normal reaction force between 2 kg and 1 kg is (Consider the surface, to be smooth) : Given g=10 ms^{-2}



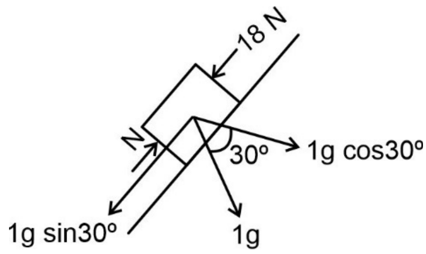
(1) 10 N (2) 25 N

(3) 39 N (4) 6N

Sol. Answer (2)

$$a = \frac{\text{Net pulling force}}{M_{total}} \quad \text{(up the inclined)}$$

$$a = \frac{60 - 18 - (3+2+1)\,g\,\sin 30^\circ}{3+2+1} = \frac{12}{6} = 2\ \text{m/s}^2$$



By taking F.B.D. of 1 kg

$$ma = N - 18 - 1 \times 10 \times \frac{1}{2}$$

$$\Rightarrow 2 = N - 23$$

$$\Rightarrow N = 25\ \text{N}$$

32. The incorrect statement about the property of a Zener diode is:

(1) p and n regions of zener diode are heavily doped

(2) Zener voltage remains constant at breakdown

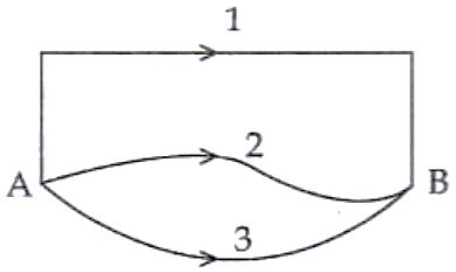
(3) It is designed to operate under reverse bias

(4) Depletion region formed is very wide

Sol. Answer (4)

Depletion region of Zener diode is not very wide.

33. A gravitational field is present in a region and a mass is shifted from A to B through different paths as shown. If W_1 W_2 and W_3 represent the work done by the gravitational force along the respective paths, then:



(1) $W_1 < W_2 < W_3$

(2) $W_1 = W_2 = W_3$

(3) $W_1 > W_2 > W_3$

(4) $W_1 > W_3 > W_2$

Sol. Answer (2)

Gravitational force is a conservative force work done by conservative force is path independent.

Hence, $\therefore W_1 = W_2 = W_3$

34. A standard filament lamp consumes 100 W when connected to 200 V ac mains supply. The peak current through the bulb will be:

(1) 2 A (2) 0.707 A

(3) 1A (4) 1.414

Sol. Answer (2)

Given, P = 100 W

V_{rms} = 200 V

$i_{rms} = \frac{P}{v_{rms}} = \frac{1}{2}$

$i_0 = i_{rms} \times \sqrt{2} = \frac{1}{\sqrt{2}}$

$i_0 = 0.707$ A

35. A The terminal velocity of a copper ball of radius 5 mm falling through a tank of oil at room temperature is 10 cm s^{-1}. If the viscosity of oil at room temperature is 0.9 kg $m^{-1}s^{-1}$, the viscous drag force is:

(1) 4.23×10^{-6} N

(2) 8.48×10^{-3} N

(3) 8.48×10^{-5} N

(4) 4.23×10^{-3} N

Sol. Answer (2)

Given, r = 5 mm = 5×10^{-3} m

V_t = 10 cm s^{-1} = 10×10^{-2} $m^{-1}s$

Viscous drag force

$F = 6\pi\eta r V_t$

$F = 6 \times \pi \times 0.9 \times 5 \times 10^{-3} \times 10 \times 10^{-2}$

$F = 84.78 \times 10^{-4}$

$F = 8.478 \times 10^{-3}$ N

36. In a gravitational field, the gravitational potential is given by, $V = -\frac{K}{x}$ (J/kg).

The gravitational field intensity at point (2, 0, 3)m is :

(1) $+\frac{K}{4}$ (2) $+\frac{K}{2}$

(3) $-\frac{K}{2}$ (4) $-\frac{K}{4}$

Sol. Answer (4)

$v(x) = -\frac{K}{x}$

$E_g = -\frac{dv}{dx} = -\frac{d}{dx}\left(\frac{-k}{x}\right)$

$\vec{E}_g = -\frac{K}{x^2}\hat{i}$

Now $|\vec{E}_g(2,0,3)| = \frac{-K}{(2)^2} = \frac{-K}{4}$

37. The percentage error in the measurement of g is :

(Given that $g = \frac{4\pi^2 L}{T^2}$, L = (10 ± 0.1) cm,

T = (100 ± 1) s)

(1) 7% (2) 2%

(3) 5% (4) 3%

Sol. Answer (4)

$g = \frac{4\pi^2 L}{T^2}$

$\frac{\Delta g}{g} \times 100 = \frac{\Delta L}{L} \times 100 + 2\frac{\Delta T}{T} \times 100$

$= \left(\frac{0.1}{10} \times 100\right) + 2\left[\frac{1}{100} \times 100\right]$

$\frac{\Delta g}{g} \times 100 = 1 + 2 = 3\%$

38. Two very long, straight, parallel conductors A and B carry current of 5 A and 10 A respectively and are at a distance of 10 cm from each other. The direction of current in two conductors is same. The force acting per unit length between two conductors is: ($\mu_0 = 4\pi \times 10^{-7}$SI unit)

(1) 1×10^{-4} Nm^{-1} and is repulsive

(2) 2×10^{-4} Nm^{-1} and is attractive

(3) 2×10^{-4} Nm^{-1} and is repulsive

(4) 1×10^{-4} Nm^{-1} and is attractive

Sol. Answer (4)

Two parallel wires carrying current in same direction will attract each other.

$$\frac{F}{l} = \frac{\mu_0 i_1 i_2}{2\pi d} = \frac{2\times 10^{-7} \times 5\times 10}{10\times 10^{-2}} = 10^{-4} \text{ N/m}$$

39. The magnetic field on the axis of a circular loop of radius 100 cm carrying current $\mathrm{I} = \sqrt{2}$ A, at point 1 m away from the centre of the loop is given by:

(1) 6.28×10^{-4} T

(2) 3.14×10^{-7} T

(3) 6.28×10^{-7}T

(4) 3.14×10^{-4} T

Sol. Answer (2)

On axis of wire B = $\dfrac{\mu_0 I R^2}{2(R^2 + x^2)^{3/2}}$

$$= \frac{4\pi \times 10^{-7} \times \sqrt{2} \times 1^2}{2(1^2 + 1^2)^{3/2}}$$

$$= \frac{4\pi \times 10^{-7} \times \sqrt{2}}{2\times 2\sqrt{2}} = \pi \times 10^{-7} \text{ T}$$

$$= 3.14 \times 10^{-7} \text{ T}$$

40. At any instant, two elements X_1 and X_2 have same number of radioactive atoms. If the decay constant of X_1 and X_2 are 10 λ and λ respectively, then thetime when the ratio of their atoms becomes $\dfrac{1}{e}$ respectively will be :

(1) $\dfrac{1}{5\lambda}$

(2) $\dfrac{1}{11\lambda}$

(3) $\dfrac{1}{9\lambda}$

(4) $\dfrac{1}{6\lambda}$

Sol. Answer (3)

$$N_x = N_0 e^{-\lambda_x t}$$

$$N_y = N_0 e^{-\lambda_y t}$$

$$\frac{N_x}{N_y} = e^{-(\lambda_x - \lambda_y)t}$$

$$\frac{1}{e} = e^{-(\lambda_x - \lambda_y)t}$$

$$\Rightarrow e^{-1} = e^{-(\lambda_x - \lambda_y)t}$$

$$(\lambda_x - \lambda_y)t = 1$$

$$t = \frac{1}{\lambda_x - \lambda_y} = \frac{1}{10\lambda - 1\lambda} = \frac{1}{9\lambda}$$

41. Two rods one made of copper and other made of steel of the same length and same cross sectional area are joined together. The thermal conductivity of copper and steel are 385 J $s^{-1}K^{-1}m^{-1}$ and 50 J $s^{-1}K^{-1}m^{-1}$ respectively. The free ends of copper and steel are held at 100°C and 0°C respectively. The temperature at the junction is, nearly:

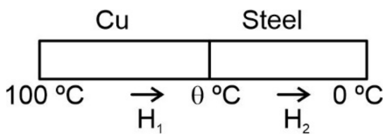
(1) 88.5°C

(2) 12°C

(3) 50°C

(4) 73°C

Sol. Answer (1)



$H_1 = H_2$

$$\frac{K_{Cu}A[100-\theta]}{l} = \frac{K_{steel}A[\theta - 0]}{l}$$

$$385\,[100-\theta] = 50\,[\theta - 0]$$

$\Rightarrow \theta = 88.5$ ºC [junction temperature]

42. The ratio of Coulomb's electrostatic force to the gravitational force between an electron and a proton separated by some distance is 2.4×10^{39}. The ratio of the proportionality constant, $K = \dfrac{1}{4\pi\varepsilon_0}$ to the Gravitational constant G is nearly (Given that the charge of the proton and electron each=1.6×10^{-19} C, the mass of the electron=9.11×10^{-31} kg, the mass of the proton=1.67×10^{-27} kg) :

(1) 10

(2) 10^{20}

(3) 10^{30}

(4) 10^{40}

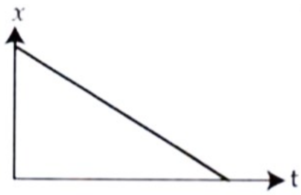
Sol. Answer (2)

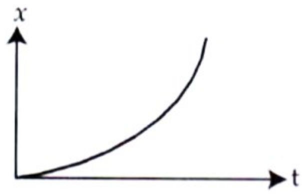
$$\frac{F_G}{F_G} = \frac{\dfrac{kq_1q_2}{r^2}}{\dfrac{Gm_1m_2}{r^2}} = \frac{k}{G}\frac{(1.6\times 10^{-19})^2}{(1.67\times 9.11)\times 10^{-58}}$$

$$2.4\times10^{39} = \frac{k}{G}\frac{1.6\times1.6\times10^{-38}}{(1.67\times9.11)\times10^{-58}}$$

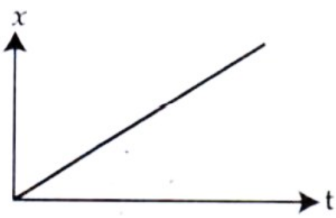
$$\frac{k}{G}\approx10^{20}$$

43. The position-time (x–t) graph for positive acceleration is :

(1)


(2)


(3)

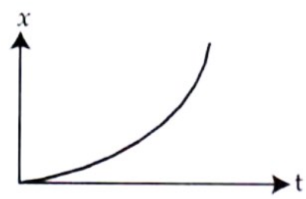

(4)


Sol. Answer (2)

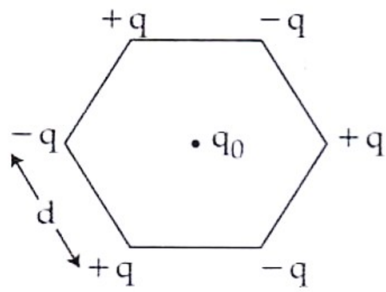
+ve acceleration

$\frac{dv}{dt}>0$ so, velocity is increasing

$\Rightarrow$ slop of x-t graph is increasing

$\therefore$


44. Six charges +q, –q, +q, –q, +q and –qare fixed at the corners of a hexagon of side d as shown in the figure. The work done in bringing a charge q_0 to the centre of the hexagon from infinity is : (ε_0 - permittivity of free space)



(1) $\frac{-q^2}{4\pi\varepsilon_0 d}\left(6-\frac{1}{\sqrt{2}}\right)$

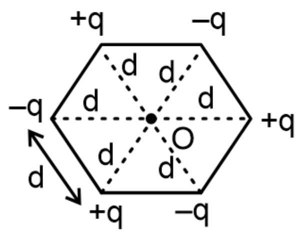
(2) Zero

(3) $\frac{-q^2}{4\pi\varepsilon_0 d}$

(4) $\frac{-q^2}{4\pi\varepsilon_0 d}\left(3-\frac{1}{\sqrt{2}}\right)$

Sol. Answer (2)

Potential at the centre of hexagon is zero.



$V_0 = 0$

$\therefore W_{\infty\to0} = q\Delta v = q_0(0)$

$= 0$

45. An astronomical refracting telescope is being used by an observer to observe planets in normal adjustment. The focal lengths of the objective and eye piece used in the construction of the telescope are 20 m and 2 cm respectively. Consider the following statements about the telescope :

(a) The distance between the objective and eyepiece is 20.02 m

(b) The magnification of the telescope is (–) 1000

(c) The image of the planet is erect anddiminished

(d) The aperture of eye piece is smaller thanthat of objective

The correct statements are :

(1) (a), (b) and (d)

(2) (a), (b) and (c)

(3) (b), (c) and (d)

(4) (c), (d) and (a)

Sol. Answer (1)

In normal adjustment of Astronomical Telescope final image is formed at infinity & inverted image is formed.

$$m = -\frac{-f_0}{f_e} = -\frac{20}{2\times10^{-2}} = -1000$$

$$L = f_o + f_e = 20 + 0.02 = 20.02$$

Aperture of eye piece is smaller than that of objective.

So, statement (a), (b) & (d) are correct.

46. The magnetic flux linked to a circular coil of radius $R$is :

$$\phi = 2t^3 + 4t^2 + 2t + 5 \text{ Wb}$$

The magnitude of induced emf in the coil at t=5 s is:

(1) 192 V

(2) 108 V

(3) 197 V

(4) 150 V

Sol. Answer (1)

$$\phi = 2t^3 + 4t^2 + 2t + 5$$

$$|e| = \left|\frac{d\phi}{dt}\right| = \frac{d}{dt}[2t^3 + 4t^2 + 2t + 5] = 6t^2 + 8t + 2$$

$$e(t) = 6t^2 + 8t + 2$$

$$e(t=5) = 6(5)^2 + 8(5) + 2$$

$$= 150 + 40 + 2$$

$$= 192 \text{ V}$$

47. Three vessels of equal capacity have gases at the same temperature and pressure. The first vessel contains helium (monoatomic), the second contains fluorine (diatomic) and the third contains sulfur hexafluoride (polyatomic). The correct statement, among the following is:

(1) The root mean square speed of sulfur hexafluoride is the largest

(2) All vessels contain unequal number of respective molecules

(3) The root mean square speed of molecules is same in all three cases

(4) The root mean square speed of helium is the largest

Sol. Answer (4)

$$v_{rms} = \sqrt{\frac{3RT}{M}}$$

Concept :v_{rms} is independent of degree of freedom.

M_{Helium} is smallest among all given so, v_{rms} for Helium is maximum.

48. An organ pipe filled with a gas at 27°C resonates at 400 Hz in its fundamental mode. If it is filled with the same gas at 90°C, the resonance frequency at the same mode will be:

(1) 512 Hz

(2) 420 Hz

(3) 440 Hz

(4) 484 Hz

Sol. Answer (3)

We know

$$f = \frac{v}{\lambda}$$

Velocity of sound $\propto \sqrt{T}$

$$\frac{f_1}{f_2} = \sqrt{\frac{T_1}{T_2}}$$

$$\frac{400}{f_2} = \sqrt{\frac{273+27}{273+90}} = \sqrt{\frac{300}{363}} = \frac{1}{1.1}$$

$$\Rightarrow f_2 = 440 \text{ Hz}$$

49. The collector current in a common base amplifier using n-p-n transistor is 24 mA. If 80% of the electrons released by the emitter is accepted by the collector, then the base current is numerically:

(1) 3 mA and entering the base

(2) 6 mA and leaving the base

(3) 3 mA and leaving the base

(4) 6 mA and entering the base

Sol. Answer (4)

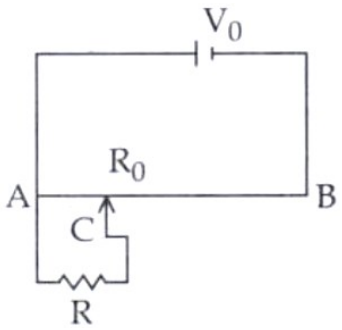
$$I_c = 24 \text{ mA}$$

$$I_c = 80\% \text{ of } I_E$$

$$\therefore I_E = 30 \text{ mA}$$

$$\therefore I_B = 6 \text{ mA entering the base}$$

50. The sliding contact C is at one fourth of the length of the potentiometer wire (AB) from A as shown in the circuit diagram. If the resistance of the wire AB is R_o, then the potential drop (V) across the resistor R is



(1) $\dfrac{2\,V_0R}{2\,R_0+3\,R}$ (2) $\dfrac{4\,V_0R}{3\,R_0+16\,R}$

(3) $\dfrac{4\,V_0R}{3\,R_0+R}$ (4) $\dfrac{2\,V_0R}{4\,R_0+R}$

Sol. Answer (2)

$$R_{eq}=\frac{\frac{R_0}{4}\times R}{\frac{R_0}{4}+R}+\frac{3R_0}{4}=\frac{R_0\left(16R+3R_0\right)}{4(R_0+4R)}$$

$$\left(\mathrm{I}=\frac{V}{R_{eq}}\right)$$

$$\therefore V_R=\mathrm{I}\frac{\frac{R_0}{4}\times R}{\frac{R_0}{4}+R}=\left(\frac{4V_0R}{16R+3R_0}\right)$$

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