FINAL NEET(UG)–2022 (RE-EXAMINATION)

(Held On Sunday 4th SEPTEMBER, 2022)

PHYSICS

TEST PAPER WITH ANSWER & SOLUTION

SECTION-A

1. Identify the function which represents a non-periodic motion.

(1) $e^{-\omega t}$

(2) $\sin\omega t$

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

(4) $\sin(\omega t + \pi/4)$

Ans. (1)

Sol. $e^{-\omega t}$ represents non-periodic motion.

2. The magnetic field of a plane electromagnetic wave is given by $\vec{B} = 3\times10^{-8}\cos(1.6\times10^{3}x + 48\times10^{10}t)\hat{j}$, then the associated electric field will be :

(1) $3\times10^{-8}\cos(1.6\times10^{3}x + 48\times10^{10}t)\,\hat{i}\ V/m$

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

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

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

Ans. (4)

Sol. $B = 3\times10^{-8}\cos(1.6\times10^{3}x + 48\times10^{10}t)$

$$C = \frac{\omega}{k} = \frac{48\times10^{10}}{1.6\times10^{3}} = 3\times10^{8}\ m/s$$

$C = E_0 / B_0$

$E = 3\times10^{-8}\times3\times10^{8} = 9\ N/C$

$\therefore E = 9\cos(1.6\times10^{3}x + 48\times10^{10}t)$

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

(1) Zener voltage remains constant at breakdown

(2) It is designed to operate under reverse bias

(3) Depletion region formed is very wide

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

Ans. (3)

Sol. For zener diode → Doping is high

& Depletion region is thin

& It is operated in Reverse Bias region

& Zener voltage (V_z) is constant

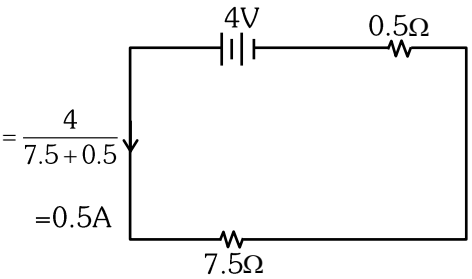
4. A cell of emf 4 V and internal resistance 0.5 Ω is connected to a 7.5 Ω external resistance. The terminal potential difference of the cell is :-

(1) 3.75 V (2) 4.25 V

(3) 4 V (4) 0.375 V

Ans. (1)

Sol.



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

$= 0.5A$

TPD = $4 - 0.5\times0.5$

$= 4 - 0.25$

TPD = 3.75 volt

5. 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) Both **statement-I** and **statement-II** are correct

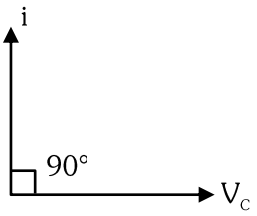
(2) Both **statement-I** and **statement-II** are incorrect

(3) **Statement-I** is correct but **statement-II** is incorrect

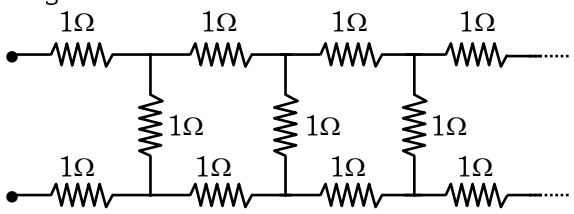
(4) **Statement-I** is incorrect but **statement-II** is correct

Ans. (3)

Sol.



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

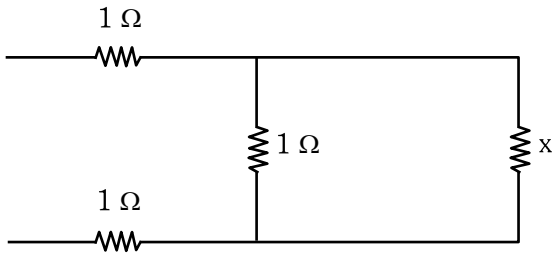


(1) 2 Ω (2) $(1+\sqrt{2})$ Ω

(3) $(1+\sqrt{3})$ Ω (4) $(1+\sqrt{5})$ Ω

Ans. (3)

Sol. If effective resistance is x,



$$\Rightarrow x = 1 + \frac{x \times 1}{x+1} + 1$$

$$\Rightarrow (x-2) = \frac{x}{x+1}$$

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

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

$$\text{So, } x = \frac{2 \pm \sqrt{12}}{2}$$

$$= 1 \pm \sqrt{3}\,\Omega$$

neglecting negative value, $x = 1 + \sqrt{3}\,\Omega$

7. 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) 5 m (2) 10 m (3) 20 m (4) 25 m

Ans. (1)

Sol. $H = \frac{u^2 \sin^2\theta}{2g} = \frac{(20)^2 \sin^2 30^\circ}{2(10)}$

$= 5m$

8. A closely packed coil having 1000 turns has an average radius of 62.8 cm. If current carried by 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^{-1} T (2) 10^{-2} T

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

Ans. (4)

Sol. $B = \frac{\mu_0 Ni}{2R}$

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

$$= \frac{4 \times 3.14 \times 10^{-7} \times 10^{3}}{2 \times 62.8 \times 10^{-2}}$$

$= 10^{-3}$ T

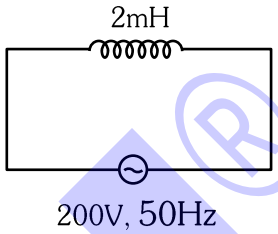
9. An inductor of inductance 2 mH is connected to a 220 V, 50 Hz a.c. source. Let the inductive reactance in the circuit is X_1. If a 220 V dc source replaces the ac source in the circuit, then the inductive reactance in the circuit is X_2. X_1 and X_2 respectively are :

(1) 6.28 Ω, zero (2) 6.28 Ω, infinity

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

Ans. (3)

Sol.



For AC $X_L = \omega L$ For DC, $\omega = 0$

$X_1 = 100\pi \times 2 \times 10^{-3}$ $X_L = \omega L$

$X_1 = 0.2\ \pi\Omega$ $X_2 = 0$

$X_1 = 0.628\ \Omega$

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

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

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

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

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

Ans. (3)

Sol. Secondary Rainbow is due to double internal reflection and it is formed above the Primary Rainbow.

11. 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) 2 eV (2) 2 V

(3) 1.1 V (4) 6.4 V

Ans. (2)

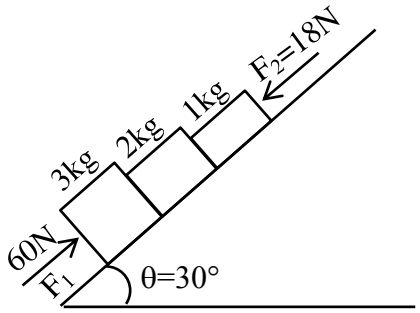
Sol. $KE = h\nu - \phi$

$eV_0 = h\nu - \phi$

$eV_0 = 4.2\ eV - 2.2\ eV$

$\Rightarrow V_0 = 2$ Volts

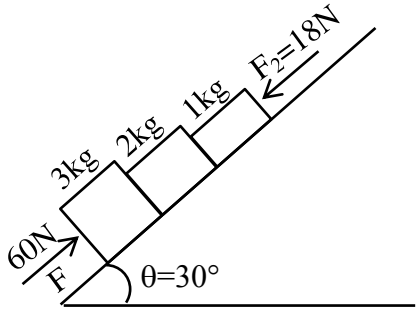
12. In the diagram shown, the normal reaction force between 2 kg and 1 kg is (Consider the surface, to be smooth):
Given g = 10 ms^{-2}



(1) 25 N (2) 39 N (3) 6 N (4) 10 N

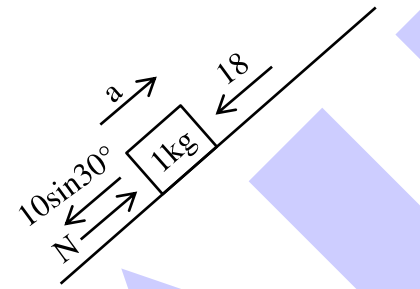
Ans. (1)

Sol.



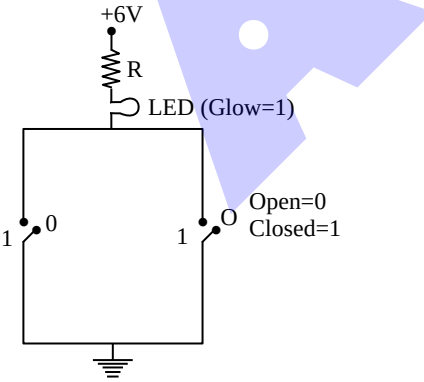
$$a = \frac{\text{Net force}}{\text{Total mass}} = \frac{60-(18+60\sin 30°)}{6} = 2ms^{-2}$$

FBD of 1kg



N – 18 – 5 = 1(2)
N = 25 N

13.



Identify the equivalent logic gate represented by the given circuit :
(1) OR (2) NOR
(3) AND (4) NAND

Ans. (1)

Sol. Here, current flows when any of the switch is in ON (1) state.

A	B	LED
0	0	0
0	1	1
1	0	1
1	1	1

OR Gate

14. Two copper vessels A and B have the same base area but of different shapes. A lakes 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) Pressure on the base area of vessels A and B is same.
(2) Pressure on the base area of vessels A and B is not same.
(3) Both vessels A and B weigh the same.
(4) Vessel B weighs twice that of A.

Ans. (1)

Sol. Pressure depends on height above base only which is same for two vessels.

15. 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) 2C (2) C/2
(3) 4C (4) C/4

Ans. (4)

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

Now, $C' = \frac{\varepsilon_0 (A/2)}{2d} = \frac{\varepsilon_0 A}{4d} = \frac{C}{4}$

16. 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) 8.48×10^{-3} N
(2) 8.48×10^{-5} N
(3) 4.23×10^{-3} N
(4) 4.23×10^{-6} N

Ans. (1)

Sol. $F = 6\pi\eta r v$

$= 6 \times 3.14 \times 0.9 \times 5 \times 10^{-3} \times 10 \times 10^{-2}$

$= 847.8 \times 10^{-5}$ N

$= 8.48 \times 10^{-3}$ N

17. 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) 5, $\sqrt{3}$ (2) 4, $\sqrt{5}$

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

Ans. (3)

Sol. $\vec{F} = 2\hat{i} + \hat{j} - \hat{k}$ $\quad \vec{r} = 3\hat{i} + 2\hat{j} - 2\hat{k}$

$\vec{F}.\vec{r} = 6 + 2 + 2 = 10$

$$\vec{F} \times \vec{r} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 1 & -1 \\ 3 & 2 & -2 \end{vmatrix}$$

$= \hat{i}(0) - \hat{j}(-1) + \hat{k}(1)$

$= \hat{j} + \hat{k}$

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

18. 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) $\frac{I}{2}$ (2) $\frac{I}{3}$

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

Ans. (3)

Sol. According to Malus law

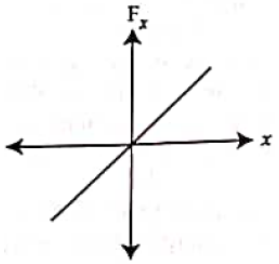
$I_2 = I_1 \cos^2\theta$

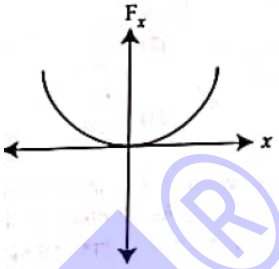
Where I_1 is incident Polarised light

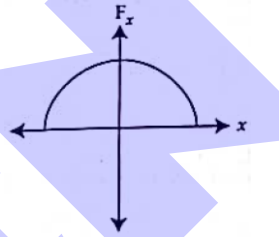
$I_2 = I \cos^2 30 = I\left(\frac{\sqrt{3}}{2}\right)^2$

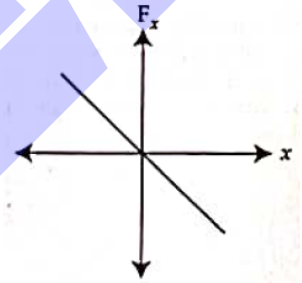
$I_2 = \frac{3I}{4}$

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

(1) 

(2) 

(3) 

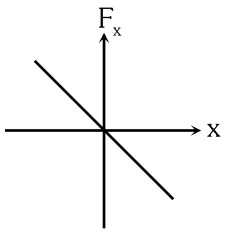
(4) 

Ans. (4)

Sol. Restoring force of spring is

$F = -kx$

$\boxed{F \propto -x}$



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

(1) angular separation of the fringes increases

(2) angular separation of the fringes decreases

(3) linear separation of the fringes increases

(4) linear separation of the fringes decreases

Ans. (3)

Sol. Linear fringe width is given as = $\frac{\lambda D}{d}$

When Screen is moving away from slits then D increases, so that fringe width increases.

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

(1) 10 μF, 6 μF

(2) 8 μF, 8 μF

(3) 12 μF, 4 μF

(4) 1.2 μF, 1.8 μF

Ans. (3)

Sol. $\frac{C_1C_2}{C_1+C_2}=3$

$C_1 + C_2 = 16$

$C_1\, C_2 = 48$

$C_1 = 12\ \mu F$

$C_2 = 4\ \mu F$

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

(1) 300 m

(2) 30 m

(3) 3 m

(4) 0.3 m

Ans. (1)

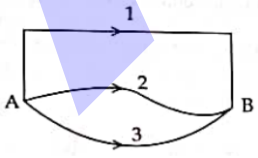
Sol. mv = 0.3

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

Distance covered = vt

= 60×5 = 300 m

23. 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) $W_1 > W_3 > W_2$

(4) $W_1 < W_2 < W_3$

Ans. (1)

Sol. Gravitational force is a conservative force so W.D. is independent of path taken between two points.

24. The reciprocal of resistance is :

(1) reactance

(2) mobility

(3) conductivity

(4) conductance

Ans. (4)

Sol. Conductance = $\frac{1}{\text{Resistance}}$

25. 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) Both **(A)** and **(R)** are correct and **(R)** is the correct explanation of **(A)**

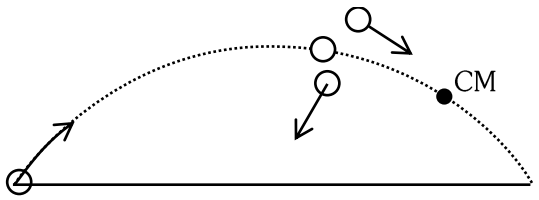
(2) Both **(A)** and **(R)** are correct but **(R)** is not the correct explanation of **(A)**

(3) **(A)** is correct but **(R)** is not correct

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

Ans. (4)

Sol.



After explosion C.O.M. moving is the same path but particles moving in different direction.

26. 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) $h\nu_0$ (2) $2\ h\nu_0$

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

Ans. (3)

Sol. $(KE)_{max} = h\nu - h\nu_{Th}$

$(KE)_{max} = h(4\nu_0) - h\nu_0$

$= 3\ h\nu_0$

27. 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) c (2) $\frac{1}{c}$

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

Ans. (2)

Sol. $\frac{B_0}{E_0} = \frac{1}{c} = \sqrt{\mu_0\varepsilon_0}$

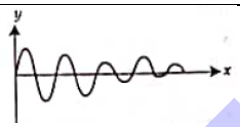
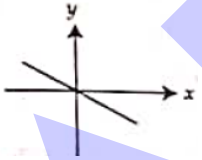
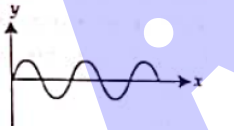
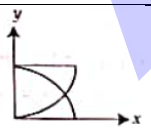
28. The shape of the magnetic field lines due to an infinite long, straight current carrying conductor is :

(1) a straight line
(2) circular
(3) elliptical
(4) a plane

Ans. (2)

Sol. Straight current carring wire produces circular magnetic field.

29. 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) - (iv), (b) - (ii), (c) - (iii), (d) - (i)
(2) (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)
(3) (a) - (i), (b) - (iv), (c) - (iii), (d) - (ii)
(4) (a) - (iii), (b) - (ii), (c) - (i), (d) - (iv)

Ans. (2)

Sol. (a) → (iv) Amplitude is continuously decreasing
(b) → (iii) $F \propto -x$
(c) → (ii) Amplitude is constant
(d) → (i) K.E. + P.E. =M.E. = constant

30. 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) Both **Statement I** and **Statement II** are correct
(2) Both **Statement I** and **Statement II** are incorrect
(3) **Statement I** is correct but **Statement II** is incorrect
(4) **Statement I** is incorrect but **Statement II** is correct

Ans. (2)

Sol. Since, $dN = -\lambda N dt$

($dN \propto N$) statement I is wrong.

$T_{1/2}$ = time in which active no. of nuclei becomes half therefore statement II is wrong.

31. 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) thermodynamics states, where C is a constant. Then :

(1) If $P_1 > P_2$ then $T_1 < T_2$
(2) If $V_2 > V_1$ then $T_2 > T_1$
(3) If $V_2 > V_1$ then $T_2 < T_1$
(4) If $P_1 > P_2$ then $V_1 > V_2$

Ans. (3)

Sol. $PV^2 = C$

$\Rightarrow \frac{nRT}{V}V^2 = C$

$\Rightarrow TV = \text{constant}$

$\therefore V_2 > V_1 \Rightarrow T_1 > T_2$

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

(1) 0.707 A (2) 1 A
(3) 1.414 A (4) 2 A

Ans. (1)

Sol. $I_{rms}\, V_{rms} = P$

$I_{rms} \times 200 = 100$

$I_{rms} = \frac{1}{2}$

So, $I_{peak} = I_{rms}\sqrt{2}$

$= \frac{1}{2} \times \sqrt{2}$

$= \frac{1}{\sqrt{2}} = 0.707\,A$

33. Let R_1 be the radius of the second stationary orbit 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) 0.25 (2) 0.5 (3) 2 (4) 4

Ans. (1)

Sol. $R(n) = 0.529\,\frac{n^2}{z}$

$\frac{R_1(n=2)}{R_2(n=4)} = \frac{2^2}{4^2} = \frac{1}{4} = 0.25$

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

(1) Force

(2) Momentum

(3) Young's modulus of elasticity

(4) Coefficient of viscosity

Ans. (3)

Sol. $Y = \frac{\text{stress}}{\text{strain}}$ (Strain is dimensionless)

$\therefore$ [Y] = [stress] = [Pressure]

35. 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) 0.7 kg-m^2 (2) 3.22 kg-m^2

(3) 30.8 kg-m^2 (4) 0.07 kg-m^2

Ans. (1)

Sol. $\omega_i = 60\text{ rpm} = 60 \times \frac{2\pi}{60} = 2\pi\,\text{rad/s}$

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

$\Delta K.E. = \frac{1}{2} I\left(\omega_f^2 - \omega_i^2\right) = 484$

$\frac{1}{2} I(144\pi^2 - 4\pi^2) = 484$

$I \approx 0.7\text{ kg} - m^2$

SECTION-B

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

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

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

(1) 108 V (2) 197 V

(3) 150 V (4) 192 V

Ans. (4)

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

$emf = \left|\frac{d\phi}{dt}\right| = 6t^2 + 8t + 2$

$= 6 \times 5^2 + 8 \times 5 + 2$

$= 192$ V

37. 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 eye piece is 20.02 m

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

(c) The image of the planet is erect and diminished

(d) The aperture of eye piece is smaller than that of objective

The correct statements are :

(1) (a), (b) and (c)

(2) (b), (c) and (d)

(3) (c), (d) and (a)

(4) (a), (b) and (d)

Ans. (4)

Sol. $f_0 = 20$ m = 2000 cm

$f_e = 2$ cm

for Normal adjustment

$\rightarrow$ M.P. $= -\frac{f_0}{f_e} = \frac{-2000}{2} = -1000$

$\rightarrow$ Distance between both lens = $f_0 + f_e$

= 2000 + 2

= 2002 cm

= 20.02 m

$\rightarrow$ Image is inverted and magnified

$\rightarrow$ Aperture of eye piece is smaller than objective.

38. 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 the time when the ratio of their atoms becomes $\frac{1}{e}$ respectively will be :

(1) $\frac{1}{11\lambda}$ (2) $\frac{1}{9\lambda}$

(3) $\frac{1}{6\lambda}$ (4) $\frac{1}{5\lambda}$

Ans. (2)

Sol. $N_1(10\lambda) = N_0e^{-10\lambda t}$

$N_2(\lambda) = N_0e^{-\lambda t}$

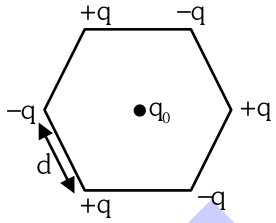
Ratio $\frac{N_1}{N_2} = \frac{N_0e^{-10\lambda t}}{N_0e^{-\lambda t}} = \frac{1}{e}$

$\Rightarrow e^{-9\lambda t} = e^{-1}$

or $t = \frac{1}{9\lambda}$.

39. Six charges +q, –q, +q, –q, +q and –q are 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)

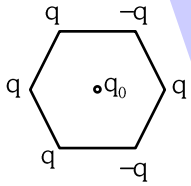


(1) Zero (2) $\frac{-q^2}{4\pi\varepsilon_0 d}$

(3) $\frac{-q^2}{4\pi\varepsilon_0 d}\left(3-\frac{1}{\sqrt{2}}\right)$ (4) $\frac{-q^2}{4\pi\varepsilon_0 d}\left(6-\frac{1}{\sqrt{2}}\right)$

Ans. (1)

Sol.



Work = $U_f - U_i$

= 0 – 0

Work = 0

40. 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) 420 Hz (2) 440 Hz

(3) 484 Hz (4) 512 Hz

Ans. (2)

Sol. $\frac{n_1}{n_2} = \frac{\frac{v_1}{4\ell}}{\frac{v_2}{4\ell}}$

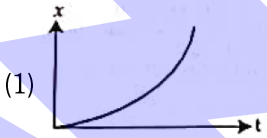
$\frac{400}{n_2} = \frac{v_1}{v_2}\left[\text{from } v \propto \sqrt{T}\right]$

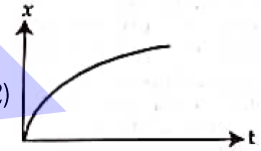
$\frac{400}{n_2} = \sqrt{\frac{T_1}{T_2}}$

$\frac{400}{n_2} = \sqrt{\frac{300}{363}}$

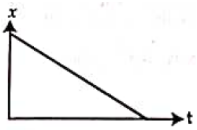
$\Rightarrow \boxed{n_2 = 440\,Hz}$

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

(1) 

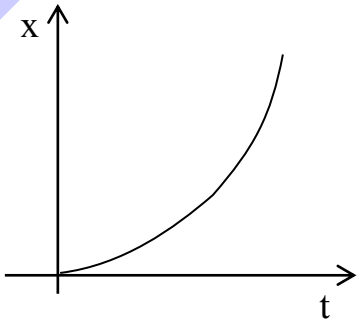
(2) 

(3) 

(4) 

Ans. (1)

Sol.



$x = \frac{1}{2}at^2$ (if coefficients of t^2 is positive (a > 0) upward opening parabola)

42. 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) 6 mA and leaving the base

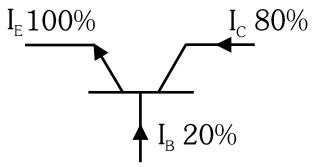
(2) 3 mA and leaving the base

(3) 6 mA and entering the base

(4) 3 mA and entering the base

Ans. (3)

Sol.



$I_C = 24$ mA

and $I_E = \frac{I_C}{\alpha}$

$I_E = \frac{24mA}{0.8} = 30mA$

$\therefore I_B = I_E - I_C$

= 6 mA (into the base)

43. 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) All vessels contain unequal number of respective molecules

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

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

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

Ans. (3)

Sol. $V_{rms} = \sqrt{\frac{3KT}{m}} \propto \frac{1}{\sqrt{m}}$

= maximum for He

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

Ans. (3)

Sol. $V = -\frac{K}{x}$

$E_x = -\frac{dV}{dx} = K\frac{d\left(x^{-1}\right)}{dx}$

$= \frac{-K}{x^2} = \frac{-K}{2^2} = -\frac{K}{4}$

45. Two very long, straight, parallel conductors A and B carry current of 5A and 10A 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) 2×10^{-4} Nm^{-1} and is attractive

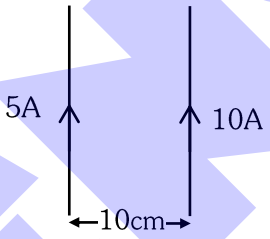
(2) 2×10^{-4} Nm^{-1} and is repulsive

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

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

Ans. (3)

Sol.



$\frac{F_M}{\ell} = \frac{\mu_0 i_1 i_2}{2\pi r}$

$= \frac{4\pi \times 10^{-7} \times 5 \times 10}{2\pi \times 0.1} = 10^{-4}$ N/m

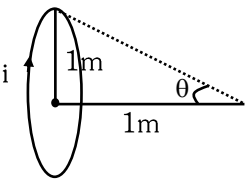
46. The magnetic field on the axis of a circular loop of radius 100 cm carrying current $I = \sqrt{2}$ A, at point 1 m away from the centre of the loop is given by:

(1) 3.14×10^{-7} T (2) 6.28×10^{-7} T

(3) 3.14×10^{-4} T (4) 6.28×10^{-4} T

Ans. (1)

Sol.



$B_A = B_0 \sin^3\theta$

$= \frac{\mu_0 i}{2R} \times \sin^3\theta$

$= \frac{4\pi \times 10^{-7} \times \sqrt{2}}{2 \times 1} \times \left(\frac{1}{2\sqrt{2}}\right)$

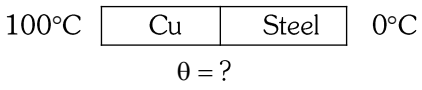
$B_A = 3.14 \times 10^{-7}$ T

47. 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) 12°C (2) 50°C (3) 73°C (4) 88.5°C

Ans. (4)

Sol.



$$\frac{\Delta\theta}{\Delta t} = \frac{385A(100-\theta)}{\ell} = \frac{50A(\theta-0)}{\ell}$$

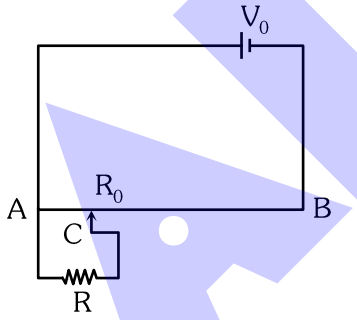
$\Rightarrow 77(100-\theta) = 10\,\theta$

$\Rightarrow 7700 - 77\theta = 10\,\theta$

$\Rightarrow 87\,\theta = 7700$

$\Rightarrow \theta = \frac{7700}{87} = 88.5°C$

48. 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_0, then the potential drop (V) across the resistor R is:



(1) $\frac{4V_0R}{3R_0+16R}$

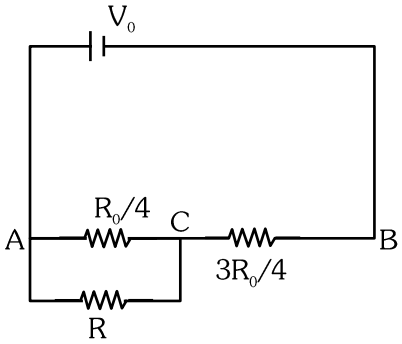
(2) $\frac{4V_0R}{3R_0+R}$

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

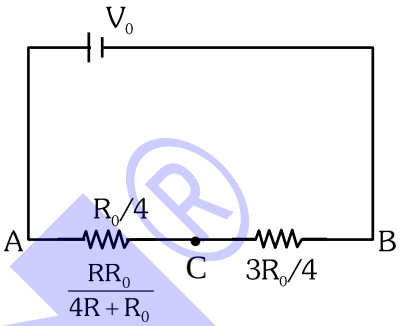
(4) $\frac{2V_0R}{2R_0+3R}$

Ans. (1)

Sol.



$\Rightarrow$



In series, potential divides in direct ratio of resistance,

So, $V_{AC} = \frac{R_{AC}}{R_{AC}+R_{CB}}V_0$

$= \frac{\frac{RR_0}{4R+R_0}}{\frac{RR_0}{4R+R_0}+\frac{3R_0}{4}} \times V_0 = \frac{4RV_0}{16R+3R_0}$

49. 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, $K = \frac{1}{4\pi\varepsilon_0}$ 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^{20}

(2) 10^{30}

(3) 10^{40}

(4) 10

Ans. (1)

Sol. $\frac{F_e}{F_G} = \frac{\frac{Kq_1q_2}{r^2}}{\frac{Gm_1m_2}{r^2}}$

$$2.4\times10^{39} = \frac{K}{G}\times\frac{(1.6\times10^{-19})^2}{(9.11\times10^{-31}\times1.67\times10^{-27})}$$

$$\frac{K}{G} = \frac{2.4\times10^{39}\times15.2137\times10^{-58}}{2.56\times10^{-38}}$$

$= 14.26 \times 10^{19}$

$= 1.426 \times 10^{20}$

$\approx 10^{20}$

50. 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) 2% (2) 5%

(3) 3% (4) 7%

Ans. (3)

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

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

% error in g = $\frac{0.1}{10} \times 100 + 2\left(\frac{1}{100}\right) \times (100)$

= 3%