Physics Sample Paper - 2

Total Question : 40

Q.No. 1

Two point charges (—q) and (+4q) are placed at separation 'r'. Where should a third charge be placed so that entire system of charges becomes in equilibrium ?

(A)

at separation 'r' from (—q) on the extreme side of —q

(B)

at separation ' 1' from (4q) on the extreme side of 4q

(C)

at separation 3 from (—q) in between the two charges.

(D)

at separation a from (4q) in between the two charges

Q.No. 2

To convert a galvanometer into an ammeter, one should connect :

(A)

high resistance in series with galvanometer

(B)

low resistance in series with galvanometer

(C)

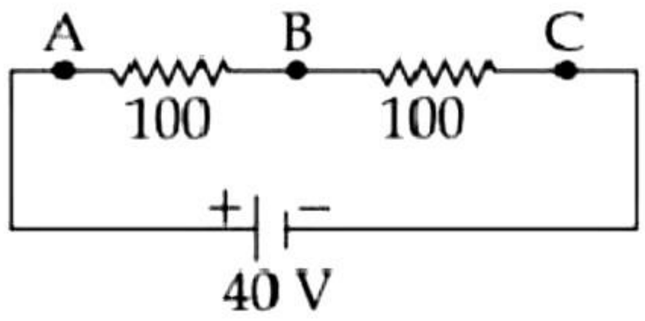
low resistance in parallel with galvanometer

(D)

high resistance in parallel with galvanometer

Q.No. 3

A voltmeter of resistance 150 ohm is connected across A and B in the given circuit. The reading of voltmeter will be :



(A)

40V

(B)

20V

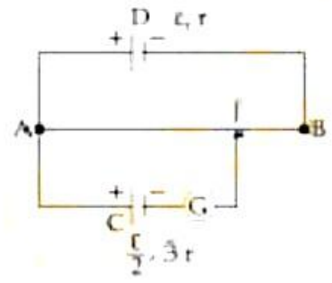
(C)

15V

(D)

25V

Q.No. 4 A potentiometer wire AB having length L and resistance 12 r is joined to a cell D of emf ε and internal resistance r. A cell C having emf ε/ 2 and internal resistance 3r is connected. The length AJ at which



the galvanometer as shown in fig shows no deflection is :

(A) 5/12 L

(B) 11/12 L

(C) 13/24 L

(D) 11/24 L

Q.No. 5

A proton and an alpha particle moving with same kinetic energy enter in the region of uniform magnetic field perpendicular to it. The ratio of radii of their trajectories will be :

(A)

1:1

(B)

1:2

(C)

2:1

(D)

1:12

Q.No. 6 An ideal gas occupies a volume of 2 m^3 at a pressure of 3 x 10^6 Pa. The energy of the gas is :

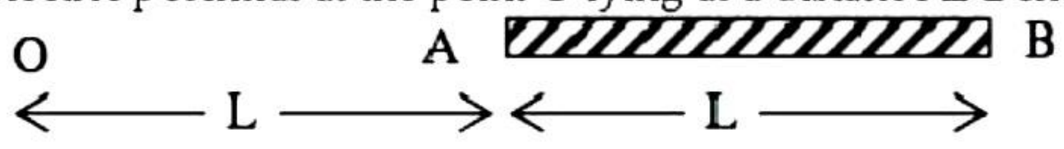
(A) 9 x 10^6 J

(B) 3 x 10^2 J

(C) 6 x 10^4 J

(D) 10^8 J

Q.No. 7 A charge Q is uniformly distributed over a long rod AB of length L as shown in the figure. The electric potential at the point O lying at a distance L from the end A is:



(A) $3Q/4\pi\varepsilon_0 L$

(B) $Q/4\pi\varepsilon_0 L \ln 2$

(C) $Q \ln 2 /4\pi\varepsilon_0 L$

(D) $Q/8\pi\varepsilon_0 L$

Q.No. 8 When a current of 5 mA is passed through a galvanometer having a coil of resistance 15 Ω, it shows full scale deflection. The value of the resistance to be put in series with the galvanometer to convert it into a voltmeter of range 0–10 V is :

(A) 1.985×10^3 Ω

(B) 2.045×10^3 Ω

(C) 2.535×10^3 Ω

(D) 4.005×10^3 Ω

Q.No. 9 A telephonic communication service is working at carrier frequency of 10 GHz. Only 10% of it is utilized for transmission. How many telephonic channels can be transmitted simultaneously if each channel requires a bandwidth of 5 kHz ?

(A) 2×10^3

(B) 2×10^4

(C) 2×10^5

(D) 2×10^6

Q.No. 10 An ideal fluid flows (laminar flow) through a pipe of non-uniform diameter. The maximum and minimum diameters of the pipes are 6.4 cm and 8 cm respectively. The ratio of the minimum and the maximum velocities of fluid in this pipe

(A) 9/16

(B) $(\sqrt{3})/2$

(C) 3/4

(D) 81/256

Q.No. 11 A copper ball of mass 100 gm is at a temperature T. It is dropped in a copper calorimeter of mass 100 gm, filled with 170 gm of water at room temperature. Subsequently, the temperature of the system is found to be 75°C. T is given by: (Given: room temperature=30°C, specific heat of copper=0.1 cal/gm°C)

(A) 800°C

(B) 885°C

(C) 1250°C

(D) 825°C

Q.No. 12

A conducting sphere is charged . If the electric field at a distance 20cm from the center of the sphere is 1.2x 10^3 NC^{-1} and points radially inwards, the net charge on the sphere is

(A)

$4.5x10^{9}C$

(B)

$-4.5x10^{-9}C$

(C)

$1.7x10^{9}C$

(D)

$-5.3x10^{-9}C$

Q.No. 13

A parallel plate capacitor having cross - sectional area 'A' and separated by distance 'd' is filled by copper plate of thickness b. It's capacitance is :

(A)

$$\frac{\varepsilon_0 A}{2d}$$

(B)

$$\frac{\varepsilon_0 A}{d-b}$$

(C)

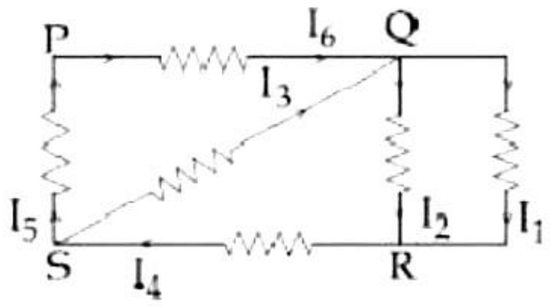
$$\frac{2\varepsilon_0 A}{d+\frac{b}{2}}$$

(D)

$$\frac{\varepsilon_0 A}{d+\frac{b}{2}}$$

Q.No. 14

In the given circuit diagram, the currents, $I_1 = -0.3$ A, $I_4 = 0.8$ A and $I_5 = 0.4$ A, are flowing as shown. The currents $I_2 I_3$ and I_6 and respectively, are :



(A) 1.1 A, 0.4 A, 0.4 A

(B) -0.4 A, 0.4 A, 1.1 A

(C) 1.1 A, -0.4 A, 0.4 A

(D) 0.4 A, 1.1 A, 0.4 A

Q.No. 15 An EM wave from air enters a medium. The electric fields are

$\vec{E}_1 = E_{01}\ \hat{x} \cos\left[2\pi\nu\left(\frac{z}{c} - t\right)\right]$ in air and

$\vec{E}_2 = E_{02}\ \hat{x} \cos\left[k\,(2z - ct)\right]$ in medium, where the wave number k and frequency ν refer to their values in air. The medium is non-magnetic. If ϵ_{r_1} and ϵ_{r_2} refer to relative permittivities of air and medium respectively, which of the following options is **correct** ?

(A) $\varepsilon_{r1}/\varepsilon_{r2} = 4$

(B) $\varepsilon_{r1}/\varepsilon_{r2} = 2$

(C) $\varepsilon_{r1}/\varepsilon_{r2} = 1/4$

(D) $\varepsilon_{r1}/\varepsilon_{r2} = 1/2$

Q.No. 16 A rod, of length L at room temperature and uniform area of cross section A, is made of a metal having coefficient of linear expansion α/°C. It is observed that an external compressive force F, is applied on

each of its ends, prevents any change in the length of the rod, when its temperature rises by ΔTK. Young's modulus, Y, for this metal is :

(A) $\frac{2F}{A\alpha\Delta T}$

(B) $\frac{F}{A\alpha\Delta T}$

(C) $\frac{F}{2A\alpha\Delta T}$

(D) $\frac{F}{A\alpha(\Delta T - 273)}$

Q.No. 17

An electron is projected in a uniform magnetic field along the direction of field, the electron will experience :

(A)

a force opposite to the magnetic field

(B)

a force in the direction of magnetic field

(C)

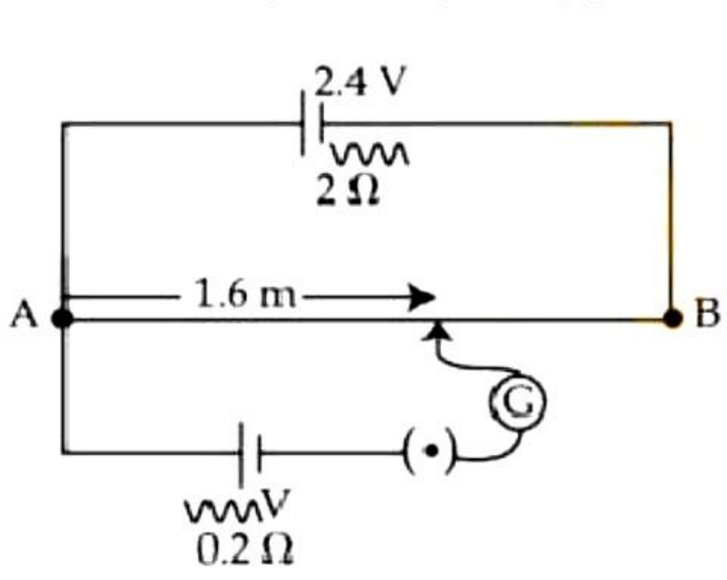
no force in magnetic field

(D)

a force perpendicular to the magnetic field

Q.No. 18

A potentiometer with a cell of 2.4 volt and internal resistance of 2 ohm maintains a potential drop across the resistance wire AB of length 2 meters and resistance 10 ohm. A standard cell which maintains a constant emf of "V' volt with internal resistance 0.2 ohm gives a balance point at 1.6 m length of the wire, The value of emf of second (standard) cell (V) is :



(A)

2.0 volt

(B)

1.9 volt

(C)

1.8 volt

(D)

16 volt

Q.No. 19 A pendulum is executing simple harmonic motion and its maximum kinetic energy is K_1. If the length of the pendulum is doubled and it performs simple harmonic motion with the same amplitude as in the first case, its maximum kinetic energy is K_2. Then :

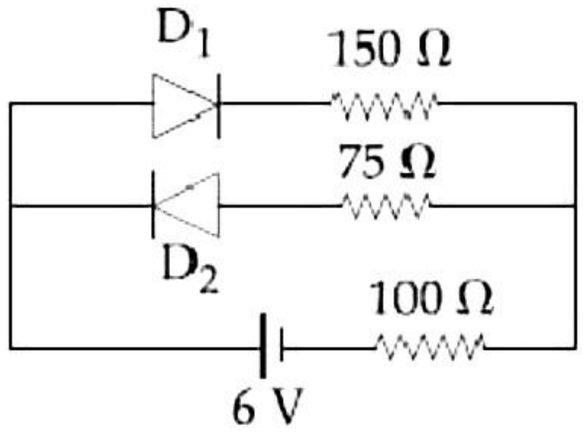
(A) $K_2 = \frac{K_1}{4}$

(B) $K_2 = \frac{K_1}{2}$

(C) $K_2 = K_1$

(D) $K_2 = 2K_1$

Q.No. 20 The circuit shown below contains two ideal diodes, each with a forward resistance of 50 Ω. If the battery voltage is 6 V, the current through the 100 Ω resistance(in Amperes) is :



(A) 0.027

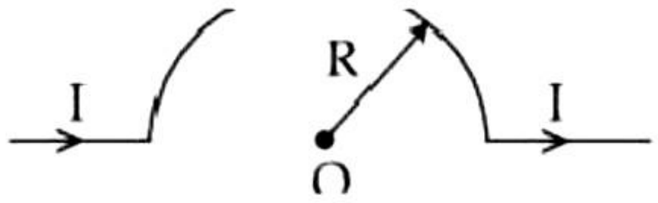
(B) 0.030

(C) 0.036

(D) 0.020

Q.No. 21

Magnetic field due to the current carrying wire as shown in the figure at point "O" will be:



(A)

$\frac{\mu_0 I}{2R}$

(B)

$$\frac{\mu_0 I}{4R}$$

(C)

$$\frac{\mu_0 I}{2\pi R}$$

(D)

$$\frac{\mu_0 I}{4\pi R}$$

Q.No. 22

An electron is shot into the uniform magnetic field, normal to the direction of field. Then the frequency of revolution of the electron in its circular orbit :

(A)

is independent of its speed

(B)

decreases with its speed

(C)

increases with its speed

(D)

increase with radius of revolution

Q.No. 23

The expression for torque $\vec{\tau}$ experienced by an electric dipole of dipole moment' $\vec{P}$' is an external uniform electric Held "$\vec{E}$"s given by :

(A)

$$\vec{\tau} = \vec{P} \cdot \vec{E}$$

(B)

$$\vec{\tau} = \frac{\vec{P}}{\vec{E}}$$

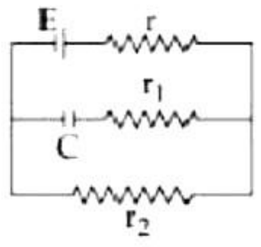
(C)

$$\vec{\tau} = \frac{\vec{E}}{\vec{P}}$$

(D)

$$\vec{\tau} = \vec{P} \times \vec{E}$$

Q.No. 24 In the given circuit diagram when the current reaches steady state in the circuit, the charge on the capacitor of capacitance C will be:



(A) CE

(B) $CE\, r_1/(r_2 + r)$

(C) $CE\, r_2 / (r + r_2)$

(D) $CE\, r_1 / (r_1 + r)$

Q.No. 25 An electron from various excited states of hydrogen atom emit radiation to come to the ground state. Let λ_n, λ_g be the de Broglie wavelength of the electron in the n^{th} state and the ground state respectively. Let Λ_n be the wavelength of the emitted photon in the transition from the n^{th} state to the ground state. For large n, (A, B are constants)

(A) $A_n = A + B / \lambda^2_n$

(B) $A_n = A + B\, \lambda_n$

(C) $A^2_n = A + B\, \lambda^2_n$

(D) $A^2_n = \lambda$

Q.No. 26 Charge is distributed within a sphere of radius R with a volume charge density $\rho(r) = \frac{A}{r^2} e^{-2r/a}$ where A and a are constants. If Q is the total charge of this charge distribution, the radius R is:

(A) $a \log\left(\frac{1}{1 - \frac{Q}{2\pi aA}}\right)$

(B) $a \log\left(1 - \frac{Q}{2\pi aA}\right)$

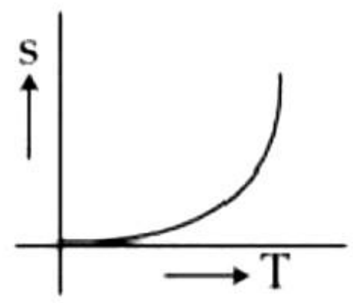
(C) $\frac{a}{2} \log\left(1 - \frac{Q}{2\pi aA}\right)$

(D) $\frac{a}{2} \log\left|\frac{1}{1 - \frac{Q}{2\pi aA}}\right)$

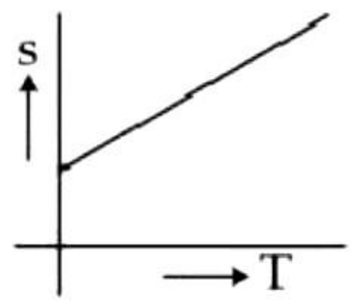
Q.No. 27

Which of the following graph correctly represents the variation of resistivity 's' with temperature 'T' for a semiconductor material ?

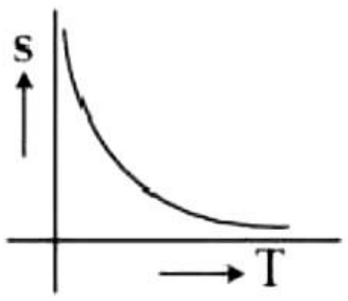
(A)



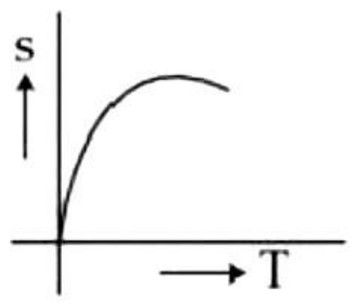
(B)



(C)



(D)



Q.No. 28 Water flows into a large tank with flat bottom at the rate of $10^{-4} m^3 s^{-1}$ Water is also leaking out of a hole of area $1 cm^2$ at its bottom. If the height of the water in the tank remains steady, then this height is :

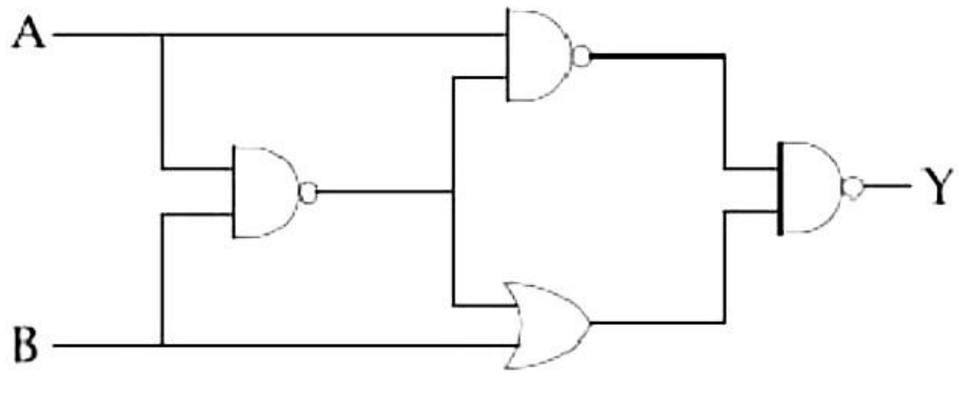
(A) 2.9 cm

(B) 4 cm

(C) 1.7 cm

(D) 5.1 cm

Q.No. 29 The output of the given logic circuit is :



(A) $\overline{AB}$

(B) $A\overline{B}$

(C) $AB + \overline{AB}$

(D) $A\overline{B} + \overline{A}B$

Q.No. 30 A passenger train of length 60 m travels at a speed of 80 km/hr. Another freight train of length 120 m travels at a speed of 30 km/hr. The ratio of times taken by the passenger train to completely cross the freight train when : (i) they are moving in the same direction, and (ii) in the opposite directions is :

(A) 25/11

(B) 3/2

(C) 5/2

(D) 11/5

Q.No. 31

Drift velocity of electrons is directly proportional to the :

(A)

Temperature

(B)

Voltage applied

(C)

Length of the conductor

(D)

Area of cross section of conductor

Q.No. 32 In a communication system operating at wavelength 800 nm, only one percent of source frequency is available as signal bandwidth. The number of channels accommodated for transmitting TV signals of bandwidth 6 MHz are (Take velocity of light $c=3 \times 10^8$ m/s, $h=6.6 \times 10^{-34}$ J-s)

(A) 3.75×10^6

(B) 4.87×10^5

(C) 6.25×10^5

(D) 3.86×10^6

Q.No. 33 A travelling harmonic wave is represented by the equation $y(x, t) = 10^{-3} \sin(50t + 2x)$, where x and y are in meter and t is in seconds. Which of the following is a correct statement about the wave?

(A) The wave is propagating along the positive x-axis with speed 25 ms^{-1}.

(B) The wave is propagating along the positive x-axis with speed 100 ms^{-1}.

(C) The wave is propagating along the negative x-axis with speed 25 ms^{-1}.

(D) The wave is propagating along the negative x-axis with speed 100 ms^{-1}.

Q.No. 34 A simple pendulum, made of a string of length l and a bob of mass m, is released from a small angle θ_0. It strikes a block of mass M, kept on a horizontal surface at its lowest point of oscillations, elastically. It bounces back and goes up to an angle θ_1. Then M is given by:

(A) $\frac{m}{2}\left(\frac{\theta_0 - \theta_1}{\theta_0 + \theta_1}\right)$

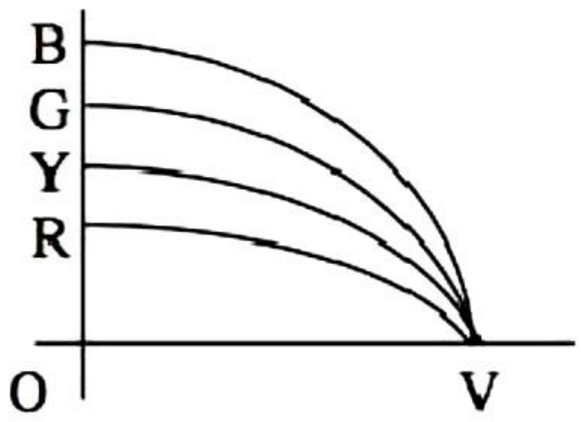
(B) $m\left(\frac{\theta_0 + \theta_1}{\theta_0 - \theta_1}\right)$

(C) $\frac{m}{2}\left(\frac{\theta_0 + \theta_1}{\theta_0 - \theta_1}\right)$

(D) $m\left(\frac{\theta_0 - \theta_1}{\theta_0 + \theta_1}\right)$

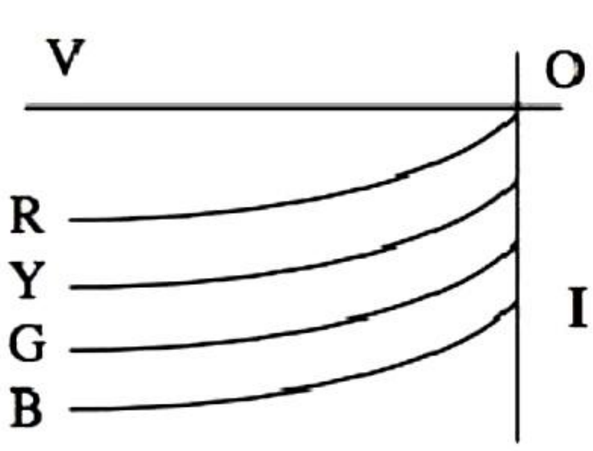
Q.No. 35 The I – V characteristic of an LED is

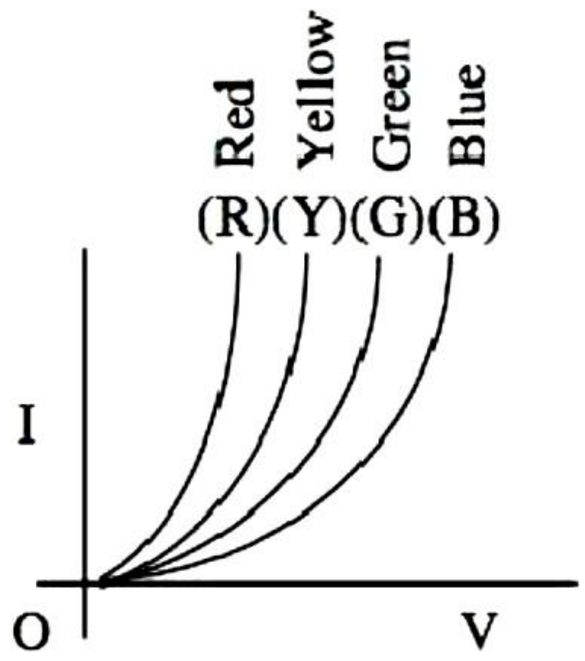
(A)



(B)

(C)





(D)

Q.No. 36 A uniform metallic wire has a resistance of 18Ω and is bent into an equilateral triangle. Then, the resistance between any two vertices of the triangle is :

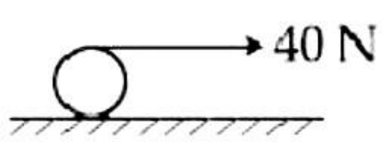
(A) 2Ω

(B) 8Ω

(C) 4Ω

(D) 12Ω

Q.No. 37 A string is wound around a hollow cylinder of mass 5 kg and radius 0.5 m. If the string is now pulled with a horizontal force of 40 N, and the cylinder is rolling without slipping on a horizontal surface(see figure), then the angular acceleration of the cylinder will be (Neglect the mass and thickness of the string):



(A) $20 rad/s^2$

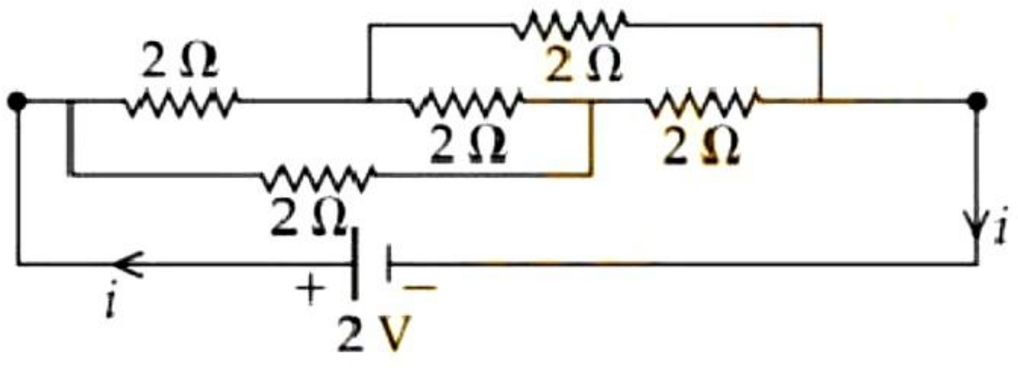
(B) $10 rad/s^2$

(C) $16 rad/s^2$

(D) $12 rad/s^2$

Q.No. 38

Find the value of current in the circuit



(A)

4A

(B)

3A

(C)

2A

(D)

1A

Q.No. 39

An infinitely long wire is charged uniformly with charge density λ and placed in air, the electric field at distance r from wire will be :

(A)

$$\frac{1}{4\pi\varepsilon_0}\frac{\lambda}{r}$$

(B)

$$\frac{1}{4\pi\varepsilon_0}\frac{\lambda}{r^2}$$

(C)

$$\frac{\lambda}{2\varepsilon_0}$$

(D)

$$\frac{\lambda}{2\pi\varepsilon_0 r}$$

Q.No. 40 An electron, a proton and an alpha particle having the same kinetic energy are moving in circular orbits of radii r_e, r_p, r_α respectively in a uniform magnetic field B. The relation between r_e, r_p, r_α is :

(A) $r_e > r_p = r_\alpha$

(B) $r_e < r_p = r_\alpha$

(C) $r_e < r_p < r_\alpha$

(D) $r_e < r_\alpha < r_p$

Answer Sheet

Q.No	Answer
Q.No. 1	(A)

Q.No. 2	(C)
Q.No. 3	(C)
Q.No. 4	(C)
Q.No. 5	(A)
Q.No. 6	(A)
Q.No. 7	(C)
Q.No. 8	(A)
Q.No. 9	(C)
Q.No. 10	(A)
Q.No. 11	(B)
Q.No. 12	(D)
Q.No. 13	(B)
Q.No. 14	(A)
Q.No. 15	(C)
Q.No. 16	(B)
Q.No. 17	(C)
Q.No. 18	(D)
Q.No. 19	(B)
Q.No. 20	(D)
Q.No. 21	(B)
Q.No. 22	(A)
Q.No. 23	(D)
Q.No. 24	(C)
Q.No. 25	(A)
Q.No. 26	(D)
Q.No. 27	(C)
Q.No. 28	(D)
Q.No. 29	(B)
Q.No. 30	(D)
Q.No. 31	(B)
Q.No. 32	(C)
Q.No. 33	(C)
Q.No. 34	(B)
Q.No. 35	(D)
Q.No. 36	(C)
Q.No. 37	(C)
Q.No. 38	(D)
Q.No. 39	(D)

Q.No. 40	(B)