doubtnut
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PHYSICS

BOOKS - D MUKHERJEE PHYSICS (HINGLISH)

MOTION OF CHARGED PARTICLES

Others

1. An electron of mass m_e initially at rest moves through a certain distance in a uniform

electric field in time t_1. A proton of mass m_p also initially at rest takes time t_2 to move through an equal distance in this uniform electric field.Neglecting the effect of gravity, the ratio of t_2 / t_1 is nearly equal to

A. 1

B. $(m_P / m_e)^{1/2}$

C. $\left(\frac{m_e}{m_P}\right)^{1/2}$

D. 1836

Answer: B

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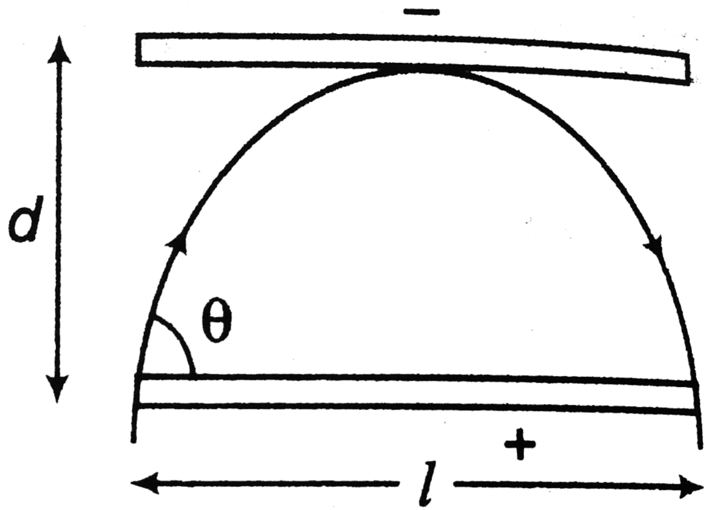
2. An electron enters the region between the plates of a parallel plate capacitor at an angle θ to the plates. The plate width is l, the plate separation is d. The electron follows the path shown just missing the upper plate. Neglect gravity. Then,



A. $\tan\theta = 2d/l$

B. $\tan\theta = 4d/l$

C. $\tan\theta = 8d/l$

D. The data given is insufficient to find a relation between d, l, θ.

Answer: B

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3. Which of the following statements is correct?

A. A charged particle canbe accelerated by a magnetic field.

B. A charged particle cannot be accelerated by a magnetic field.

C. The speed of a charged particle can be increased by a uniform magnetic field.

D. The speed of a charged particle can be increaed by a nonuniform magnetic field.

Answer: A

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4. A charged particle begins to move in a magnetic field, initially parallel to the field. The direction of the field now begins to change, with its magnitude remaining constant

A. The magnitude of the force acting on the particle will remain constant.

B. The magnitude of the force acting on the particle will change.

C. The particle will always move parallel to the field.

D. The speed of the particle will change.

Answer: B

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5. A proton moves horizontally towards a vertical conductor carrying a current upwards. It will be deflected

A. to the left

B. to the right

C. upwards

D. downwards

Answer: D

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6. A charged particle moves with velocity $\overrightarrow{v} = a\hat{i} + d\hat{j}$ in a magnetic field $\overrightarrow{B} = A\hat{i} + D\hat{j}$. The force acting on the particle has magnitude F. Then,

A. $F = 0$, if $aD = dA$

B. $F = 0$ if $aD = -dA$

C. $F = 0$, if $aA = -dD$

D. $F \propto \left(a^2 + b^2\right)^{1/2} \times \left(A^2 + D^2\right)^{1/2}$

Answer: A

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7. A charged particle moves horizontally without deflection near the earth's surface. In this region

A. only electric field is present

B. only vertical magnetic field is present

C. only horizontal magnetic field is present

D. mutually perpendicular electric and magnetic fields are present

Answer: A

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8. Two very long straight parallel wires carry steady currents i and $2i$ in opposite directions. The distance between the wires is d. At a certain instant of time a point charge q is at a point equidistant from the two wires in the plane of the wires. Its instantaneous velocity $\vec{v}$ is perpendicular to this plane. The magnitude of the force due to the magnetic field acting on t he charge at this instant is

A. $\frac{\mu_0 I q v}{2\pi d}$

B. $\frac{\mu_0 I q v}{\pi d}$

C. $\frac{2\mu_0 I q v}{\pi d}$

D. zero

Answer: D

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9. An electron is ejected from the surface of a long, thick straight conductor carrying a current, initially in a direction perpendicular to the conductor. The electron will

A. ultimately return to the conductor

B. move in a circular path around the conductor

C. gradually move away from the conductor along a spiral

D. move in a helical path, with the conductor as the axis

Answer: A

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10. A particle with a specific charge s is fired with a speed v toward a wall at a distance d, perpendicular to the wall. What minimum magnetic field must exist in this region for the particle not to hit the wall?

A. v/sd

B. $2v/sd$

C. $v/2sd$

D. $v/4sd$

Answer: A

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11. A particle with charge q, moving with a momentum p, enters a uniform magnetic field normally. The magnetic field has magnitude B and is confined to a region of width d, where $d < \dfrac{p}{Bq}$, The particle is deflected by an angle q in crossing the field. Then

A. $\sin\theta = \dfrac{BQd}{p}$

B. $\sin\theta = \dfrac{p}{BQd}$

C. $\sin\theta = \dfrac{Bp}{Qd}$

D. $\sin\theta = \dfrac{pd}{BQ}$

Answer: A

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12. Electrons moving with different speeds enter a unifrom magnetic field in a direction perpendicular field. They will move along circular paths .

A. of the same radius

B. with larger radii for the faster electrons

C. with smaller radii for the faster electrons

D. either (b) or (c) depending on the magnitude of the magnetic field

Answer: B

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13. A charged particle entering a magnetic field from outside in a direction perpendicular to the field

A. can never complete one rotation inside the field

B. may or may not complete one rotation in the field dependent on its angle of entry into the field

C. will always complete exactly half of a rotatioin before leaving the field

D. may follow a helical path depending on its angle of entry into the field

Answer: A

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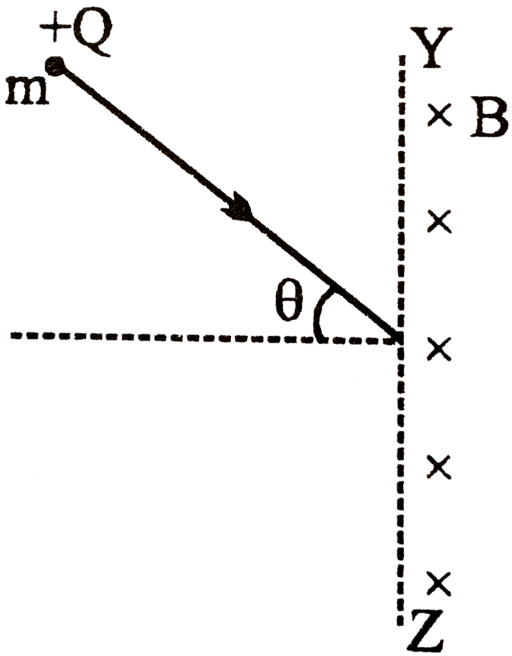
14. A particle with charge $+Q$ and mass m enters a magnetic field to magnitude B existing only of the right of the boundary YZ The direction of the motion of the particle is perpendicular to the direction of B Let $T = 2\pi \frac{m}{QB}$ The time spent by the particle in the field will be



A. $T\theta$

B. $2T\theta$

C. $T\left(\dfrac{\pi + 2\theta}{2\pi}\right)$

D. $T\left(\frac{\pi - 2\theta}{2\pi}\right)$

Answer: C

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15. A charged particle moves undeflected in a region of crossed electric and magnetic fields. If the electric field is switched off, the particle has an initial acceleration a. If the magnetic field is switched off, instead of electric field, the particle will have an initial acceleration

A. equal to 0

B. $> a$

C. equal to a

D. $< a$

Answer: C

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16. A charged particle begins to move from the origin in a region which has a uniform magnetic field in the x-direction and a uniform electric field in the y-direction. Its speed is v when it reaches the point (x, y, z). Then, v will depend

A. only on x

B. only on y

C. on both x and y but not z

D. on x, y and z

Answer: b

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17. A charged particle moving in an electric field

A. must undergo change in velocity

B. must undergo change in speed

C. may not undergo change in velocity

D. may not undergo change in speed

Answer: A::B

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18. A particle having charge to mass ratio 's' starts from rest in a region where the electric field has constant direction but magnitude varying with time t as $E = E_0 t$ .In time t, it is observed that the particle acquire a velocity v after covering a distance x then

A. $v \propto s$

B. $v \propto \sqrt{s}$

C. $v \propto t$

D. $v \propto t^2$

Answer: A::D

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19. In a parallel capacitor the potential difference between the plates is V ,A particle of mass m and charge $-Q$ leaves the negative plate and reaches the positive plate at distance d in time t with a momentum p .Then

A. $m^{1/2}$

B. $Q^{1/2}$

C. $V^{1/2}$

D. V

Answer: A::B::C

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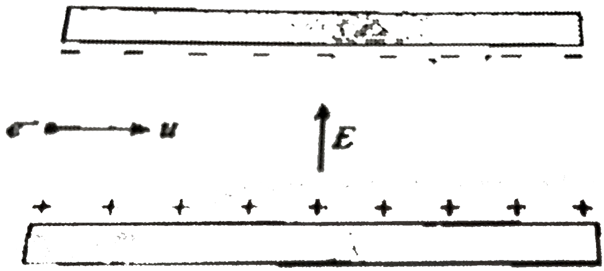
20. A uniform electric field E is established between two parallel charged plates as shown in figure. An electron enter the field symmetrically between the plates with a speed u. The length of each plate is l. if the electron does not stricke any of the plates, find the angle of deviation of the electron as it comes out of the field at the outer end of plates.

$\left[\tan^{-1}\left(\frac{eEl}{\mu^2}\right)\right]$



A. E

B. s

C. l^2

D. u^{-2}

Answer: A::B::C::D

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21. In which of the following situations will a charge experience no force?

A. It is stationary in an electric field.

B. It moves parallel to an electric field.

C. It is stationary in a magnetic field.

D. It moves parallel to a magnetic field.

Answer: C::D

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22. When a charged particle moves in an elecltric or a magnetic field, its speed is v and acceleration is a

A. In a magnetic field v is constant if the particle moves in a circular path, and variable if it moves in a helical path.

B. In a magnetic field, v is always constant

a may or may not ber zero

C. In an electric field, v can never remain

constant.

D. In a uniform electric field, a must be

constant in magnitude and direction.

Answer: B::C::D

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23. A proton moves horizontally towards a vertical conductor with a uniformly distributed positive charge. It will, undergo

A. horizontal deflection

B. vertical deflection

C. no deflection

D. retardation

Answer: C::D

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24. Two parallel conductors carrying current in the same direction attract each other, while two parallel beams of electrons moving in the same direction repel each other. Which of the following statement provide part of all of the reason for this ? (Choose the incorrect option)

A. The conductors are electrically neutral

B. The conductors produce magnetic fields on each other.

C. The electron beams do not produce magnetic fields on each other.

D. The magnetic forces caused by the electron beams on each other are weaker than the electrostatic forces between them.

Answer: A::B::D

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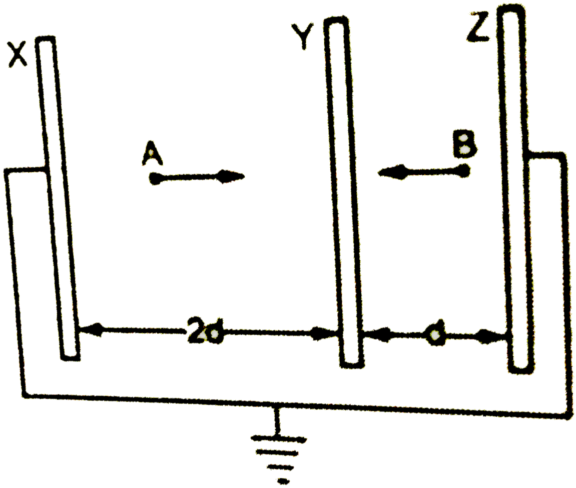
25.



X, Y and Z are parallel plates. Y is given some positive charge. Two electrons A and B start form X and Z respectively and reach Y in times t_A and t_B respectively.

A. $t_A = t_B$

B. $t_A = \sqrt{2}t_B$

C. $2t_A = t_B$

D. $t_A = 2t_B$

Answer: D

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26. Two particles X and Y with equal charges, after being accelerated throuhg the same potential difference, enter a region of uniform magnetic field and describe circular paths of radii R_1 and R_2 respectively. The ratio of the mass of X to that of Y is

A. $(R_1/R_2)^{1/2}$

B. R_2/R_1

C. $(R_1/R_2)^2$

D. R_1/R_2

Answer: C

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27. A proton, a deuteron and an α- particle having the same kinetic energy are moving in circular trajectors in a constant magnetic field. If r_p, r_d and r_α denote respectively the radii of the trajectories of these particles then

A. $r_a = r_P = r_d$

B. $r_a > r_d > r_P$

C. $r_a = r_d > r_P$

D. $r_P = r_d = r_a$

Answer: A

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28. A neutral atom which is stationary at the origin in gravity -free space emits an α-particle (A) in the z-direction. The product atom is P. A uniform magnetic field exists in the x-direction. Disregard the electrostatic forces between A and P.

A. A and P will move along circular parths of equal radii.

B. A has greater time period of rotation than P

C. A has greater kinetic energy than P

D. A and P will meet again somewhere in the yz plane.

Answer: A::C::D

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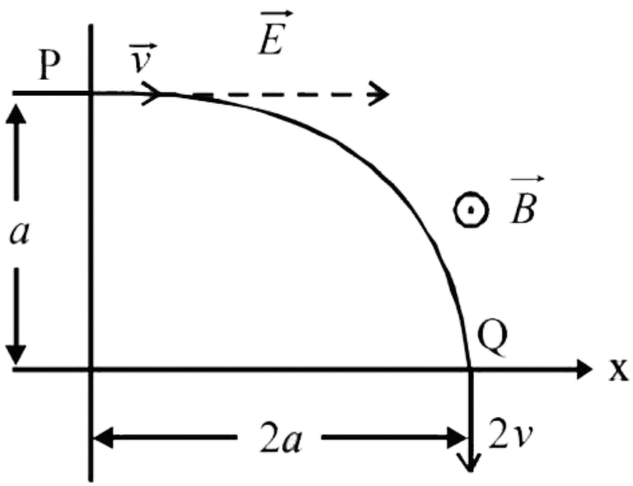
29. A particle of charge $+q$ and mass m moving under the influence of a uniform electric field $E\hat{i}$ and uniform magnetic field $B\hat{k}$ follows a trajectory from $P \rightarrow Q$ as shown in fig. The velocities at P and Q are $v\hat{i}$ and $-2v\hat{j}$. which of the following statement(s) is/are correct ?



A. $E = \frac{3}{4}\left(\frac{mv^2}{qa}\right)$

B. The rate of work done by the electric field at P is $\frac{3}{4}\left(\frac{mv^3}{a}\right)$

C. The rate of work done by the electric field at P is 0.

D. The rate of work done by both the fields at Q is 0

Answer: A::B::D

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30. Two long, thin,parallel conductor are kept very close to each other, without touching. One carries a current I, and the other has charge λ per unit length. An electron moving parallel to the conductors is undeflected. Let $C =$ velocity of light.

A. $v = \frac{\lambda c^2}{i}$

B. $v = \frac{i}{\lambda}$

C. $c = \frac{i}{\lambda}$

D. The electron may be at any distance from the conductor.

Answer: A::D

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31. A region has uniform electric and magnetic fields along the positive x-direction. An electron is fired from the origin at an angle $\theta(< 90^\circ)$ with the x-axis. It will

(i) move along a helical path of increasing pitch

(ii) move along a helical path of decreasing pitch initially

(iii) return to the yz plane at some time

(iv) come to rest momentarily at some position

A. move along a helical path of increasing pitch

B. move along a helical path of decreasing pitch initially

C. return to the yz plane at some time

D. come to rest momentarily at some position

Answer: B::C

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32. A charged particle P leaves the origin with speed $v = v_0$ at some inclination with the x-axis. There is a uniform magnetic field B along the x-axis. P strikes a fixed target T on the x-axis for a minimum value of $B = B_0$. P will also strike T if

A. $B = 2B_0, v = 2v_0$

B. $B = 2B_0, v = v_0$

C. $B = B_0, v = 2v_0$

D. $B = B_0/2, v = 2v_0$

Answer: A::B

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33. A charged particle is fired at an angle θ to a uniform magnetic field directed along the x-axis. During its motionalong a helical path, the particle will

A. never move parallel to the x-axis

B. move parallel to the x-axis once during every rotation for all values of θ

C. move parallel to the x-axis at least once during every rotation if $\theta = 45^\circ$

D. never move perpendicular to the x-direction

Answer: A::D

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34. A rectangular, horizontal conducting frame carries current, flowing clockwise as seen from above,. P is a point vertically above the centre of the frame. The direction of the magnetic field at P due to the current is

A. vertically upwards

B. horizontal, prallel to the loner sides of the frame

C. vertically downwards

D. horizontal parallel to the diagonal of the frame

Answer: A

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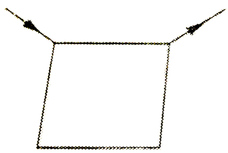
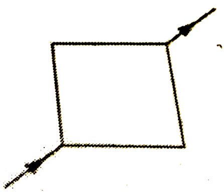
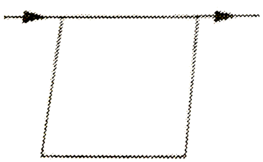
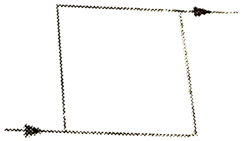
35. Current flows through uniform square frames as shown. In which case is the magnetic field at the centre of the frame not zero ?

A. 

B. 

C. 

D. 

Answer: A

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36. A long, narrow beam of electrons, of uniform cross-section consists of electrons moving with velcity v ($c =$ velocity of light). The ratio of the electric field to the magnetic field at any point near the beam is

A. v

B. c

C. c^2 / v

D. v^2 / v

Answer: A

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37. A long, straight conductor lies along the axis of a ring. Both carry current I. The force on the ring is proportional to

A. I

B. $I^{3/2}$

C. I^2

D. zero

Answer: A

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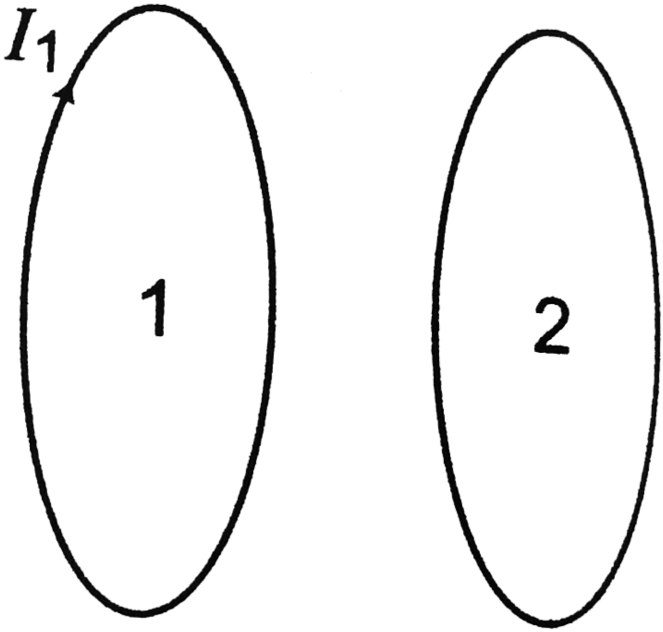
38. Two loops are facing each other as shown in Figure. State whether the loops will attract each other or repel each other if current I_1 is increased



A. in all cases

B. only if I is decreasing

C. only if I is decreasing

D. if I is changing

Answer: A

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39. A pair of long, smooth, parallel, horizontal, conducting rails are joined to a cell at one end. There are no external electric or magnetic fields. A metal rod is placed on the rails. The rod will

A. remain stationary

B. move towards the cell

C. move away from the cell

D. oscillate

Answer: A

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40. A flat, rectangular coil, carrying current is placed beside a long, straight conductor carrying current. The two are coplanar. The net force and net torque experienced by the coil are F and τ

A. $F = 0, \tau = 0$

B. $F \neq 0, \tau = 0$

C. $F \neq 0, \tau \neq$

D. $F = 0, \tau \neq$

Answer: A

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41. A small bar magnet moves along the axis of a flat, closed coil. The magnet will attract the coil

A. only when it moves towards the coil

B. only when it moves away from the coil

C. both a and b

D. only if its south pole is facing the coil

Answer: A

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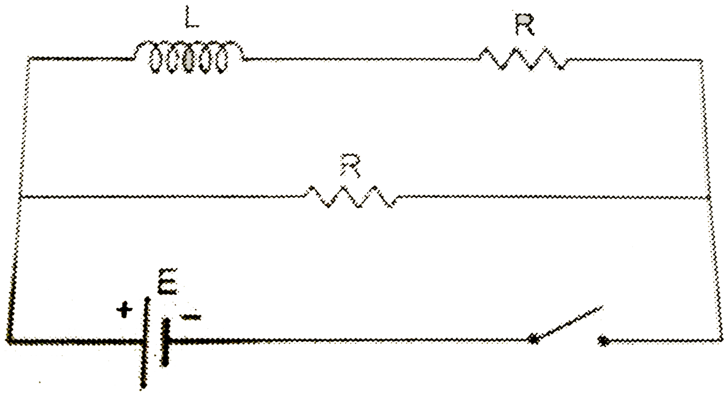
42.



A coil of self -inductance L and resistance R is connected to a resistance R and a cell of emf E as shown. The switch is kept closed for a long time and then opened. The heat produced in the coil, after opening the switch is

A. $LE^2 / 2R^2$

B. $LE^2/4R^2$

C. $LE^2/8R^2$

D. $2LE^2/3R^2$

Answer: A

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43. If L and C denote inductance and capacitance then the quantity L/C has the same dimension as

A. time

B. $(\text{time})^{-1}$

C. resistance $\times$ time

D. $(\text{resistance})^2$

Answer: A

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44. A metal ring is placed in a magnetic field, with its plane $\perp$ to the field. If the magnitude of the field begins to change, the ring will experience

A. a net force

B. a torque about its axis

C. a torque about a diameter

D. a tension along its length

Answer: A

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45. A metal rod of length l pivoted at is upper end. It is released from a horizontal position. There is a uniform magnetic field $\perp$ to its plane of rotation. When it becomes vertical, the p.d. across its ends is proportional to

A. $l^{1/2}$

B. l

C. $l^{3/2}$

D. l^2

Answer: A

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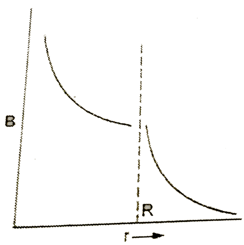
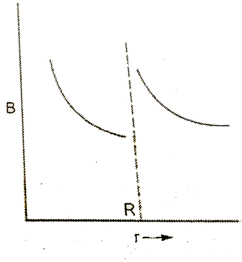
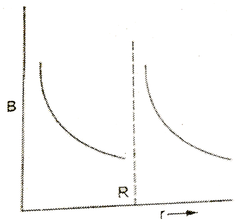
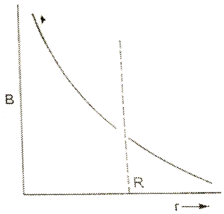
46. A thin, straight conductor lies along the axis of a hollow conductor of radius R. The two carry equal currents in the same direction. The magnetic field B is plotted against the distance r from the axis. Which of the following best represents the resulting curve?

A. 

B. 

C. 

D. 

Answer: A

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47. A solenoid is connected to a cell. There is no resistance in the circuit. If the current I flowing in the circuit is plotted against time t, the slope of the curve (dI/dt) will

A. increase with time

B. decrease with time

C. remain constant

D. be almost infinite

Answer: C

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48. In a region of space with mutually perpendicular electric and magnetic fields, a charged particle moves without deflection, with a speed very much smaller tan the speed of light in vacuum (c). The energy densities due to the electric and magnetic fields are u_E and u_B respectively.

A. $u_E = u_B$

B. $u_E < u_B$

C. $u_E > u_B$

D. the data is not sufficient to reach a conclusion.

Answer: A

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49. A charged particle passes through a uniform electric field existing between the parallel plates of a capacitor. The length of each plate is l. Its initial velocity is parallel to the plates. When it emerges from the field, its deflection from its initial path is δ, and its angular deflection from its initial directioin θ. Then,θ is equal to

A. δ / l

B. $2\delta / l$

C. $\delta / 2l$

D. none of these

Answer: A

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50. A particle of mass m and charge q is projected into a region having a perpendicular magnetic, field B. Find the angle of deviation of the particle as it comes out of the magnetic field if th,, width of the region is (b)

(a) $\frac{2mv}{Bq}(b)$(mv)/(Bq)(c)(mv)/(2 Bq)`

A. $\pi / 4$

B. $\pi / 3$

C. $\pi / 2$

D. π

Answer: A

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51. A ring of area A and resistance R is placed on the axis of a solenoid. The mutual inductance between them is M. When the current in the solenoid changes at the rate of I, the magnetic moment of the ring is

A. $ARMI$

B. AI / RM

C. MRI / A

D. AMI / R

Answer: A

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52. A long straight conductor carries current I. Assume that every charge carrier in it moves with the same drift velocity v. An observer moves parllel to the conductor, in the direction of the current, with a constant velocity $v/2$. He will observe that the current flowing in the conductor is

A. $I/2$

B. I

C. $3I/2$

D. Zero

Answer: A

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53. The flux linked with a coil is $0.8Wb$ when $2A$ current flows thorugh it. If this current begins to increase at the rate of $0.4A/s$, the emf induced in the coil will be

A. $0.02V$

B. $0.04V$

C. $0.08V$

D. $0.16V$

Answer: A

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54. A small flat coil carrying current has magnetic moment μ. It is placed in an external magnetic field B. The maximum potential energy of the system can be

A. $\mu B / 2$

B. μB

C. $\mu B In 2$

D. $2\mu B$

Answer: A

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55. An electron moving in a circular orbit of radius r makes n rotation per secound. The magnetic field produced at the centre has magnitude

A. $\mu_0 \omega e / 2r$

B. $\mu_0 \omega e / 2\pi r$

C. $\mu_0 \omega e / 4\pi r$

D. $\mu_0 \omega^2 e / 4\pi r$

Answer: A

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56. A small, flat coil of resitance r is placed at the centre of a large, closed coil of resistance R. The coils are coplanar. Their mutual inductance is M. Initially a constant current i was flowing in the inner coil. If this curent is suddenly swithced off, what charge will circulate in the outer coil?

A. Mir / R^2

B. MiR / r^2

C. Mi / R

D. Mi / r

Answer: A

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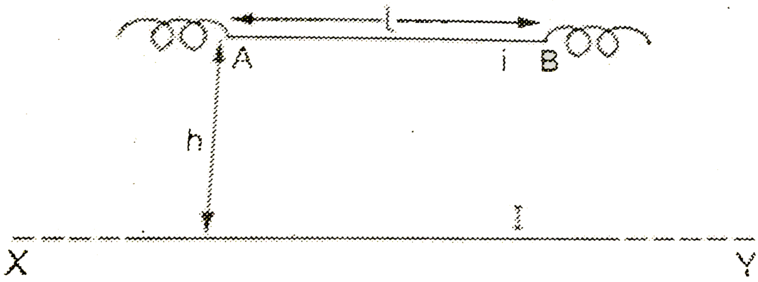
57. 

A conductro AB carrying current i is placed vertically above and parallel to a long horizontal conductor XY carrying current I. Assume that AB is free to move and that the wires through which currents enter and leave it do no exert any forces on it. If AB is in equilibrium

A. $i = I$

B. i and I must flow in the same directiion

C. the equilibrum of AB is usntable

D. if AB is given a small vertical displacement it will undergo oscillations

Answer: A

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58. There is a uniform magnetic field B normal to the xy plane. A conductor ABC has length $AB = l_1$, parallel to the x axis, and lengthh

$BC = l_2$ parallel to the y-axis. ABC moved in the xy plane with velocity $v_x \hat{i} + v_y \hat{j}$. The potential difference between A and C is proportional to

A. $v_x l_1 + v_y l_2$

B. $v_x l_2 + v_y l_1$

C. $v_x l_2 - v_y l_1$

D. $v_x l_1 - v_y l_2$

Answer: A

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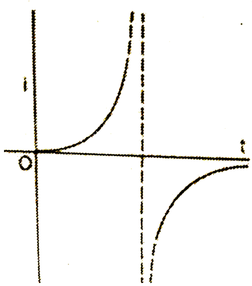
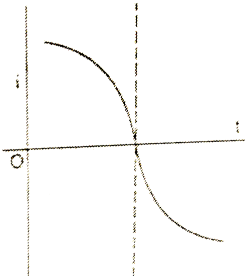
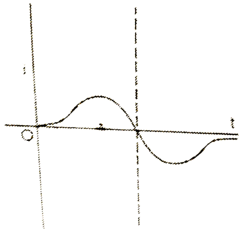
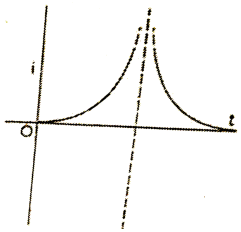
59. A long bar magnet moves with constant velocity along the axis of a fixed metal ring. It stars form a large distance from the ring, passes through the ring and then moves away far from the ring. The current i flowing in the ring is plotted against time t. Which of the following best represents the resulting curve?

A. 

B. 

C. 

D. 

Answer: A

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60. In a cell, or accumulatr battery, current flows inside the cell from the negatilve plate to the positive plate when

A. it drives currents through an external resistance

B. it is being charged from an external source

C. its emf is being measured by a potentiometer and the balance position has been reached.

D. when it is connected to a charged capacitor whose potential diefference is greater than its emf, and its positive and negative plates are connected to the plates of similar polarities of the capacitor.

Answer: A

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