Topic : Magnetism and magnetic material

1. An electron with kinetic energy K_1 enters between parallel plates of a capacitor at an angle $'\alpha'$ with the plates . It leaves the plates at an angle $'\beta'$ with kinetic energy K_2 . Then the ratio of kinetic energies $K_1 : K_2$ will be :

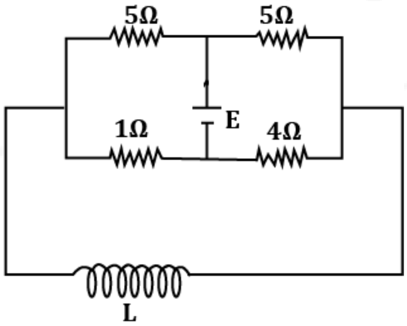
   A. $\dfrac{\sin^2\beta}{\cos^2\alpha}$

   B. $\dfrac{\cos^2\beta}{\cos^2\alpha}$

   C. $\dfrac{\cos\beta}{\sin\alpha}$

   D. $\dfrac{\cos\beta}{\cos\alpha}$

2. The current I at time $t = 0$ and $t = \infty$ respectively for the given circuit is :



   A. $\dfrac{18E}{55}, \dfrac{5E}{18}$

   B. $\dfrac{5E}{18}, \dfrac{18E}{55}$

   C. $\dfrac{5E}{18}, \dfrac{10E}{33}$

   D. $\dfrac{10E}{33}, \dfrac{5E}{18}$

3. A proton, a deuteron and an α - particle are moving with the same momentum in a uniform magnetic field. The ratio of magnetic forces acting on them and the ratio of their speeds are respectively :

A. $2:1:1$ and $4:2:1$

B. $1:2:4$ and $2:1:1$

C. $1:2:4$ and $1:1:2$

D. $4:2:1$ and $2:1:1$

4. Magnetic fields at two points on the axis of a circular coil at a distance of $0.05\ \mathrm{m}$ and $0.2\ \mathrm{m}$ from the centre are in the ratio $8:1$. The radius of coil is :

A. $0.15\ \mathrm{m}$

B. $0.2\ \mathrm{m}$

C. $0.1\ \mathrm{m}$

D. $1.0\ \mathrm{m}$

5. A charge Q is moving $\overrightarrow{dl}$ distance in the magnetic field $\overrightarrow{B}$. Find the value of work done by $\overrightarrow{B}$.

A. Infinite

B. 1

C. -1

D. Zero

6. An aeroplane, with its wings spread $10 \mathrm{~m}$, is flying at a speed of $180 \mathrm{~km} / \mathrm{h}$ in a horizontal direction. The total intensity of earth's field at that part is $2.5 \times 10^{-4} \mathrm{~Wb} / \mathrm{m}^{2}$ and the angle of dip is 60°. The emf induced between the tips of the plane wings will be :

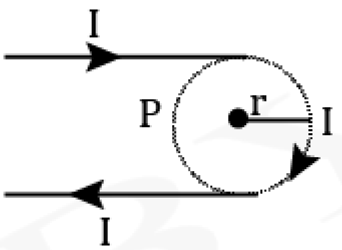
A. $88.37 \mathrm{~mV}$

B. $62.50 \mathrm{~mV}$

C. $54.125 \mathrm{~mV}$

D. $108.25 \mathrm{~mV}$

7. A hairpin like shape as shown in figure is made by bending a long current carrying wire. What is the magnitude of a magnetic field at point P which lies on the centre of the semicircle?



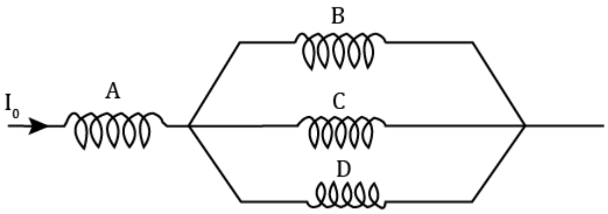
A. $\frac{\mu_0 I}{4 \pi r}(2-\pi)$

B. $\frac{\mu_0 I}{4 \pi r}(2+\pi)$

C. $\frac{\mu_0 I}{2 \pi r}(2+\pi)$

D. $\frac{\mu_0 I}{2 \pi r}(2-\pi)$

8. Four identical long solenoids A, B, C and D are connected to each other as shown in the figure. If the magnetic field at the center of A is $3\ \mathrm{T}$, the field at the center of C would be: (Assume that the magnetic field is confined within the volume of respective solenoid.)



A. $6\ \mathrm{T}$

B. $12\ \mathrm{T}$

C. $1\ \mathrm{T}$

D. $9\ \mathrm{T}$

9. A plane electromagnetic wave propagating along $y-$direction can have the following pair of electric field $(\vec{E})$ and magnetic field $(\vec{B})$ components -

A. E_x, B_z or E_z, B_x

B. E_y, B_x or E_x, B_y

C. E_y, B_y or E_x, B_x

D. E_y, B_y or E_z, B_z

10. Figure A and B shown two long straight wires of circular cross-section (a and b with a<b). carryingcurrent Iwhich is uniformly distributed across the cross-section. The magnitude of magnetic field B varies with radius r ad can be represented as:

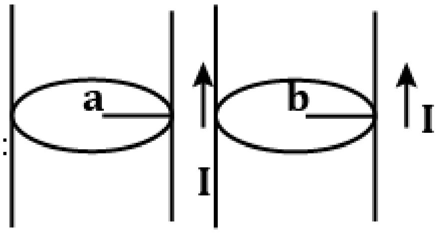
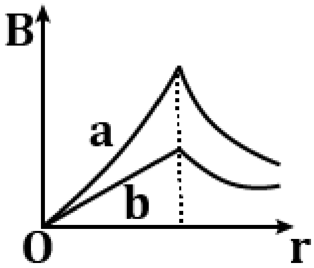


Fig A Fig B

A.



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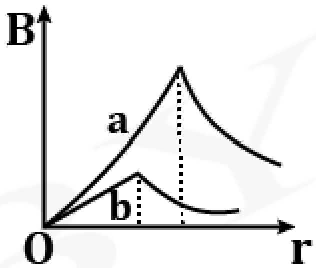
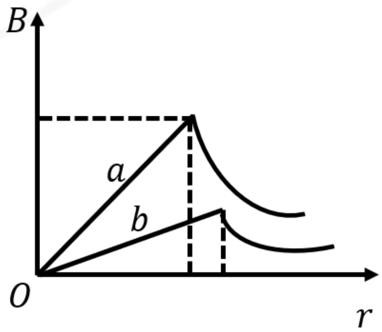
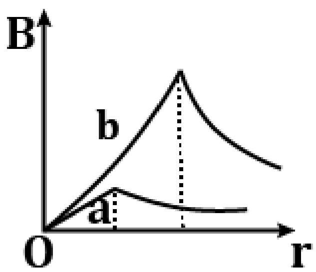


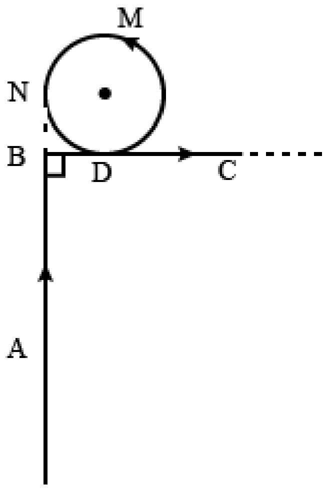
C.



D.



11. A very long wire ABDMNDC is shown in figure carrying current I. AB and BC parts are straight, long and at right angle. At D wire forms a circular turn DMND of radius R. AB, BC parts are tangential to circular turn at N and D. Magnetic field at the centre of circle is



A. $\frac{\mu_0 I}{2\pi R}\left(\pi + \frac{1}{\sqrt{2}}\right)$

B. $\frac{\mu_0 I}{2\pi R}\left(\pi - \frac{1}{\sqrt{2}}\right)$

C. $\frac{\mu_0 I}{2\pi R}(\pi + 1)$

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

12. A particle of mass m and charge q has an initial velocity $\vec{v} = v_0\hat{j}$. If an electric field $\vec{E} = E_0\hat{i}$ and magnetic field $\vec{B} = B_0\hat{i}$ act on the particle, its speed will double after a time :

A. $\frac{2mv_0}{qE_0}$

B. $\frac{3mv_0}{qE_0}$

C. $\frac{\sqrt{3}mv_0}{qE_0}$

D. $\frac{\sqrt{2}mv_0}{qE_0}$

13. A long, straight wire, of radius a, carries a current distributed uniformly over its cross-section. The ratio of the magnetic fields due to the wire, at distances $\frac{a}{3}$ and $2a$ respectively from the axis of the wire, is:

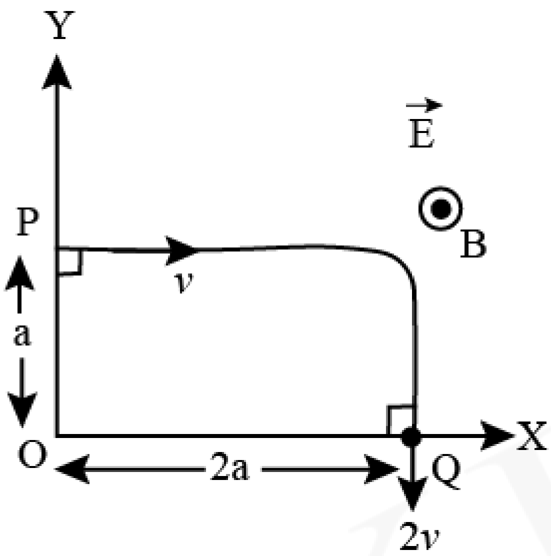
A. $\frac{2}{3}$

B. 2

C. $\frac{1}{2}$

D. $\frac{3}{2}$

14. A charged particle of mass m and charge q, moving under the influence of a uniform electric field $E\,\hat{i}$ and a uniform magnetic field $B\,\hat{k}$, follows a trajectory from point P to Q as shown in figure. The velocities at P and Q are respectively, $v\hat{i}$ and $-2v\hat{j}$. Then, which of the following statements (A, B, C, D) are correct? (Trajectory shown is schematic and not to scale)



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

(B) Rate of work done by the electric field at P is $\frac{3}{4}\left(\frac{mv^2}{a}\right)$.

(C) Rate of work done by both the fields at Q is zero.

(D) The difference between the magnitude of angular momentum of the particle at P and Q is $2mav$.

A. $A,\ C,\ D$

B. $B,\ C,\ D$

C. $A,\ B,\ C$

D. $A,\ B,\ C,\ D$

15. A proton with kinetic energy of $1\ \mathrm{MeV}$ moves from south to north. It gets an acceleration of $10^{12}\ \mathrm{ms}^{-2}$ by an applied magnetic field (west to east). The value of magnetic field:
$(\text{Rest mass of proton is } 1.6 \times 10^{-27}\ \mathrm{kg})$

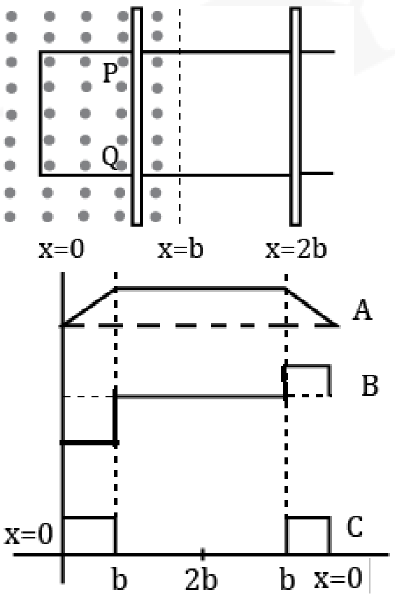
A. $0.71\ \mathrm{mT}$

B. $7.1\ \mathrm{mT}$

C. $0.071\ \mathrm{mT}$

D. $71\ \mathrm{mT}$

16. The arm PQ of a rectangular conductor is moving from $x = 0$ to $x = 2b$ outwards and then inwards from $x = 2b$ to $x = 0$ as shown in the figure. A uniform magnetic field perpendicular to the plane is acting from $x = 0$ to $x = b$. Identify the graph showing the variation of different quantities with distance.



A. A-Flux, B-Power dissipated, C-EMF

B. A-Power dissipated, B-Flux, C-EMF

C. A-Flux, B-EMF, C-Power dissipated

D. A-EMF, B-Power dissipated, C-Flux

17. Intensity of sunlight is observed as $0.092\ \mathrm{Wm}^{-2}$ at a point in free space. What will be the peak value of magnetic field at that point ? $\left(\varepsilon_0 = 8.85 \times 10^{-12}\ \mathrm{C^2 N^{-1} m^{-2}}\right)$

A. $2.77 \times 10^{-8}\ \mathrm{T}$

B. $1.96 \times 10^{-8}\ \mathrm{T}$

C. $8.31\ \mathrm{T}$

D. $5.88\ \mathrm{T}$

18. The fractional change in the magnetic field intensity at a distance r from center on the axis of current carrying coil of radius $'a'$ to the magnetic field intensity at the centre of the same coil is $(r << a)$

A. $\dfrac{3\,a^2}{2\,r^2}$

B. $\dfrac{2\,a^2}{3\,r^2}$

C. $\dfrac{2\,r^2}{3\,a^2}$

D. $\dfrac{3\,r^2}{2\,a^2}$

19. A coaxial cable consists of an inner wire of radius a surrounded by an outer shell of inner and outer radii b and c respectively. The inner wire carries an electric current i_0, which is distributed uniformly across cross-sectional area. The outer shell carries an equal current in opposite direction and distributed uniformly. What will be the ratio of the magnetic field at a distance x from the axis when (i) $x < a$ and (ii) $a < x < b$?

A. $\dfrac{x^2}{a^2}$

B. $\dfrac{a^2}{x^2}$

C. $\dfrac{x^2}{b^2 - a^2}$

D. $\dfrac{b^2 - a^2}{x^2}$

20. A current of $1.5\ A$ is flowing through a triangle, of side $9\ \mathrm{cm}$ each. The magnetic field at the centroid of the triangle is
(Assume that the current is flowing in the clockwise direction.)

A. $3 \times 10^{-5}\ \mathrm{T},\ \text{inside the plane of triangle}$

B. $3 \times 10^{-7}\ \mathrm{T},\ \text{outside the plane of triangle}$

C. $2\sqrt{3} \times 10^{-5}\ \mathrm{T},\ \text{inside the plane of triangle}$

D. $2\sqrt{3} \times 10^{-7}\ \mathrm{T},\ \text{outside the plane of triangle}$

21. In a ferromagnetic material below the Curie temperature, a domain is defined as:

A. a macroscopic region with consecutive magnetic dipoles oriented in opposite direction.

B. a macroscopic region with zero magnetization.

C. a macroscopic region with saturation magnetization.

D. a macroscopic region with randomly oriented magnetic dipoles.

22. A soft ferromagnetic material is placed in an external magnetic field. The magnetic domains:

A. decrease in size and changes orientation.

B. may increase or decrease in size and change its orientation.

C. increase in size but no change in orientation.

D. have no relation with external magnetic field.

23. Which of the following statements are correct?

(A) Electric monopoles do not exist, whereas magnetic monopoles exist.

(B) Magnetic field lines due to a solenoid at its ends and outside cannot be completely straight and are confined.

(C) Magnetic field lines are completely confined within a toroid.

(D) Magnetic field lines inside a bar magnet are not parallel.

(E) $\chi = -1$ is the condition for a perfect diamagnetic material, where χ is its magnetic susceptibility.

Choose the correct answer from the options given below.

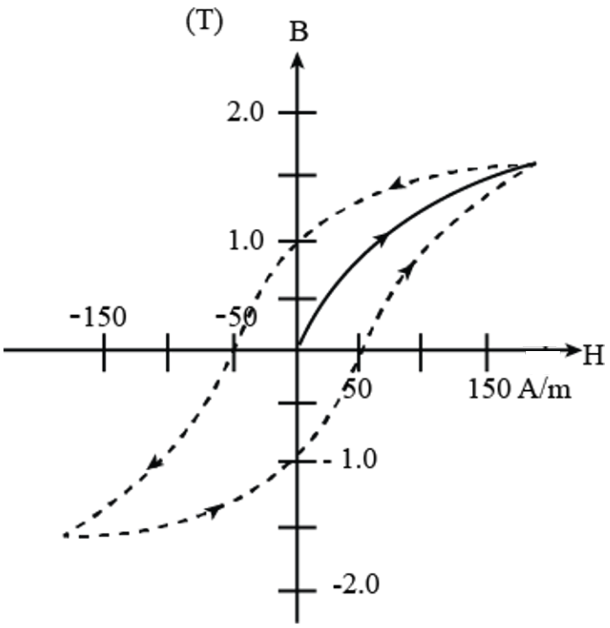
A. (B) and (C) only

B. (B) and (D) only

C. (C) and (E) only

D. (A) and (B) only

24.



The figure gives experimentally measured B vs H variation in a ferromagnetic material. The retentivity, co-ercivity and saturation magnetization, respectively, of the material are:

A. 1.5 T, 50 A/m and 2.0 T

B. 1.5 T, 50 A/m and 1.0 T

C. 150 A/m, 1.0 T and 1.0 T

D. 1.0 T, 50 A/m and 1.5 T

25. A wire carrying current l is bent in the shape $ABCDEFA$ as shown, where rectangle $ABCDA$ and $ADEFA$ are perpendicular to each other. If the sides of the rectangles are of length a and b, then the magnitude and direction of magnetic moment of the loop $ABCDEFA$ is

A. abl, along $\left(\frac{\hat{j}}{\sqrt{2}}+\frac{\hat{k}}{\sqrt{2}}\right)$

B. $\sqrt{2}abl$, along $\left(\frac{\hat{j}}{\sqrt{2}}+\frac{\hat{k}}{\sqrt{2}}\right)$

C. $\sqrt{2}abl$, along $\left(\frac{\hat{j}}{\sqrt{5}}+\frac{2\hat{k}}{\sqrt{5}}\right)$

D. abl, along $\left(\frac{\hat{j}}{\sqrt{5}}+\frac{2\hat{k}}{\sqrt{5}}\right)$

26. Magnetic materials used for making permanent magnets (P) and magnets in a transformer (T) have different properties of the following, which property best matches for the type of magnet required?

A. T : Large retentivity, small coercivity

B. P : Small retentivity, large coercivity

C. T : Large retentivity, large coercivity

D. P : Large retentivity, large coercivity

27. At an angle of 30° to the magnetic meridian, the apparent dip is 45°. Find the true dip :

A. $\tan^{-1}\sqrt{3}$

B. $\tan^{-1}\frac{1}{\sqrt{3}}$

C. $\tan^{-1}\frac{2}{\sqrt{3}}$

D. $\tan^{-1}\frac{\sqrt{3}}{2}$

28. The magnetic susceptibility of a material of a rod is 499. Permeability in vacuum is $4\pi \times 10^{-7}\ \mathrm{H/m}$. Absolute permeability of the material of the rod is :

A. $4\pi \times 10^{-4}\ \mathrm{H/m}$

B. $2\pi \times 10^{-4}\ \mathrm{H/m}$

C. $3\pi \times 10^{-4}\ \mathrm{H/m}$

D. $\pi \times 10^{-4}\ \mathrm{H/m}$

29. Statement I : The ferromagnetic property depends on temperature. At high temperature, ferromagnet becomes paramagnet.
Statement II : At high temperature, the domain wall area of a ferromagnetic substance increases.

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

A. Statement I is true, but Statement II is false.

B. Both Statement I and Statement II are true.

C. Both Statement I and Statement II are false.

D. Statement I is false, but Statement II is true.

30. Choose the correct option :

A. True dip is not mathematically related to apparent dip.

B. True dip is less than apparent dip.

C. True dip is always greater than the apparent dip.

D. True dip is always equal to the apparent dip.