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QUESTION PAPER FOR CBT AUGUST 2023-24

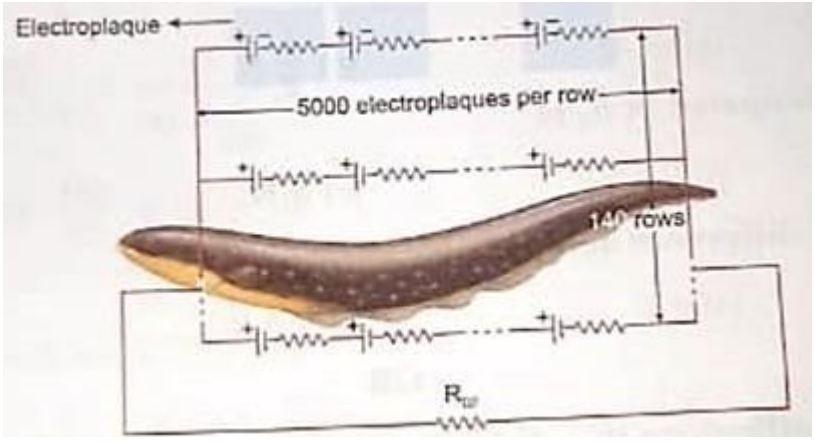
CLASS :-XII SUBJECT :-PHYSICS

TOPIC :- ELECTRIC CURRENT AND MGNEI'IC EFFECT OF ELECTRIC CURRENT

CASE STUDY – I

Eel: The Electíic Fish

Electric fish are able to generate current with biological cells called electroplaques, which are physiological emf devices. The electro-plaques in the South American ell shown in the photograph that open his chapter are arranged in 140 rows, each row stretching horizontally along the body and each containing 5000 electro-plaques. The arrangement is suggested in figure each electro-plaque has an emf (*E*) of 0.15V and an internal resistance (*r*) of 0.25 ohm. The water surrounding the eel completes a circuit between the two ends of the electroplaque array, one end at the animal's head and other near its tail.



Q1. For a cell, the terminal potential difference is 3.6 V, when the circuit is open. If the potential difference reduces to 3 V, when cell is connected to a resistance of 5 ohm, the internal resistance of cell is *

- (a) 1 Ω
- (b) 2 Ω
- (c) 4 Ω
- (d) 8 Ω

Ans – A

Feedback - r = (E/V -1)R = [(3.6/3) -1] * 5 = 1 ohm

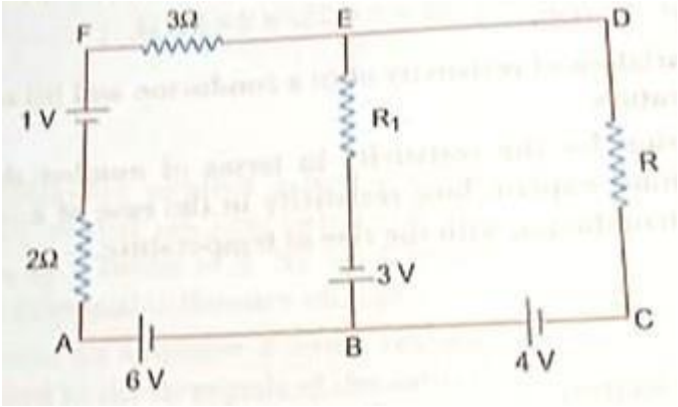
Q2. **If the water surrounding the eel has resistance R = 800 ohm, how much current can the eel produce in the water?** *

- (a) 6.6 mA
- (b) 6.6 A
- (c) 0.93 A
- (d) 9.3 mA

Ans – C

Feedback - internal resistance of each row = 0.25*5000 = 1250 ohm
internal resistance due to 140 column = 1250/140 = 125/14 ohm = 8.92 ohm
emf due to each row = 0.15*5000 = 750 V (it is emf across two ends)
I= E/(R+r) = 750/(800 + 8.92) = 0.93 A

Q3. **Use Kirchhoff's rules to determine the potential difference between the points *A* and *D* when no current flow in the arm *BE* of the electric network shown in the figure.** *



- (a) 9V
- (b))2V
- (c) 10V
- (d) 1V

Ans – A

Feedback - $V_{DA} = V_{DE} + V_{EB} + V_{BA} = 0 + 3V + 6V = 9V$
(As no current flow in arm BE so voltage across resistance R1 is zero)

CASE STUDY – II
BIOT - SAVART LAW

The Biot-Savart law, named after the French physicists Jean-Baptiste Biot and Félix Savart, describes the relationship between a current-carrying element and the magnetic field it produces at a point in space. Magnetic field $\overrightarrow{dB}$ produced by a current-carrying element of length dl at a distance r from current element is given by:

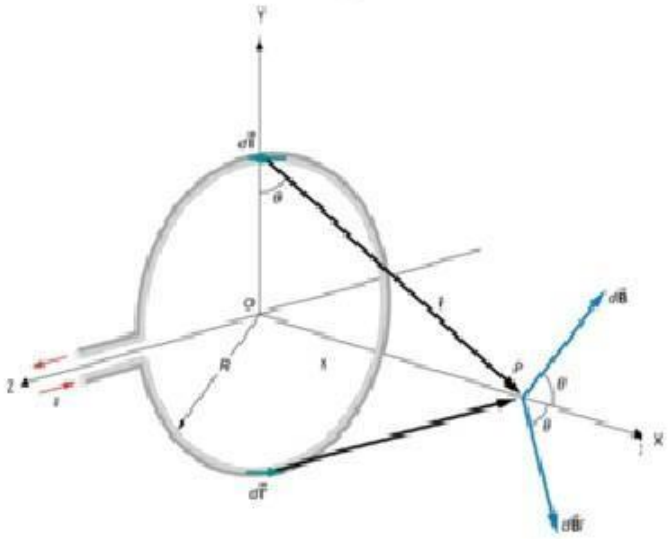
$$\overrightarrow{dB} = \frac{\mu_0}{4\pi} \frac{i\,\vec{dl} \times \vec{r}}{r^3}$$

Where $\mu_0 = 4\pi \times 10^{-7}\ TmA^{-1}$ is permeability of free space.

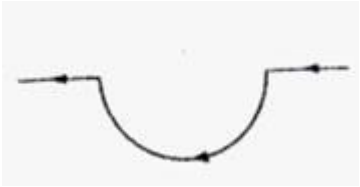
The Biot-Savart law is used to determine the magnetic field produced by simple and complex current distributions. It allows for the calculation of magnetic fields around straight wires, circular loops, solenoids and more intricate current configurations.

Magnetic field due to a circular current-carrying loop at a point on the axis of the loop is given by:

$$\mathbf{B} = B_x\hat{\mathbf{i}} = \frac{\mu_0 I R^2}{2\left(x^2+R^2\right)^{3/2}}\hat{\mathbf{i}}$$



Q4. A straight wire carrying current of 12 A is bent into a semicircular arc of radius 2.0 cm . What is the magnitude and direction of **B** at the centre of the arc? *



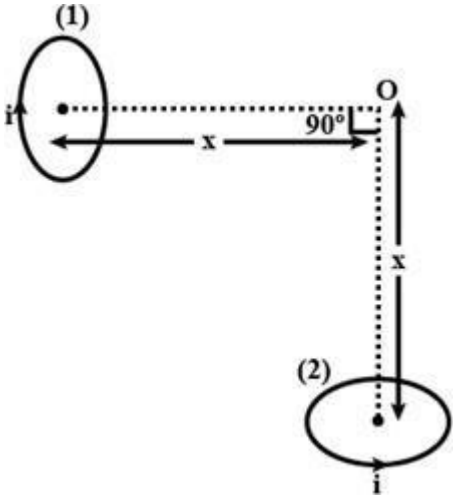
(a) 1.9 x 10^-4 ,normally into the plane of paper
(b) 1.9 x 10^4 normally into the plane of paper

(c)1.9 x 10^-4 normally out of the plane of paper
(d) 1.9 x 10^4 normally out of the plane of paper

Ans – A

Feedback - B =1/2 * $\mu_0 I/2R = 1/2 * (4\pi*10^{-7}*12)/(2*2*10^{-2}) = 1.9 \times 10^{-4}$
Direction is into the plane of paper as per right hand thumb rule.

Q5. Two small identical circular loops, marked (1) and (2), carrying equal currents, *are placed with the geometrical axes perpendicular each other as shown on figure. The magnitude and direction of the net magnetic field produced at the point O is



(a) $\frac{\mu_0 i R^2}{2\sqrt{2}(R^2+x^2)^{1/2}}$, B directed at an angle $\frac{\pi}{4}$ with the direction of magnetic field B_1

(b) $\frac{\mu_0 i x^2}{\sqrt{2}(R^2+x^2)^{3/2}}$, B directed at an angle $\frac{\pi}{2}$ with the direction of magnetic field B_1

(a) (b)

(c) $\sqrt{2}\frac{\mu_0 i R^2}{2(R^2+x^2)^{3/2}}$, **B** directed at an angle $\frac{\pi}{4}$ with the direction of magnetic field $\mathbf{B_1}$

(d) $\sqrt{2}\frac{\mu_0 R^2}{2i(R^2+x^2)^{3/2}}$, **B** directed at an angle $\frac{\pi}{4}$ with the direction of magnetic field $\mathbf{B_1}$

(c) (d)

Ans -C

Feedback - $B_1 = (\mu_0 I R^{2})/2 (R^2 + x^2)^{3/2}$ and $B_2 = (\mu_0 I R^{2})/2 (R^2 + x^2)^{3/2}$
We can see that B1 = B2

Resultant $B = \sqrt{B1^2 + B2^2} = \sqrt{2}B_1 = \sqrt{2}\,(\mu_0 I R^{2})/2 (R^2 + x^2)^{3/2}$

Q6. Biot-Savart law indicates that the moving electrons (velocity v) produce a magnetic field B such that: *

(a) B ⊥ v

(b) B || v

(c) it obeys inverse cube law.

(d) it is along the line joining the electron and point of observation.

Ans – A
Feedback - as per formula B = q(**v × B)** **we get** B ⊥ v

Paragraph-III

Magnetic Properties of Materials

Based on the behavior of materials in the magnetic field, the magnetic materials are divided into three categories. the types of categorization related to the types of materials include diamagnetic materials, paramagnetic materials, and ferromagnetic materials. When diamagnetic substances produce negative magnetization when placed in an external magnetic field, magnetic fields repel diamagnetic substances. Paramagnetic substances have a small net magnetic moment in the direction of the applied field. the magnetic field attracts paramagnetic substances. In a magnetic field, Feííomagnetic materials are strongly attracted. Magnetism is retained in the Ferromagnetic materials even after removing the magnetic field.

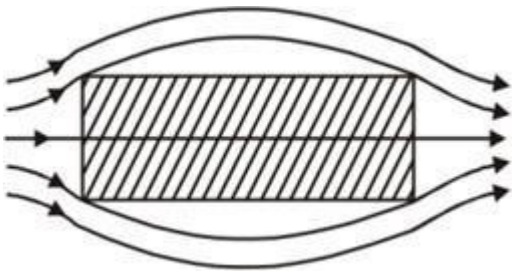
Q7. Consider the given statements with respect to the figure showing a bar of diamagnetic material placed in an external magnetic field *

I. The field lines are repelled or expelled and the field inside the material is reduced

II. When placed in a non–uniform magnetic field, the bar will tend to move from high to low field.

III. Reduction in the field inside the material is slight, being one part in 10^5.

Which of the above statements are correct?



(a) I and II

(b) I and III

(c) II and III

(d) I, II and III

Ans – D
Feedback - all are properties of diamagnetic substance.

Q8. The domain formation is a necessary feature of *

(a) Diamagnetism
(b) Para magnetism
(c) Ferromagnetism
(d) all of these

Ans – c
Feedback - ferromagnetism

Assertion and Reasoning

Directions: These questions consist of two statements, each printed as Assertion and Reason.

While answering these questions, you are required to choose any one of the following four responses.

Q9. **Assertion**: The magnetic field produced by a current carrying solenoid is independent of its length and cross-sectional area. *

Reason: The magnetic field inside the solenoid is uniform.

(a) Both Assertion and Reason are correct and the Reason is a correct explanationof the Assertion.
(b) Both Assertion and Reason are correct but Reason is not a correct explanationof the Assertion.
(c) Assertion is correct, Reason is incorrect
(d) Both Assertion and Reason are incorrect.

Ans -b
Feedback - assertion and reason are correct but it is not the correct explanation.

Q10. **Assertion (A)** : An electrical bulb starts glowing instantly as it is switched on. *

Reason (R): Drift speed of electrons in a metallic wire is very large.

(a) Both Assertion and Reason are correct and the Reason is a correct explanationof the Assertion.
(b) Both Assertion and Reason are correct but Reason is not a correct explanationof the Assertion.
(c) Assertion is correct, Reason is incorrect
(d) Both Assertion and Reason are incorrect.

Ans – C

Feedback - assertion are correct but reason is false.

Answer Key AUGUST Month CBT Physics XII

Q No	Answer
1	a
2	c
3	a
4	a
5	c
6	a
7	d
8	c
9	b
10	c

Feedback:

1. Average score in this test is 5.66/10
2. Question 1 and 6 are scored by most of the students,
3. Question 7 and 10 is scored by least No of students.
4. Median marks scored by students is 6