CHAPTER 6

Electromagnetism

SYNOPSIS

- A magnet attracts magnetic materials. The magnetic force of attraction is maximum in small regions near the ends of the magnet. These are called the poles of the magnet.
- A freely suspended magnet always points in north-south direction. The pole pointing towards north is called north pole. The other pole which points towards south is called south pole. Like poles repel and unlike poles attract.
- Magnetic poles always exist in pair.
- Magnetic compass consists of a magnetic needle pivoted at its centre and encased in a brass box with a glass top. It is used to find 'directions'.
- The product of the pole strength (m) and the magnetic length (2ℓ) of a bar magnet is called magnetic moment (M). $M = m \times 2\ell$. I is unit is ampere-metre^2
- The process in which a magnetic substance becomes a magnet when kept near a powerful magnet is called magnetic induction.
- The substances which are strongly attracted by a magnet are called ferromagnetic substances. These substance can be easily magnetized to make strong magnets.
- The substances which are feebly attracted by a magnet are called paramagnetic substances.
- The substances which are feebly repelled by a strong magnet are called diamagnetic substances.
- The ability of the pole of a magnet to attract or repel another magnetic pole is called its pole strength (m). Its SI unit is ampere–metre (A m).
- The force of attraction (F) or repulsion between two magnetic poles is directly proportional to the product of their pole strength (m) and inversely proportional to the square of the distance (r^2) between them and acts along the line joining the poles.

  $F = \frac{\mu}{4\pi}\frac{m_1 m_2}{r^2}$ where μ is the permeability of the medium.
- Magnetic permeability (μ) of a medium is defined as its ability to allow the magnetic lines of force to pass through it.

  $\mu = \mu_0 \mu_r$ where μ_r is the relative permeability and μ_0 is the permeability of vacuum or air.
- The space surrounding a magnet within which the magnetic effect is felt is called a magnetic field.
- When a unit north pole is placed at a point in a magnetic field, the force experienced by it is called the intensity of the magnetic field at that point. The intensity of the magnetic field decreases with an increase in the distance of the point from the magnet.
- The path along which a free north pole moves in a magnetic field is called a line of force. They leave the

north pole and enter the south pole externally and from south pole to north pole within the magnet.

- The total number of magnetic lines of force passing through a given area is called magnetic flux 'φ'. Unit of magnetic flux is weber (Wb). Magnetic flux per unit area (A) is called magnetic flux density or magnetic induction (B). $B = \frac{\phi}{A}$
- Magnetic induction (B) can also be defined as the force experienced by a unit north pole kept in a magnetic field. Magnetic induction (B) at a point in a magnetic field is $B = \frac{\mu_0}{4\pi}\frac{m}{r^2}$. Its SI unit is Wb m^{-2} or tesla (T) and CGS unit is gauss (G), 1 T = 10^4 G.
- Intensity of magnetic field (H) can be defined as the force acting on a unit north pole independent of the medium. $H = \frac{m}{4\pi r^2}$. Its SI unit is ampere $metre^{-1}$ (A m^{-1}), in CGS system, its unit is oersted.
- Intensity of magnetic field (H) and magnetic flux density (B) are related as $B = \mu_0 H$.
- Magnetic moment (M) of a bar magnet is given by the product of its length (2 ℓ) and pole strength (m). M = (2 ℓ) × m. Its unit is A m^2.
- The magnetic field induction (B) of a bar magnet on the axial line is given by $B = \frac{\mu_0}{4\pi}\frac{2M}{d^3}$, d is the distance of the null point from the centre of the magnet. Its unit is N $A^{-1}m^{-1}$.
- Magnetic field induction 'B' of a magnet on the equatorial line is given by $B = \frac{\mu_0}{4\pi}\frac{M}{d^3}$ N A^{-1} m^{-1}.
- Magnetic susceptibility 'χ' is the measure of capability of a medium to get magnetized. Susceptibility of a substance is defined as the ratio of intensity of magnetization 'I' to the intensity of applied magnetic field (H). χ =I/H, magnetic susceptibility is a constant for a given substance and has no unit.
- When current passes through a conductor magnetic field is created around it, this is known as electromagnetism.
- The direction of magnetic field due to a current carrying conductor can be found using right hand grip rule. Hold a linear conductor in your right hand. If the direction of pointing a thumb indicates the direction of current through the conductor, then the direction of the other fingers curled around the rod indicates the direction of the magnetic field produced by the current through the conductor.
- A coil made of an insulated conducting wire, wound around a cylindrical tube behaving like a magnet when an electric current flows through it is known as 'solenoid'.
- Solenoid with a soft iron core inside it can act as an electromagnet. It behaves like a magnet as long as current flows through it.
- Magnetic field induction 'B' due to a long straight current (i) carrying wire at a distance 'r' from the wire is B $= \frac{\mu_0 i}{2\pi r}$ where μ_0 is the permeability of vacuum.
- Magnetic field induction 'B' at the centre of a circular current carrying wire of 'n' turns is $B = \frac{\mu_0 i}{2r}$
- When a current (i) carrying conductor of length (ℓ) is kept in a magnetic field (B) by making an angle θ with the direction of magnetic field, it experiences a force F. F= B i ℓ sinθ
- The phenomenon in which an induced emf is produced in a coil due to a change in the current with respect to the time, $\left(\frac{di}{dt}\right)$ in the same coil is called self-induction, and the induced emf is called self induced emf (E). E = – L di/dt, where L is the self inductance of the coil.
- The phenomenon due to which a change in the current with respect to the time (di/dt) in a coil induces an emf in another coil held close to it is called 'mutual induction' and the induced emf (E), E = – M di/dt where M is the mutual inductance.
- Transformer works on the principle of electromagnetic induction using mutual inductance of two coils. Transformer ratio secondary

$$= \frac{\text{Output voltage in secondary coil}}{\text{Input voltage in primary coil}}$$

$$= \frac{\text{Number of turns in secondary coil}}{\text{Number of turns in primary coil}}.$$

- Earth behaves like a huge bar magnet with its south pole near its geographic north and vice versa.
- The geographic meridian at a given place is an imaginary plane containing the place and passing through the geographical north pole and the south pole and the magnetic meridian at a given place is an imaginary plane containing the place and passing through the magnetic north and the south poles.
- The angle of declination at a given place is the angle between the geographic meridian and the magnetic meridian.

- The angle through which north pole dips with respect to the horizontal is called the angle of dip. It is also be defined as the angle between the resultant intensity of the earth's magnetic field (I) and horizontal component (H) at a given place.
- Null point is a point where the net magnetic field is zero.
- When south pole of a bar magnet points towards geographical north, two neutral points are formed on the axial line of the magnet.
- When north pole of a bar magnet pointing towards geographical north, null points are obtained on the equatorial line.

Solved Examples

1. Two magnetic poles of pole strength 2 A m and 3 A m respectively when separated by certain distance experiences 5 N force. When the pole strength of both the magnetic poles increased by half of their original pole strength without changing the distance between them, calculate the force of attraction between them.

Solution: $m_1 = 2$ A m, $m_2 = 3$ A m

$$F = 5\ N \Rightarrow 5 = \frac{4\pi \times 10^{-7}}{4\pi} \times \frac{2 \times 3}{d^2} \rightarrow (1)$$

$$m_1^1 = 2 + 1 = 3 \text{ A m};\ m_2^1 = 3 + 1.5 = 4.5 \text{ A m}$$

$$F_1 = \frac{\mu_o}{4\pi} \quad \frac{m_1^1 \times m_2^1}{d^2}$$

$$F_1 = \frac{4\pi \times 10^{-7}}{4\pi} \times \frac{3 \times 4.5}{d^2} \rightarrow (2)$$

$$5 = \frac{10^{-7} \times 6}{d^2} - (1)$$

$$F_1 = \frac{10^{-7} \times 13.5}{d^2} \rightarrow (2)$$

$$\frac{5}{F_1} = \frac{6 \times 10^{-7}}{d^2} \times \frac{d^2}{10^{-7} \times 13.5}$$

$$\frac{5}{F_1} = \frac{6}{13.5};$$

$$F_1 = \frac{13.5 \times 5}{6} = 11.25 \text{ N}$$

2. By taking the values of V and H at a given place as 40,000 nT and 16000 nT (approximately), where 1 nT = 10^{-9} T, calculate the magnetic intensity I upto one place of decimal.

Solution: $I = \sqrt{H^2 + V^2}$

$$= \sqrt{(40000\ nT)^2 + (16000\ nT)^2}$$

$$= 10^4 \times \sqrt{4^2 + 1.6^2}\ nT = \sqrt{16 + 2.56} \times 10^4\ nT$$

$$= \sqrt{18.56} \times 10^4\ nT = 4.3 \times 10^4\ nT.$$

3. The magnetic moment of a bar magnet is 2 A m^2. If the magnetic length of the bar magnet is 5 cm, determine the force acting on it in an external magnetic field of strength 0.6 T.

Solution: Magnetic moment M = 2 A m^2; Magnetic length 2ℓ = 5 cm = 5 × 10^{-2} m.

Magnetic field B = 0.6 T

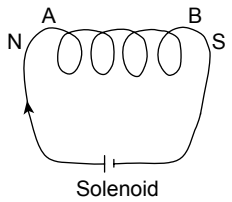
$$B = \frac{\text{force}}{\text{pole strength (m)}};\ F = B \times m;\ M = m \times 2\ell$$

$$2 = m \times 5 \times 10^{-2};\ m = \frac{2 \times 100}{5} = 40 \text{ A m}$$

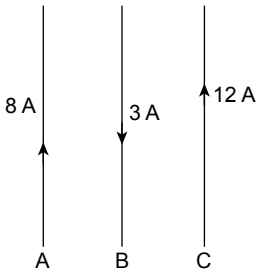
$\therefore F = 0.6 \times 40 = 24$ N

4. Ranjith purchased a bar magnet to map the magnetic lines of force. When he cut the magnet into two pieces along its length, he found that the crowding of the magnetic lines of force is different. Explain why the crowding of magnetic lines of force is different.

Solution: When a magnet is cut along its length, the magnetic pole strength of each part is half of the pole strength of the original magnet. Hence the number of lines of force at the pole would be less.



5. Three straight current carrying conductors A, B and C are placed parallel next to each other by an electrician as shown in the figure. Then determine the direction of resultant force acting on the wire B.



Solution: The wire B is repelled by both the wires A and C as they carry current in the opposite direction to that of B. However, as 'C' carries large current, it repels 'B' with greater force than 'A'. Hence 'B' moves towards A.

6. If a magnetic compass and a dip circle are taken to the magnetic poles of the earth, what would be the directions of their needles? Explain giving reasons.

Solution: Needle of a compass shows random direction, whereas needle of a dip circle is oriented towards the direction of earth's magnetic field.

7. Two magnetic poles separated by a certain distance experiences a force of 10 N between them. Determine the force between them if the pole strength of each pole is doubled and distance between them is reduced to half of the original distance.

Solution: $F_1 = \frac{\mu}{4\pi}\frac{m_1 m_2}{d^2} = 10$ N;

$$F_2 = \frac{\mu}{4\pi} \times \frac{2m_1 \times 2m_2}{(d/2)^2} = \frac{\mu}{4\pi} \times \frac{m_1 m_2 \times 4 \times 4}{d^2}$$

$$= F_1 \times 4 \times 4 = 10 \times 16 = 160 \text{ N}$$

8. When a bar magnet is placed along the magnetic meridian such that its north pole is pointed towards the geographical south, a null point is obtained at a distance of 10 cm from the bar magnet. Determine the magnetic moment of the bar magnet. The horizontal component of earth's magnetic field at that place is 0.39×10^{-4} T.

Solution: The null points are obtained on the axial line when the north pole faces the geographical south pole. At the null point, horizontal component of earths magnetic field

(B_H) = the magnetic field due to the bar magnet.

Therefore, $B = \frac{\mu_0}{4\pi} \times \frac{2M}{d^3} = B_H$;

$$\frac{4\pi \times 10^{-7}}{4\pi} \times \frac{2M}{(0.1)^3} = 0.39 \times 10^{-4}$$

$$M = \frac{0.39 \times 10^{-4} \times 10^{-3}}{2 \times 10^{-7}} = 0.195 \text{ A m}^2$$

PRACTICE EXERCISE 6 (A)

Directions for questions 1 to 35: For each of the questions, four choices have been provided. Select the correct alternative.

1. The space surrounding a magnet within which the magnetic effect is felt is called
(1) magnetic field.
(2) intensity of magnetic field.
(3) magnetic meridian.
(4) None of these

2. What is the angle of dip when both vertical and horizontal components of the earth's magnetic field are equal?
(1) 30° (2) 45°
(3) 60° (4) 90°

3. A conductor carrying current from south to north deflects the magnetic needle placed parallel and above it towards _____.
(1) east (2) west
(3) north (4) south

4. The magnetic field near the centre of a current carrying coil is uniform and _____.
(1) parallel to the plane of coil
(2) perpendicular to the plane of coil
(3) circular
(4) Both (2) and (3)

5. The angle of dip increases as we move from
(1) poles to equator.
(2) equator to poles.
(3) Dip is equal at all places.
(4) None of these

6. A solenoid is _____.
(1) an electromagnet
(2) a temporary magnet
(3) a permanent magnet
(4) Both (1) and (2)

7. A solenoid with a soft iron core is called a _____.
(1) electromagnet
(2) magnet
(3) conducts
(4) insulator

8. In a DC electric motor, a pair of _____is used as a commentator.
(1) split rings (2) sliprings
(3) plug key (4) tap key

9. Sita, a student of 10th class demonstrates an experiment with help of a cell and connecting wires of uniform area of cross section. She made a closed square loop ABCD with the connecting wires and connected across a cell as shown in the figure. She found the ratio of magnetic-fields at the centre produced by side AD to that of side BC as_____.
(1) 2 : 1 (2) 1 : 1
(3) 3 : 1 (4) 1 : 2

10. Calculate the magnetic field induction 'B' at the centre of a circular coil having 500 turns, radius π cm and carrying 5 A of current.
(1) 0.1 T (2) 0.005 T
(3) 0.5 T (4) 0.05 T

11. A pole of strength 150 A m is placed axially at a distance of 10 cm from a short bar magnet of dipole moment 20 A m^2. The force experienced by it is _____
(1) 0.2 N (2) 0.4 N
(3) 0.6 N (4) 0.8 N

12. When two magnetic poles having same pole strength are separated by a distance of 20 cm, a force of 5 N acts between them. If the distance is halved, the force becomes _____
(1) 20 N (2) 10 N
(3) 15 N (4) 25 N

13. Which of the following is minimum at the poles?
(1) Angle of dip.
(2) Horizontal component of the earth's magnetic field.
(3) Angle of declination.
(4) Vertical component of the earth's magnetic field.

14. A bar magnet of dipole moment 'M' is initially parallel to a magnetic field of induction B. The angle through which it should be rotated so that the torque acting on it is half the maximum torque is _____.
(1) 90^o (2) 60^o
(3) 45^o (4) 30^o

15. Among the following _____ has the highest retentively.

(1) aluminium (2) steel
(3) nickel (4) soft iron

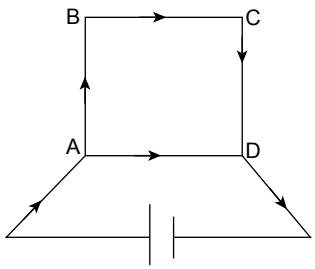
16. An emf is induced in an aeroplane during its ascent and descent in east-west direction due to

(1) the horizontal component of the earth's magnetic field.
(2) the vertical component of the earth's magnetic field.
(3) Both (1) and (2)
(4) None of the above

17. A current of 8 A flows through a horizontal wire from east to west. If the horizontal component of the earth's magnetic field is 4×10^{-5} T, then the neutral point is _____

(1) not formed.
(2) formed at 0.08 m south of the wire.
(3) formed at 0.06 m above the wire.
(4) formed at 0. 04 m below the wire.

18. In a straight conductor carrying current, if the current is tripled and the distance of the point from the conductor is doubled, then the ratio of magnetic inductions is _____.



(1) 3 : 2 (2) 2 : 3
(3) 4 : 9 (4) 9 : 4

19. A cycle dynamo works on the principle of _____.

(1) chemical effects of current
(2) magnetic effects of current
(3) electromagnetic induction
(4) mechanical effects of current

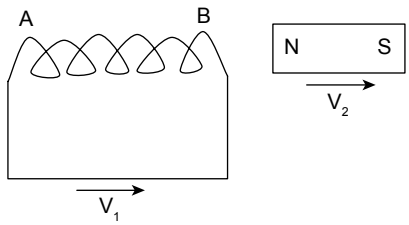
20. When an electric current passes through a solenoid, the distance between any two adjacent rings of the solenoid _____.

(1) decreases
(2) increases
(3) does not change
(4) first increases and then decreases

21. The amount of deflection of the magnetic needle in a galvanoscope depends on

(1) the amount of current passing through the insulated copper wire that is wound over it.
(2) magnetic strength of the magnetic needle.
(3) number of turns of the coil.
(4) All the above

22. A conducting coil and a bar magnet move in the same direction along a straight line as shown in the figure. If the velocity of coil is more than the velocity of the bar magnet, then which of the following statements is true?

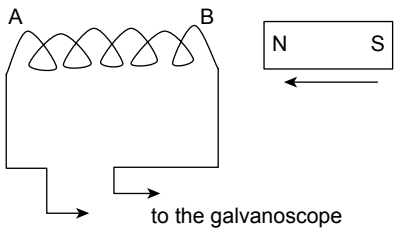


(1) There is no change in magnetic flux linked with the coil.
(2) A magnetic south pole is formed at the end B of the coil.
(3) A magnetic north pole is formed at the end B of the coil.
(4) There is no induced emf in the coil.

23. The input A.C. voltage to the transformer is 3 kV and output is 100 V. Then

(1) the ratio of number of turns in the primary to secondary coil is 30 : 1
(2) the transformer is a step-down transformer.
(3) the transformer is a step-up transformer.
(4) Both (1) and (2)

24. The deflection of the magnetic needle in the galvanoscope connected to the stationary circular coil AB (see figure) increases if



(1) the strength of the magnet is decreased.
(2) the velocity of the magnet is increased.
(3) the number of turns in the coil is increased.
(4) Both (2) and (3)

25. For a given transformer, the ratio of number of turns in primary and secondary coils is 1 : 7. If the input voltage and current are 50 V and 5 A respectively then the value of output current is _____ A.
(1) 0.71
(2) 0.97
(3) 35
(4) 9

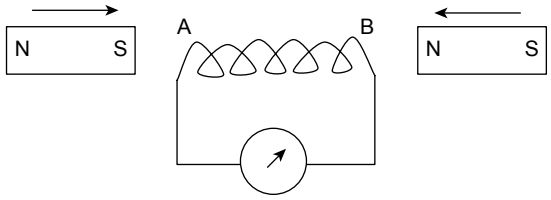
26. Choose the correct statement from the following.
(A) The strength of a solenoid can be increased by increasing the number of turns
(B) The magnetic filed due to a solenoid is similar to the magnetic field produced by a bar magnet.
(1) Only A is true
(2) Only B is true
(3) Both A and B are true
(4) Both A and B are false

27. An electron at rest gives rise to only _____.
(1) magnetic filed
(2) electric filed
(3) Both electric and magnetic field
(4) neither electric filed nor magnetic field

28. Two magnetic needles, which can rotate in a vertical plane, are placed on either side of a straight current carrying conductor placed horizontally. Then
(1) the two magnetic needles point upwards.
(2) the two magnetic needles point downwards.
(3) one magnetic needle points upwards and other points downwards.
(4) two magnetic needles point towards the wire.

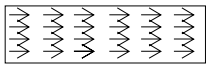
29. In an atom, electrons revolve around the nucleus. This gives rise to
(1) only electric field.
(2) only magnetic field.
(3) both electric and magnetic fields.
(4) None of the above

30. Two identical bar magnets move towards a stationary coil as shown in the figure with the same velocity. If windings of the coil at point A is clockwise then the true statement is



(1) the end A of the coil becomes magnetic S-pole.
(2) the end B of the coil becomes magnetic N-pole.
(3) the current flows from A to B ends in the coil.
(4) All the above

31. Match the following:

(A)		(1) A magnetic substance with no magnetism
(B)		(2) partially magnetised magnet
(C)		(3) substance saturated with magnetism

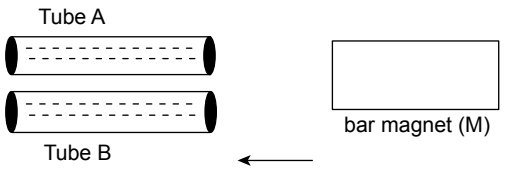
(1) A – 1, B – 2, C – 3
(2) A – 3, B – 1, C – 2
(3) A – 2, B – 3, C – 1
(4) A – 3, B – 3, C – 1

32. (A) While magnetizing a substance we force all molecular magnets to align in a specific direction.
(B) In demagnetization, we disturb the regular alignment and force molecular magnets to orient randomly.
(1) Both A and B are true.
(2) Both A and B are false.
(3) A is true but B is false.
(4) A is false but B is true.

33. Magnetic equator is _____.
(1) isoclinic line
(2) aclinic line
(3) isogonic line
(4) agonic line

34. When a bar magnet is placed in earth's magnetic field, neutral points are obtained. At neutral point
(1) net magnet field is zero.
(2) earth's magnetic field is not present.
(3) magnetic field due to bar magnet is not present.
(4) horizontal component of earth's magnetic field and magnetic field due to bar magnet are present and they are equal in magnitude and opposite in direction.

35.



In the above figure, tube A contains copper fillings and tube B contains aluminium fillings. If a strong magnet is brought close to the two tubes as shown in the figure, then

(A) centre of gravity of the tube A move towards right

(B) centre of gravity of tube B move towards right.

(1) Only A is true.

(2) Only B is true.

(3) Both A and B are true.

(4) Neither A nor B is true.

PRACTICE EXERCISE 6 (B)

Directions for questions 1 to 35: For each of the questions, four choices have been provided. Select the correct alternative.

1. The resultant intensity I of the earth's magnetic field can be resolved into two components, viz horizontal component H and vertical component V. Which of the following statements is false of a place closer to the north pole?

(1) $V > H$.

(2) V is nearly equal to I.

(3) H is nearly equal to I.

(4) $V = \sqrt{I^2 - H^2}$

2. Given below are two statements. Which of the statements is/are true?

Statement A: When the south pole of a magnet points towards the geographic north pole, the null points are along the equatorial line.

Statement B: At the null point, the earth's magnetic field is zero.

(1) A is true, B is false.

(2) Both A and B are false.

(3) A is false, B is true.

(4) Both A and B are true.

3. Consider the following two statements A and B, and select the correct choice.

A: Repulsion is a sure test of magnetism.

B: Magnetic induction precedes attraction.

(1) Only A is true

(2) Only B is true

(3) Both are true

(4) Both are false

4. Which of the following statements is true?

(1) Magnetic equator is also called aclinic line.

(2) On an agonic line, the angle of declination is zero.

(3) Two places on an isoclinic line have the same angle of inclination.

(4) All the above

5. If m is the pole strength, A is the area of cross section and I is the intensity of magnetization of a given magnet, prove that $I = \frac{m}{A}$.

(1) $I = mA$ (2) $I = \frac{m}{A}$

(3) $I + m = A$ (4) $m - A = I$

6. In a science fair, a student performed an activity with a magnet. First, he placed the magnet with its south pole pointing towards the geographic north of the earth and rotated the magnet by an angle of 180°, then calculated how the angle made by the line joining the neutral points had rotated. Find the angle.

(1) 180° (2) 360°

(3) 45° (4) 90°

7. A bar magnet of magnetic moment M is cut into 'p' parts along the axial line and 'q' parts perpendicular to the axial line. Find the magnetic moment of each piece.

(1) M (2) $\frac{M}{pg}$

(3) $\frac{M}{q}p$ (4) pq/M

8. Magnetic induction due to a short bar magnet on its axial line at a distance 'd' is 'B'. Determine its magnetic induction value at the same distance on the equatorial line.

(1) B (2) 2B
(3) Bd (4) B/2

9. Which of the following statements is incorrect? In the process of electromagnetic induction, the magnitude of the induced emf depends on _____.

(1) the number of turns of the coil
(2) the magnetic flux linked with the coil
(3) the rate of change of magnetic flux linked with the coil
(4) area of the coil

10. In an AC generator, the rate of change of magnetic flux through the coil is maximum when the angle between the plane of the coil and the lines of force is

(1) 0° (2) 60°
(3) 30° (4) 90°

11. When a coil of 100 turns and resistance 0.5 Ω is moved towards a stationary magnet, the magnetic flux linked with the coil changes from 5×10^{-2} weber to 0.15 weber. Find the charge flowing through the coil during its motion.

(1) 80 C (2) 40 C
(3) 20 C (4) 60 C

12. Lenz's law is in accordance with the _____.

(1) law of conservation of momentum
(2) law of conservation of energy
(3) law of conservation of mass
(4) both (1) and (2)

13. The transformer turns ratio is 1 : 5 and 0.4 A current flows through the secondary when power developed across it is 200 W. Calculate primary and secondary voltage.

(1) 2000 V (2) 1500 V
(3) 1000 V (4) 500 V

14. A transformer

(1) converts AC to DC.
(2) converts DC to AC.
(3) increases or decreases (step up or step down) AC voltage.
(4) increases or decreases (step up or step down) DC voltage.

15. Two circular coils are made up of identical wires of length 30 cm. The number of turns in one coil is 5 and the number of turns in the other is 10. The ratio of magnetic induction at the centre of each coil when the same current flows through them is _____.

(1) 2 : 1 (2) 1 : 2
(3) 4 : 1 (4) 1 : 4

16. A coil having 100 turns is kept in a uniform magnetic field of induction 0.5 T. If its area changes from 0.3 m^2 to 0.1 m^2 in 10 s, then the emf induced is _____ V.

(1) 2 (2) 1
(3) 4 (4) 3

17. A feature common to both AC and DC generator is _____.

(1) split rings
(2) electrical energy is converted to mechanical energy
(3) slip rings
(4) mechanical energy is converted to electrical energy

18. In self induction

(A) when current in a coil is increasing, induced emf opposes it.
(B) when current in a coil is decreasing, induced emf supports it.
(1) A is true, B is false.
(2) A and B are false.
(3) A and B are true.
(4) A is false, B is true.

19. The mutual inductance between two coils when a current of 5 A changes to 10 A in 1 s and induces an emf of 100 mV in the secondary is _____.

(1) 20 mH (2) 10 mH
(3) 30 mH (4) 15 mH

20. A step up transformer converts 100 V at primary to 300 V at secondary. If the primary current is 6 A, then the secondary current is _____A.

(1) 4 (2) 8
(3) 2 (4) 10

21. The south pole of a short magnet faces the geographical south. The neutral point is formed 4 cm from the centre of the magnet. The horizontal component of the earth's magnetic field is 5×10^{-5} T. The dipole moment of magnet is _____A m^2.

(1) 1.6 (2) 3.2
(3) 8 (4) 2

22. Two circular coils made up of identical wires of length 40 cm have respectively 8 and 4 turns and the current flowing through the second coil is 4 times greater than in the first coil. The ratio of magnetic induction at their centres is _____.

(1) 2 : 3 (2) 3 : 2
(3) 1 : 1 (4) 1 : 2

23. The force experienced by a pole of strength 200 A m placed along a perpendicular bisector, 20 cm away from the centre of a bar magnet of length 5 cm and pole strength 300 A m is _____ N.

(1) 350×10^{-9} (2) 375×10^{-4}
(3) 400×10^{-4} (4) 325×10^{-4}

24. The product of pole strengths of two magnetic poles separated by a distance is 100 A^2 m^2 and the force between them is 20 N. Find the force if the poles are replaced by another pair of poles whose product of the pole strengths is 320 A^2 m^2 and are maintained at the same distance.

(1) 12 N (2) 48 N
(3) 52 N (4) 64 N

25. A bar magnet of dipole moment M is initially perpendicular to a magnetic field of intensity B. The angle by which the magnet should be rotated so that the torque acting on it is half the maximum torque is _____.

(1) 30° (2) 45°
(3) 60° (4) 90°

26. Which of the following is minimum at the equator?

(1) Angle of dip.
(2) Horizontal component of earth's magnetic field.
(3) Angle of declination.
(4) Intensity of the earth's field.

27. Among the following _____ has highest susceptibility.

(1) soft iron (2) steel
(3) aluminum (4) nickel

28. An emf is induced in an axle of a moving train, due to _____

(1) the horizontal component of the earth's magnetic field.
(2) the vertical component of the earth's magnetic field.
(3) Both (1) and (2)
(4) None of the above

29. A horizontal wire placed along north-south direction carries a current of 10 A. The neutral points are _____ if the earth's horizontal component is 5×10^{-5} T.

(1) not formed. (2) 0.08 m east of wire.
(3) 0.07 m west of wire. (4) 0.05 m above wire.

30. The magnetic induction at a point near a current carrying conductor is doubled when current through it is changed and the point is shifted so that its distance is 2/3rd of the original distance. The ratio of the currents is _____.

(1) 2 : 1 (2) 3 : 4
(3) 1 : 2 (4) 4 : 3

31. Two circular coils made up of identical wires of length 40 cm have respectively 18 and 9 turns and the current flowing through the second coil is 4 times the current through the first coil. The ratio of magnetic induction at their centres is _____.

(1) 2 : 3 (2) 3 : 2
(3) 1 : 1 (4) 1 : 2

32. A coil having 200 turns each of area 0.2 m^2 is kept in a magnetic field whose induction changes from 0.8 T to 1.2 T in 2 s. The induced emf is _____ V.

(1) 8 (2) 2
(3) 12 (4) 20

33. If the speed of rotation of armature coil is increased in an AC generator

(1) magnitude of current increases.
(2) frequency of current increases.
(3) Both (1) and (2)
(4) magnitude of current increases, frequency decreases.

34. In mutual induction

A : when current in one coil increases, induced current in neighbouring coil flows in the opposite direction.
B : when current in one coil decreases, induced current in neighbouring coil flows in the opposite direction.

(1) A is true, B is false (2) A and B are false
(3) A and B are true (4) A is false, B is true

35. The current flowing through the primary coil of mutual inductance 8 H is reduced to zero in 10^{-3}s. As a result of which a 24×10^3 V is induced in the secondary. The initial current through the primary is ____ A.

(1) 2 (2) 1
(3) 4 (4) 3

ANSWER KEYS

PRACTICE EXERCISE 6 (A)

1. 1	**2.** 2	**3.** 1	**4.** 2	**5.** 2	**6.** 4	**7.** 1	**8.** 1	**9.** 3	**10.** 4
11. 3	**12.** 1	**13.** 2	**14.** 4	**15.** 2	**16.** 1	**17.** 4	**18.** 2	**19.** 3	**20.** 1
21. 4	**22.** 3	**23.** 4	**24.** 4	**25.** 1	**26.** 3	**27.** 1	**28.** 3	**29.** 3	**30.** 4
31. 2	**32.** 1	**33.** 2	**34.** 4	**35.** 2					

PRACTICE EXERCISE 6 (B)

1. 3	**2.** 2	**3.** 3	**4.** 4	**5.** 2	**6.** 4	**7.** 2	**8.** 4	**9.** 2	**10.** 1
11. 3	**12.** 2	**13.** 4	**14.** 3	**15.** 4	**16.** 2	**17.** 4	**18.** 1	**19.** 1	**20.** 3
21. 2	**22.** 3	**23.** 2	**24.** 4	**25.** 3	**26.** 1	**27.** 1	**28.** 2	**29.** 1	**30.** 2
31. 3	**32.** 1	**33.** 3	**34.** 1	**35.** 4					