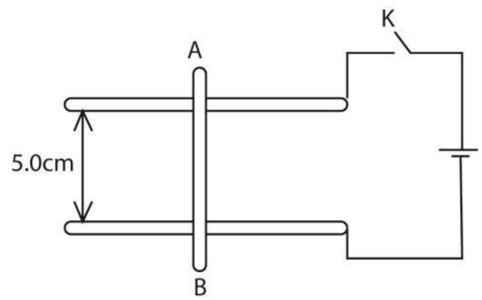
MAGNETIC FIELD QUESTIONS

1. (a)(i) Write down an expression for the force on a charge, q coulombs moving with velocity, u, at an angle, α, to a uniform magnetic field of flux density B. (01mark)

   (ii) Use the expression in (a)(i), to deduce the force on a conductor carrying a current in magnetic field. (03marks)

   (b) Figure below shows an aluminum bar AB resting on two horizontal aluminum rails connected to a battery through switch K. a magnetic field of flux density 0.10T acts perpendicularly into paper.




   (i) Explain what happens to AB when switch K is closed(03marks)

   (ii) Calculate the angle to horizontal to which the rail must be tilted to keep AB stationary if its mass is 5.0g, current in it is 4.0A and the direction of the field remains unchanged. (04marks)

   (c)(i) With the aid of a labelled diagram, describe the structure and mode of operation of a moving coil galvanometer. (06marks)

   (iii) Discuss the factors which affect the current sensitivity of a moving coil galvanometer (03marks)

2. (a) With the aid of a sketch graph, explain the hysteresis curve for ferromagnetic material (07mark)

   (b)(i) Describe with the aid of a labeled diagram, the structure and mode of action of a moving coil galvanometer (06marks)

   (ii) Explain why eddy currents are useful in a moving coil galvanometer. (02marks) (c) A conducting disc of radius 0.05m with its plane perpendicular to uniform magnetic field of flux density 0.25T, rotates at 15 revolution per second about an axis through its center and perpendicular to its plane.

   Calculate

(i) Magnetic flux threading the disc at any time (03marks)

(ii) E.m.f generated between the center of the disc and any point on its rim.

(d) Define magnetic moment of a coil. (01mark)

A small circular coil of 20 turns of wire lies in a uniform magnetic field of flux density $5.0 \times 10^{-2}$T. The normal to the coil makes an angle of 300 with the direction of the magnetic field. If the radius of the coil is 4cm and the coil carries a current of 2.0A, find the

(i) magnetic moment of the coil (02marks)

(ii) torque on the coil

3. (a) Define magnetic flux density. (01mark)

(b) Write the expression for the

(i) Magnetic flux density B at a distance r from long straight wire currying current I. (01mark)

(ii) Force F on a straight wire of length L carrying current I perpendicular to a uniform magnetic field of flux density B.

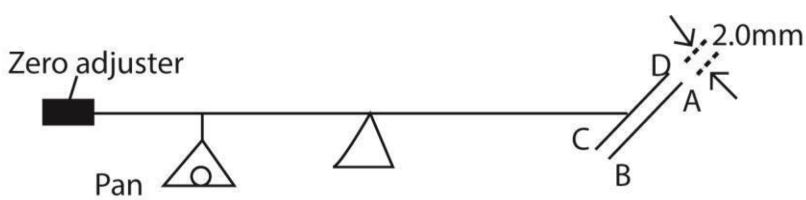
(c) A moving-coil galvanometer consists of a rectangular coil of N-turns each of area A suspended in a radial magnetic flied of flux density B.

i. Derive an expression for the torque on the coil when a current I pass through it (04marks) ii. If the coil is suspended by a torsion wire for which the couple per unit twist is C, show that the instrument will have a linear scale. (03mark)

iii. How can current sensitivity of the instrument be measured? (02marks)

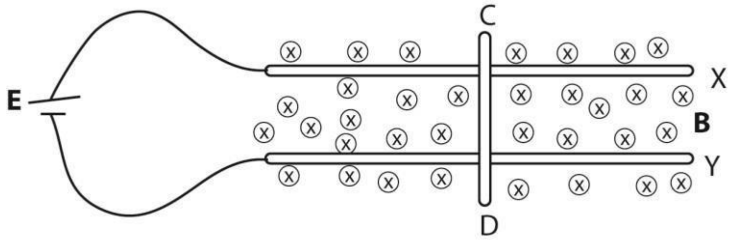
(d) Describe an experiment to determine the magnetic flux density of a uniform magnetic field using a search coil and ballistic galvanometer

(e) Figure 2 shows an ampere balance, wires AB and CD each of length 100cm, lie in the same vertical plane and separated by 2.0mm.




When a current I is passed in opposite direction through the wires, a mass of 0.3g is placed in the pan to obtain balance. Find the value of the current I

(f) In the figure below X and Y are smooth conducting rails connected to a source of e.m.f, E. CD is a metal rod of length L m placed horizontally on X and Y perpendicular to magnetic field of flux density B




(i) Copy the diagram and indicate the direction of Force acting on the rod. (01mark)

(ii) Using the principle of conservation of energy, show that F = BIL, where I is the current supplied by the source. (04marks)

4. (a) (i) Describe the feature of earth's magnetic field (05marks)

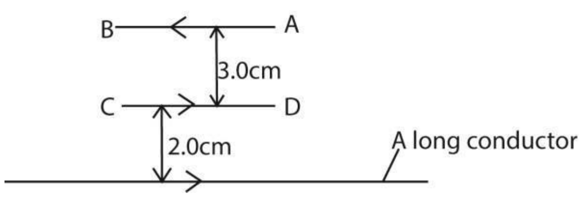
(ii) Sketch the resultant magnetic flux around a wire carrying current vertically upwards in in earth's magnetic field. (02marks)

(b) A circular coil of 50 turns and radius 0.5m is placed with its plane perpendicular to earth's magnetic meridian. It is connected to a ballistic galvanometer of sensitivity 5.7 x $10^3$ rad$C^{-1}$ and circuit resistance of 100Ω. When the coil is rotated through $180^0$ about a horizontal axis, the galvanometer deflects through 0.8 rads.

Calculate

(i) Horizontal component of earth's magnetic flux density. (04marks) (ii) p.d across a solenoid of 2000 turns per meter and resistance 5Ω that produces the same magnetic flux density as calculated in (c)(i). (04marks)

(c) Figure below shows two wires AB and Cd of length 5.0cm each currying a current of 10.0A in the direction shown. A long conductor carrying a current of 15A is placed parallel to the wire CD 2.0cm below it.




(i) Calculate the net force on the long wire (06marks)

(ii) Sketch the magnetic field pattern between the long wire and wire CD after removing wire AB. Use the field pattern to define a neutral point (03marks)

5. (a) What is meant by the following as applied to the earth's magnetic field?

(i) Magnetic meridian (01mark)

(ii) Magnetic variance (01mark)

(b) Describe the structure and mode of action of the deflected magnetometer (06marks)

(c) A circular coil of four turns and diameter 11cm has its plane vertical and parallel to the magnetic meridian of the earth. Determined the resultant magnetic flux density at the center of the coil when a current of 0.35A flows in it.

(Take the horizontal component of the earth's magnetic flux density to be $1.6 \times 10^{-5}$T) (04marks)

6. (a) What is meant by the following as applied to the earth's magnetic field?
   (i) Magnetic meridian (01 mark)
   (ii) Angle of dip (01marK)

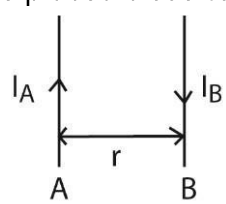
(b) (i) Define the ampere (01mark)

(ii) there conductors P, Q and R carrying currents 3A, 6A and 8A respectively are arranged as shown in the figure below

7. (a) Define Tesla (01mark)

(b) Describe a method of measuring the magnetic flux density in the region between the poles of a magnet. (06marks)

(c) Two straight parallel wires A and B carrying steady currents IA and IB respectively are placed close to each other as shown in figure below




(i) Sketch the resultant magnetic field pattern (02marks)
(ii) Explain what happens when the current $I_A$ and $I_B$ are steady currents. (04marks)
(iii) Find the force per unit length of the wires when IA = 8.0A , $I_B$ =11.0A and r = 3.0cm (04marks)

Explain how eddy currents are produced (02marks)

7. (a) (i) Write an expression for the force exerted on a straight wire of length, L meters carrying a current, I, amperes, placed at right angles to a uniform magnetic field flux density B Tesla. (01 marks)

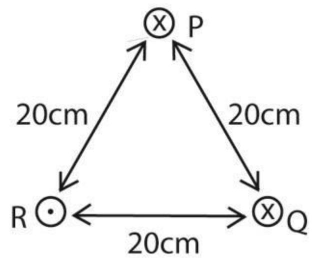
(ii) Explain the origin of the force n (a) (i). (04marks)

(b) A rectangular coil of N turns each of length, L, and breadth, b, is inclined at an angle θ to a uniform magnetic field of flux density B. Derive an expression for torque of the coil when a current I is passed through it.

(c) A single rectangular loop of wire with dimensions 35cm by 75cm is arranged such that part of it is inside a region of uniform magnetic field of flux density 0.45T and part of it is outside the field. The total resistance of the loop is 0.23Ω. Calculate the force

required to pull the loop from the field at a constant velocity of $3.4ms^{-1}$ perpendicular to the field. (05marks)

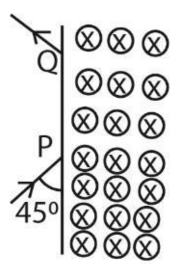
(ii) An electron resolves in a circular orbit of radius $2.0 \times 10^{-10}$m at a frequency of $6.8 \times 10^{15}$ revolution per second. Calculate the magnetic flux density at the center of the orbit (04marks)




Calculate the force experienced by conductor P. (06marks)

(d) (i) Define magnetic flux and magnetic flux density (02marks)

(ii) A charge particle of mass $1.4 \times 10^{-27}$kg and charge $1.6 \times 10^{-19}$C enters a region of uniform magnetic field of flux density 0.2T at point P and emerges at a point Q as shown in the figure below




If the speed of the particle is $10^7ms^{-1}$, calculate the distance PQ. (04marks)

(e) Describe an experiment to measure the magnetic flux density between the pole pieces of a strong magnet. (05 marks)

(f) A current of 3.25A flows through a long solenoid of 400 turns and length 40.0cm.

Determine the magnitude of force exerted on a particle of charge 15.0μC moving at $1.0 \times 10^3ms^{-1}$ through the center of the solenoid at an angle of $11.5^0$ relative to the axis of the solenoid. (04marks)

(e) Describe with the aid of a diagram, an absolute method of measuring current. (06marks)

8. (a) Define the following:

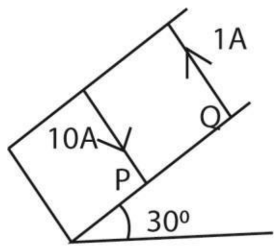
(i) Weber (01mark)
(ii) Ampere (01mark)

(b) A circular coil of N turns, each of radius R carries a current I.

(i) Write an expression for the magnetic flux density at the center of the coil (01mark)
(ii) Sketch the magnetic field pattern associated with the coil. (02marks)

(c) Describe how deflection magnetometer can be used to investigate the variation of magnetic flux density at the center of a circular coil with the current flowing through the coil. (06marks)

(d) Two parallel wires P and Q, each of length 0.2m carry currents of 10A and 1A respectively



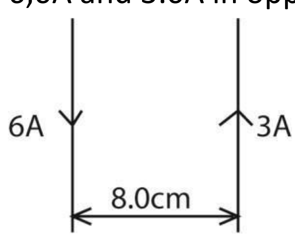

The distance between the wires is 0.04m. If both wires remain stationary and the angle of the plane with the horizontal is $30^0$. Calculate weight of Q.

(e) (i) State why the damping in the ballistic galvanometer should be as small as possible. (01mark)

(ii) Describe how the damping can be reduced in practice (03marks)

(f) Write expression for the magnetic flux density at a perpendicular distance, R, from a long straight wire carrying current, I, in air. (01mark)

(g) Two straight long and straight wires of negligible cross-section area carry currents of 6,0A and 3.0A in opposite direction as shown below




If the wire are separated by a distance of 8.0cm, find the;

(i) Magnetic flux density at a point mid-way between the wires (04marks)
(ii) Force per meter between the wire (03marks)

9. (a) Define the terms magnetic flux and magnetic flux density. (02marks)

(b) A straight wire of length 20cm and resistance 0.25Ω lies at right angles to a magnetic field of flux density 0.4T. The wire moves when a p.d of 2.0V is applied across its ends.

Calculate the;

(i) initial force on the wire
(ii) force on the wire when it moves at a speed of $15ms^{-1}$. (02marks)
(iii) Maximum speed attained by the wire (02marks)

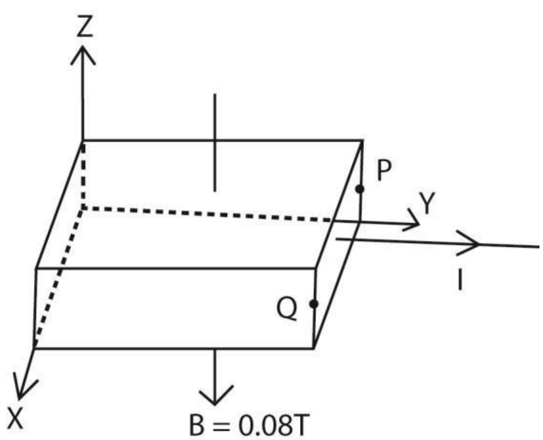
(c) (i) sketch the magnetic field pattern around a vertical straight wire carrying a current in the earth's magnetic field and use it to explain a neutral point in magnetic field. (03marks)

(ii) Two long parallel wires placed 12cm apart in air carry currents of 10A and 15A respectively in the same direction. Determine the position where the magnetic flux is zero. (04marks)

(d) Describe with the aid of a diagram, an absolute method of determining resistance. (05mark).

10. (a)(i) What is a magnetic field? (01marks)

(b)




A magnetic field of flux density 0.08T is applied to a metal strip currying current, I, as shown above

(i) Account for the occurrence of potential difference (p.d) between points P and Q.
(ii) Calculate the electric field intensity between P and Q if the drift velocity of the conduction electrons is $4.0 \times 10^{-4}$m/s (03marks)

(c)(i) Describe with the aid of a diagram the structure and mode of action of moving coil galvanometer. (03marks)

(e) A flat circular coil X of 30 turns and mean diameter 30cm is fixed in a vertical plane and carries a current of 3A. Another coil Y of 2cm x 2cm and having 2000 turns is suspended in a vertical plane at the center of the circular coil. Initially the planed of the two coils coincides. Determine the torque on the coil Y when a current of 2.0A is passed through it. (04marks)

11. (a) Define magnetic flux density and state its units (02marks)

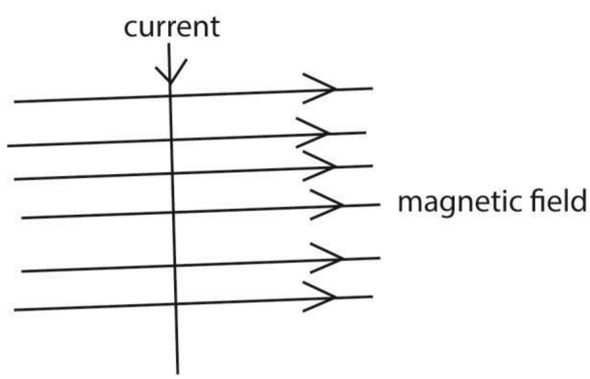
(b) Describe how the magnetic flux density between the poles of a powerful magnet can be determined. (03marks)

(c)(i) Explain with the aid of sketch, the terms angles of dip and declination. (04marks)

(ii) Explain what happens to the angle of dip as one moves along the same longitude from the equator to the North Pole. (02marks)

(iii) Find the force per unit length on a straight horizontal wire carrying a current of 2.0A in the direction north to south if the angle of dip is $70^0$ and the earth's horizontal field component is $1.6 \times 10^{-5}$T. (04marks)

(d)




A wire is placed vertically in a horizontal magnetic field as shown in figure above. Sketch the resultant magnetic field pattern (03marks)

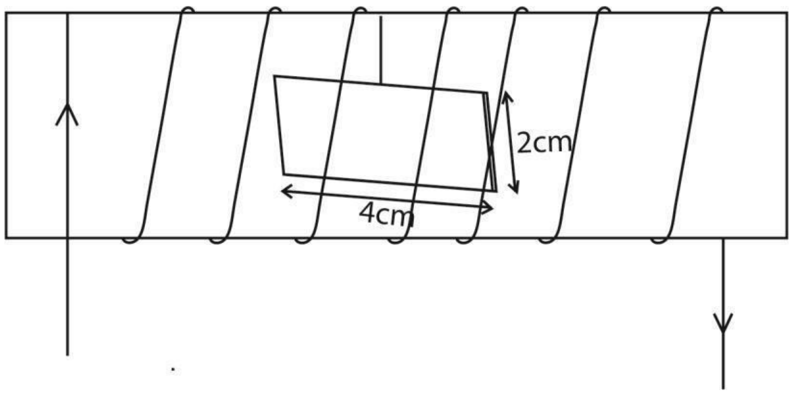
12. (a) Define magnetic flux density. (01mark)

(b) Two identical circular coils are placed coaxially at distance equal to the radius of each coil.

(i) Sketch the magnetic field pattern which results when equal current are passed through the coils. (02marks)

(ii) Describe how you would investigate the variation of magnetic flux density with distance along the axis of the coils. Draw a sketch graph to show the expected results. (06marks)

(c) A small rectangular coil of 10turns and dimensions 4cm by 2cm is suspended inside a long solenoid of 1000 turns per meter so that its plane lies along the axis of the solenoid as shown in the figure below. The coil is connected in series with solenoid.




The coil deflects through 300 when a current of 2.0A is passed through the solenoid. Find the torsion constant of the suspension. (05mark)

(d) A moving coil galvanometer reads 15mA when it is connected in series with a source of e.m.f of negligible internal resistance is replaced with one of resistance 100Ω. The galvanometer reads 10mA when the 100Ω resistor is replaced with one of resistance
200Ω. Find the

(i) Resistance of the galvanometer

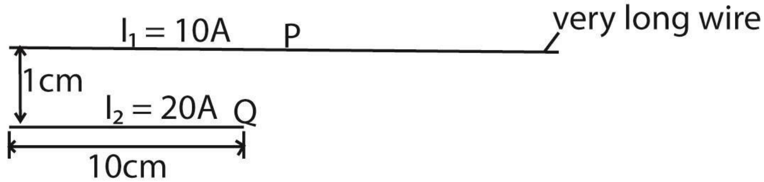
(ii) E.m.f of the source.

(e) A small circular coil of 10 turns and mean radius 2.4cm is mounted at the center of a long solenoid of 750 turns per meter with its axis at right angles to the axis of the solenoid. If the current in the solenoid is 2.0A, calculate the initial torque on the circular coil when a current of 1.0A is passed through it. (05marks)

(f) Explain why a current carrying conductor placed in a magnetic field experience a
force.
(03marks)

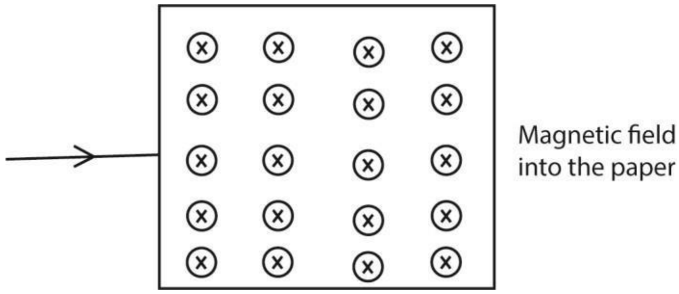
13. (a) (i) Define ampere (01mark)

(ii)



The diagram in the figure above show a parallel wire P and Q placed 1cm apart and carrying current currents of 10A and 20A respectively in the same direction. If wire Q is 10cm long, find the magnetic force acting on it. (04marks)

(b) A stream of electrons enters normally, a uniform magnetic field which is perpendicular to and directed into the plane of the page as shown below



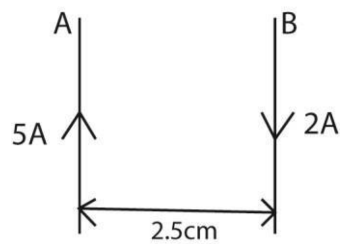

Explain, with the aid of a diagram, the path of electrons while inside the field and after leaving it (06marks)

(c) Explain why, when a current is switched off in some circuits, a spark is seen across the gap of the switch. (03mark)

14. (a) (i) Write down the expression for the force on a charge q coulombs moving with velocity V at an angle, θ, to a uniform magnetic field of flux density, B.

Use the expression in (a)(i) above to deduce the force on a conductor carrying a current in magnetic field. (03marks)

(ii) Two thin, long parallel wires A and B carry current of 5A and 2A respectively in opposite directions, if the wires are separated by a distance of 2.5cm in vacuum, calculate the force exerted by wire B on 1m of wire A (03 marks)

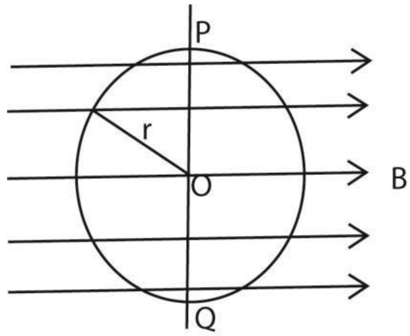



(b) With the aid of a diagram, explain the terms angle of dip and magnetic meridian, as applied to earth's magnetic field. (04marks)

(c)(i) Describe, using an appropriate circuit diagram, an expression to investigate the dependence of magnetic flux density at the center of circular coil on the current through the coil. (07mark)

(ii) State two other factors on which the magnetic flus density in (c)(i) depends. (02marks)

15. (a)




A circular loop of wire of radius, r, is placed in a uniform magnetic field of flux density, B, with the axis to the field as shown above. Explain what happens to the loop when current starts to flow in it a clockwise direction if the loop is pivoted about the axis POQ. (04marks)

(c) A vertical square coil of the side 5cm has 100 turns and carries a current of 1A. Calculate the torque on the coil when it is placed in a horizontal magnetic field of flux density 0.2T with its plane making an angle of $30^0$ to the field. (03marks)

(d) Explain why a moving coil galvanometer should have a radial magnetic field, fine springs and many turns. (06marks)

16. (a)(i) Define the ampere (2marks)

(ii) Write down the expression for the force on a conductor carrying current which is inclined at an angle θ to a uniform magnetic field (02mark)

(b)

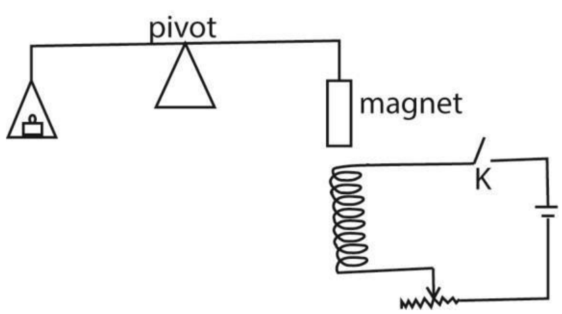



Figure above represents a current balance. When switch, K, is open the force required to balance the magnet is 0.2N. When switch, K, is closed and a current of 0.5A flows, a force of 0.22N is required for balance.

(i) Determine the polarity at the end of the magnet closest to the coil (03marks)

(ii) Calculate the weight required for balance when a current of 2A flows through the coil (03marks)

(c) A ballistic galvanometer of sensitivity 2 divisions per μC is connected across a coil of 10 turns wound tightly round the middle of a solenoid of $10^3$ turns per meter and diameter 5.0cm. When the current in the solenoid is reversed, the ballistic galvanometer deflects through 8 divisions. If the total resistance of the coil and galvanometer is 20Ω, find the current in the coil.

17. (a) Write down an expression for the magnetic flux density at

(i) A perpendicular distance, d, from a long straight wire carrying a current I, in vacuum. (01mark)

(ii) The center of a circular coil of N turn of radius, R, and carrying a current, I(01mark) (iii) The center of an air-cored solenoid of a turns per meter each carrying a current I.

(01mark)

(b) Sketch the magnetic field pattern around a vertical current carrying straight wire in the earth's field and used it to explain a neutral point in a magnetic field. (04marks).

(d) A circular coil of 10 turn and diameter 12cm carries current I. The coil is placed with its plane in the magnetic meridian. A small magnetic needle placed at the center of the coil makes 30 oscillation per minute about a vertical axis. When the current is cut off, it makes 15 oscillations per minute. If the horizontal component of the earth's magnetic flux density is $2.0 \times 10^{-5}$T, calculate the magnitude of I.

(Assume that the square of frequency of oscillation is proportional to the magnetic flux density) (07marks)

(e) Explain what is meant by eddy currents and give four of their applications. (04marks) - objects from solid wastes.