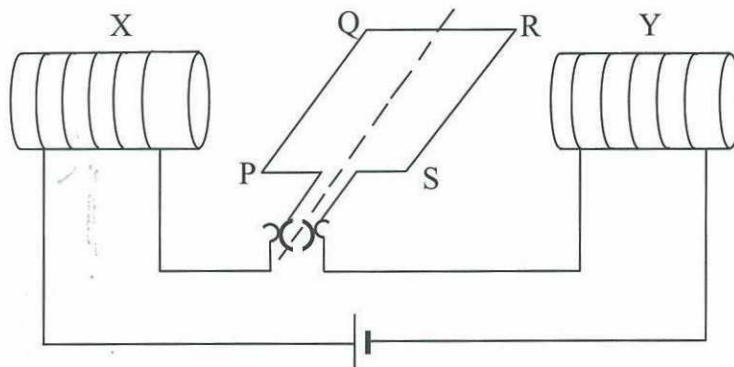


8. [16 marks]

The schematic diagram below shows an electric motor that produces its magnetic field from *field coils* either side of the *armature coil*. It is called a series wound motor because the field coils X and Y are wired in series with the armature coil.



The armature coil of the motor has 150 turns. Side PQ is 5.0 cm long and side QR is 4.0 cm long. When the armature coil is connected to the 12 V supply as shown, a current of 0.75 A produces a magnetic field of 0.095 T across the armature coil.

- (a) [4 marks]
- Draw one arrow on the above diagram to show the direction of the magnetic field created by the field coils X and Y. Label this arrow B.
 - Draw one arrow on the above diagram to show the direction of the force on the side PQ due to the current in the armature coil. Label this arrow F.
 - Will the armature rotate clockwise or anticlockwise (as viewed from the point of connection to the external circuit)?

Answer: _____

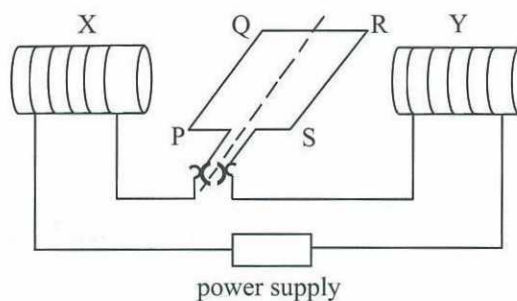
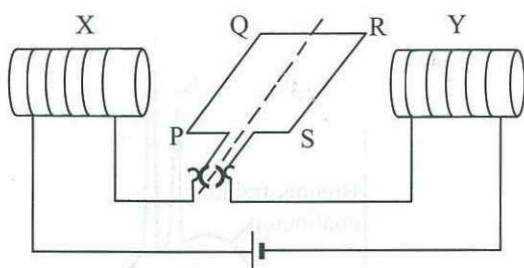
- (b) Calculate the force on the side PQ of the armature. [3 marks]

- (c) Calculate the torque produced on the armature coil when PS is: [4 marks]
- horizontal, as shown in the diagram.

- Vertical.

- (d) State two ways in which the motor can be modified so that a greater torque is obtained.
[2 marks]

- (e) One advantage of this type of motor is that it works on either AC or DC electrical supplies. Using either or both of the diagrams below as part of your answer, explain why this motor will turn in the same direction, regardless of the direction of the electric current.
[3 marks]



SECTION A: Short Answers

(60 Marks)

Attempt **ALL** 15 questions in this section. Each question is worth 4 marks. Answers are to be written in the space provided.

1. A ship has a sonar system with frequency of 5×10^4 Hz that is being used to measure the depth of the ocean. Sound reflected from the ocean floor is detected 4.0 seconds after it is emitted by the ship's sonar device.

How deep is the ocean?

2. Using the following diagram, draw field lines to show the following features of the Earth's magnetic field. Clearly label your diagrams to show

- (i) the direction of the field;
- (ii) the shape of the field; and
- (iii) what is meant by the angle of dip.

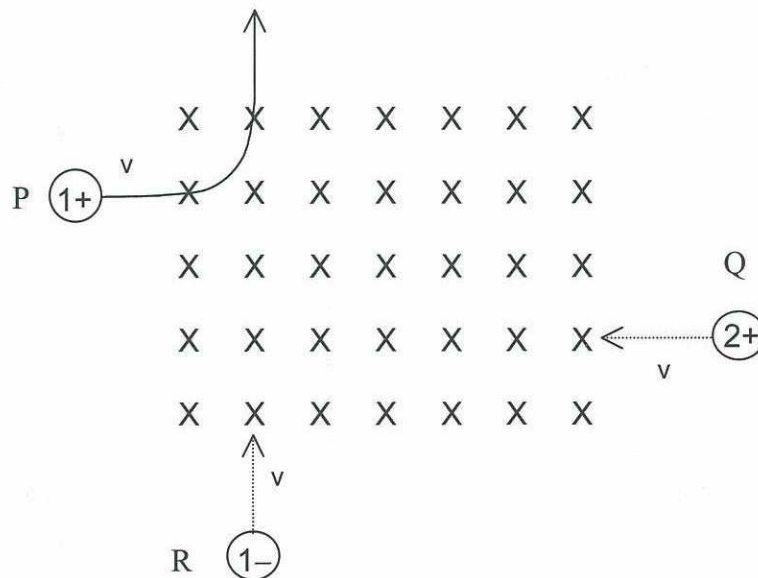


SEE NEXT PAGE

13. When a charged particle enters a magnetic field in a cloud chamber, the trail of droplets of condensed gas indicates that it has moved in a circular pathway. Explain why it moves this way rather than in a straight line.

14. The diagram below shows a uniform magnetic field directed into the page. Three particles P, Q and R have masses and charges as shown in the table below. They each enter the magnetic field with the same velocity, v , as shown. Complete the diagram to show the paths of particles Q and R. The path of particle P has been already been drawn.

Particle	Relative charge	Relative mass
P	1 +	m
Q	2 +	$2m$
R	1 -	$2m$



SEE NEXT PAGE

6. A rock band covers the internal walls and ceilings of a shed with egg cartons, so that during band practice the sound intensity outside the building drops by a factor of 1000.

(a) If the reading outside the shed before the change was 90dB, what was the reading after the sound proofing was done?

(2 marks)

(b) The band discovers that their high noise output problem was partially due to the wall panels resonating to certain frequencies of their music. Explain how this might occur.

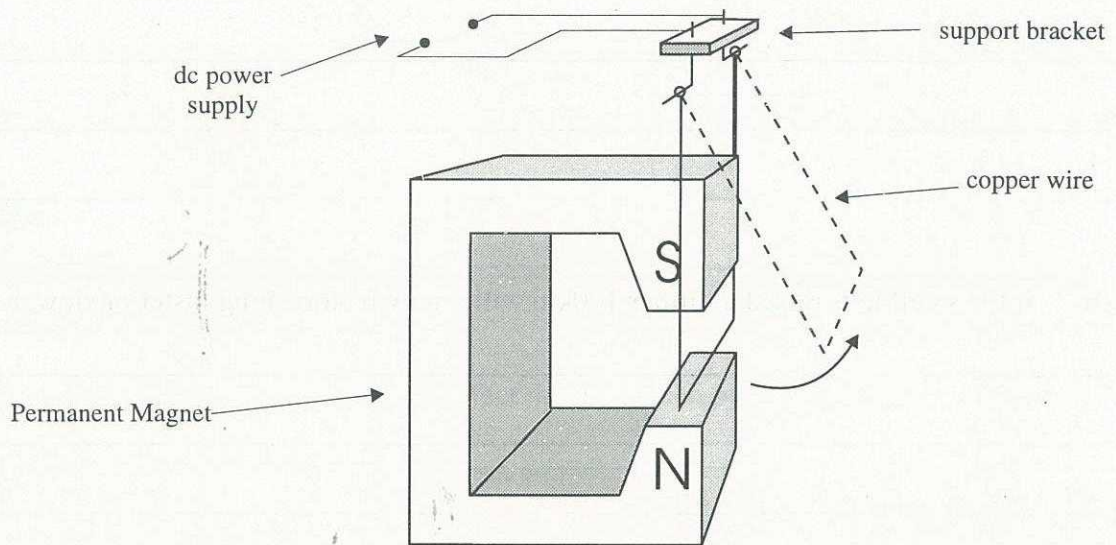
(2 marks)

7. An electric motor in a food mixer needs 9.40A to operate. If the side of the motor armature between the poles of the magnets is 80.0mm long, what force acts on each wire in the armature when the magnetic field strength is 1.80T and the armature is cutting across the field?

(3 marks)

SEE PAGE 7

7. Following a laboratory investigation on the effect of an external magnetic field on a current carrying conductor, a student set up the apparatus shown in the diagram above to report her findings to the rest of her physics class.

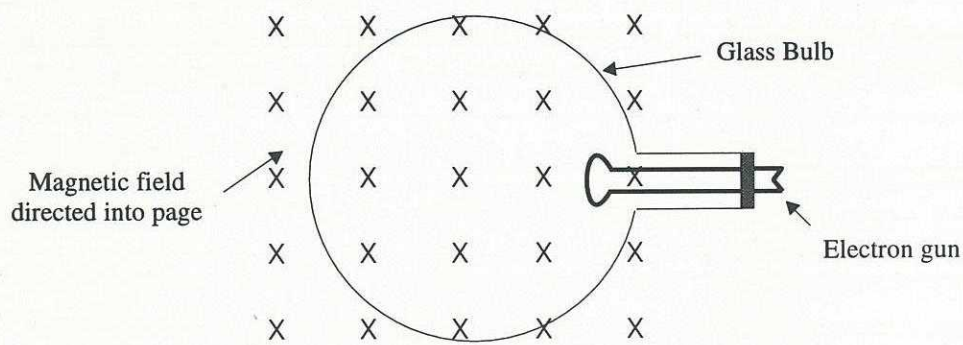


- Label the positive and negative terminals on the dc power supply in the diagram and indicate the current flow through the circuit to enable the copper wire to swing outwards when the switch is closed.
- If you were the student and demonstrated the copper wire swinging outwards (as shown in the diagram), what explanation would you give as to why this happened when the switch was closed.

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There is no handwriting or other markings on the paper.

[4 marks]

3. [12 marks total]



The diagram shows a type of cathode ray oscilloscope which consists of a glass bulb. The glass bulb contains hydrogen gas at low pressure and is placed in a magnetic field. An electron gun produces a beam of electrons which follow a circular path in the glass bulb.

(a) (i) Explain why the path followed by the electrons is circular.

(ii) Will the beam of electrons move in a clockwise or anticlockwise direction?

(iii) Calculate the radius of the circular path if the electrons have a speed of $8.4 \times 10^6 \text{ ms}^{-1}$ and the flux density of the magnetic field is $1.8 \times 10^{-3} \text{ T}$.

[5 marks]

(b) Suggest a possible process by which the gas in the glass bulb might make the path of the beam visible.

[2 marks]

- (c) If visible light is emitted with a wavelength of 661nm, calculate the energy of the photons which produce this light.

[2 marks]

- (d) From the context you have studied, give an example of the production of electromagnetic radiation by a beam of electrons or other charged particles. With the aid of a diagram, briefly describe how the electromagnetic radiation is produced.

[3 marks]

SECTION B

MARKS ALLOTTED : 52

Attempt FOUR questions from this section. Answers are to be written in the answer booklet provided. Credit will only be obtained for method and reasoning if these are clearly shown. Answers should be evaluated numerically - reasonable approximations are acceptable. Numerical constants which may be required are listed on page 2.

(8 marks)

- 1(a) A satellite is in circular orbit around the moon 250 km above the moon's surface, and takes 2 hours 13 minutes for one revolution of the moon.
Calculate the moon's mass.

(5 marks)

- (b) An electron moves in a vacuum between two parallel plates 5.0 mm apart, with a 10 volt potential difference between them.
- (i) What is the electric field strength between the plates?
 - (ii) What is the force on the electron?
 - (iii) What is the acceleration due to the applied field?

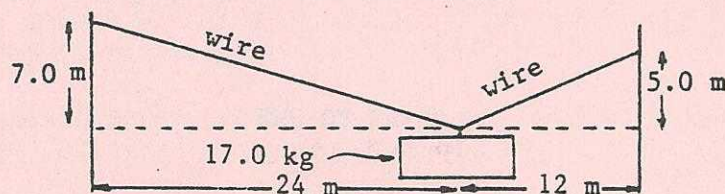
(5 marks)

- 2(a) An office worker heats a cup of water with a 200 watt electric heater. The glass cup has a mass of 0.200 kg and contains 0.200 kg of water at 20.0°C.
- (i) What heat is needed to raise the temperature of the water and cup to 80.0°C?
 - (ii) How many minutes and seconds will this take?

Assume all the heat is used to warm the water and glass cup.

(8 marks)

- (b) A street decoration of mass 17.0 kg is suspended over a road by two wires which are attached to poles 36.0 metres apart (as shown in the diagram).
What are the tensions in the two wires?



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