TUTORIAL QUESTIONS ELECTROMAGNETISM

Question 1

A stationary negatively-charged particle experiences a force in the direction of the field in which it is placed. State, with a reason in each case, whether or not the field is magnetic, electric or gravitational.

Question 2

a.) What is meant by field of force?

b.) A particle has mass m and charge +q. State the magnitude (in symbols) and direction of the force on this particle when it is at rest in

i.) a gravitational field,

ii.) an electric field,

iii.) and a magnetic field.

c.) State the magnitude and the direction of the force on this particle when it is moving with velocity,v in a direction normal to

i.) a gravitational field,

ii.) an electric field,

iii.) and a magnetic field.

Question 3

Fig. 3.1 illustrates the pattern of the magnetic flux due to a current in a solenoid.

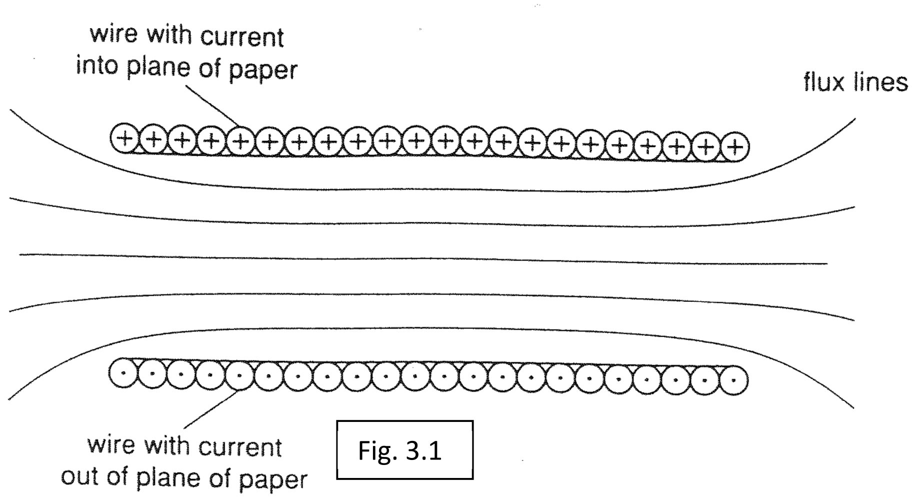

Fig. 3.1

a.) On the figure, draw arrows to show the direction of the magnetic field in the solenoid.

b.) Draw a line to represent a current-carrying conductor in the magnetic field which does not experience a force due to the magnetic field. Label the conductor C.

c.) The coils of wire on an electromagnet are usually wound on a ferrous core. State the two important properties of the core when it is being used in an electromagnet.

Question 4

a.) Atoms of Neon-20 are ionized by the removal of one electron from each atom. For a Neon-20 ion, state the charge on the ion & calculate its mass.

b.) The Neon-20 ions in (a) are accelerated form rest in a vacuum through a potential difference of 1400 V. They are then injected into a region of space where there are uniform electric and magnetic fields acting at right angles to the original direction of motion of the ions, as shown in Fig. 4.1.

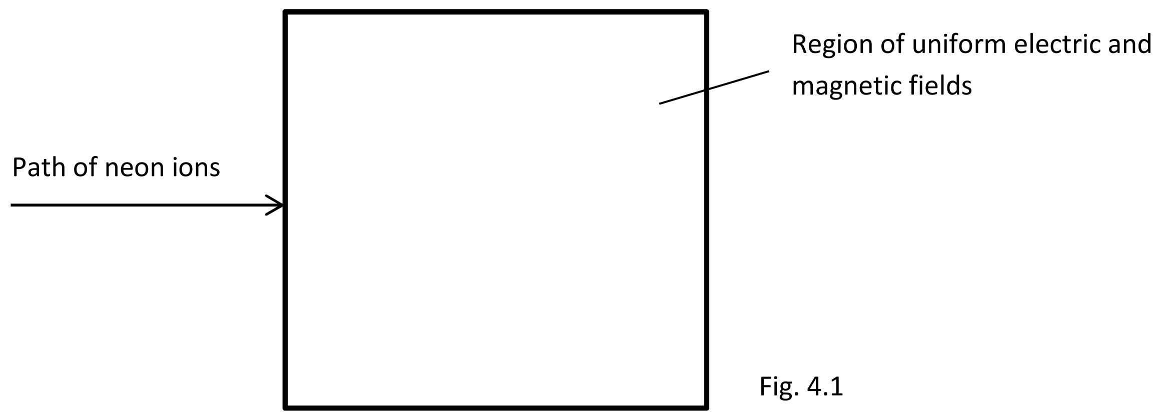

Fig. 4.1

The electric field has field strength E and the flux density of the magnetic field is B.

i.) On Fig. 4.1 indicate clearly the directions of the electric and magnetic fields so that the ions pass undeflected through the region.

ii.) Calculate the speed of the accelerated ions on entry into the region of the electric and magnetic fields.

iii.) The electric field strength E is 6.2×10^{3} Vm^{-1}. Calculate the magnitude of the magnetic flux density so that the ions are not deflected in the region of the fields.

d.) The mechanism by which the neon atoms above are ionized is changed so that each atom loses two electrons. State what occurs in

i.) the speed of the ions entering region of the electric and magnetic fields as above.

ii.) the path of the ions in the two fields.

Question 5

A metal wire of length 0.57 m and cross-sectional area 1.0×10^{-6} m^2 is situated at right angles to a uniform magnetic field of flux density 1.8×10^{-3} T, as illustrated in Fig. 5

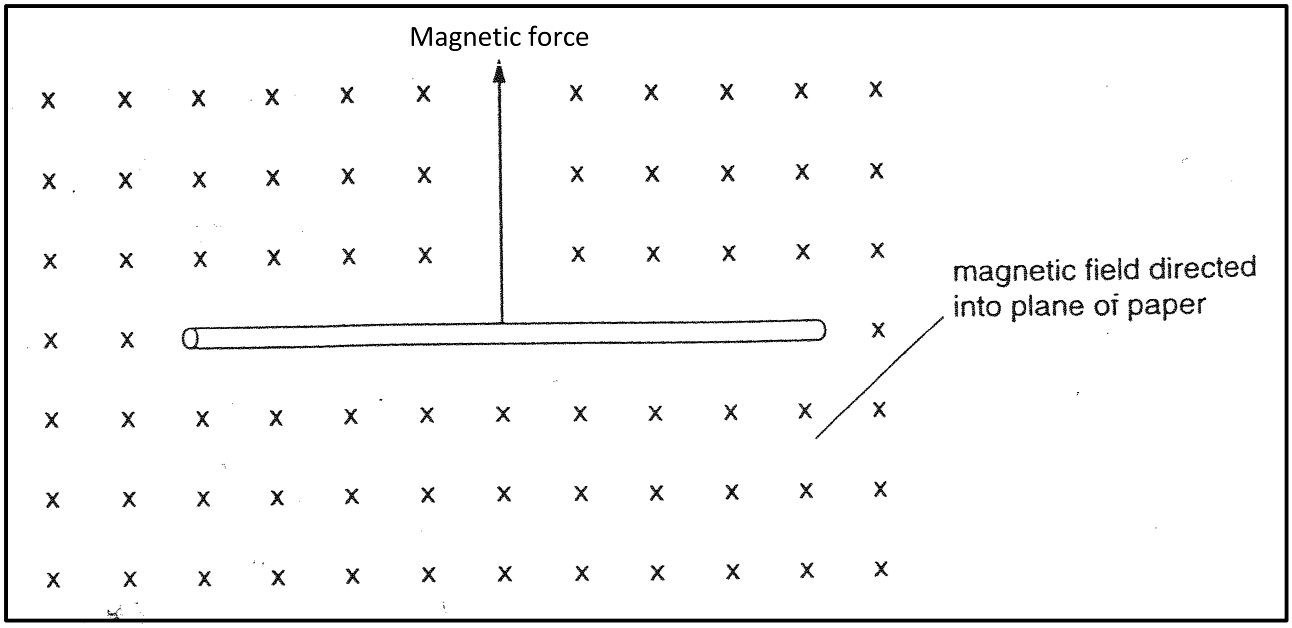

Fig. 5.1

The metal of the wire has density 7.9×10^3 kgm^{-3} and resistivity 8.8×10^{-8} Ωm. A potential difference is applied between the ends of the wire so that there is magnetic force acting on the wire.

a.) On Fig. 5.1, mark the direction of the current in the wire.

b.) For the wire, calculate its weight.

c.) For the wire, calculate its resistance.

d.) Calculate the potential difference required between the ends of the wire for the magnetic force on the wire to equal its weight.

e.) The horizontal component of the Earth's magnetic field is 1.8×10^{-5} T. State and explain why in practice current-carrying wires are not seen to lift off the ground.