TUTORIAL ANSWERS ELECTROMAGNETISM

Question 1

Magnetic field: No, since object is stationary.

Electric field: No, because force is in the directional of field when it should be opposite.

Gravitational field: Yes, force on object is always in the direction of field.

Question 2

a.) Region of space where a force is experienced.

b.) i.) F = mg (in the direction of the field)

ii.) F = qE (in the direction of the field)

iii.) No force, since at rest.

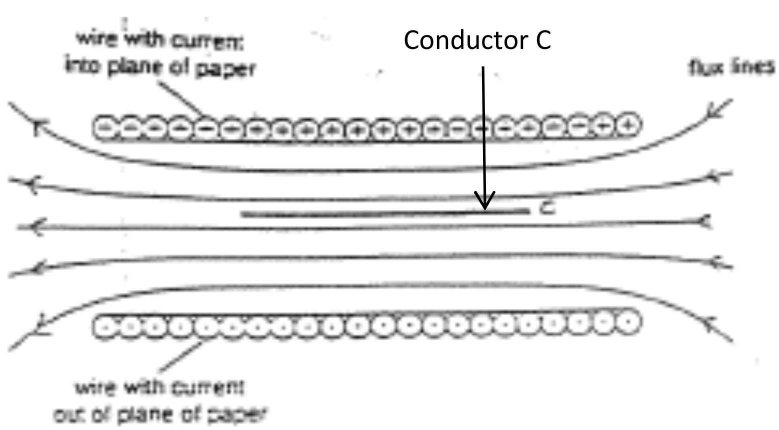
b.) i.) F = mg (in the direction of the field)

ii.) F = qE (in the direction of the field)

iii.) F = Bqv (normal / perpendicular to the direction of the field)

Question 3

a.)



b.) Conductor C is drawn along the direction of the field.

c.) Easily magnetized

Easily demagnetized.

High permeability, so that a large field can be created.

Question 4

a.) Charge, $Q = + 1.6 \times 10^{-19}$ C

Mass, $m = 20 \times 1.66 \times 10^{-27} = 3.3 \times 10^{-26}$ kg

b.) i.) On the diagram: electric field “downwards”, magnetic field “into the paper”.

OR electric field “upwards”, magnetic field “out of the paper”

ii.) $\frac{1}{2} mv^2 = qV$

$v = \sqrt{[(2)(1.6 \times 10^{-19})(1400) / (3.3 \times 10^{-26})]} = 1.17 \times 10^5\ ms^{-1}$

iii.) $qE = Bqv$

$B = E / v = (6.2 \times 10^3) / (1.17 \times 10^5) = 53$ mT

c.) Speed will increase since $v \propto q$.

$Bqv > qE$, magnetic force will be greater than electric force.

Thus, path is now curved / circular in the opposite direction to electric field.

Question 5

a.) To the right along the wire.

b.) $W = mg = \rho Vg = \rho Ahg$

$W = (7.9 \times 10^{3} \times 0.57 \times 1.0 \times 10^{-6} \times 9.81)$

$W = 4.42 \times 10^{-2}$ N

c.) $R = \rho l / A = (8.8 \times 10^{-8})\ (0.57) / (1.0 \times 10^{-6})$

$R = 0.05\ \Omega$

d.) $W = BIL$; $I = W/BL$

$V = IR$; $V = (W/BL)(R)$

$V = WR/BL = (4.42 \times 10^{-2})(0.05)/(1.8 \times 10^{-3})(0.57)$

$V = 2.15$ V

e.) Since the horizontal component of the Earth's magnetic field is only 1.8×10^{-5} T, the electromagnetic force acting on a 1m long wire carrying a current of 1A is only 1.8×10^{-5} N.

This force is likely to be much lower than the weight of a 1m long wire.

Hence, the resultant force on the current-carrying wire will still act downwards and the wire will not be seen lifting off the ground.