World of the Electron: Coursework 2

1a) A moving-coil galvanometer consists of a coil that is free to rotate between the poles of a permanent magnet. The magnetic field strength between the poles is 5×10^{-2} T. The coil consists of 250 loops of copper wire, diameter 0.5 mm, wound to form a square coil, with an average side length of 2.5 cm. At full-scale deflection, the plane of the coil makes an angle of 60° to the magnetic field and the torque on the coil is 40 μN. You can assume that all of the resistance of the galvanometer comes from the coil. Resistivity of copper = 1.7×10^{-8} Ωm.

i) How can this instrument be adapted so that it can be used to measure potential differences up to 20 V?
ii) How can it be modified to measure currents up to 1 A?
iii) What, briefly, would be the effect on the sensitivity of the instrument (i.e. the current required in the coil to give full-scale deflection) of putting a soft iron core in the centre of the coil? Justify your answer.

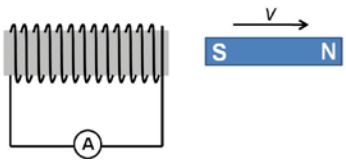
[16 marks]

b) What would be the resistance of an ideal voltmeter and an ideal ammeter? *Briefly* explain your answers.

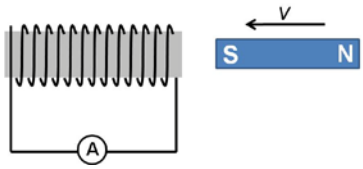
[4 marks]

2. A bar magnet is moved relative to a solenoid, as shown in the diagrams below. In each case, state the direction of the current (i.e. left or right) at the ammeter, A. *v* shows the direction of motion of the bar magnet. *Briefly* explain your answers.

i)



ii)



[4 marks]

3. An AC generator, originally designed to provide a peak output voltage of ± 155 V at a frequency of 60 Hz, is required to provide a peak output of ± 340 V at 50 Hz. If the generator is connected to a transformer with 200 loops in its primary coil, how many loops should there be in the secondary coil in order to provide the required output?

[6 marks]