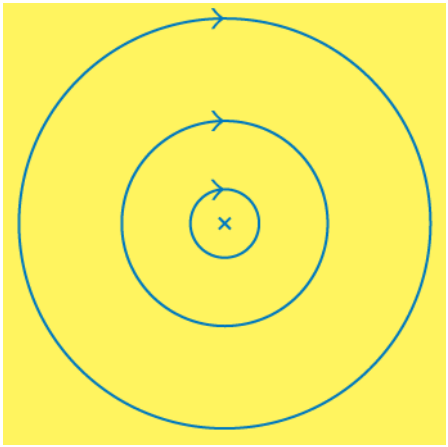
Mark scheme for Extension Worksheet – Topic 5, Worksheet 6

1 See diagram.



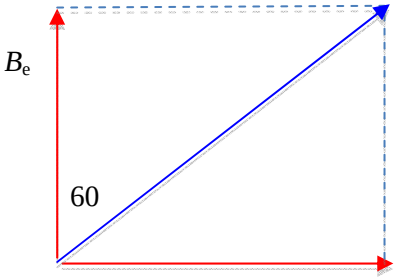
[2]

2 **a** Blue vertical arrows are magnetic fields. Forces are repulsive by any rule for magnetic force direction.

[2]

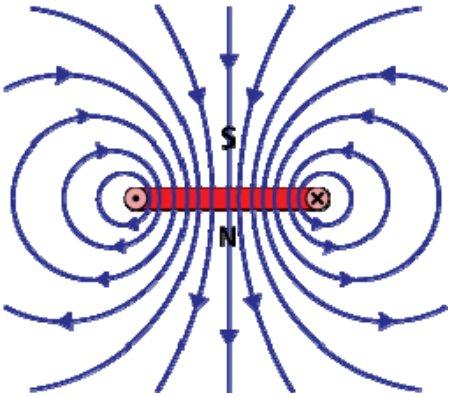
b Forces double; on **both** wires. [1]

3 The magnetic fields at the position of the compass are as shown;



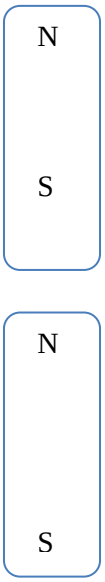
Hence $\tan 60^\circ = \frac{B_w}{B_e}$; and so $B_w = B_e \tan 60^\circ = 3.2 \times 10^{-5} \times \tan 60^\circ = 5.5 \times 10^{-5}$ T [3]

4 **a**



[2]

b Each loop is equivalent to a bar magnet as shown below and so attract.



[2]

5 **a**

[2]

b Each loop is equivalent to a bar magnet as shown below and so attract.

[1]

6 **a** Red is positive because the field lines leave the charge and green is negative because the field lines enter the charge. [1]

b The electric field appears to be zero at the point with coordinates (approximately) $x = -3.5$ and $y = 0$; this means that

$$\frac{kQ_{red}}{2.5^2} = \frac{kQ_{green}}{4.5^2} \Rightarrow \frac{Q_{green}}{Q_{red}} = \left(\frac{4.5}{2.5}\right)^2 = 3.24 \approx 3$$ [2]

7 **a** The magnetic field is zero somewhere above the wire. This means that the magnetic field above the wire due to the wire is directed to the right and hence the current is going into the page. [1]

b At the position of the wire the magnetic field is directed right to left and since the current is into the page; the force by the right hand force rule is directed upwards. [2]