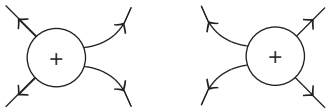
Neap:

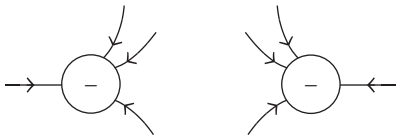
PHYSICS VCE UNITS 3&4
DIAGNOSTIC TOPIC TESTS 2017

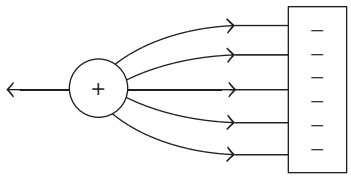
TEST 1: HOW DO THINGS MOVE WITHOUT CONTACT? (I)

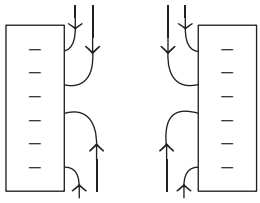
SUGGESTED SOLUTIONS AND MARKING SCHEME

Question 1 (8 marks)

a.  2 marks

b.  2 marks

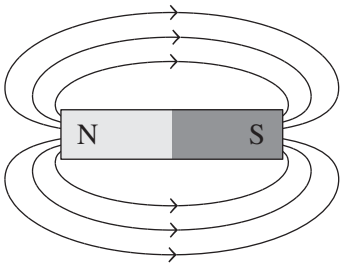
c.  2 marks

d.  2 marks

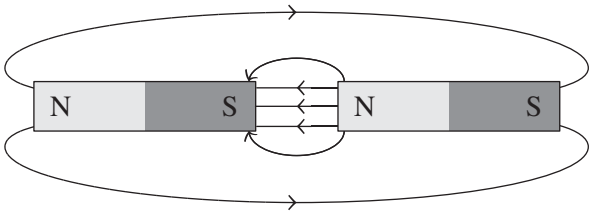
Note: Field-line arrows go into ⊖ and come out from ⊕

Question 2 (12 marks)

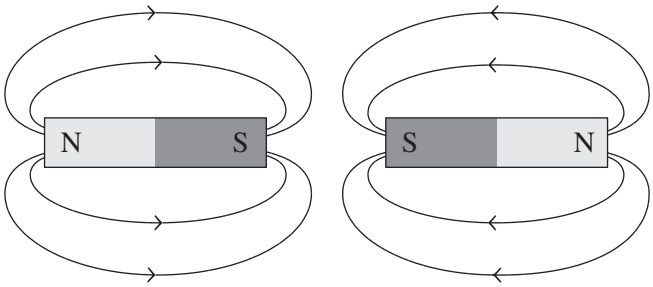
a. 2 marks



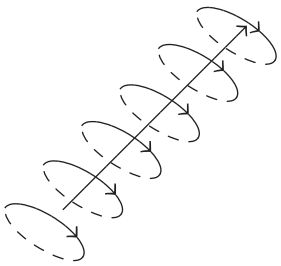
b. 2 marks



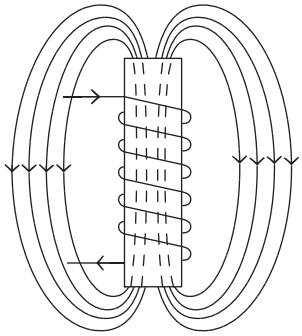
c. 3 marks



d. 3 marks



e. 2 marks



Note: Magnetic fields propagate out from the N pole and into the S pole and never cross or touch.

Question 3 (4 marks)

a. As an electric field probe is passed from A to B along the line AB, the electric field direction is **changing** 1 mark
and the magnitude of the electric field is **changing**. 1 mark

b. As an electric field probe is passed from the centre radially outwards, the electric field direction is **constant** 1 mark
and the magnitude of the electric field is **decreasing**. 1 mark

Note: The electric field is always pointing radially outwards from the centre. Its magnitude decreases (inverse square law) with increasing distance from centre.

Question 4 (4 marks)

a. $E = \dfrac{kq}{r^2}$

$= \dfrac{9.0 \times 10^{9} \times 1.6 \times 10^{-19}}{(1.0 \times 10^{-10})^2}$ 1 mark

$= 1.4 \times 10^{11}\ \text{N C}^{-1}$ 1 mark

b. $F = qE$ or $F = \dfrac{kq_1q_2}{r^2}$

$= 1.6 \times 10^{-19} \times 1.4 \times 10^{11}$ 1 mark

$= 2.3 \times 10^{-9}\ \text{N}$ 1 mark

*Note: Consequential on answer to **Question 4a.***

Question 5 (6 marks)

a. $E = \dfrac{V}{d}$

$= \dfrac{12.0}{0.02}$ 1 mark

$= 600$

$= 6.0 \times 10^{2}\ \text{N C}^{-1}$ 1 mark

b. $F = qE$

$= 1.6 \times 10^{-19} \times 6.0 \times 10^{2}$ 1 mark

$= 9.6 \times 10^{-17}\ \text{N}$ 1 mark

*Note: Consequential on answer to **Question 5a.***

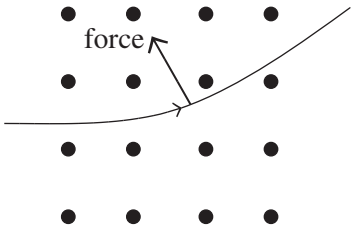
c. $W = qV$

$= 1.6 \times 10^{-19} \times 12.0$ 1 mark

$= 1.9 \times 10^{-18}\ \text{J}$ 1 mark

Question 6 (11 marks)

a.



1 mark

By using the right-hand palm rule, the current is to the left and the magnetic field is out of the page. The initial force is up and as the electron turns the force is perpendicular to the tangent of the curve. 1 mark

b. $F = Bvq\sin\theta$

$F = 0.50 \times 2.0 \times 10^{6} \times 1.6 \times 10^{-19} \sin 90°$ 1 mark

$= 1.6 \times 10^{-13}$ N 1 mark

c. $\frac{mv^2}{r} = Bvq$

$\therefore r = \frac{mv}{Bq}$ 1 mark

$= \frac{9.11 \times 10^{-31} \times 2.6 \times 10^{6}}{0.50 \times 1.6 \times 10^{-19}}$ 1 mark

$= 3.0 \times 10^{-5}$ m 1 mark

d. If the electron direction was parallel or anti-parallel to the external magnetic field then no force would act on the electron (right-hand palm rule). 1 mark

In part **a.**, the electron continues at a constant velocity (same speed and direction). 1 mark

In part **b.**, no force exists because $\theta = 0°$ in $F = Bvq\sin\theta$. 1 mark

In part **c.**, it is meaningless to refer to a radius, as no circular motion exists. 1 mark