



# ALL SAINTS' COLLEGE

Ewing Avenue, Bull Creek, Western Australia

Year 12 Physics 3A3B    Electric Power Test 1    Practice

Time allowed: 50 minutes  
Total marks available: 50  
Show calculation answers to 3 significant figures

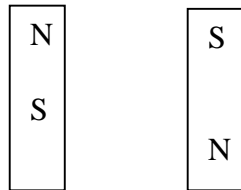
Student Name: \_\_\_\_\_

Q1 Sketch the magnetic field lines that would be established in the bar magnet configurations below and state whether the magnets are likely to attract, repel or remain stationary if set on a low friction surface.

a) (2)

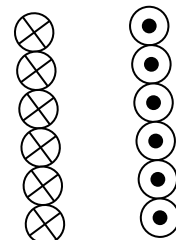
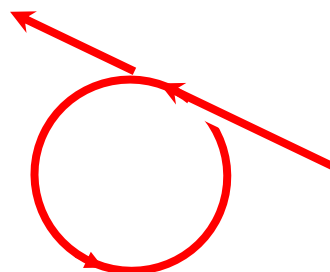
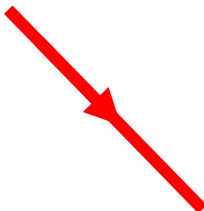


b) (2)

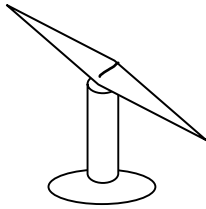


Q2 The following diagrams indicate current flow in wires. Draw the magnetic field lines associated with them. For each diagram, indicate where the dipoles (North and South) are formed or state "no dipole".

a) b) c) (3)



Q3 A compass that is free to align in 3 dimensions aligns with the Earth's field as in the diagram below; the left pole of the magnet rests higher than the pole on the right.



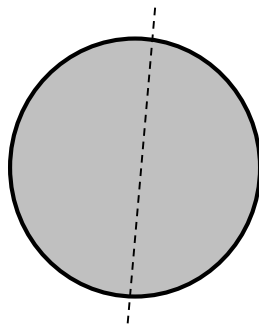
a) If this compass is in the northern geographical hemisphere indicate, on the diagram at left, which is the North Pole of the compass.

(1)

b) Explain, with the aid of field lines added to the diagram below, why the compass does not lay horizontal.

(2)

Planet Earth



Q4 The Holden Volt is an electric vehicle whose DC electric motor is powered by a 370 V Lithium Ion battery. During a 7 second period of acceleration from rest the battery delivers a current of 45.0 A to the motor. The mass of a Holden Volt and driver is 1800 kg. The energy conversion efficiency of the vehicle is 80%.

a. Calculate the velocity of the vehicle after 7 seconds of acceleration.

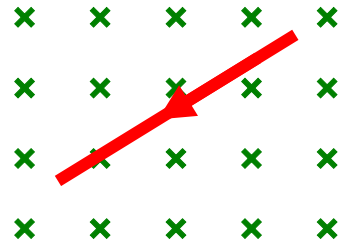
(4)

Q5 a) Indicate the direction of force acting on the current carrying wires in the following diagrams (4)

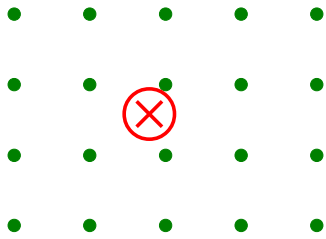
i)



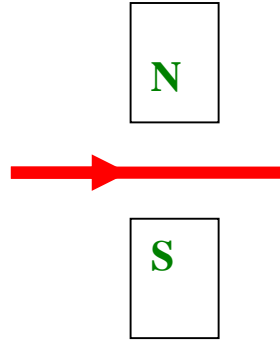
ii)



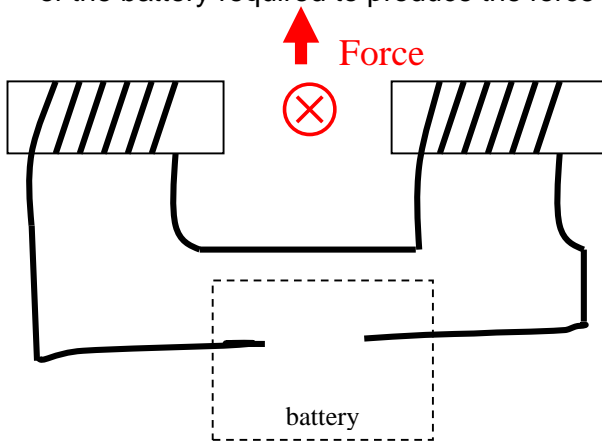
iii)



iv)



b) Indicate the external magnetic field, direction of current in the solenoid circuit and the polarity of the battery required to produce the force shown. (2)



Q6 Two conductors P and Q are placed next to each other and each carry a current of 1.75 A. Q is placed North East of P. The magnetic flux density at position Q established by the current in P is 325 mT. Calculate the magnetic force and direction experienced by Q which has a length of 640 mm (3)

Q



P

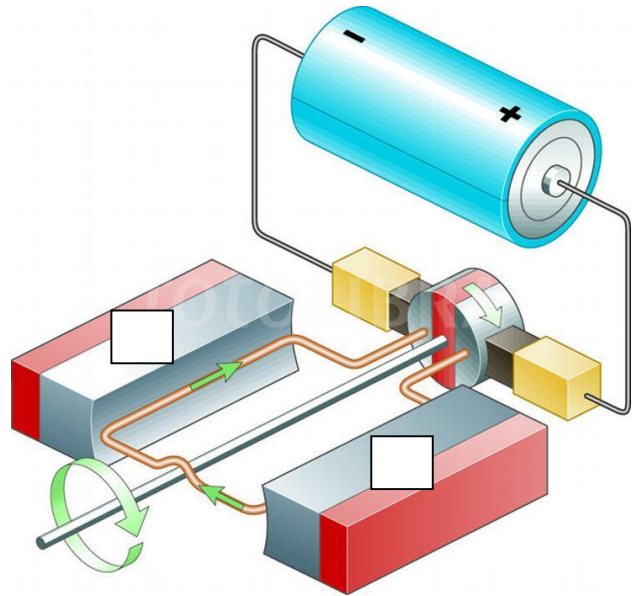


(3)

Q7 The diagram shows a small DC motor connected via a commutator and brushes to a 12.0 V DC battery.

The direction of conventional current is shown.

The direction of rotation is also shown.



a) Indicate the magnetic poles in the boxes on the diagram required to achieve the direction of rotation shown.

(1)

b) Explain how the commutator and brush arrangement works and why it is necessary on a DC motor.

(3)

The coil has a length ( $l$ ) of 8.00 cm and width ( $w$ ) 5.00 cm with a single turn of wire. The uniform magnetic flux density between the poles is 270 mT. The coil is drawing a current of 515 mA from the battery.

c) Calculate the force acting on the length of the coil that runs alongside the North pole in this motor

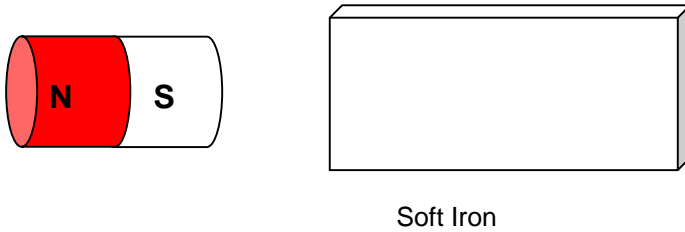
(2)

- d) Calculate the torque acting on this length of the coil at the position shown. (2)
- e) Calculate the total maximum torque this motor can produce (1)
- f) When the coil rotates  $40^\circ$  from the position shown, determine what percentage of the maximum torque the motor will have then. (2)
- g) When the coil rotates  $40^\circ$  from the initial position shown, determine what will happen to the magnitude and direction of the force on each length. (1)
- h) This simple design means that the motor is not smooth in its operation. Describe 3 possible design changes that make an industrial DC electric motor smoother and more efficient. (3)

Q8 Referring to magnetic domain theory:

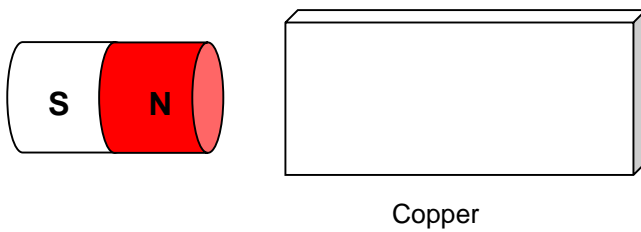
a. Explain how a permanent magnet and a piece of soft iron are attracted to each other.

(3)



b. Explain whether the copper strip will be attracted to the magnet.

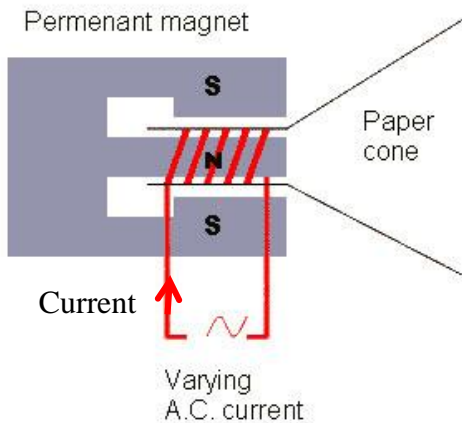
(1)



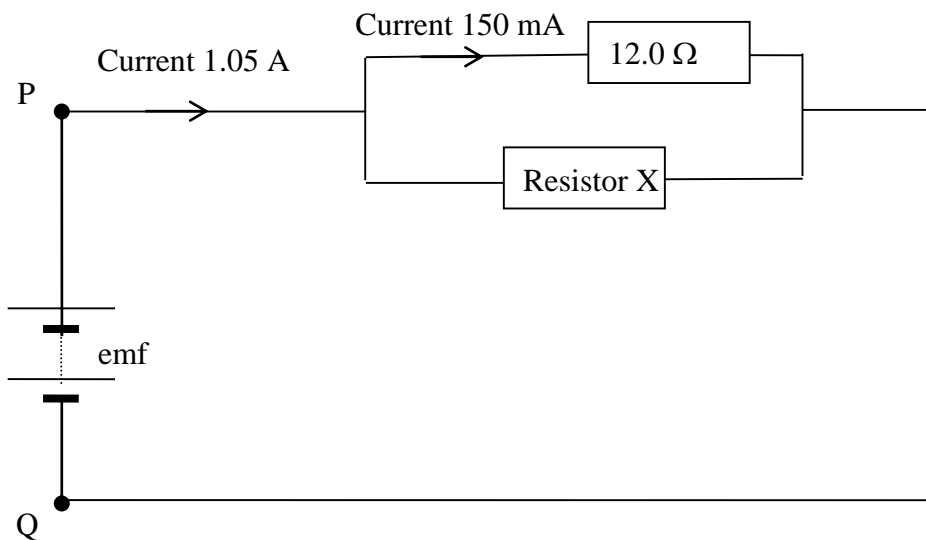
Q9 The cutaway view of the magnet and coil arrangement of a loudspeaker is shown in the diagram. The coil and paper cone are attached and free to move within the cylindrical space between the magnetic poles. The magnet is fixed in position.

At this instant current is flowing in the direction shown. Determine the direction of force on the paper cone and explain briefly how you arrived at your answer.

(2)



Q10 A simple circuit is shown in the diagram below. The  $12.0\ \Omega$  resistor is rated to take a maximum current of  $150\ \text{mA}$ .



a) Calculate the value of Resistor X to ensure that a current of  $150\ \text{mA}$  flows in the  $12.0\ \Omega$  resistor when a current of  $1.05\ \text{A}$  flows from the source of emf.

(4)

b) Calculate the energy delivered by the source of emf in a time of 3 minutes.

(2)