Physics 3AB

Electricity and Magnetism Test 2013

|	Mark: / 57
Name:	= %

Notes to Students:

- You must include **all** working to be awarded full marks for a question.
- Marks will be deducted for incorrect or absent units and answers stated to an incorrect number of significant figures.
- **No** graphics calculators are permitted – scientific calculators only.

Question 1 **(4 marks)**

A proton moves at a speed of 5.00×10^6 ms^{-1} at an angle of 30.0° relative to a magnetic field. It experiences a force of 4.80×10^{-13} N. What is the strength of the magnetic field?

Question 2 **(4 marks)**

A rectangular loop of wire, as shown in the diagram below, is located in a magnetic field of 4.00 mT, which is directed into the page. The side AB is 6.00 cm long.
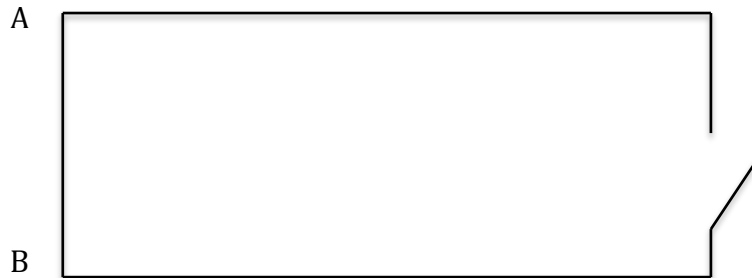
(a)   If the loop is moved to the right at 2.00 ms^{-1}, with the switch open, determine the magnitude of the induced emf across AB
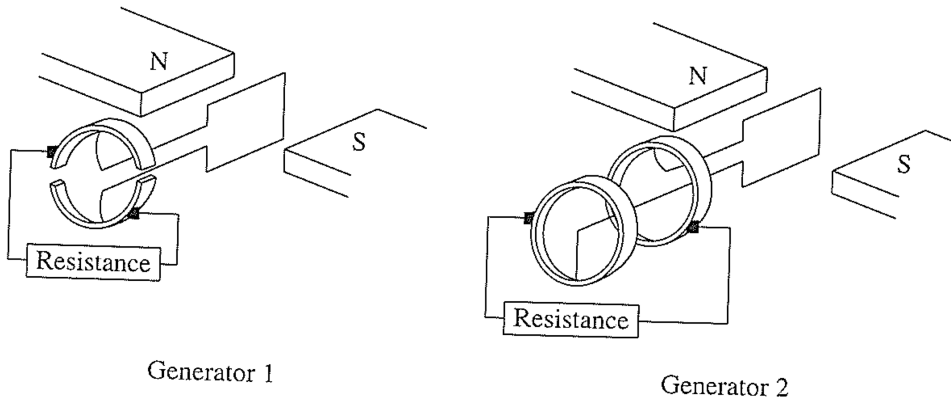
(3 marks)

(b)   Which end of the wire (A or B) will be at the higher potential?

(1 mark)

Question 3 (4 marks)

The diagram below shows two different types of generator (1 and 2) spinning at the same number of revolutions per minute. The only difference between the two generators is the way they are connected to the external circuits.

Generator 1

Generator 2

On the axes below, sketch a graph of **induced emf** vs **time** for each generator over **2** complete cycles from the position shown in the diagram.

EMF (V)

Generator
1

Time (s)

EMF (V)

Generator
2

Time (s)
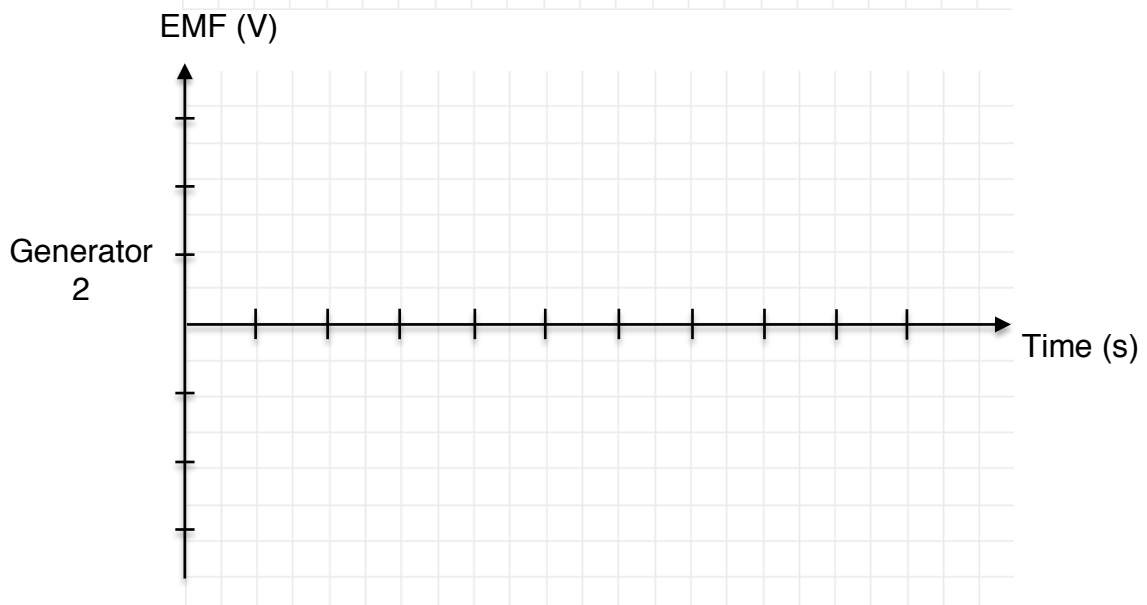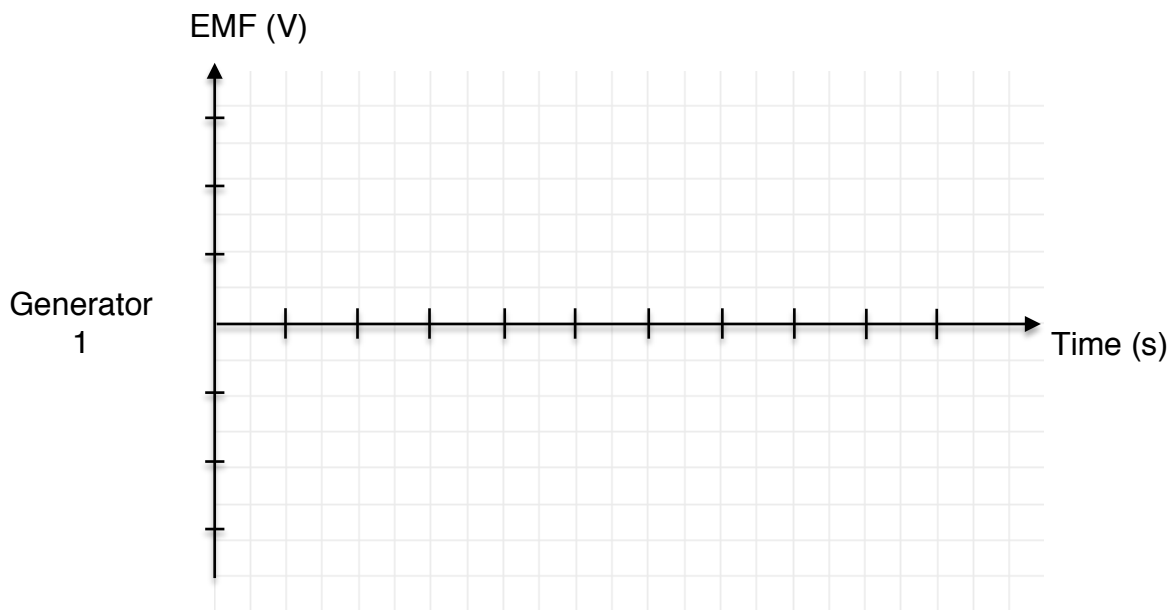
Question 4   (18 marks)

A simple DC electric motor, as shown in the diagram below, consists of a 10.0 cm x 10.0 cm square plane coil of 200 turns and resistance 0.300 Ω which can rotate in a radial field of magnetic flux density 0.400 Wbm^{-2}. The coil is wound on a core and connected to a 12.0 V battery.
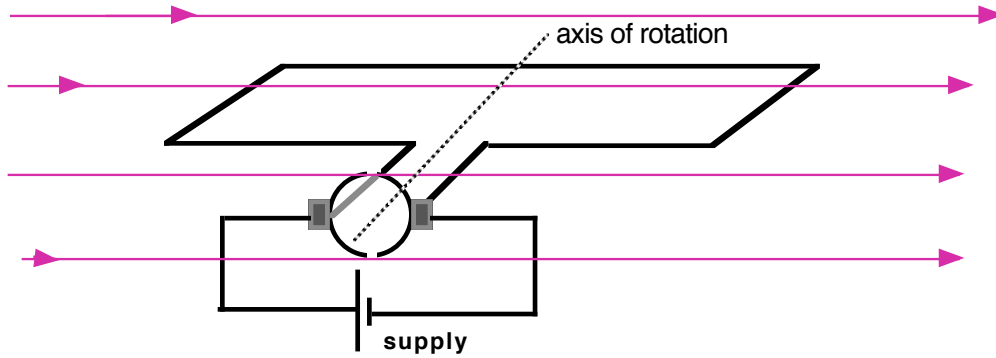
(a)   What is the starting current in the coil?

(3 marks)

(b)   Draw arrows to show the direction of the current in the sides of the coil and the forces on all the sides of the coil.

(2 marks)

(c)   Explain why the coil rotates in the external magnetic field, when an electric current flows through it.

(3 marks)

(d)   Determine the torque of the coil when the motor has just started.

(4 marks)

(e)   As the motor continues to spin, would the magnitude of the torque increase, decrease or remain the same? Explain your reasoning.

(6 marks)

Question 5   **(10 marks)**

An electricity substation delivers a current of 10.0 A at a voltage of 6.00 kV to an office building. The building uses a transformer to provide a current of 230 A at a voltage of 240 V.

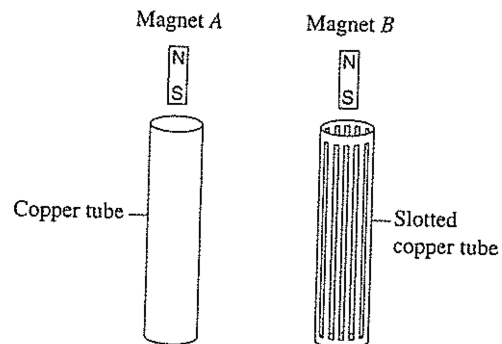(a)   Determine the turns ratio of the transformer

                                                                         (3 marks)

(b)   Calculate the energy lost by the transformer in eight hours

                                                                         (4 marks)

(c)   State **one** cause of energy loss in a transformer and explain how the effect can be reduced.

                                                                         (3 marks)

Question 6 (6 marks)

Identical magnets, A and B, are suspended above vertical copper tubes as shown in the diagram below.


The magnets are dropped at the same time. Each magnet falls straight through its tube without touching the tube walls.

Which magnet leaves its tube first? Explain your reasoning.

Question 7   **(11 marks)**

The diagram below shows an electric generator. The coil has 100 turns and is being turned with a speed of 15.0 ms^{-1}. Sides AB and CD are of length 20.0 cm and side BC is of length 10.0 cm. The coils are located in an area with a magnetic flux density of 0.500 T?
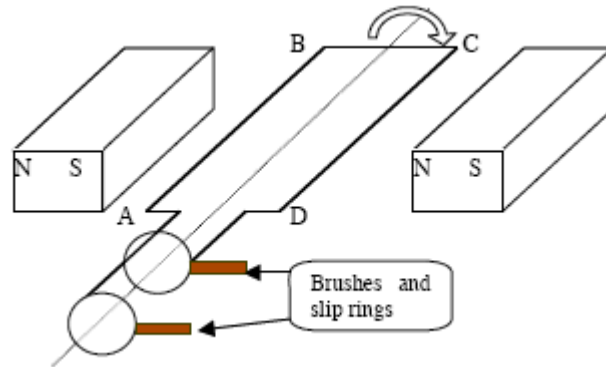
(a)   On the diagram, indicate the direction of the induced current in the coil.

(1 mark)

(b)   Determine the maximum emf induced in the generator.

(3 marks)

(c)   What is the frequency of the generator?

(3 marks)

(d)   If the current delivered by the generator is 10.0 A, what is the magnetic
force on the side AB?

(4 marks)

End of Test