Year 12
Physics 3AB

Electricity and Magnetism Unit Test 2015

Name:

Mark: / 54

= %

Time Allowed: 50.0 Minutes

Notes to Students:

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

Question 1 **(9 marks)**

A set of transmission lines have a resistance of 1.00 Ω. A generator supplies the lines with 500 kW and the potential difference across the lines is 600 V.

(a) Calculate the power loss in the lines.

(4 marks)

The power loss in (a) would make the transmission of power along these lines very uneconomical.

(b) State what could be included to the transmission line system to minimise the power loss.

(1 mark)

(c) Explain why your answer to (b) would make the transmission line system more efficient.

(4 marks)

Question 2 **(4 marks)**

A 15.0 m long wire is held vertically and a current of 10.0 A runs from the top to the bottom of it. If the wire is in Perth, where the Earth's magnetic field is 5.50×10^{-6} T at 66.0° to the horizontal, calculate the force on the current-carrying wire.

Question 3 **(3 marks)**

A transformer used to operate a fluorescent light has 260 coils on the primary winding and 65 coils on the secondary winding. If the transformer is plugged into a 240 V household circuit, calculate the potential difference required to operate the fluorescent light.

Question 4 **(4 marks)**

A proton moving at 3.00×10^{6} ms^{-1} through a uniform magnetic field experiences a maximum force of 5.20×10^{-12} N directly upwards when it is travelling due East. Calculate the magnitude and direction of the magnetic flux density.

Question 5 **(8 marks)**

A motor is used to drive a large crane on a worksite.

(a) Describe and explain the changes that occur in the motor as it is turning with a light load.

(5 marks)

The crane operator decides to finish his jobs quickly and uses the crane to lift a greater load than the operating manual specifies.

(b) Explain why the crane operator is at risk of overheating the crane motor.

(3 marks)

Question 6 **(6 marks)**

A long length of wire is wound 200 times onto a square frame of side 20.0 cm. The wire carries a current of 1.25 A and is located in a uniform, 0.500 T magnetic field.

(a) Calculate the maximum magnitude of force that can be exerted on one side of the coil.

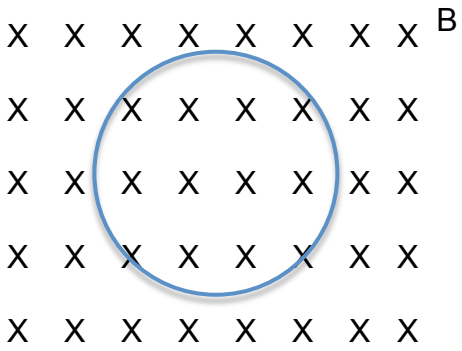
(3 marks)

(b) Calculate the maximum magnitude of torque that can be exerted on the coil.

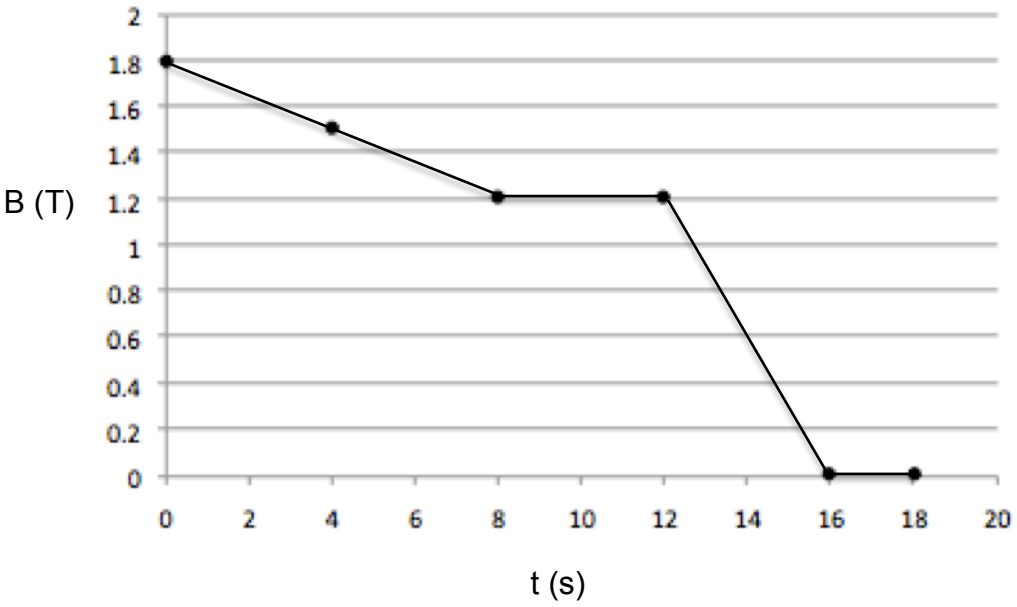
(3 marks)

Question 7 **(12 marks)**

The diagram below shows a circular loop of area 2.50 x 10^3 cm^2 and resistance 12.0 Ω that lies in the plane of the page. A magnetic field of magnitude B is directed into the page.



The value of B varies with time as shown in the graph below.



(a) Calculate the magnitude of the induced emf in the loop from t = 0 to t = 8s.

(3 marks)

(b) Calculate the total energy dissipated in the first 8 seconds.

(4 marks)

(c) State the direction of the induced current in the coil from t = 0 s to t = 8 s.

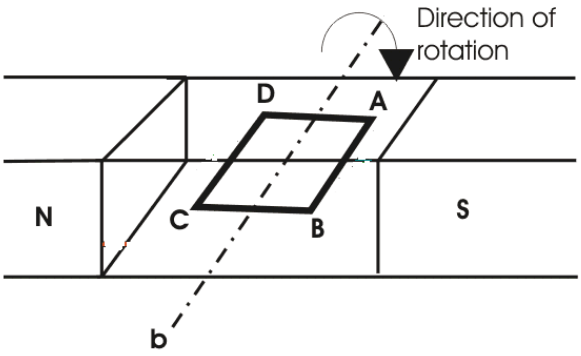
(1 mark)

(d) Explain the reasoning behind your choice of direction for (c).

(4 marks)

Question 8 **(8 marks)**

An engineer wishes to design an AC generator using an armature on which is wound a flat tight rectangular coil, 8.00 cm (AD) x 20.0 cm (AB), of 150 turns, as shown in the diagram below. The generator output is to have a peak voltage of 20.0 V and a frequency of 50.0 Hz



(a) Calculate the required rotational speed of the generator if it is to meet these specifications.

(3 marks)

(b) Calculate the magnetic flux density required for the generator to meet these specifications.

(3 marks)

(c) State which of A, B, C and D will be at the higher potential when the coil turns.

(2 marks)

End of Test