Physics 3AB

Electricity and Magnetism Unit Test 2012

Name:

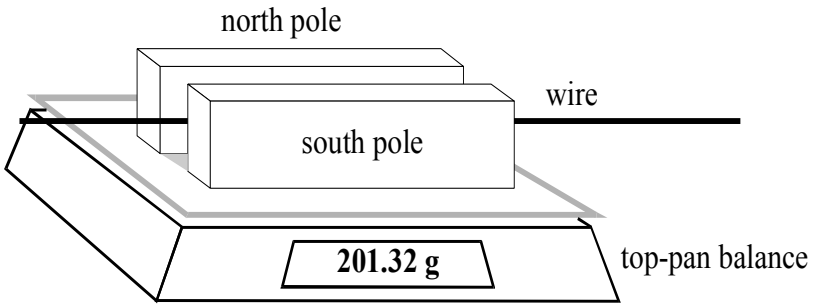
Mark: / 64

= %

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.

1. The diagram below shows a magnet placed on a top-pan balance. A fixed, horizontal wire, through which a current can flow, passes centrally through the magnetic field, parallel to the pole pieces. With no current flowing, the balance records a mass of 201.32 g. When a current of 5.00 A flows, the reading on the balance is 202.86 g.



(a) Annotate the diagram to show the direction of current flow.

(1 mark)

(b) Explain why the reading on the balance increased when the current was switched on.

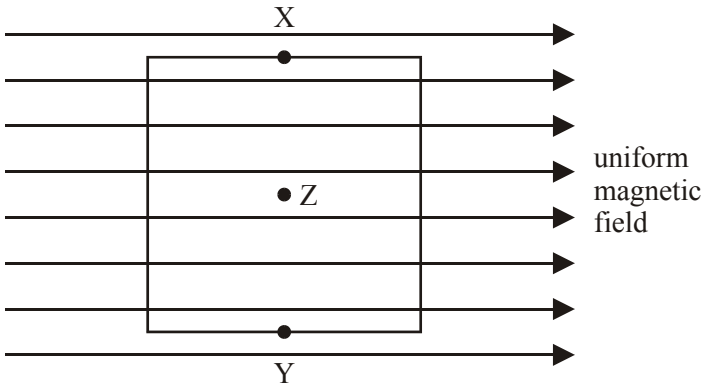
(4 marks)

(c) If the length of the wire in the magnetic field is 60.0 mm, calculate the magnitude of the flux density of the magnetic field.

(4 marks)

2. The diagram below shows a square coil with its plane parallel to a uniform magnetic field. Which one of the following would induce an emf in the coil? Circle your chosen response.

(1 mark)



(i) Movement of the coil slightly to the left.

(ii) Movement of the coil slightly to the right.

(iii) Rotation of the coil about an axis through XY.

(iv) Rotation of the coil about an axis perpendicular to the plane of the coil through Z.

3. A student wishes to charge his phone. The charger he uses has a transformer operating on 12.0 V. If there are 80 turns in the secondary coil, how many turns are present in the primary coil? Assume the mains voltage is 240 V.

(3 marks)

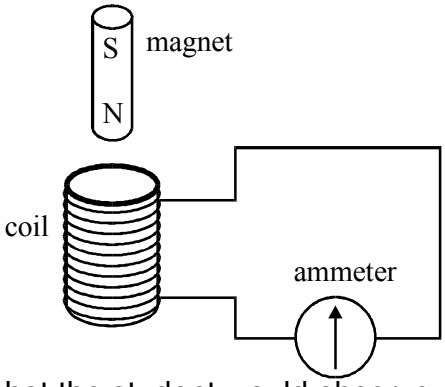
4. The transformer used in Q3, makes use of a laminated, soft iron core. Explain why the laminations are used.

[3]

5. A 90.0 km transmission line made from aluminium cable has an effective radius of 1.00 cm and a total resistance of 9.00 Ω. The line carries the electrical power from the 500 MW power station to a substation. Calculate the percentage power loss in the line when the power station is operating at 250 kV.

(4 marks)

6. A coil is connected to a centre zero ammeter, as shown below. A student drops a magnet so that it falls vertically and completely through the coil.



(a) Describe what the student would observe on the ammeter as the magnet falls through the coil.

(2 marks)

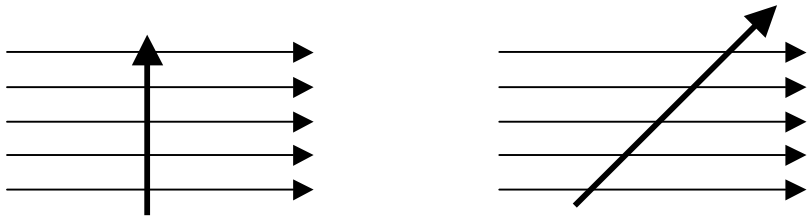
(b) Determine the direction of the induced current in the coil (when looking directly from above) as the magnet moves towards the coil.

(1 mark)

(c) As the magnet exits the coil, would you expect it to be falling at a rate greater than, equal to or less than acceleration due to gravity. Explain your reasoning.

(4 marks)

7. The two wires below are in a uniform magnetic field of 0.400 T. Both wires are 0.500 m long and carry a current of 2.00 A.



A B

(a) Calculate the size of the force on:

(5 marks)

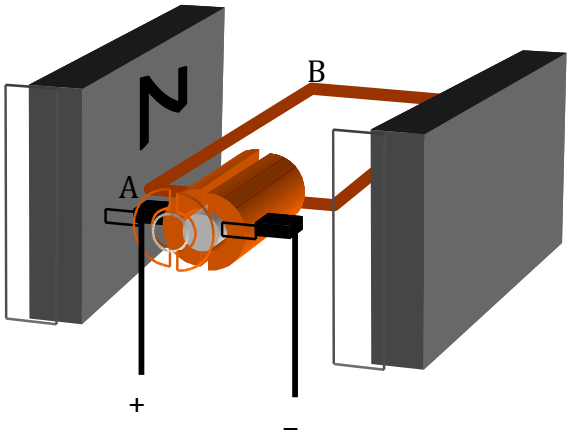
(i) wire (A)

(ii) wire (B) which is at 45° to the field.

(b) In which direction would the wires experience a force in the diagrams above?

(1 mark)

8. A simple d.c motor is shown in the diagram below. The armature is made of a rectangular coil of length 5.00 cm and width 2.00 cm and has 25 turns of wire. The magnet produces a uniform field with a magnetic flux density of 0.300 T. The coil carries a current of 2.20 A.



(a) Calculate the force exerted on side AB of the coil.

(4 marks)

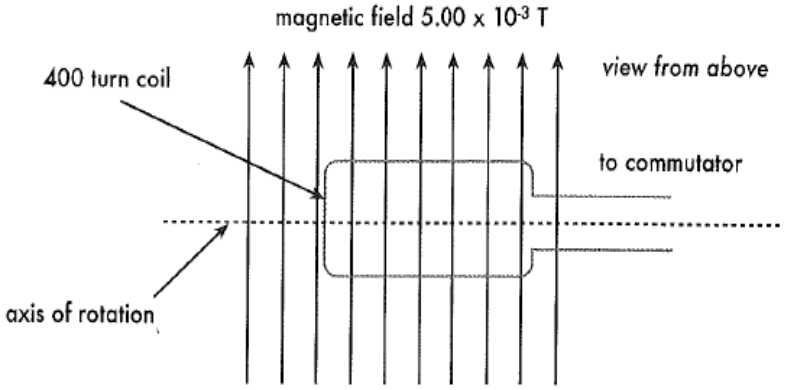
(b) Determine the torque of the motor.

(4 marks)

(c) Explain what happens to the magnitude of the current flowing through the motor as it spins up to maximum speed.

(4 marks)

9. The rotor of a generator has a coil of 400 turns and is rectangular in shape with dimensions 5.00 cm x 3.00 cm. It lies in a magnetic field of 5.00 mT and is rotated at a rate of 3.00 x 10^3 revolutions per minute.



(a) Determine the magnetic flux threading through the rotor when it is in the position shown in the diagram.

(1 mark)

(c) Calculate the magnitude of the average emf produced by the generator if it is rotated through 90°.

(4 marks)

10. Two parallel plates are positioned 12.0 cm apart and connected to a 240 V power supply which creates an electric field between the plates.

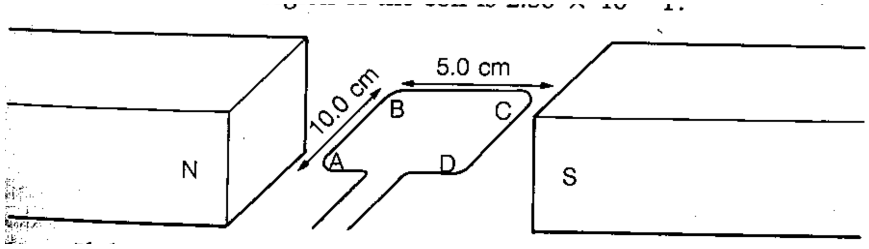
(a) What is the strength of the electric field between the plates?

(3 marks)

(b) Determine the force on an electron placed at rest next to the negative plate.

(4 marks)

11. A generator consists of 50 loops of copper wire which have a length of 10.0 cm and a width of 5.00 cm, as shown in the diagram below. The magnetic flux density in the region of the coil is 2.50×10^{-1} T. The coil is manually rotated at 150 Hz.



(a) Calculate the speed at which side AB is moving.

(3 marks)

(b) If the coil is rotated anticlockwise, which end will be at the higher potential A or D?

(1 mark)

(c) What will be the maximum emf generated?

(3 marks)