Module 6 Electromagnetism
HSC Style questions
30 marks

2009

6 Which of the following would increase the output of a simple DC generator?

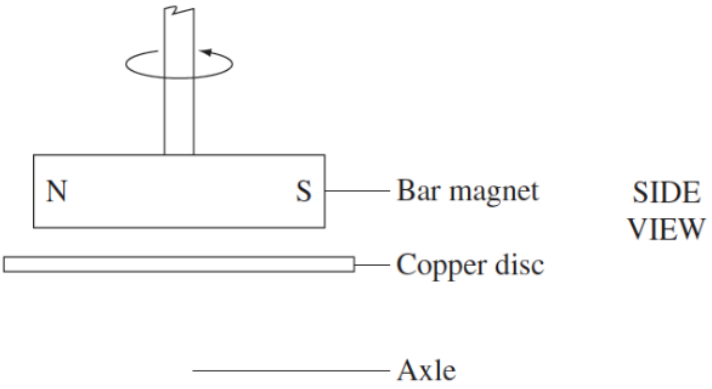
(A) Increasing the rotation speed of the rotor

(B) Reducing the number of windings in the coil

(C) Using slip rings instead of a split ring commutator

(D) Wrapping the windings around a laminated, aluminium core

7 A type of car speedometer consists of a rotating bar magnet which produces eddy currents in a copper disc. A model of this is shown.



As the magnet begins to rotate, in which direction does the disc move?

(A) Toward the magnet

(B) Away from the magnet

(C) Rotates in the same direction as the magnet

(D) Rotates in the opposite direction to the magnet

8 What is an essential requirement for the operation of a step-down transformer?

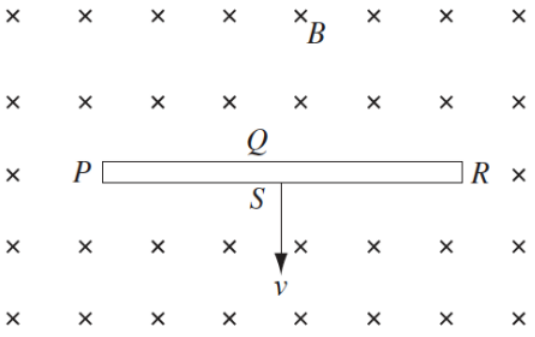
(A) A laminated iron core

(B) A non-conducting core

(C) A magnetic interaction between the primary and secondary coils

(D) An electrical connection between the primary and secondary coils

9 A thin solid conductor with sides *PQRS* is moving at constant velocity *v*, at right angles to a uniform magnetic field *B*, directed into the page as shown.



Which side of the conductor has the greatest concentration of electrons?

(A) *P*

(B) *Q*

(C) *R*

(D) *S*

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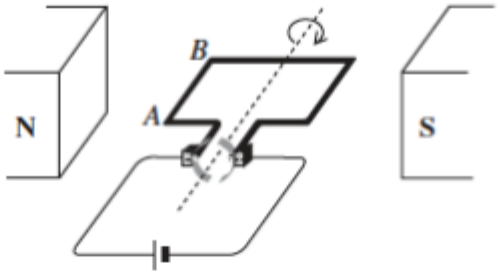
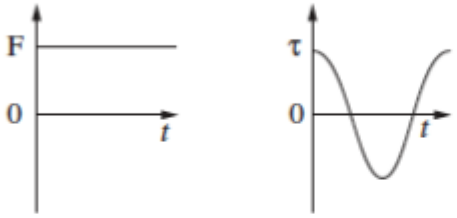
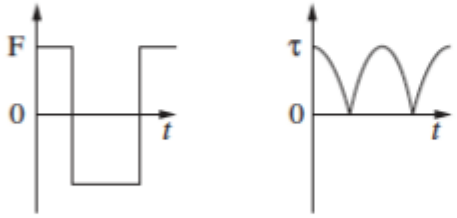
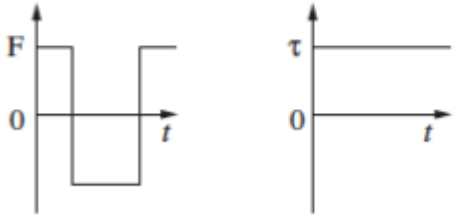
11 The diagram shows a DC motor with a constant current flowing to the rotor.

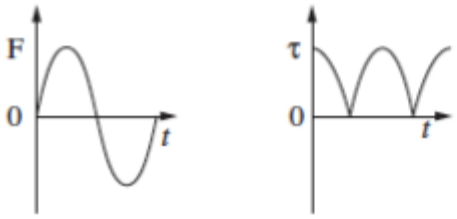


Which pair of graphs best describes the behaviour of the force F on wire AB, and the torque τ on the rotor as functions of time t?

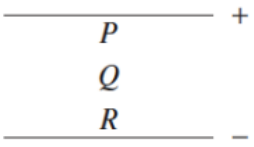
(A)


(B)


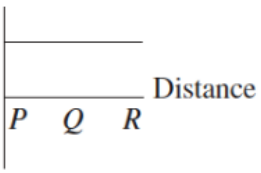
(C)


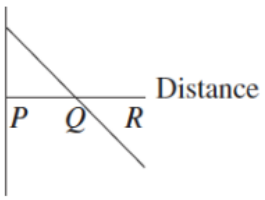
(D)


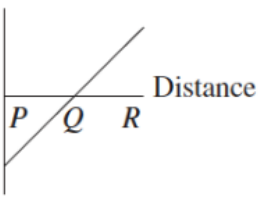
15 The diagram shows two parallel plates with opposite charges. P, Q and R represent distances from the positive plate.

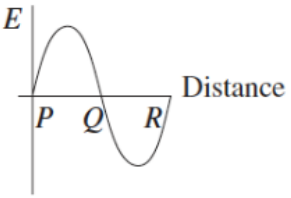


Which of the following graphs describes the electric field strength, E, between the plates?

(A)


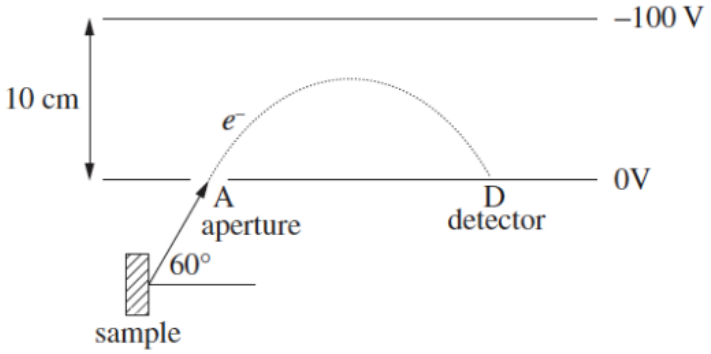
(B)


(C)


(D)


Question 19 (6 marks)

An electron is emitted from a mineral sample, and travels through aperture A into a spectrometer at an angle of 60° with a speed of 6.0×10^6 m s^{-1}.



NOT TO SCALE

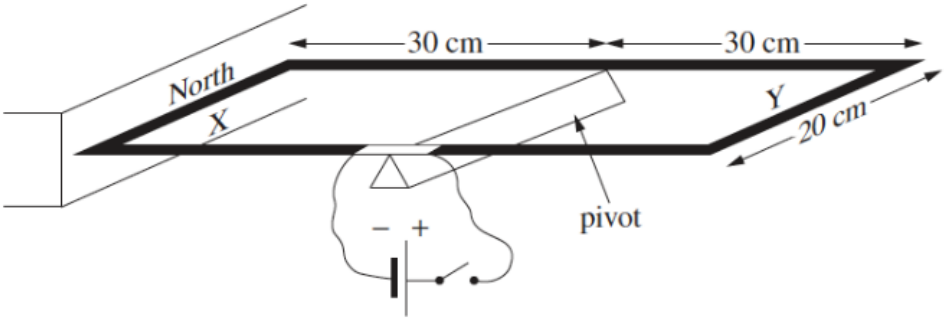
(a) Calculate the magnitude and direction of the force experienced by the electron inside the spectrometer. **3**

(b) The electron experiences constant acceleration and eventually strikes the detector, D. **3**

What is the time taken for the electron to travel from A to D?

Question 21 (6 marks)

A rectangular wire loop is connected to a DC power supply. Side X of the loop is placed next to a magnet. The loop is free to rotate about a pivot.



NOT TO SCALE

When the power is switched on, a current of 20 A is supplied to the loop. To prevent rotation, a mass of 40 g can be attached to either side X or side Y of the loop.

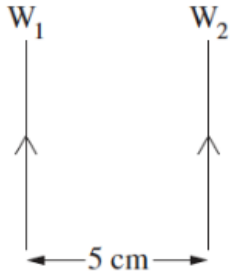
(a) On which side of the loop should the mass be attached to prevent rotation? **1**

(b) Calculate the torque provided by the 40 g mass. **2**

(c) Calculate the magnetic field strength around side X. **3**

Question 23 (6 marks)

Two identical wires, W_1 and W_2, each 2.5 m in length, are positioned as shown. They carry identical currents in the direction indicated.

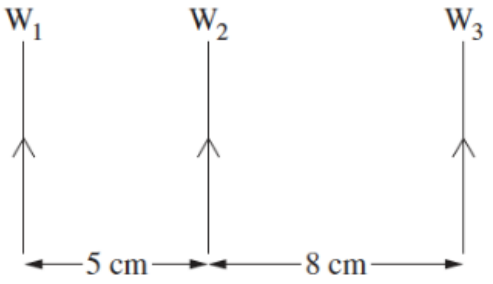


NOT TO SCALE

(a) Identify the direction of the force which W_2 experiences as a result of the current in W_1. **1**

(b) Calculate the current in each wire, given that the two wires experience a force of 6.9×10^{-4} N. **2**

(c) A third wire, W_3, carrying a smaller current, is now placed as shown. **3**

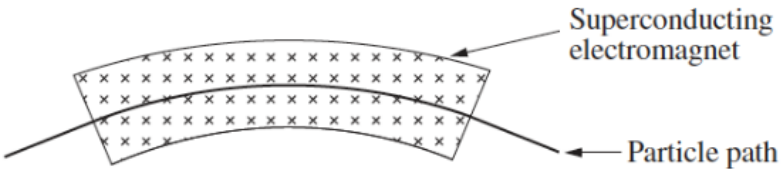


NOT TO SCALE

Explain qualitatively the forces on W_2 as a result of the currents in W_1 and W_3.

Question 25 (5 marks)

In the Large Hadron Collider (LHC), the particle beams are steered using magnetic fields, as shown.



(a) Two particles with the same mass and speed are travelling through the LHC in opposite directions. **2**

What can be deduced about the charge on the particles?

(b) During a test run, a proton travels with a speed of 1.0×10^7 m s^{-1} around the LHC. The radius of curvature of its path is 4.2 m. **3**

Calculate the magnetic field strength.