

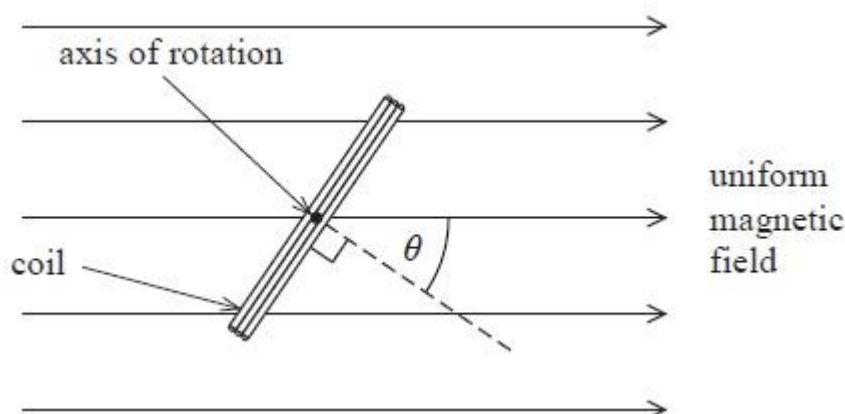
Student: _____

Max. Marks : 27 Marks

Time : 27 Minutes

Q1.

The diagram shows an end view of a simple electrical generator. A rectangular coil of wire is rotated in a uniform magnetic field of magnetic flux density 3.0×10^{-2} T. The axis of rotation is at right angles to the field direction.



- (a) The coil has 200 turns and an area of 2.0×10^{-4} m².

Calculate the magnetic flux linkage for the coil when $\theta = 0^\circ$.

(2)

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Flux linkage = ...

- (b) The coil is rotated at a constant rate of 2 revolutions per second.

- (i) Calculate the average e.m.f. induced in the time taken for the coil to rotate from $\theta = 0^\circ$ to $\theta = 90^\circ$

(3)

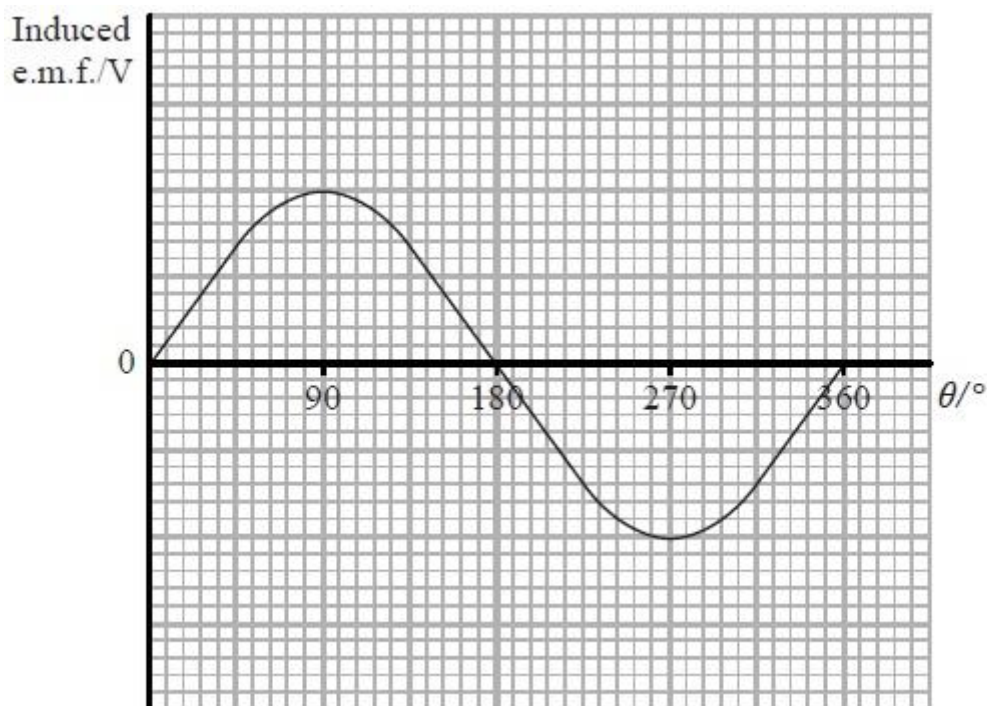
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- (ii) The graph shows how the induced e.m.f. varies over one cycle of rotation of the coil.



Explain why the magnitude of the e.m.f. is smallest and greatest at the values of θ shown in the graph.

(3)

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- (iii) State and explain how the graph would differ if the coil rotated at a slower rate.

(2)

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(c) Vehicles such as electric cars are driven by electric motors. These vehicles use regenerative braking to reduce the speed of the vehicle. The motor is operated as a generator during braking and the output from the generator is used to recharge the batteries of the car.

- (i) Explain how using the motor as a generator slows the car down.

(2)

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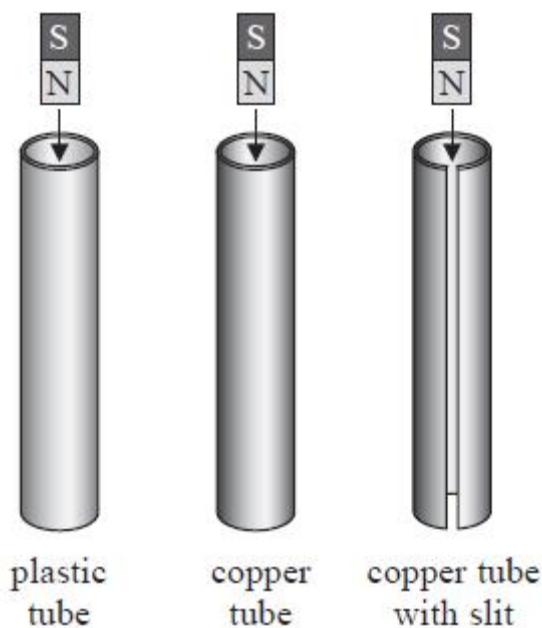
(ii) In practice, these vehicles also use friction braking as well as regenerative braking. This is because regenerative braking on its own will not fully stop a car. Suggest why.

(2)

(Total for Question = 14 marks)

Q2.

A teacher carries out a demonstration to illustrate the laws of electromagnetic induction. She uses three tubes of identical dimensions. One is made of plastic, one copper and one copper with a slit cut into its length.



(a) The teacher releases a magnet from rest at the top of the plastic tube and it takes 0.45 s to fall through the tube.

Calculate the average acceleration of the magnet as it falls through the tube.

length of tube = 0.75 m

(2)

Average acceleration = ...

*(b) The teacher suggests that the magnet would take longer to fall through the copper tube as a consequence of the laws of electromagnetic induction.

Assess the validity of this suggestion.

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(c) Before the teacher releases the magnet through the copper tube with a slit along its length, she asks the class to consider how the time taken will compare with the time for the other copper tube. The class predicts that the time will be the same.

Explain, using electromagnetic induction, whether this prediction is correct.

(3)

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(d) The times for the magnets to fall through the tubes were measured manually using an electronic timer.

Explain how suitable this is as a means of recording these times.

(2)

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(Total for question = 13 marks)