Electromagnetic Induction

Question paper

Level	International A Level
Subject	Physics
Exam Board	Edexcel
Topic	Physics on the move
Sub Topic	Electromagnetic Induction
Booklet	Question paper

Time Allowed: **29 minutes**

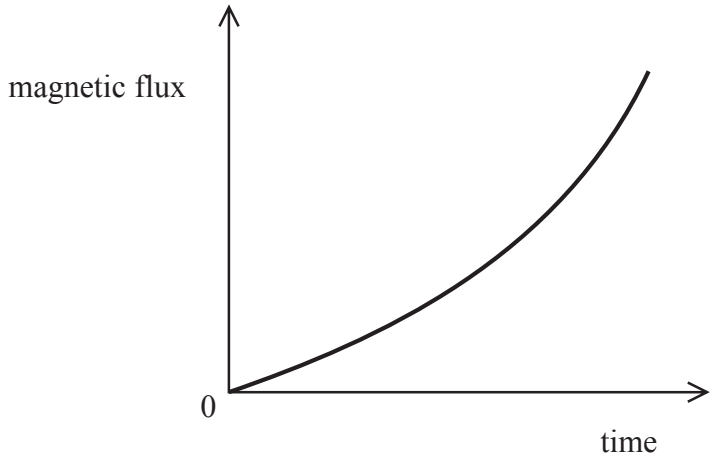
Score: **/24**

Percentage: **/100**

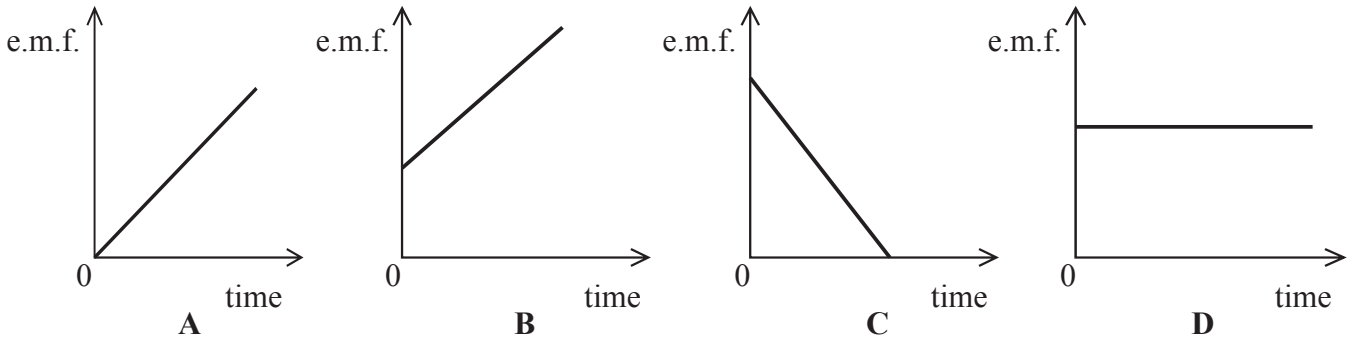
Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 The graph shows how the magnetic lux passing through a coil varies with time.



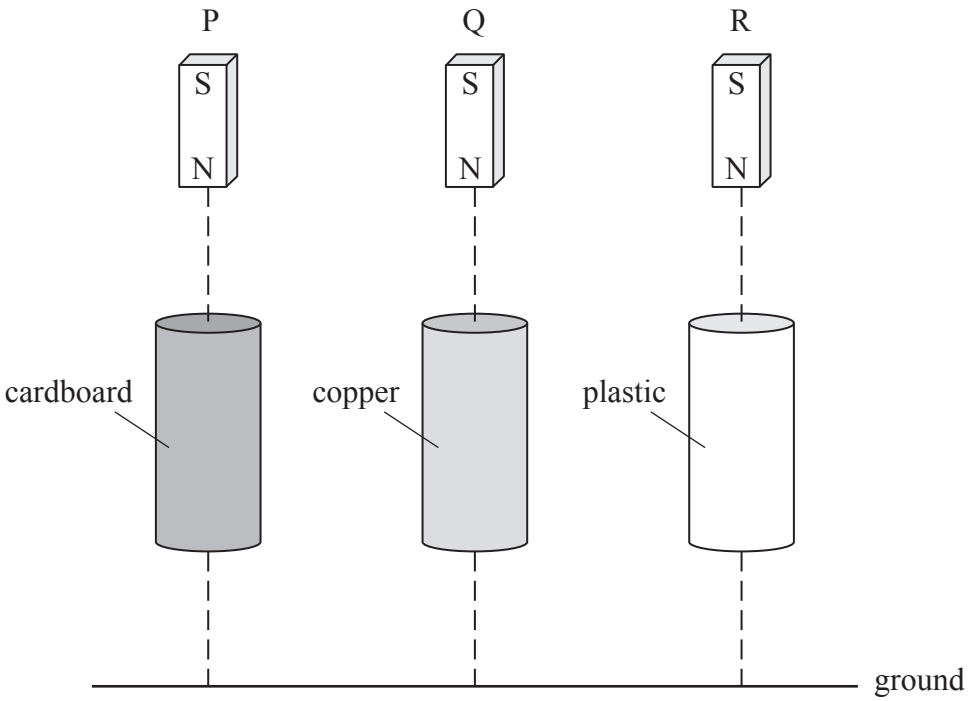
Which of the following graphs could show how the magnitude of the e.m.f. induced in the coil varies with time?



- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(Total for Question 1 = 1 mark)

2 The diagram shows three bar magnets P, Q and R, being dropped simultaneously to fall through tubes of different materials.



The order in which the magnets reach the ground is

☒ **A** P and Q simultaneously followed by R.

☒ **B** P and R simultaneously followed by Q.

☒ **C** Q first then P and R simultaneously.

☒ **D** all three arrive simultaneously.

(Total for Question 2 = 1 mark)

3 (a) State Faraday's law of electromagnetic induction.

(2)

(b) Vehicles such as buses may be powered by electric motors. The motors on these buses use batteries which need to be charged often. This is normally done by connecting to a fixed electrical supply whilst the bus is parked.

The photograph shows a bus on a road in South Korea. This road enables the batteries to charge whilst the bus is in motion.

Under the road there are electric cables, connected to a 440V 60 Hz supply. These generate magnetic fields. There is a coil inside the charging device which is located below the floor of the bus. This enables the batteries on the bus to charge.

*(i) Explain how this system works.

(3)

(ii) It is not necessary for the cable to be installed under the entire length of the road. The batteries used to power these buses can be much smaller than those used in other electric buses.

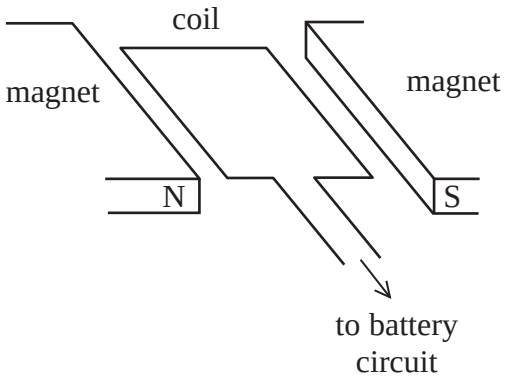
Explain why the cables do not need to be installed under the entire length of the road and why the batteries can be smaller.

(3)

(Total for Question 3 = 8 marks)

4 Regenerative braking is used in electric cars. When the driver applies the brakes the motor acts as an electric generator, making use of the rotation of the wheels as they slow down. This enables the battery to be charged whilst the car is braking.

The diagram shows a coil in a magnetic field which when rotating can be used as an electric generator.



*(a) The coil rotates.

Explain how this produces a current in the coil.

(3)

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(b) State why the current produced in the coil cannot be used directly to charge a battery.

(1)

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(c) When regenerative braking is being used, explain how the magnitude of the generated e.m.f. changes as the driver brakes steadily.

(3)

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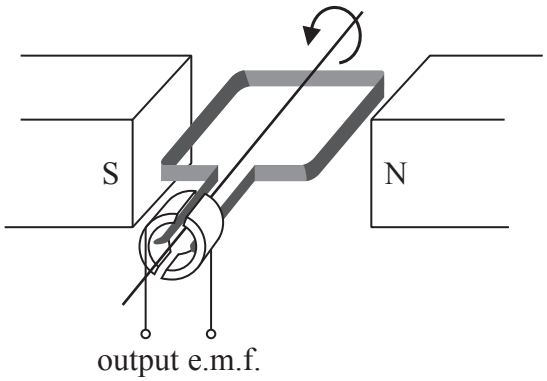
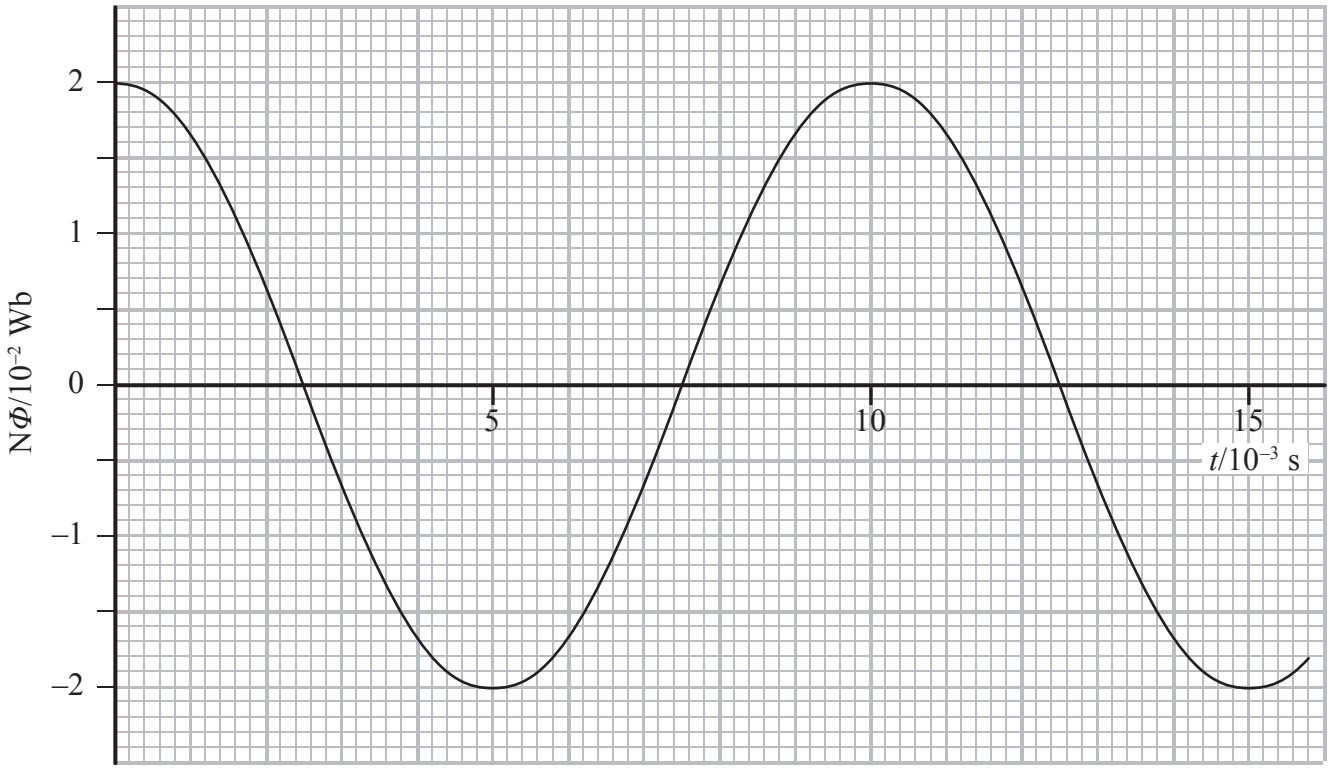
(Total for Question 4 = 7 marks)

5 The diagram shows a simple generator. It has a flat coil of negligible resistance which can be rotated in a magnetic field. The coil has 500 turns and an area of 2.5×10^{-3} m^2.



The graph shows the variation of the magnetic flux linkage $N\Phi$ with time t as the coil is rotated at a steady frequency in a uniform magnetic field.



(a) Determine the frequency of rotation of the coil.

(2)

Frequency = ...

(b) Determine the magnetic flux density of the field.

(2)

Magnetic flux density = ...

(c) Determine the maximum e.m.f. induced in the coil.

(3)

Maximum e.m.f. = ...

(Total for Question 5 = 7 marks)