Write your name, centre number and candidate number in the boxes below.

Surname	Other names

Centre number | | | | | |

Candidate number | | | | |

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Electromagnetic induction

Time allowed: 1 hour

Subject code **0625**

Physics

Questions from Paper 3 and Paper 4

You must have: a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.

Total marks

/ 64

Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.

Information

- This paper has 10 questions worth 64 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

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Print at 100% (Actual size) so diagrams keep their real measurements.

1 A solenoid with many turns is connected across a sensitive centre-zero millivoltmeter, as shown in Fig. 9.1.

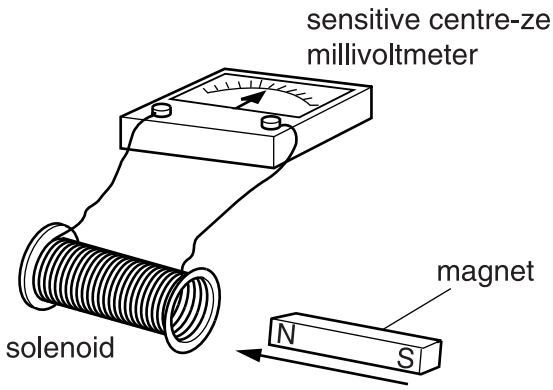


Fig. 9.1

(a) The N pole of a magnet is moved into the solenoid, and then held stationary in the solenoid.

Describe what happens to the needle of the millivoltmeter during this process.

.....

..... [2]

(b) The N pole is then removed from the solenoid.

Describe what happens to the needle during this process.

.....

..... [1]

(c) Complete the following sentence.

When the N pole moves into the solenoid, ... is

..... in the solenoid. [2]

[Total: 5]

Electromagnetic induction and the a.c. generator Click for more variations

1 **(a)** moves/deflects M1
momentary (or equivalent) OR goes back to zero/centre A1

(b) moves/deflects in other direction B1

(c) e.m.f./electromagnetic force/current/voltage/p.d. B1
induced B1
(allow B1 for magnetic field is changed)

[Total: 5]

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2 A student demonstrates electromagnetic induction.

(a) Describe how to demonstrate electromagnetic induction using a magnet, a coil of wire and a sensitive ammeter. You may include a diagram.

.....

.....

.....

..... [3]

(b) State **two** factors that affect the size of an induced electromotive force (e.m.f.)

1. .....

2. ..... [2]

[Total: 5]

Electromagnetic induction and the a.c. generator Click for more variations

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2(a)	coil of wire connected in series with (sensitive) ammeter	**B1**
	magnet moves relative to coil	**B1**
	meter indicates/measures (induced) current	**B1**
2(b)	Any two from:	**B2**
	speed of movement owtte	
	strength of magnet	
	number of coils/turns per metre	
	Total:	**5**

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3 A rotating-coil generator consists of a rectangular coil of wire that rotates at constant speed between the poles of a permanent magnet.

Figs. 10.1, 10.2 and 10.3 show views from one end of the coil, when the coil is in different positions.

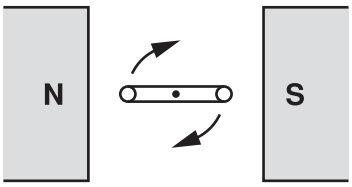


Fig. 10.1

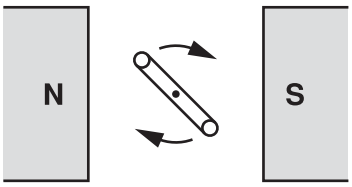


Fig. 10.2

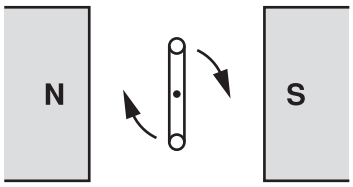


Fig. 10.3

(a) Which diagram shows the coil in the position where

(i) the induced e.m.f. in the coil is at its maximum, ...

(ii) the induced e.m.f. in the coil is zero? ..... [2]

(b) On Fig. 10.4, sketch the graph of e.m.f. against time, for two complete rotations of the coil.



Fig. 10.4

[4]

[Total: 6]

Electromagnetic induction and the a.c. generator Click for more variations

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3 **(a)** **(i)** Fig. 10.1 B1

(ii) Fig. 10.3 B1

(b) 2 complete cycles, any shape (if full-wave rectified, must be 4 humps) B1
cyclical and equal amplitude above & below axis B1
uniform spacing B1
intention of sinusoidal shape accept sinusoidal full-wave rectification B1 [6]

4 A coil P is joined to a battery and a switch S. A similar coil Q is joined to a sensitive centre-zero millivoltmeter G.

P and Q are placed end to end, as shown in Fig. 10.1.

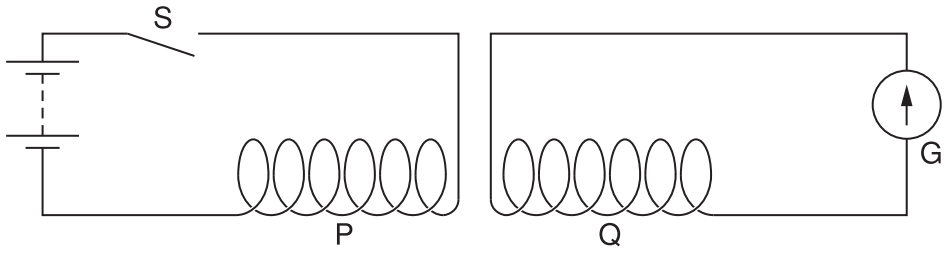


Fig. 10.1

(a) Describe what is seen happening to the reading of G

(i) as switch S is closed,

.....

.....

.....[2]

(ii) as switch S is opened again.

.....

.....

.....[1]

(b) A soft iron bar, as long as the combined lengths of P and Q, is placed inside P and Q.

State what difference this makes to what is observed on G as S is closed.

.....

.....[1]

(c) The bar in **(b)** is removed and the battery is changed for one with a smaller e.m.f.

State what difference this makes to what is observed on G as S is closed.

.....

.....[1]

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(d) The battery is replaced by an a.c. power supply of frequency 50 cycles per second, and then S is closed.

Describe what is seen on G.

.....

.....[1]

[Total: 6]

Electromagnetic induction and the a.c. generator Click for more variations

4 **(a)** **(i)** deflection (in one direction) M1
idea of momentary OR goes back to zero again A1

(ii) idea of same as **(i)** but opposite direction B1

(b) larger B1

(c) smaller B1

(d) nothing OR small oscillations about zero position OR blurred light spot B1 [6]

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5 In Fig. 7.1, XY is a copper rod placed between the N and S poles of a magnet.

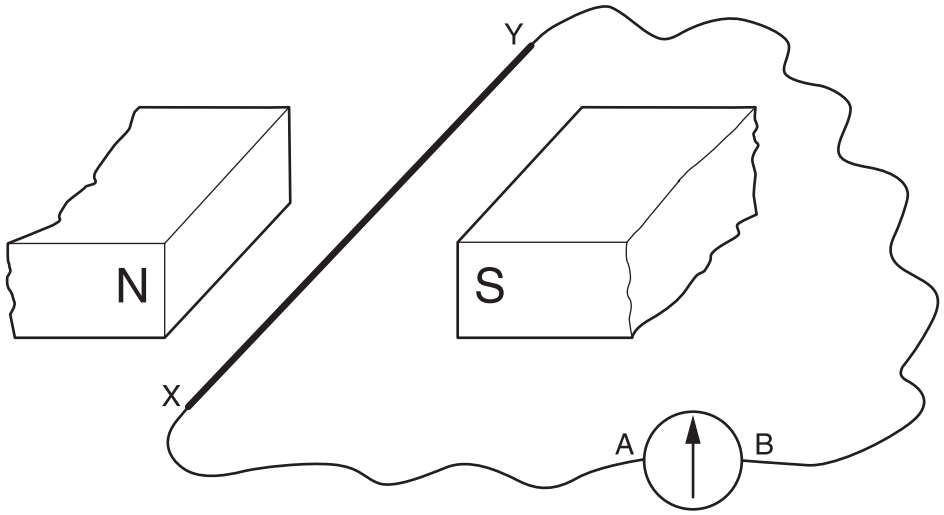


Fig. 7.1

XY is connected to the terminals A and B of a sensitive, centre-zero instrument that measures current.

(a) State the name of this instrument. .....[1]

(b) When there is no current, the pointer on the instrument points half-way between A and B.

State what, if anything, is **seen** happening to the pointer when XY is

(i) held stationary,

.....[1]

(ii) moved horizontally at a steady speed towards the N pole,

.....[1]

(iii) moved horizontally at a steady speed towards the S pole,

.....[1]

(iv) moved repeatedly up and down at right angles to the magnetic field.

.....[2]

(c) Suggest one electrical device that makes use of the effect demonstrated in **(b)**.

.....[1]

[Total: 7]

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5	**(a)**	(milli)ammeter **OR** galvanometer **NOT** ampmeter	B1
	(b) **(i)**	nothing / stays the same / half-way	B1
	(ii)	nothing / stays the same / half-way	B1
	(iii)	nothing / stays the same / half-way	B1
	(iv)	it / arrow / pointer moves / goes / flicks **OR** current changes	M1
		left and right **OR** backwards and forwards	A1
	(c)	generator **OR** dynamo **OR** microphone	B1

[Total: 7]

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6 **(a)** The apparatus in Fig. 10.1 is set up in a laboratory. The metal wheels are rolled along the rails from the left-hand end to the right-hand end.

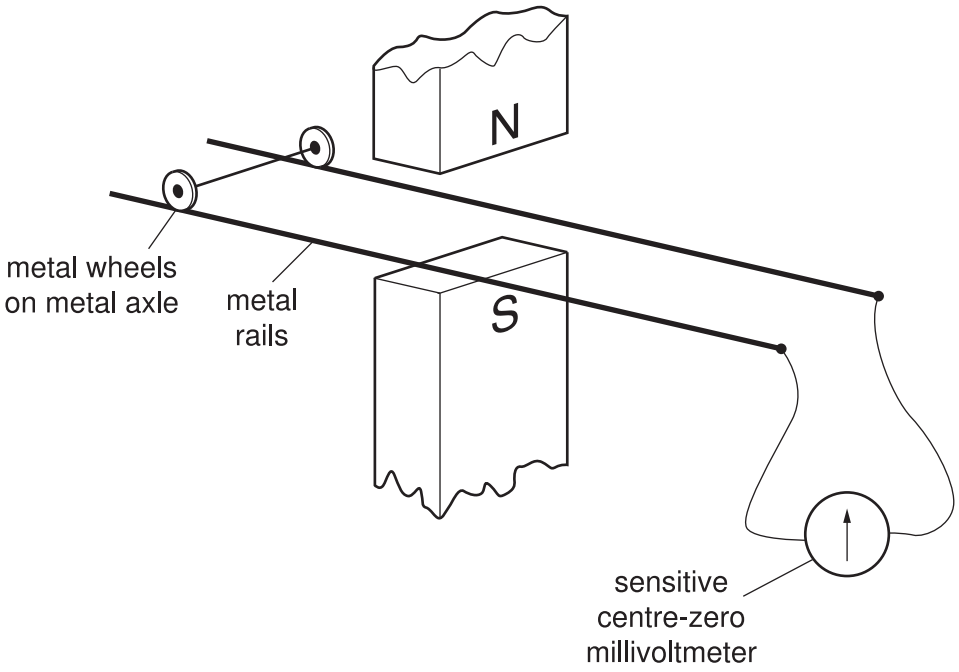


Fig. 10.1

(i) Describe what is seen happening to the pointer on the sensitive centre-zero millivoltmeter.

.....

..... [2]

(ii) Explain why this happens.

.....

.....

.....

.....

..... [3]

(iii) The metal wheels are now rolled back to the left-hand end again.

Describe what now happens to the millivoltmeter pointer.

.....

..... [1]

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(b) Fig. 10.2 shows a magnet suspended above a coil of wire.

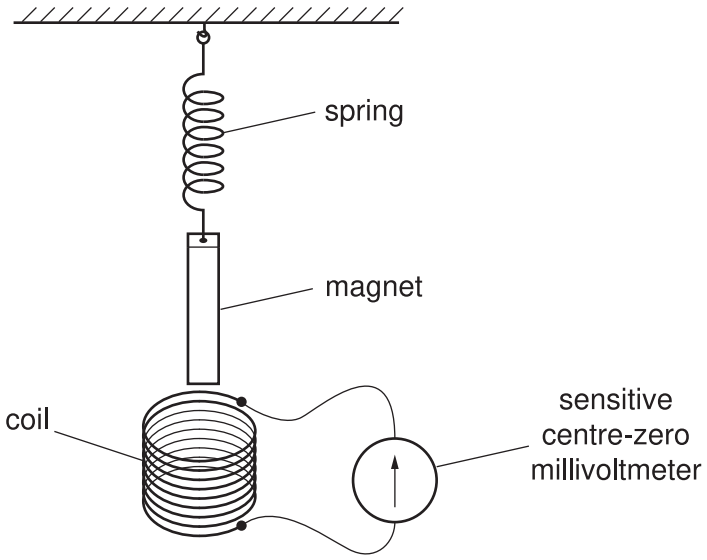


Fig. 10.2

The end of the magnet is pushed into the coil and released, so that it bounces repeatedly in and out of the coil.

Describe what is seen on the sensitive centre-zero millivoltmeter.

.....

..... [1]

[Total: 7]

Electromagnetic induction and the a.c. generator Click for more variations

6 **(a)** **(i)** deflects NOT vibrates OR oscillates M1
returns to zero/centre again A1

(ii) induction/induced current or emf B1
axle/wire cuts magnetic field B1
not when axle out of field B1

(iii) opposite deflection B1

(b) needle/pointer swings from side to side B1

[Total: 7]

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7 A coil is wound on a cylindrical cardboard tube and connected to a sensitive centre-zero millivoltmeter.

Figs. 8.1, 8.2 and 8.3 show three situations involving the coil and a magnet.

(a) On the lines alongside each situation, describe what, if anything, is seen happening on the millivoltmeter.

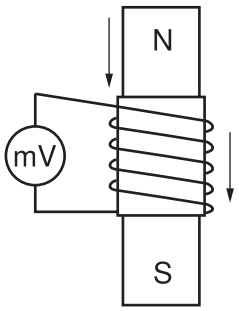


Fig. 8.1

magnet inside coil, both moving at same speed

.....

.....

.....

.....

..... [1]

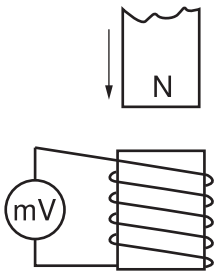


Fig. 8.2

magnet moving towards coil

coil stationary

.....

.....

.....

.....

..... [1]

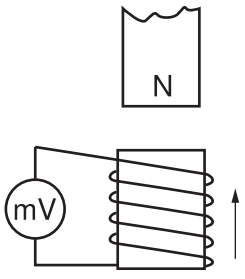


Fig. 8.3

magnet stationary

coil moving towards magnet

.....

.....

.....

.....

..... [2]

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(b) Choose one of the situations in **(a)** where something is seen happening to the millivoltmeter. For this situation, state three changes which could be made to increase the magnitude of what is seen.

1. .....

2. .....

3. ..... [3]

[Total: 7]

Electromagnetic induction and the a.c. generator Click for more variations

7 **(a)** Fig.8.1 nothing seen/no current/no deflection/no voltage B1

Fig. 8.2 deflection (of needle)/current in mV/voltage induced B1

Fig. 8.3 deflection (of needle)/current in mV/voltage induced
(**ignore** size of deflection) M1
same direction as Fig. 8.2 A1

(b) increase speed B1

increase turns (of wire)/more coils (**ignore** longer wire) B1

increase magnet strength (**ignore** larger magnet) B1

[Total: 7]

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8 In the laboratory demonstration shown in Fig. 11.1, a copper rod rolls at a steady speed down the sloping parallel copper rails. The rails are in the region of a strong magnetic field that acts vertically downwards.

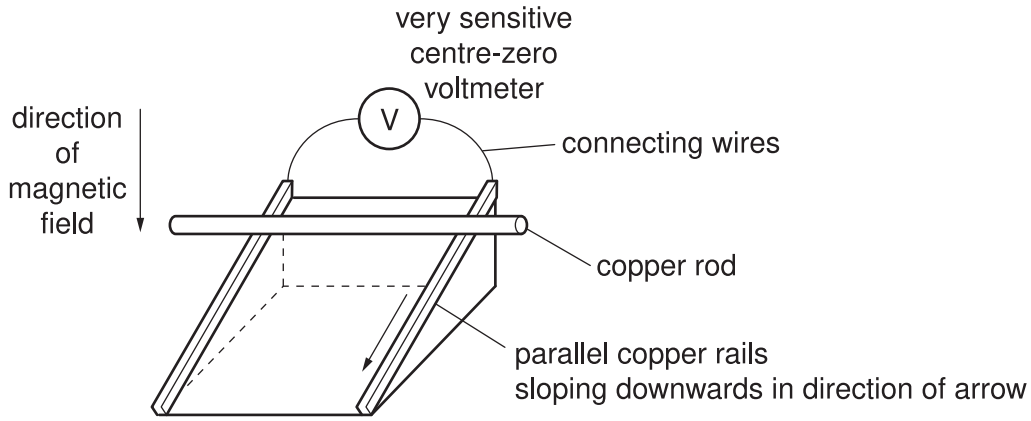


Fig. 11.1

(a) Explain why the voltmeter shows a deflection.

.....

.....

.....

..... [2]

(b) State, with reasons, the effect on the voltmeter deflection of the following changes:

(i) increasing the strength of the magnetic field,

deflection .....

reason .....

.....

.....

(ii) slightly increasing the slope of the copper rails,

deflection .....

reason .....

.....

.....

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(iii) changing the direction of the magnetic field so it is parallel to the copper rails and directed down the slope.

deflection .....

reason .....

.....

.....

[4]

[Total: 6]

Electromagnetic induction and the a.c. generator Click for more variations

8 **(a)** magnetic flux changes / rod cuts magnetic field B1
emf / voltage induced ignore current induced B1 [2]

(b) Mark **(i)** & **(ii)** together
deflection increases/to R in **(i)** B1
deflection increases/to R in **(ii)** B1
correct reason in **(i)** or **(ii)** AND consistent with deflection:
in **(i)** or **(ii)** rate of change of flux (linkage) increases
in **(i)** more (magnetic) field lines cut/stronger (magnetic) field cut
in **(ii)** rod moves faster/field lines cut faster B1

(iii) no deflection AND no (magnetic) field lines cut/no change of flux (linkage) B1 [4]

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9 A student holds a magnet above a solenoid, which is connected to a centre-zero milli-ammeter as shown Fig. 8.1.

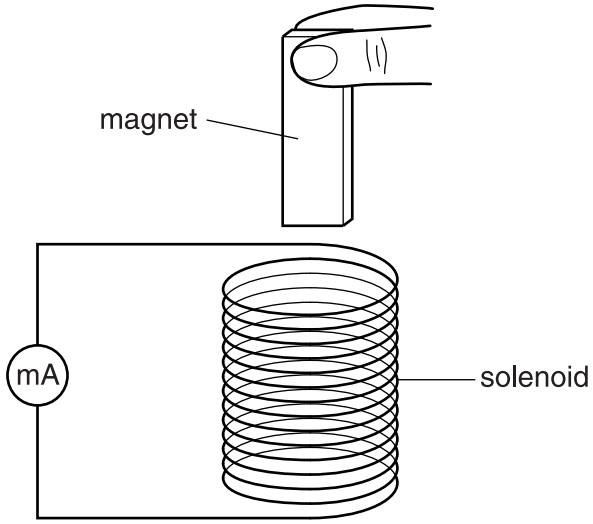


Fig. 8.1

(a) The student drops the magnet so that it falls through the solenoid.

State and explain what would be observed on the milliammeter

(i) as the magnet enters the solenoid,

.....

.....

..... [2]

(ii) as the magnet speeds up inside the solenoid.

.....

.....

..... [2]

(b) As the magnet passes into the coil in part **(a)**, the coil exerts a force on the magnet even though there is no contact between them.

(i) State the direction of this force.

.....

(ii) Explain how this force is caused.

.....

.....

.....

[3]

[Total: 7]

Electromagnetic induction and the a.c. generator Click for more variations

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9	(a)	(i)	(milliammeter) deflects/shows reading/current OR reading changes OR there is a current	B1	
			change of flux/field (lines) cut OR emf/current induced/produced	B1	[2]
		(ii)	greater deflection/current	B1	
			rate of change of flux (linkage) is greater o.w.t.t.e e.g. more magnetic field lines cutting coil (per second) OR field cut faster	B1	[2]
	(b)	(i)	upwards/opposite to magnet's direction of travel ignore towards magnet	B1	
		(ii)	current (in coil) causes a magnetic field	B1	
			force caused by overlapping (magnetic) fields	B1	[3]
					[Total: 7]

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10 A student turns the handle of an alternating current (a.c.) generator and the coil rotates.

Fig. 8.1 represents the structure of the a.c. generator.

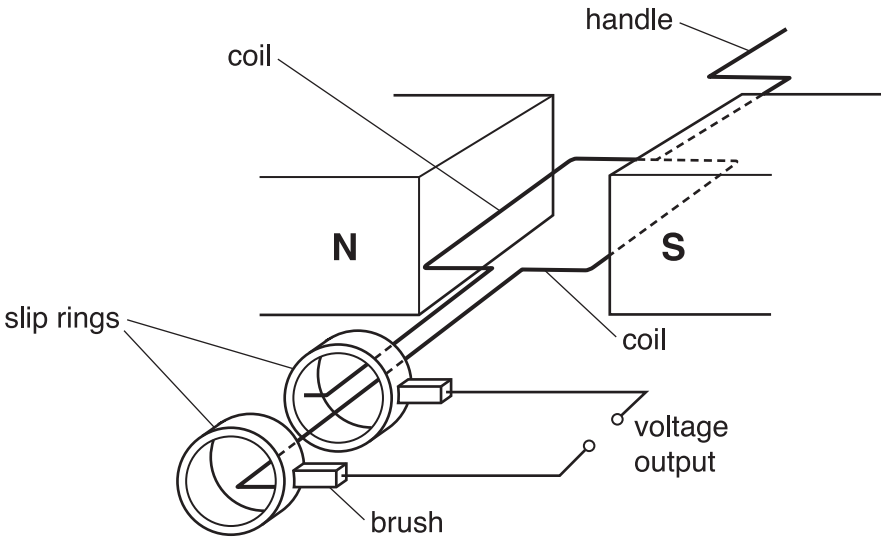


Fig. 8.1

(a) There is an alternating voltage output between the two terminals.

(i) Explain why rotating the coil produces an output voltage.

.....

.....

.....

..... [3]

(ii) State the position of the rotating coil when the alternating output voltage is at a maximum value and explain why the maximum output occurs at this position.

.....

.....

..... [2]

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(b) A lamp and an open switch are connected in series to the output terminals of the a.c. generator.

The switch is closed and the lamp lights up. The student has to apply a greater force on the handle.

Explain why a greater force is needed to keep the lamp lit.

.....

.....

.....

..... [3]

[Total: 8]

Electromagnetic induction and the a.c. generator Click for more variations

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10(a)(i)	magnetic field mentioned			**B1**
	coil / wire cuts (magnetic) field **OR** changing (magnetic) field (through coil)			**B1**
	e.m.f. / voltage induced **OR** produced by electromagnetic induction			**B1**
10(a)(ii)	(plane of coil) horizontal **OR** in position shown in diagram coil cutting magnetic field the fastest			**B1** **B1**
10(b)	current in coil	**OR**	energy supplied to / lost from lamp	**B1**
	current in (magnetic) field experiences a force		student must do more work / supply more energy / more energy needed	**B1**
	opposes the change causing it		greater force to do more work	**B1**

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