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

Surname	Other names

Centre number | | | | | |

Candidate number | | | | |

STEM | Exam Builder

Electromagnetic effects

Time allowed: 1 hour 15 minutes

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

/ 78

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 78 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)** Fig. 12.1 shows two circuits, A and B, linked by a relay.

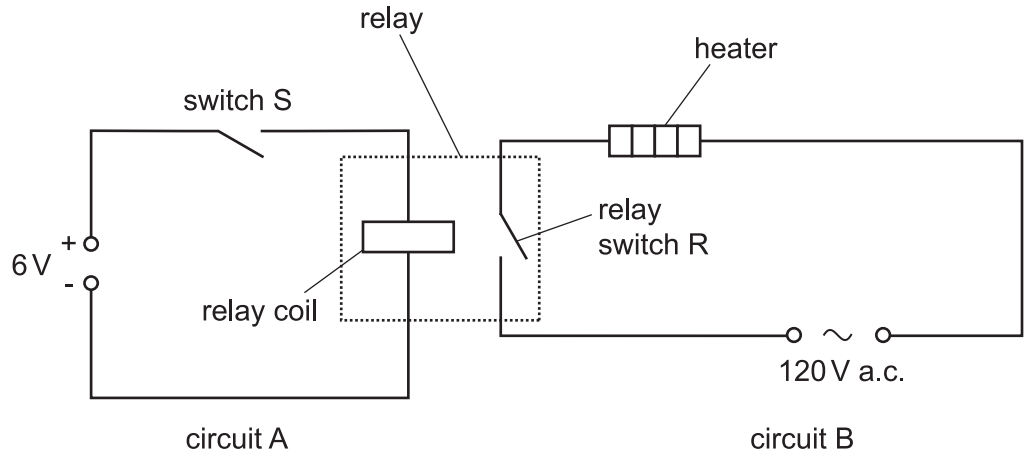


Fig. 12.1

Describe what happens in the two circuits when switch S is closed.

.....

.....

.....

.....

..... [3]

(b) Another circuit includes a transformer. The input voltage of the transformer is 120 V a.c. The input coil has 480 turns of wire and the output coil has 60 turns of wire.

Calculate the output voltage of the transformer.

output voltage = ... V [3]

[Total: 6]

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Magnetic effect of a current (solenoids, relays) Click for more variations

1(a)	any **three** from: current in relay coil produces magnetic field relay / switch R is closed heater connected to 120 V or switches on	**B3**
1(b)	$V_s / V_p = N_s / N_p$ in any form	**C1**
	(V_s =) (60 × 120) ÷ 480 OR 120 ÷ 8	**C1**
	15 (V)	**A1**

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2 **(a)** Fig. 11.1 shows a simple electric motor.

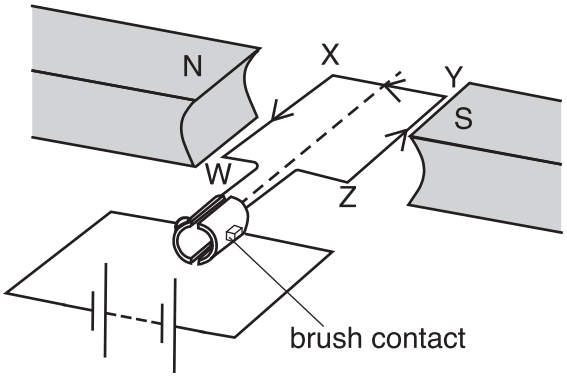


Fig. 11.1

(i) There is a current in the coil WXYZ. The direction of this current is shown by the arrows.

On Fig. 11.1, draw an arrow to show the direction of the force acting on side WX and an arrow to show the direction of the force acting on side YZ.

[1]

(ii) State three ways of increasing the turning effect of the motor.

1. .....

2. .....

3. .....

[3]

(b) In a home, a step-down transformer reduces the mains voltage of 225 V to 4.5 V.

The transformer has 4000 turns on the primary coil.

Calculate the number of turns on the secondary coil.

number of turns = ... [3]

[Total: 7]

Motor effect and the d.c. motor Click for more variations

STEM | Exam Builder

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2(a)(i)	arrow up from side WX of coil **AND** an arrow down from side YZ of coil	**B1**
2(a)(ii)	any **three** from: stronger / more powerful magnets smaller gap between coil and magnet(s) larger current in coil more coils / turns	**B3**
2(b)	$V_p / V_s = N_p / N_s$ **OR** ratio used	**C1**
	4000 ÷ (225 ÷ 4.5) OR (4000 × 4.5) ÷ 225 OR 4000 ÷ 50	**C1**
	80	**A1**

3 A transformer has 500 turns in both its primary and its secondary coils. It is connected to a 240 V mains supply. There are 4 possible connections to the secondary, labelled W, X, Y and Z on Fig. 10.1.

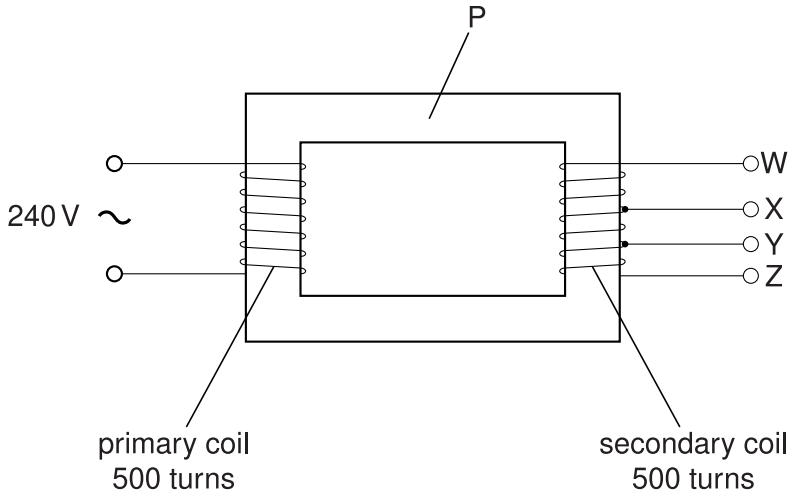


Fig. 10.1

Between W and X there are 300 turns.

Between X and Y there are 175 turns.

Between Y and Z there are 25 turns.

(a) A person wishes to run a 12 V electric bell, using the transformer.

Between which two of the labelled terminals should the bell be connected?

Show your working.

bell connected between terminal ..... and terminal ..... [4]

(b) State the voltage between terminals W and Z.

..... [1]

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(c) State the name given to the part labelled P and the material from which it is made.

name .....

material ..... [2]

(d) Why are the coils normally made from copper wire?

.....

..... [1]

[Total: 8]

Transformers Click for more variations

3 **(a)** V_1/V_2 or N_1/N_2 or V_1/N_1 or V_2/N_2 in any form — Allow full credit for use — C1
substitution correct **and seen** — of 25 turns to give 12V, — **M1**
25 turns — with working seen

A1

Y and Z (either order) B1

(b) 240 (V) B1

(c) core B1
iron NOT steel B1

(d) good conductor OR low resistance OR to reduce heating
OR for high efficiency IGNORE good/bad conductor of heat B1

[8]

STEM | Exam Builder

4 A student is experimenting with electromagnetic effects.

(a) Describe an experiment, using any standard laboratory equipment, to demonstrate electromagnetic induction. You may draw a diagram.

.....

.....

.....

..... [3]

(b) Fig. 11.1 shows a transformer connected to an input voltage of 12 V a.c.

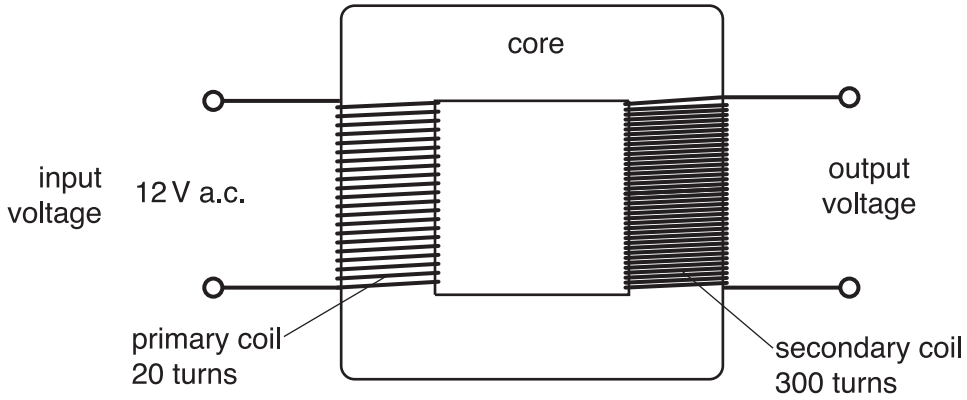


Fig. 11.1

(i) State the name of a suitable material for the core of the transformer.

..... [1]

(ii) Explain how the diagram in Fig. 11.1 shows a step-up transformer.

.....

..... [1]

(iii) Using the information in Fig. 11.1, calculate the output voltage of the transformer.

output voltage = ...V [3]

[Total: 8]

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

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Reduced to 78% to fit the page (wider than A4).

4(a)	relative movement (between conductor and magnetic field) And any **two** from: connect conductor/coil to (sensitive) meter use of magnet/magnetic field	**B1**
	deflection on meter (indicates emf) OR voltage generated OR current in conductor	**B2**
4(b)(i)	(soft-) iron	**B1**
4(b)(ii)	more turns on output coil (than input coil) ora	**B1**
4(b)(iii)	Vs / Vp = Ns / Np in any form	**C1**
	Vs / 12 = 300 / 20 OR Vs = (300 / 20) × 12 OR Vs = 15 × 12 OR 12 / 20 = ? / 300	**C1**
	180 (V)	**A1**

STEM | Exam Builder

5 Fig. 7.1 shows a small plotting compass which is aligned with the magnetic field between magnetic poles A and B of a U-shaped magnet.

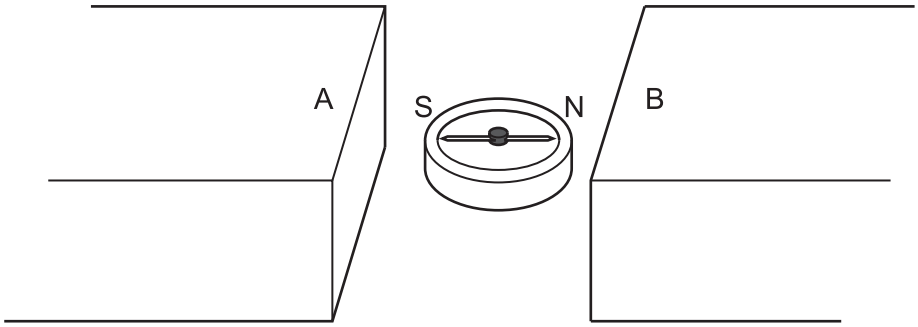


Fig. 7.1

(a) State the polarity of the poles.

pole A .....

pole B .....

[1]

(b) Fig. 7.2 shows a wire, placed between two poles, carrying a current in the direction of the arrow.

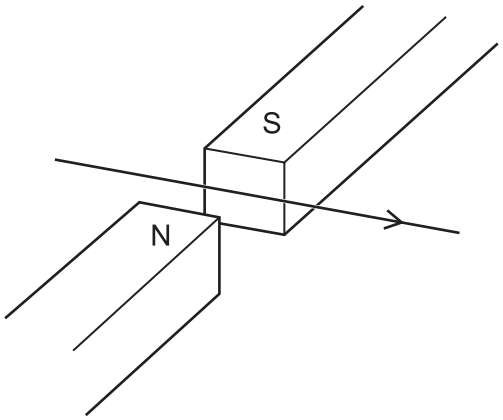


Fig. 7.2

On Fig. 7.2, draw an arrow to show the direction of the force on the wire due to the magnetic field. [2]

STEM | Exam Builder

(c) Fig. 7.3 shows a β-particle moving in the direction of the arrow between the same two poles.

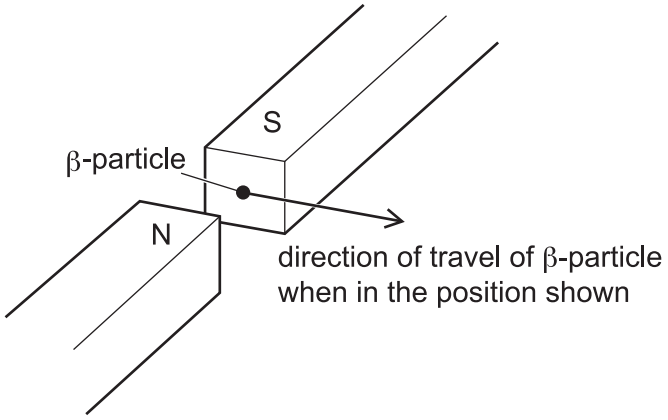


Fig. 7.3

On Fig. 7.3, draw an arrow to show the direction of the force on the β-particle due to the magnetic field. [2]

[Total: 5]

Motor effect and the d.c. motor Click for more variations

Reduced to 77% to fit the page (wider than A4).

5(a)	(pole A:) N AND (pole B:) S	**B1**
5(b)	vertical	**B1**
	up	**B1**
5(c)	vertical	**B1**
	down	**B1**

STEM | Exam Builder

6 Fig. 9.1 shows a simple direct current (d.c.) electric motor. The coil rotates about the axis when there is a current in the coil. The coil is connected to the rest of the circuit by the brushes.

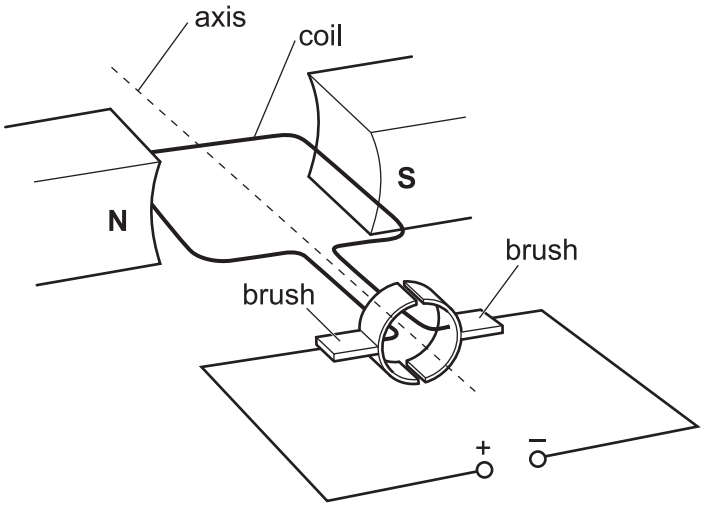


Fig. 9.1

(a) (i) On Fig. 9.1, draw a pair of arrows to show which way the coil rotates. Explain the direction you have chosen.

.....

.....

..... [3]

(ii) On Fig. 9.1, draw an arrow to show the direction in which electrons flow through the coil. [1]

(iii) Explain why the electrons flow in the direction you have shown in **(a)(ii)**.

.....

..... [1]

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(b) State any difference each of the following changes makes to the rotation of the coil in Fig. 9.1:

(i) changing the polarity of the power supply to that shown in Fig. 9.2

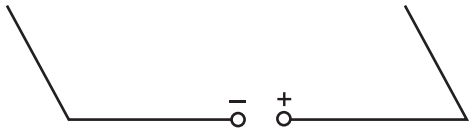


Fig. 9.2

..... [1]

(ii) changing the coil to the new coil shown in Fig. 9.3



original coil new coil

Fig. 9.3

..... [1]

(iii) using a stronger magnetic field.

..... [1]

[Total: 8]

Motor effect and the d.c. motor Click for more variations

Reduced to 78% to fit the page (wider than A4).

6(a)(i)	anti-clockwise (seen from brushes)	**M1**
	I correctly described	**A1**
	F down on left / up on right	**A1**
6(a)(ii)	arrow labelled correct direction on coil	**B1**
6(a)(iii)	electrons –ve OR repelled from –ve connection of supply	**B1**
6(b)(i)	rotates in opposite direction	**B1**
6(b)(ii)	turns faster OR greater moment / turning effect	**B1**
6(b)(iii)	turns faster OR greater moment / turning effect	**B1**

STEM Exam Builder

7 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.

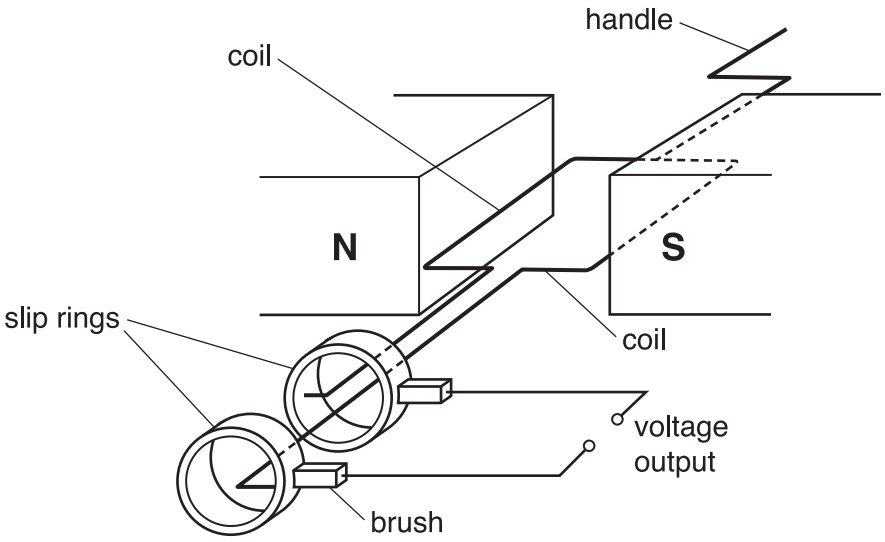


Fig. 8.1

(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

Reduced to 75% to fit the page (wider than A4).

7(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**
7(a)(ii)	(plane of coil) horizontal **OR** in position shown in diagram coil cutting magnetic field the fastest			**B1** **B1**
7(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**

STEM | Exam Builder

8 **(a)** Fig. 8.1 shows a wire carrying a large current.

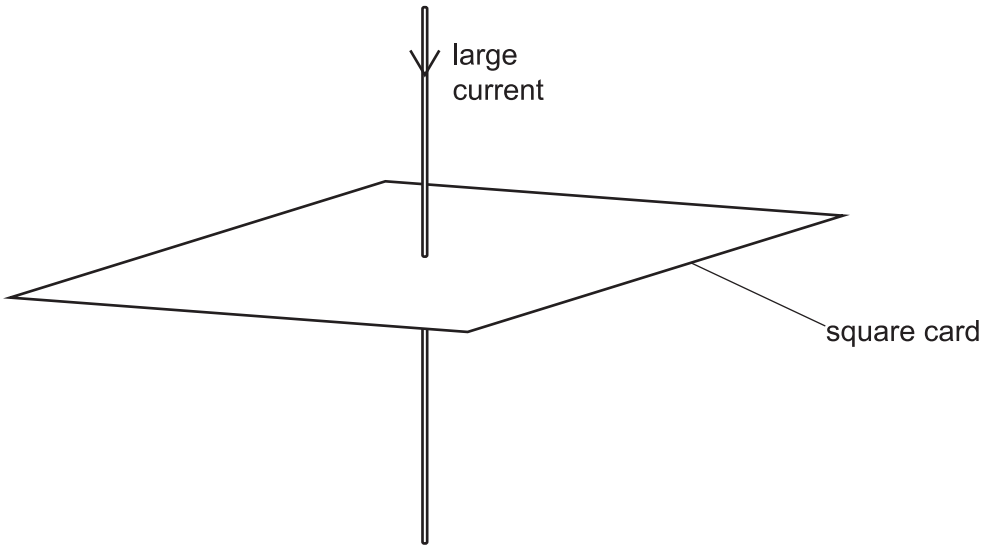


Fig. 8.1

(i) Fig. 8.2 shows the square card viewed from above.

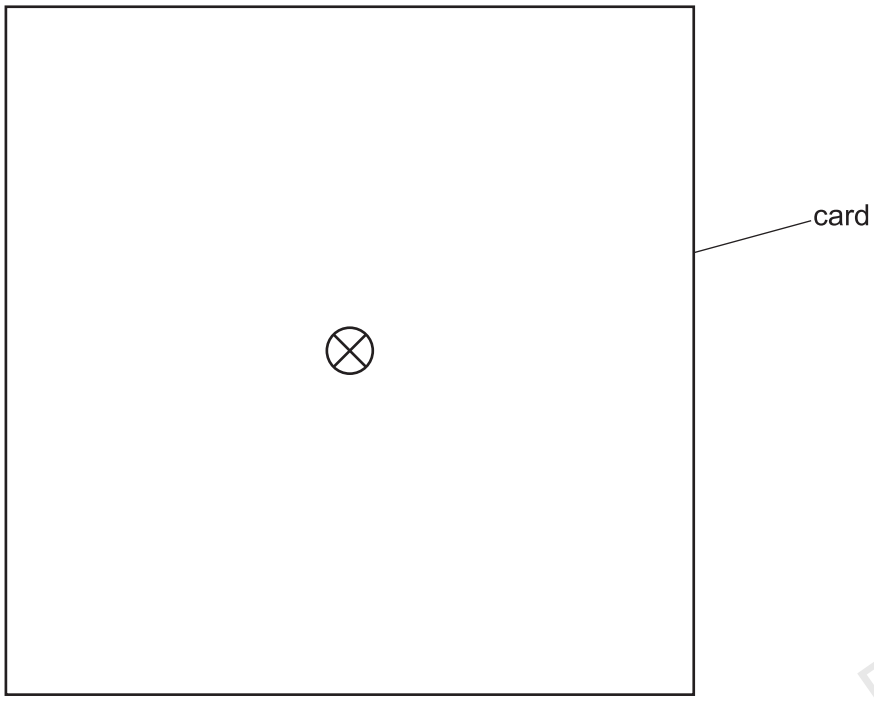


Fig. 8.2

On Fig. 8.2, draw **three** magnetic field lines that indicate the direction of the magnetic field and how its strength varies with distance from the wire. [3]

(ii) The current in the wire increases and the direction of the current is reversed.

State how these changes affect the magnetic field.

.....

..... [2]

STEM Exam Builder

(b) Electricity is transmitted at high voltage.

Explain why a high voltage increases the efficiency of transmission even with thinner wires.

.....

.....

.....

..... [3]

[Total: 8]

Magnetic effect of a current (solenoids, relays) Click for more variations

Reduced to 77% to fit the page (wider than A4).

8(a)(i)	three concentric circles centred on X	**B1**
	second and third circles further apart than first and second circles	**B1**
	direction of arrows clockwise	**B1**
8(a)(ii)	strength of magnetic field increases	**B1**
	its direction reverses	**B1**
8(b)	any three from: • $P = I^2R$ **OR** power (loss) = I^2R • (high voltage allows) low current (so at same power output, less power / energy lost) • thin wires have high resistance (so more power / energy lost) • (low) current has a greater effect (on efficiency) than (high) resistance (of the thin wires)	**B3**

9 Fig. 8.1 shows a diagram of part of a simple a.c. generator.

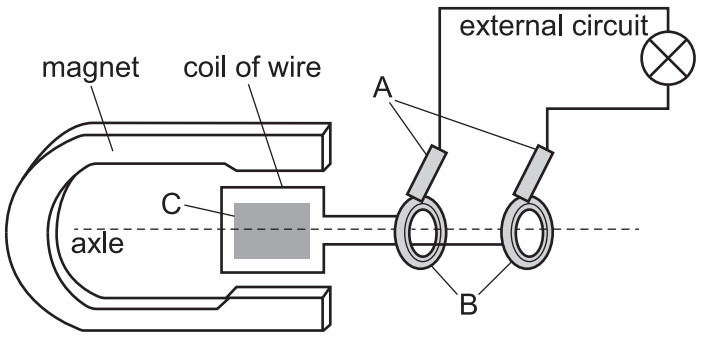


Fig. 8.1

(a) (i) Identify components A and B in Fig. 8.1.

A .....

B .....

[2]

(ii) Component C is made of soft iron.

Describe the effect of this component on the generator.

.....

..... [1]

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(b) The coil of the generator rotates at a constant speed of two complete revolutions per second. Sketch a graph of the e.m.f. generated against time on the axes in Fig. 8.2. The coil is in the position shown in Fig. 8.1 at time = 0.

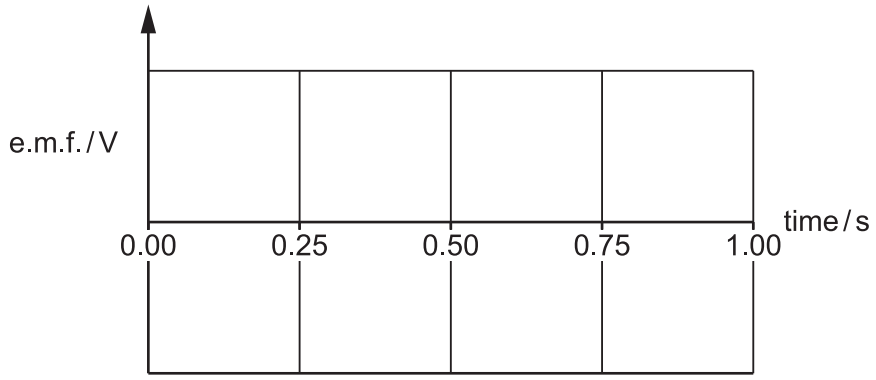


Fig. 8.2

[3]

(c) In power stations, transformers are used to step up the voltage of electricity generated before it is transmitted through cables over long distances.

(i) Explain the advantages of transmitting electricity at high voltages.

.....

.....

..... [2]

(ii) A power station generates electricity at 25 000 V. A transformer steps up the voltage to 300 000 V. The primary coil of the step-up transformer has 450 turns.

Calculate the number of turns N_s on the secondary coil of the transformer.

N_s = ... [2]

[Total: 10]

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

STEM | Exam Builder

9(a)(i)	(A is carbon) brushes	**B1**
	(B is) slip rings	**B1**
9(a)(ii)	strengthens the magnetic field (of the magnet)	**B1**
9(b)	graph is sinusoidal with positive and negative e.m.f.	**B1**
	graph shows minimum of one cycle completed in 0.5 s	**B1**
	e.m.f. is a maximum at 0.00 s, curves to a minimum at 0.25 s and curves to maximum at 0.50 s **OR** e.m.f. is a minimum at 0.00 s and curves to a maximum at 0.25 s and curves to a minimum at 0.50 s braille: e.m.f. starts at time zero at either maximum or minimum value	**B1**

9(c)(i)	**either:** less power loss (for same power transmission) **AND** (because) $P = I^2R$ **OR** low current (for same power transmission) **AND** (allows) thinner / cheaper cables	**A2**
	any **one** from: • less power loss (for same power transmission) • $P = I^2R$ • low current (for same power transmission) • thinner / cheaper cables	C1
9(c)(ii)	5400	**A2**
	$\frac{V_p}{V_s} = \frac{N_p}{N_s}$ **OR** $(N_s =)\ \frac{N_p V_s}{V_p}$ **OR** $(N_s =)\ \frac{450 \times 300\,000}{25\,000}$	C1

STEM | Exam Builder

10 A solid bar is inside a copper solenoid. Fig. 7.1 shows that the copper solenoid is connected in series with a battery and a variable resistor.

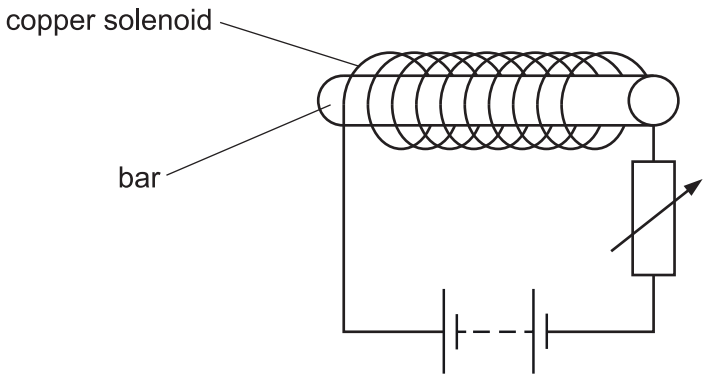


Fig. 7.1

The device shown in Fig. 7.1 is an electromagnet.

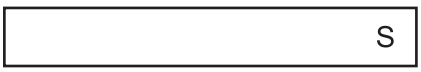
(a) Suggest a suitable material for the bar.

..... [1]

(b) The right-hand end of the bar is the S pole.

(i) Fig. 7.2 shows the bar viewed from above.

On Fig. 7.2, draw at least six field lines to show the pattern and direction of the magnetic field surrounding the bar.



STEM | Exam Builder

Fig. 7.2

[3]

(ii) The resistance of the variable resistor increases.

Explain what happens to the magnetic field surrounding the bar and state how the pattern of field lines that represents the field changes.

.....

.....

.....

..... [3]

(c) A square coil of many turns is placed close to the bar. Fig. 7.3 shows the plane of the square coil parallel to the flat circular surface at the right-hand end of the bar.

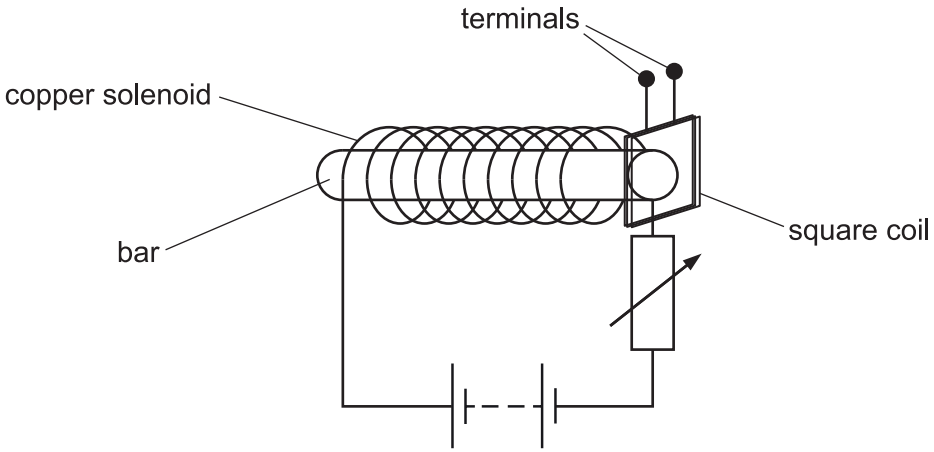


Fig. 7.3

The resistance of the variable resistor is alternately increased and decreased.

Explain what happens in the wires of the square coil.

.....

.....

.....

..... [3]

[Total: 10]

Magnetic effect of a current (solenoids, relays) Click for more variations

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10(a)	(soft) iron	**B1**
10(b)(i)	(at least) one complete field line between the poles of the bar (either above or below the bar)	**B1**
	no crossing **AND** attempt at correct shape **AND** at least six lines from / to poles	**B1**
	at least **one** arrowhead towards S pole	**B1**
10(b)(ii)	current (in the coil) decreases	**B1**
	(current decreases so magnetic field) strength decreases	**B1**
	(field strength decreases so) fewer field lines (in same area) **OR** (field strength decreases so) field lines further apart	**B1**
10(c)	*Any two from:* 1 (changing resistance causes) changing current (through solenoid) 2 (changing current causes) changing magnetic field (around solenoid) 3 (square) coil cuts (changing) magnetic field **OR** coil in changing magnetic field	**B2**
	e.m.f. induced (between terminals)	**B1**

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