Eduqas Physics GCSE
Topic 8.3: Induced potential and transformers
Questions by topic

1.

A power station delivers an output of 2×10^8 W of electricity at 50 kV which is changed to 400 kV for transmission.

(a) Explain how the National Grid provides a reliable supply of electricity. [2]

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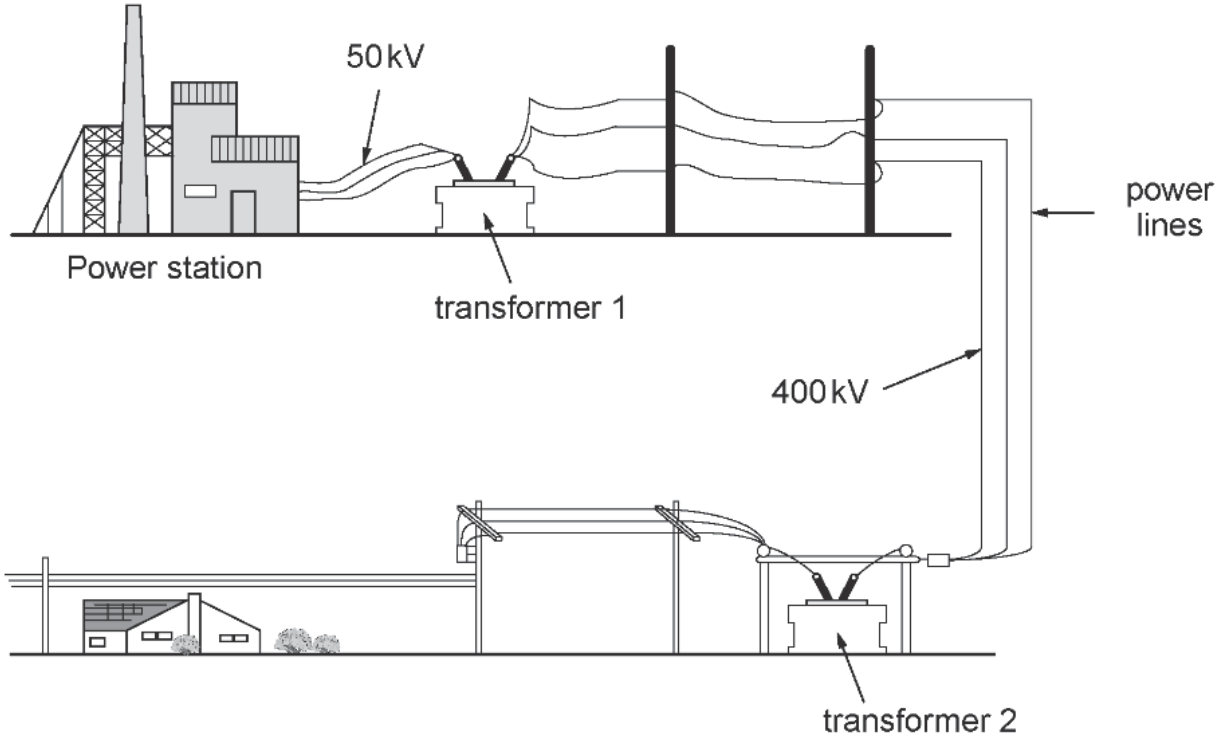

(b) Use an equation from page 2 to calculate the current in the National Grid power lines. (You can assume that transformer 1 is 100% efficient.) [3]

current = ... A

(c) In fact some energy is lost as heat in transformers. Explain how the use of the **two** transformers is still more **energy efficient** than transmitting the electricity at 50 kV along the National Grid. [3]

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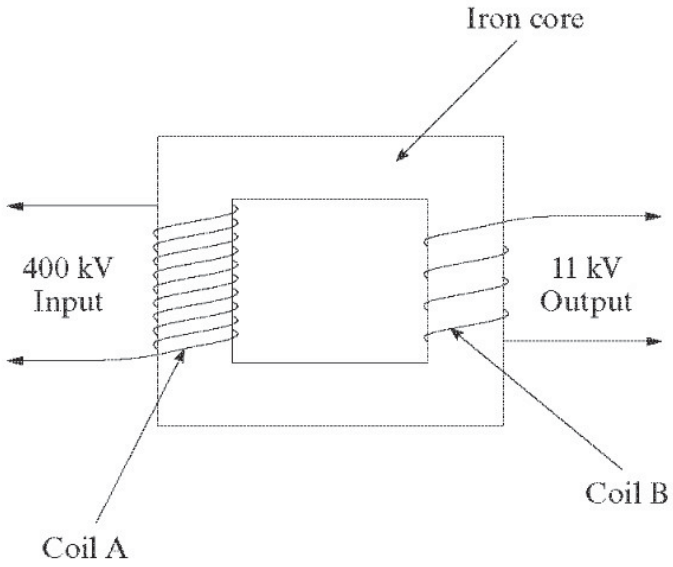
2.

The diagram shows a transformer that is made up of two coils and an iron core. Transformers are used in the supply of electricity to homes, schools and industry. The one shown below has an input power of 10 MW and is 99% efficient.



(a) (i) Describe the National Grid. [2]

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(ii) Explain why electrical power is transmitted at high voltages in the National Grid. [2]

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(b) (i) Name the type of transformer shown in the above diagram and give a reason for your answer. [1]

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(ii) Use an equation from page 2 to calculate the current in the input coil. [3]

input current = ... A

(iii) Use the equation:

$$\% \text{ efficiency} = \frac{\text{useful power transfer}}{\text{total power input}} \times 100$$

to calculate the power delivered to the output coil and give its unit. [3]

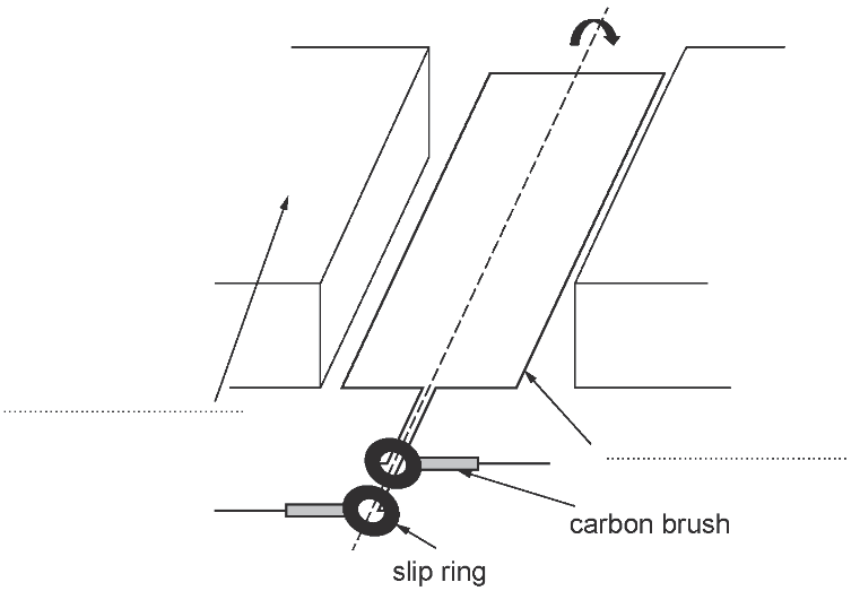
output power = ... unit =.....

11

3 (HIGHER).

The diagram shows a simple a.c. generator in which the coil is made to spin in the direction shown.

(a) (i) **Complete** the labelling of the diagram. [2]



(ii) State why a voltage is produced when the coil spins. [1]

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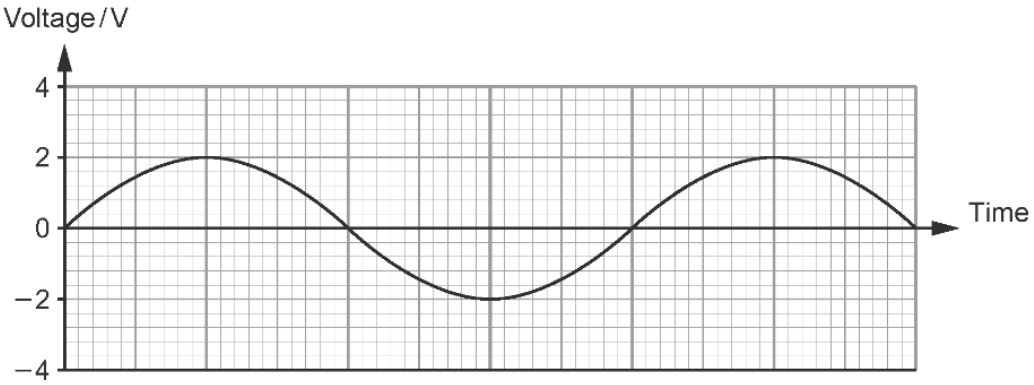
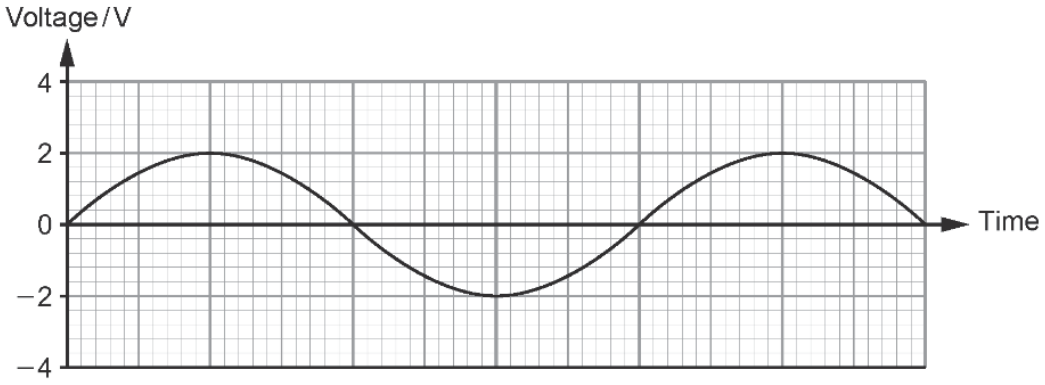
(b) The original output from the generator is shown in each of the following graphs. **On each of the graphs**, draw the new voltage curve for the stated change.

(i) The magnetic field is made twice as strong. [1]



(ii) The coil is spun twice as fast. [2]



(c) The table below shows how the output voltage changes with the input voltage for five different transformers A to E.

Input voltage to transformer (V)	Output voltage from transformer (V)				
	A	B	C	D	E
10	20	30	150	2	10
20	40	60	300	4	20
30	60	90	450	6	30
40	80	120	600	8	40

(i) I. Identify the step-down transformer. ..... [1]

II. Identify the transformer that steps up the current. ..... [1]

III. Identify the transformer with the same number of turns on the input and output coils.

..... [1]

IV. An input voltage of 2 V a.c. is supplied to transformer **B**. Calculate its output voltage. [1]

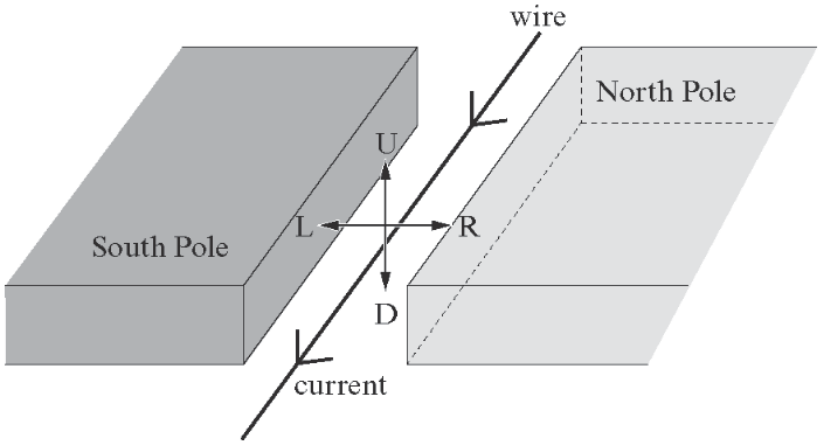
output voltage = ...V

(ii) Use an equation from page 2 to calculate the number of turns on the output coil of transformer **C** given that its input coil has 500 turns. [2]

number of turns = ...

4 (HIGHER).

The diagram shows a wire being moved in a magnetic field between two permanent magnets.



(a) By using one of the letters on the diagram, state the direction in which the wire needs to move so that the current is induced in it in the direction shown. [1]

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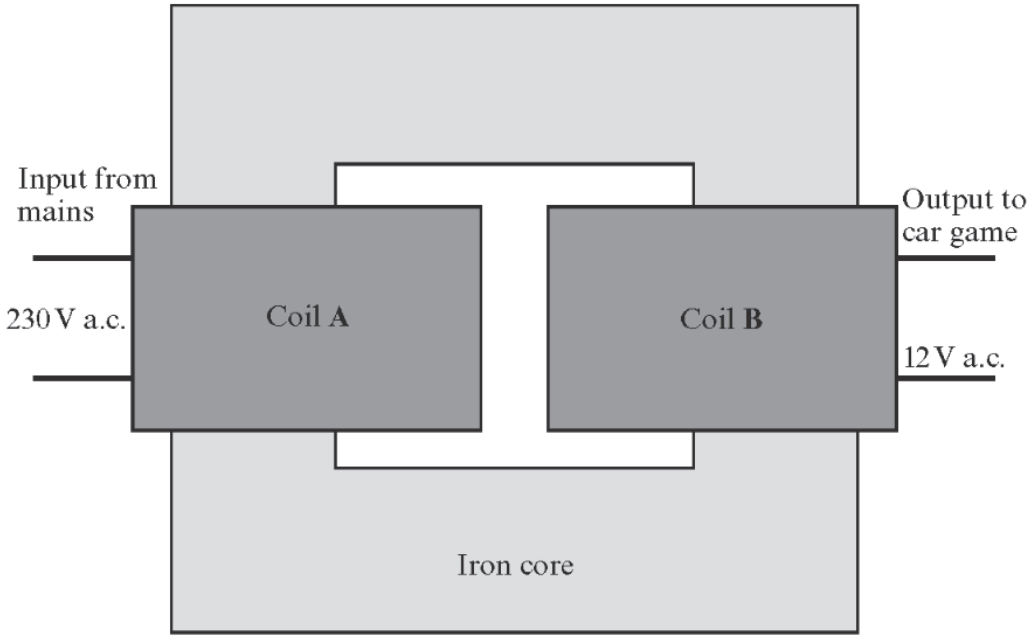
(b) A model racing car game uses a transformer. It changes a 230 V input to a 12 V output by using two coils **A** and **B**.



(i) Which coil, **A** or **B** should have the bigger number of turns? Give a reason for your answer. [1]

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(ii) State why the input voltage has to be alternating for the transformer to work. [1]

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(iii) One function of the iron core is to increase the strength of the magnetic field inside the primary coil. State **one** other function that it has. [1]

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.....

(iv) Briefly state why an output voltage is produced by the transformer. [1]

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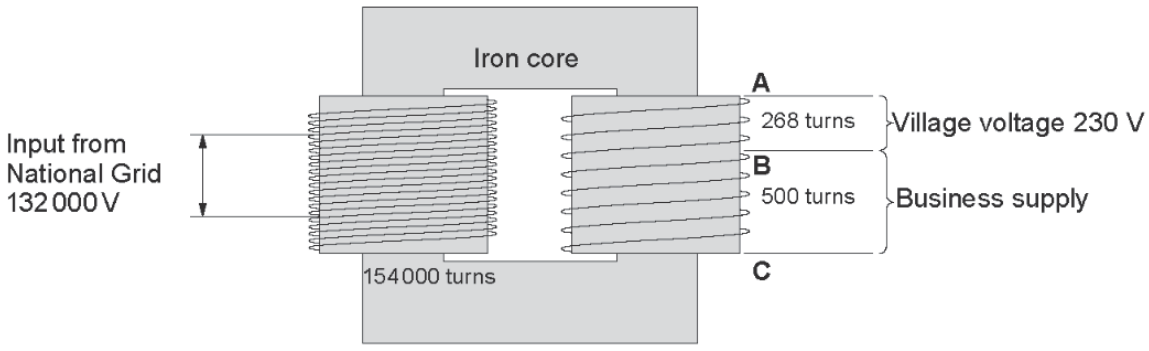
(v) Coil **A** has 18400 turns. Use an equation from page 2 to calculate the number of turns in coil **B**. [2]

Number of turns = ...

7

5 (HIGHER).

A transformer supplies both a village and a business with electricity from the National Grid. The business and the village need electricity at different voltages so they are connected to different numbers of secondary turns on the iron core of the transformer.



(a) Using an equation from page 2 and information from the diagram calculate the voltage supplied to the business. [3]

business supply voltage = ... V

(b) During a severe storm the connections from the transformer are altered by a falling tree. The **village is now connected to A and C**.

(i) Explain what effect, if any, this would have on the voltage supplied to the village. [2]

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(ii) State the effect, if any, you would expect this to have on the village. [1]

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(iii) Explain what effect, if any, this would have on the business. [2]

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(c) Describe how a transformer works. [3]

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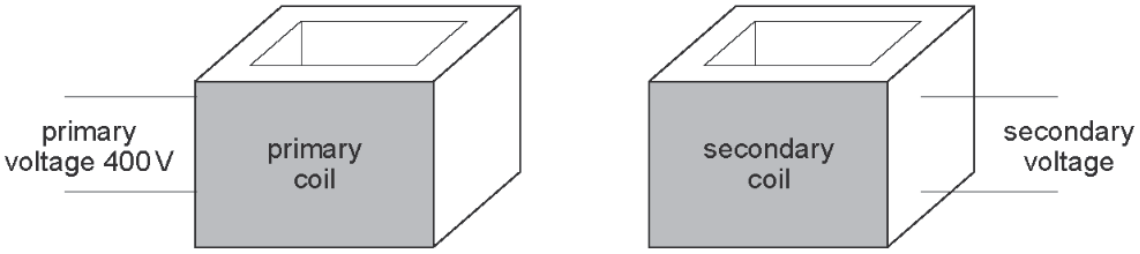
11

6 (HIGHER).

The diagram shows parts of a transformer. The diagram is incomplete.



(a) **Draw** and **label** the missing part in the correct position on the diagram above and state its function. [2]

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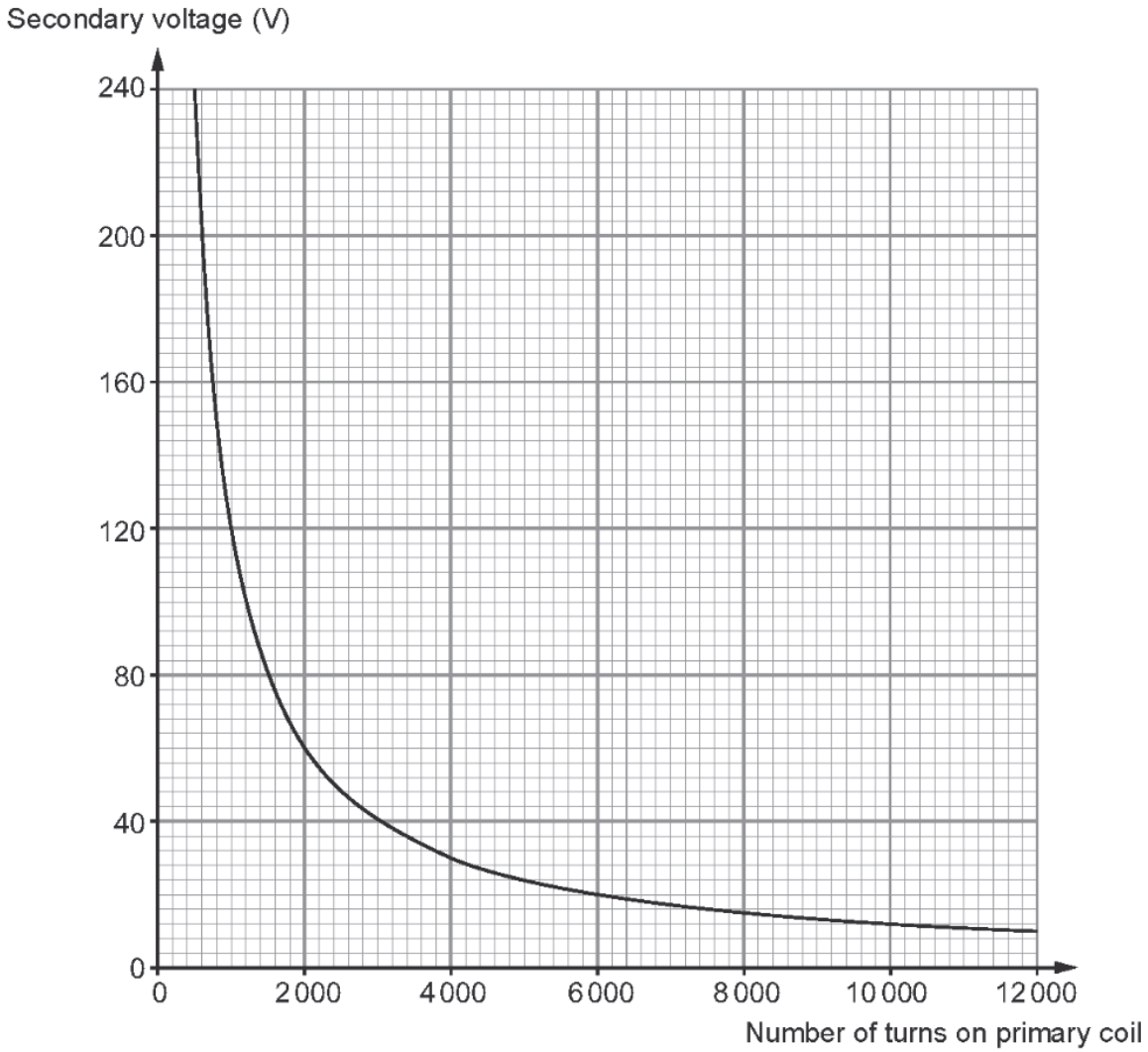
(b) This transformer has a **fixed** number of turns on its **secondary coil**. The number of turns on its **primary coil** can be changed. This affects the **secondary voltage** in the way shown on the graph below.



(i) Describe how the secondary voltage changes as the number of turns on the primary coil is increased. [2]

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(ii) The voltage on the primary coil is 400V. Use an equation from page 2 and a pair of readings from the graph to calculate the number of turns on the **secondary coil**. [2]

number of turns = ...

(iii) When the primary coil has 1 000 turns, it is used to power a 480 W heater that is connected to the secondary coil. Use the graph and an equation from page 2 to calculate the current in the secondary coil. [3]

current = ... A

(iv) **Draw a line** on the grid opposite, to show how the secondary voltage would change with the number of turns on the primary coil if this transformer had fewer turns on its secondary coil. [1]

10

7 (HIGHER).

The diagram shows apparatus that was used to investigate transformers.

www.indosaw.com

The same input coil was used throughout the investigation.

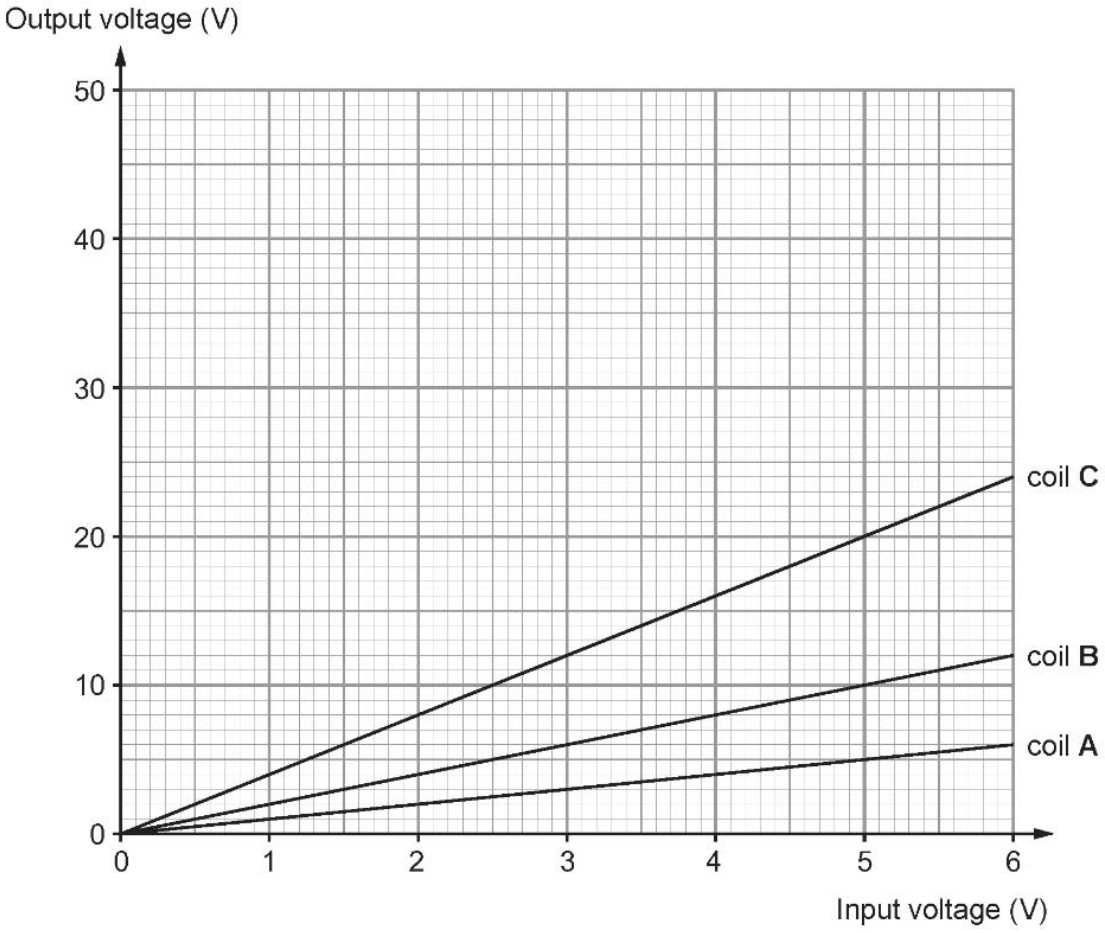
Different output coils (**A**, **B**, **C** and **D**) were used.

The results are shown below.

Input voltage (V) to coil	Output voltage (V) from			
	coil **A**	coil **B**	coil **C**	coil **D**
1	1	2	4	8
2	2	4	8	16
.....	4	8	16	32
5	5	10	.....	40
6	6	12	24	48

(a) (i) **Complete** the table. [2]

Some of the results have been plotted on the grid below.



(ii) Use the information in the table **to plot a graph** for coil **D**. [3]

(iii) Describe the relationship between the input voltage and the output voltage for coil **B**. [2]

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(iv) Select the output coil which would be used to operate a 12 V lamp at normal brightness from a 3 V input voltage.

..... [1]

(v) Which of the output coils does not step-up the voltage? ..... [1]

(b) Explain the use of step-down transformers in the National Grid. [2]

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8 (part (b) HIGHER).

(a) Complete the sentence by putting a cross (☒) in the box next to your answer.

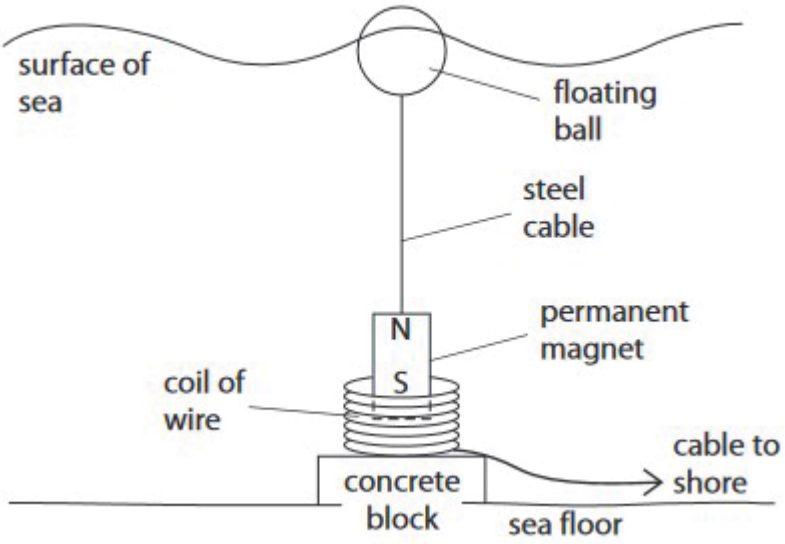
Electrical energy can be measured in

(1)

- ☒ **A** amps
- ☒ **B** kilowatt-hours
- ☒ **C** volts
- ☒ **D** watts

(b) Scientists are looking for new ways to produce electricity from renewable resources.

The diagram shows a model of a device to generate electricity from waves.
The coil is fixed to the concrete block.
The magnet can move freely inside the coil.



(i) Explain how this device produces an electric current.

(3)

(ii) Describe how the device can be altered to increase the electric current.

(2)

9 (HIGHER).

The photograph shows a portable petrol-driven generator.

The small petrol engine drives the dynamo.
The dynamo generates electricity.
This arrangement is not efficient in generating electricity.

(a) Apart from efficiency, state one advantage and one disadvantage this petrol-driven generator has, when compared with a small wind-powered generator.

(i) Advantage

(1)

.....

.....

(ii) Disadvantage

(1)

.....

.....

(b) The table gives some data about the small petrol engine.

energy transferred to surroundings in each second	5200 J
energy supplied to dynamo in each second	2800 J

(i) Calculate the total energy supplied to the petrol engine in each second.

(1)

total energy supplied to the petrol engine in each second = ... J

(ii) Use the data to calculate the efficiency of the petrol engine.

(2)

efficiency = ... %

(c) The dynamo generates an electric current by induction.

Explain what is meant by induction of a current.

(3)

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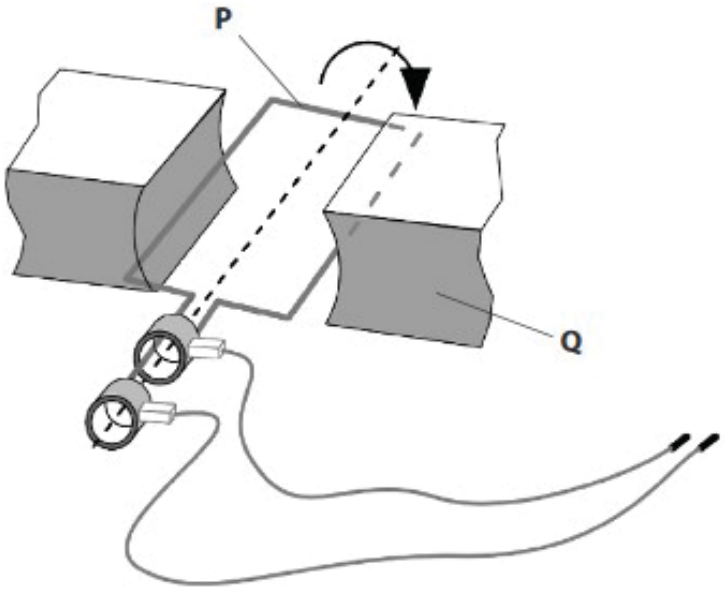
10 (HIGHER).

The diagram shows a generator producing an alternating voltage.



(a) Draw **one** straight line from each letter to its correct label.

(2)

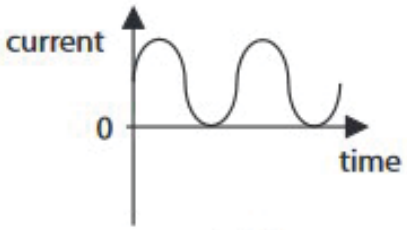
letter	label
	slip ring
P	coil
	axle
Q	brush
	magnet

(b) The generator is connected to a lamp.
The current in the lamp is alternating.

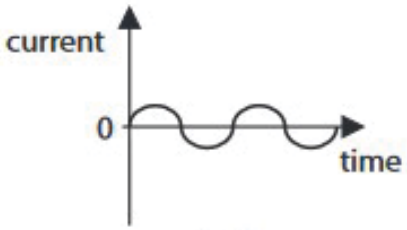
(i) Which of these is an alternating current?

Put a cross (☒) in the box next to your answer.

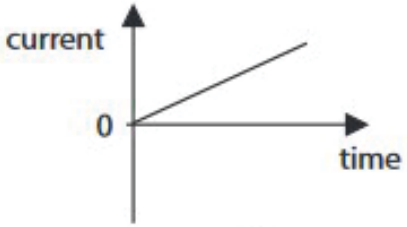
(1)



☐ A



☐ B



☐ C

☐ D

(ii) The generator is turned faster.

Explain what happens to the lamp.

(2)

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.....

(c) A larger generator produces a current of 2 A at a voltage of 12 V.

Calculate the electrical power generated.
State the unit.

(3)

power generated = ... unit = ...

(d) Transformers are designed to use alternating current.

Describe what change happens when a step-up transformer is used.

(2)

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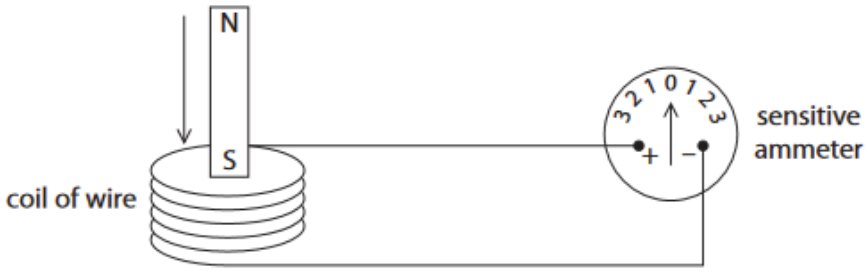
11 (HIGHER).

(a) A student uses this apparatus to investigate electromagnetic induction.



When the S pole of the magnet is moved into the coil, the pointer on the sensitive ammeter moves to the left.

Describe two ways that the student can make the pointer move to the right.

(2)

1 .....

.....

2 .....

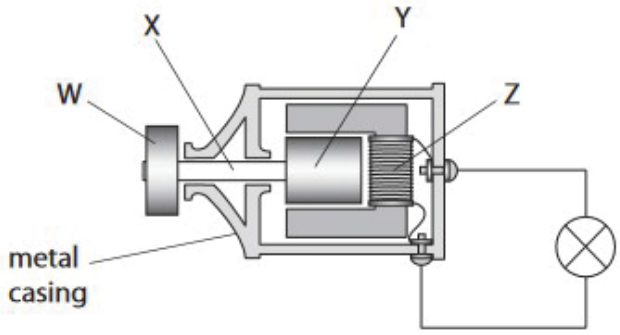
.....

(b) The student has a bicycle with a dynamo (generator) that supplies electricity for its lights. The diagram shows the dynamo.

The friction wheel, W, presses against the bicycle tyre. When the student pedals, the friction wheel turns and causes part Y to rotate.

Key

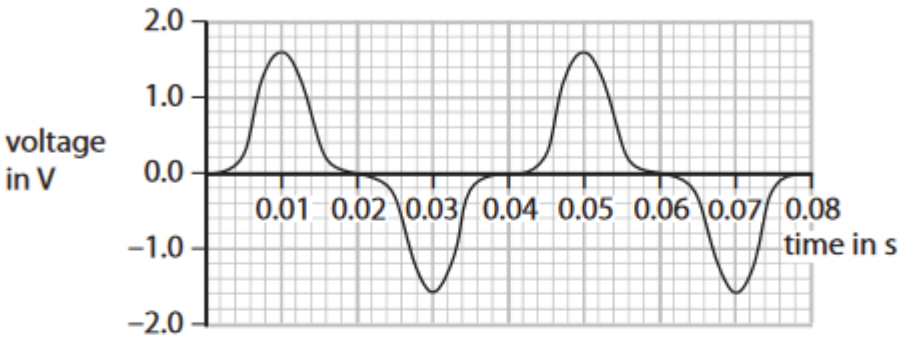
W	friction wheel
X	axle
Y	
Z	



(i) Complete the key for the diagram by giving the names of parts Y and Z.

(2)

(ii) The graph shows how the output voltage of the dynamo varies with time as the student pedals steadily.



State the maximum output voltage of the dynamo.

(1)

maximum output voltage = ... V

(iii) Calculate the frequency of the output voltage.

(2)

frequency = ... Hz

(iv) Which row of the table is correct when the friction wheel turns faster?

(1)

	Output voltage is	Frequency of output voltage is
☒ A	lower	lower
☒ B	higher	lower
☒ C	higher	higher
☒ D	lower	higher

(v) Apart from changing the speed of the friction wheel, suggest how the output voltage of the dynamo can be increased.

(1)

.....

.....

(c) The student cycles for 290 s.

Her dynamo produces a constant useful power output of 3.1 W and is 72% efficient.

(i) Calculate the total useful energy output.

(3)

useful energy output = ... J

(ii) State the relationship between efficiency, useful energy output and total energy input.

(1)

(iii) Calculate the total energy input.

(3)

total energy input = ... J