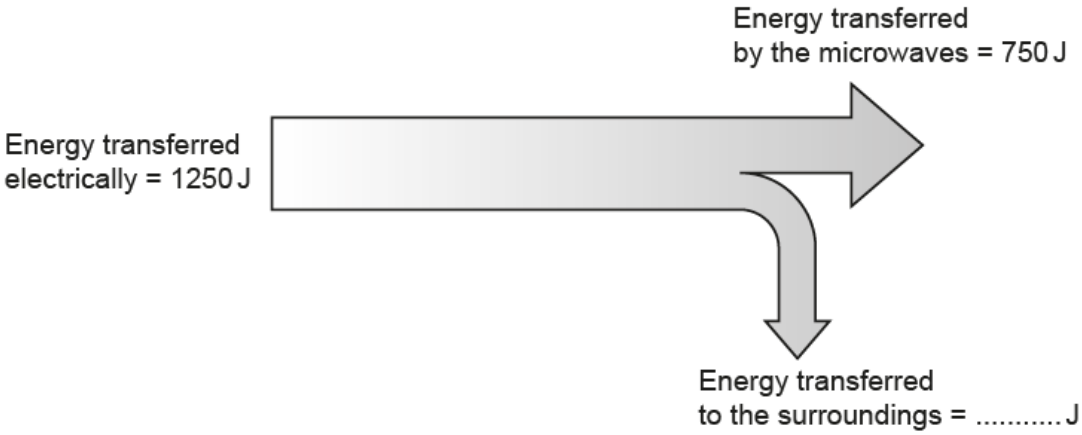
Sustainable energy – 2022 GCSE 21st Physics Combined Science B

1. June /2022/Paper_ J250/03/No.2

Jamal uses a microwave oven.

The diagram shows the energy transfers taking place inside the microwave oven when it is used.



(a) Complete the diagram to show the energy transferred to the surroundings. **[1]**

(b) Calculate the efficiency of the microwave oven.

Use the equation: efficiency = $\frac{\text{useful energy transferred}}{\text{total energy transferred}}$

Give your answer as a percentage.

Efficiency = ... % **[3]**

(c) Jamal cannot switch the microwave oven on unless the door is closed.
This is because the microwaves can damage body cells.

Why do microwaves damage body cells?

Tick (✓) **one** box.

They are electromagnetic radiation. ☐

They are ionising radiation. ☐

They cause electric currents in the body. ☐

They transfer energy to cells heating them up. ☐

[1]

2. June /2022/Paper_ J250/03/No.5(b, c)

(b) Kai uses the crane to lift the box of 0.25 kg from the floor to a height of 0.84 m.

(i) Calculate the gravitational potential energy gained by the box.

Use the equation:
gravitational potential energy = mass × gravitational field strength × height

Gravitational field strength = 10 N / kg

Gravitational potential energy = ... J **[2]**

(ii) The box is then dropped and falls back down to the floor.

How much kinetic energy does the box have just before it hits the floor?

Kinetic energy = ... J **[1]**

3. June /2022/Paper_ J250/03/No.11

(a) Which of these statements about the domestic electricity supply in the UK is true?

Tick (✓) **one** box.

The domestic electricity supply in the UK is d.c. ☐

The energy transferred = current × potential difference. ☐

The frequency of the supply is 230 Hz. ☐

Transmitting power at higher voltages is more efficient. ☐

[1]

(b) Sundip installs panels made of material with low thermal conductivity to the walls of a house.

Describe how this will help to keep the house warm when it is cold outside.

.....

..... **[1]**

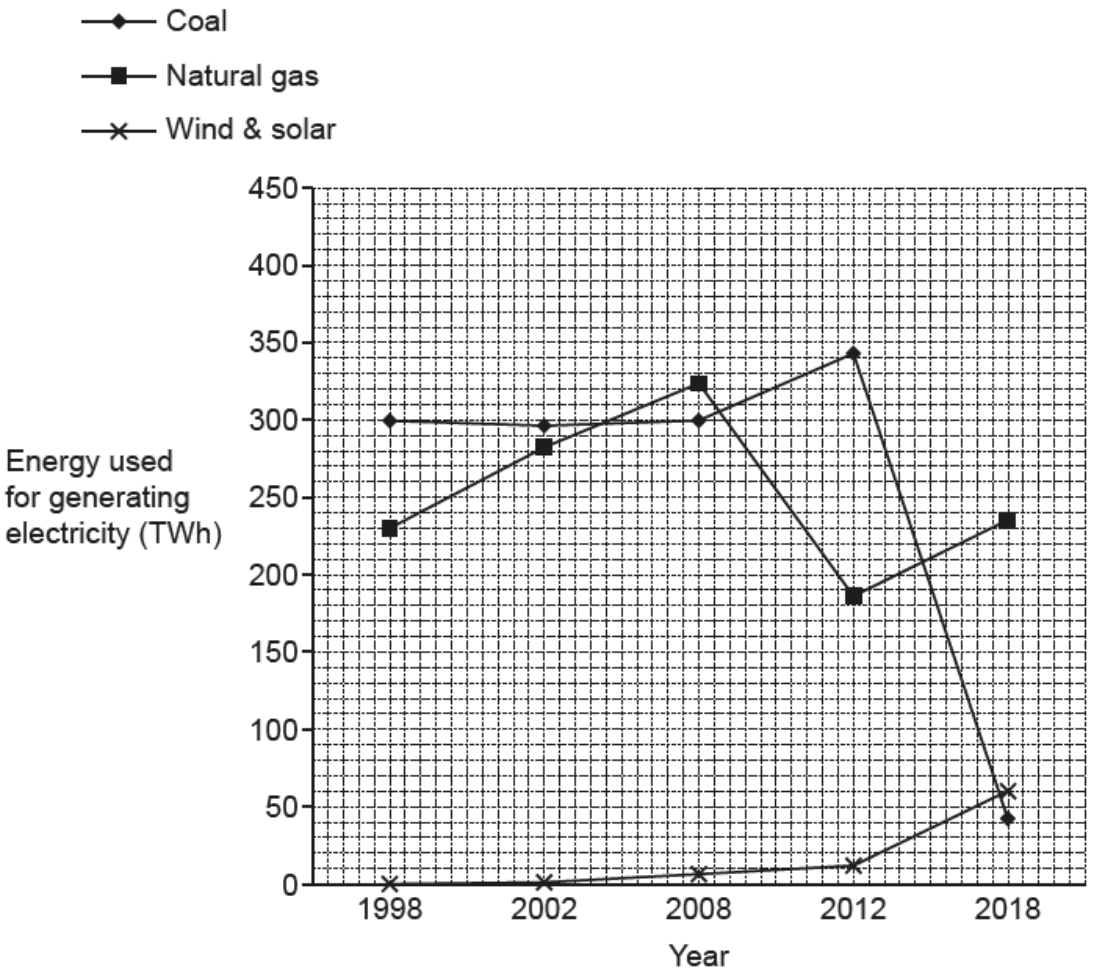
(c) Sundip buys electricity from a company that uses energy from renewable energy resources.

What is the difference between a renewable and non-renewable energy resource?

.....

..... **[1]**

(d)* The graph shows how some energy resources were used to generate electricity in the UK over 20 years.



Explain how the use of these **three** energy resources changed between 1998 and 2018.

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..... **[6]**

4. June /2022/Paper_ J250/04/No.1

The energy needs of the UK are met by a wide range of energy resources.

(a) Which two energy resources are burned for heating?

Tick (✓) **two** boxes.

- Biofuel ☐
- Fossil fuels ☐
- Hydroelectricity ☐
- Nuclear fuel ☐
- The Sun ☐
- Wind ☐

[2]

(b) Complete the sentences to describe how fossil fuel power stations generate electricity.

Use words from the list.

You can use each word once, more than once or not at all.

gas **hydroelectric** **transformer** **turbine** **water** **wind**

In coal and ..... power stations ..... is heated to produce steam. The steam turns a ..... which makes a generator rotate.

[3]

(c) The table compares the ways in which the main energy resources are used to generate electricity.

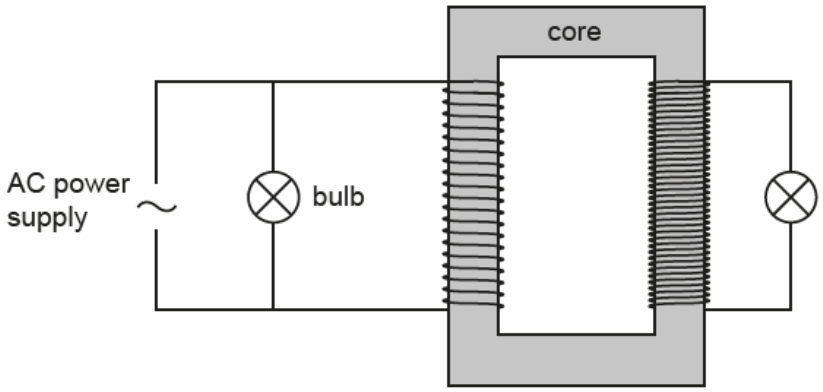
For each row, tick (✓) **all** the statements that are true about the method used to generate electricity from each energy resource in the table.

	Statement		
Energy resource used to generate electricity	Has a boiler to make steam	Has a turbine to operate the generator	Does not release carbon dioxide whilst generating electricity
Nuclear Power			
The Sun			
Wind			

[3]

5. June /2022/Paper_ J250/04/No.7

Eve is investigating transformers.



(a) The power in the primary coil is equal to the power in the secondary coil.

State in what unit is power measured.

Unit of power = ... **[1]**

(b) Eve's circuit has a current of 1.5A in the primary coil and a potential difference of 2.5V across the primary coil.

A potential difference of 6V is induced in the secondary coil.

She uses the equation:

potential difference across primary coil × current in primary coil = potential difference across secondary coil × current in secondary coil

Calculate the current in the secondary coil.

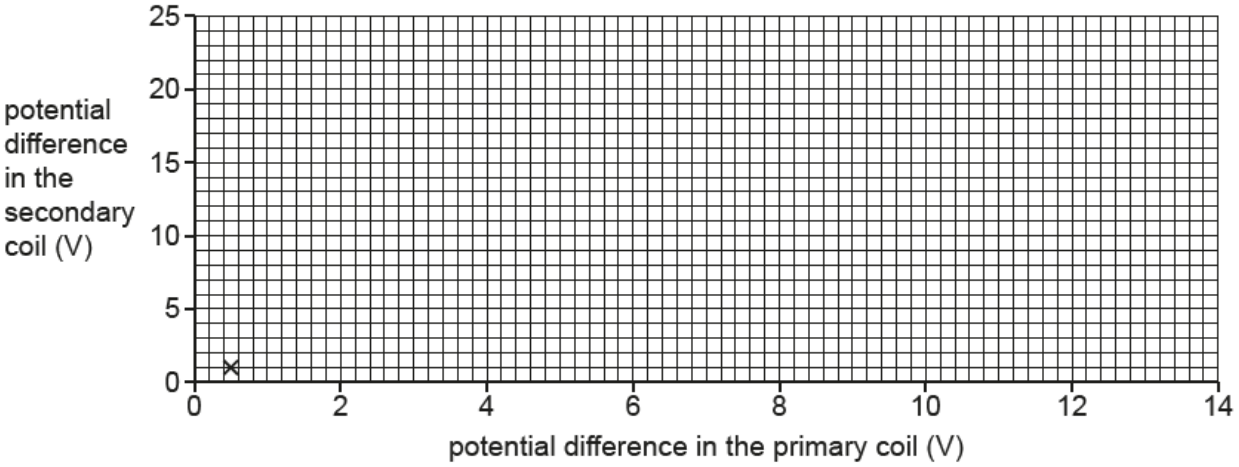
Current = ... A **[3]**

(c) Eve does experiments with five different potential differences in the primary coil and records the potential differences in the secondary coil for each one.

Her results are in the table.

Potential difference in the primary coil (V)	Potential difference in the secondary coil (V)
0.5	1.0
2.0	4.0
6.0	12.5
10.0	20.0
12.0	23.0

(i) Complete the graph of Eve's results by plotting the data points **and** drawing a line of best fit. The first point has been plotted for you.



[3]

(ii) Describe the relationship shown by the graph.

.....

..... **[2]**

(d) Transformers are used in the transmission of electrical power.
Eve uses her data to explain why transmitting power at higher voltages is a more efficient way to transfer electrical energy.

Complete the sentences.

Put a (ring) around each correct option.

As the potential difference across the secondary coil increases,

the current in the secondary coil **decreases / increases / stays the same**.

This **reduces / stops / increases** energy loss in electrical power transmission.

[2]

6. June /2022/Paper_ J250/07/No.1

(a) Which of these statements about the domestic electricity supply in the UK is true?

Tick (✓) **one** box.

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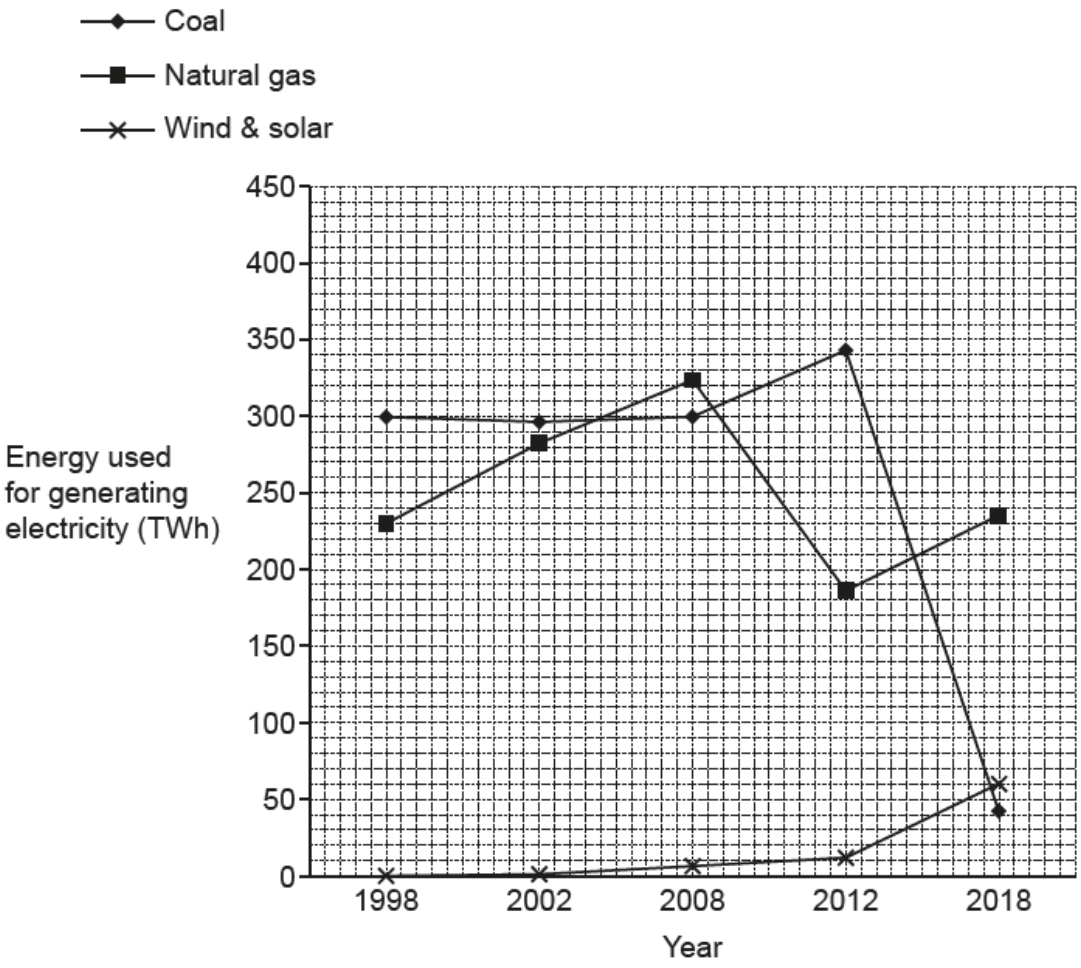

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..... **[6]**

7. June /2022/Paper_ J250/07/No.4(a)

A resistor **X** is connected to the terminals of a 12 V battery. The energy transferred from the battery to the resistor is 1.2 J per second.

(a) What is the power transferred to the resistor?

Use the Data Sheet.

Explain your answer.

Power = ... W

Explanation .....

.....

..... **[2]**