Surname	Centre Number	Candidate Number
Other Names		0

GCSE – NEW

3430UC0-1

S18-3430UC0-1

SCIENCE (Double Award)

Unit 3 – PHYSICS 1
HIGHER TIER

FRIDAY, 15 JUNE 2018 – MORNING

1 hour 15 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**15**	
2.	**11**	
3.	**6**	
4.	**9**	
5.	**8**	
6.	**11**	
Total	**60**	

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01

ADDITIONAL MATERIALS

In addition to this paper you will require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the continuation pages at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

The assessment of the quality of extended response (QER) will take place in question **5*(b)***.

Equations

current = $\dfrac{\text{voltage}}{\text{resistance}}$	$I = \dfrac{V}{R}$
total resistance in a series circuit	$R = R_1 + R_2$
total resistance in a parallel circuit	$\dfrac{1}{R} = \dfrac{1}{R_1} + \dfrac{1}{R_2}$
energy transferred = power × time	$E = Pt$
power = voltage × current	$P = VI$
power = current^2 × resistance	$P = I^2R$
% efficiency = $\dfrac{\text{energy (or power) usefully transferred}}{\text{total energy (or power) supplied}}$ × 100	
density = $\dfrac{\text{mass}}{\text{volume}}$	$\rho = \dfrac{m}{V}$
units used (kWh) = power (kW) × time (h) cost = units used × cost per unit	
wave speed = wavelength × frequency	$v = \lambda f$
speed = $\dfrac{\text{distance}}{\text{time}}$	

SI multipliers

Prefix	Multiplier
p	1×10^{-12}
n	1×10^{-9}
µ	1×10^{-6}
m	1×10^{-3}

Prefix	Multiplier
k	1×10^{3}
M	1×10^{6}
G	1×10^{9}
T	1×10^{12}

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Answer **all** *questions.*

1. Water waves on the sea where the water is shallower than $\frac{1}{20}$ of their wavelength are known as shallow water waves. The speed of shallow water waves is described by the equation:

$$v = 3.13\sqrt{d}$$

where v is the wave speed (in m/s) and d is the depth of the water (in m).
This equation applies to sea waves whose wavelengths range between 10 m and 150 m.

In regions of the sea where the depth is small, for example near the shore, the speed noticeably changes but the frequency of the waves remains constant.

A shallow water wave is an example of a transverse wave.

(a) Describe what is meant by a transverse wave. [2]

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(b) (i) Use the equation above to **complete the table below**. [2]
Space for workings.

Depth of water, d (m)	$\sqrt{d}$	Wave speed, v (m/s)
0	0	0
0.5	0.71	2.21
1.0	1.00	3.13
1.5	....	3.83
2.5	1.58	4.95
3.0	1.73	5.42
3.5	1.87	....
4.0	2.00	6.26

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(ii) Chris suggests that if the depth of the water increases four times, the wave speed doubles. **Use data in the table opposite** to explain whether or not this statement is true. [2]

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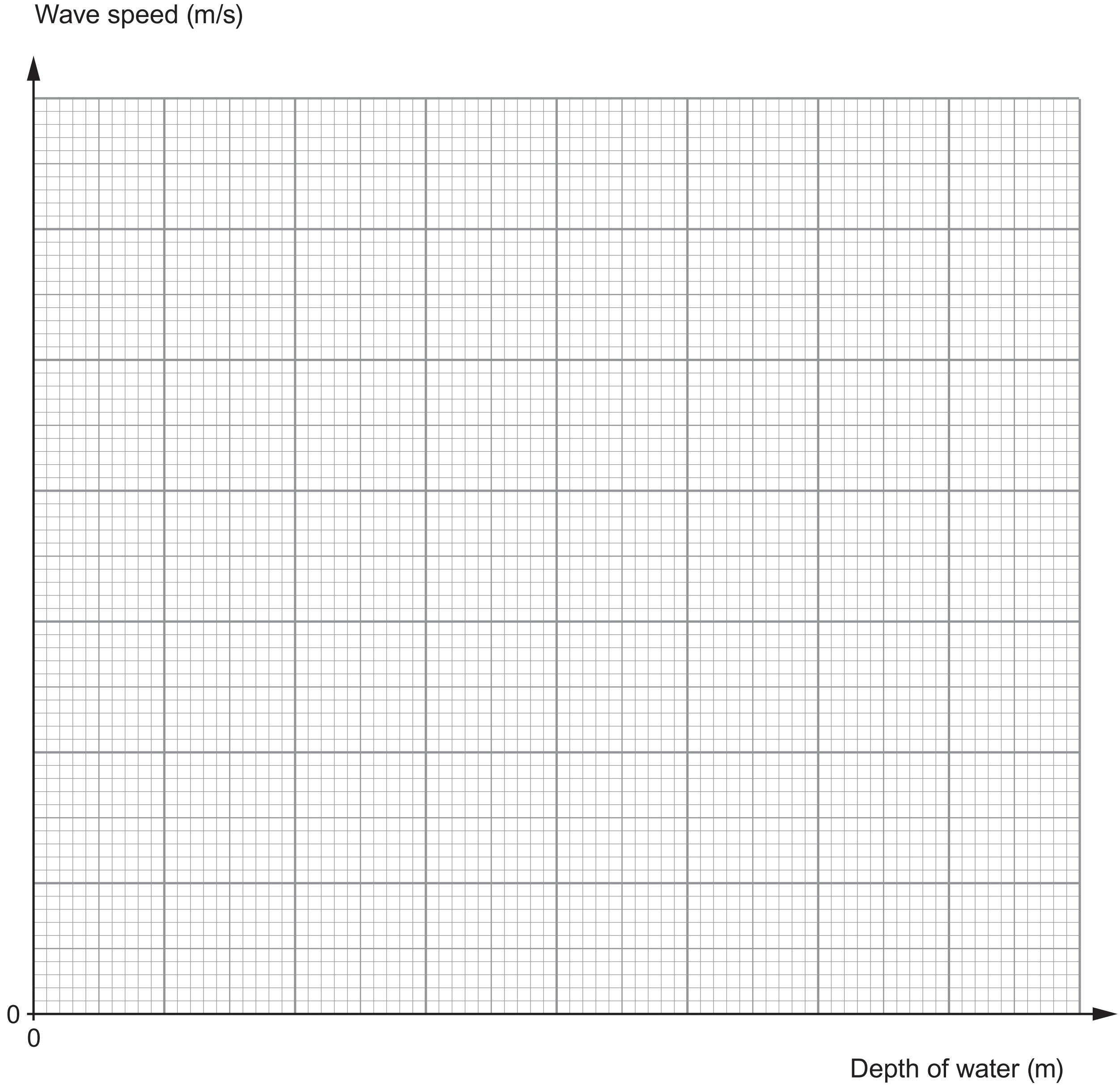
(iii) Plot the data on the grid below and draw a suitable line. [4]



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(c) (i) Use the graph and the equation:

$$\text{wavelength} = \frac{\text{wave speed}}{\text{frequency}}$$

to calculate the wavelength of water waves that have a frequency of 0.2 Hz in water that is 2.0 m deep. [3]

Wavelength = ... m

(ii) Chris now suggests that as the depth increases, the wavelength decreases. Explain whether this statement is correct. [2]

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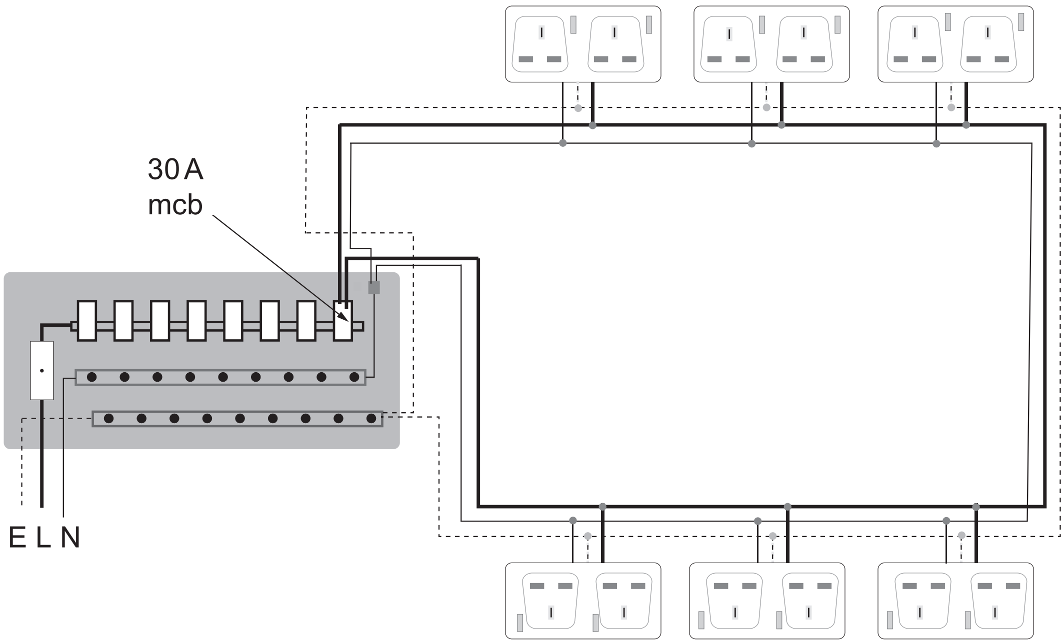
2. The diagram shows a common domestic ring main circuit.



(a) Give **two** advantages of having a ring main circuit in a house. [2]

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(b) (i) State the function of the live wire. [1]

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(ii) Describe the function of the earth wire. [2]

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(c) The following information is printed on the bottom of a domestic kettle:

TYPE: KBZ3001.BQ
230 V ~ a.c.
2 760 W
CAPACITY 1.5L
SERIAL NUMBER 53023

(i) State the differences between alternating current (a.c.) and direct current (d.c.). [2]

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(ii) The voltage of the mains electricity supply in the U.K. is 230 V. Use equations from page 2 and information on the kettle to calculate the resistance of the kettle heater. [4]

Resistance = ... Ω

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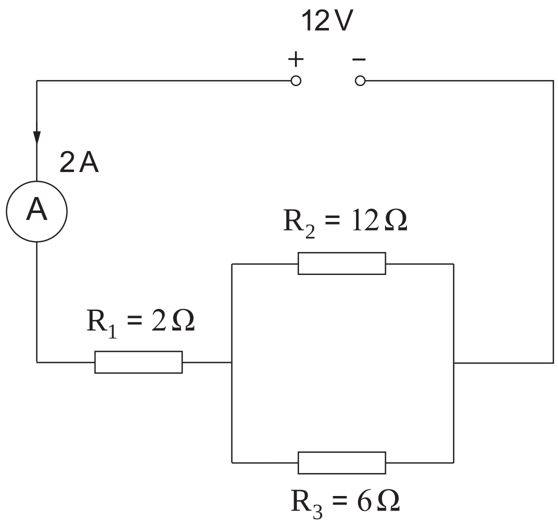
3. A group of students set up the following circuit. Their aim is to measure the current through the ammeter and to use it to calculate the currents and voltages in the various parts of the circuit.



Use an equation(s) from page 2 to answer the following questions.

(i) Calculate the voltage across R_1. [2]

Voltage = ... V

(ii) Use your answer to part (i) to calculate the current through each of the parallel resistors. [4]

Current through R_2 = ... A

Current through R_3 = ... A

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4. In 2015, a householder paid £780 for electricity and £950 for gas. On 1 January 2016 solar panels were installed on the roof to provide **hot water** for the house. The cost of the solar panels was £4 680. In 2016, the householder paid £830 for electricity and £840 for gas.

(a) (i) Gas was used to heat the water in the house in 2015. State how the figures allow you to come to this conclusion. [1]

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(ii) Calculate the expected payback time to recover the cost of the solar panels. [2]

Payback time = ... years

(iii) Explain how an increase in the cost of a unit of electricity **and** a unit of gas would affect the payback time. [3]

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(b) During the two years, the cost of a unit of electricity did not change but the number of **extra** units **of electricity** used in 2016 was 300 kWh. Use an equation from page 2 to calculate the cost of a unit of electricity (in pence) during 2015-2016. [3]

Cost of unit = ... p

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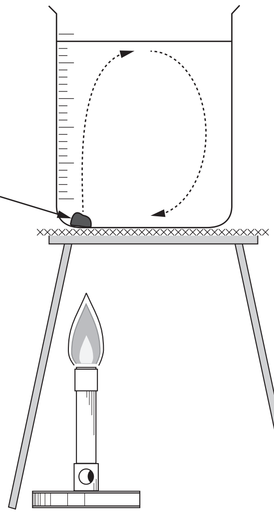
5. A class carries out experiments to study heat transfer in solids and liquids.

(a) In one experiment, the process of convection is shown by colouring some water with potassium permanganate(VII) crystals in the bottom corner of a beaker. The water is then heated and a clockwise convection current is set up.



Explain why the coloured water moves in the way described above. [2]

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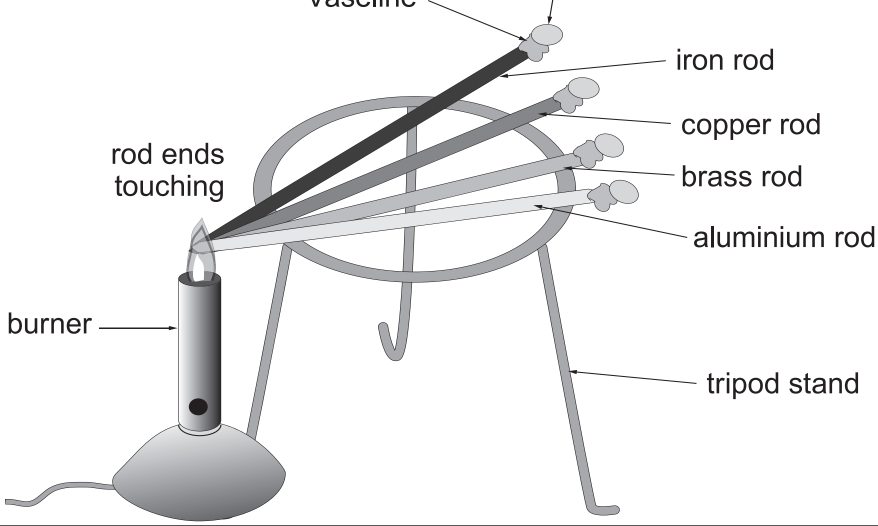
(b) In another experiment, four metal rods are tested to compare their ability to conduct heat energy.



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The outcome of the experiment is as follows:

copper (best conductor)
aluminium
brass
iron (poorest conductor).

Explain in detail, the process of conduction in **copper** in terms of the motion of **particles**. [6 QER]

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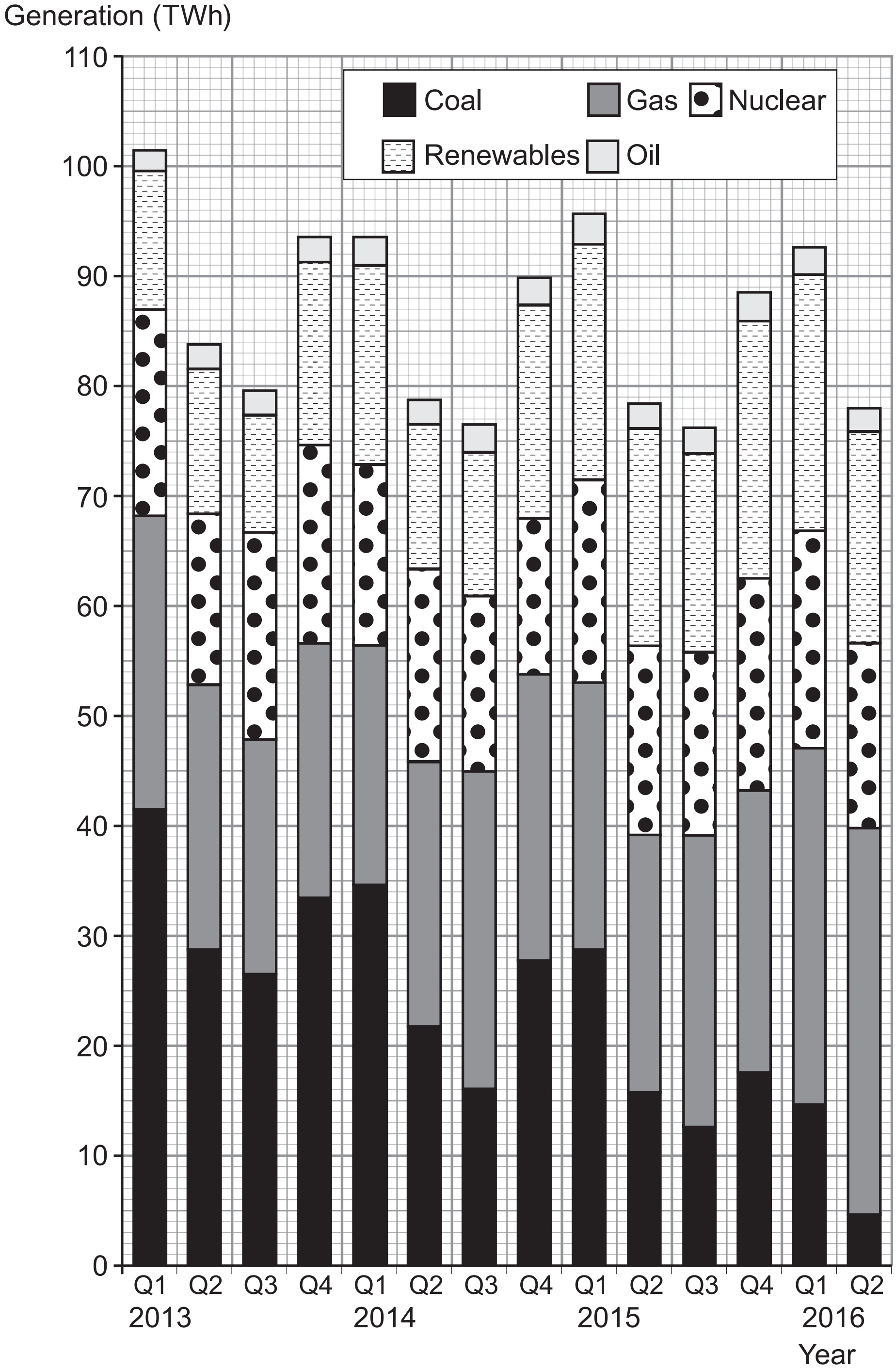
6. The Climate Change Act established a target for the UK to reduce its 1990 CO_2 emissions by at least 80 % by 2050. This target represents an appropriate contribution from the UK towards the agreed reduction in CO_2 emissions globally. It aims to limit the global temperature rise to as little as possible above 2 °C.
To ensure that regular progress is made towards this long-term target, the Act also established a system of five-yearly carbon budgets, to serve as stepping stones on the way.

The diagram below shows the sources of fuel used in the production of electrical energy between the first quarter of 2013 and the middle of 2016.



KEY:

Q1 is 1st quarter of the year (Jan – Mar)

Q2 is 2nd quarter of the year (Apr – June)

Q3 is 3rd quarter of the year (July – Sept)

Q4 is 4th quarter of the year (Oct – Dec)

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(a) (i) Use the information in the diagram to describe trends in the use of individual fossil fuels and the total use of fossil fuels over the time shown. [3]

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(ii) The use of nuclear fuel for the production of electricity between Q1 2013 and Q1 2016 remained roughly constant. Suggest possible reasons for this. [2]

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(iii) Production of electricity from renewable sources remained roughly constant for Q2 2015 and Q2 2016. However, there was a reduction in the contribution by wind and a change in the contribution from solar power. Describe how the weather conditions were different in Q2 2016 compared to Q2 2015. [2]

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Turn over.

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(b) The first four carbon budgets, leading to 2027, have been set in law. The UK is currently in the third carbon budget period (2018-22). Meeting the fourth carbon budget (2023-27) will require that emissions be reduced by 50% on 1990 levels by 2027.

The 1990 levels of CO_2 emissions were 3900 million tonnes.

Budget	CO_2 emission targets from all sources	% reduction below 1990 levels for all sources
1st 5 yr period achievement (2008-12)	Down to 3018 million tonnes of CO_2 by the end of 2012	
2nd 5 yr period target (2013-17)	Down to 2782 million tonnes of CO_2 by the end of 2017	
3rd carbon target (2018-22)	Down to 2544 million tonnes of CO_2 by the end of 2022	
4th carbon target (2023-27)	Down to 1950 million tonnes of CO_2 by the end of 2027	50% by the end of 2027

(i) Calculate the targeted percentage drop in CO_2 emissions **from all sources** between 1990 and the end of 2022. Show your workings clearly. [2]

Percentage drop = ...

(ii) Between 1990 and the end of 2022, the mean percentage drop in the use of **fossil fuels in the production of electricity** is expected to be 40%. Comment on the progress being made in achieving the government's overall target for CO_2 emissions by 2027. [2]

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END OF PAPER

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