

Surname	Centre Number	Candidate Number
Other Names		0



LEVEL 1/2 AWARD

9851/01



S15-9851-01-R1

**SCIENCE FOR WORK (IVQ)
Reducing Our Carbon Footprint**

P.M. MONDAY, 8 June 2015

1 hour

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	6	
2.	9	
3.	7	
4.	17	
5.	7	
6.	8	
Total	54	

ADDITIONAL MATERIALS

In addition to this paper you will require:
a calculator, pencil and a ruler;
a copy of the data sheet with a list of equations supplied by WJEC.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.
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.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.
You are reminded to show all your workings. Credit is given for correct workings even when the final answer given is incorrect.

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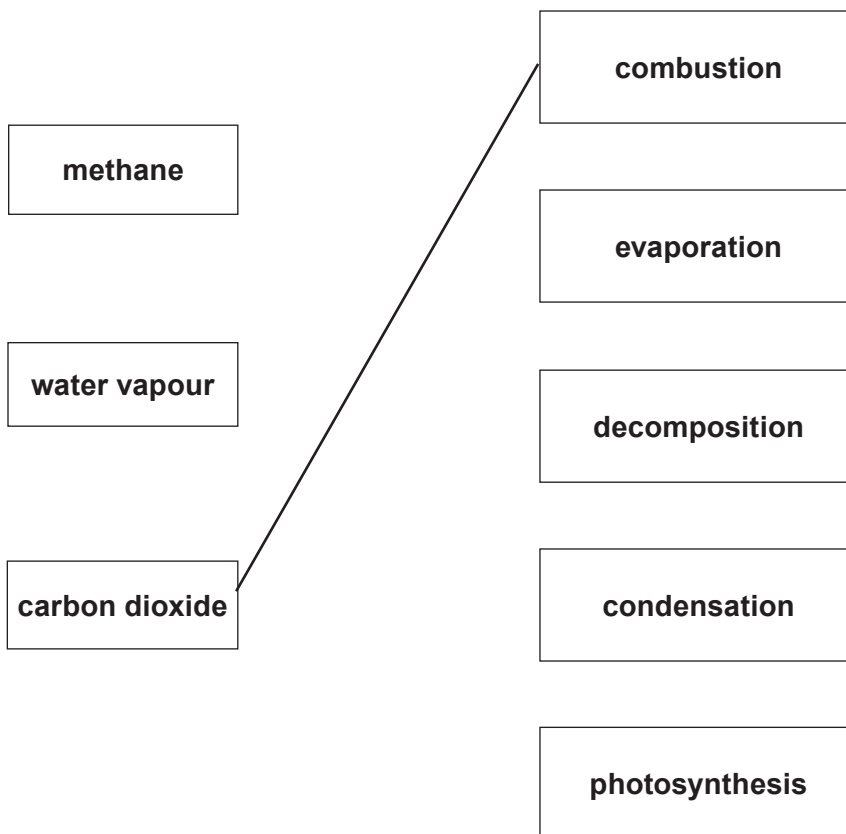
Answer **all** the questions in the spaces provided.

1. Carbon dioxide is a greenhouse gas. It is believed that mankind's production of carbon dioxide through combustion of fossil fuels is changing our environment.

(i) In the box below circle **three** ways in which increasing levels of carbon dioxide in the atmosphere is believed to be changing our environment. [3]

melting of polar ice caps	fossil fuels running out
more tsunamis	more earthquakes
more extremes of weather	expanding deserts

(ii) Methane and water vapour are also greenhouse gases. Draw lines to link the **main** process by which each gas enters the atmosphere. Carbon dioxide has been done as an example. [2]



(iii) Complete this word equation for combustion of coal. [1]

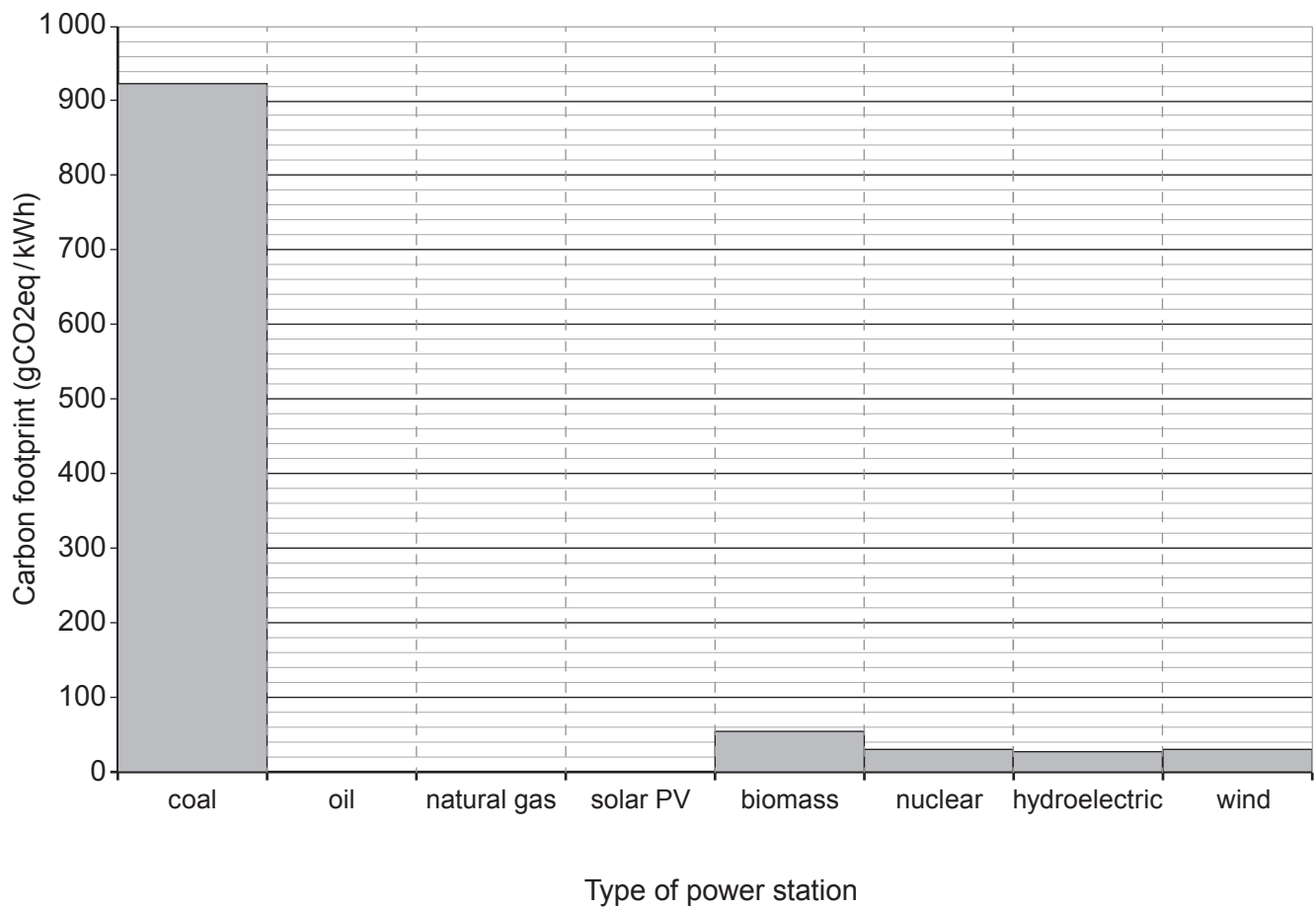


2. The table below shows the mean carbon footprint for 1 kWh of electricity generated by different types of power stations.

Type of power station	Carbon footprint gCO ₂ eq/kWh
coal	921
oil	750
natural gas	500
solar PV	100
biomass	52
nuclear	30
hydroelectric	27
wind	30

- (a) (i) Use the table to complete the bar chart below.

[2]



(ii) Use the data from the table to calculate the carbon dioxide equivalent mass produced when 50 kWh of electricity is produced using hydroelectric power. [1]

..... 9

(b) (i) What is meant by the term *carbon footprint*? [2]

.....
.....
.....

(ii) Nuclear power stations produce no carbon dioxide while generating electricity. Give **two** reasons why they still have a carbon footprint. [2]

1.

.....

2.

.....

(iii) Suggest **one** way of reducing the *carbon footprint* of nuclear power stations. [1]

.....
.....

(iv) Give **one** reason why a biomass power station is described as *carbon neutral*. [1]

.....
.....

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3. All buildings in the UK must have an Energy Performance Certificate (EPC). An energy performance survey could help you identify ways to save money on your energy bills.

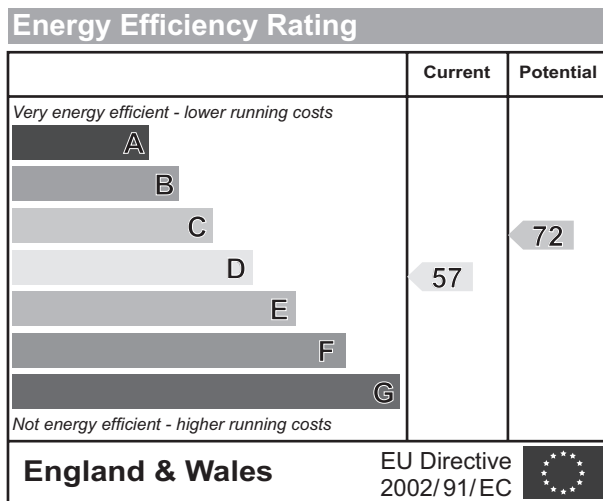


Ed and Yvette buy a house.

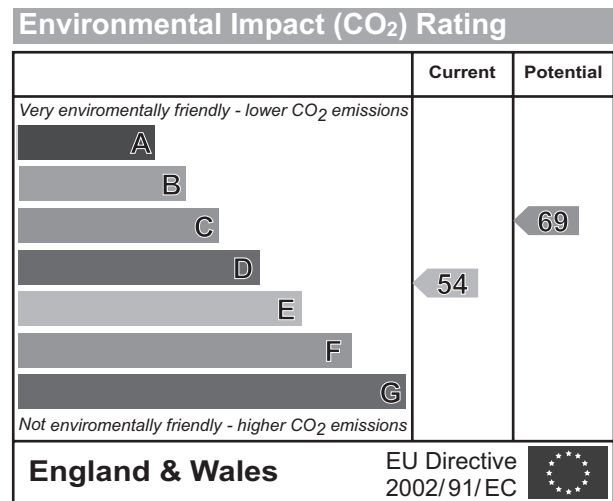
The house was built in the 1930's.

In 2014, the previous owners fitted a new boiler, double glazing and 10 cm thick loft insulation.

The house was given the following EPC:



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills will be.



The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO₂) emissions. The higher the rating the less impact it has on the environment.

(a) Ed and Yvette want to make the house as energy efficient as they can.

(i) Calculate by how much they can increase their energy efficiency rating. [1]

.....

(ii) State **two** advantages of making the house more energy efficient. [2]

1.

.....

2.

.....

(iii) Explain **one** way that they could improve the overall energy efficiency of the house. [2]

Method

Reason

.....

(b) Ed and Yvette are considering fitting solar photovoltaic panels. Discuss how the solar panels could affect the EPC. [2]

.....

.....

.....

4. The UK government encourages energy providers to use several forms of energy generation. These include fossil fuels (coal, oil and gas), wind power and nuclear energy.

(a) Describe the energy changes that take place in a fossil fuel power station. [3]

.....

.....

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.....

(b) State **one** advantage of fossil fuels over:

(i) wind power. [1]

.....

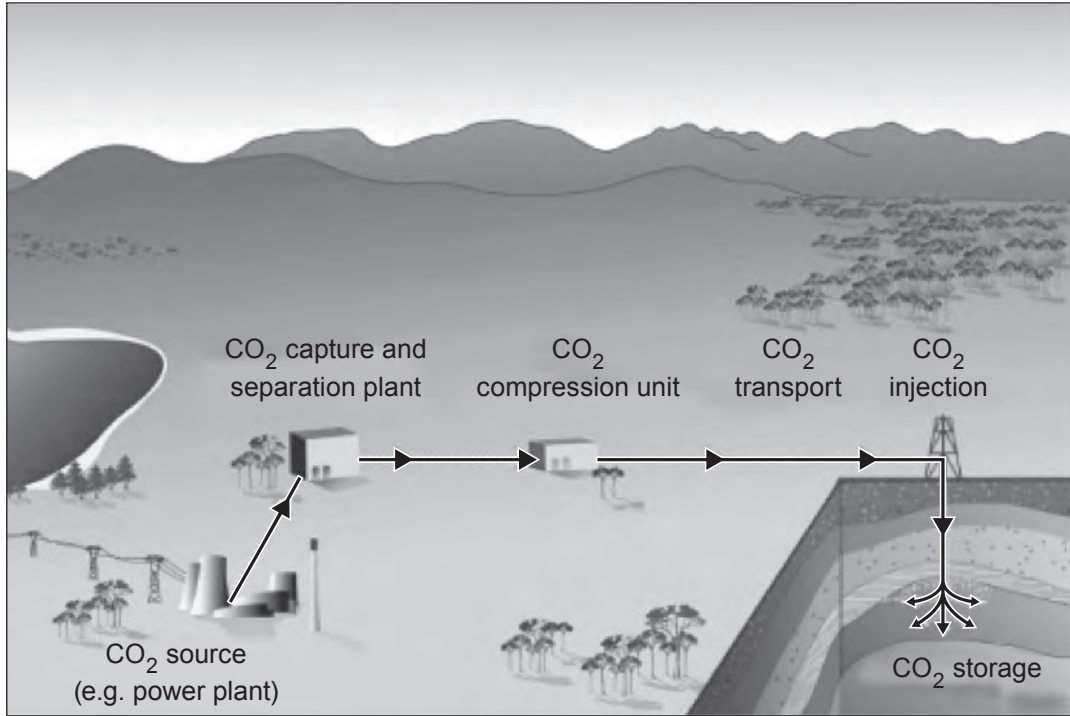
.....

(ii) nuclear power. [1]

.....

.....

- (c) Governments also support Carbon Capture and Storage (CCS) technologies. Carbon capture and storage traps carbon dioxide permanently underground. One such scheme is in the Latrobe Valley in Australia. Local politicians are in favour of the scheme, but local residents are protesting against it.



- (i) Why is the permanent storing of carbon dioxide important to the environment? [1]

.....

.....

- (ii) Local politicians like the scheme. State **one** reason for this. [1]

.....

.....

- (iii) Give **two** reasons why local residents may object to the scheme. [2]

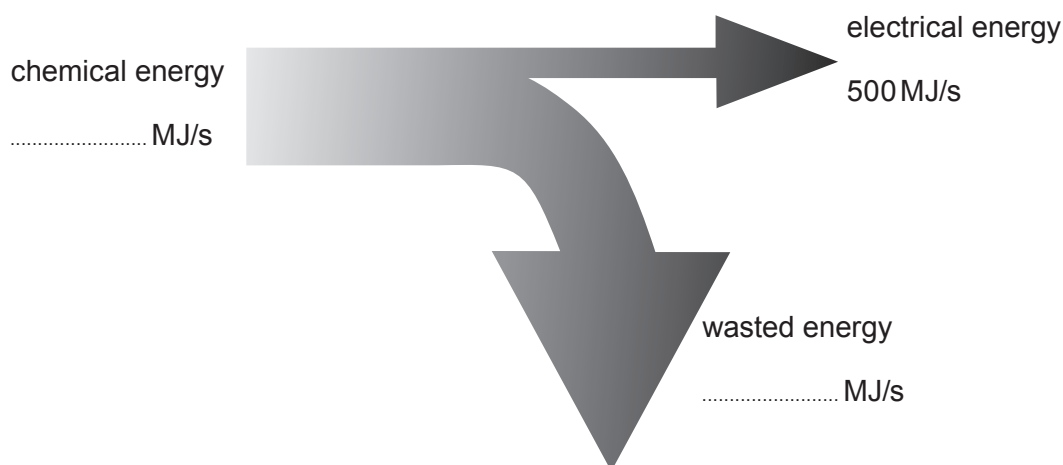
1.

2.

(d) The Latrobe power plant generates 500MW of electricity and has an efficiency of 25%.

(i) What is meant by the phrase, “has an efficiency of 25%”? [1]

(ii) Complete the Sankey diagram for the Latrobe power plant. [2]



(iii) CCS reduces the electrical energy output by a further 7%. Calculate the new output of the power plant. [2]

Output = MJ/s

(iv) Calculate the new efficiency of the power plant. You will need to use an equation from the Data Sheet and the answer to part (d)(iii). [2]

Efficiency = %

(e) In order to build the CCS plant, trees will need to be cut down. This can increase the greenhouse effect. Name **one** possible *economic* effect of an increased greenhouse effect. [1]

5. The following was published in a newspaper.

A study suggests that a vast reservoir of the potent greenhouse gas methane, may be locked beneath the Antarctic ice sheet.

Half of the West Antarctic Ice Sheet and a quarter of the East Antarctic Ice Sheet lie on pre-glacial sedimentary basins containing around 2.1×10^{17} kg of methane.

Scientists say “If enough of the ice melts away, methane could be released into the atmosphere, adding to global warming”.

(a) Explain how methane in the atmosphere causes the greenhouse effect. [3]

.....

.....

.....

.....

.....

(b) Methane has a global warming potential of 25.

(i) Explain the term *global warming potential* (GWP). [1]

.....

.....

(ii) Calculate the carbon dioxide equivalent for the methane locked beneath the Antarctic ice sheet using an equation from the Data Sheet. [2]

..... kgCO₂eq

(c) State **one** reason why it is important to have some greenhouse gases in the atmosphere. [1]

.....

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6. Sheldon and Aimee are a young couple whose flat is fitted with six old style filament lamps.

Sheldon has seen an advert for LED light bulbs and is convinced they should replace all of the lamps. Aimee is not sure. She thinks they should wait and only replace the filament lamps if they break.

Information taken from the advert:

	One Filament lamp	Equivalent LED lamp
Power input (watts)	100	10
Expected lifetime (years)	2	15
Cost to buy	£0.75	£15.00
Carbon footprint for one lamp (kgCO ₂ /year)	63	11
Average hours used (per year)	1500	1500

- (a) (i) Sheldon says that these bulbs will help reduce their carbon footprint. Calculate the mass of carbon dioxide produced by six filament lamps in one year. [1]

..... kg

- (ii) Calculate how much more carbon dioxide is produced using the six filament lamps compared to six LED lamps in **one** year. [2]

..... kg

(b) Sheldon also says that they will save money on their electricity bill.

Calculate, using appropriate equations from the Data Sheet:

(i) how much energy (in kWh) the six filament lamps will use in **one** year. [2]

..... kWh

(ii) how many units of electricity the six LED lamps will use in **one** year. [2]

..... units

(iii) the cost of using the six LED lamps for **one** year if one unit of electricity costs 15p. [1]

..... p

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9851/01-A



S15-9851-01A

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DATA SHEET

Useful Equations

Work done or energy transferred = force \times distance

$$W = Fd$$

Power (W) = current (A) \times voltage (V)

$$P = IV$$

Energy (J) = power (W) \times time (s)

$$E = Pt$$

Units used (kWh) = power (kW) \times time (h)

Cost = units used \times cost of each unit

Percentage efficiency = $\frac{\text{useful energy transfer}}{\text{total energy used}} \times 100$

kgCO₂eq = mass of gas(kg) \times global warming potential of the gas

$$\text{kgCO}_2\text{eq} = m(\text{kg}) \times \text{GWP}$$

Units

g carbon dioxide equivalent

gCO₂eq

kg carbon dioxide equivalent

kgCO₂eq

kg carbon dioxide equivalent per kilowatt hour

kgCO₂eq/kWh

SI multipliers

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

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