

Surname	Centre Number	Candidate Number
Other Names		0



GCSE

4781/02

SCIENCE B

**UNIT 1: Space, Energy and Life
HIGHER TIER**

P.M. FRIDAY, 6 June 2014

1 hour 15 minutes

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	24	
2.	10	
3.	6	
4.	9	
5.	4	
6.	6	
7.	11	
Total	70	

ADDITIONAL MATERIALS

In addition to this paper you may require a calculator and a ruler.
You will also need a copy of the Resource Folder to answer **Section A**.

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.
Section A is based upon the Pre-Release Article.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.
You are reminded that assessment will take into account the quality of written communication used in your answer to question 1(a)(ii) and question 2(a).

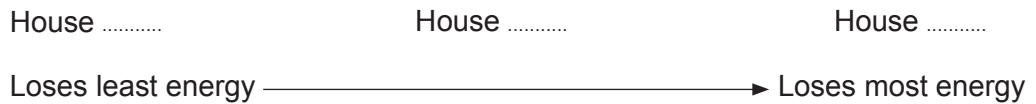
SECTION A

Answer all questions in the spaces provided.

Use the information in the separate Resource Folder to answer the following questions.

1. (a) Use the information in **Diagram 1** and **Table 1** to answer the following questions.

(i) Arrange the houses **A, B** and **C** in order of amount of energy loss starting with the house that loses least energy. [2]



(ii) Compare the cost effectiveness of loft insulation, double-glazing and cavity wall insulation. [6 QWC]

In your answer you should compare:

- the energy saved by each type of insulation
- the value for money of each type of insulation.

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(b) Refer to the information about **double-glazing** and **Graph 1** to answer the following questions.

(i) I. Describe how the rate of loss of energy is related to the size of the air gap. [1]

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II. Give **one** reason why makers of double-glazing are unlikely to use an air gap larger than 20 mm. [1]

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(ii) A house has a window area of 24m². The air gap used in the windows is 15 mm. There is a 20 °C temperature difference between the inside and outside of the house.

Calculate the rate of loss of energy through the windows of the house. [2]

Rate of loss of energy = W

(c) Refer to the information about **cavity walls** and **Table 2** to answer the following questions.

(i) I. Which of the materials used in the wall will be most effective at reducing heat loss? [1]

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II. Give **one** reason for your answer. [1]

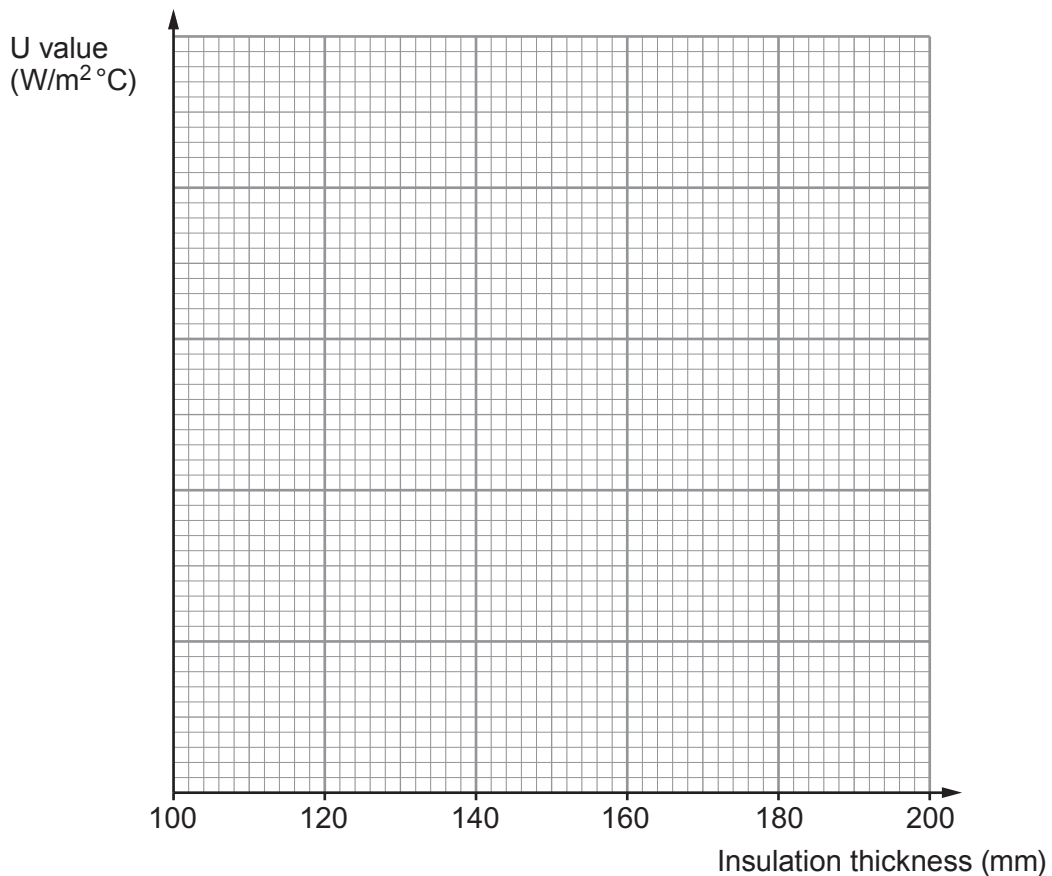
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(ii) Calculate the **total** R value for the wall. [1]

R value = W

(d) Refer to the information about **loft insulation** and **Table 3** to answer the following questions.

(i) Plot a graph of U value against insulation thickness for insulator **B**. [4]



(ii) Use your graph to find the thickness of insulator **B** that needs to be used to achieve a U value of 0.16 (W/m²°C). [1]

Thickness = mm

(e) A heating system uses 2000 W of electrical power to keep a house at constant temperature.

Calculate the cost of using the heating for 24 h. Include the **unit** in your answer. [4]
One unit of electricity costs 14p.

Cost =

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SECTION B

Answer all questions in the spaces provided.

2. (a) Describe the process of natural selection and its importance as a driving force for evolution. [6 QWC]

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- (b) (i) Describe what is meant by the term *biodiversity*. [2]

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- (ii) Explain why the number of different species is not distributed evenly on Earth. [2]

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3. Intensive farming methods include the use of fertilisers, herbicides, pesticides and 'battery' farming. These methods increase food production but there are disadvantages.

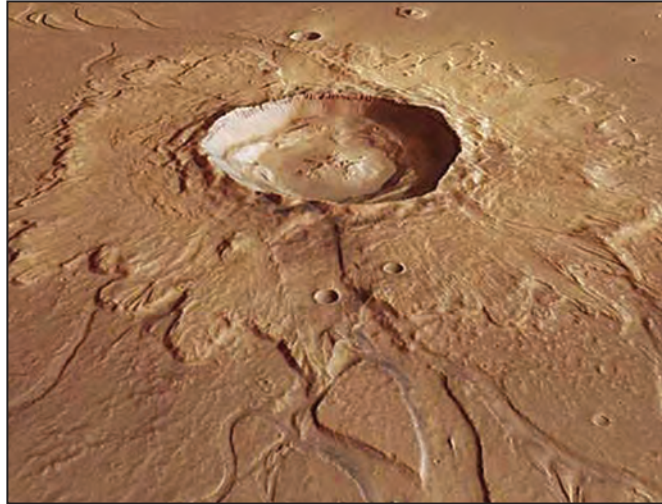
Complete the table below. *The first line has been completed for you.*

[6]

Intensive farming method	Reason for use	Disadvantage
Herbicide spray	Removes competing plants.	Reduces biodiversity.
Fertiliser spray
Pesticide spray
'Battery' farming

4. The photographs below show different features on Mars.

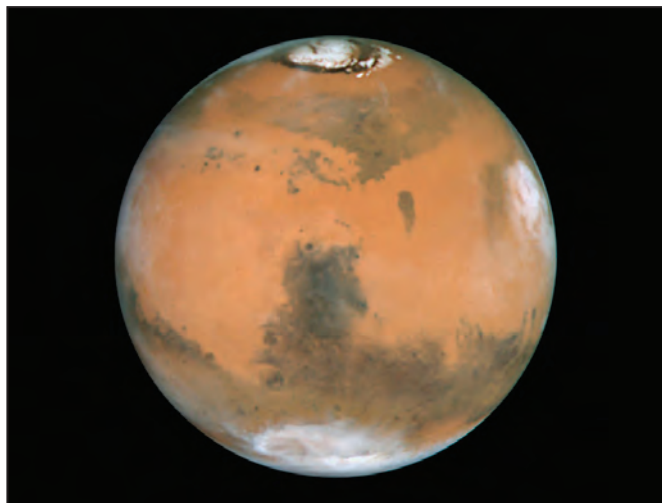
Photograph 1



Photograph 2



Photograph 3



- (i) Explain what the many craters shown in **photograph 1** tell us about the atmosphere on Mars. [3]

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- (ii) Describe what can be predicted about the structure of Mars from the presence of volcanoes such as the one shown in **photograph 2**. [3]

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- (iii) Only frozen water has been found on Mars, for example, at the ice cap shown in **photograph 3**. Explain what this information tells us about the composition of the atmosphere on Mars. [3]

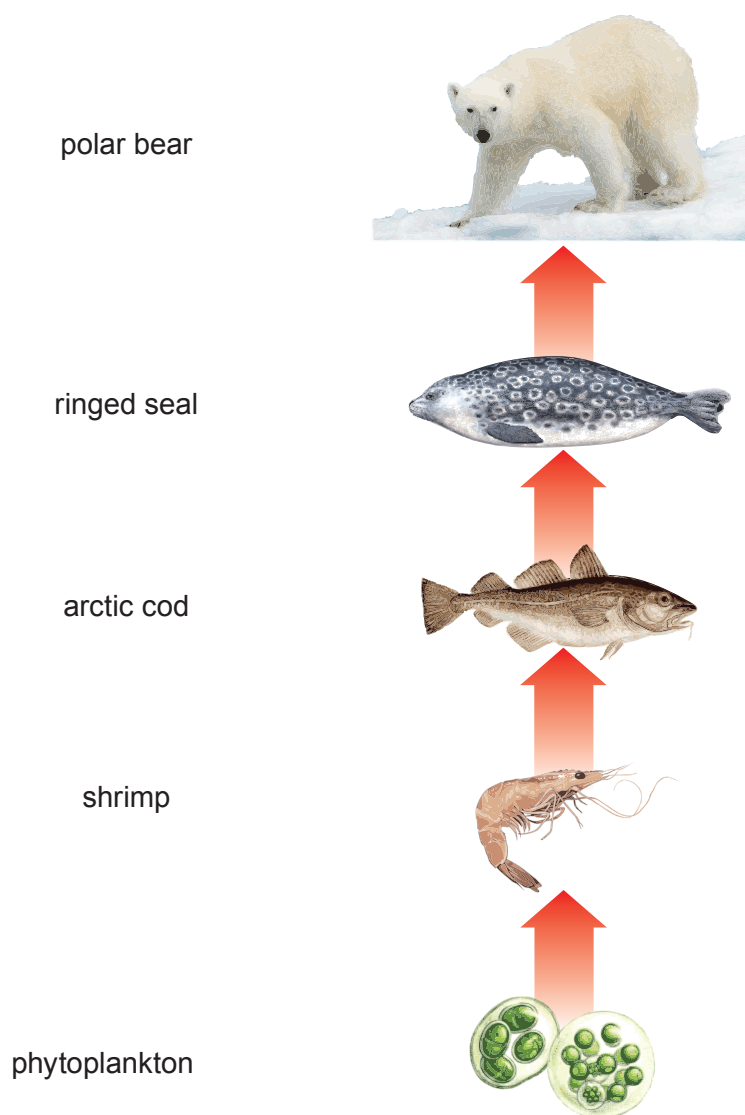
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5. About 150 tonnes of the highly toxic heavy metal mercury enter the environment every year. Some of this will enter the food chain below.



- (i) State **one** source of heavy metal pollution. [1]

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- (ii) Explain why the effect of mercury on the polar bear is different to the effect on shrimps. [3]

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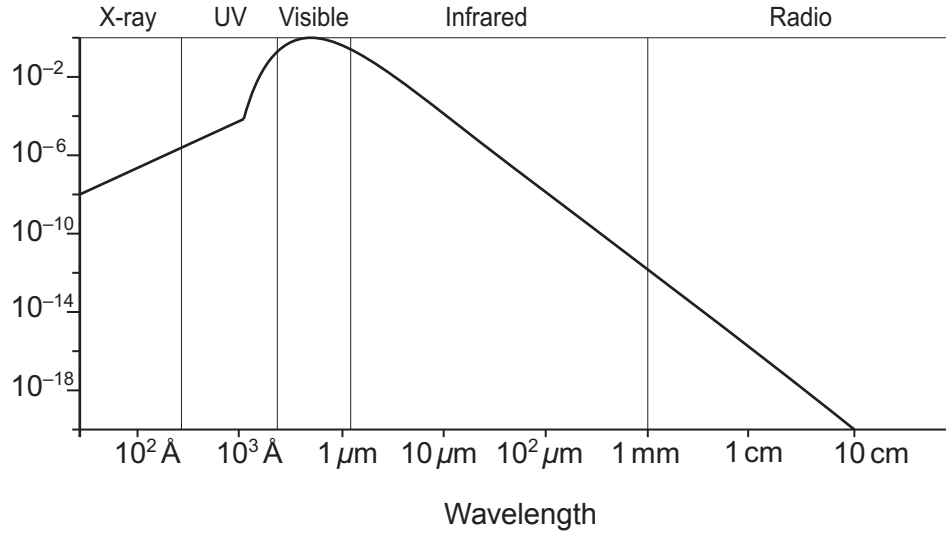
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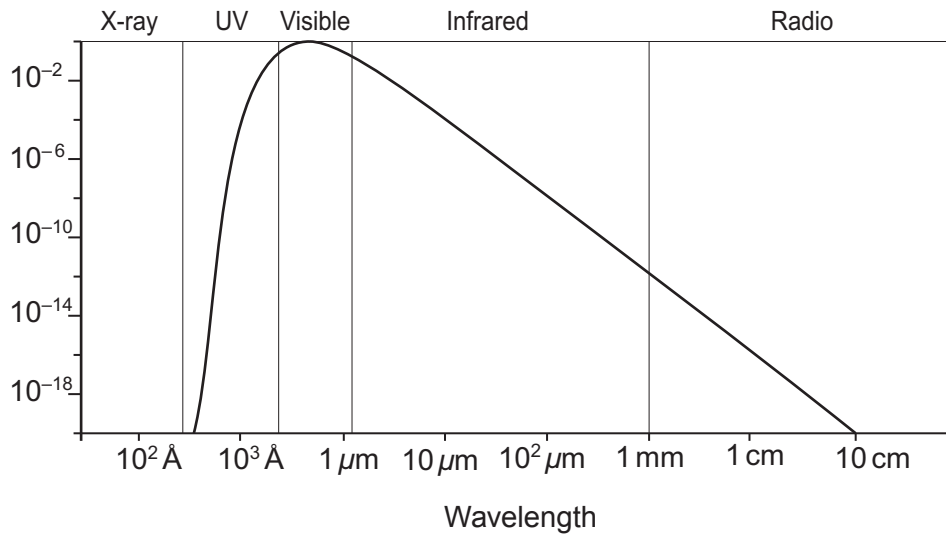
6. (i) Graph 1 shows the energy emission of the Sun at different wavelengths. Graph 2 shows the theoretical energy emissions that were expected at the same wavelengths.

The y-axis in each graph shows the relative amount of energy emitted compared to visible light, which has a value of 1.

Graph 1



Graph 2



Use the graphs to compare the actual emissions with the theoretical emissions. [3]

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- (ii) Calculate the frequency of the longest radio waves emitted from the Sun. You will need to use information from the graphs and the equation:

[3]

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

$$\text{Speed of light} = 3 \times 10^8 \text{ m/s}$$

Frequency = Hz

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only

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Turn over for Question 7

7. Wood chip boilers work in the same way as gas, coal and oil boilers.

(a) (i) Explain why wood chips are described as a sustainable fuel. [2]

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(ii) Explain why wood chips are described as a carbon neutral fuel. [2]

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(b) In a few cases, coal power stations have been converted to run on wood chips. **They also act as combined heat and power (CHP) stations.** These make use of the heat in the water that is used for cooling purposes. The water is piped to provide central heating for the power station and houses nearby.

The input power to a particular CHP station from burning wood chips is 500 MW. This power station is 80% efficient.

(i) Calculate the useful output power transferred by the power station using the equation: [3]

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

Useful output power transferred = MW

(ii) 220 MW of the useful output power is distributed for district heating. Calculate the electrical power in MW that is transferred to the National Grid. [1]

Power transferred to the National Grid = MW

(iii) Suggest **one** reason why CHP stations should be located near a large community. [1]

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(c) Power stations are connected to the National Grid. Explain why this makes for a more reliable supply of electricity to consumers. [2]

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END OF PAPER