WJEC GCSE SCIENCE B

# SCIENCE



## EXAM QUESTION PACK

UNIT 1 HIGHER TIER 4781 PAPERS

STEMUP

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|---|---|---|
| Other Names | | 0 |

# GCSE

4781/02

S16-4781-02

# SCIENCE B

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

A.M. FRIDAY, 10 June 2016

1 hour 15 minutes

| | For Examiner's use only | | |
|---|---|---|---|
| | **Question** | **Maximum Mark** | **Mark Awarded** |
| **Section A** | **1.** | **11** | |
| | **2.** | **13** | |
| **Section B** | **3.** | **8** | |
| | **4.** | **8** | |
| | **5.** | **7** | |
| | **6.** | **8** | |
| | **7.** | **9** | |
| | **8.** | **6** | |
| | **Total** | **70** | |

4781 020001

### 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.

### INFORMATION FOR CANDIDATES

**Section A** is based upon the Pre-Release Article.
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 (QWC) used in your answer to question **1***(c)* and question **8**.

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## SECTION A

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

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

**1.** Use the information in **Diagram 1** to answer the questions below.

*(a)* Complete the table below: [3]

| Stored carbon pool | Quantity (billions of tonnes) |
|---|---|
| soil | 2300 |
| fossil pool | 10000 |
| atmosphere | ..... |
| oceans (total) | ..... |
| plant biomass | ..... |

*(b)* Humans contribute 9 billion tonnes of carbon to the atmosphere every year. The net increase in the atmosphere is only 4 billion tonnes.

Give **two** reasons for this difference. [2]

1. .....

2. .....

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*(c)* Explain how carbon is recycled between the land and the atmosphere. [6 QWC]



11

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**2.** *(a)* Read the information about carbon footprint and **Table 1** to answer the questions below.

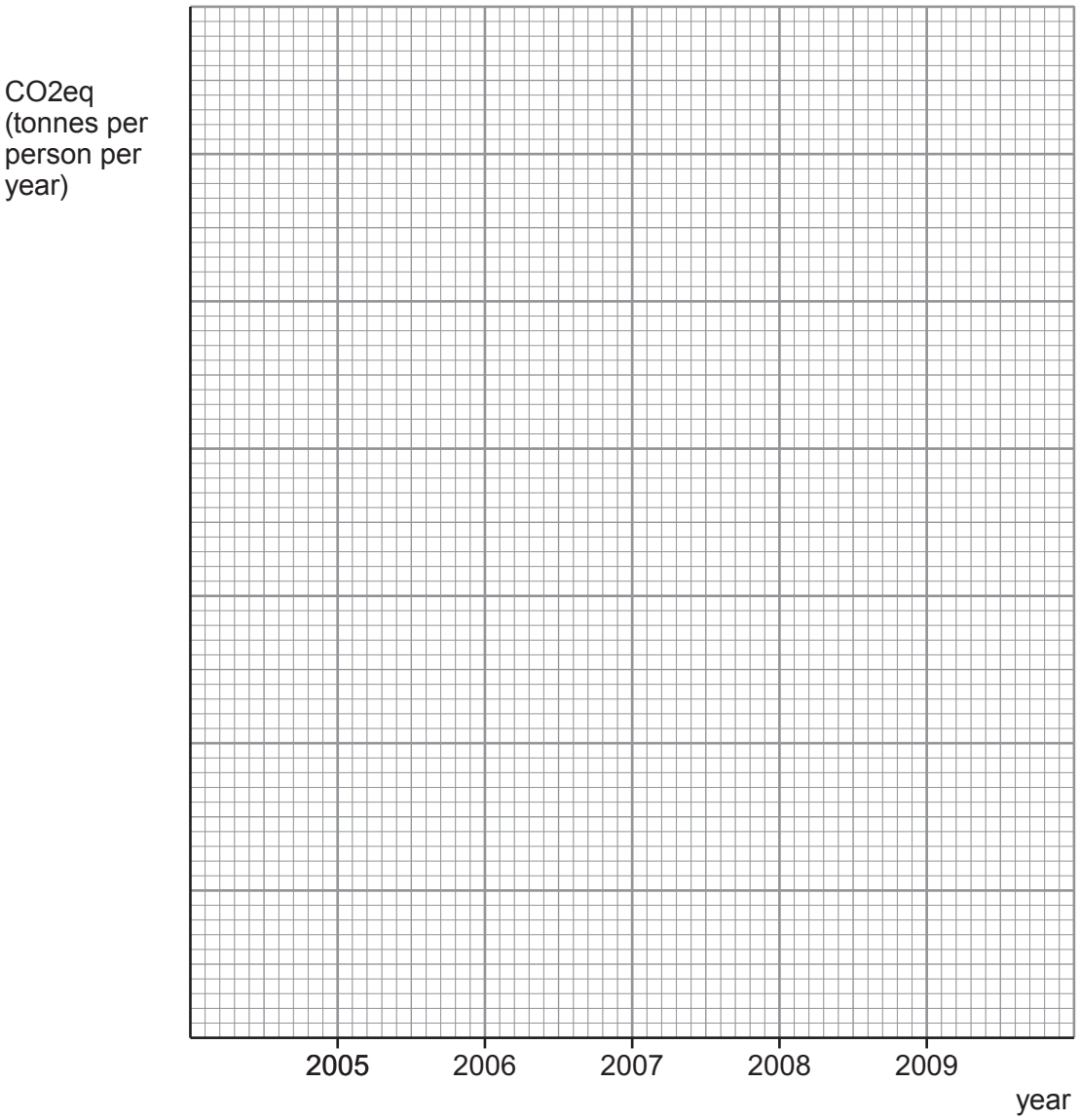
(i) State the countries which produced the lowest carbon dioxide emissions in 2009. [1]

.....

(ii) Name the country with the biggest increase in carbon dioxide emissions in tonnes per person per year between 2005 and 2009. [1]

.....

(iii) Plot a graph on the grid below to show how carbon dioxide emissions per person has changed over time in the UK. [4]




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(iv) Use the data to estimate the year in which the carbon dioxide emissions per person in the UK will reach the maximum allowed for sustainable living. Show how you arrived at your answer. [3]

year = .....

*(b)* A homeowner installs photovoltaic cells on the roof of their house and a log burner in their living room.
Describe how this will alter the pie chart of their personal $CO_2$ contributions shown in **Diagram 2**. [2]

.....

.....

*(c)* A farmer supplies 2000 kg of beef to the food industry every year. He is told that if he changed to supplying 2000 kg of poultry instead, he would reduce his carbon footprint. Use the information in **Table 2** to calculate the savings in his carbon footprint. [2]

Savings in carbon footprint = ..... kgCO2eq

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## SECTION B

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

**3.** The table shows information about planets in our Solar System. Use this to answer the questions that follow.

| Planet | Mean distance from the Sun (AU) | Diameter ($10^6$ m) | Time to spin on axis | Time to orbit the Sun (Earth years) | Number of known moons |
|---|---|---|---|---|---|
| Mercury | 0.4 | 5 | 59 days | 0.24 | 0 |
| Venus | 0.7 | 12 | 243 days | 0.6 | 0 |
| Earth | 1.0 | 13 | 23 hours, 56 mins | 1 | 1 |
| Mars | 1.5 | 7 | 24 hours, 37 mins | 2 | 2 |
| Jupiter | 5.2 | 143 | 9 hours, 55 mins | 12 | 63 |
| Saturn | 9.5 | 120 | 10 hours, 39 mins | 29 | 61 |
| ..... | 19.2 | 51 | 17 hours, 14 mins | 84 | 27 |
| Neptune | 30.0 | 50 | 16 hours, 7 mins | 165 | 13 |

*(a)* (i) Complete the table. [1]

(ii) Vesta is one of the largest asteroids. Estimate the distance of Vesta from the Sun and its time to orbit the Sun. [2]

distance of Vesta from the Sun = ..... AU

time for Vesta to orbit the Sun = ..... Earth years

(iii) Pluto is too small to be classed as a planet. Estimate the diameter of Pluto. [1]

..... × $10^6$ m

*(b)* It is suggested that Venus does not have any moons because it is too small to hold them in orbit.

Explain whether the data supports this suggestion. [2]

.....

.....

*(c)* Explain whether the time for a planet to orbit the Sun is proportional to its distance from the Sun. [2]

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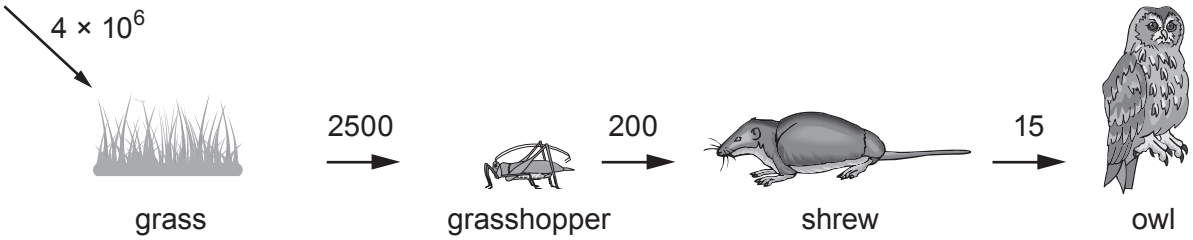
8

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**4.** The diagram shows the flow of energy through a food chain (in kJ/m$^2$).




*(a)* Name the producer in this food chain. ..... [1]

*(b)* (i) Calculate the efficiency of the energy transfer from the sun to the owls. Use the equation: [2]

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

efficiency % = .....

(ii) Explain why the efficiency is low. [2]

.....

.....

(iii) Explain the difference in the amount of energy transferred to the two predators. [3]

.....

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**5.** In this question you will need to use the following equations:

units used = power (kW) × time (h)

total cost = cost per unit × units used

Some builders sharing a house were worried about their electricity bill.
They decided to record how much electricity they used.
They found that they used 145 units in one week.
One unit of electricity costs 18p.

(i) Calculate the cost of electricity for a week. [2]

cost = £ .....

(ii) Cooking using an electric oven costs the builders £4.80 a week.
They found that if they did the cooking using a microwave they would use only 5 units in the week. They bought a microwave for £54.60.
Calculate how many weeks it took for the saving on the electricity bill to cover the cost of buying the microwave. [3]

answer = ..... weeks

(iii) The builders used a kettle for a total of 30 minutes each day.
The kettle used 8.4 units in the week.
Calculate the power of the kettle. [2]

power = ..... kW

7

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**6.** *(a)* Describe and explain the importance of natural selection in the evolution of species. [4]

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*(b)* Changes in species can be brought about through genetic modification.

(i) State **two** advantages of genetic modification. [2]

1. .....

2. .....

(ii) State **two** disadvantages of genetic modification. [2]

1. .....

2. .....

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**7.** The table shows properties of types of waves in the electromagnetic (em) spectrum.

| Spectrum of Electromagnetic Radiation | | | |
|---|---|---|---|
| Type | Wavelength range (cm) | Frequency range (Hz) | Energy range (eV) |
| radio waves | $> 10$ | $< 3 \times 10^{9}$ | $< 10^{-5}$ |
| microwave | $10 - 0.01$ | $3 \times 10^{9} - 3 \times 10^{12}$ | $10^{-5} - 0.01$ |
| infrared | $0.01 - 7 \times 10^{-5}$ | $3 \times 10^{12} - 4.3 \times 10^{14}$ | $0.01 - 2$ |
| visible | $7 \times 10^{-5} - 4 \times 10^{-5}$ | $4.3 \times 10^{14} - 7.5 \times 10^{14}$ | $2 - 3$ |
| ultraviolet | $4 \times 10^{-5} - 10^{-7}$ | $7.5 \times 10^{14} - 3 \times 10^{17}$ | $3 - 10^{3}$ |
| X-rays | ..... | $3 \times 10^{17} - 3 \times 10^{19}$ | $10^{3} - 10^{5}$ |
| gamma rays | $< 10^{-9}$ | $> 3 \times 10^{19}$ | $> 10^{5}$ |

*(a)* (i) Describe how the properties of the waves change from gamma rays to radio waves. [3]

.....

.....

.....

(ii) Complete the table using the equation: [3]

speed = frequency × wavelength.

*All em waves travel through space with a speed of $3 \times 10^{8}$ m/s.*

*Space for working.*

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*(b)* Describe why modern space science projects need different countries to collaborate. [3]

9

**8.** Describe the formation of the Earth and Jupiter, two planets in our Solar System. [6 QWC]

6

**END OF PAPER**

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|---|---|---|
| Other Names | | 0 |

# GCSE

4781/02

W16-4781-02

# SCIENCE B

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

A.M. THURSDAY, 14 January 2016

1 hour 15 minutes

| | For Examiner's use only | | |
|---|---|---|---|
| | **Question** | **Maximum Mark** | **Mark Awarded** |
| **Section A** | **1.** | **12** | |
| | **2.** | **6** | |
| | **3** | **6** | |
| **Section B** | **4.** | **9** | |
| | **5.** | **11** | |
| | **6.** | **10** | |
| | **7.** | **8** | |
| | **8** | **8** | |
| | **Total** | **70** | |

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### ADDITIONAL MATERIALS

In addition to this paper you may require a calculator, a pencil and a ruler.

You will also need a copy of the **Resource Folder** (Pre-Release Article) 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.

### 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 (QWC) used in your answer to questions **2** and **8**.

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

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## 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 **Table 1** to answer the question below.

Calculate the drop in the power generated by non-renewable sources from 2010 to 2050. Assume that the maximum power generated remains at a constant 34 GW. [2]

Drop in power generation by non-renewable sources = ..... GW

*(b)* (i) Use the information in **Table 2** to answer the following questions.

A 10 MW power station needs 60 000 tonnes of willow crop per year.

I. Calculate the area of land needed to grow this amount of willow crop. [1]

area ..... $km^2$

II. Calculate the energy content of 60 000 tonnes of willow crop. [1]

energy content = ..... units

(ii) Explain why burning biofuels is more environmentally friendly than burning fossil fuels. [2]

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*(c)* Use the information about wind power on **page 5** to answer the following question.

Complete the table by ticking (✓) the correct column for each steady wind speed.

One has been completed as an example. [3]

| Steady wind speed (m/s) | Zero power output | Rated output power | Between zero and rated output power |
|---|---|---|---|
| 2.9 | ✓ | | |
| 27.2 | | | |
| 19.6 | | | |
| 12.2 | | | |

*(d)* Describe the advantages of tidal water turbines compared to wind turbines using your knowledge and the information in **Table 3**. [3]

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12

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**Turn over.**

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**2.** Compare the use of wind power and nuclear power to generate electricity using the information in **Table 4** and your own knowledge. [6 QWC]

Include in your answer, details about:

- cost effectiveness;
- effect on the environment;
- reliability.



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**3.** Use the information about solar panels on **page 7** to answer the questions that follow.

(i) Calculate the efficiency of a solar panel using the equation: [2]

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

percentage efficiency = .....

(ii) Household voltage is 230 V. Calculate the maximum current that can be drawn from a solar panel of area 1 square metre, using the equation:

$$\text{current} = \frac{\text{power}}{\text{voltage}}$$

[2]

current = ..... A

(iii) Calculate the energy (Wh) produced by a 5 square metre solar panel in 6 hours of good sunlight. [2]

energy = ..... Wh

6

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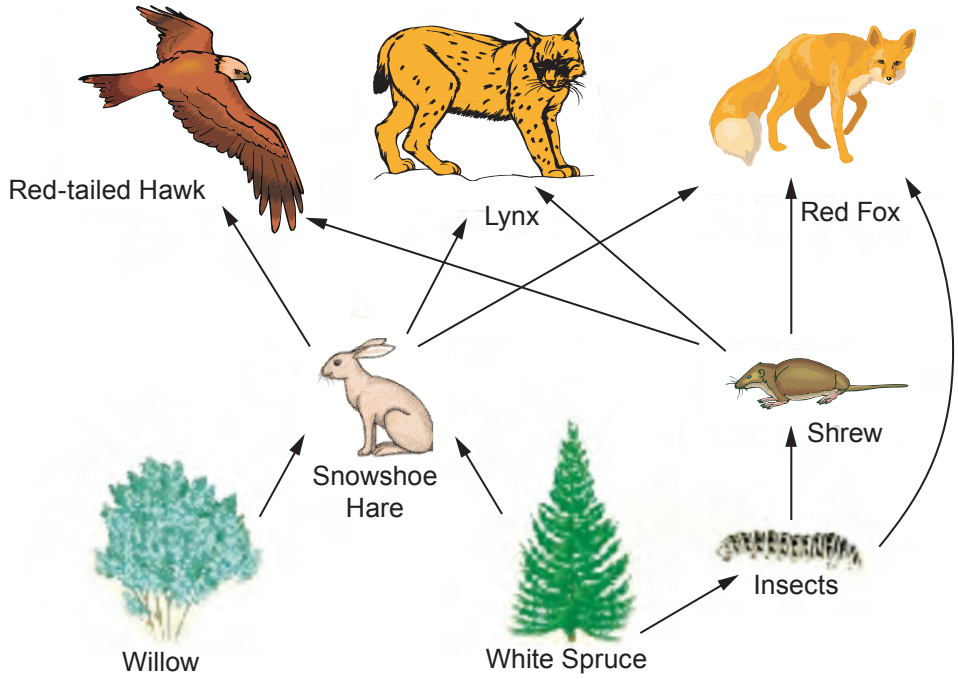
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## SECTION B

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

**4.** The picture shows a food web.




*(a)* (i) State **three** factors that will affect the size of the white spruce population. [3]

1. .....

2. .....

3. .....

(ii) Name the source of energy for this food web. ..... [1]

(iii) Construct a pyramid of numbers for the food chain below: [2]

white spruce → insects → shrew → lynx

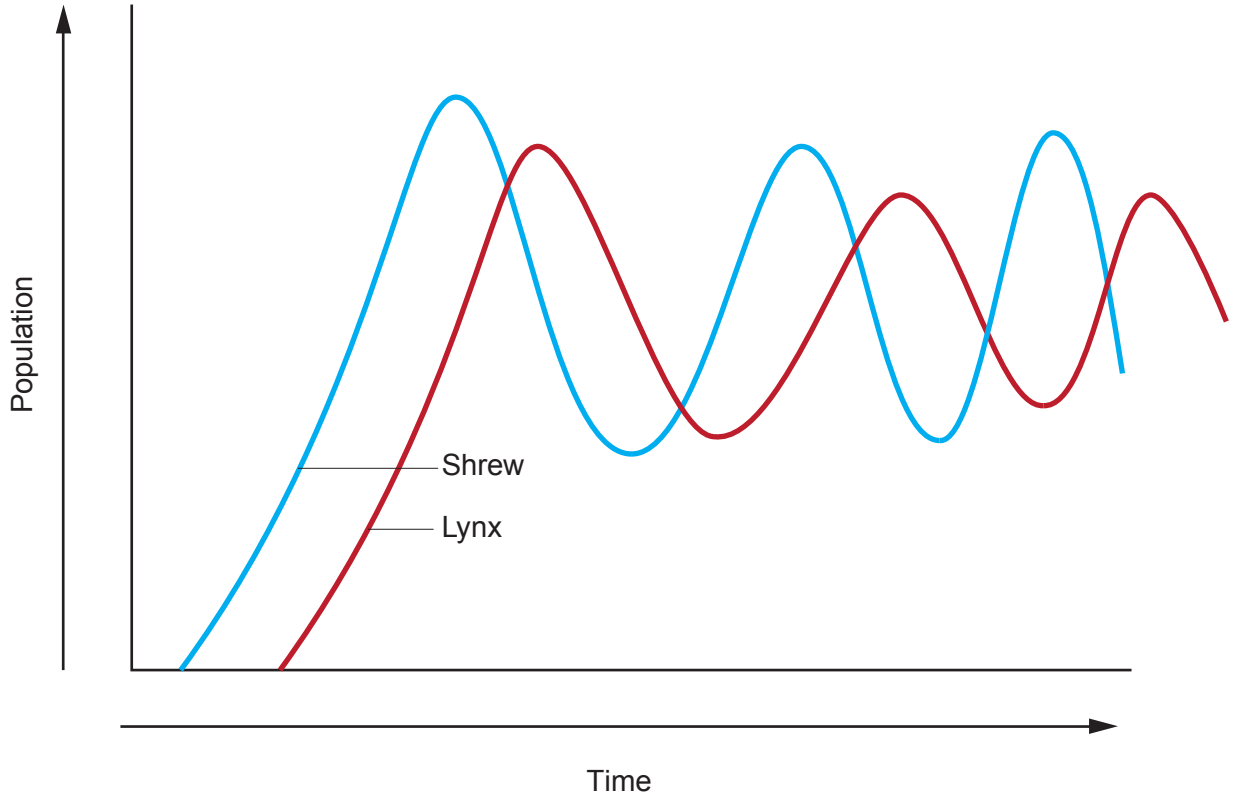
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*(b)* In their natural habitat, the lynx is a predator of the shrew.

The populations of lynx and shrew will change in a pattern shown in the graph.




Explain why the population change of the lynx lags behind that of the shrew. [3]

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**5.** A homeowner is shopping for a washing machine. He compares information about four different models assuming they will all be used for the same amount of time.

| Model | Price (£) | Power (W) | Power (kW) | Units used per year (kWh/y) | Annual running cost (£) |
|---|---|---|---|---|---|
| **A** | 350 | 2200 | 2.2 | 220 | ..... |
| **B** | 345 | 2400 | ..... | 240 | 38.40 |
| **C** | 320 | 2700 | 2.7 | 270 | 43.20 |
| **D** | 340 | ..... | 2.1 | ..... | 33.60 |

*(a)* To answer the following questions you will need to use the equations below.

units used = power (kW) × time (h)

annual cost = cost of one unit (16p) × units used in a year

(i) Calculate the length of time model **C** uses electricity during the year. [2]

time = ..... h

(ii) **Complete** the gaps in the table. [6]

*Space for workings.*

*(b)* Compare the total cost of washing machines **B**, **C** and **D** over a five year period, to select which is the most economical model to buy.

*Space for workings.*

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Explain your answer. [3]

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11

**6.** *(a)* (i) Describe how untreated sewage is damaging to the environment. [3]

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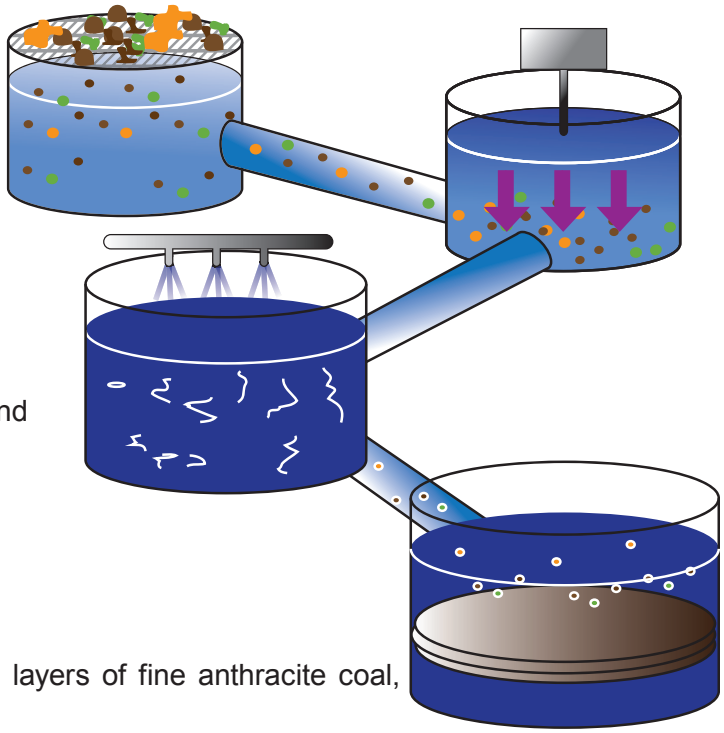
.....

(ii) Use the information in the diagram below to explain how sewage is made harmless to the environment. [3]

**PRIMARY TREATMENT**
Solids are removed from the water.

**SECONDARY TREATMENT**
Microbes are added and jets inject air into the sewage.

**TERTIARY TREATMENT**
Water moves through layers of fine anthracite coal, sand and gravel.



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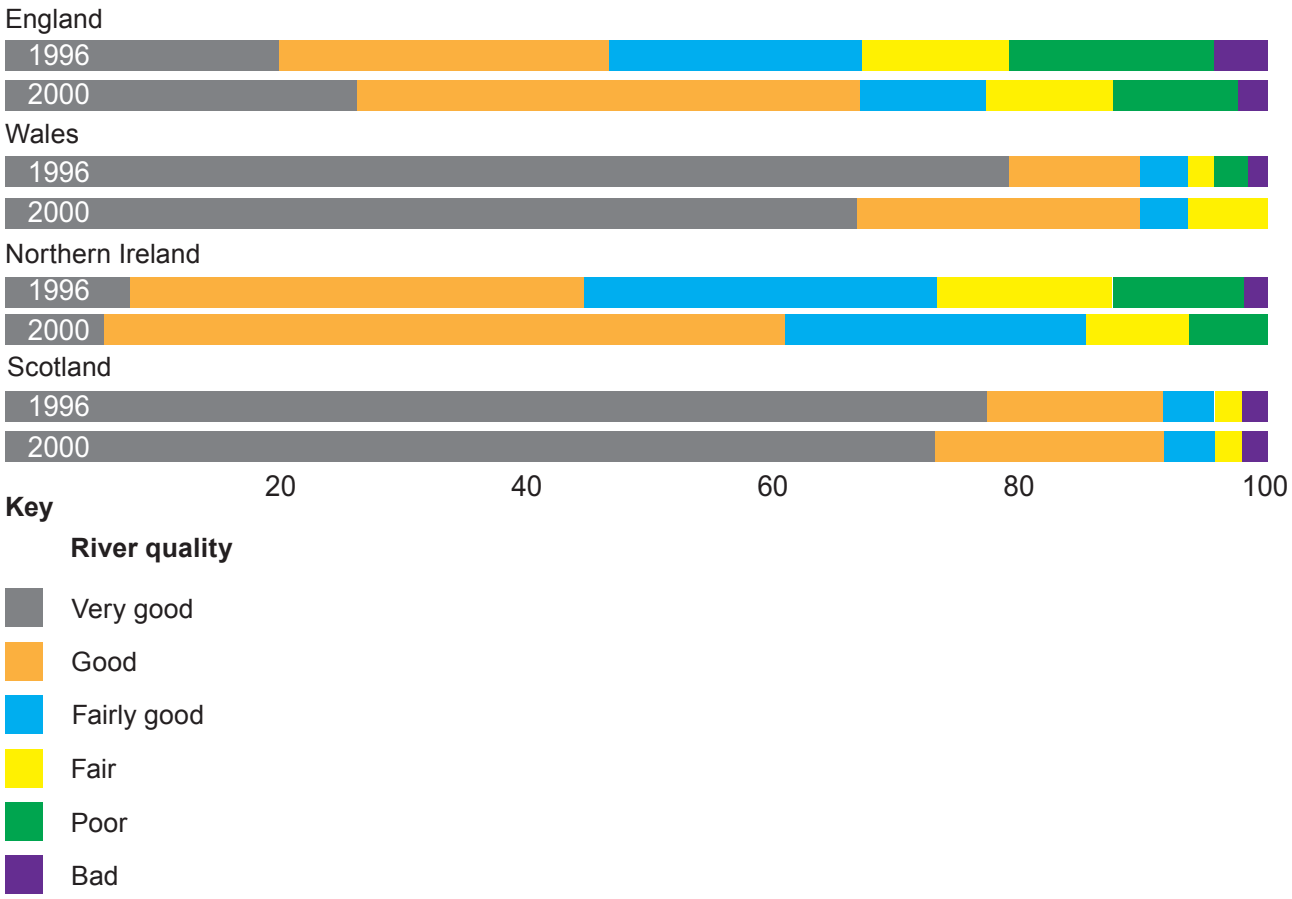


**Turn over.**

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*(b)* The chart shows how river quality in the UK changed over a 4 year period.




Compare the quality of rivers in England and Wales over this time period. [4]

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.....

10

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**7.** The table below gives information about different regions of the electromagnetic (em) spectrum.

| Region | Wavelength (m) | Frequency (Hz) |
|---|---|---|
| radio | $> 1 \times 10^{-1}$ | $< 3 \times 10^{9}$ |
| microwave | $1 \times 10^{-3} - 1 \times 10^{-1}$ | $3 \times 10^{9} - 3 \times 10^{11}$ |
| ..... | $7.5 \times 10^{-7} - 1 \times 10^{-3}$ | $3 \times 10^{11} - 4 \times 10^{14}$ |
| visible | $4 \times 10^{-7} - 7.5 \times 10^{-7}$ | $4 \times 10^{14} - 7.5 \times 10^{14}$ |
| ..... | $1 \times 10^{-8} - 4 \times 10^{-7}$ | $7.5 \times 10^{14} - 3 \times 10^{16}$ |
| X-ray | $1 \times 10^{-11} - 1 \times 10^{-8}$ | $3 \times 10^{16} - 3 \times 10^{19}$ |
| gamma-ray | $< 1 \times 10^{-11}$ | $> 3 \times 10^{19}$ |

(i) Complete the table. [2]

(ii) Use information from the table and the equation below to calculate the speed of em waves in space. [3]

wave speed = frequency x wavelength

speed = ..... m/s

(iii) Some of the energy values shown in the table are in the incorrect position. Complete the table below by inserting these values in the correct order. [3]

| Region | Energy (J) in **incorrect** order | Energy (J) in **correct** order |
|---|---|---|
| radio | $> 2 \times 10^{-14}$ | ..... |
| microwave | $3 \times 10^{-19} - 5 \times 10^{-19}$ | ..... |
| visible | $2 \times 10^{-17} - 2 \times 10^{-14}$ | ..... |
| X-ray | $2 \times 10^{-24} - 2 \times 10^{-22}$ | ..... |
| gamma-ray | $< 2 \times 10^{-24}$ | ..... |



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**8.** *(a)* Use the Accretion Theory to describe the formation of the planet Mars. [2]

*(b)* Name and describe **three** conflicting theories about the formation of our Moon. [6 QWC]

8

**END OF PAPER**

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# GCSE MARKING SCHEME

## JANUARY 2016

## SCIENCE B
## UNIT 1 - HIGHER TIER
## 4781/02

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## INTRODUCTION

This marking scheme was used by WJEC for the 2016 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

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**GCSE SCIENCE B**

**UNIT 1 HIGHER TIER**

**JANUARY 2016 MARK SCHEME**

## Section A

<table>
<tr><th colspan="2">Question</th><th>Marking point</th><th>Marks</th></tr>
<tr><td>1</td><td>(a)</td><td>Reduction from 29 to 3 (1) = 26 (GW) (1)<br>or<br>31 – 5 (1) = 26 (GW) (1)</td><td>2</td></tr>
<tr><td></td><td>(b) (i)</td><td>I. Area = (60 000/15) = 4000 (km$^2$) (1)<br>II. Energy content = (60 000 x 20) = 1200000 (units) (1)</td><td>2</td></tr>
<tr><td></td><td>(ii)</td><td>$CO_2$ released during burning (1)<br>= $CO_2$ absorbed during growing / photosynthesis (1)<br>so carbon neutral (1)<br>Any two points<br>The points must be correctly and coherently connected to be awarded two marks</td><td>2</td></tr>
<tr><td></td><td>(c)</td><td>1 mark for each correct point<br><table><tr><th>Steady wind speed (m/s)</th><th>Zero power output</th><th>Maximum power output</th><th>Between zero and maximum power output</th></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td>27.2</td><td>✓</td><td></td><td></td></tr><tr><td>19.6</td><td></td><td>✓</td><td></td></tr><tr><td>12.2</td><td></td><td></td><td>✓</td></tr></table></td><td>3</td></tr>
<tr><td></td><td>(d)</td><td>smaller, larger power output, more reliable, less of an eyesore</td><td>3</td></tr>
</table>

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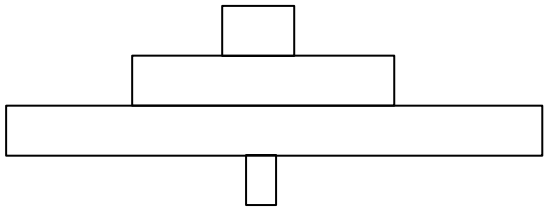
| Question | | Marking point | Marks |
|---|---|---|---|
| **2** | | **Indicative content**<br>• power output one nuclear power station is equivalent to 900 wind turbines<br>• nuclear power stations last 3 times longer / in the lifetime of one nuclear power station equivalent 2 700 wind turbines.<br>• cost wind turbines more than double the cost of a nuclear power station / nuclear option cheaper per unit produced<br>• wind power is less reliable<br>• radioactive waste more detrimental to the environment since it has to be stored safely for long periods of time / danger of leakage into the ecosystem.<br><br>**Marking bands**<br><br>**5 - 6 marks.**<br>The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>**3 - 4 marks**<br>The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br><br>**1 - 2 marks**<br>The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions.<br>The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br><br>**0 marks**<br>The candidate does not make any attempt or give a relevant answer worthy of credit. | 6 |
| **3** | (i) | 200/1000 (1) x 100 = 20 (1) | 2 |
| | (ii) | Current = 200/230 (1) = 0.87 / 0.9 (A) (1) | 2 |
| | (iii) | 5 x 200 x 6 (1) = 6000 (Wh) (1) | 2 |

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## Section B

<table>
<tr><th>Question</th><th>Marking point</th><th>Marks</th></tr>
<tr><td>4 (a) (i)</td><td>Any three of:<br>• disease<br>• competition for nutrients with willow<br>• competition for light<br>• number of insects/snowshoe hares<br>• deforestation</td><td>3</td></tr>
<tr><td>(ii)</td><td>sunlight (accept Sun)</td><td>1</td></tr>
<tr><td>(iii)</td><td>relative proportions All correct (2), Three correct (1)<br></td><td>2</td></tr>
<tr><td>(b)</td><td>as supply of food (shrew) increases so will lynx (1). This causes the number of shrew to decrease (1) and so will the lynx (1)<br>The points must be correctly and coherently connected to be awarded three marks.</td><td>3</td></tr>
<tr><td>5 (a) (i)</td><td>time = 270/2.7 (1) = 100 (h) (1)</td><td>2</td></tr>
<tr><td>(ii)</td><td>Note: Answers: 35.2, 210. 1 mark will be awarded if candidate as shown correct workings for calculation but given incorrect answer.<br><br>
<table>
<tr><th>Model</th><th>Cost to buy (£)</th><th>Power (W)</th><th>Power (kW)</th><th>Units used per year (kWh/y)</th><th>Annual running cost (£)</th></tr>
<tr><td>A</td><td>350</td><td>2 200</td><td>2.2</td><td>220</td><td>35.20 (2)</td></tr>
<tr><td>B</td><td>345</td><td>2 400</td><td>2.4 (1)</td><td>240</td><td>38.40</td></tr>
<tr><td>C</td><td>320</td><td>2 700</td><td>2.7</td><td>270</td><td>43.20</td></tr>
<tr><td>D</td><td>340</td><td>2 100 (1)</td><td>2.1</td><td>210 (2)</td><td>33.60</td></tr>
</table></td><td>6</td></tr>
<tr><td>(b)</td><td>A & B cost more to buy and run than D so it wouldn’t be one of those (1) C costs £216 and D costs £168 to run over 5 years (1) The saving in running costs of £48 is more than the extra cost to buy £20 so chose C (1)<br>The points must be correctly and coherently connected to be awarded three marks.</td><td>3</td></tr>
</table>



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| Question | Marking point | Marks |
|---|---|---|
| **6** (a) (i) | Any **two** of:<br>• increase in the number of bacteria<br>• decreases the oxygen content of the water<br>• plants / animals need oxygen to survive<br><br>**One** mark for:<br>• decreases biodiversity / decreases range/diversity of the river animals / plants | 3 |
| (ii) | Any **three** of:<br>• waste broken down by the action of decay micro-organisms<br>• which need lots of oxygen because:<br>• anaerobic respiration (by bacteria) only partly breaks down the waste<br>• plentiful oxygen means that the bacteria use aerobic respiration<br>• aerobic respiration makes the breaking down process complete<br><br>*The points must be correctly and coherently connected to be awarded three marks.* | 3 |
| (b) | Wales has always had more 'very good' river quality (1).<br>The river quality in England improved (1) but worsened in Wales (1)<br>In 2000, there is no bad river quality in Wales but there is in England (1) | 4 |

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<table>
<tr><th>Question</th><th>Marking point</th><th>Marks</th></tr>
<tr><td>7 (i)</td><td>1 mark each label<br><table><tr><td>Region</td></tr><tr><td></td></tr><tr><td></td></tr><tr><td>infra-red</td></tr><tr><td></td></tr><tr><td>ultra violet</td></tr><tr><td></td></tr><tr><td></td></tr></table></td><td>2</td></tr>
<tr><td>(ii)</td><td>speed = 1 x $10^{-1}$ (1) x 3 x $10^{9}$ (1)<br>or use of another pair of values = 3 x $10^{8}$ (m/s) (1)</td><td>2</td></tr>
<tr><td>(iii)</td><td>minimum value at top (1 maximum value at bottom (1) correct order in between (1)<br><table><tr><th>Region</th><th>Energy (J)</th></tr><tr><td>radio</td><td>< 2 x $10^{-24}$</td></tr><tr><td>microwave</td><td>2 x $10^{-24}$- 2 x $10^{-22}$</td></tr><tr><td>visible</td><td>3 x $10^{-19}$ - 5 x $10^{-19}$</td></tr><tr><td>X-ray</td><td>2 x $10^{-17}$ - 2 x $10^{-14}$</td></tr><tr><td>gamma-ray</td><td>> 2 x $10^{-14}$</td></tr></table></td><td>3</td></tr>
</table>

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| Question | Marking point | Marks |
|---|---|---|
| **8** (a) | matter swirling around an emerging star forms small pellets (1) which collide and make larger bodies (1) | 2 |
| (b) | **Indicative content**<br><br>**Three** of the following need to be discussed.<br>• *The Fission Theory:* The Moon was once part of the Earth and somehow separated from the Earth early in the history of the Solar System.<br>• *The Capture Theory:* The Moon was formed somewhere else, and was later captured by the gravitational field of the Earth.<br>• *The Co-formation Theory:* The Moon and the Earth condensed together from the original cloud that formed the Solar System.<br>• *The Impact Theory:* A body the size of Mars struck the earth, ejecting large volumes of matter. A disk of orbiting material was formed, and this matter eventually condensed to form the Moon in orbit around the Earth.<br><br>**Marking bands:**<br><br>**5 - 6 marks.**<br>The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>**3 - 4 marks**<br>The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br><br>**1 - 2 marks**<br>The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions.<br>The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br><br>**0 marks**<br>The candidate does not make any attempt or give a relevant answer worthy of credit. | 6 |



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# GCSE

4781/02

S15-4781-02

# SCIENCE B

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

P.M. FRIDAY, 5 June 2015

1 hour 15 minutes

| For Examiner's use only | | |
|---|---|---|
| **Question** | **Maximum Mark** | **Mark Awarded** |
| **1.** | **6** | |
| **2.** | **9** | |
| **3.** | **6** | |
| **4.** | **3** | |
| **5.** | **9** | |
| **6.** | **5** | |
| **7.** | **10** | |
| **8.** | **12** | |
| **9.** | **10** | |
| **Total** | **70** | |

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### 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.

### INFORMATION FOR CANDIDATES

**Section A** is based upon the Pre-Release Article.
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 (QWC) used in your answer to question **2***(a)* and question **9***(b)*.

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## SECTION A

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

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

**1.** Use **Diagram 1** to answer the following questions.

*(a)* Describe how the diagram shows the universe has changed over time. [1]

.....

*(b)* Explain why the diagram does not support the Steady-State theory of the universe. [2]

.....

.....

.....

*(c)* Imagine **C** is our galaxy, the Milky Way. Compare how the distances of galaxies **A** and **D** from the Milky Way have changed from the early universe to some time later. [2]

.....

.....

*(d)* Arrange galaxies **A**, **B**, **D** and **E**, in order of speed of travel away from **C** from fastest to slowest. [1]

*Fastest* ..... ..... ..... ..... *Slowest*

6

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**2.** Use the information in **Diagram 2**, **the text** and **Table 1** to answer the following questions.

*(a)* Describe how the properties of galaxies change from left to right along the Hubble Classification Scheme. [6 QWC]

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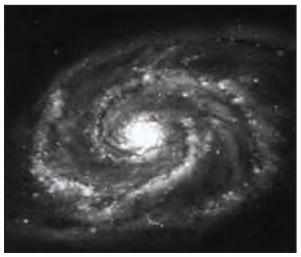
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*(b)* Write down the class of each galaxy shown in the diagrams below. [3]

*The first one has been done for you.*



Class E0



Class .....



Class.....



Class .....

9

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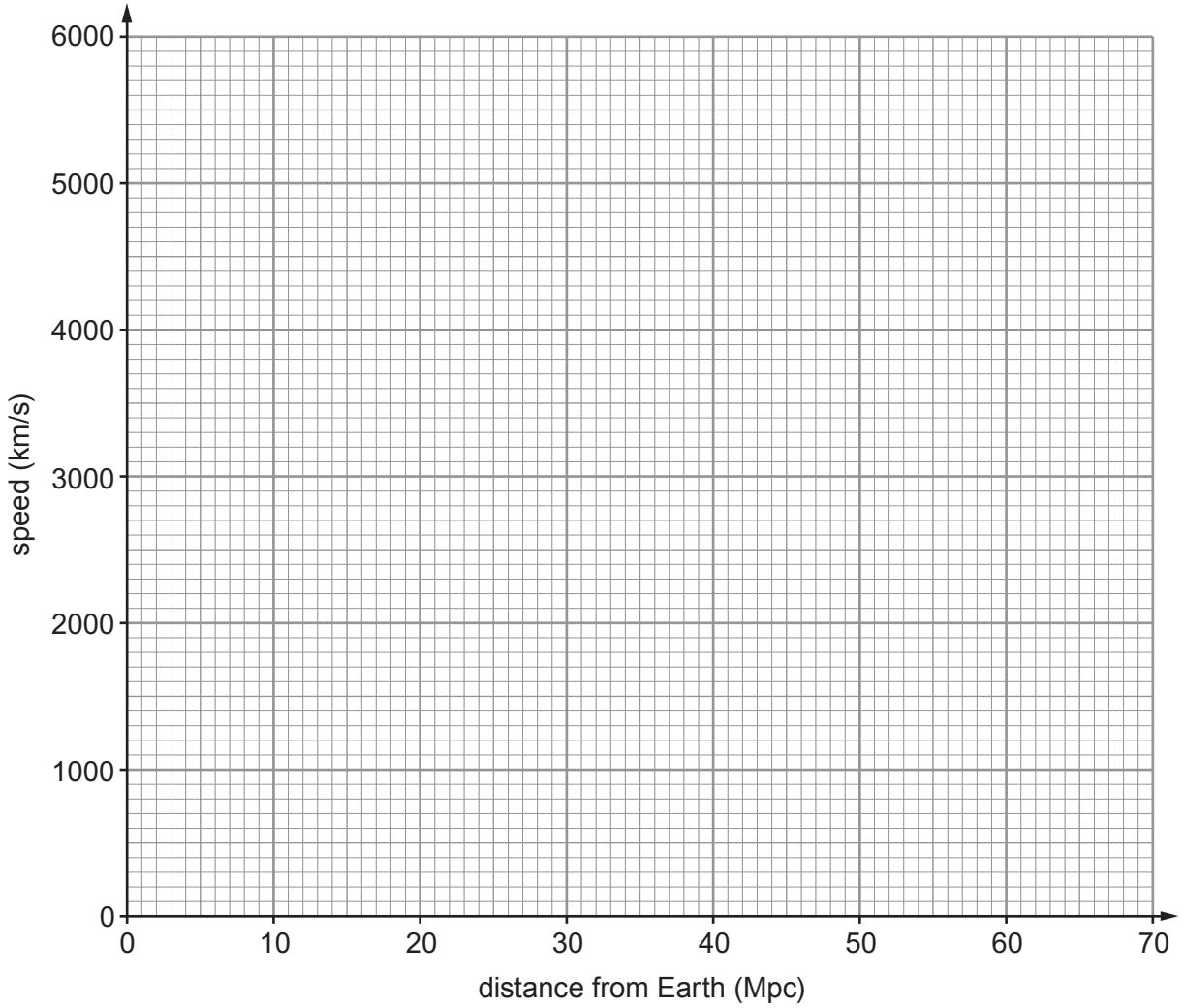
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**3.** *(a)* Use the data in **Table 2** to plot a graph on the grid below.

Use **only** the data for the six galaxies from NGC-4486 to NGC-5548.

Add a straight line of best fit that goes through the origin. [3]




*(b)* Use your graph to find a value for the Hubble constant. [3]

Hubble constant = ..... km/s/Mpc

6

**4.** Refer to **Diagram 3** to answer this question.

Describe how the surface temperature of our Sun will change as it becomes a red giant similar to Aldebaran and then a white dwarf similar to Sirius B. You should include data in your answer. [3]

.....

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## SECTION B

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

**5.** The table shows what happens to the energy taken in each day by organisms in a food chain.

| Organism | Energy (MJ) per day | | |
|---|---|---|---|
| | As waste | Released during respiration | Used for growth |
| plant | 18 | 12 | 8 |
| caterpillar | 14 | 22 | 4 |
| bird | ..... | 26 | 4 |

*(a)* (i) Calculate the total energy taken in by the plant each day. [1]

Energy taken in = ..... MJ

(ii) The bird releases 60% of its energy during respiration and for growth. Calculate how much energy is released in waste. [2]

Energy in waste = ..... MJ

(iii) Explain why the amount of energy released during respiration changes as you move higher in the food chain shown in the table. [3]

.....

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*(b)* Crops can be sprayed with a pesticide which kills large numbers of caterpillars. Explain the effect of spraying crops on the other living things in this food chain. [3]

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**6.** Reduce, reuse and recycle schemes promote sustainability. [5]

(i) State **one** impact of **reduce** schemes on obtaining new raw materials.

.....

.....

(ii) Explain the benefit of **reuse** schemes on landfill.

.....

.....

.....

(iii) Explain how **recycle** schemes affect energy demand.

.....

.....

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5

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**7.** Homeowners who generate electricity from solar power get paid for energy they produce under a scheme called 'Feed-in Tariff'.

They are paid for the energy they produce and use themselves. They are also paid for any electricity they produce and put into the grid. They will also see their energy bills fall slightly. The initial cost of installing solar panels is £7 800.

The total return for a typical **2.4 kW** household installation:

- £1 100 a year from the Generation Tariff;
- £80 a year from the Export Tariff;
- £120 a year reduction of current electricity bills.

*(a)* Explain how the use of solar panels will impact on $CO_2$ emissions. [2]

.....

.....

.....

*(b)* Use the information above to calculate the payback time of the cost of installing the solar panels. [2]

Payback time = ..... years

*(c)* (i) Calculate how long it would take for a 2.4 kW installation of solar panels providing maximum power to produce enough electricity to save the homeowner £120. Use the equations: [3]

units used = power (kW) x time (h)
cost = units used x cost per unit

One unit of electricity costs 15p.

Time = .....

(ii) The power output from an installation of solar panels is only 1.2 kW. State how long this installation will take to save £120. [1]

.....

(iii) Explain why the power output from an installation of solar panels may be less than 2.4 kW during daylight hours. [2]

.....

.....

10

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**8.** The wavelength of the infra-red (I-R) radiation from the Sun ranges from $2 \times 10^{-7}$ to $4 \times 10^{-6}$ m.

I-R radiation travels through space at a speed of $3 \times 10^{8}$ m/s.

*(a)* Calculate the highest frequency of I-R radiation that arrives at Earth, using the equation: [4]

wavespeed = frequency x wavelength

Frequency = ..... Hz

*(b)* (i) I-R radiation is one part of the electromagnetic (em) spectrum.

Complete the **first column only** to show the missing regions of the em spectrum in order of decreasing frequency. [2]

| Region of em spectrum | Typical wavelength (m) |
|---|---|
| visible light | ..... |
| I-R | $4 \times 10^{-6}$ |
| ..... | ..... |
| ..... | ..... |



Highest frequency

Lowest frequency

(ii) Typical wavelengths (in meters) for each region of the em spectrum are listed below in a random order.

| | | |
|---|---|---|
| $4 \times 10^{-2}$ | $5 \times 10^{-7}$ | 1.5 |

Use these values to complete the **wavelength column** in the table. [2]

*(c)* Explain how this incoming I-R radiation eventually leads to the greenhouse effect. [4]

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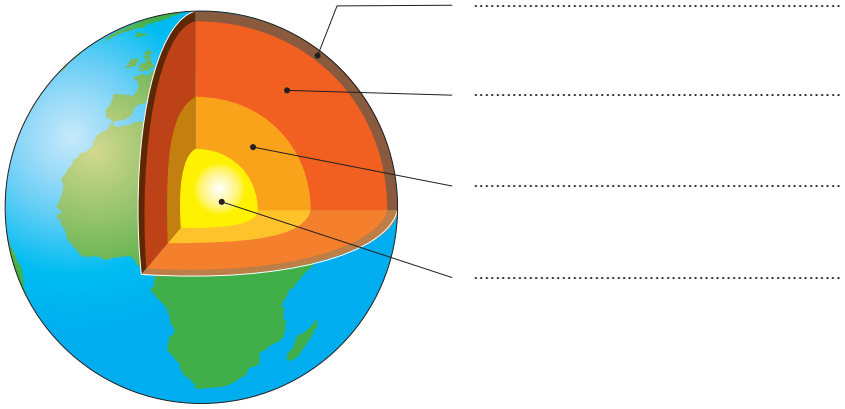


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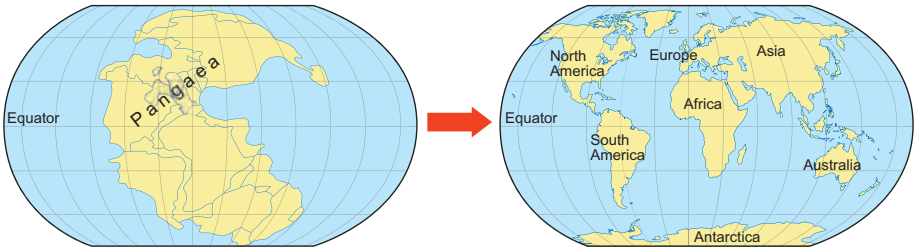
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**9.** The diagram below shows the structure of the Earth.

*(a)* Label the **four** parts shown. [4]



*(b)* The diagrams below show how the surface of the Earth has changed over a long period of time. There was only one mass of land 3 billion years ago. This was called Pangaea.




3 billion years ago Today

Account for the differences in surface appearance between 3 billion years ago and today. [6 QWC]

Include in your answer:

- a description of how the appearance of the surface has changed;
- an explanation of how these changes were brought about.

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10

**END OF PAPER**

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|---|---|---|
| Other Names | | 0 |

# GCSE

4781/02

W15-4781-02

# SCIENCE B

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

P.M. THURSDAY, 15 January 2015

1 hour 15 minutes

| | For Examiner's use only | | |
|---|---|---|---|
| | **Question** | **Maximum Mark** | **Mark Awarded** |
| **Section A** | **1.** | **24** | |
| **Section B** | **2.** | **10** | |
| | **3.** | **9** | |
| | **4.** | **8** | |
| | **5.** | **12** | |
| | **6.** | **7** | |
| | **Total** | **70** | |

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### ADDITIONAL MATERIALS

In addition to this paper you may require a calculator, a pencil and a ruler.
You will also need a copy of the **Resource Folder** (Pre-Release Article) 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.

### 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 questions **1***(e)* and **5***(c)*.
**Section A** is based upon the **Pre-Release Article**.

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## SECTION A

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

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

**1.** *(a)* (i) Give **one** reason why phytoplankton and plants **only** increase the oxygen concentration during sunlight hours. [1]

.....

.....

(ii) Give **one** reason why living phytoplankton and other plants are **only** found in the epilimnion layer of water. [1]

.....

.....

*(b)* Name the process by which phytoplankton and plants will decrease the oxygen concentration at night. [1]

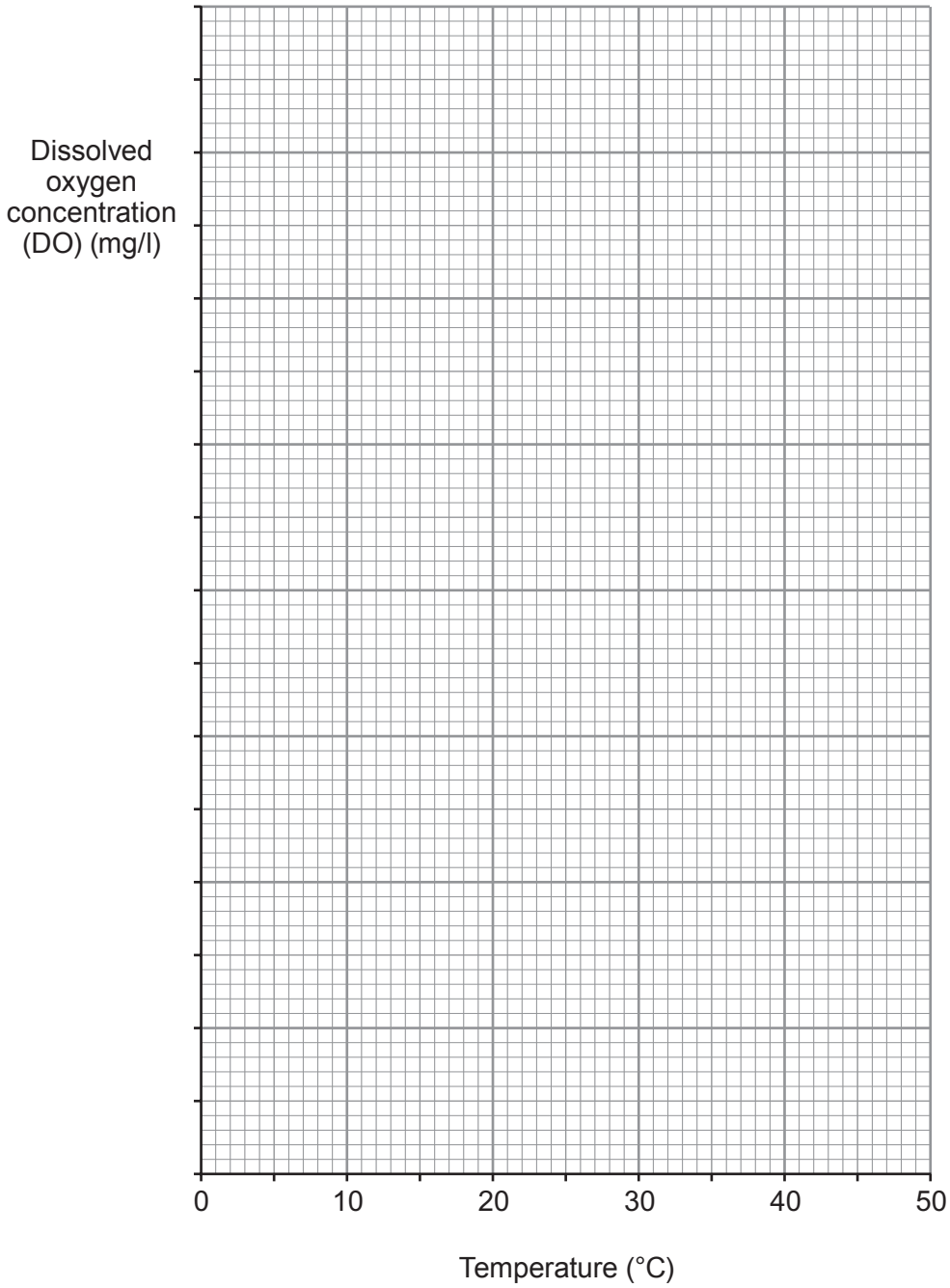
.....

*(c)* (i) Use the information in **Table 1** to complete the table below and then plot a graph to show how the dissolved oxygen concentration varies with temperature. [5]

| Temperature (°C) | Dissolved oxygen concentration (DO) (mg/l) |
|---|---|
| 0 | ..... |
| 6 | ..... |
| 10 | ..... |
| 14 | ..... |
| 20 | ..... |
| 26 | ..... |
| 30 | ..... |
| 40 | ..... |

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(ii) Describe the pattern shown by your graph. [2]

.....

.....

(iii) Continue your graph to estimate the temperature at which oxygen levels become low enough to cause stress to fish. [1]

.....

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*(d)* (i) Use **Graph 2** and your answer to *(c)*(ii) to describe how the dissolved oxygen concentration will vary in the epilimnion between May and November. [3]

.....

.....

.....

.....

(ii) Use the information in **Diagram 1** and **Graph 1** to complete the table below for the year **2006**. [4]

| Month | Dissolved oxygen concentration (DO) (mg/l) | Condition of fish |
|---|---|---|
| May | 9 | OK |
| June | ..... | ..... |
| July | ..... | ..... |
| August | ..... | ..... |
| September | ..... | ..... |

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*(e)* Use the food web in **Diagram 3** to answer the following question.
The dissolved oxygen concentration drops enough to decrease the number of anchovies.
Describe how this will affect the other living things in the food web. [QWC 6]



24

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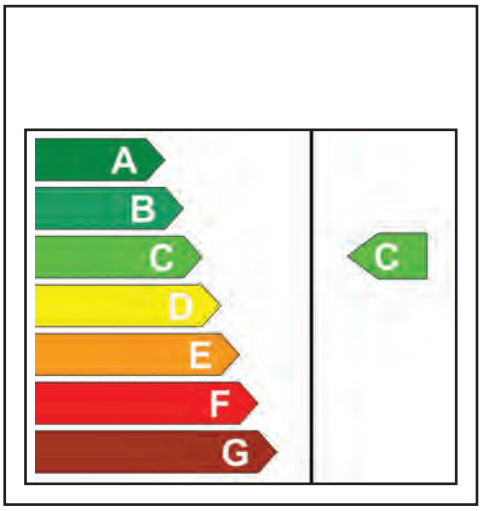
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## SECTION B

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

**2.** Dishwashers are rated by the amount of energy they use. Dishwashers rated **A** use less energy and are cheaper to run than those rated **G**.

Energy Rating
Dishwashers




The following table gives information about dishwashers rated **A**, **B** and **D**.

| Dishwasher energy rating | Voltage (V) | Current (A) | Units of energy used per year (kWh) |
|---|---|---|---|
| **A** | 230 | 4 | 210 |
| **B** | 230 | 6 | 315 |
| **D** | 230 | 8 | 420 |

*(a)* Calculate the power of dishwashers rated **D** using the equation: [2]

power = voltage x current

Power = ..... kW

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*(b)* Estimate the units of energy used per year by a dishwasher rated **C**. .....[1]

*(c)* A homeowner buys a dishwasher rated **D**.

(i) Find the cost of using this dishwasher for a year using the equation: [2]

cost = units used x cost per unit

One unit of electricity costs 20p.

Cost = £ .....

(ii) The homeowner could have bought a dishwasher rated **A** that was £35 more than the one rated **D**. Explain why the dishwasher rated **A** would have been more cost effective. [2]

.....

.....

.....

*(d)* Use the information in the table opposite and your answer to part *(a)*, to calculate the time that the dishwasher rated **D** was used during a year. [3]

Use the equation:

units used = power (kW) x time (h)

Time = ..... h

10

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**3.** *(a)* During the last 100 years, the percentage of land area covered by forest has fallen by 20%. At the same time, there has been a rapid increase in the Earth's human population. There has also been an increase in captive breeding programmes.

(i) Explain why an increase in the population has been accompanied by a decrease in forest coverage. [2]

.....

.....

.....

(ii) Explain the effect on the environment of this reduced forest coverage. [2]

.....

.....

.....

(iii) Explain the importance of captive breeding programmes. [2]

.....

.....

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*(b)* Many people believe that intensive farming methods are needed to feed the growing population. Other people who prefer their food to be produced by organic farming oppose this view. Discuss the reasons for this difference of opinion. [3]

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**4.** The table below shows information about gases in the atmosphere on Venus and on Earth.

| Gas | Venus | Earth |
|---|---|---|
| $CO_2$ | >98 % | 0.03 % |
| $N_2$ | 1 % | 78 % |
| Ar | 1 % | 1 % |
| $O_2$ | 0.0 % | 21 % |
| $H_2O$ | 0.0 % | 0.1 % |

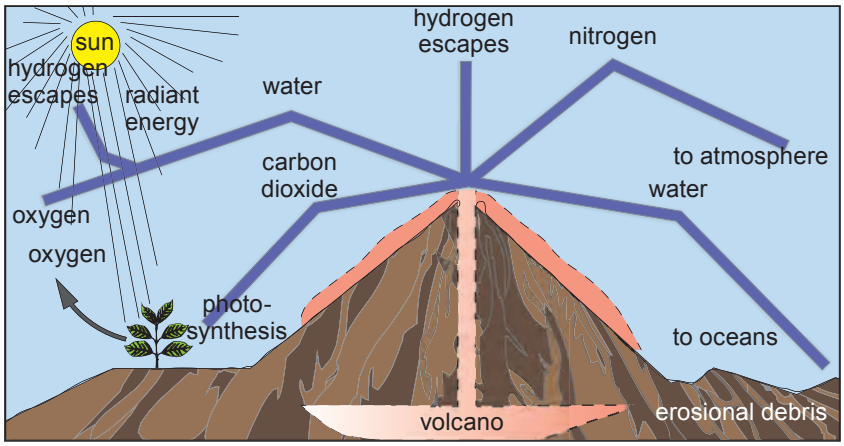
(i) The early atmosphere on earth was very similar to that on Venus today. Describe how the Earth's atmosphere has changed over time. [2]

.....

.....

.....

(ii) Use the information in the diagram to explain why the atmosphere of the Earth changed over millions of years. [3]




.....

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(iii) Explain how the greenhouse effect occurs and why this effect is greater on Venus than on Earth. [3]

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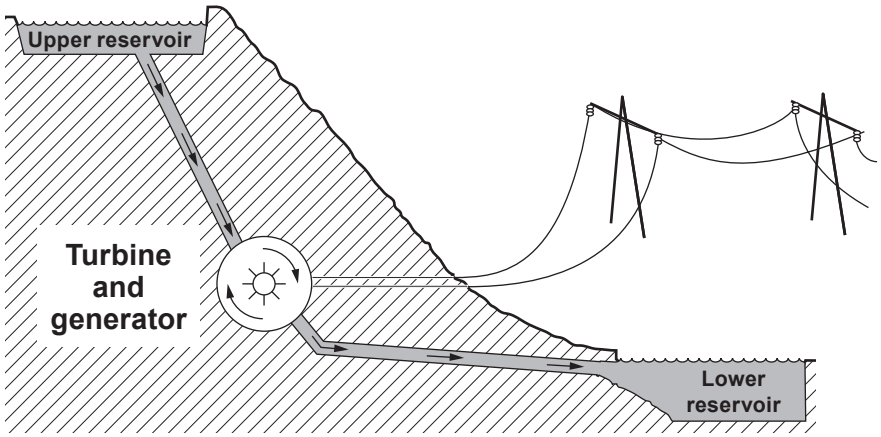


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**5.** The diagram shows how electricity is generated in a hydroelectric power station.




The hydroelectric power station is only used when we need more electricity than the rest of the power stations around the country can supply.

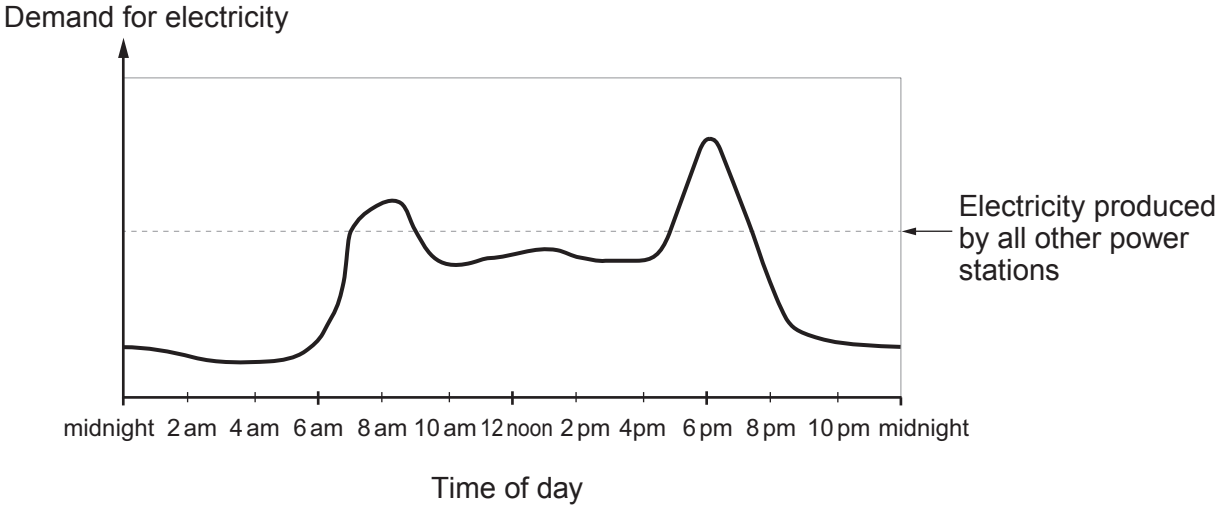
*(a)* (i) State **one** non-environmental advantage of generating electricity in a hydroelectric power station. [1]

.....

(ii) State **one** environmental disadvantage of using hydroelectric power. [1]

.....

*(b)* The need for electricity changes in the way shown below.




(i) Between which times of day is demand for electricity greater than the supply from 'all other power stations'? [2]

.....

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(ii) In the early hours of the morning, the water in the lower lake of this power station is pumped back up to the upper reservoir. By looking at the graph opposite, explain why it is done at this time. [2]

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*(c)* The electricity that is generated is transmitted through the National Grid to users. Explain the need for transformers in the transmission of electrical energy from the power station to users. [QWC 6]

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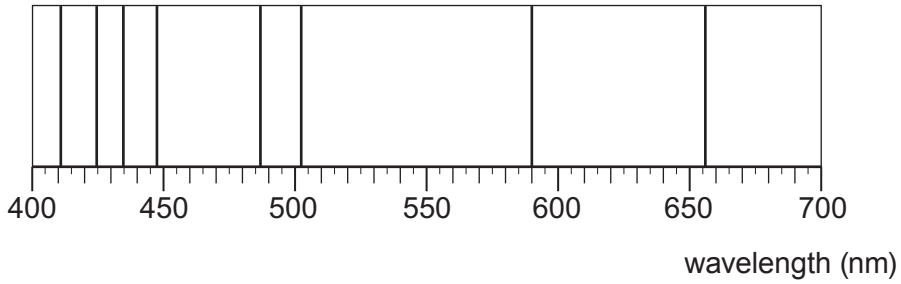
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**6.** *(a)* The spectrum below is from a nearby star. It is crossed by dark lines. We know helium is present in the star because of the presence of dark lines at the wavelengths shown in the table.




| Element | Wavelengths (nm) |
|---|---|
| helium | 447 and 502 |

(i) **Label** the helium lines **X** and **Y** on the diagram above. [1]

(ii) When the spectrum from a more distant star is examined, it is found that these lines are red shifted by 5 nm. At what wavelengths do these dark lines now appear? [1]

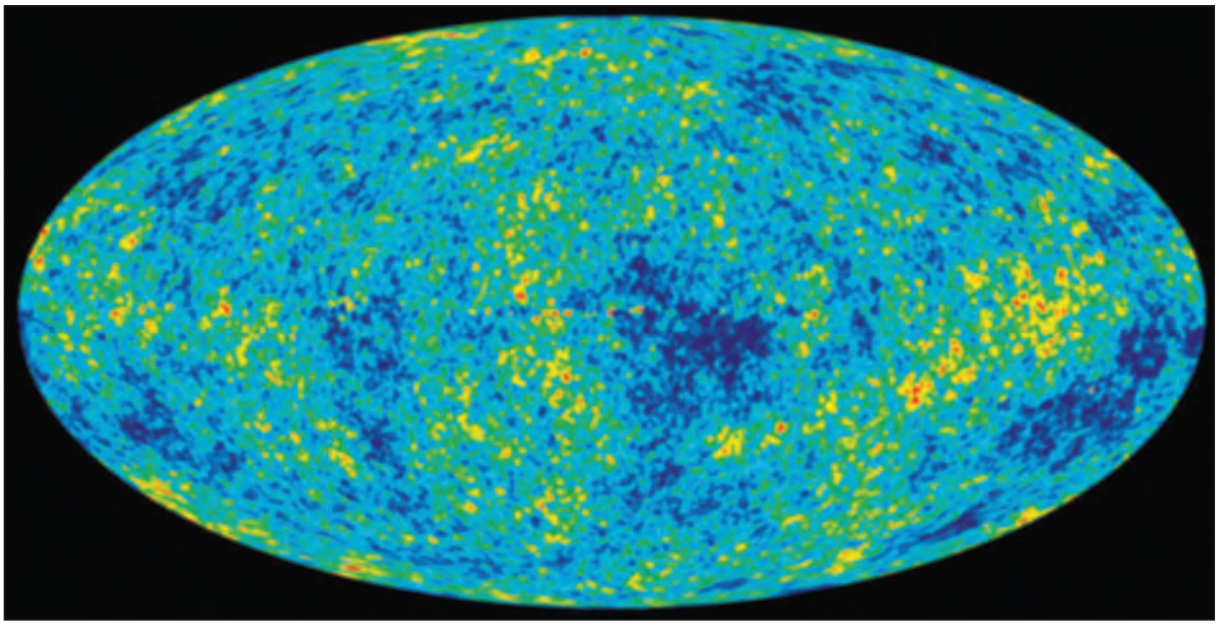
Wavelengths = ..... and ..... nm

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*(b)* In 1965, **cosmic microwave background radiation (CMBR)** was found to be spread all over the universe. This CMBR is the remains of energy produced at the time of the Big Bang.



(i) Explain how the CMBR developed. [2]

.....

.....

.....

(ii) The intensity of CMBR reaches a maximum at a wavelength of 0.1 cm. Calculate the frequency at this maximum, using the equation:

wave speed = frequency x wavelength

The wave speed of electromagnetic waves is $3 \times 10^8$ m/s. [3]

Frequency = ..... Hz

7

**END OF PAPER**

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# GCSE MARKING SCHEME

## SCIENCE B

## JANUARY 2015

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## INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2015 examination in GCSE SCIENCE B. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.


| | Page |
|---|---|
| FOUNDATION TIER | 1 |
| HIGHER TIER | 5 |


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**GCSE SCIENCE B FOUNDATION TIER**

**JANUARY 2015 MARK SCHEME**

## Section A

<table>
<tr><th colspan="3">Question</th><th>Marking point</th><th>Marks</th></tr>
<tr><td>1</td><td>(a)</td><td>(i)</td><td>More land for (any) building [1] more land for food [1]</td><td>2</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td><u>Endangered</u> animals (are bred) [1] in zoos/wildlife parks [1]</td><td>2</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Protect (endangered) animals / prevent extinction of an animal</td><td>1</td></tr>
<tr><td></td><td>(c)</td><td></td><td>[1 x 3]<br><table><tr><th></th><th>Intensive farming</th><th>Organic farming</th></tr><tr><td>Uses pesticides</td><td>✓</td><td></td></tr><tr><td>Produces more food</td><td>✓ (1)</td><td></td></tr><tr><td>Produces cheaper food</td><td>✓ (1)</td><td></td></tr><tr><td>Does not use caged animals</td><td></td><td>✓ (1)</td></tr></table></td><td>3</td></tr>
<tr><td>2</td><td>(a)</td><td>(i)</td><td>Explosion</td><td>1</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Expand</td><td>1</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>Red</td><td>1</td></tr>
<tr><td></td><td></td><td>(iv)</td><td>Microwave</td><td>1</td></tr>
<tr><td></td><td></td><td>(v)</td><td>Million</td><td>1</td></tr>
<tr><td></td><td>(b)</td><td></td><td>Distance light travels in a year</td><td>1</td></tr>
<tr><td>3</td><td>(a)</td><td>(i)</td><td>Any three of (to max 3 marks):<br>The (% of) carbon dioxide has decreased [1]<br>Sulfur dioxide decreased/No Sulfur dioxide [1]<br>Nitrogen has increased [1]<br>Oxygen has appeared / increased [1]</td><td>3</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Volcanic eruptions released nitrogen [1] and water into the atmosphere [1]</td><td>2</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>Venus [1] Most/more carbon dioxide [1]</td><td>2</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>More extreme weather / hotter [1]<br>Melting ice caps / rising sea levels / flooding [1]</td><td>2</td></tr>
</table>

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| Question | | | Marking point | Marks |
|---|---|---|---|---|
| **4** | (a) | (i) | All correct [2] one correct [1]<br><br>U-V \| Visible \| I-R | **2** |
| | | (ii) | <u>increases</u><br><u>decreases</u><br><u>decreases</u> | **3** |
| | (b) | | Visible<br><br>Brighter / darker<br><br>I-R | **3** |
| **5** | (a) | | 230 x 8 = 1 840 (W) [1] 1.84 KW [1] | **2** |
| | (b) | | 350 circled [1] | **1** |
| | (c) | (i) | 420 x 20 = 8 400 [1] £84 [1] | **2** |
| | | (ii) | <u>half as much</u> | **1** |
| | | (iii) | Saves more on running costs in a year / saves more than £35 [1] | **1** |
| | (d) | | 420 / 1.84 (ecf) [1] answer = 228.26 / 228.3 hours [1] | **2** |
| **6** | (a) | (i) | No water to heat up | **1** |
| | | (ii) | Flooding of land destroys habitats | **1** |
| | (b) | (i) | 5 p.m. - 7.30 p.m. (+/- 15 mins) | **2** |
| | | (ii) | Between midnight and 6.00 a.m. | **1** |
| | | (iii) | Low demand / ‘spare’ electricity is used | **1** |

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## Section B

<table>
<tr><th colspan="3">Question</th><th>Marking point</th><th>Marks</th></tr>
<tr><td>7</td><td>(a)</td><td>(i)</td><td>That is the time <u>photosynthesis</u> occurs [1]</td><td>1</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Light penetrates this layer / does not penetrate lower. [1]</td><td>1</td></tr>
<tr><td></td><td>(b)</td><td></td><td>Respiration [1]</td><td>1</td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td>
<table>
<tr><th>Temperature ($^0$C)</th><th>Dissolved oxygen (DO) (mg/l)</th></tr>
<tr><td>0</td><td>14.60</td></tr>
<tr><td>6</td><td>12.43</td></tr>
<tr><td>10</td><td>11.27</td></tr>
<tr><td>14</td><td>10.29</td></tr>
<tr><td>20</td><td>9.07</td></tr>
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<tr><td>30</td><td>7.54</td></tr>
<tr><td>40</td><td>6.41</td></tr>
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Table [1]<br>DO scale which covers at least half the axis [1]<br>Points [2]<br>Smooth curve [1]</td><td>5</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>As temperature increases the dissolved oxygen decreases / negative correlation [1] non uniformly [1]</td><td>2</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>Between 44-45˚C (from candidates graph)</td><td>1</td></tr>
<tr><td></td><td>(d)</td><td>(i)</td><td>Temperature increases (May-Aug) <u>and</u> then decreases (to Nov) [1] (May to August) DO decreases <u>and</u> then increases (to November) [1] reference to months [1]</td><td>3</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Each line [1] x 4
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<tr><th>Month</th><th>Dissolved oxygen levels (mg/l)</th><th>Condition of fish</th></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>June</td><td>8</td><td>OK</td></tr>
<tr><td>July</td><td>5</td><td>Stressed</td></tr>
<tr><td>August</td><td>3</td><td>Choking</td></tr>
<tr><td>September</td><td>5</td><td>Stressed</td></tr>
</table></td><td>4</td></tr>
</table>

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| Question | | | Marking point | Marks |
|---|---|---|---|---|
| | (e) | | Indicative content<br>• Food supply / prey of the anchovies will increase i.e. zooplankton and phytoplankton.<br>• Less competition for these food sources will result in an increase in invertebrates and bivalves.<br>• Animals that feed on anchovies will decrease in number e.g. gulls, waders and bass.<br>• Since they have no other food source they may die.<br>• Ospreys will decrease / die.<br>• Bald eagles will feed more on Sea Ducks so their numbers will decrease meaning less competition for swans so their number will increase<br><br>**Marking bands**<br><br>**5-6 marks.**<br>The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>**3-4 marks**<br>The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br><br>**1-2 marks**<br>The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br><br>**0 marks**<br>The candidate does not make any attempt or give a relevant answer worthy of credit. | 6 |

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**GCSE SCIENCE B HIGHER TIER**

**JANUARY 2015 MARK SCHEME**

## Section A

<table>
<tr><th colspan="3">Question</th><th>Marking point</th><th>Marks</th></tr>
<tr><td>1</td><td>(a)</td><td>(i)</td><td>That is the time <u>photosynthesis</u> occurs [1]</td><td>1</td></tr>
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<tr><td></td><td></td><td>(iii)</td><td>Between 44-45˚C (from candidate graph)</td><td>1</td></tr>
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</table></td><td>4</td></tr>
</table>

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| Question | Marking point | Marks |
|---|---|---|
| (e) | **Indicative content**<br>• Food supply / prey of the anchovies will increase i.e. zooplankton and phytoplankton.<br>• Less competition for these food sources will result in an increase in invertebrates and bivalves.<br>• Animals that feed on anchovies will decrease in number e.g. gulls, waders and bass.<br>• Since they have no other food source they may die.<br>• Ospreys will decrease / die.<br>• Bald eagles will feed more on Sea Ducks so their numbers will decrease meaning less competition for swans so their number will increase<br><br>**Marking bands:**<br><br>**5-6 marks.**<br>The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>**3-4 marks**<br>The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br><br>**1-2 marks**<br>The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited terminology and inaccuracies in spelling, punctuation and grammar.<br><br>**0 marks**<br>The candidate does not make any attempt or give a relevant answer worthy of credit. | 6 |

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## Section B

| Question | | | Marking point | Marks |
|---|---|---|---|---|
| **2** | (a) | | 230 x 8 = 1840 (W) [1] 1.84 kW [1] | **2** |
| | (b) | | Any value between 316 and 419 | **1** |
| | (c) | (i) | 420 x 20 = 8 400 [1] £84 [1] | **2** |
| | | (ii) | **A** uses half the units of **D** [1] so would only cost £42 to run saving more than the extra cost (in a year) [1]<br>*The points must be correctly and coherently connected to be awarded two marks* | **2** |
| | (d) | | 420 = 1.84 (ecf) x time [1] manipulation [1] answer = 228.26 / 228.3 hours [1] | **3** |
| **3** | (a) | (i) | An increase in population needs more land for housing / more land for food [1] so forest are cleared for land / for farming [1]<br>*The points must be correctly and coherently connected to be awarded two marks* | **2** |
| | | (ii) | Habitats destroyed [1] so less biodiversity [1]<br><br>Also accept less photosynthesis [1] so adds to greenhouse effect / more $CO_2$[1]<br>*The points must be correctly and coherently connected to be awarded two marks* | **2** |
| | | (iii) | Endangered animals are bred [1] so prevents extinction [1]<br>*The points must be correctly and coherently connected to be awarded two marks* | **2** |
| | (b) | | For intensive farming: higher yield / cheaper [2 max]<br>Against: uses artificial chemicals / animal welfare / quality of product [2 max] Question total [3 max] | **3** |
| **4** | | (i) | The % of carbon dioxide has decreased [1] nitrogen <u>and</u> oxygen has increased [1] | **2** |
| | | (ii) | Volcanic eruptions released (nitrogen and) water into the atmosphere [1] which split into hydrogen and oxygen [1] green plants developed and used water and carbon dioxide in photosynthesis [1] so producing oxygen [1]<br>[Question total 3 max]<br><br>*The points must be correctly and coherently connected to be awarded the marks.* | **3** |
| | | (iii) | More carbon dioxide on Venus [1] gases in the atmosphere absorb (infra-red) radiation emitted from planet surface [1] **which is then** re-emitted back to the planet [1]<br>*The points must be correctly and coherently connected to be awarded two marks.* | **3** |

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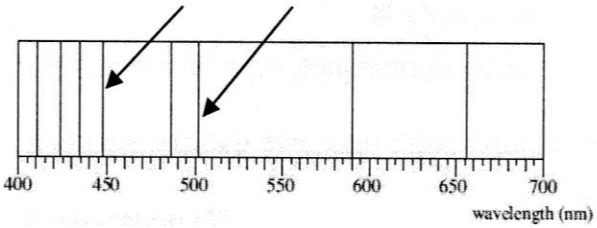
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| Question | | | Marking point | Marks |
|---|---|---|---|---|
| **5** | (a) | (i) | No delay in start up | **1** |
| | | (ii) | Flooding of land destroys habitats | **1** |
| | (b) | (i) | 7.30a.m. and 9a.m. 5p.m. - 7.30p.m. ± 15 mins | **2** |
| | | (ii) | Low demand [1] so 'spare' electricity is used [1] | **2** |
| | (c) | | **Indicative content**<br>• Electricity from power station is increased to a higher voltage<br>• Using a step-up transformer<br>• This reduces the current so there is less heating of the cables<br>• Resulting in a lower energy loss<br>• A step down transformer reduces the voltages for users to a safe level.<br><br>**Marking bands:**<br><br>**5-6 marks**<br>The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>**3-4 marks**<br>The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br><br>**1-2 marks**<br>The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br><br>**0 marks**<br>The candidate does not make any attempt or give a relevant answer worthy of credit. | **6** |

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| Question | | | Marking point | Marks |
|---|---|---|---|---|
| **6** | (a) | (i) | Both must be correct for 1 mark<br><br> | **1** |
| | | (ii) | Both must be correct for 1 mark 452 & 507 (nm) | **1** |
| | (b) | (i) | (High energy) gamma rays [1] stretched as Universe expanded [1] | **2** |
| | | (ii) | Conversion 0.1cm to 0.001m [1] subs/manipulate [1]<br>answer = $3 \times 10^{11}$ Hz [1] | **3** |



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| 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** | |

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020001

### 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)*.

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## 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]

House ..... House ..... House .....

Loses least energy ⟶ Loses most energy

(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]

.....

.....

.....

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

.....

.....

(ii) A house has a window area of 24 $m^2$. 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



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**Turn over.**

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*(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]

.....

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

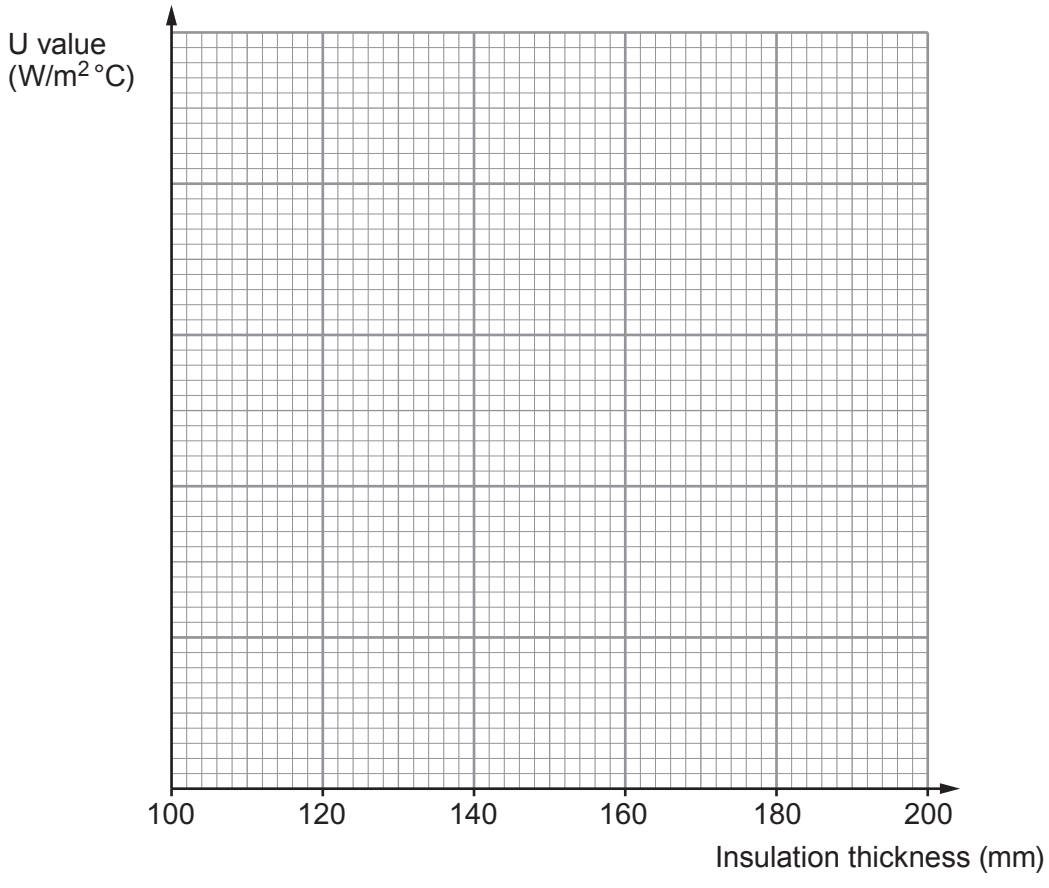
.....

(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]




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(ii) Use your graph to find the thickness of insulator **B** that needs to be used to achieve a U value of 0.16 ($W/m^2\,°C$). [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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24



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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]

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

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

10

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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 | ..... | ..... |

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6

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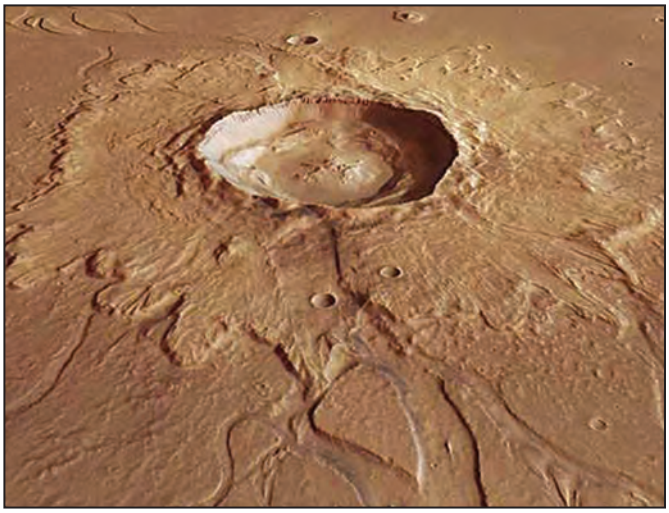


**Turn over.**

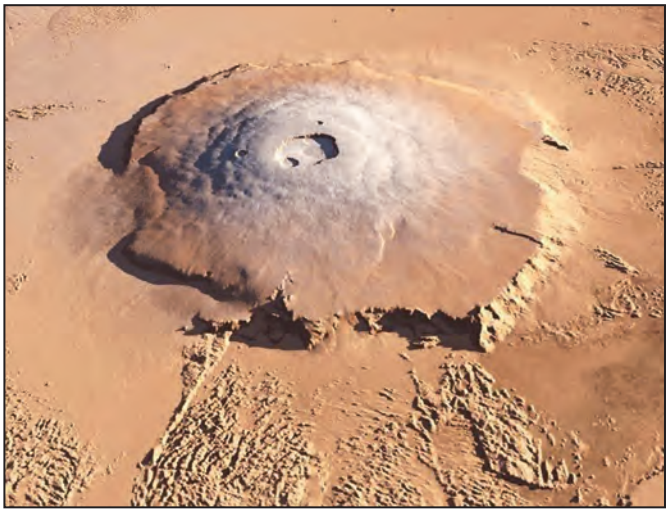
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**4.** The photographs below show different features on Mars.

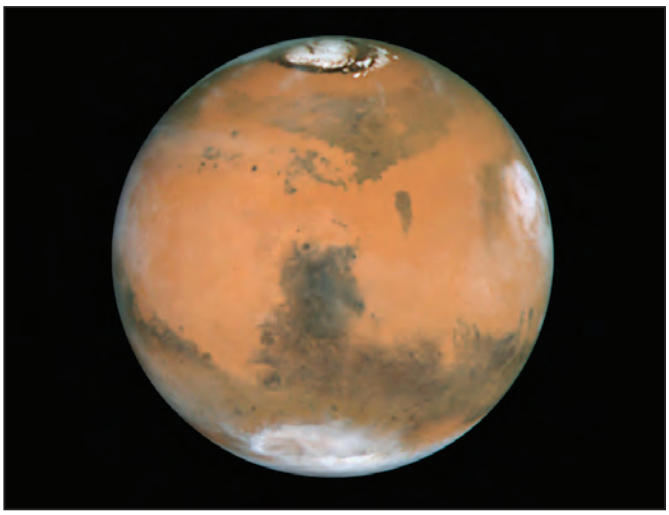
**Photograph 1**



**Photograph 2**



**Photograph 3**



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

.....

.....

.....

.....

(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]

.....

.....

.....

.....

(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]

.....

.....

.....

.....

9

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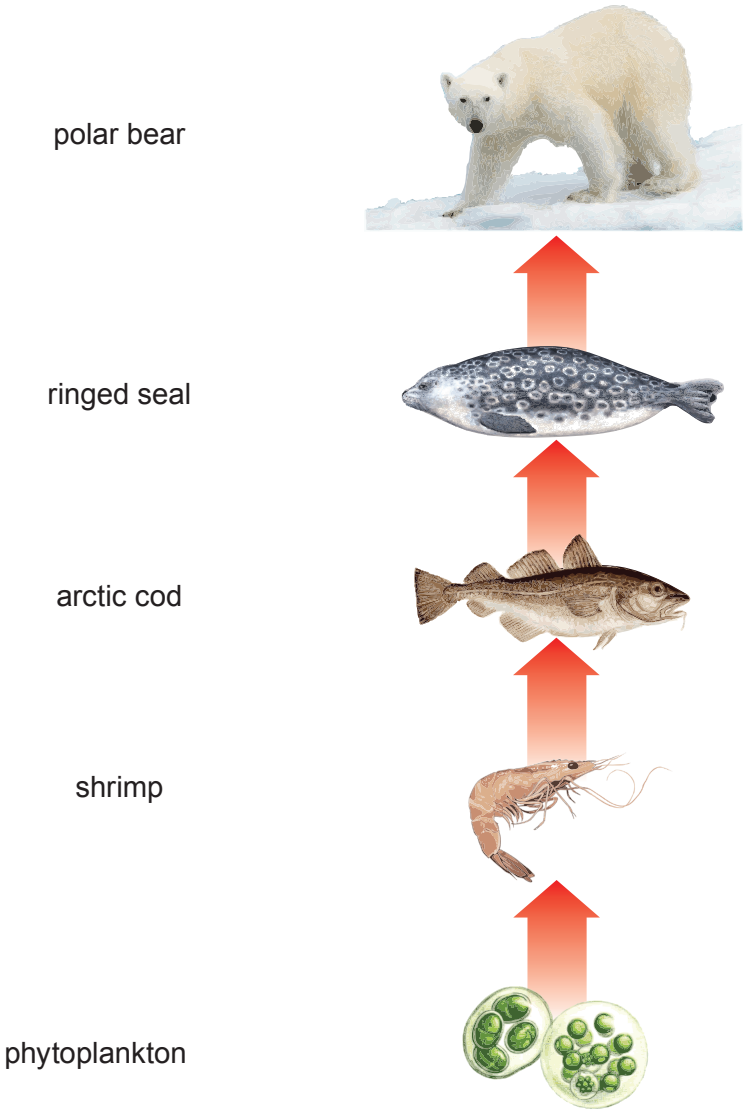


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**Turn over.**

Examiner only

**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]

.....

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

.....

.....

.....

.....

4

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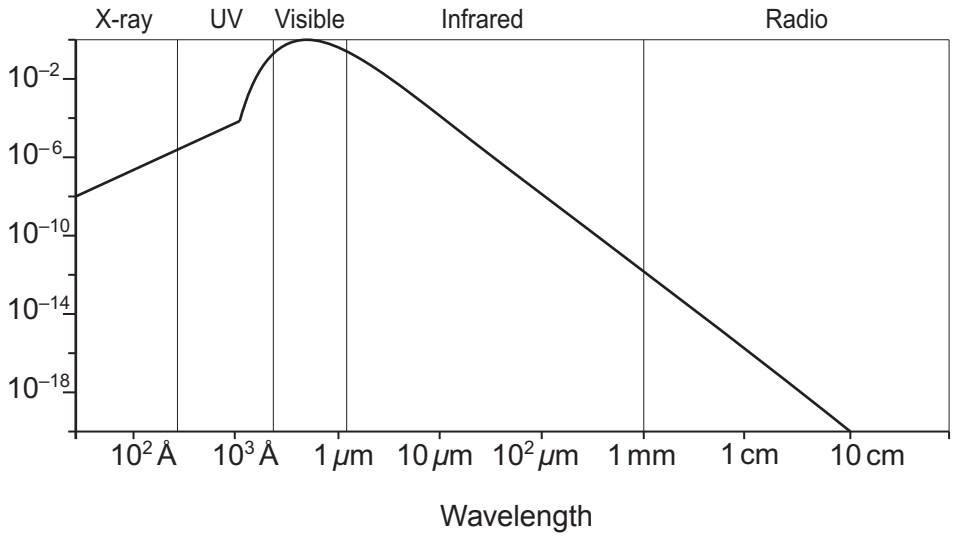
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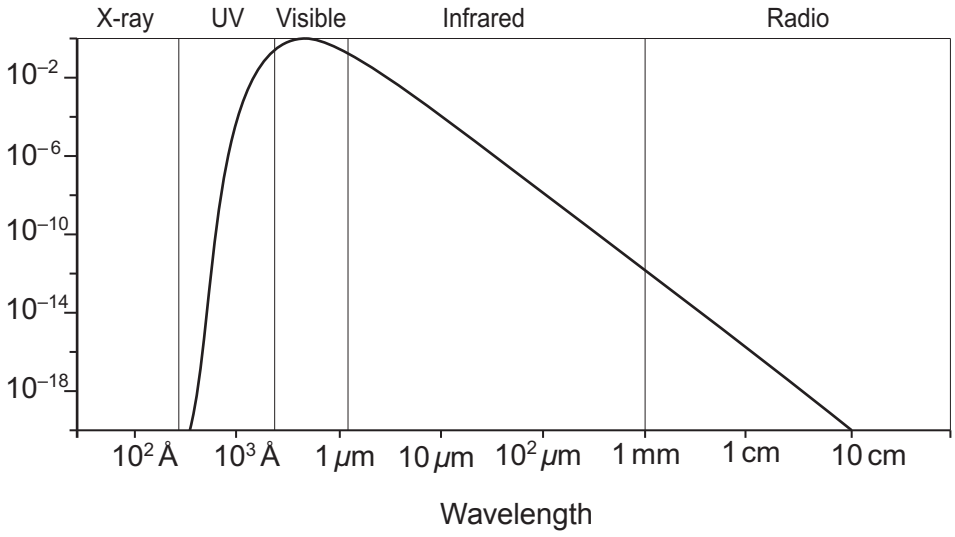
**6.** (i) Graph **1** shows the energy emission of the Sun at different wavelengths. Graph **2** shows the theoretical energy emissions that were expected at the same wavelengths.

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]

wave speed = frequency × wavelength

*Speed of light* = $3 \times 10^8$ *m/s*

Frequency = ..... Hz

6

## Turn over for Question 7

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**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]

.....

.....

.....

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

.....

.....

.....

*(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

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

.....

.....

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

.....

.....

.....

11

**END OF PAPER**

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# GCSE MARKING SCHEME

## SCIENCE B

## SUMMER 2014

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## INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2014 examination in GCSE SCIENCE B. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.


| | Page |
|---|---|
| Unit 1 - Foundation Tier | 1 |
| Unit 1 - Higher Tier | 5 |
| Unit 2 - Foundation Tier | 10 |
| Unit 2 - Higher Tier | 13 |


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**GCSE SCIENCE B**

**UNIT 1 FOUNDATION TIER (4781/01)**

**SUMMER 2014 MARK SCHEME**

<table>
<tr><th colspan="3">Question</th><th>Marking detail</th><th>Mark</th></tr>
<tr><td>1</td><td>(a)</td><td>(i)</td><td>Natural selection</td><td>1</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Genes</td><td>1</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>Well suited to the environment</td><td>1</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>The variety / range (of life) (1) in the world / habitat / ecosystem (1)</td><td>2</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>Richer in tropics / rainforest / equator (1) because of greater resources / more favourable living conditions (1) (accept converse). The second point can be awarded for coherently and correctly linking the conclusion.</td><td>2</td></tr>
<tr><td>2</td><td colspan="2"></td><td>1 mark for each correct answer<br>Correct words (bold text) to complete statement are shown in the table below.<br><table><tr><th>Intensive farming method</th><th>Reason for use</th><th>Disadvantage</th></tr><tr><td>Herbicide spray</td><td>plants</td><td>biodiversity</td></tr><tr><td>Fertiliser spray</td><td>nutrients</td><td>rivers</td></tr><tr><td>‘Battery’ farming</td><td>output</td><td>indoors</td></tr></table></td><td>6</td></tr>
<tr><td>3</td><td>(a)</td><td></td><td>Sunlight</td><td>1</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>The shrimps (intake mercury) as they feed / eat algae.</td><td>1</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>As bigger animals eat smaller animals/polar bears eat a <u>lot</u> (1) bioaccumulation / the concentration level of mercury increases / to toxic levels. (1) The second point can be awarded for coherently and correctly linking the conclusion.</td><td>2</td></tr>
<tr><td>4</td><td colspan="2">(i)</td><td>Gamma rays<br>Microwaves</td><td>2<br>1</td></tr>
<tr><td></td><td colspan="2">(ii)</td><td>From visible to radio waves graphs are identical / maximum wavelength of radio waves the same / at longer UV wavelength, the graphs are similar / they both go down to 10 cm / both have a maximum in the visible region.</td><td>1</td></tr>
<tr><td></td><td colspan="2">(iii)</td><td>No X-rays in the theoretical graph / ‘kink’ (in UV region) / starts at a longer wavelength (1)</td><td></td></tr>
<tr><td></td><td colspan="2">(iv)</td><td>Longest wavelength = 10 cm</td><td>1</td></tr>
<tr><td></td><td colspan="2">(v)</td><td>Subs (1) answer = 3 000 000 000Hz (1)</td><td>2</td></tr>
</table>

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| Question | | | Marking detail | Mark |
|---|---|---|---|---|
| **5** | (a) | | Labels down: crater – volcano – ice cap<br>*All correct* (2); 1 *correct* (1) | 2 |
| | (b) | (i) | Lava / molten rock / magma | 1 |
| | | (ii) | Must be a molten core / hot / liquid core | 1 |
| | | (iii) | Volcano formed at their <u>boundaries</u> / where they meet / moving over each other | 1 |
| | (c) | (i) | Craters caused by meteors / asteroids | 1 |
| | | (ii) | More meteors got through atmosphere / don't burn up | 1 |
| | (d) | (i) | Temperatures must be low | 1 |
| | | (ii) | Global warming (1) because carbon dioxide is a greenhouse gas / carbon dioxide traps heat (1)<br>*The second point can be awarded for coherently and correctly linking the conclusion.* | 2 |
| **6** | (a) | | Because new trees are planted / more trees are grown (1) to replace those cut down (1)<br>*The second point can be awarded for coherently and correctly* | 2 |
| | (b) | (i) | Carbon dioxide / $CO_2$ | 1 |
| | | (ii) | Carbon dioxide / $CO_2$ | 1 |
| | | (iii) | Carbon emissions caused by burning are balanced by carbon intake by photosynthesis | 1 |
| | (c) | (i) | 400 MW | 1 |
| | | (ii) | subs 400/500 [1] (allow ecf from bi) ans = 80% | 2 |
| **7** | | | 1 mark for each correct answer (bold text)<br><br>Action / Is it reduce, reuse or recycle?<br>*Place glass bottles in bottle bank* – *recycle*<br>Make compost from left over fruit and vegetable peelings – recycle<br>Buy food with less packaging – reduce<br>Buy 'bags for life' – re-use<br>Don't buy more than you need – reduce | 4 |

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| Question | Marking detail | Mark |
|---|---|---|
| **8** (a) (i) | C-B-A<br>All correct 2; 1 correct 1 | 2 |
| (ii) | Indicative content:<br>• The loft saves 1200 J/s and double-glazing saves 800 J/s.<br>• The cavity wall insulation saves 1000 J/s<br>• The loft insulation is also the cheapest to install.<br>• Therefore installing loft insulation would save the householder most money and the payback time would be shortest.<br>• However, double-glazing saves least energy and costs significantly more than other methods so the payback time would be the longest.<br>**5-6 marks**<br>The candidate constructs an articulate, integrated account correctly linking relevant points such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br>**3-4 marks**<br>The candidate constructs an account correctly linking some relevant points such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br>**1-2 marks**<br>The candidate makes some relevant points such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br>**0 marks**<br>The candidate does not make any attempt or give a relevant answer worthy of credit. | 6 |

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| Question | | | Marking detail | Mark |
|---|---|---|---|---|
| (b) | (i) | I. | The larger the air gaps the lower the (rate of) energy loss. | 1 |
| | | II. | (After 20mm), not much increase in saving | 1 |
| | (ii) | | Reading from graph of 50 ($W/m^2$) (1) 50 x 24 (1) = 1 200 W (correct answer only - 1 200 W (2)) | 2 |
| (c) | (i) | I. | Foam insulation | 1 |
| | | II. | Largest R value | 1 |
| | (ii) | | Total R value = 6 | 1 |
| (d) | (i) | | Scale (at least half y axis) (1) plots (2) suitable best fit line (1) | 4 |
| | (ii) | | Value from their graph (e.g. 148 +/-2) (1) | 1 |
| (e) | | | Convert 2000 W to 2 KW (1) units used = 2 x 24 = 48 (1) cost = 48 (allow ecf) x 14 = 672 (1) matching unit (1) (either 672p or £6.72). (NOT £6.72p) | 4 |

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**GCSE SCIENCE B**

**UNIT 1 - HIGHER TIER (4781/02)**

**SUMMER 2014 MARK SCHEME**

| Question | Marking detail | Mark |
|---|---|---|
| **1** (a) (i) | C-B-A<br>All correct 2; correct 1 | 2 |
| (ii) | Indicative content:<br>• The loft insulation saves 1200 J/s and double-glazing saves 800 J/s.<br>• The cavity wall insulation saves 1000 J/s.<br>• The loft insulation is also the cheapest to install.<br>• Therefore installing loft installation would save the householder most money and the payback time would be shortest.<br>• However, double-glazing saves least energy and costs significantly more than the other methods so the payback time would be the longest.<br><br>**5-6 marks**<br>The candidates constructs an article, integrated account correctly linking relevant points such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>**3-4 marks**<br>The candidate constructs an account correctly linking some relevant points such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br><br>**1-2 marks**<br>The candidate makes some relevant points such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br><br>**0 marks**<br>The candidate does not make any attempt or give a relevant answer worthy of credit. | 6 |

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| Question | | | Marking detail | Mark |
|---|---|---|---|---|
| (b) | (i) | III. | The larger the air gaps the lower the (rate of) energy loss. | 1 |
| | | IV. | (After 20mm), not much increase in saving | 1 |
| | (ii) | | Reading from graph of 50 ($W/m^2$) (1) 50 x 24 (1) = 1 200 W (correct answer only - 1 200 W (2)) | 2 |
| (c) | (i) | III. | Foam insulation | 1 |
| | | IV. | Largest R value | 1 |
| | (ii) | | Total R value = 6 | 1 |
| (d) | (i) | | Scale (at least half y axis) (1) plots (2) suitable best fit line (1) | 4 |
| | (ii) | | Value from their graph (e.g. 148 +/-2) (1) | 1 |
| (e) | | | Convert 2000 W to 2 KW (1) units used = 2 x 24 = 48 (1) cost = 48 (allow ecf) x 14 = 672 (1) matching unit (1) (either 672p or £6.72). (NOT £6.72p) | 4 |

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| Question | Marking detail | Mark |
|---|---|---|
| **2** (a) | Indicative content:<br>• Organisms that are best adapted to their environment are those that are most likely to survive.<br>• The better-adapted organisms will reproduce at a greater rate than the less well-adapted organisms.<br>• Organisms with the most favourable genetic adaptions out-compete other organisms in a population.<br>• Natural selection is dependent on the existence of mutations in the genes.<br>• Natural selection taking place over the course of many generations can change the characteristics of the original population of organisms.<br><br>**5-6 marks**<br>The candidate constructs an articulate, integrated account correctly linking relevant points such as those in the indicative content, which allows shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>**3-4 marks**<br>The candidate constructs an account correctly linking some relevant points such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br><br>**1-2 marks**<br>The candidate makes some relevant points such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br><br>**0 marks**<br>The candidate does not make any attempt or give a relevant answer worthy of credit. | 6 |
| (b) (i) | The variety / range of life (1) in the world / habitat / ecosystem / area (1) | 2 |
| (ii) | Richer in tropics / rain forest / equator (1) because of greater resources / more favourable living conditions (1) (accept converse).<br><br>*The second point can be awarded for coherently and correctly linking the conclusion.* | 2 |

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<table>
<tr><th colspan="2">Question</th><th>Marking detail</th><th>Mark</th></tr>
<tr><td>3</td><td></td><td>6 x 1 marks<br><br><table><tr><th>Intensive farming method</th><th>Action</th><th>Disadvantages</th></tr><tr><td>Fertiliser spray</td><td>Add nutrients to the soil</td><td>Eutrophication / causes dense plant growth in rivers</td></tr><tr><td>Pesticide spray</td><td>Remove animals that feed on the crop</td><td>Reduces biodiversity/poison helpful organisms.</td></tr><tr><td>‘Battery’ farming</td><td>Increased product</td><td>Lower quality product/ethical concerns / keep animals indoors</td></tr></table></td><td>6</td></tr>
<tr><td>4</td><td>(i)</td><td>Craters caused by meteors (1) large numbers of craters / meteors got through atmosphere / lack of erosion (1) so atmosphere must be ‘thin’ (1)<br>The third mark can be awarded for coherently and correctly linking to three points.</td><td>3</td></tr>
<tr><td></td><td>(ii)</td><td>Must be a molten core (1) (possible) tectonic plates (1) for volcano to be formed at their boundaries (1)<br>Accept similar structure to earth for 1 mark.</td><td>3</td></tr>
<tr><td></td><td>(iii)</td><td>Temperatures must be low (1) so no ‘global’ warming (1) so lack of greenhouse gases / low concentrations (1)<br>The third mark can be awarded for coherently and correctly linking the three points.</td><td>3</td></tr>
<tr><td>5</td><td>(i)</td><td>Mining / Industry (Not: from ships)</td><td>1</td></tr>
<tr><td></td><td>(ii)</td><td>The shrimps take in mercury as they feed. (1) Concentration is low (1) As bigger animals eat many smaller animals / bioaccumulation / the concentration level of mercury increases to toxic levels. (1) The third point can be awarded for coherently and correctly linking the conclusion.</td><td>3</td></tr>
</table>

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| Question | | | Marking detail | Mark |
|---|---|---|---|---|
| **6** | (i) | | Any **three** from:<br>• from visible to radio waves graphs are identical<br>• maximum wavelength of radio waves the same<br>• at longest U-V wavelength the graphs are similar<br>• no X-rays in the theoretical graph<br>• they both go down to 10 cm<br>• both have a maximum in the visible region. | 3 |
| | (ii) | | Longest wavelength = 10 cm converted to 0.1m (1) subs / manipulate (1)<br>Answer = $3 \times 10^9$ / 3 000 000 000) Hz (1) Allow ecf for incorrect wavelength | 3 |
| **7** | (a) | (i) | They will never run out (1) because new trees are planted to replace those cut down (1)<br>*The second point can be awarded for coherently and correctly linking the conclusion.* | 2 |
| | | (ii) | Carbon emissions caused by <u>burning</u> [1] are balanced by carbon intake by <u>photosynthesis</u> [1]<br>($CO_2$ given out = same as taken in (1) only)<br>*The second point can be awarded for coherently and correctly linking the conclusion*. | 2 |
| | (b) | (i) | 500 x 0.8 answer = 400 MW<br>Substitution (1) manipulation (1) answer (1) | 3 |
| | | (ii) | 180 MW [1] (allow ecf from bi, their answer - 220) | 1 |
| | | (iii) | If water is piped over large distances it will cool too much | 1 |
| | (c) | | Demand fluctuates / if demand increases / if a power station breaks down [1] other power stations can be brought on line to avoid power cuts [1]<br>*The second point can be awarded for coherently and correctly linking the conclusion.* | 2 |

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| Surname | Centre Number | Candidate Number |
|---|---|---|
| Other Names | | 0 |

# GCSE

4781/02

# SCIENCE B

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

P.M. THURSDAY, 16 January 2014

1 hour 15 minutes

| | For Examiner's use only | | |
|---|---|---|---|
| | **Question** | **Maximum Mark** | **Mark Awarded** |
| **Section A** | **1.** | **18** | |
| | **2.** | **6** | |
| **Section B** | **3.** | **9** | |
| | **4.** | **12** | |
| | **5.** | **9** | |
| | **6.** | **8** | |
| | **7.** | **8** | |
| | **Total** | **70** | |

### ADDITIONAL MATERIALS

In addition to this paper you may require a calculator, a pencil 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 questions **2** and **4***(c)*.

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## SECTION A

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

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

**1.** Use the information in **Table 1** to answer the questions that follow.

*(a)* (i) Which planet is closest in size to Earth? ..... [1]

(ii) Which planet has a day length longer than its year? ..... [1]

(iii) Name the only planet that does not have an atmosphere. ..... [1]

*(b)* Suggest a relationship between the number of moons around a planet and **one** *other* factor in **Table 1**. [2]

.....

.....

*(c)* (i) Describe how the temperature on a planet depends on the distance from the Sun. [1]

.....

(ii) Explain why Venus does not follow this trend. [2]

.....

.....

.....

*(d)* Ceres is a dwarf planet found in the asteroid belt.

(i) **Estimate** its temperature. ..... °C [1]

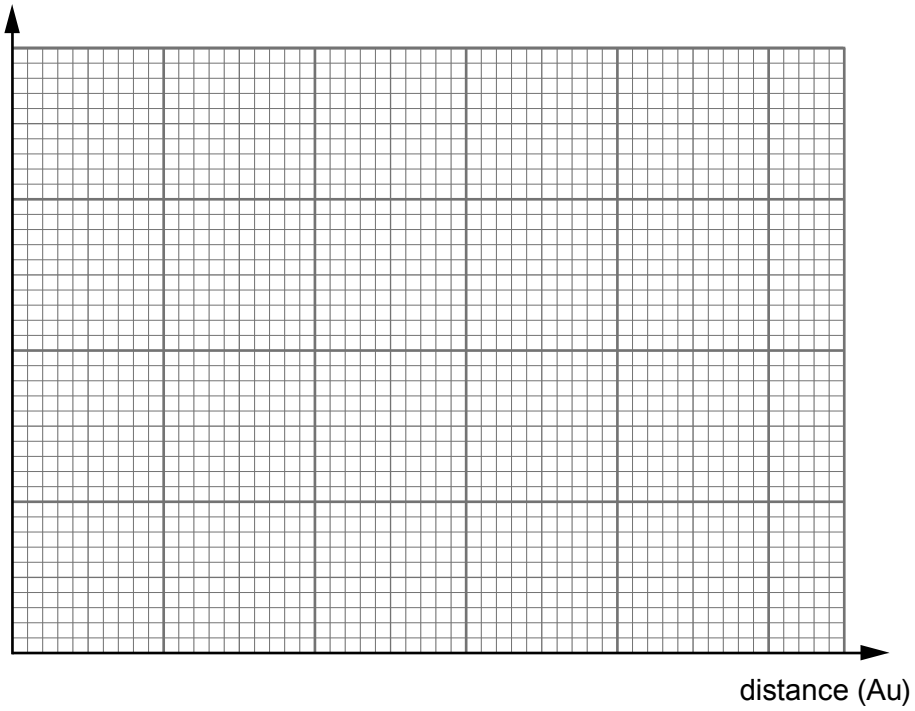
(ii) **Estimate** its orbital time around the Sun. ..... Earth years [1]

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*(e)* (i) Plot a graph to show how the time it takes a planet to orbit the Sun depends on distance from the Sun.
**Only** include the planets **Earth**, **Mars**, **Jupiter** and **Saturn** in your graph. [4]




(ii) It was once thought that the time of orbit would be proportional to distance from the Sun.

Does your graph agree with this statement? ..... [1]

Give **one** reason for your answer.

.....



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**Turn over.**

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*(f)* Answer the following question using **only** information from the Resource Folder.

(i) Give **one** reason why an Earth-based telescope would not be able to see the surface of Venus. [1]

.....

.....

(ii) Give **one** reason why an Earth-based telescope may not be able to see the rings around Uranus. [1]

.....

.....

*(g)* **Draw** a diagram to show the path of a comet as it orbits the Sun. [1]

● **Sun**

18

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**2.** Use only the information in the Resource Folder to compare the four inner planets with the four outer planets of the Solar System. (6 QWC)

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6

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**Turn over.**

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## SECTION B

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

**3.** The koala bear is not really a bear.

Bears have heavy bodies with extremely powerful limbs. Each limb has five strong, sharp claws used for tearing and digging. Most bears are partly carnivorous. They have a long snout.

Koalas are *diprotodont* meaning "two front teeth". They are herbivores. They have a condition called "fused fingers". In diprotodonts, the second and third digits of the feet are completely fused together, except for the claws.





*(a)* Which features of an animal would scientists use to decide whether to classify it as Diprotodontia? [2]

.....

.....

.....

*(b)* The scientific classifications of koalas and other animals are shown in the table below.

| Level of classification | Polar bear | Grizzly bear | Koala bear | Wombat | Kangaroo |
|---|---|---|---|---|---|
| Kingdom | Animalia | Animalia | Animalia | Animalia | Animalia |
| Phylum | Chordata | Chordata | Chordata | Chordata | Chordata |
| Class | Mammalia | Mammalia | Mammalia | Mammalia | Mammalia |
| Order | Carnivora | Carnivora | Diprotodontia | Diprotodontia | Diprotodontia |
| Family | Ursidae | Ursidae | Phascolarctidae | Vombatidae | ..... |
| Genus | *Ursus* | *Ursus* | *Phascolarctos* | *Vombatus* | ..... |
| Species | *maritimus* | *horriblis* | *cinereus* | *ursinus* | ..... |

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(i) Which level of classification shows that koalas are not related to grizzly bears? [1]

.....

(ii) In the 18th century Carl Linnaeus developed the system of giving all living organisms a two-word scientific name.

How does this system help scientists in different countries who are studying these animals? [1]

.....

.....

(iii) What is the scientific name for koalas? [1]

.....

(iv) The scientific name for a kangaroo is *Macropus rufus* and it belongs to the family Macropodidae.

Use this information to **complete** the table opposite. [2]

*(c)* In the wild, koalas are found in Australia. The koala only eats eucalyptus leaves. The koala climbs the tree to get the leaves. The koala will eat 1 kg of leaves a day. Explain why the koala population is under threat. [2]

.....

.....

9



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**4.** The picture shows solar panels installed on the roof of a house. Each solar panel converts the Sun's radiant energy directly into electrical energy.



On a typical summer day in the UK, the solar radiation energy input per second to the panel is 6000 W. The efficiency of the panel in converting solar power to electrical power is 15%.

*(a)* (i) Calculate the useful power transfer from the panel using the equation: [2]

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

Useful power transfer = ..... W

(ii) Calculate the maximum current that this panel could supply to the 230 V house circuits using the equation: [2]

$$\text{power} = \text{voltage} \times \text{current}$$

Current = ..... A

*(b)* On most Summer days the assistants claim the panel will generate electricity, as described above, for 10 hours.
Calculate the maximum units produced in a day using the equation: [2]

$$\text{Units produced (kWh)} = \text{power (kW)} \times \text{time (hours)}$$

Units produced = ..... kWh

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*(c)* The typical cost of solar panels for a home is £10 000.
It is claimed that over a year the panels will produce a mean value of energy of 3 kWh per day.
Discuss the use of this solar panel to produce electricity for the home. [6 QWC]

Include in your answer:

- A calculation to show the payback time of installing the panels if the cost of one unit of electricity is 15p;
- What factors will affect the payback time and how;
- Whether it is a practical option for a home.



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**5.** The table shows a life cycle analysis of PVC and wooden window frames. The data can be used to decide which is the more sustainable option. The table does not include any benefit from recycling the frames.

| | Wooden | PVC |
|---|---|---|
| Total energy used in production, use and disposal | 9150 MJ | 9713 MJ |
| Natural gas consumption in replacing heat lost through window | 178 kg | 183 kg |
| Coal and oil used in production and/or painting | 5.37 kg | 18.23 kg |
| Greenhouse effect | 457 kg $CO_2$ | 487 kg $CO_2$ |
| Water Eutrophication (grammes of phosphate) | 67 | 1.6 |
| Depletion of non-renewable resources in production and painting | 81 kg | 88.5 kg |
| Wastes after use without recycling | 16.5 kg | 28.2 kg |
| Lifetime cost to consumer | £167 | £122 |

(i) Use the data to describe why the wooden option is the most sustainable in terms of preserving natural resources. [3]

.....

.....

.....

(ii) Use the data to explain why using wood will have a greater detrimental effect on water animals. [3]

.....

.....

.....

(iii) Use the data to explain the benefits of recycling both types of windows after their lifetime. [3]

.....

.....

.....



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**6.** Theories about the universe have changed over time as more evidence has become available. Initially the Steady-State theory was widely accepted. This believed the universe was not only homogenous in space but also in time, i.e. it looked the same at any place and at any time.

(i) Explain how the detection of the Cosmic Microwave Background Radiation was a powerful blow against the Steady-State theory. [3]

.....

.....

.....

.....

(ii) Name and explain other evidence, apart from CMBR, that shows that the universe continues to expand away from a Big Bang. [3]

.....

.....

.....

.....

(iii) There are many galaxies observable from Earth. Describe what observations tell us about the motion of distant galaxies compared to those closer to us. [2]

.....

.....

8

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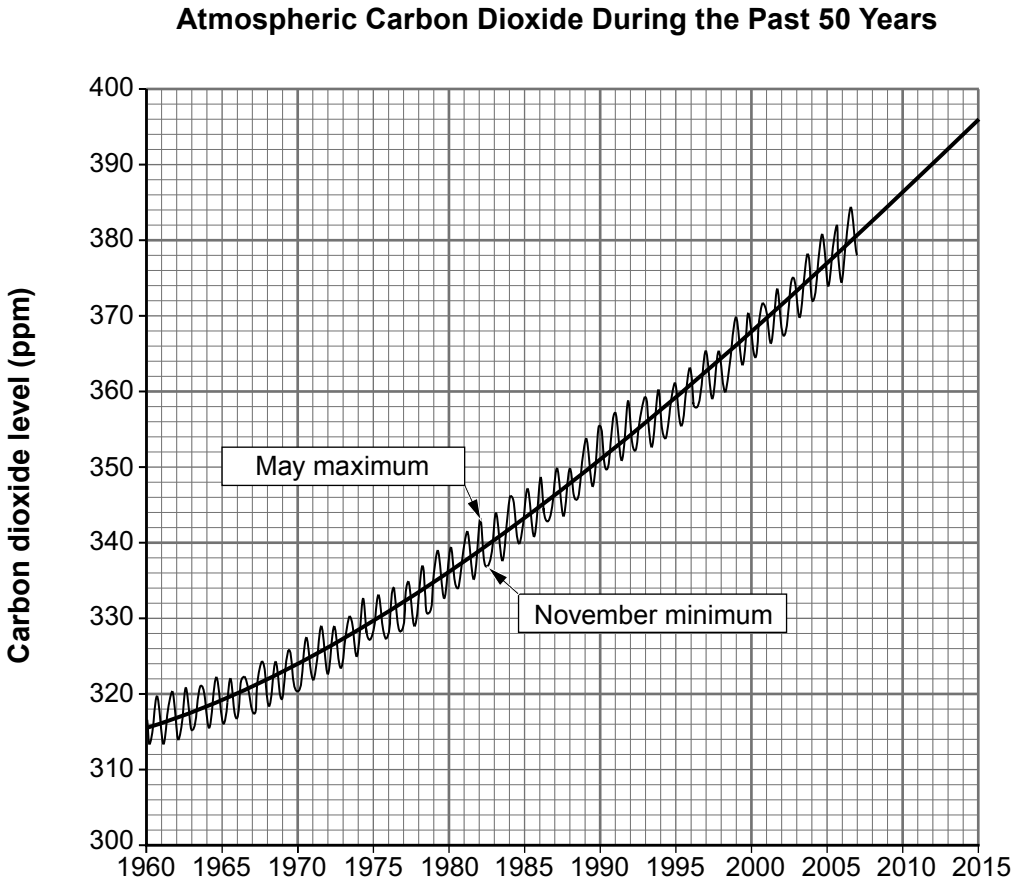


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**7.** The graph shows the carbon dioxide levels in the atmosphere for the past 50 years.

The wavy line records the variation in levels during each year. Every year the maximum occurs in May, at the beginning of the plant growing season. Every year the minimum occurs in November, at the end of the growing season. The solid trend line shows the same data but with the yearly variations removed.




*(a)* Explain why the carbon dioxide level fluctuates between May and November every year. [3]

.....

.....

.....

.....

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*(b)* (i) Describe the trend in carbon dioxide levels over time shown by the graph. [2]

.....

.....

(ii) State **three** methods of reducing the carbon dioxide levels in the atmosphere. [3]

1. .....

2. .....

3. .....

8

**END OF PAPER**

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# GCSE MARKING SCHEME

## GCSE SCIENCE B

## JANUARY 2014

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## INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2014 examination in GCSE SCIENCE B. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.


| | Page |
|---|---|
| Unit 1 Science B - Foundation Tier | 1 |
| Unit 1 Science B - Higher Tier | 5 |
| Unit 2 Science B - Foundation Tier | 10 |
| Unit 2 Science B - Higher Tier | 14 |


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**GCSE SCIENCE B**

**Unit 1 Foundation Tier**

**SECTION A**

| Question | | | Marking detail | Mark |
|---|---|---|---|---|
| **1** | (a) | | Teeth - “two front teeth” | 1 |
| | | | Feet - the second and third digits of the feet are (completely) fused together, (except for the claw). | 1 |
| | (b) | (i) | The order | 1 |
| | | (ii) | Avoids confusion from common names /same in every country | 1 |
| | | (iii) | cinereus | 1 |
| | | (iv) | Macropodidae<br>Macropus | 1<br>1 |
| | (c) | | Any **two** from:<br>Increase in logging/agriculture, urban development, decreased the habitat, reduced food source.<br>Not: natural disaster | 2 |
| **2** | (a) | (i) | Substitution [1] answer = 10% [1] | 2 |
| | | (ii) | Substitution [1] answer = 2.2 A [1] | 2 |
| | (b) | | Conversion 500 W to 0.5 kW [1] answer = 5 kWh [1]<br>Answer: 5000 kWh - 1 mark only | 2 |
| | (c) | (i) | 10 000/0.5 [1] = 20 000 (days) [1]<br>Answer: 200 days - 1 mark only | 2 |
| | | (ii) | Decrease | 1 |
| | | (iii) | Decrease | 1 |
| **3** | | (i) | Less waste (with wood) | 1 |
| | | (ii) | More phosphate (washed into streams) | 1 |
| | | (iii) | Less carbon dioxide produced | 1 |
| | | (iv) | Less coal/oil used to produce them [1]<br>less heat loss through window so less gas burned [1] | 2 |

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<table>
<tr><th colspan="2">Question</th><th>Marking detail</th><th>Mark</th></tr>
<tr><td>4</td><td>(i)</td><td>Steady state model of the universe<br>• The universe looks the same at all times<br>• The universe looks the same at any place<br><br>Big Bang model of the universe<br>• Red shift<br>• CMBR<br><br>1 mark each for each point in the correct column</td><td>4</td></tr>
<tr><td></td><td>(ii)</td><td>Distance travelled by light in 1 year</td><td>1</td></tr>
<tr><td>5</td><td>(a)</td><td><table><tr><th>Process</th><th>Increases $CO_2$</th><th>Decreases $CO_2$</th></tr><tr><td>Photosynthesis</td><td></td><td>✓</td></tr><tr><td>Burning gas</td><td>✓</td><td></td></tr><tr><td>Plant respiration</td><td>✓</td><td></td></tr><tr><td>Cutting down trees</td><td>✓</td><td></td></tr></table></td><td>4</td></tr>
<tr><td></td><td>(b) (i)</td><td>Start of plant growing season</td><td>1</td></tr>
<tr><td></td><td>(ii)</td><td>Carbon dioxide levels over time are increasing / going up</td><td>1</td></tr>
<tr><td></td><td>(iii)</td><td>400 (ppm) (allow 398-400)</td><td>1</td></tr>
<tr><td>6</td><td>(i)</td><td>Mice/rabbits/gerbils</td><td>1</td></tr>
<tr><td></td><td>(ii)</td><td>Foxes/eagle owls/buzzards</td><td>1</td></tr>
<tr><td></td><td>(iii)</td><td>Carnivore</td><td>1</td></tr>
<tr><td></td><td>(iv)</td><td>Dense fur coat</td><td>1</td></tr>
<tr><td></td><td>(v)</td><td>Hairy soles</td><td>1</td></tr>
<tr><td></td><td>(vi)</td><td>White coat is camouflaged [1]<br>predators have difficulty in seeing them [1]</td><td>2</td></tr>
<tr><td></td><td>(vii)</td><td>Those eaten balanced by those born</td><td>1</td></tr>
<tr><td></td><td>(viii)</td><td>Do not eat crops/ They eat animals that feed on crops</td><td>1</td></tr>
<tr><td></td><td>(ix)</td><td>They eat animals that feed on crops</td><td>1</td></tr>
</table>

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## SECTION B

| Question | | | Marking detail | Mark |
|---|---|---|---|---|
| **7** | (a) | (i) | Venus | 1 |
| | | (ii) | Venus | 1 |
| | | (iii) | Mercury | 1 |
| | (b) | | The bigger (the diameter) [1]<br>the more moons around a planet [1] | 2 |
| | (c) | (i) | The further from the Sun the lower the temperature | 1 |
| | | (ii) | Atmosphere is mainly carbon dioxide [1]<br>which means there is a large global warming/greenhouse effect [1]<br><br>*Second mark can only be awarded if it is coherently and correctly linked to the first marking point.* | 2 |
| | (d) | (i) | Accept value between -64 and -129°C | 1 |
| | | (ii) | Accept value between 3 and 11 years | 1 |
| | (e) | (i) | Scales [1] points (+/- square) [2] curve [1] | 4 |
| | | (ii) | (No) because line is curved (non-proportional) | 1 |
| | (f) | (i) | Surface covered in (thick)- clouds | 1 |
| | | (ii) | Rings too faint | 1 |
| | | (g) | Ellipse drawn (Not a circle, Sun not in the middle) | 1 |

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| Question | Marking detail | Mark |
|---|---|---|
| 8 | **Indicative content:**<br>• by comparison<br>○ **terrestrial** or **rocky** planets: Mercury, Venus, Earth and Mars:<br>• rock and metal<br>• have relatively high densities, slow rotation solid surfaces, no rings and few satellites.<br>○ **jovian** or**, gas** planets: Jupiter, Saturn, Uranus and Neptune:<br>• hydrogen and helium<br>• generally have low densities, rapid rotation, deep atmospheres, rings and lots of satellites.<br>• by size<br>○ **small** planets: Mercury, Venus, Earth, Mars.<br>• diameters less than 13000 km.<br>○ **giant** planets: Jupiter, Saturn, Uranus and Neptune.<br>• diameters greater than 48000 km.<br><br>**Marking Bands**<br><br>**5-6 marks**<br>The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no relevant inclusions or significance omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>**3-4 marks**<br>The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br><br>**1-2 marks**<br>The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br><br>**0 marks**<br>The candidate does not make any attempt or give a relevant answer worthy of credit. | 6QWC |

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**GCSE SCIENCE B**

**Unit 1 Higher Tier**

**SECTION A**

| Question | | | Marking detail | Mark |
|---|---|---|---|---|
| **1** | (a) | (i) | Venus | 1 |
| | | (ii) | Venus | 1 |
| | | (iii) | Mercury | 1 |
| | (b) | | The bigger (the diameter) [1]<br>the more moons around a planet [1] | 2 |
| | (c) | (i) | The further from the Sun the lower the temperature | 1 |
| | | (ii) | Atmosphere is mainly carbon dioxide [1]<br>which means there is a large global warming/greenhouse effect [1]<br><br>*Second mark can only be awarded if it is coherently and correctly linked to the first marking point.* | 2 |
| | (d) | (i) | Accept value between -64 and -129°C | 1 |
| | | (ii) | Accept value between 3 and 11 years | 1 |
| | (e) | (i) | Scales [1] points (+/- square) [2] curve [1] | 4 |
| | | (ii) | (No) because line is curved (non-proportional) | 1 |
| | (f) | (i) | Surface covered in (thick) clouds | 1 |
| | | (ii) | Rings too faint | 1 |
| | (g) | | Ellipse drawn | 1 |

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| Question | Marking detail | Mark |
|---|---|---|
| 2 | **Indicative content:**<br>• by comparison<br>○ **terrestrial** or **rocky** planets: Mercury, Venus, Earth and Mars:<br>• rock and metal<br>• have relatively high densities, slow rotation, solid surfaces, no rings and few satellites.<br>○ **jovian** or**, gas** planets: Jupiter, Saturn, Uranus and Neptune:<br>• hydrogen and helium<br>• generally have low densities, rapid rotation, deep atmospheres, rings and lots of satellites.<br>• by size<br>○ small planets: Mercury, Venus, Earth, Mars.<br>• diameters less than 13000 km.<br>○ giant planets: Jupiter, Saturn, Uranus and Neptune.<br>• diameters greater than 48000 km.<br><br>**Marking Bands**<br>**5-6 marks**<br>The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no relevant inclusions or significance omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>**3-4 marks**<br>The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br><br>**1-2 marks**<br>The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br><br>**0 marks**<br>The candidate does not make any attempt or give a relevant answer worthy of credit. | 6QWC |

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## SECTION B

| Question | | | Marking detail | Mark |
|---|---|---|---|---|
| **3** | (a) | | Teeth - “two front teeth”. | 1 |
| | | | Feet - the second and third digits of the feet are (completely) fused together, except for the claw. | 1 |
| | (b) | (i) | The order | 1 |
| | | (ii) | Avoids confusion form common names | 1 |
| | | (iii) | Phascolarctos cinereus | 1 |
| | | (iv) | Macropodidae [1]<br>Macropus<br>rufus [1] | 2 |
| | (c) | | Increase in logging/agriculture/urban development [1] which has decreased the koala’s habitat/reduced food source[1]<br>*Second mark can only be awarded if it is linked to first marking point.* | 2 |

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| Question | | | Marking detail | Mark |
|---|---|---|---|---|
| **4** | (a) | (i) | Substitution [1], answer = 900 W [1] | 2 |
| | | (ii) | Substitution (ecf from i) [1] answer = 3.9 A [1] | 2 |
| | (b) | | Conversion 900 W (allow ecf) to 0.9 kW [1] answer = 9 kWh [1] | 2 |
| | (c) | | Indicative content:<br>• savings every day on average would be 45p.<br>• payback time is £10 000/0.45 which is 22 222.2 days (60.8 years)<br>• if electricity costs rise the payback time would decrease.<br>• payback time will also depend on weather since the mean daily energy production will be affected by the amount of sunshine. The sunnier the weather the higher the mean energy production and the greater the daily savings.<br>• No electricity at night. Depends upon the direction of roof. House consumption > 3 KWh<br><br>**Marking Bands**<br>**5-6 marks**<br>The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>**3-4 marks**<br>The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. the candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br><br>**1-2 marks**<br>The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br><br>**0 marks**<br>The candidate does not make any attempt or give a relevant answer worthy of credit. | 6QWC |

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| Question | | Marking detail | Mark |
|---|---|---|---|
| **5** | (i) | Less energy used in production, use and disposal [1],<br>Lower natural gas consumption in replacing heat lost through the window [1]<br>Less coal and oil used in production and/or painting [1] | 3 |
| | (ii) | Water eutrophication effect /phosphates greater for wooden windows [1]<br>causes excessive growth of algae in water [1]<br>depletes the water of oxygen causing the death of fish [1]<br><br>*Third mark can only be awarded if it is correctly and coherently linked to either of other marking points.* | 3 |
| | (iii) | Recycling reduces need to use new resources [1]<br>Recycling also reduces waste [1]<br>so less rubbish in landfill/ so natural resources last longer [1]<br><br>*Three marks can only be awarded if it points correctly and coherently linked* | 3 |
| **6** | (i) | "Steady state" is based upon unchanging universe/ Big bang is based upon expanding universe [1]<br>CMBR is the remains of energy created during the Big Bang [1]<br>gamma rays stretching to microwaves due to expansion of universe [1]<br><br>*Third mark can only be awarded if it is correctly and coherently linked to other marking points.* | 3 |
| | (ii) | Red shift [1]<br>caused due to the wavelength increase of light/movement of spectral lines to red end of spectrum [1]<br>because galaxies moving apart [1]<br><br>*Third mark can only be aw*arded if it is *linked to either of other marking points.* | 3 |
| | (iii) | The further away a galaxy the faster [1] it moves away [1] | 2 |
| **7** | (a) | Depends on plant growing season [1].<br>during the season rate of plant photosynthesis increase [1]<br>so more carbon dioxide is removed from the atmosphere [1].<br><br>*Third mark can only be awarded if it is linked to either of other marking points.* | 3 |
| | (b) (i) | Carbon dioxide levels over time are increasing [1]<br>at an increasing rate [1] | 2 |
| | (ii) | Any **three** from:<br>Burn less fossil fuels, less deforestation, plant more trees, carbon capture | 3 |

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| Surname | Centre Number | Candidate Number |
|---|---|---|
| Other Names | | 0 |

# GCSE

4781/02

# SCIENCE B

## UNIT 1: Space, Energy and Life

## HIGHER TIER

P.M. WEDNESDAY, 5 June 2013

1¼ hours

| For Examiner's use only | | |
|---|---|---|
| **Question** | **Maximum Mark** | **Mark Awarded** |
| **1.** | **24** | |
| **2.** | **11** | |
| **3.** | **11** | |
| **4.** | **6** | |
| **5.** | **6** | |
| **6.** | **12** | |
| **Total** | **70** | |

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## 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***(e)* and question **4**.

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## SECTION A

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

**Use the information in the separate resource booklet to answer the following questions.**

**1**. *(a)* Explain how the shape of the blades causes the wind turbine to turn in the wind. [2]

.....

.....

.....

*(b)* Use the information in **Table 1** to answer the questions below.

(i) What is the range of wind speeds in which wind turbine **5** will operate? [1]

.....

(ii) State the value of the swept area by wind turbine **2**. ..... [1]

(iii) I. State the maximum power output of wind turbine **2**. ..... [1]

II. To give the maximum power output recorded in **Table 1**, the wind power must be 1500 kW.
Calculate the efficiency of wind turbine **2** using the equation: [2]

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

% Efficiency = .....

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*(c)* A wind turbine has a blade diameter of 80 m.

(i) Calculate the swept area of the blades. [2]

Swept area = ..... $m^2$

(ii) The turbine is placed at an altitude of 160 m.
Calculate the mean kinetic energy/second delivered to the turbine. [2]
*(Use (wind speed)$^3$ = 1300 $m^3/s^3$)*

Mean kinetic energy/second = ..... J/s



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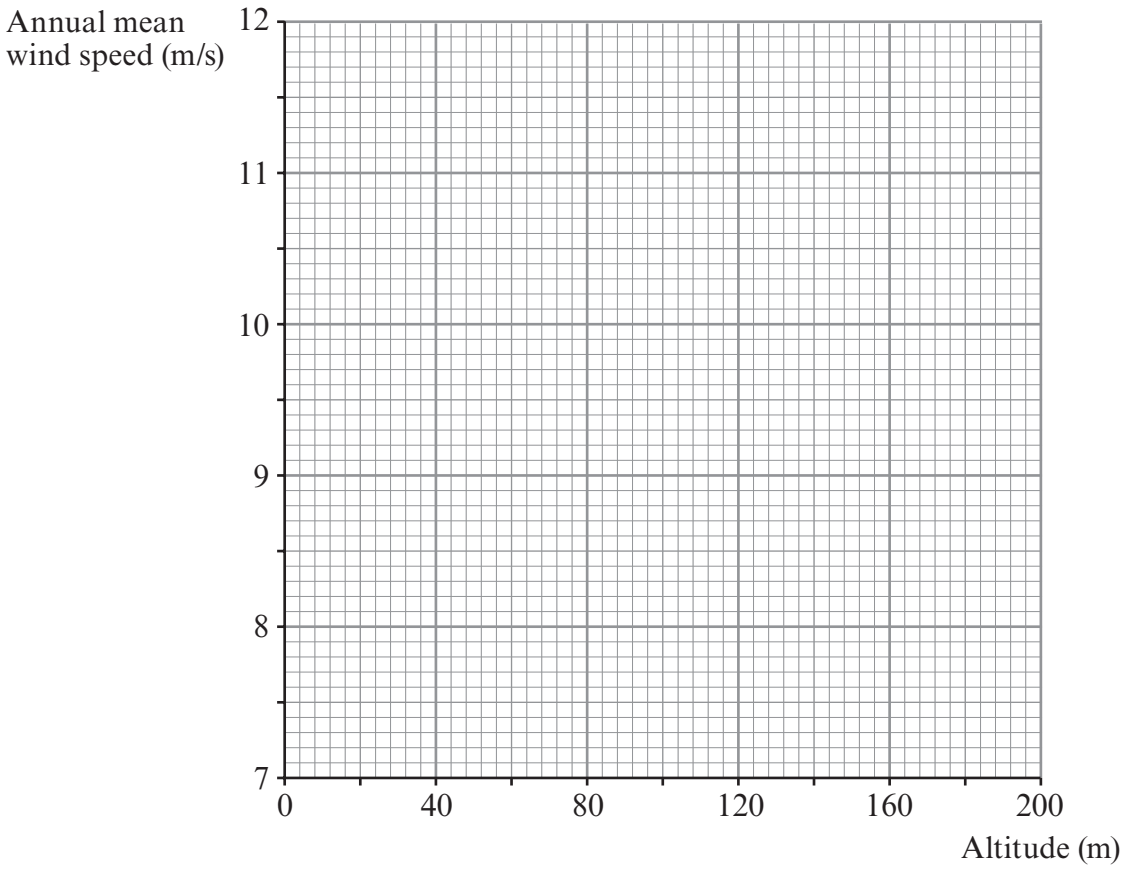
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*(d)* (i) Use the information in **Table 2** to answer the questions below.

I. Plot a graph on the grid below to show how **annual mean wind speed** varies with **altitude**. [3]




II. Explain why the maximum power output of a wind turbine is affected by altitude. [2]

.....

.....

.....

(ii) Use the information in **Table 3** to explain why the power output of the wind turbine will be different in summer and winter. [2]

.....

.....

.....

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*(e)* Evaluate the benefits and drawbacks of meeting more of the electricity demand with wind power in the future. [6 QWC]

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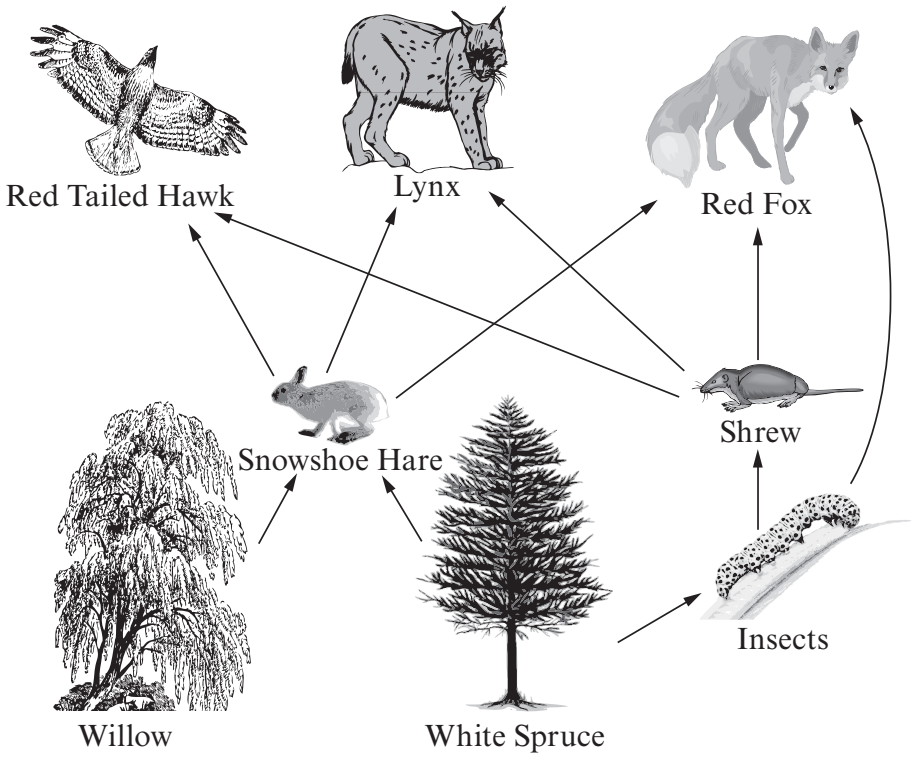
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## SECTION B

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

**2.** The diagram below shows a food web.




*(a)* (i) Name the source of energy for this food web. ..... [1]

(ii) Construct and label the pyramid of numbers for the food chain below: [3]

white spruce ⟶ insects ⟶ shrew ⟶ red fox.

*(b)* State **three environmental** factors that will affect the size of the **willow** population. [3]

1. .....

2. .....

3. .....

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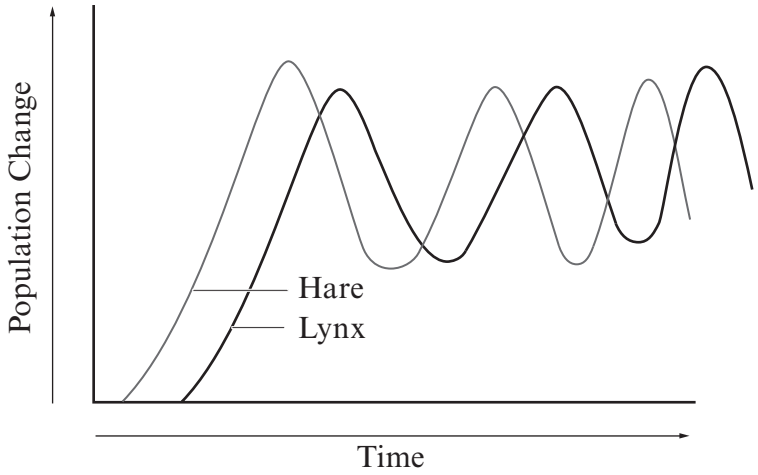
*(c)* In the natural habitat, the lynx is a predator of the snowshoe hare.



(i) State **one** way in which the hare is adapted to its environment. [1]

.....

(ii) The population of lynx and hares changes in the pattern shown in the graph.




Explain why the population change of lynx lags behind that of the hare. [3]

.....

.....

.....

.....



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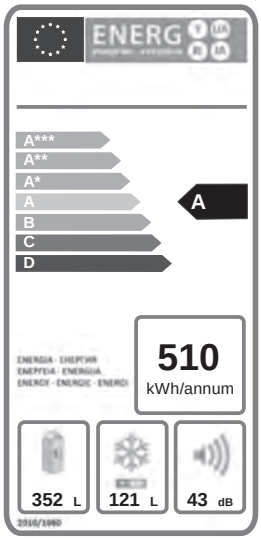


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**3.** A homeowner is shopping for a refrigerator.

She sees a label attached to each one. An example of a label is shown below.




The homeowner is given a leaflet containing information about four similar size refrigerators. The information is shown in the table below.

| Model | Voltage V | Current A | Power W | Power kW | Units used in a year kWh | Annual Cost £ |
|---|---|---|---|---|---|---|
| **A** | 230 | 0.70 | 161 | 0.161 | 310 | 37.20 |
| **B** | 230 | 0.78 | ..... | ..... | 345 | 41.40 |
| **C** | 230 | 0.67 | 154 | 0.154 | 297 | 35.64 |
| **D** | 230 | 0.72 | 166 | 0.166 | ..... | 38.40 |
| **E** | 230 | ..... | 158 | 0.158 | 305 | ..... |

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*(a)* To answer the following questions you will need to use the equations below.

Power = voltage × current

Units used = power (kW) × time (h)

Annual cost = cost of one unit (12p) × units used in a year

(i) Calculate the length of time model **A** uses electricity during the year. [2]

Time = .....

(ii) **Complete** the gaps in the table. [6]

*Space for working.*

*(b)* (i) Model **C** was £5 more expensive to buy than model **B**. Explain why you would still recommend that the homeowner buys model **C**. [2]

.....

.....

.....

(ii) Apart from cost, state **one** *other* benefit of using model **C** instead of model **B**. [1]

.....

.....

11

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**Turn over.**

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**4.** Describe the process of carbon capture and evaluate its use to reduce global warming. [6 QWC]

6

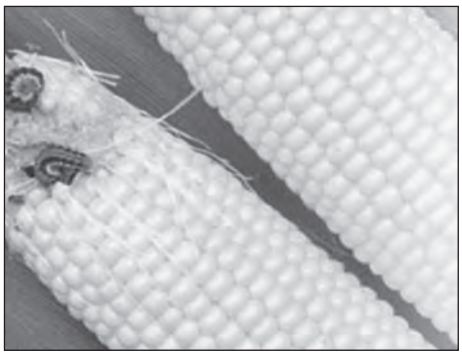
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**5.** Some insects feed on and destroy sweetcorn crops. Scientists have developed genetically modified (GM) sweetcorn that produces a poison, which kills these insects.



(i) Explain the benefits to the environment of growing this type of sweetcorn. [3]

.....

.....

.....

.....

(ii) Explain why opponents of GM crops argue against using this type of sweetcorn. [3]

.....

.....

.....

.....

6

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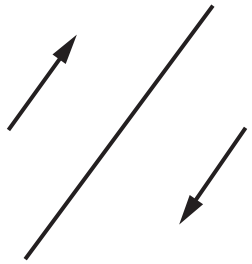
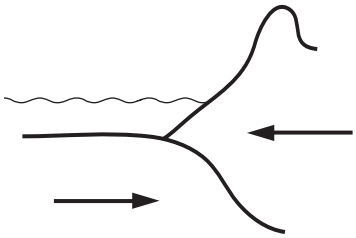
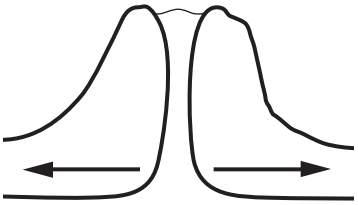
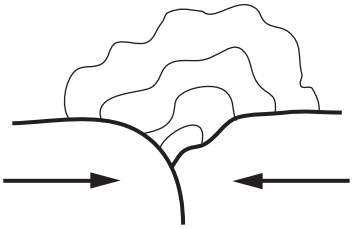


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**6.** The point where two or more tectonic plates meet is known as a plate boundary. There are four main types of plate boundary. These are conservative, destructive, constructive and collision boundaries.

*(a)* Complete the table below. *One has been completed for you.*

| Type of Plate Boundary | Diagram | Description | |
|---|---|---|---|
| **Conservative** |  | Conservative plate boundaries occur when two plates slide past each other. | |
| **Destructive** |  | ..... ..... ..... ..... | [3] |
| **Constructive** |  | ..... ..... ..... | [1] |
| **Collision** |  | ..... ..... ..... | [2] |

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*(b)* The natural phenomena below occur at more than one plate boundary.

(i) At which plate **boundaries** could fold mountains be formed? [1]

.....

(ii) At which plate **boundaries** could earthquakes occur? [1]

.....

(iii) At which plate **boundaries** could volcanoes appear? [1]

.....

*(c)* Apart from the movement of tectonic plates, state **three** *other* natural causes that change the surface of the Earth. [3]

1. .....

2. .....

3. .....

12

**END OF PAPER**

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**Turn over.**

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# GCSE MARKING SCHEME

## SCIENCE B

## SUMMER 2013

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## INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2013 examination in GCSE SCIENCE B. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.


| | Page |
|---|---|
| Unit 1 - Foundation Tier | 1 |
| Unit 1 - Higher Tier | 5 |
| Unit 2 - Foundation Tier | 11 |
| Unit 2 - Higher Tier | 14 |


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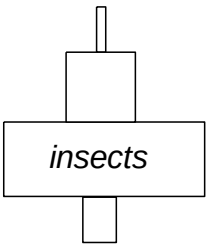
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**GCSE SCIENCE B**

**SUMMER 2013 - MARKSCHEME**

**UNIT 1 - FOUNDATION TIER**

## SECTION A

| Question | Answer | Marks |
|---|---|---|
| **1.** | **One** mark for **each** correct answer.<br>**Advantages** / **Disadvantages**<br>The farmer no longer uses insecticide to kill insects. ✓ (Advantages)<br>No build- up of insecticides to toxic levels in food chains. ✓ (Advantages)<br>The insects can become resistant to the poison. ✓ (Disadvantages)<br>Other insects are at risk of being killed. ✓ (Disadvantages) | 1<br>1<br>1<br>1 |
| **2.** (i) | Plates. | 1 |
| (ii) | Volcanoes, plates. | 2 |
| (iii) | Earthquakes / tsunamis (accept tidal wave) | 1 |
| **3.** (a) (i) | Insects. | 1 |
| (ii) | Willow or white spruce. | 1 |
| (iii) | Red tailed hawk / lynx / red fox / shrew. | 1 |
| (iv) | One mark for each correct label.<br><br><br>1. red tailed hawk/ lynx/red fox<br>2. shrew<br>3. white spruce | 3 |
| (b) | Any three of:<br>Disease<br>(Competition for) light<br>Number of grazing animals<br>(Amount of) nutrients or water (in soil) | 3 |
| (c) (i) | Camouflage/ blend in. | 1 |
| (ii) | I. More food / hare (not hair) / prey available.<br>II. Food / prey supply is decreasing / less hare. | 1<br>1 |

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| Question | | | Answer | Marks |
|---|---|---|---|---|
| **4.** | (a) | (i) | Subs: time (h) = 310 / 0.161 (1), answer 1925.46 (h) - accept 1925 or 1925.5. (Allow use of data for **C** and **D**)<br>1925.4 - No workings but incorrect rounding give 1 mark | 1+1 |
| | | (ii) | Power = 230 x 0.78 (1) 179.4 - accept 179 (W)<br>conversion to 0.179 (kW). (allow ecf) | 1+1<br>1 |
| | | (iii) | Total cost = 12p x 305<br>3660p or (£)36.60 | 1<br>1 |
| | (b) | | Save more (than £5) in running costs in first year / more than £5 cheaper to run (Do not accept just 'cheaper') | 1 |
| **5.** | (a) | (i) | Production of carbon dioxide.<br>Adds to greenhouse effect/global warming.<br>Two points must be coherently and correctly linked for 2 marks | 1<br>1 |
| | | (ii) | Less trees / forest.<br>to absorb carbon dioxide/less photosynthesis.<br>Two points must be coherently and correctly linked for 2 marks | 1<br>1 |
| | (b) | | • Rising sea levels / melting ice caps<br>• Climate change / extreme weather conditions/rising temperature. | |
| **6.** | (a) | | Number of extinctions increases over time (1)<br>at an increasing rate / speeds up / gets faster (or wte) (1) | 2 |
| | (b) | (i) | Any two from:<br>More land for housing / building / room to live.<br>More land for food production.<br>More land for energy crops<br>(Allow: more land for waste disposal). | 2 |
| | | (ii) | Less habitat<br>therefore less food<br>Two points must be coherently and correctly linked for 2 marks | 2 |
| | | (iii) | (Captive) breeding programmes / protected areas / protected species / no hunting (or however expressed). | 1 |
| **7.** | (a) | (i) | Sun more active in picture 2 / more flares in 2 | 1 |
| | | (ii) | (Solar) flare. | 1 |
| | | (iii) | Less interference from atmosphere / atmosphere not blocking signals / no light pollution / better image | 1 |
| | (b) | (i) | D | 1 |
| | | (ii) | C | 1 |

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**SECTION B**

| Question | | | Answer | Marks |
|---|---|---|---|---|
| **8.** | (a) | | Different shape surfaces / one side is more curved / flatter<br>which causes difference in air pressure.<br>Two points must be coherently and correctly linked for 2 marks. | 1<br>1 |
| | (b) | (i) | 6 – 25 (m/s). | 1 |
| | | (ii) | 1520 ($m^2$). | 1 |
| | | (iii)I | 900 (kW). | 1 |
| | | II | Subs of 900 / 1500<br>%Efficiency = 60. | 1<br>1 |
| | (c) | (i) | Calculation of radius 40 m. | 1 |
| | | | Answer = 5027.2 $m^2$ / accept 5027. Use of π in calculator gives 5024<br>Accept range 5024-5027<br>Use of $\pi r^2$ to give 20096<br>Accept range 20096- 20109 | 1 |
| | | (ii) | Extraction of air density value 1.173.<br>Subs ½ x 1.173 x 5027 (allow ecf) x 1300.<br>Answer of 3 832 836 shown gets both marks. | 1<br>1 |
| | (d) | (i) I | Plots (tolerance +/- 0.5 square) All correct (2), 4 correct (1)<br>Line of best fit (not point to point) | 2<br>1 |
| | | II | Power output of a wind turbine depends on wind speed and air density.<br>Both vary with altitude.<br>Points must be correctly and coherently connected for 2 marks. | 1<br>1 |
| | | (ii) | Power output varies with air density.<br>which depends on temperature.<br>Points must be correctly and coherently connected for two marks | 1<br>1 |

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| Question | Answer | Marks |
|---|---|---|
| (e) | **Indicative content:**<br><br>**Benefits** include references to no fuel costs, renewable resource, no air pollution, no effect on climate.<br><br>**Drawbacks** include references to variable wind speed, low power outputs, noise pollution, visual pollution.<br><br>Benefits or drawbacks only max of 3.<br><br>**5 – 6 marks**<br>The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>**3 – 4 marks**<br>The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br><br>**1 – 2 marks**<br>The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br><br>**0 marks**<br>The candidate does not make any attempt or give a relevant answer worthy of credit. | 6 |

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## UNIT 1 - HIGHER TIER

### SECTION A

| Question | | | Answer | Marks |
|---|---|---|---|---|
| **1.** | (a) | | Different shape surfaces / one side is more curved / flatter.<br>which causes difference in air pressure.<br>Two points must be coherently and correctly linked for 2 marks. | 1<br>1 |
| | (b) | (i) | 6 – 25 (m/s). | 1 |
| | | (ii) | 1520 ($m^2$). | 1 |
| | | (iii)I | 900 (kW). | 1 |
| | | II | Subs of 900 / 1500<br>%Efficiency = 60. | 1<br>1 |
| | (c) | (i) | Calculation of radius 40 m.<br><br>Answer = 5027.2 $m^2$ / accept 5027. Use of π in calculator gives 5024<br>Accept range 5024-5027<br>Use of $\pi r^2$ to give 20096<br>Accept range 20096- 20109 | 1<br><br>1 |
| | | (ii) | Extraction of air density value 1.173.<br>Subs ½ x 1.173 x 5027 (allow ecf) x 1300.<br>Answer of 3 832 836 shown gets both marks. | 1<br>1 |
| | (d) | (i) I | Plots (tolerance +/- 0.5 square) All correct (2), 4 correct (1)<br>Line of best fit (not point to point) | 2<br>1 |
| | | II | Power output of a wind turbine depends on wind speed and air density.<br>Both vary with altitude.<br>Points must be correctly and coherently connected for 2 marks. | 1<br><br>1 |
| | | (ii) | Power output varies with air density.<br>which depends on temperature.<br>Points must be correctly and coherently connected for two marks | 1<br>1 |

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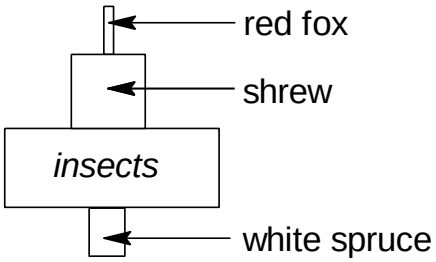
| Question | Answer | Marks |
|---|---|---|
| (e) | **Indicative content:**<br><br>**Benefits** include references to no fuel costs, renewable resource, no air pollution, no effect on climate.<br>**Drawbacks** include references to variable wind speed, low power outputs, noise pollution, visual pollution.<br><br>Benefits or drawbacks only max of 3.<br><br>**5 – 6 marks**<br>The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>**3 – 4 marks**<br>The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology an some accurate spelling, punctuation and grammar.<br><br>**1 – 2 marks**<br>The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br><br>**0 marks**<br>The candidate does not make any attempt or give a relevant answer worthy of credit. | 6 |

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**SECTION B**

| Question | Answer | Marks |
|---|---|---|
| **2.** (a) (i) | Sun(light) | 1 |
| (ii) | Pyramid shape for top three layers<br>Narrow box at bottom<br>Correctly labelled | 1<br>1<br>1 |
| |  | |
| (b) | **Any 3 of:**<br>Disease<br>(Competition for) light<br>Number of grazing animals<br>(Amount of) nutrients or water (in soil) | 3 |
| (c) (i) | Camouflage/blend in | 1 |
| (ii) | If the population of prey increases, there will be more food<br>so predator population will increase.<br>As the population of predators increases more food is needed<br>so eventually the population of prey will decrease.<br>Less food for the predators<br>so their population falls again<br>Three from above. Must be correctly and coherently connected points to get 3 marks. | 3 |

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<table>
<tr><th colspan="2">Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3. (a) (i)</td><td></td><td>Subs time (h) = 310/0.161,<br>Ans 01925.46(h) - accept 1925 or 1925.5 (Allow for data for C and D)<br>1925.4 – No workings but incorrect rounding give 1 m</td><td>1<br>1</td></tr>
<tr><td></td><td>(ii)</td><td>
<table>
<tr><th>Model</th><th>Voltage (V)</th><th>Current (A)</th><th>Power (W)</th><th>Power (kW)</th><th>Units used in one year (kWh)</th><th>Annual Cost (£)</th></tr>
<tr><td>1</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2</td><td></td><td></td><td>179 (2)</td><td>0.179 (1)</td><td></td><td></td></tr>
<tr><td>3</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>4</td><td></td><td></td><td></td><td></td><td>320 (1)</td><td></td></tr>
<tr><td>5</td><td></td><td>0.69 (1)</td><td></td><td></td><td></td><td>36.60 (1)</td></tr>
</table>
</td><td>6</td></tr>
<tr><td></td><td>(b) (i)</td><td>Model C has lower running costs (1)<br>Thereby saving the homeowner <u>more than £5</u> in the first year (1)<br>Two statements must be coherently and correctly connected for 2 marks</td><td>2</td></tr>
<tr><td></td><td>(ii)</td><td>Environmental benefit due to less electricity used / less electricity needs to be produced / less pollution caused / less effect on climate<br>(Not: help the environment)</td><td>1</td></tr>
</table>

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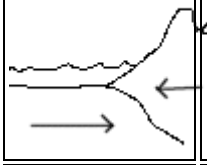
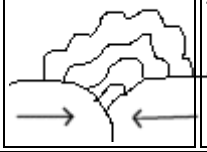
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| Question | Answer | Marks |
|---|---|---|
| **4.** | **Indicative content:**<br><br>**Carbon capture** involves trapping the carbon dioxide at its emission source, transporting it to a storage location (usually deep underground) and isolating it.<br><br>The pressure found deep underground causes $CO_2$ to behave more like a liquid than a gas. Because it can seep into the spaces in porous rocks, a great amount of $CO_2$ can be stored in a relatively small area. The focus is all wrong. They argue that we should be coming up with ways to wean ourselves off fossil fuels instead of spending time and money on ways to continue using fossil fuels.<br><br>Current CC technologies actually require a lot of energy to implement and run. What happens if the carbon dioxide leaks out in the ocean?<br><br>Excess $CO_2$ in the water increases acidity.<br><br>**5 – 6 marks**<br>The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>**3 – 4 marks**<br>The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br><br>**1 – 2 marks**<br>The candidate makes some relevant points, such as those in the indicative, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br><br>**0 marks**<br>The candidate does not make any attempt or give a relevant answer worthy of credit. | 6 |

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<table>
<tr><th colspan="2">Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>5.</td><td>(i)</td><td>The farmer no longer has to use insecticide / pesticide on insects<br>so the surrounding environment is no longer exposed to large amounts of harmful insecticide<br>therefore no build-up of insecticides to toxic levels in food chains<br>Statements must be coherently and correctly connected for 3 marks</td><td>1<br>1<br><br>1</td></tr>
<tr><td></td><td>(ii)</td><td>This type of genetically modified corn will poison the insects over a longer period than the farmer who would spray the crops once or twice.<br>In this way the insects can become accustomed (or resistant) to the poison.<br>A variety of insects are at risk of being killed / It might be predatory insects that eat the harmful ones or, perhaps attractive insects such as butterflies.<br>Statements must be coherently and correctly connected for 3 marks</td><td>1<br><br>1<br><br>1</td></tr>
<tr><td>6.</td><td>(a)</td><td>
<table>
<tr><th>Type of Plate Boundary</th><th>Diagram</th><th>Description</th></tr>
<tr><td>Destructive</td><td></td><td>Oceanic plate(1) forced under (1) continental plate (1)<br>If: one plate forced under another (2)</td></tr>
<tr><td>Constructive</td><td></td><td>Two plates move apart (1)</td></tr>
<tr><td>Collision</td><td></td><td>Two continental plates (1) move towards each other (1)</td></tr>
</table>
</td><td>6</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>Destructive <u>and</u> collision boundaries</td><td>1</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>All</td><td>1</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>Destructive <u>and</u> constructive boundaries</td><td>1</td></tr>
<tr><td></td><td>(c)</td><td></td><td>Any three of: weathering, erosion, meteorite impact, volcanic eruptions</td><td>3</td></tr>
</table>

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| Surname | Centre Number | Candidate Number |
|---|---|---|
| Other Names | | 0 |

# New GCSE

4781/02

# SCIENCE B
## UNIT 1: Space, Energy and Life
## HIGHER TIER

P.M. THURSDAY, 17 January 2013

1¼ hours

| | For Examiner's use only | | |
|---|---|---|---|
| | **Question** | **Maximum Mark** | **Mark Awarded** |
| **Section A** | **1.** | **24** | |
| **Section B** | **2.** | **8** | |
| | **3.** | **10** | |
| | **4.** | **12** | |
| | **5.** | **6** | |
| | **6.** | **10** | |
| **Total** | | **70** | |

4781
020001

**ADDITIONAL MATERIALS**

In addition to this paper you may require a calculator, pencil 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 questions **1***(a)* and **6***(a)*.

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## SECTION A

*You need to refer to the resource folder to answer questions in this section.*

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

**1.** Water pollution can be monitored using invertebrate animals as indicators.

*(a)* Describe how you would carry out an investigation into monitoring water pollution using invertebrates. [6 QWC]

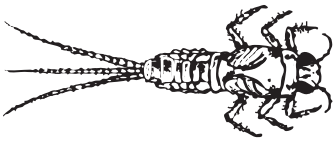
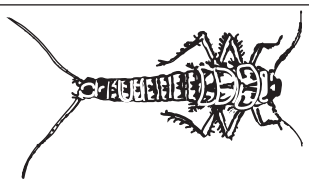
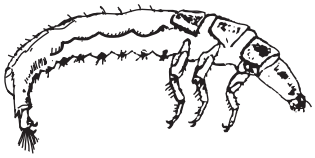
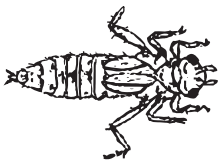
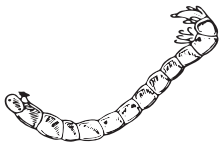
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*(b)* This table shows the results of invertebrates identified in three parts of a stream **A**, **B** and **C** obtained during an investigation.

| | | | Total biomass in sample (g) | | |
|---|---|---|---|---|---|
| | **Photograph of invertebrate** | **Species** | **A** | **B** | **C** |
| 1 |  | ..... | 50 | 0 | 4 |
| 2 |  | ..... | 65 | 0 | 0 |
| 3 |  | Caddisfly larva | 0 | 0 | 30 |
| 4 |  | ..... | 0 | 4 | 34 |
| 5 |  | ..... | 0 | 45 | 10 |
| 6 |  | ..... | 0 | 100 | 2 |

(i) Use the information in the resource folder to identify each invertebrate and complete the table. One has been completed for you. [5]

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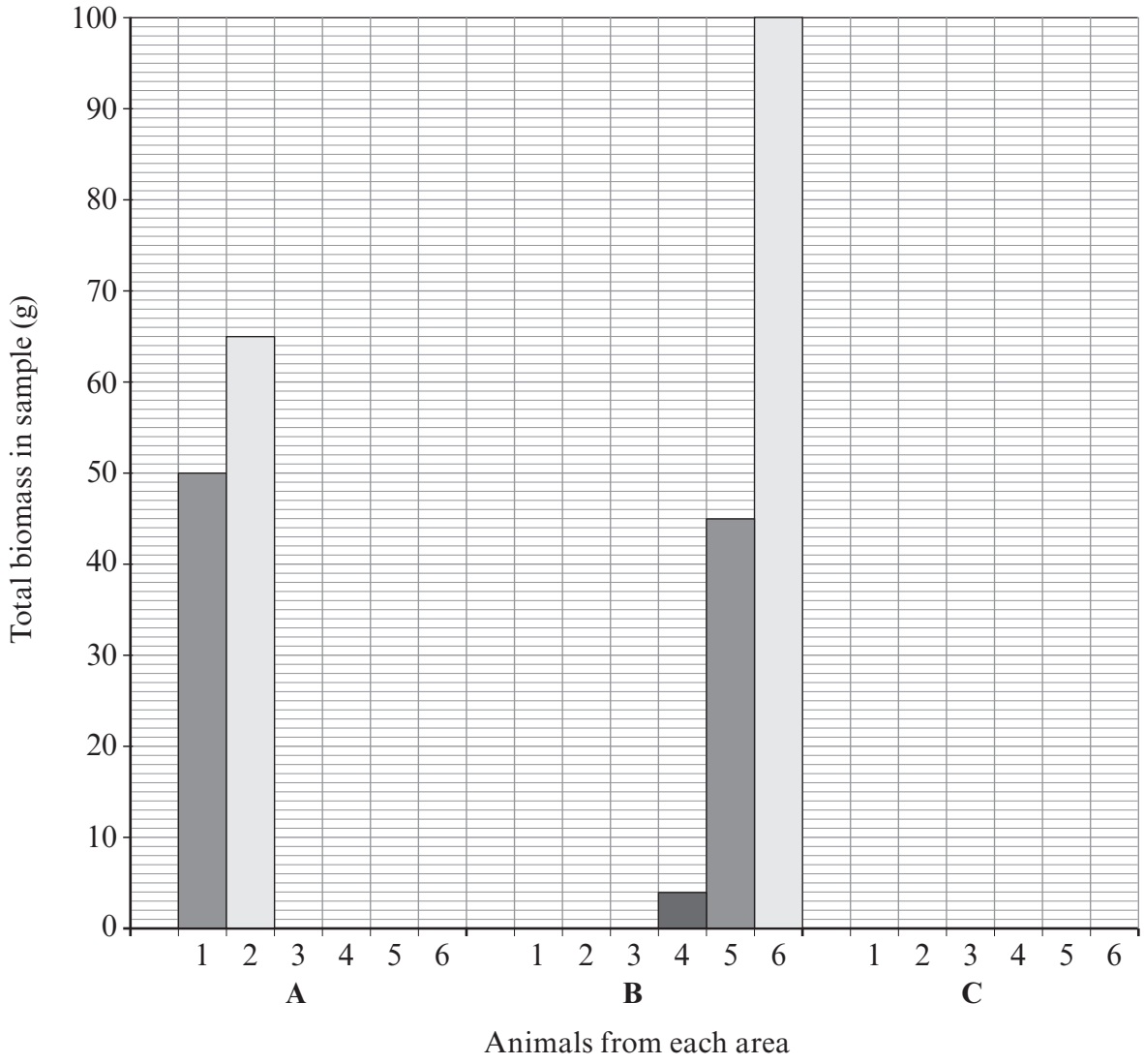
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(ii) Plot the results for part **C** of the stream as a bar chart on the grid below. The data for parts **A** and **B** in the stream have already been plotted for you. [3]




(iii) Use the information in the resource folder and the results of the investigation to describe how the quality of water (pollution level) changes from part **A** of the stream, as it flows to parts **B** and **C**. [3]

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(iv) Explain how the results to the investigation support your answer to (iii). [3]

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*(c)* During the investigation, any water boatmen collected were not counted. Explain why they were ignored. [2]

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*(d)* How could the repeatability of the data collected be improved? [2]

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**Turn over.**

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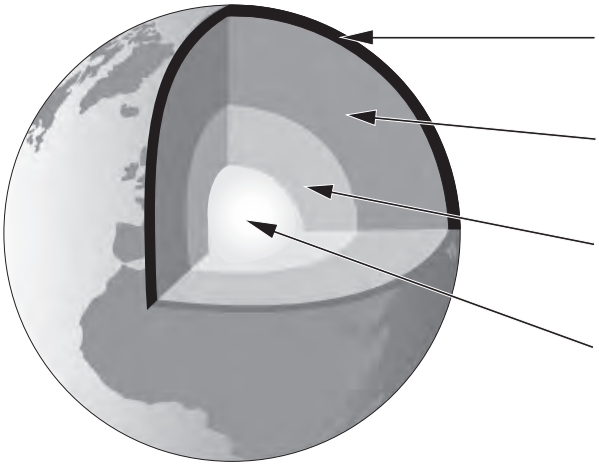
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## SECTION B

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

**2.** *(a)* The diagram below shows the structure of the Earth.

Label the four parts shown. [4]



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*(b)* The surface of the Earth changes due to geological processes. For example, Iceland was only formed because the Earth is made of plates that move.

(i) Complete the sentences below.

The Earth's crust is made up of huge slabs of rock called ..... plates. [1]

The movement of these plates is known as ..... drift. [1]

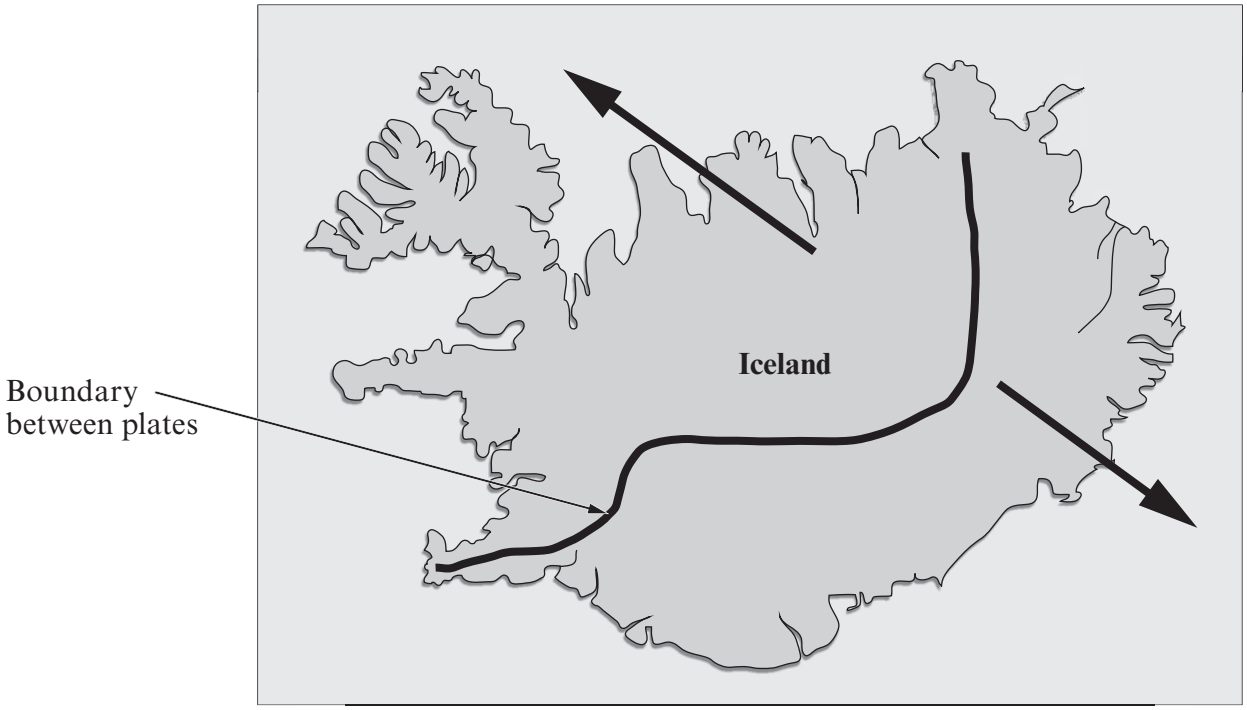
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(ii) Iceland sits on the boundary between two of these plates, which are moving in the direction shown by the arrows.




State **two** natural disasters that could be caused by these moving plates. [2]

1. .....

2. .....

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**3.** Homeowners who generate electricity from solar power get paid for energy they produce under a scheme called 'Feed-in Tariff'.

The Feed-in Tariffs scheme means that homeowners who generate electricity from solar power get paid for energy they produce and use themselves. They also get paid for any electricity they produce and put into the grid. They will also see their energy bills fall slightly. This scheme is intended to compensate the homeowner for the initial cost of installing solar panels, which is approximately £9 000.

The total return is split like this for a typical **2.9 kW** household installation:

- £1 050 a year from the Generation Tariff
- £60 a year from the Export Tariff
- £90 a year reduction of current electricity bills.

*(a)* Explain why the use of home solar power would benefit the **environment**. [3]

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*(b)* (i) Use the information above to calculate the payback time of the cost of installing the solar panel. [2]

Payback time = ..... years

(ii) Explain why this payback time could change. [2]

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*(c)* Calculate how long it would take for the solar panel to produce enough electricity to save the homeowner £90 using the equations: [3]

Units used = power (kW) × time (h)

Cost = units used × cost per unit

One unit of electricity costs 12p

Time = .....

10

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**4.** Astronomical images are collected using different parts of the electromagnetic spectrum.

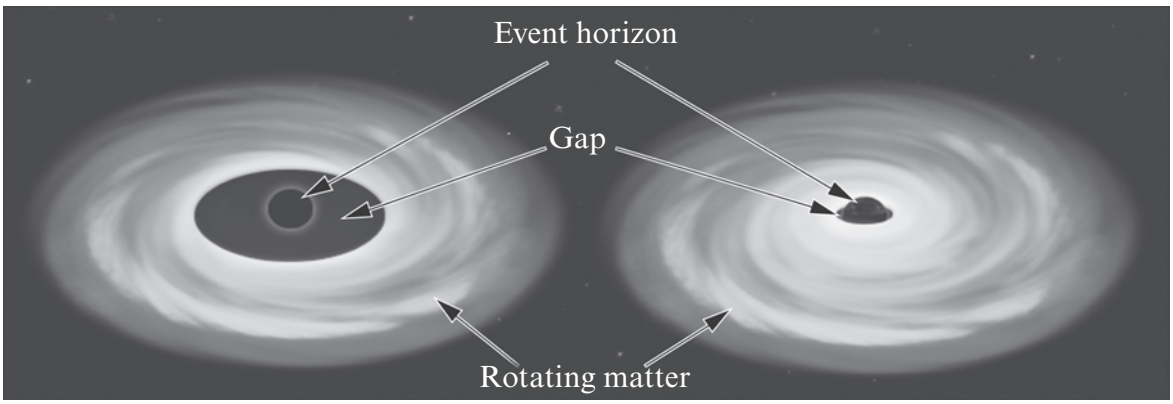
*(a)* Compare the use of Earth-based and space-based telescopes to produce these images. [2]

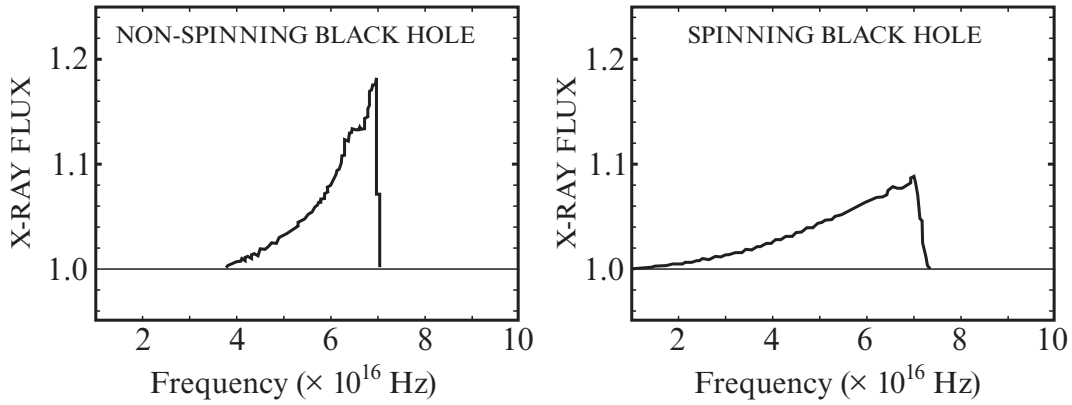
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*(b)* The diagrams below show X-ray images and X-ray spectra of two black hole systems taken by a space based telescope.




(i) Compare the images from the black holes. [2]

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(ii) Compare the X-ray spectra from both black holes. [2]

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(iii) Calculate the wavelength of the most intense X-rays in the spectrum given that the wave speed of X-rays through space is $3 \times 10^8$ m/s using the equation: [3]

wave speed = frequency × wavelength

Wavelength = ..... m

*(c)* NASA and the European Space Agency plan to work together to build very sensitive X-ray telescopes in the future. Describe the benefits to both organisations of working together. [3]

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**5.** The peppered moth exists as a light form and as a mutant dark form.

Light form



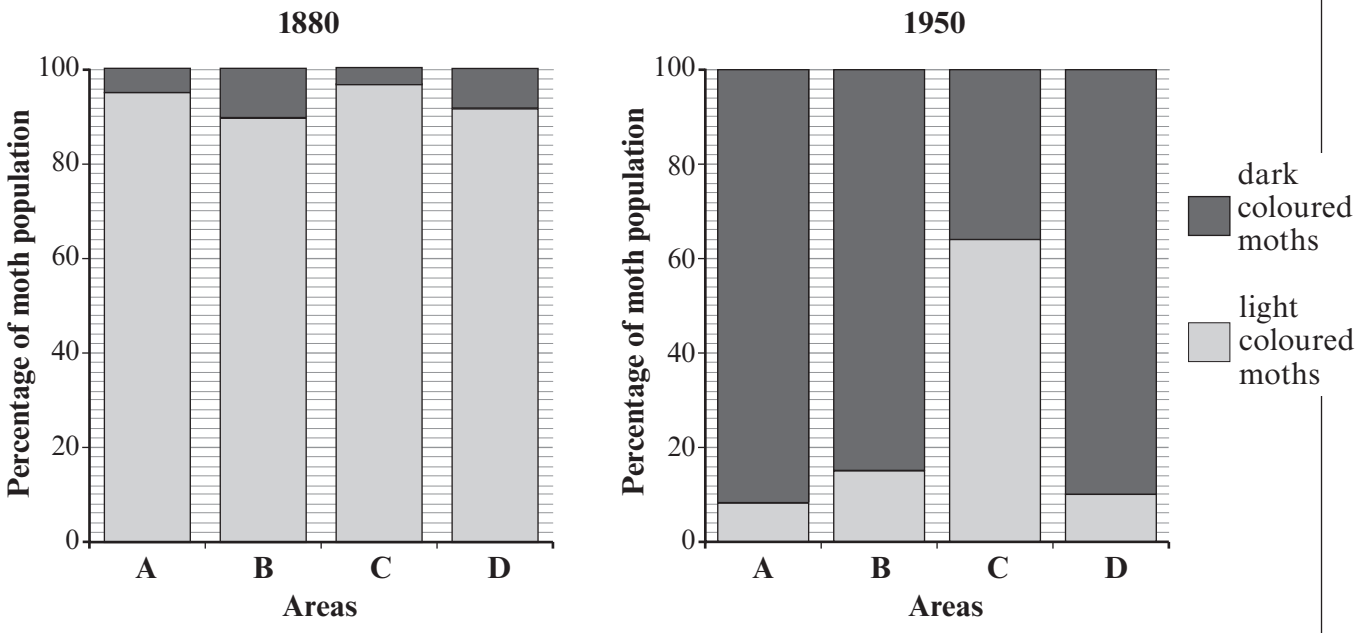
Dark form



Peppered moths can be eaten by birds.

In areas affected by air pollution, the surfaces on which moths land are covered by dark, sooty deposits. The industrial revolution took place in the 1880s and was the cause of very high levels of air pollution by soot.

The graphs show the percentages of dark and light forms of moth in the same four areas of Britain **A**, **B**, **C** and **D** in 1880 and 1950.




*(a)* Using the information in the graphs, explain how peppered moths have been affected by natural selection between 1880 and 1950. [3]

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*(b)* Since the Clean Air Act of 1956, industrial areas have become much less polluted.

(i) Explain the expected effect on the number of light coloured moths surviving in areas **A**, **B**, **C** and **D**. [2]

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(ii) Suggest why it might be an advantage to the species for dark mutants to occur even in a non-polluted environment. [1]

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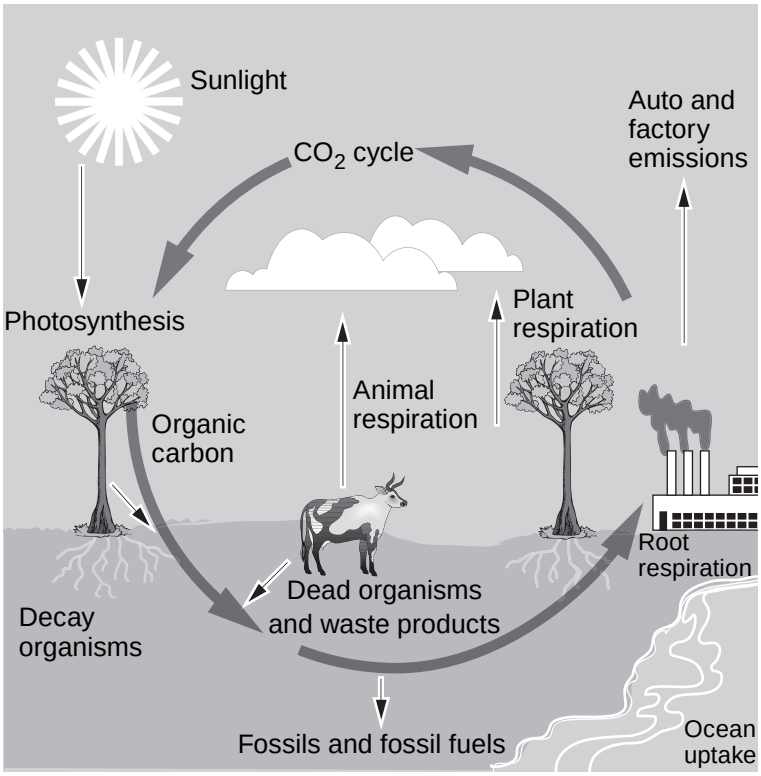


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**6.** *(a)* This diagram represents the carbon cycle.




Use the information in the diagram to explain why for thousands of years the amount of carbon dioxide in the earth's atmosphere remained approximately constant. [6 QWC]

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*(b)* During the past 100 years, evidence suggests that the amount of carbon dioxide in the atmosphere has been steadily rising. One factor that contributes to this increase is people travelling to work.
Information from a website includes the table below. This gives information about the amount of carbon dioxide produced for **each journey** taken by **100 people** travelling to work by different methods.

| | Distance to work (km) | | | |
|---|---|---|---|---|
| | 10 | 20 | 25 | 50 |
| Carbon dioxide produced travelling by car (tonnes) | 0.4 | 0.8 | 1.0 | 2.0 |
| Carbon dioxide produced travelling by coach (tonnes) | 0.05 | 0.1 | 0.125 | 0.25 |
| Carbon dioxide produced travelling by train (tonnes) | 0.09 | 0.18 | 0.225 | 0.45 |

Use this information to calculate the amount of carbon dioxide saved during a 5 day working week, if 200 people travel 40 km **to and from** work by coach instead of car. [4]

Amount of carbon dioxide saved = ..... tonnes

10

**END OF PAPER**

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# GCSE MARKING SCHEME

## SCIENCE B

## JANUARY 2013

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## INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2013 examination in GCSE SCIENCE B. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.


| | Page |
|---|---|
| UNIT1 - FOUNDATION TIER | 1 |
| UNIT 1 - HIGHER TIER | 5 |
| UNIT 2 - FOUNDATION TIER | 11 |


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## GCSE SCIENCE B – UNIT 1 (FOUNDATION TIER)

## SECTION A

| Question | Answers | Marks |
|---|---|---|
| **1** (a) | Top down:<br>Crust, mantle, molten iron outer core, solid iron core | 4 |
| (b) (i) | Tectonic, continental | 2 |
| (ii) | Earthquakes, volcanoes, (accept tsunami) | 2 |
| **2** (a) | Any 1 of:<br>• less power stations / less land used<br>• less impact on habitats<br>• less fossil fuels burned<br>• less greenhouse gases / reduced global warming<br>• less acid rain | 1 |
| (b) (i) | 9000/1200, = 7.5 years | 2 |
| (ii) | Decreases | 1 |
| (iii) | Decreases | 1 |
| (c) (i) | 2.5 x 300 (1)<br>Calculation of units = 750 (1) | 2 |
| (ii) | 750 (allow ecf) x 12 (1)<br>Answer = 9000p or £90 (1) | 2 |
| **3** (a) | Signals not absorbed / blocked by atmosphere (1)<br>Earth based cheaper (1) | 2 |
| (b) (i) | Similar pattern of circulating matter (1)<br>larger gap between event horizon and rotating matter (1) | 2 |
| (ii) | Any 2 of gamma, X rays, UV, visible, IR, microwaves, radiowaves. | 2 |
| **4** (a) (i) | Any 2 of: burning, respiration, decay | 2 |
| (ii) | Photosynthesis / ocean uptake | 1 |
| (b) (i) | Any 2 of: Deforestation, more demand for electricity, more use of fossil fuels, more industry, more animals bred for providing food, more transport | 2 |
| (ii) | Global warming | 1 |
| (c) (i) | 1.6 (tonnes) | 1 |
| (ii) | 1.4 (tonnes) | 1 |
| (iii) | No – bigger carbon footprint or wte | 1 |

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| Question | Answers | Marks |
|---|---|---|
| **5** (a) (i) | *1 mark for the following point:*<br>dark coloured moths increase<br><br>*The second mark can only be awarded if the candidate coherently and correctly links the conclusion to the statement above.*<br>so more trees must have been covered in soot | 2 |
| (ii) | C | 1 |
| (b) | *1 mark for the following point:*<br>less sooty deposits<br><br>*The second mark can only be awarded if the candidate coherently and correctly links the conclusion to the statement above:*<br>so light coloured moths are better camouflaged | 2 |
| **6** (a) (i) | Mammalia | 1 |
| (ii) | Carnivora | 1 |
| (iii) | Move in search of food | 1 |
| (iv) | Both have vertebral column | 1 |
| (v) | Panthera leo | 1 |
| (b) | Down: Chordata, Mammalia, Carnivora (1), Crocuta (1), crocuta (1) | 3 |
| | *1 mark for correct use of bold capital letters.* | 1 |

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## SECTION B

| Question | Answers | Marks |
|---|---|---|
| **7** (a) | Indicative content<br>• Collect some water in your large tray.<br>• Use the same technique each time you collect a sample – holding the net in the same way for the same length of time.<br>• Scoop up some of the material from the bottom of the stream, or stir the bottom material and place the net downstream to catch it.<br>• Try to identify the animals against the indicator chart.<br>• Count the animals.<br>• Pour the water gently back into the pond or stream.<br>• Repeat at different times / different sections of the stream.<br><br>5-6 marks<br>The candidate constructs an articulate, integrated account correctly linking relevant points such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>3-4 marks<br>The candidate constructs an account correctly linking some relevant points such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br><br>1-2 marks<br>The candidate makes some relevant points such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br><br>0 marks<br>The candidate does not make any attempt or give a relevant answer worthy of credit. | 6 |

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| Question | Answers | Marks |
|---|---|---|
| (b) (i) | In descending order:<br>• Mayfly Nymph<br>• Stonefly Nymph<br>• *(Caddis fly larva)*<br>• Dragonfly Nymph<br>• Bloodworm<br>• Bristleworm | 5 |
| (ii) | 5/6 correct (3) 3/4 correct (2) 1/2 correct (1) | 3 |
| (iii) | A - good water quality<br>B – polluted<br>C – becoming cleaner / low levels of pollution | 3 |
| (iv) | Quotes examples of preferred water quality for the invertebrates (x3), e.g. Mayfly Nymph – pollution intolerant / large numbers indicate good water quality.<br><br>Explanation must coherently and correctly connect points to achieve 3 marks. | 3 |
| (c) | *1 mark for the following point:*<br>adults breathe surface air.<br><br>*The second mark can only be awarded if the candidate coherently and correctly links the conclusion to the statement above:*<br>so do not indicate water quality. | 2 |
| (d) | Collect more than one sample at each location,<br>Collect samples in the same way | 2 |

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## GCSE SCIENCE B – UNIT 1 (HIGHER TIER)

## SECTION A

| Question | Answers | Marks |
|---|---|---|
| 1 (a) | **Indicative content**<br>• Collect some water in your large tray.<br>• Use the same technique each time you collect a sample – holding the net in the same way for the same length of time.<br>• Scoop up some of the material from the bottom of the stream, or stir the bottom material and place the net downstream to catch it.<br>• Try to identify the animals against the indicator chart.<br>• Count the animals.<br>• Pour the water gently back into the pond or stream.<br>• Repeat at different times / different sections of the stream.<br><br>**5-6 marks**<br>The candidate constructs an articulate, integrated account correctly linking relevant points such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>**3-4 marks**<br>The candidate constructs an account correctly linking some relevant points such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br><br>**1-2 marks**<br>The candidate makes some relevant points such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br><br>**0 marks**<br>The candidate does not make any attempt or give a relevant answer worthy of credit. | **6** |

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| Question | Answers | Marks |
|---|---|---|
| (b) (i) | In descending order:<br>• Mayfly Nymph<br>• Stonefly Nymph<br>• *(Caddis fly larva)*<br>• Dragonfly Nymph<br>• Bloodworm<br>• Bristleworm | **5** |
| (ii) | 5/6 correct (3) 3/4 correct (2) 1/2 correct (1) | **3** |
| (iii) | A - good water quality<br>B – polluted<br>C – becoming cleaner / low levels of pollution | **3** |
| (iv) | Quotes examples of preferred water quality for the invertebrates (x3), e.g. Mayfly Nymph – pollution intolerant / large numbers indicate good water quality.<br><br>Explanation must coherently and correctly connect points to achieve 3 marks. | **3** |
| (c) | *1 mark for the following point:*<br>adults breathe surface air.<br><br>*The second mark can only be awarded if the candidate coherently and correctly links the conclusion to the statement above:*<br>so do not indicate water quality. | **2** |
| (d) | Collect more than one sample at each location,<br>Collect samples in the same way | **2** |

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## SECTION B

| Question | Answers | Marks |
|---|---|---|
| **2** (a) | Top down: crust, mantle, molten outer (iron) core, solid/ iron/ inner core | **4** |
| (b) (i) | Tectonic, continental | **2** |
| (ii) | Earthquakes, volcanoes.(accept tsunami) | **2** |
| **3** (a) | *Any **two** points from:*<br>• need less power from national grid / less power stations / burn less fossil fuels<br>• burning fossil fuels releases $CO_2$ / less $CO_2$ formed<br>• and acid(ic) gases / less acid gases formed<br>*In each case, the third mark can be awarded if the conclusion correctly and coherently follows from the main point. Any of the following:*<br>• therefore less greenhouse gases / reduced global warming<br>• therefore less acid rain<br>• therefore less impact on habitats. | **3** |
| (b) (i) | Total return = £1200 (1), 9000/1200 = 7.5 years (1) | **2** |
| (ii) | Cost of electricity could change, so each unit generated saves different amount (2)<br>**OR** sunlight varies, so different amount exported to grid(2)<br>**OR** feed in tariff changes, so different income for generating electricity (2)<br>*In each case, the conclusion must correctly and coherently follow from the main point to achieve 2 marks.* | **2** |
| (c) | Convert £90 to 9000p **OR** 12p to £0.12 (1)<br>Calculation of units = 750 (1)<br>Time = 258.6/259/260(h)( (1) | **3** |

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| Question | Answers | Marks |
|---|---|---|
| **4** (a) | Earth based cheaper (1)<br>but signals absorbed / blocked by atmosphere (1).<br>Accept converse. | **2** |
| (b) (i) | Similar pattern of circulating matter (1)<br>larger gap between event horizon and circulating matter (1) | **2** |
| (ii) | Non-spinning - Any 2 of:<br>narrower spectrum, higher peak or converse, peak at same frequency | **2** |
| (iii) | Value from graph = 7 x $\underline{10^{16}}$ Hz (1)<br><br>Substitution/manipulation (1)<br><br>Answer = 4.3 x $10^{-9}$ m (1) | **3** |
| (c) | Any 3 of:<br>• sharing cost<br>• scientific expertise<br>• technology<br>• equipment / facilities / locations | **3** |
| **5** (a) | Any 3 of: (Pollution has increased).<br>Dark moths are at an advantage / well camouflaged (or converse) (1)<br>less predation on black forms / fewer black moths eater (1)<br>more predation on light forms / more light moths eaten (1)<br>more black forms survive (1)<br>to breed / pass on genes (1) | **3** |
| (b) (i) | *1 mark for the following point:*<br>less sooty deposits / cleaner surfaces<br><br>*The second mark can only be awarded if the candidate coherently and correctly links the conclusion to the statement above:*<br>so light moths should increase | **2** |
| (ii) | Increases chances of survival if environment changes | **1** |

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| Question | Answers | Marks |
|---|---|---|
| **6** (a) | **Indicative content:**<br><br>• Carbon is recycled via photosynthesis, food chains and respiration.<br>• The role of microbes, bacteria and fungi in transferring carbon by feeding on waste materials from organisms and dead plants and animals.<br>• These microbes respire and release carbon dioxide into the atmosphere.<br><br>**5-6 marks**<br>The candidate constructs an articulate, integrated account correctly linking relevant points such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.<br><br>**3-4 marks**<br>The candidate constructs an account correctly linking some relevant points such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.<br><br>**1-2 marks**<br>The candidate makes some relevant points such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.<br><br>**0 marks**<br>The candidate does not make any attempt or give a relevant answer worthy of credit. | **6** |
| (b) | Values for 40 km are: car 1.6 coach 0.2 (1)<br>Difference 1.4 (1)<br>Double values 2.8 (table for 100 people) (1)<br>10 journeys so saving = 28 (Tonnes) (1) | **4** |

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