GCSE

4781/02

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W16-4781-02

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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	

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**.

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

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.

6

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:

[2]

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

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

SECTION B

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

4. The picture shows a food web.
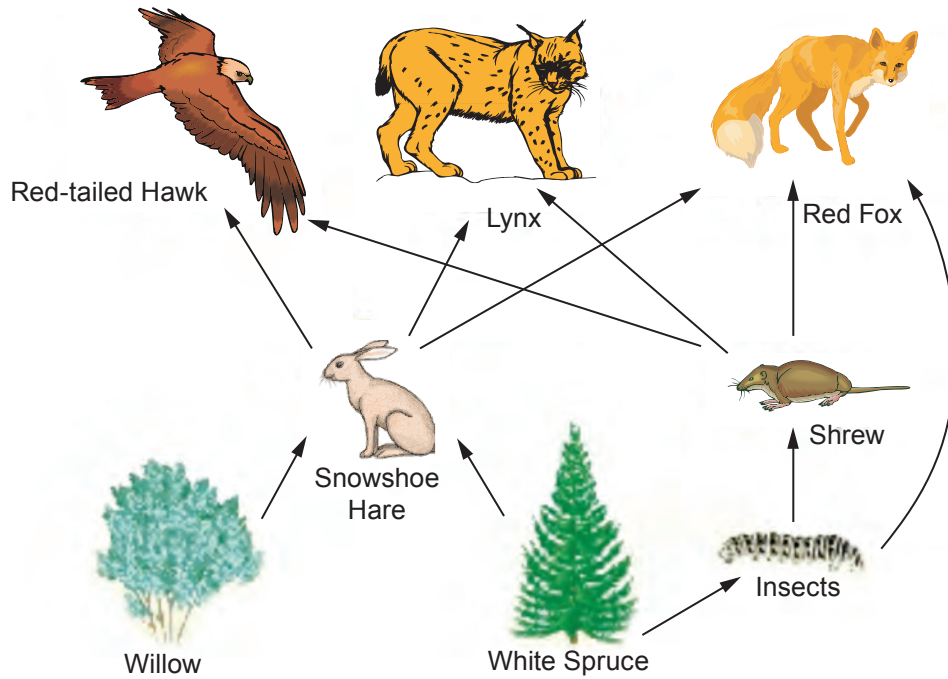
(a)   (i)   State **three** factors that will affect the size of the white spruce population.   [3]

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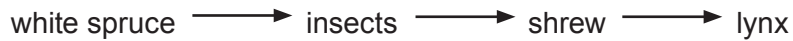
(b) In their natural habitat, the lynx is a predator of the shrew.

The populations of lynx and shrew will change in a pattern shown in the graph.
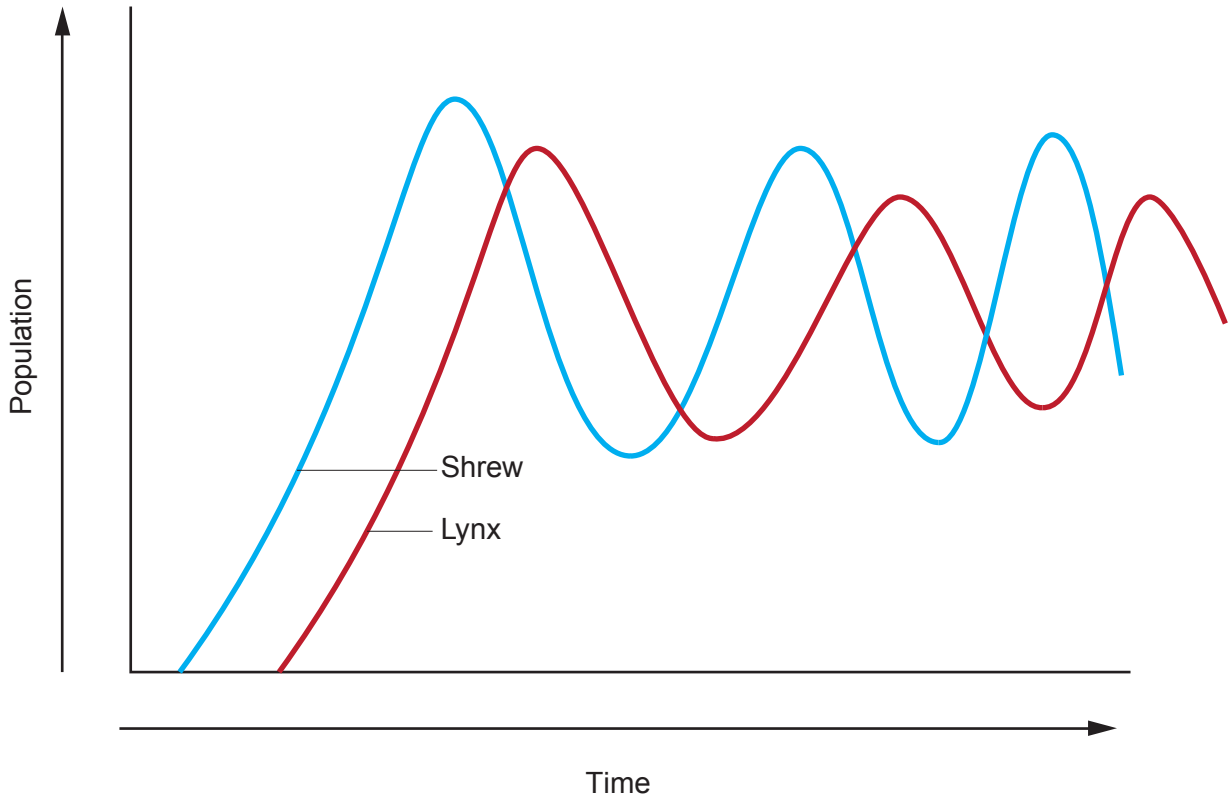
Explain why the population change of the lynx lags behind that of the shrew. [3]

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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	2 200	2.2	220	....
B	345	2 400	....	240	38.40
C	320	2 700	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.

Explain your answer. [3]

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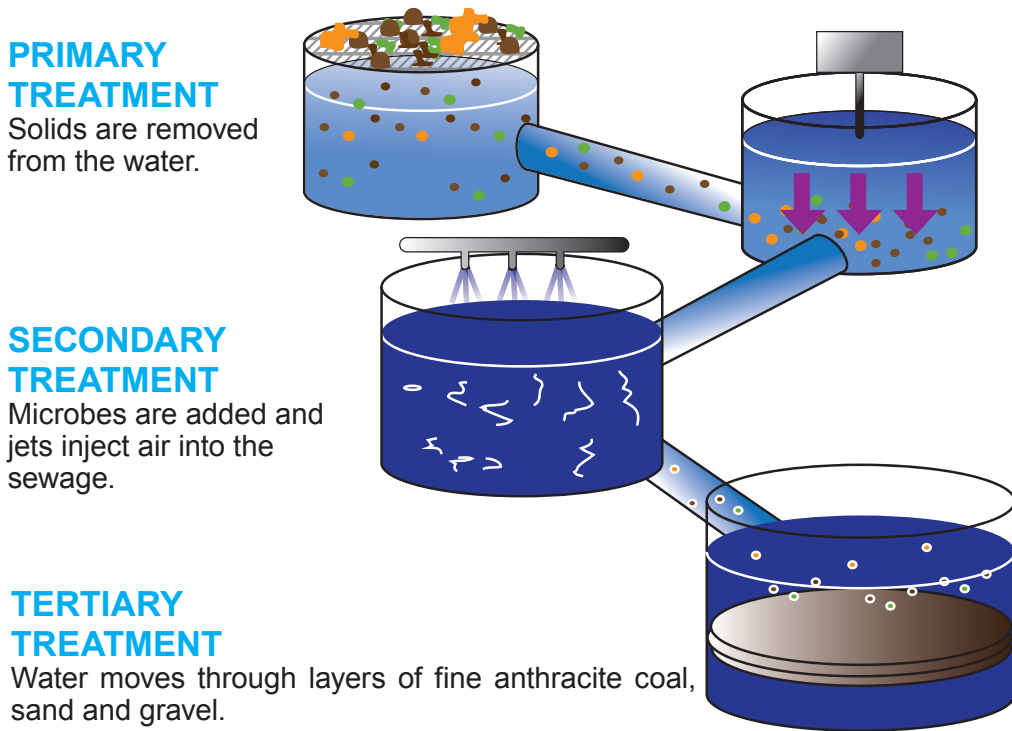
(b) The chart shows how river quality in the UK changed over a 4 year period.

England

1996	
2000	

Wales

1996	
2000	

Northern Ireland

1996	
2000	

Scotland

1996	
2000	

20   40   60   80   100

Key

River quality

Very good

Good

Fairly good

Fair

Poor

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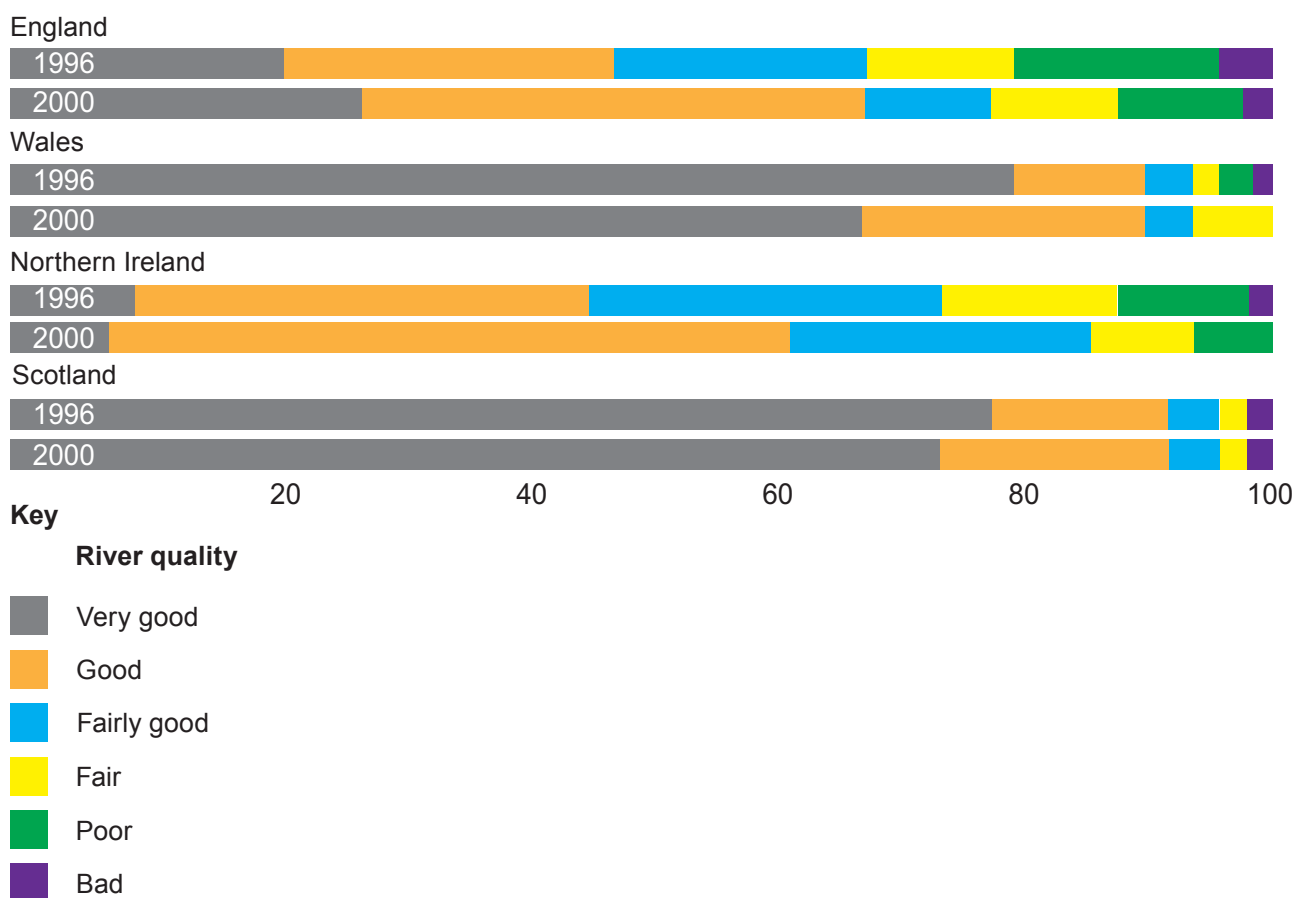
Compare the quality of rivers in England and Wales over this time period. [4]

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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]

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

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	$< 2 \times 10^{-24}$	....

8

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

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

[6 QWC]

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END OF PAPER