OCR
Oxford Cambridge and RSA

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Monday 6 November 2017 – Afternoon

GCSE GATEWAY SCIENCE
SCIENCE B

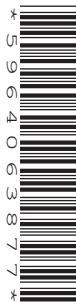**B712/02**   Science modules B2, C2, P2 (Higher Tier)

Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR supplied materials:
None

Other materials required:
•   Pencil
•   Ruler (cm/mm)

Duration: 1 hour 30 minutes

Candidate forename		Candidate surname	

Centre number					Candidate number				

INSTRUCTIONS TO CANDIDATES

•   Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
•   Use black ink. HB pencil may be used for graphs and diagrams only.
•   Answer **all** the questions.
•   Read each question carefully. Make sure you know what you have to do before starting your answer.
•   Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
•   Do **not** write in the barcodes.

INFORMATION FOR CANDIDATES

•   The quality of written communication is assessed in questions marked with a pencil (✐).
•   A list of equations can be found on page 2.
•   The Periodic Table can be found on the back page.
•   The number of marks is given in brackets **[ ]** at the end of each question or part question.
•   The total number of marks for this paper is **85**.
•   This document consists of **24** pages. Any blank pages are indicated.

OCR is an exempt Charity

Turn over

2

EQUATIONS

energy = mass × specific heat capacity × temperature change

energy = mass × specific latent heat

$$\text{efficiency} = \frac{\text{useful energy output (× 100\%)}}{\text{total energy input}}$$

wave speed = frequency × wavelength

power = voltage × current

energy supplied = power × time

$$\text{average speed} = \frac{\text{distance}}{\text{time}}$$

distance = average speed × time

$$s = \frac{(u + v)}{2} \times t$$

$$\text{acceleration} = \frac{\text{change in speed}}{\text{time taken}}$$

force = mass × acceleration

weight = mass × gravitational field strength

work done = force × distance

$$\text{power} = \frac{\text{work done}}{\text{time}}$$

power = force × speed

$$KE = \frac{1}{2}mv^2$$

momentum = mass × velocity

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

GPE = mgh

$$mgh = \frac{1}{2}mv^2$$

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

3

Answer **all** the questions.

SECTION A – Module B2

1(a) Look at the diagram.

It shows part of the carbon cycle.
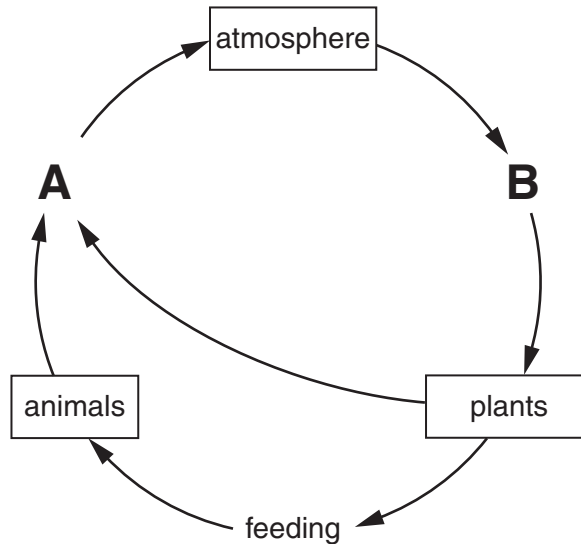
Write down the names of the two **processes A** and **B**.

A …………………………………………..

B …………………………………………..   **[2]**

(b) Nitrogen is also recycled in the environment.

Bacteria are involved in the recycling of nitrogen.

Explain how nitrifying bacteria are different to denitrifying bacteria.

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.... **[2]**

Turn over

2 Read the information about two different relationships, 1 and 2.

relationship 1 ticks and cows	relationship 2 oxpeckers and cows
Ticks are arthropods. They attach themselves to the skin of cows. They feed on the cows' blood. Some ticks carry a disease called 'African tick-bite fever'.	Oxpeckers are birds that live in Africa. They can be found sitting on the backs of cows. The oxpeckers feed on ticks that they find on the cows' skin.

(a) What type of relationship do ticks have with cows?

.... **[1]**

(b) Oxpeckers are cleaner species.

Write down the name of the type of relationship oxpeckers have with cows.

Explain your answer.

....

....

.... **[2]**

(c) Insects with the binomial name *Ctenocephalides canis* occupy a similar ecological niche to ticks.

What does that tell you about the food these insects eat?

....

.... **[1]**

3   Read the information about some different species.

Species	Where they can be found	Adaptations
A	all over North America including forests and some towns	Species **A** are omnivores so can eat both animals and plants. They can also survive in a range of climates.
B	live in eucalyptus trees in Australia	Eucalyptus leaves are toxic to most animals but not species **B**.
C	growing in the Arctic	Species **C** are plants. Their cells contain antifreeze.

Explain which of the species are **specialists** and which are **generalists**.

Explain how each adaptation helps them to survive.

🖉 *The quality of written communication will be assessed in your answer to this question.*

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.... **[6]**

Turn over

6

4   Look at the diagram. It shows part of the evolutionary tree for penguin species.

ancestor ——

Aptenodytes forsteri

Aptenodytes patagonicus

Pygoscelis papua

Pygoscelis adeliae

Pygoscelis antarctica
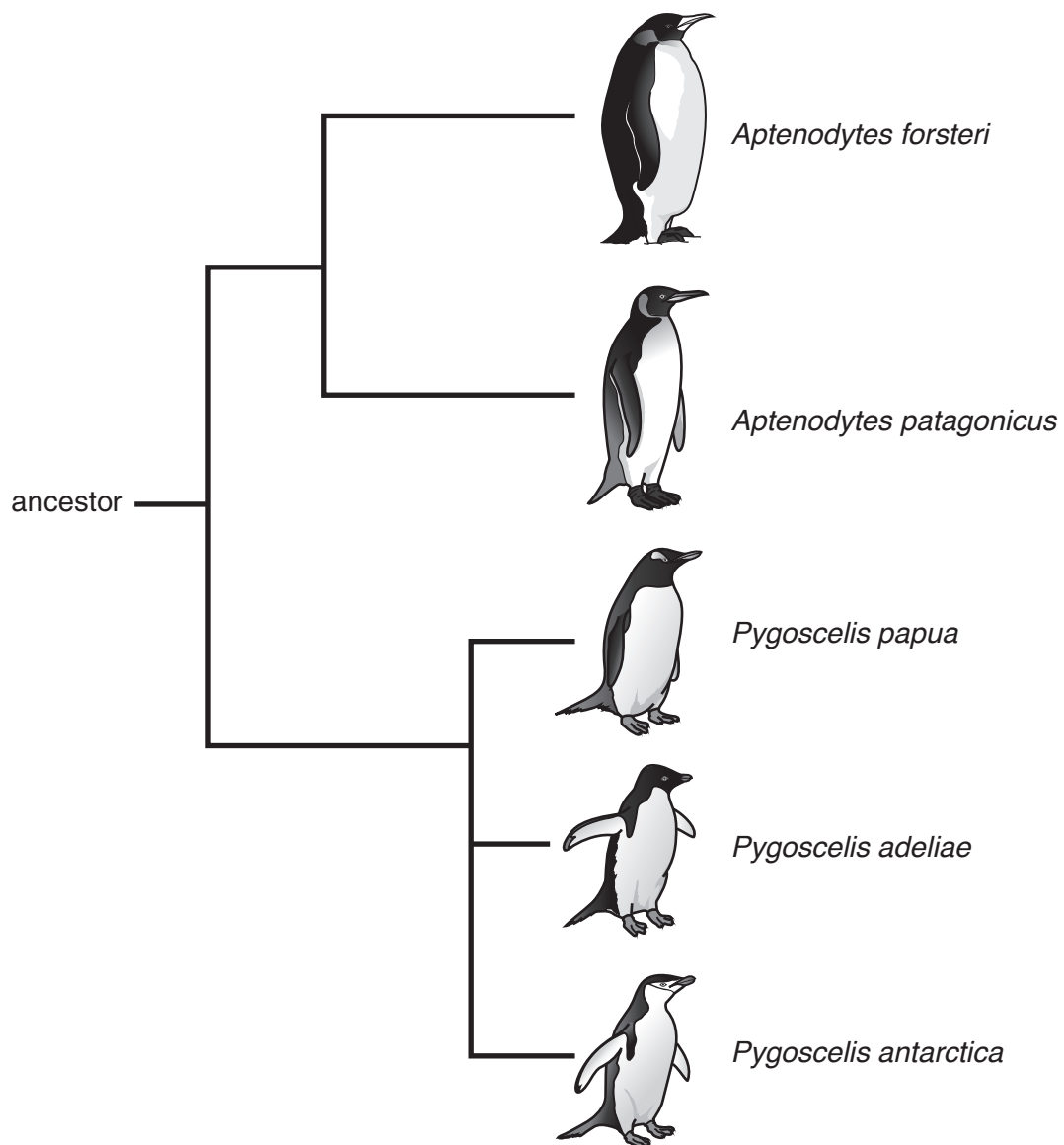
(a) Which penguin shares a **more recent** common ancestor with *Aptenodytes forsteri*?

.... **[1]**

(b) Species of penguins differ in many ways.

The evolutionary relationship of penguins is studied using ICT.

How does the use of ICT help these studies?

....

.... **[1]**

(c) Penguins are kept in zoos for captive breeding programs.

Penguins born in zoos may then be released into the wild.

The released penguins may find it hard to survive in the wild.

Suggest reasons why captive breeding programs are still important.

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.... **[2]**

Turn over

8

5 Look at the diagram.

It shows the organisms in a food chain.

Sun   plant   zebra   lion
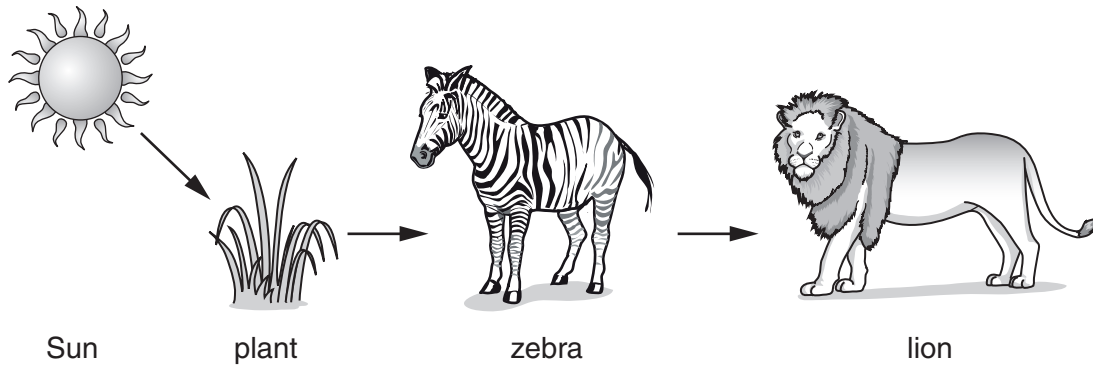
(a) (i) The plant has an efficiency of energy transfer of 1.25%.

800,000 J of energy from the Sun is available.

How much energy can be transferred to the zebra?

answer .... J   **[2]**

(ii) The zebra has an efficiency of energy transfer of 4%.

This food chain is unlikely to have a fourth trophic level.

Use your answer to part **(i)** and the zebra's efficiency of energy transfer to explain why.

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.... **[3]**

(b) Some of the energy from the zebra can be used to **start** other food chains.

Describe how.

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.... **[2]**

SECTION B – Module C2

6 Ammonium phosphate is used as a fertiliser.
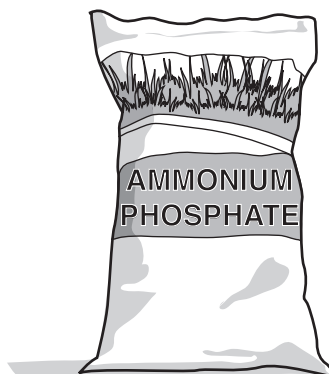
The formula for ammonium phosphate is

$$(NH_4)_3PO_4$$
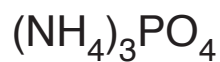
(a) (i) Complete the table.

Type of atom	Number of atoms
nitrogen, N	....
hydrogen, H	....
phosphorus, P	....
oxygen, O	....
total number of atoms	....

[2]

Ammonium nitrate is another fertiliser.

(ii) Nick wants to make ammonium nitrate by **neutralisation**.

Which acid and which alkali should he use?

.... [2]

(b) Fertilisers increase plant growth.

Explain how they do this.

....

....

.... [2]

Turn over

7   Look at the diagram. It shows the electrolysis of sodium chloride (salt) solution.
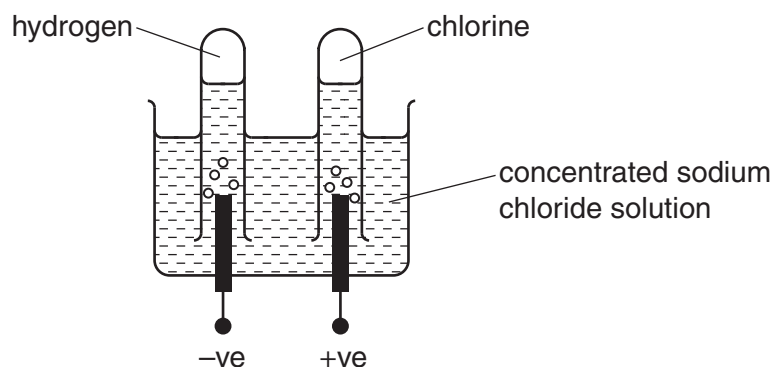
The process involves the reaction of sodium chloride and water.

Sodium hydroxide, NaOH, chlorine, Cl_2, and hydrogen, H_2, are made.

(a) Complete the **balanced symbol** equation for this reaction.

$$NaCl \quad + \quad H_2O \quad \longrightarrow$$ .... **[2]**

(b) Look at the equations for the reactions at the electrodes.

Cathode reaction $2H^+ \quad + \quad 2e^- \quad \longrightarrow \quad H_2$

Anode reaction $2Cl^- \quad - \quad 2e^- \quad \longrightarrow \quad Cl_2$
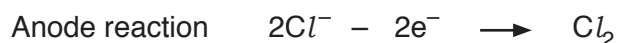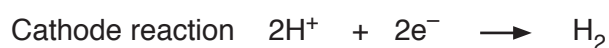
The electrolysis of sodium chloride solution involves **both** oxidation and reduction.

Explain why. Use information from the equations.

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.... **[2]**

(c) The products of this electrolysis can be used to make household bleach.

Describe how and name the active ingredient in household bleach.

....

....

.... **[2]**

8 Car bodies can be made from aluminium or from steel.
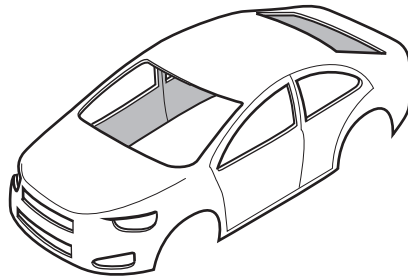
Explain the disadvantages and advantages of using aluminium and steel for making car bodies.

One has been done for you.

Disadvantage of using aluminium   It is not strong so the car is easily damaged in a crash.

Advantage of using aluminium ....

....

Disadvantage of using steel ....

....

Advantage of using steel ....

.... **[3]**

Turn over

9   John wants to replace the electrical wiring in his house.

Look at the table. It shows the properties of three metals **A**, **B** and **C**.

Metal	Density in g/cm^3	Relative flexibility (10 = high 1 = low)	Relative electrical conductivity (100 = high 10 = low)	Cost per tonne in £
A	8.9	10	64	3800
B	8.9	1	16	9120
C	2.7	8	40	1350

John needs to choose one of these metals to use as the metal in the electrical wiring for his house.

Evaluate the advantages and disadvantages of using **each metal** to make the electrical wires.

Which metal is the best choice and why?

The quality of written communication will be assessed in your answer to this question.

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.... **[6]**

10 Scientists believe that the surface of the Earth is made up of tectonic plates.

Look at the diagram. It shows a cross-section of part of the Earth.
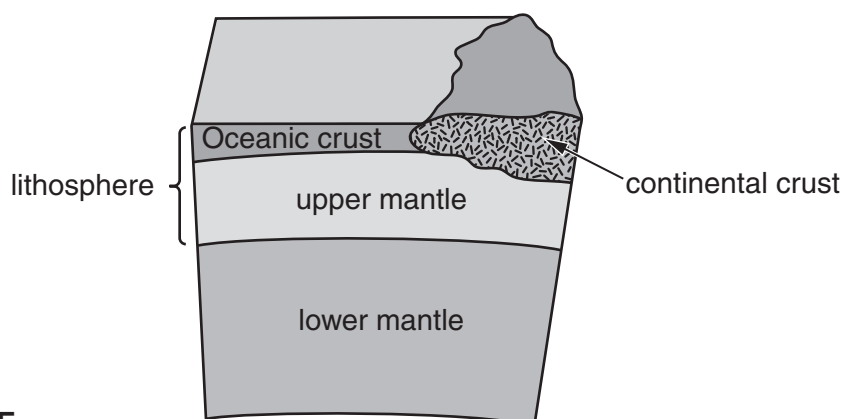
NOT TO SCALE

(a) The diagram shows the **lithosphere**.

Write about the lithosphere.

....

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.... **[2]**

(b) The theory of plate tectonics can be used to explain **subduction** at a plate boundary.

The more dense oceanic crust is forced below the less dense continental crust during subduction.
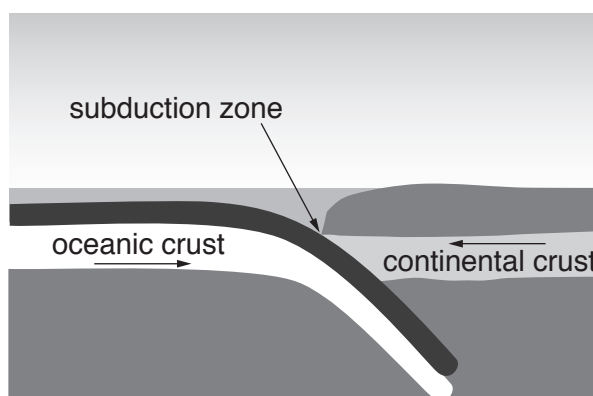
Suggest what might happen if **two continental crusts** meet at a plate boundary.

Explain your answer.

....

....

....

.... **[2]**

14

SECTION C – Module P2

11 **(a)** A Dutch company is planning to launch a manned space mission to Mars in 2026.

The journey will take about seven months.

Write about some of the difficulties of sending a manned mission to Mars.

....

....

....

.... **[2]**

(b) Rakesh has noticed that distances in space can be written in different units.

Look at the table.

Unit	Definition	Distance in km
kilometre (km)	One thousand metres	1.00
astronomical unit (AU)	Average distance between the Earth and the Sun	1.50×10^8
light year		9.46×10^{12}

(i) The table is incomplete.

Write down the definition of a light year.

.... **[1]**

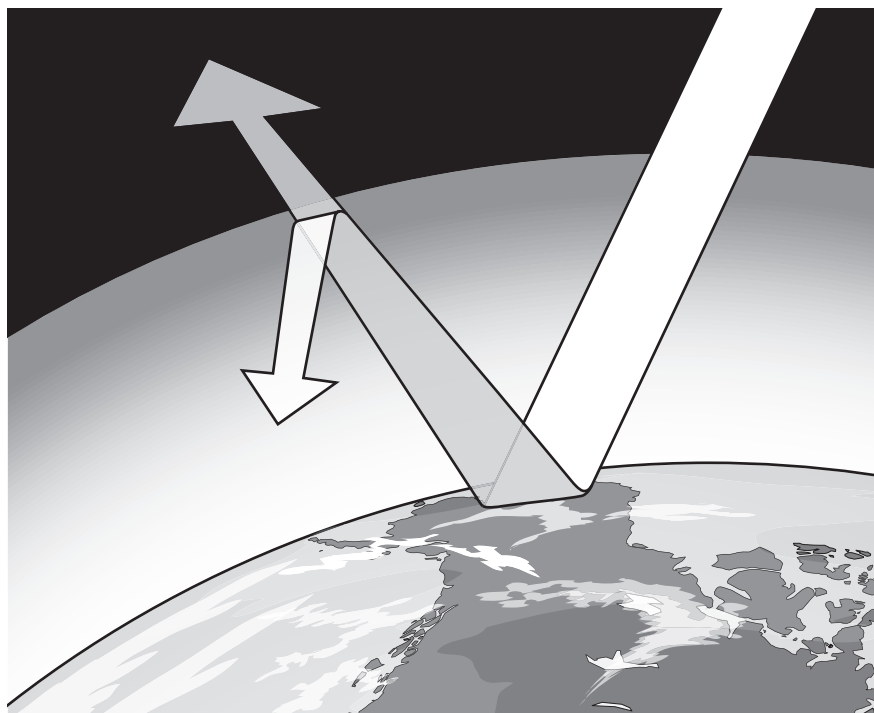**(ii)** Choose from the table which unit would be best to measure the distance from the:

Earth to Neptune ....

Earth to the Moon ....

Earth to Proxima Centauri (nearest star to Earth) .... **[2]**

12   This question is about greenhouse gases and the greenhouse effect.

Gases in the Earth's atmosphere stop heat radiation from Earth radiating into space.

Three of these gases are carbon dioxide, methane and water vapour.

Look at the diagram.

Describe some natural and man-made sources of these three gases and use the diagram to help explain the greenhouse effect.

🖉 *The quality of written communication will be assessed in your answer to this question.*

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.... **[6]**

Turn over

13 Tina would like to limit how much she spends on electricity.

There are five main appliances that Tina uses each day.

For each appliance, she writes down how long she uses it for, and its power rating.

Look at the table.

Appliance	Power in kilowatts	Time used each day in hours	Daily energy used in kilowatt hours
cooker	3.0	1.5	....
heater	3.0	2.0	6.0
washing machine	2.5	2.0	....
lights	1.0	7.0	7.0
TV	0.5	5.0	....
TOTAL			25.0

(a) Complete the three missing energy calculations in the table. **[2]**

(b) Tina wants to spend only £15 on electricity for these five appliances.

Calculate how many days Tina could use the appliances for within this limit.

One kilowatt hour costs 15p.

answer .... days **[3]**

(c) Electricity is generated in a power station.

The efficiency of the power station is 32%.

The input energy at the power station is 5.0 MJ.

Calculate the wasted energy for the power station.

wasted energy .... MJ

[3]

Turn over

14 Rhi investigates a radioactive source.

She knows that some radioactive sources emit more than one type of radiation.

Rhi puts barriers made from different materials between the radioactive source and a detector.

Look at the results of her investigation.

Count rate in counts per minute			
No barrier	**Paper**	**Aluminium**	**Lead**
500	498	325	17

Write down the type(s) of nuclear radiation given out by the source.

Explain your answer.

....

....

....

....

.... **[3]**

15 Nick has completed his homework on comets and asteroids.

> ### Comets and Asteroids Homework
>
> <u>Comets</u>
>
> These have orbits which often go beyond the Solar System.
>
> They travel fastest when they are furthest from the Sun.
>
> They have circular orbits.
>
> <u>Asteroids</u>
>
> Craters on the Moon are evidence of asteroid impacts.
>
> The asteroid belt is between Jupiter and Saturn.
>
> The gravitational attraction of Jupiter stopped a planet being formed there.

There are **three** mistakes in Nick's homework.

(a) (i) Write down the three mistakes.

1 ....

2 ....

3 ....

[2]

   (ii) For one of the mistakes, write down the correct information.

....

.... [1]

Turn over

20

SECTION D

16 This question is about saving money on household energy bills.

Look at the diagram. It shows information about energy losses from Bob's house.
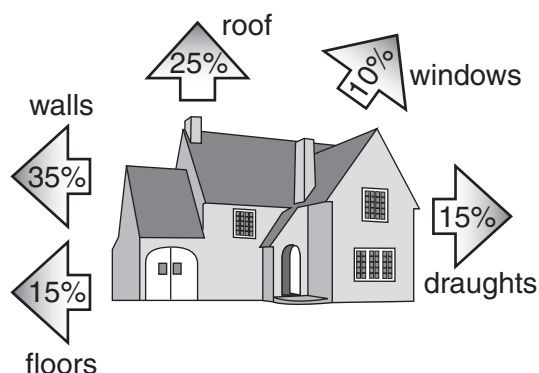
Some energy saving methods are

- cavity wall insulation

- loft insulation in roof

- draught proofing windows and doors

- double glazed windows.

(a) The diagram shows Bob's house **loses** 35% of energy through the walls.

Bob considers fitting cavity wall insulation.

His energy bills would be reduced.

Suggest reasons why his energy bills would **not** be reduced by 35%.

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.... **[2]**

(b) Look at **Table 1**. It shows

- the approximate cost to install each energy saving method

- the saving made each year

- the payback time – how long before the savings cover the cost of installation

- the saving on carbon dioxide emissions each year (carbon dioxide is linked to global warming).

Table 1

Energy saving method	Approximate cost to install in £	Saving per year in £	Payback time in years	Carbon dioxide saving per year in kg
old boiler replaced by energy efficient boiler	3100	310	10.0	1200
internal wall insulation	5500	460	11.9	1800
external wall insulation	6250	490	12.7	1900
loft insulation in roof	350	180	1.9	730
cavity wall insulation	350	140	2.5	560
replace all light bulbs with energy saving light bulbs	………..	35	17.1	110
draught proofing windows and doors	200	30	6.7	120

(i) Calculate the cost to replace all light bulbs with energy saving light bulbs.

Write your answer in the table. **[1]**

(ii) Bob decides to spend £6500 on energy saving methods.

Suggest one factor, other than those in the table, that Bob will need to consider before deciding how to spend the money.

……… **[1]**

(iii) Bob is interested in environmental issues.

Suggest which energy saving method would be **most** beneficial to the environment.

Explain your answer.

………

………

……… **[2]**

Turn over

(c) Bob is considering fitting solar panels to his roof to reduce his electricity bills.

Solar panels generate electricity.

He looks at some data for a typical house.

Look at the bar chart.

It shows the monthly electricity generation for each month of the year.

(i) Calculate the mean monthly electricity generation during the summer.

answer .... kWh **[1]**

(ii) Bob has a choice of solar panel systems.

Look at **Table 2**.

Table 2

Size of system in kW	Number of panels	Cost of installation in £	Carbon dioxide saving per year in kg	Saving per year in £	Payback time in years
2	8	4100	740	433	9
3	12	4850	1100	650	8
4	16	5600	1480	870	7

Bob wants to save as much money as possible on his energy bills.

He also wants to minimise the effect on the environment.

Bob has £6500 to spend on energy saving methods and/or solar panels.

Suggest which energy saving methods and/or solar panels he should buy.

Explain your answer.

Use information from both **Table 1** and **Table 2**.

....

....

....

....

....

.... **[3]**

END OF QUESTION PAPER

The Periodic Table of the Elements

Key

| relative atomic mass |
| **atomic symbol** |
| name |
| atomic (proton) number |

| 1 | | hydrogen | 1 |

Group 1	Group 2												Group 3	Group 4	Group 5	Group 6	Group 7	Group 0
																		4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4												11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12												27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30		70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48		115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80		204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111								

Elements with atomic numbers 112-116 have been reported but not fully authenticated

The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

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