OCR
Oxford Cambridge and RSA

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Friday 9 June 2017 – Morning

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

* B 7 1 2 0 2 *

* 6 7 5 1 3 8 8 5 3 3 *

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. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- 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 **32** pages. Any blank pages are indicated.

EQUATIONS

energy = mass × specific heat capacity × temperature change

energy = mass × specific latent heat

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

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

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

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

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Question 1 begins on page 4

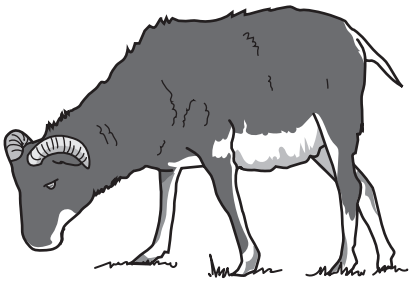
PLEASE DO NOT WRITE ON THIS PAGE

Answer **all** the questions.

SECTION A – Module B2

1 Look at the picture.

It shows a Soay sheep.

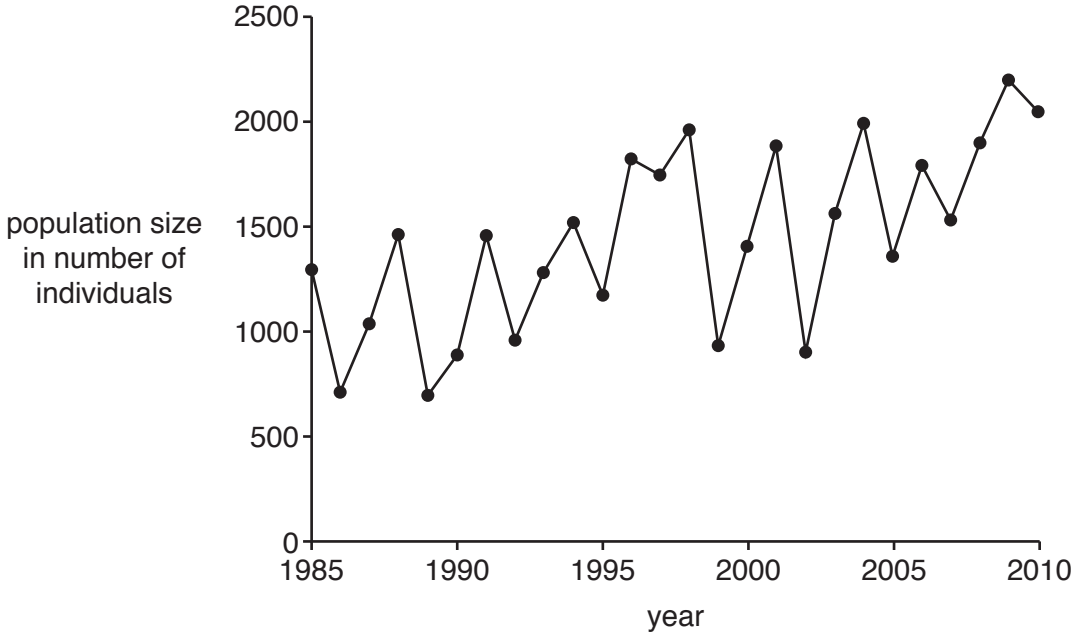


Soay sheep

There is a population of Soay sheep living on the small Scottish island of St. Kilda.

Look at the graph.

It shows the population size of Soay sheep on St. Kilda between 1985 and 2010.



(a) Does the population of Soay sheep on St. Kilda show **exponential** growth between 1985 and 2010?

Explain your answer.

.....

..... **[1]**

(b) Exponential growth in populations can have some consequences.

Write down **two** possible consequences of exponential growth.

.....

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..... **[2]**

(c) Sheep can mate with goats.

The fertilised egg formed when a sheep and a goat mate normally dies early in development.

Hybrids are rarely born.

The sheep and goat remain two separate species because their populations are isolated in this way.

Write down the name of this type of isolation and explain why it maintains two separate species.

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..... **[2]**

2 This question is about protecting the environment.

(a) Ben and Hollie want a new fire for their living room.

They have different ideas on which fire is better for the environment.

Who has the best idea on which type of fire is better for the environment?

Explain your answer.

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..... **[2]**

(b) Scientists are developing microbes that can remove sulfur dioxide from industrial waste.

Some people think using microbes to remove sulfur dioxide from industrial waste will help the environment.

Others think that it could possibly harm the environment.

Suggest one reason for both sides of the argument.

help .....

.....

harm .....

..... **[2]**

(c) Bluefin tuna are fish that are caught for food.

Fishermen are told how much bluefin tuna they can catch in one year.

This is called the **quota**.

Look at the table.
It shows the quota for bluefin tuna and the estimated total amount of bluefin tuna **actually** caught between 2005 and 2009.

Year	Quota of bluefin tuna in tonnes	Estimated total amount of bluefin tuna actually caught in tonnes
2005	32 000	48 000
2006	30 000	60 000
2007	28 000	60 000
2008	20 000	52 000
2009	12 900	46 000

(i) In 2006, the estimated total amount of bluefin tuna actually caught was 30 000 tonnes more than the quota.

This is a 100% increase on the quota.

Calculate the percentage increase on the quota for estimated catches in **2005**.

answer ..... % **[1]**

(ii) The quota is designed to prevent overfishing of bluefin tuna.

Discuss reasons why the quota may or may not be preventing overfishing of bluefin tuna.

Use the information in the table and your answer to part **(c)(i)** in your answer.

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..... **[2]**

3 **(a)** Animals and plants are classified using the binomial system.

One species of gum tree has the binomial name *Eucalyptus marginata.*

(i) The binomial name is made up of two parts*, marginata* is the species.

What is *Eucalyptus?*

Choose from.

class **family** **genus** **order** **phylum**

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

(ii) Explain why the use of binomial names is important.

.....

..... **[1]**

(b) Bushfires are fires that go out of control and can damage large areas of wild land.

Bushfires are very common in hot climates.

Eucalyptus marginata can survive bushfires by producing lots of buds just beneath the soil.

The ability to produce these buds is an **adaptation**.

(i) What controls adaptations in plants and animals?

Put a tick (✓) in the box next to the correct answer.

competition	☐
genes	☐
habitats	☐
populations	☐

[1]

(ii) *Eucalyptus marginata* has a similar **ecological niche** to other species of gum trees.

Explain what is meant by ecological niche and why similar species occupy similar niches.

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..... **[2]**

(c) Look at the picture of a koala.

Koalas are mammals native to Australia.

They are **not** found anywhere else in the wild.

Koalas were hunted and killed for the fur trade until 1927.

This hunting nearly caused the extinction of koalas.

(i) Koalas live in small, isolated populations.

Explain why this increases the risk of extinction.

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..... **[2]**

(ii) Koalas are **specialists**.
They are adapted to only eat the leaves of gum trees.

Very few other animals can eat gum tree leaves.

Other animals in the forest such as mice are **generalists**.
They eat various types of seeds, fruits, roots, small insects and worms.

Bushfires destroy most plant life above the ground, including gum trees.

Explain why koalas are better able to compete with the mice in a gum tree forest **and** suggest reasons why koalas find it harder to compete with mice following bushfires.

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

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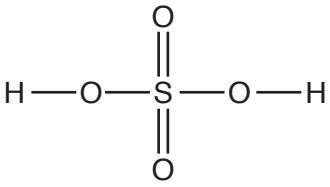
..... **[6]**

SECTION B – Module C2

4 Look at the displayed formula for sulfuric acid.



(a) What is the **molecular formula** of sulfuric acid?

..... **[1]**

(b) The atoms in a sulfuric acid molecule are held together by covalent bonds.

Explain how a covalent bond is made.

.....

..... **[1]**

(c) Sarah neutralises dilute sulfuric acid with a base.

She uses sodium hydroxide solution as the base.

(i) Write the names of the **two** compounds made when dilute sulfuric acid is neutralised by sodium hydroxide solution.

..... and ..... **[2]**

(ii) Dilute hydrochloric acid contains hydrogen ions.

Sodium hydroxide solution contains hydroxide ions, OH^-.

Construct the **ionic** equation to show the reaction of hydrogen ions with hydroxide ions.

..... **[2]**

5 David investigates different fertilisers.

(a) He finds this information from the internet.

Fertiliser	Percentage (%) by mass of element in fertiliser				Solubility in water
	Nitrogen	Oxygen	Phosphorus	Potassium	
A	34	45	0	0	very soluble
B	24	5	20	20	very soluble
C	10	40	5	0	soluble
D	0	24	15	10	soluble
E	32	10	20	25	insoluble

David concludes that fertiliser **B** is the best of the five fertilisers.

Does the information in the table support this conclusion?

Explain your answer using evidence from the table.

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..... **[2]**

(b) The manufacture of ammonia is very important in food production.

Explain why.

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..... **[2]**

6 Scientists study the structure of the Earth.

Many scientists believe in the **theory of plate tectonics**.

Describe the theory of plate tectonics and explain why the theory is now widely accepted by scientists.

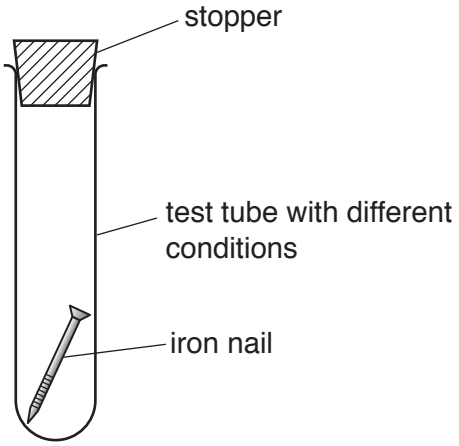
The quality of written communication will be assessed in your answer to this question.

[6]

7 Julie investigates the corrosion of aluminium and iron in different conditions.

She puts an iron nail into each three stoppered test tubes.

She leaves the test tubes for 2 weeks.



The condition inside each test tube is different.

She repeats each experiment with strips of aluminium instead of iron nails.

Look at Julie's results.

Conditions inside test tube	Result with iron	Result with aluminium
acidic moist air	nail is covered with lots of rust	very little corrosion
moist air	nail is covered with rust	no corrosion
dry nitrogen	no rust	no corrosion

(a) The results do **not** show that water is needed for rusting.

Describe an **extra** set of conditions that would need to be done to show that water is needed for rusting.

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..... **[1]**

(b) Look at the word equation for rusting.

iron + oxygen + water → hydrated iron(III) oxide

Rusting of iron is an example of **oxidation**.

How can you tell from the word equation?

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..... **[1]**

(c) Aluminium does not corrode in moist air.

This is because aluminium, Al, reacts with oxygen, O_2, to form a protective layer.

This layer is aluminium oxide, Al_2O_3.

Write the **balanced symbol** equation for this reaction.

..... **[2]**

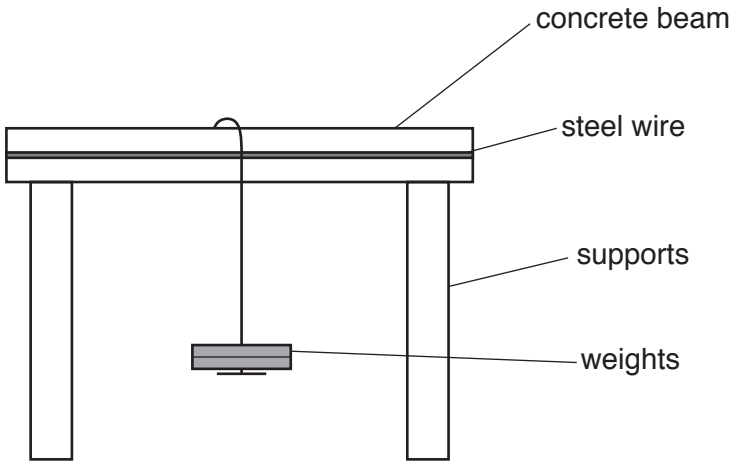
8 Ali investigates the strength of concrete beams.

He makes some beams using a cement, sand and water mixture.

Ali reinforces the beams with steel wire.

Each beam he uses has a different mass of steel wire.

Ali measures the maximum weight the beam will support before it breaks.



Ali repeats all the experiments so he can get a mean (average) result.

Look at Ali's results.

Mass of steel wire in g	Maximum weight supported by the beam in N	
	test 1	test 2
0.0	80	85
1.0	90	95
2.0	85	105
3.0	120	120
4.0	150	115
5.0	150	150

(a) Ali wants to identify any trends in the data.

Suggest how he should **process** and **present** the data in order to easily identify any trend.

Explain your answer.

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..... **[2]**

(b) **Reinforced** concrete beams are better construction materials than **non-reinforced** beams.

Explain why.

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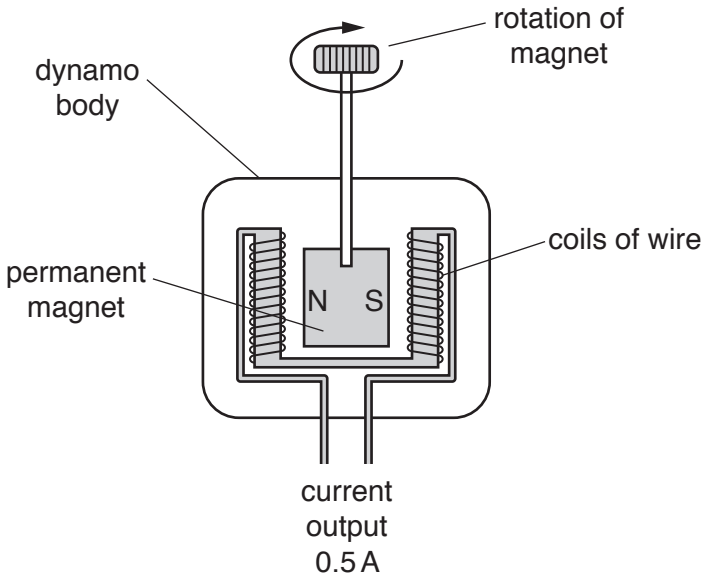
..... **[3]**

SECTION C – Module P2

9 **(a)** Bill uses a dynamo to generate electricity.

He spins the magnet at a steady speed. The current output is 0.5 A.

Look at the diagram.



Bill wants to double the output current to 1.0 A so he changes two things at once.

- he doubles the speed of rotation
- he halves the strength of the magnet.

The output current does **not** double.

Explain why and suggest the size of the output current.

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..... **[3]**

(b) Power stations produce energy but they waste energy too.

The efficiency target for a fossil fuel power station is 40%.

7 MJ of energy is wasted when the energy input to the power station is 12 MJ.

(i) Does this power station meet the 40% efficiency target?

Explain your answer using a calculation.

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..... **[2]**

(ii) Fuel is burned in power stations to produce energy.

How is this energy used to produce electricity?

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..... **[2]**

(iii) Transformers are used in power stations to pass electricity onto the National Grid.

Explain why.

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..... **[3]**

10 Nuclear scientists do lots of research into nuclear power.

These teams of scientists have investigated:

- accidents in nuclear power stations
- the nuclear industry in other countries
- the management and disposal of nuclear waste.

(a) Why is it better to use **teams** of scientists from different countries to do these investigations?

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..... **[2]**

(b) Nuclear power stations have to manage two types of waste.

- **low level** nuclear waste
- **high level** nuclear waste.

Explain some of the problems when dealing with nuclear waste and describe how the two different types of waste can be disposed of.

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

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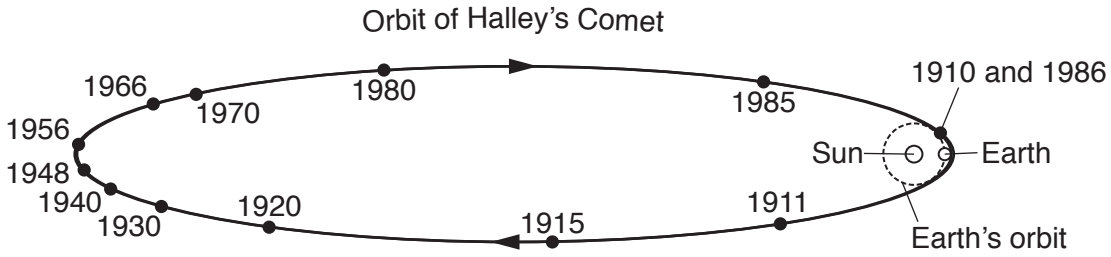
..... **[6]**

11 Halley's Comet orbits the Sun in 76 years.

It was seen from Earth for a short period in 1986 when it was near the Sun.

The speed of Halley's Comet varies from 70 km/s to 0.89 km/s.

Look at the diagram of the path of the comet. It is not to scale.



(Not drawn to scale)

(a) Use the diagram to estimate when the comet reached its highest and lowest speeds.

date of **highest** speed .....

date of **lowest** speed ..... **[1]**

(b) Explain how and why the speed of the comet changes during its orbit.

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..... **[3]**

12 Jo researches electrical safety information for household appliances.

Look at the table of her findings.

Range of current	Recommended fuse	Recommended cable
0 to 2.9 A	3 A plug fuse	5 A
3 to 4.9 A	5 A plug fuse	7 A
5 to 9.9 A	13 A plug fuse	13 A
10 to 12.9 A	13 A plug fuse	15 A
13 to 19.9 A	20 A circuit fuse	30 A static cable
20 to 49.9 A	50 A circuit fuse	60 A static cable

Jo has an electric kettle that uses 276 kJ in 2 minutes when connected to 230 V mains supply.

Calculate the current in the kettle and use the data in the table to decide which fuse and cable Jo should use for the kettle.

current = ... A

recommended fuse .....

recommended cable ..... **[3]**

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SECTION D

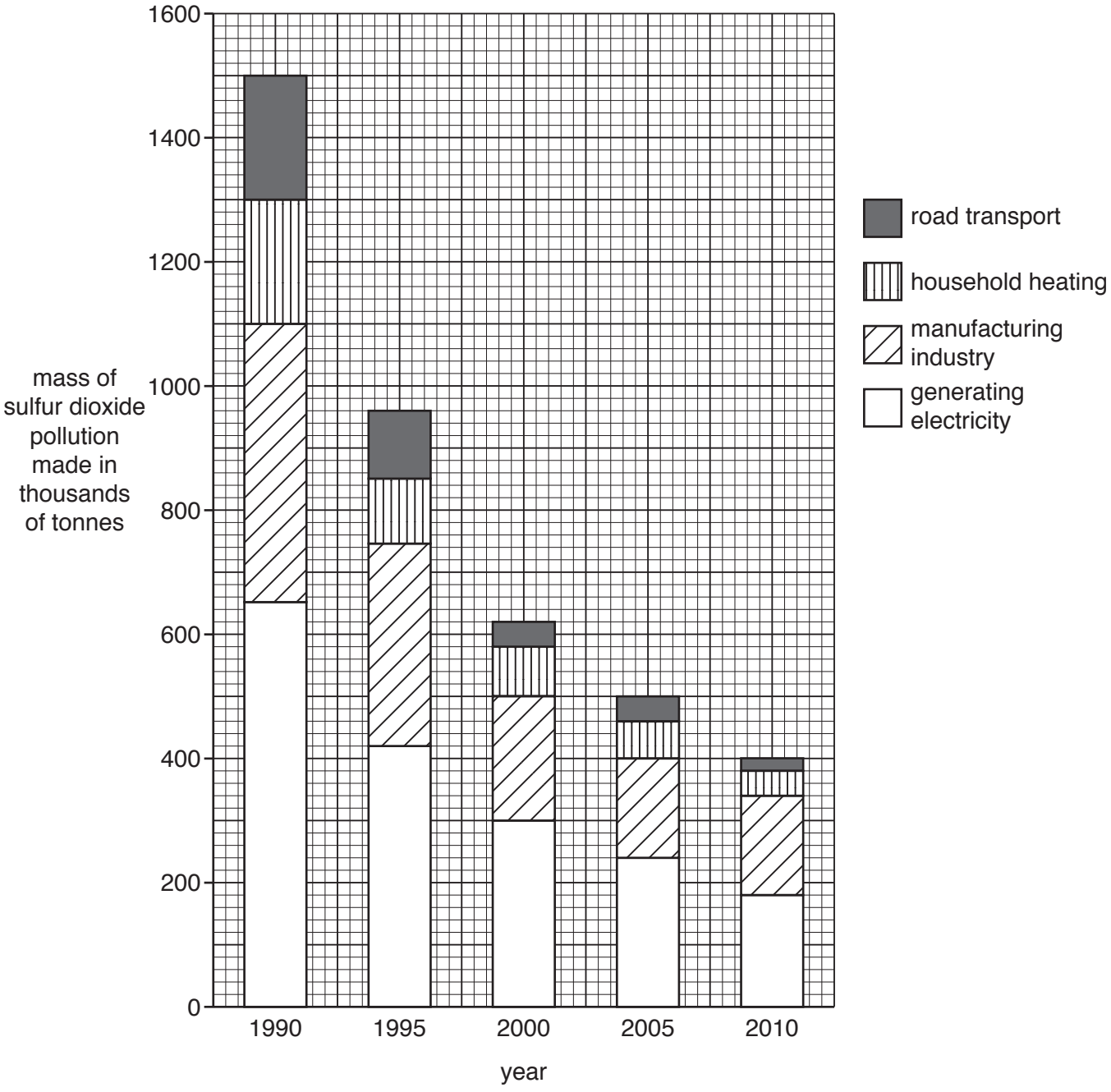
13 This question is about the atmospheric pollutants:

- sulfur dioxide, SO_2
- oxides of nitrogen, NO_x

(a) Look at bar chart 1.

It shows the mass of **sulfur dioxide** pollution made in France in different ways between 1990 and 2010.

bar chart 1



(i) What is the difference between the masses of sulfur dioxide pollution made by generating electricity between 1990 and 2010?

answer ..... thousand tonnes **[1]**

(ii) The total mass of sulfur dioxide made between 1990 and 2010 has fallen.

Suggest possible reasons why.

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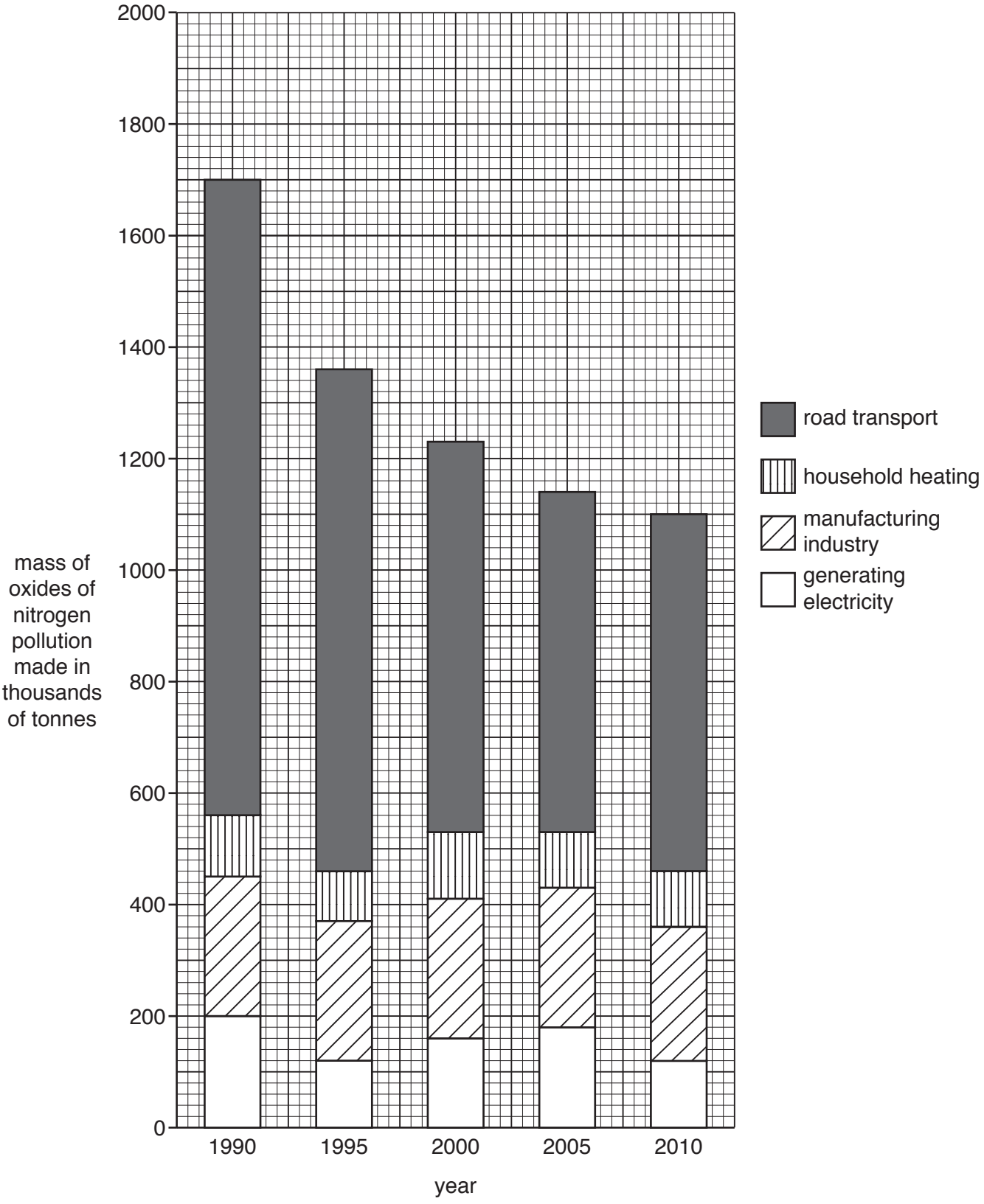
..... **[2]**

(b) Look at bar chart 2.

It shows the mass of **oxides of nitrogen** pollution made in France in different ways between 1990 and 2010.

bar chart 2



(i) Identify **three** trends about the mass of oxides of nitrogen pollution made from 1990 to 2010.

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..... **[3]**

(ii) The percentage of oxides of nitrogen pollution made by road transport in 2010 is 58.2%.

The percentage of oxides of nitrogen pollution made by household heating is 9.1%

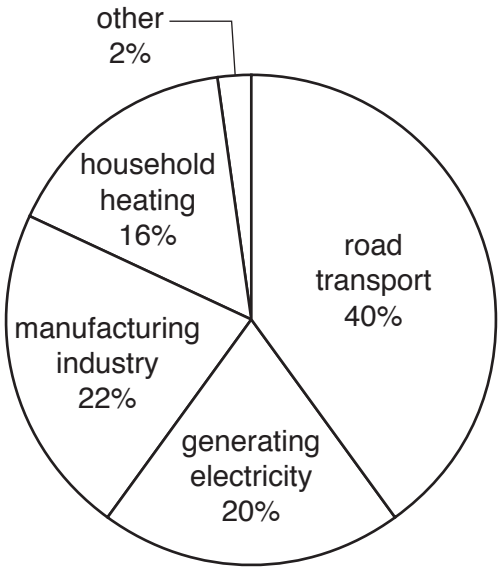
Calculate the percentages made by manufacturing industry and by generating electricity in 2010.

manufacturing industry ……..%

generating electricity ……% **[2]**

(c) Look at the pie chart.

It shows the percentages of oxides of nitrogen pollution made in different ways **in the UK** in 2010.



Use bar chart 2, your answers to part **(b)(ii)** and the pie chart to compare the production of oxides of nitrogen pollution in France and in the UK in 2010.

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..... **[2]**

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										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						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** 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.