OCR

H

Thursday 19 June 2014 – Afternoon

GCSE GATEWAY SCIENCE
FURTHER ADDITIONAL SCIENCE B

B762/02 Further Additional Science modules B6, C6, P6 (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 6 2 0 2 *

* 3 2 6 2 4 2 1 4 0 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. 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 bar codes.

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 **36** pages. Any blank pages are indicated.

EQUATIONS

$$\text{energy} = \text{mass} \times \begin{matrix}\text{specific}\\ \text{heat}\\ \text{capacity}\end{matrix} \times \begin{matrix}\text{temperature}\\ \text{change}\end{matrix}$$

$$\text{energy} = \text{mass} \times \text{specific latent heat}$$

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

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

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

$$\text{energy supplied} = \text{power} \times \text{time}$$

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

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

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

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

$$\text{force} = \text{mass} \times \text{acceleration}$$

$$\text{weight} = \text{mass} \times \text{gravitational field strength}$$

$$\text{work done} = \text{force} \times \text{distance}$$

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

$$\text{power} = \text{force} \times \text{speed}$$

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

$$\text{momentum} = \text{mass} \times \text{velocity}$$

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

$$GPE = mgh$$

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

$$v = u + at$$

$$v^2 = u^2 + 2as$$

$$s = ut + \frac{1}{2}at^2$$

$$m_1u_1 + m_2u_2 = (m_1 + m_2)v$$

$$\text{refractive index} = \frac{\text{speed of light in vacuum}}{\text{speed of light in medium}}$$

$$\text{magnification} = \frac{\text{image size}}{\text{object size}}$$

$$I_e = I_b + I_c$$

$$\frac{\text{voltage across primary coil}}{\text{voltage across secondary coil}} = \frac{\text{number of primary turns}}{\text{number of secondary turns}}$$

$$\text{power loss} = (\text{current})^2 \times \text{resistance}$$

$$V_pI_p = V_sI_s$$

Answer **all** the questions.

SECTION A – Module B6

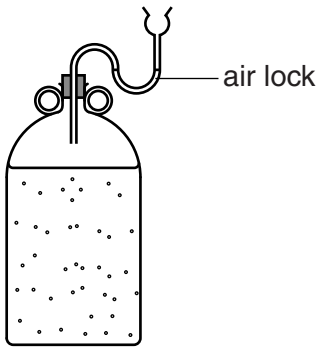
1 Tim has grown some peaches in his garden.

He gets peach juice from his peaches.

Tim knows that wine is usually made from grapes but he wants to make some wine using the peach juice.

This is possible because his peach juice contains sugar.

(a) Tim decides to make his wine in a large glass jar.



An air lock in the top of the jar allows gases to leave but stops air entering the jar.

Put ticks (✓) in the boxes next to the **two** reasons why air must not enter the jar.

Carbon dioxide from the air would kill the yeast.	☐
Nitrogen would stop the reaction.	☐
The liquid in the jar would be cooled down.	☐
Other microorganisms might enter.	☐
Fermentation is anaerobic.	☐
The sugar in the juice would be diluted.	☐

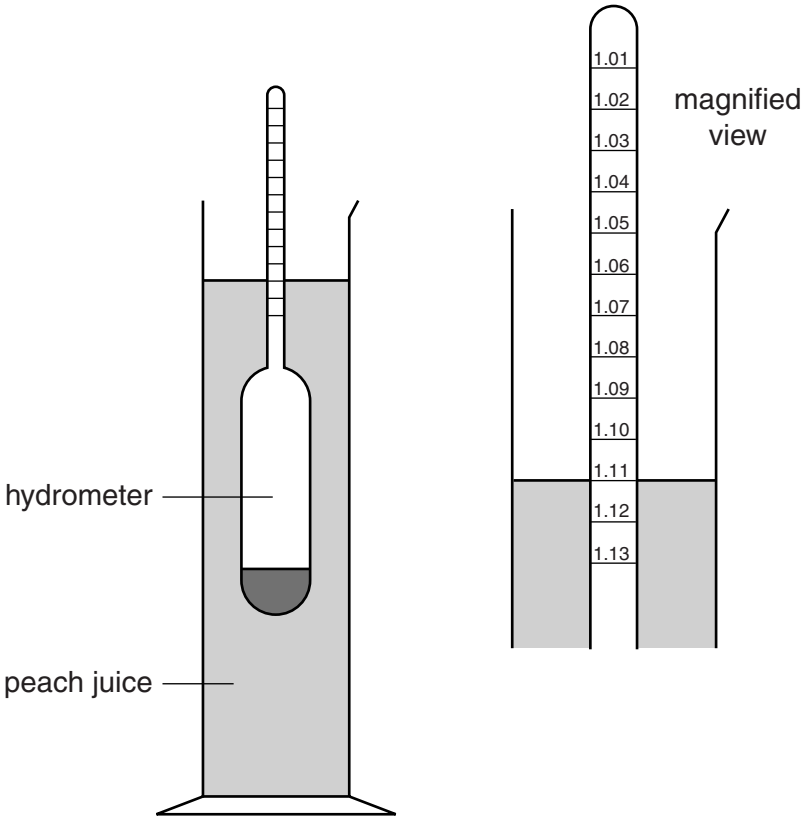
[2]

(b) Tim can find out the maximum alcohol content that can be made from his peach juice.

Tim floats a device called a hydrometer in a sample of the juice.

He can take a reading of the level of the hydrometer in the juice.

By using the table, Tim can find out the maximum alcohol content of wine this juice can make.



Reading from hydrometer	Maximum % alcohol content in the wine
1.07	9.2
1.08	10.6
1.09	12.0
1.10	13.4
1.11	14.9
1.12	16.3
1.13	17.7

Tim makes his wine and waits until it stops fermenting.

He wants to know if all the sugar from the juice has turned to alcohol.

This means the maximum alcohol content has been reached.

He uses the hydrometer this time to test his wine.

The hydrometer reading this time is **1.02**.

The actual alcohol content can be worked out using this formula:

actual % alcohol = (hydrometer reading of juice – hydrometer reading of wine) × 131

(i) Tim concludes that not all the sugar from the peach juice has turned to alcohol.

Use a calculation to find out if Tim is correct.

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

(ii) Not all the sugar has turned to alcohol even though fermentation has finished.

Suggest why.

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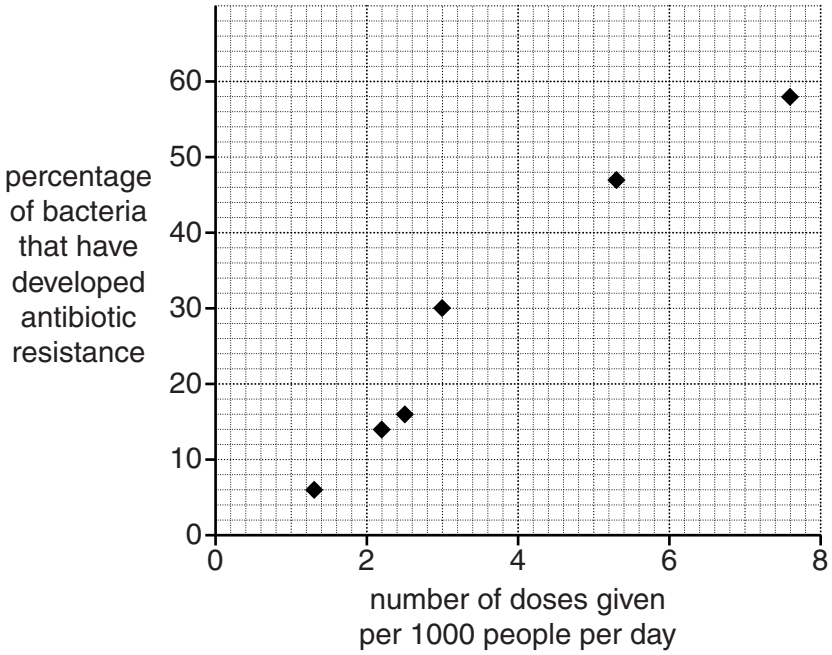
..... **[1]**

[Total: 5]

2 The graph shows data about the use of one antibiotic in different countries.

It shows the percentage of bacteria that have developed resistance to the antibiotic.



Explain how bacteria can become resistant to antibiotics.

Use evidence from the graph to support your answer.

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..... **[4]**

[Total: 4]

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Question 3 begins on page 8

PLEASE DO NOT WRITE ON THIS PAGE

3 A factory uses sugar to make sweets.

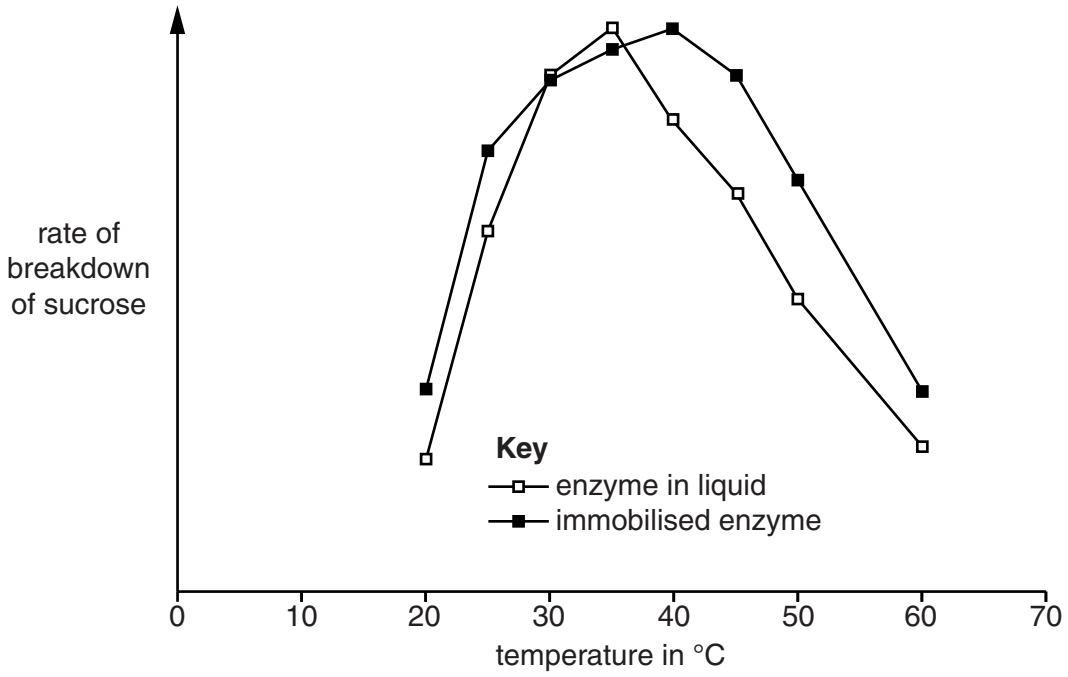
The factory buys sucrose but converts it into other sugars to make the sweets.

An enzyme called sucrase (invertase) is used to convert sucrose into other sugars.

The enzyme can be used in a liquid or it can be immobilised.

Look at the graph.

It shows how temperature affects the breakdown of sucrose using each type of enzyme.



The factory owners want to:

- make lots of sugar that is as pure as possible
- use as little energy as possible to heat the reaction.

Write about why the factory converts sucrose into other sugars, and discuss the advantages and disadvantages to the factory owners of using the **immobilised** enzyme.

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

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

[Total: 6]

4 Bacteria are often used to make human insulin by genetic engineering.

(a) Why are bacteria chosen for this process?

Put ticks (✓) in the boxes next to the **two** correct reasons.

Bacteria naturally make human insulin.	☐
Bacteria contain plasmids of DNA in their cytoplasm.	☐
Bacteria reproduce asexually to make clones of themselves.	☐
Bacteria do not get diabetes.	☐
Bacteria are resistant to insulin.	☐

[1]

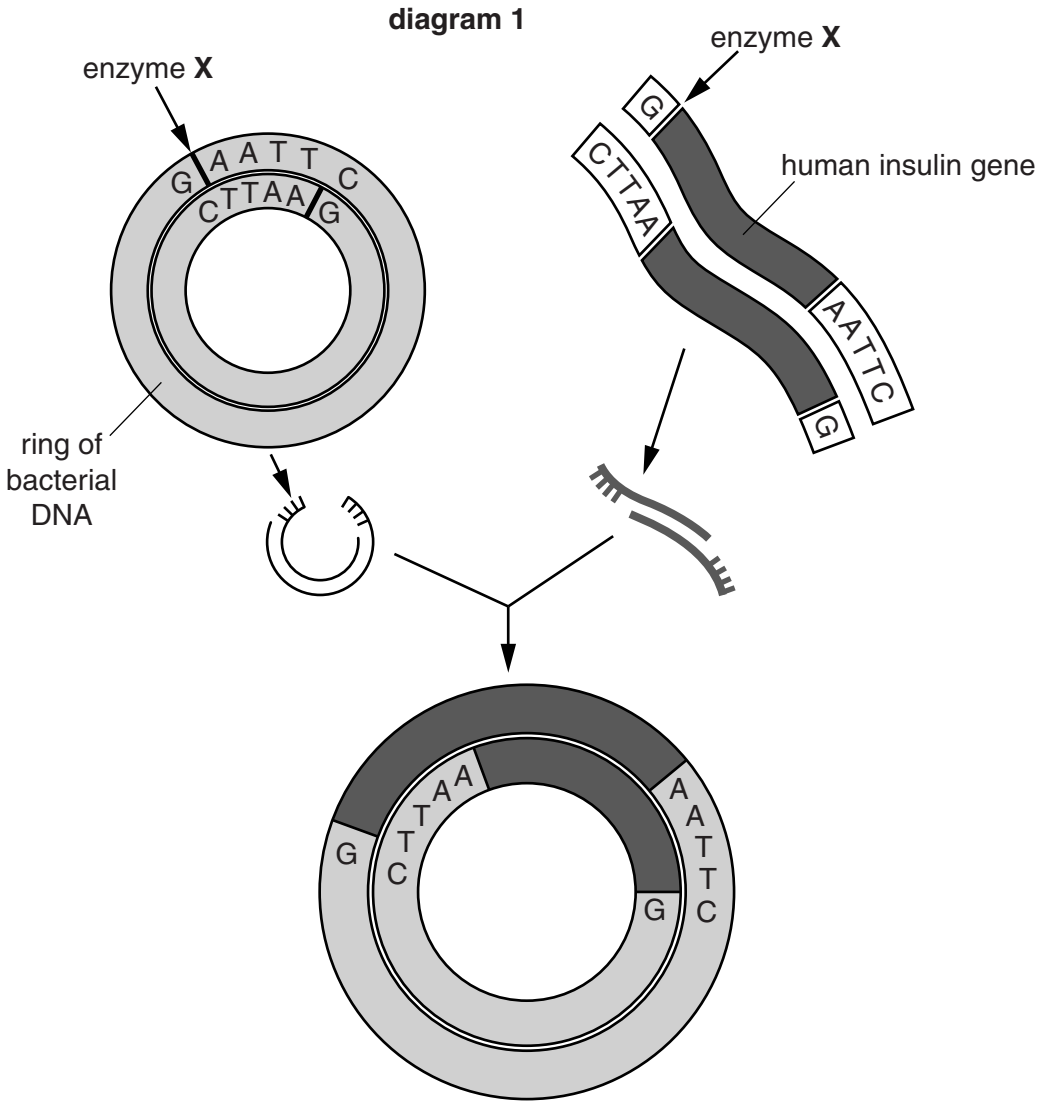
(b) **Diagram 1** shows some steps in the genetic engineering process.

It shows a ring of bacterial DNA being cut open.

It also shows a human insulin gene being cut out of a human chromosome.

The insulin gene and the bacterial DNA are then joined together.

diagram 1



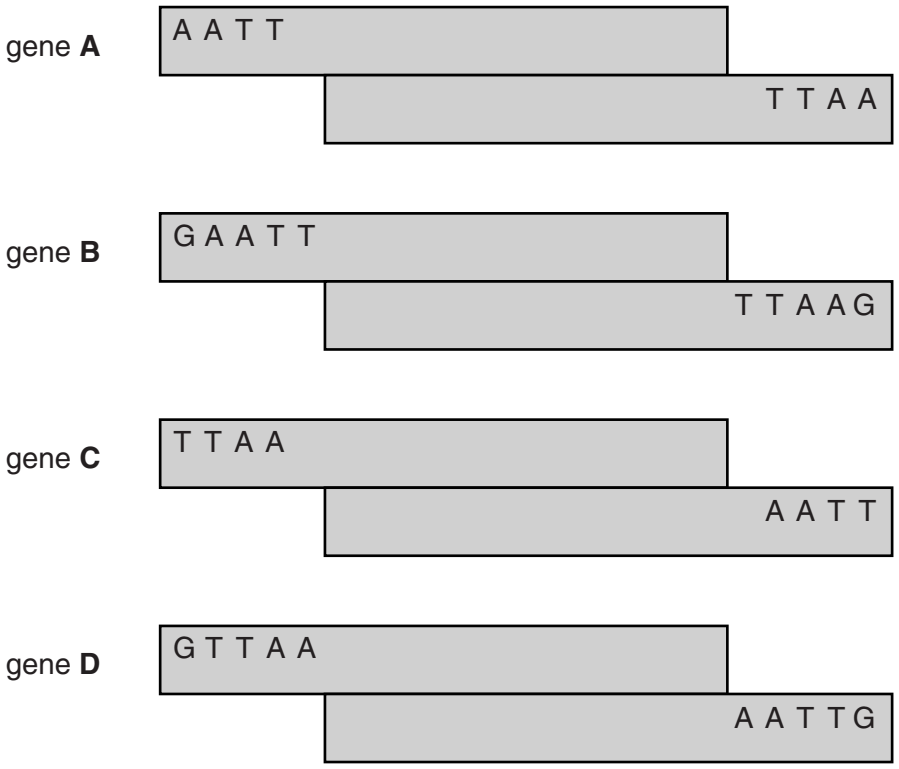
(i) What type of enzyme is enzyme **X**?

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

(ii) Look at the bases on the ring of bacterial DNA in **diagram 1**.

None of the DNA bases **in the insulin gene** are shown in the diagram.

Look at these four possible insulin genes.



Which gene, **A**, **B**, **C** or **D**, will join with the bacterial ring of DNA?

Explain your answer.

gene .....

explanation .....

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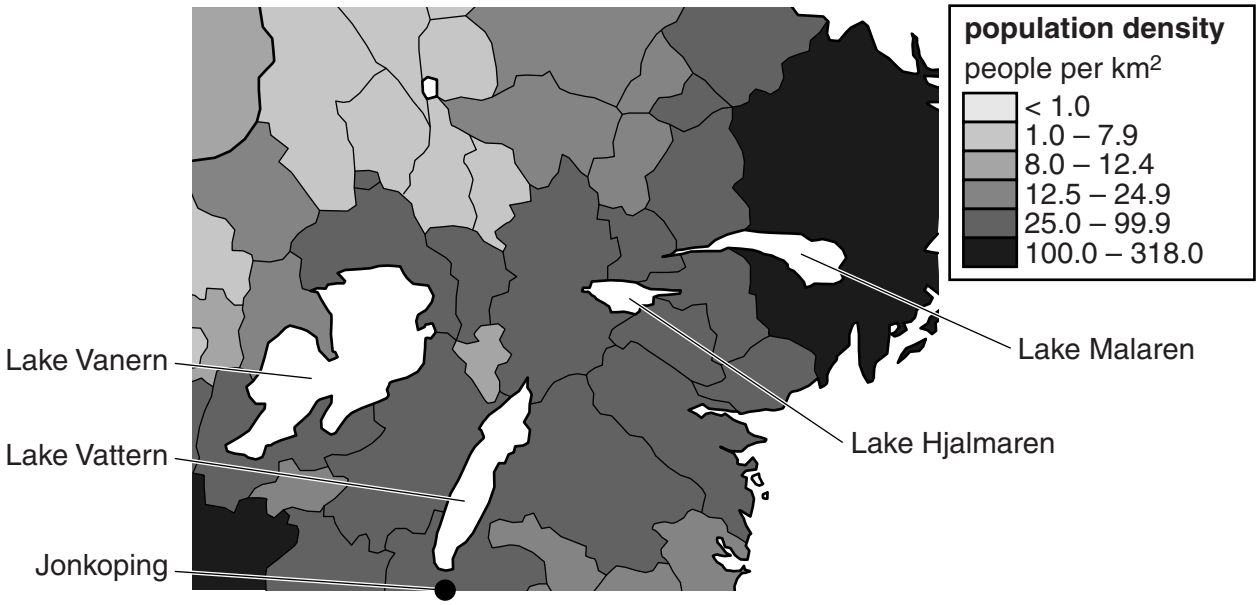
..... **[3]**

[Total: 5]

5 The map shows the number of people that live in part of Sweden.

In Sweden there are four main lakes.



Paper production is a big industry in Sweden. The main paper factories are in Jonkoping.

Scientists discovered that the four lakes were polluted.

(a) Scientists found that Lake Malaren had the lowest oxygen content in the water.

Suggest and explain why the oxygen levels were so low.

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

(b) To reduce the pollution, new water treatment works were built.

Also PCBs which were used in the paper factories were banned.

Scientists found that the pollution in Lake Malaren cleared fairly quickly.

The effects of the pollution in Lake Vattern are taking much longer to disappear.

Explain why this is taking longer.

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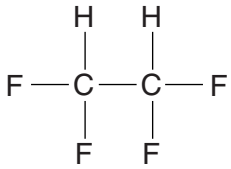
..... **[2]**

[Total: 5]

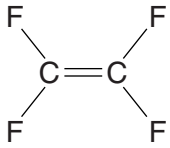
SECTION B – Module C6

6 This question is about carbon compounds.

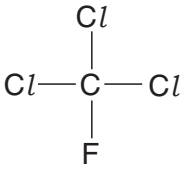
Look at the displayed formulas.



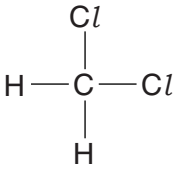
A



B



C



D

(a) Which formula shows a substance that is known to deplete the ozone layer?

Choose from **A**, **B**, **C** or **D**.

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

(b) Write down the molecular formula of compound **A**.

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

(c) One way that the ozone layer is depleted is

- chlorine atoms react with ozone molecules to make oxygen molecules and C*l*O

$$Cl + O_3 \rightarrow ClO + O_2$$

- C*l*O then reacts with oxygen atoms to make oxygen molecules and chlorine atoms

$$ClO + O \rightarrow Cl + O_2$$

A small number of chlorine atoms can destroy a large number of ozone molecules.

Explain why.

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

[Total: 4]

7 This question is about redox reactions.

(a) What is meant by a **redox** reaction?

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

(b) Iron reacts with chlorine to make iron(III) chloride.

$$2Fe + 3Cl_2 \rightarrow 2FeCl_3$$

This reaction can be split into two processes.

- iron atoms are changed into iron(III) ions, Fe^{3+}

$$Fe - 3e^- \rightarrow Fe^{3+}$$

- chlorine molecules are changed into chloride ions, Cl^-

$$Cl_2 + 2e^- \rightarrow 2Cl^-$$

Use the two processes to complete the sentences.

The substance **oxidised** is ..... .

The substance **reduced** is ..... .

The **oxidising agent** is ..... .

The **reducing agent** is ..... .

[2]

(c) The rusting of iron is another redox reaction.

Iron can be coated in a layer of zinc.

This is called **galvanising**.

Explain how galvanising protects iron from rusting.

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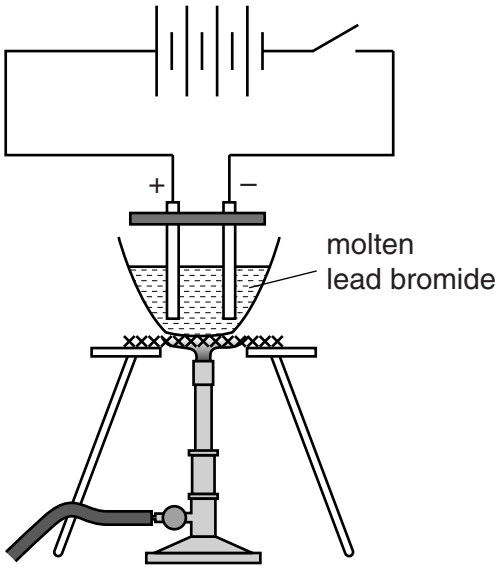
..... **[2]**

[Total: 5]

8 Gina's teacher is investigating the electrolysis of lead bromide.

Look at the diagram. It shows the apparatus she uses.



(a) **Solid** lead bromide cannot be electrolysed but **molten** lead bromide can be electrolysed.

Explain why.

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

(b) Lead bromide contains lead ions, Pb^{2+}, and bromide ions, Br^{-}.

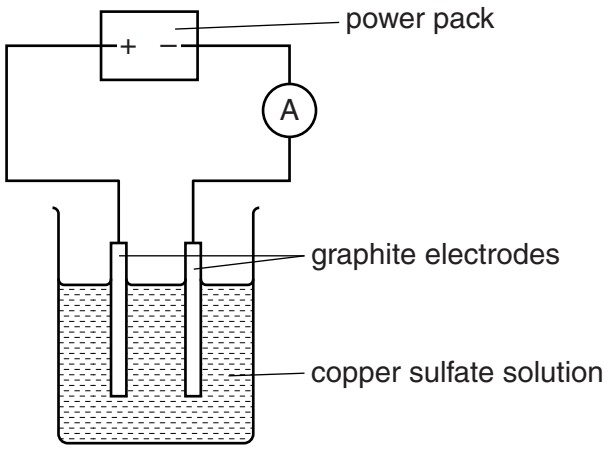
Lead is made at the cathode (negative electrode).

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

Use e^{-} to represent an electron.

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

(c) Gina now investigates the electrolysis of copper sulfate solution.



She changes the amount of current flowing.

She also changes the length of time of the electrolysis.

Each time, she measures the mass of copper made at the cathode.

Look at the table. It shows her results.

Current in amps	Time in minutes	Mass of copper made in g
0.5	10	0.1
1.0	10	0.2
2.0	10	0.4
0.5	20	0.2
0.5	30	0.3

(i) How does the mass of copper made depend on the **current** and on the **time**?

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

(ii) Predict the mass of copper made if a current of 4 amps flows for 20 minutes.

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

[Total: 7]

9 Ethanol can be made by two different methods.

The methods are **fermentation** of glucose and the **hydration** of ethene.

Look at the table. It shows information about both methods.

	Fermentation	**Hydration**
Starting material	glucose (sugar)	ethene from crude oil
Word equation	glucose → ethanol + carbon dioxide	ethene + water → ethanol
Symbol equation	$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$	$C_2H_4 + H_2O \rightarrow C_2H_5OH$
Conditions used	temperature of 40 °C presence of yeast and water	temperature of 300 °C 65 atmospheres pressure catalyst of phosphoric(V) acid
Type of process	batch	continuous
Atom economy	51%	100%
Percentage yield	15%	95%
Purification	fractional distillation	none required

Evaluate the advantages and disadvantages of **both** methods of making ethanol.

Explain which method is the best for making ethanol in the UK.

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

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[Total: 6]

10 This question is about fats and oils.

Fats react with sodium hydroxide solution to make soap.

(a) What is the name of this process?

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

(b) Bromine can be used to test for **unsaturated** fats.

The bromine is decolourised.

Explain why.

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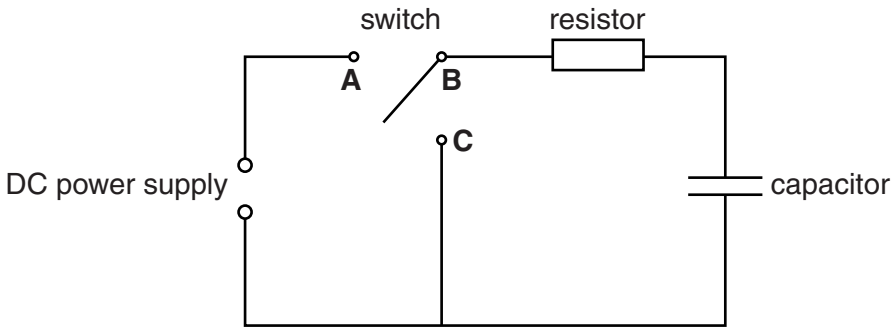
..... **[2]**

[Total: 3]

SECTION C – Module P6

11 There are many different types of electronic components.

(a) Look at the circuit. It contains a capacitor.



The capacitor is **uncharged**.

(i) The switch is connected between **B** and **C**.

The capacitor remains uncharged.

What is the voltage across the capacitor?

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

(ii) Now the switch is connected between **A** and **B**.

How does this affect the charge stored and the voltage across the capacitor?

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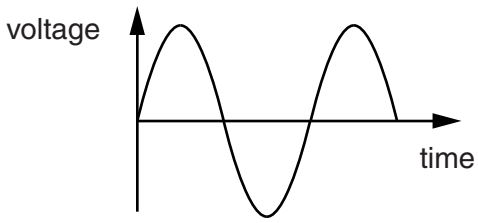
..... **[2]**

(b) Diodes can also be used in circuits.

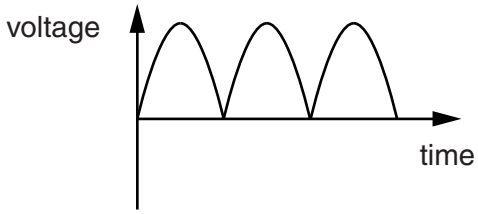
Look at the diagrams.

This diagram shows how an AC voltage changes with time.



Diodes can be used to change the AC voltage.

This diagram shows how the voltage is changed by an arrangement of diodes.



How are diodes used to produce the output shown?

You may draw a diagram to explain your answer.

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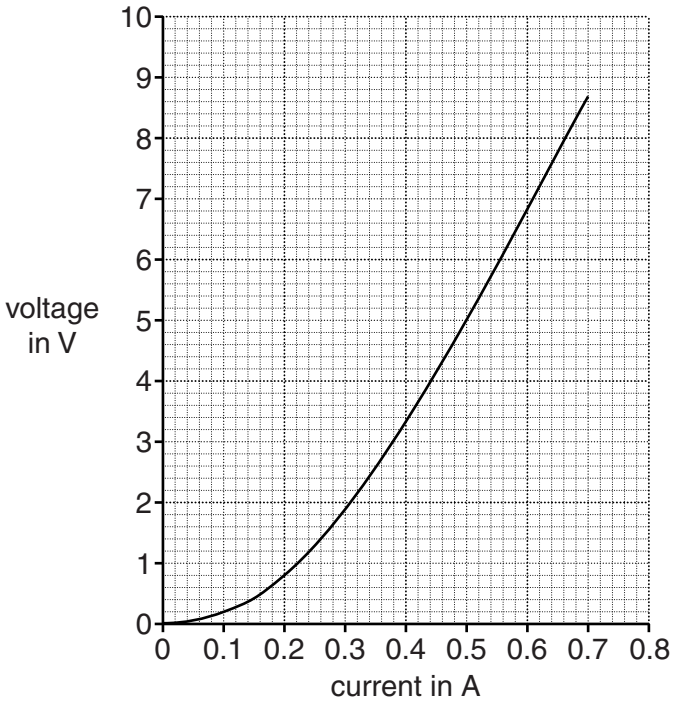
..... **[2]**

[Total: 5]

12 This question is about the voltage-current characteristics of a conductor.

Look at the voltage-current graph.



Identify the conductor and describe how the value of its resistance changes from low to high current.

Use kinetic theory to explain the changes.

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

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

[Total: 6]

13 Many electronic devices contain logic gates.

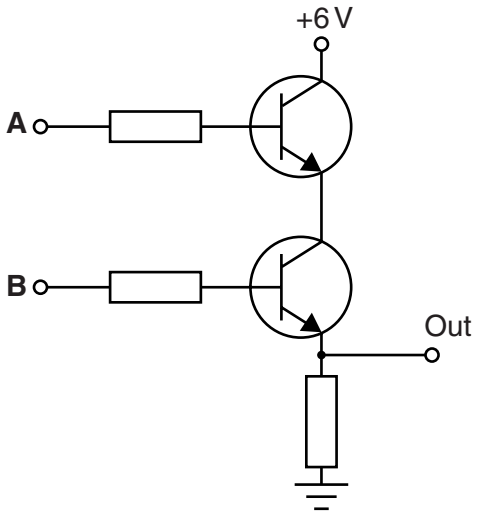
(a) Look at the truth table.

Input	Input	Output
0	0	1
0	1	0
1	0	0
1	1	0

Write down the name of the logic gate that produces this truth table.

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

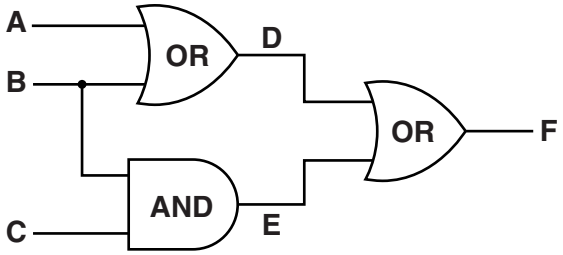
(b) Look at the diagram.



What type of logic gate is this?

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

(c) Logic gates can be combined together.



(i) Which letters represent the **input** signals to the **AND** gate?

Choose from

A and B **A and C** **B and C** **C and D** **C and E**

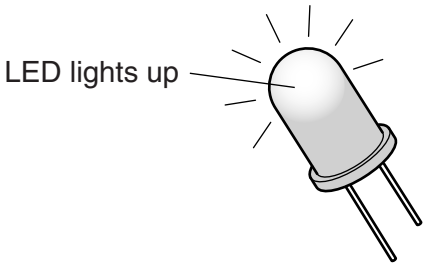
answer ..... **[1]**

(ii) Here is part of the truth table for the combination of gates shown.

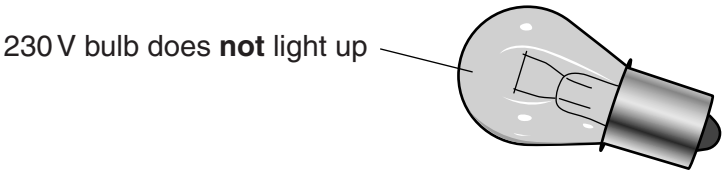
A	B	C	D	E	F
0	0	0	0	0	0
0	0	1	0	0	0
0	1	1			
1	1	1			

Complete the truth table. **[2]**

(d) A light-emitting diode (LED) is connected to the output from a logic gate circuit.



The LED is removed and a 230V bulb is connected to the same output from the logic gate circuit.



To make the 230V bulb light up a relay is needed.

The relay must be connected between the logic gate circuit and a separate circuit containing the 230V bulb.

Explain why a relay is needed and how it protects the logic gate circuit.

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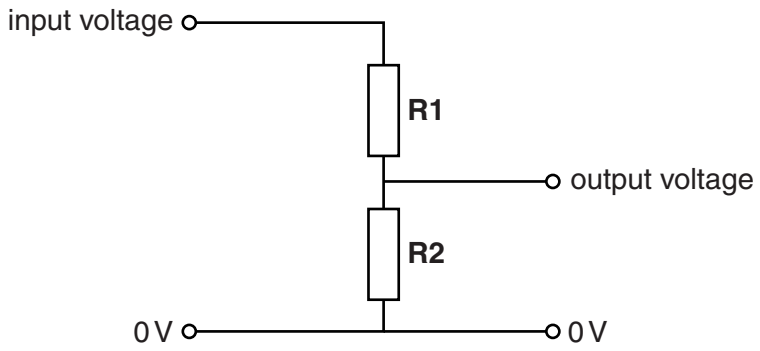
..... **[2]**

[Total: 7]

14 Louise wants to find out how potential dividers work.

(a) She connects a circuit with two resistors.



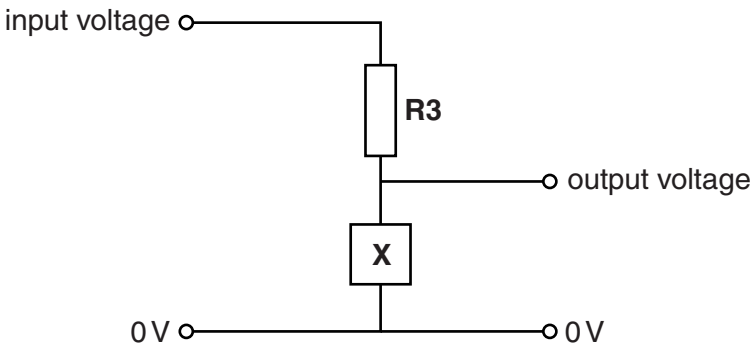
Complete the table.

Input voltage in V	R1 in Ω	R2 in Ω	Output voltage in V
12	16	8	4
12	6	6	
12	2	4	
12	24	12	

[2]

(b) Louise connects a circuit for a potential divider.

She wants the output voltage to be sensitive to temperature changes.



Write down the name of component **X** and describe how it changes the output voltage.

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

(c) Louise also has a light dependent resistor (LDR).

She measures the light levels and the resistance of the LDR during one day.

Look at her results.

Time of day	Light level in lux	Resistance in MΩ
0900	900	0.5
1200	1000	0.4
1500	800	1.0
1800	200	5.0
2100	100	10.0

Write about how the resistance changes with light levels, and the limitations of this LDR when used to detect changes in the light level during the day.

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

[Total: 7]

SECTION D

15 Some bacteria and fungi make useful products and some make harmful products.

(a) One **useful** product is yoghurt.

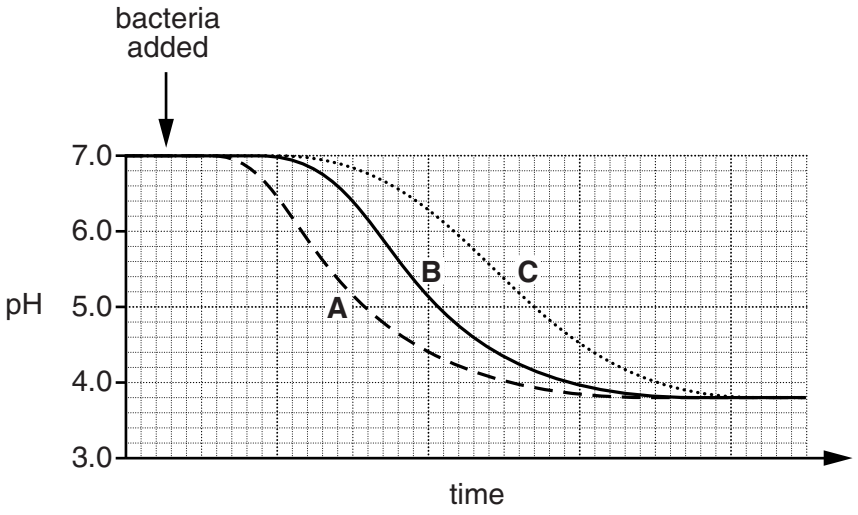
Yoghurt is made by adding bacteria to milk.

The bacteria change the sugar in milk into lactic acid.

Bacteria **A**, **B** and **C** can all be used to make yoghurt from milk.

Look at the graph.

It shows how bacteria **A**, **B** and **C** change the pH of milk.



Describe the similarities and differences of the effects of bacteria **A**, **B** and **C** on milk.

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

(b) A **harmful** product of a fungus is a chemical called aflatoxin.

Aflatoxin is sometimes found in contaminated animal food.

If the animal eats this food, aflatoxin slowly builds up in its tissues.

However, aflatoxin rapidly appears in the milk of cows after eating contaminated food.

Aflatoxin slowly breaks down in the animal.

The table shows the maximum concentration of aflatoxin allowed in animal food.

Type of animal	Mass of the animal in kilograms	Aflatoxin allowed in animal food in parts per billion
pigs	120	200
chickens	2	100
cows used for meat	700	300
cows used for milk	700	20

Look at the data in the table.

Describe the trend shown in the **first three** rows.

Explain why the aflatoxin allowed for '**cows used for milk**' does not fit this trend.

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

(c) When humans drink contaminated milk they take in aflatoxin.

The allowed concentration for aflatoxin in milk is **0.50** parts per billion (ppb).

Scientists think that adding bacteria **A**, **B** or **C** can make milk safer to drink.

Bacteria **A**, **B** and **C** were added to samples of milk that contained **1.00** ppb of aflatoxin.

After some time, the aflatoxin levels in the milk were measured.

The experiment was carried out 3 times with each type of bacteria.

The results are shown in the table.

	Concentration of aflatoxin in ppb		
Bacteria	**First trial**	**Second trial**	**Third trial**
A	0.45	0.35	0.55
B	0.50	0.48	0.58
C	0.49	0.56	0.51

(i) Write down **two** factors in the experiment that the scientists would need to keep constant.

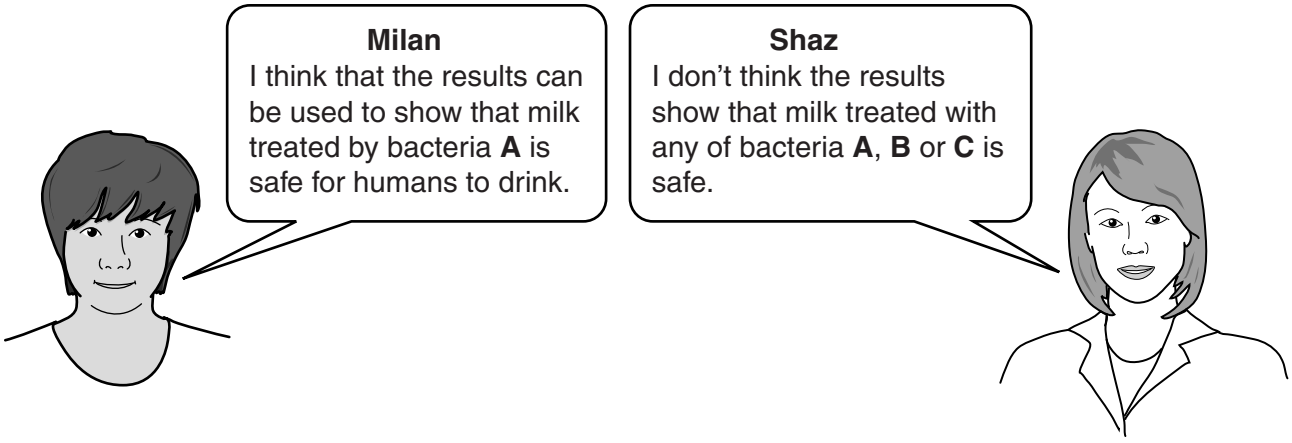
1 .....

2 .....

[1]

Question 15(c)(ii) begins on page 32

(ii) Two scientists are discussing the results of the experiment.



Use the data and suitable calculations to support the view of each of the scientists.

Milan .....

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Shaz .....

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[4]

[Total: 10]

END OF QUESTION PAPER

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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.