

**GENERAL CERTIFICATE OF SECONDARY EDUCATION
 GATEWAY SCIENCE
 SCIENCE B**

H B621/02

Unit 1 Modules B1 C1 P1
 HIGHER TIER

TUESDAY 16 JANUARY 2007

Afternoon
 Time: 1 hour

Calculators may be used.
 Additional materials: Pencil
 Ruler (cm/mm)



Candidate
 Name

Centre
 Number

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Candidate
 Number

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INSTRUCTIONS TO CANDIDATES

- Write your name, Centre number and candidate number in the boxes above.
- Answer **all** the questions.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Do **not** write in the bar code.
- Do **not** write outside the box bordering each page.
- **WRITE YOUR ANSWER TO EACH QUESTION IN THE SPACE PROVIDED. ANSWERS WRITTEN ELSEWHERE WILL NOT BE MARKED.**

INFORMATION FOR CANDIDATES

- The number of marks for each question is given in brackets [] at the end of each question or part question.
- A list of physics equations is printed on page two.
- The Periodic Table is printed on the back page.

FOR EXAMINER'S USE		
Section	Max.	Mark
A	20	
B	20	
C	20	
TOTAL	60	

This document consists of **22** printed pages and **2** blank pages.

2

EQUATIONS

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

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

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

$$\text{fuel energy input} = \text{waste energy output} + \text{electrical energy output}$$

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

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

$$\text{kilowatt hours} = \text{power (kW)} \times \text{time (h)}$$

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

3
BLANK PAGE

Section A starts on page 4.

PLEASE DO NOT WRITE ON THIS PAGE

Answer **all** the questions.

Section A

1 Many people are very overweight.

One way to lose weight is to eat less sugar.

(a) (i) Write down the name of **one** simple sugar that is found in our food.

..... [1]

(ii) Minerals are an example of a group of food substances.

Write down the name of the group of food substances that sugars belong to.

..... [1]

(b) People often try different diets to lose weight.


One new idea is called the GI diet.

Every food has a GI number.

The higher the number the faster the sugar level in the blood increases.

THE GI RATING

The Glycaemic Index (GI) measures the rate at which foods raise blood sugar levels. Foods are scored on a scale ranging from 1 to 100.



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LOW 0 – 54	
Images of apples and broccoli have been removed due to copyright restrictions	Broccoli (10)
	Peanuts (14)
	Low fat yoghurt (33)
	Wholemeal spaghetti (37)
	Apples and pears (38)
	Porridge (42)
	Stoneground wholemeal bread (53)
MEDIUM 55 – 69	
An image of a pineapple has been removed due to copyright restrictions	Honey (58)
	Basmati rice (58)
	New potatoes (62)
	Muesli (66)
Pineapple (66)	
HIGH 70 – 100	
Images of bread and doughnuts have been removed due to copyright restrictions	White bread (70)
	Short grain white rice (72)
	Watermelon (72)
	Doughnuts (76)
	Cornflakes (84)
	Baked potatoes (93)

Liz eats a meal of doughnuts and pineapple.

John eats some low fat yoghurt and honey.

Whose blood sugar level is likely to increase faster?

Explain how you decided on your answer.

Use the figures from the GI rating table.

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

(c) When food passes through the digestive system sugar passes into the bloodstream.

Describe **where** and **how** this happens.

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

(d) Scientists think that the GI diet might help prevent people from becoming diabetic.

People who are diabetic lack the hormone insulin.

Write about the role of insulin in the body.

In your answer, you should include

- what insulin does
- where it does it.

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

[Total: 8]

2 Grace is pregnant.

Rick is the father.

Grace



Rick



(a) The baby will have some of Grace's characteristics.

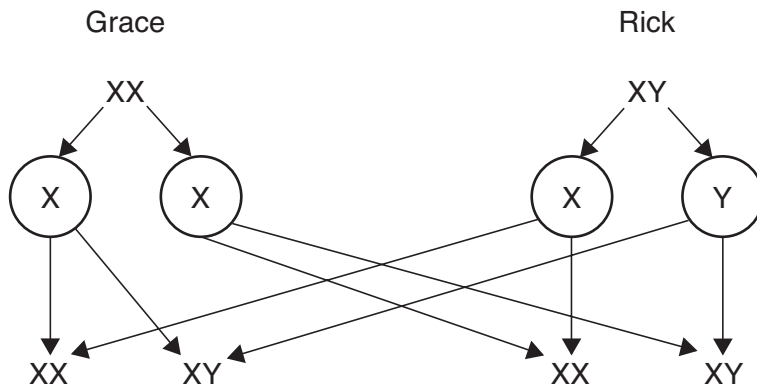
(i) Explain why the baby will have some of Grace's characteristics.

.....
 [1]

(ii) Explain why the baby will **not** have **all** the same characteristics as Grace.

.....
 [1]

(b) The diagram shows how Grace and Rick can pass on their sex chromosomes.



There is an equal chance of Grace and Rick's baby being a boy or a girl.

Explain why.

Use the diagram to help you.

.....
 [2]

- (c) Grace and Rick discover that their baby may have inherited a genetic disorder.

Grace and Rick do not have this genetic disorder.

But they have found out that they are both **heterozygous** (carriers).

Draw a genetic diagram to work out the probability of Grace and Rick's baby having the disorder.

Use **N** for the normal allele and **n** for the allele for the disorder.

probability = [3]

- (d) Suggest why Grace and Rick's discovery has made them think carefully about having more children.

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

[Total: 9]

3 This is part of a leaflet about malaria.

Protect yourself from malaria

An image has been removed due to copyright restrictions.

Details:
black and white photo of mosquito

- Malaria is one of the major causes of death worldwide. It is caused by a protozoan called *Plasmodium*.
- This organism is carried from one human to another by female *Anopheles* mosquitoes.
- If travelling to a country where there is a risk of catching malaria, there are a number of simple precautions that you can take to try to prevent getting malaria.

(a) Look at the table.

	host	parasite	vector
A	<i>Plasmodium</i>	mosquito	human
B	human	mosquito	<i>Plasmodium</i>
C	human	<i>Plasmodium</i>	mosquito

Which row in the table correctly describes the relationships mentioned in the leaflet?

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

row [1]

(b) The leaflet says that people can take 'simple precautions' to try to prevent getting malaria.

Suggest **one** 'simple precaution'.

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

(c) Antibiotics cannot be used to cure people who have malaria.

Why is this?

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

[Total: 3]

10
Section B

4 Many foods contain additives.

An additive is given an E-number.

Look at the table. It gives some information about E-numbers.

type of food additive	E-number range
food colour	E101 to E199
preservative	E200 to E299
antioxidant	E300 to E321
emulsifiers and stabilisers	E322 and E400 to E499
sweeteners	E950 to E967

Look at part of the food label found on a packet of cake mix.

<p>INGREDIENTS</p> <p>sugar, wheat flour, vegetable oil, cornflour, raising agents, whey powder, salt, milk powder, E471, E472, E450a, E153 and E104</p>

(a) Does the food contain any **food colour** additives?

Explain your answer.

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

(b) One of the raising agents is sodium hydrogencarbonate.

When sodium hydrogencarbonate is heated it breaks down.

It makes sodium carbonate, water and carbon dioxide.

Write down the word equation for the breakdown of sodium hydrogencarbonate.

.....	→	+	+
-------------------------	---	-------------------------	---	-------------------------	---	-------------------------

[1]

(c) An emulsifier is added to some foods to stop water and oil from separating.

An emulsifier molecule has a hydrophilic region and a hydrophobic region.

Look at this diagram of an emulsifier molecule.



Describe how emulsifier molecules help to stop oil and water from separating.

Use a labelled diagram to help you answer this question.

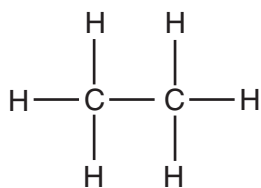
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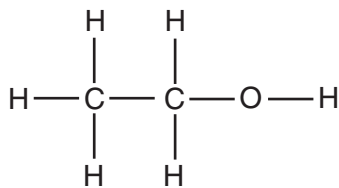
..... [2]

[Total: 4]

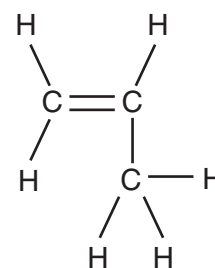
5 Look at the displayed formulae of some compounds.



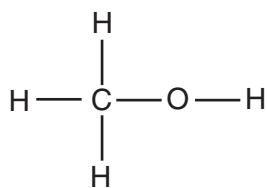
compound **A**



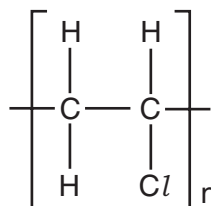
compound **B**



compound **C**



compound **D**



compound **E**

(a) Which one of the compounds has the molecular formula $\text{C}_2\text{H}_6\text{O}$?

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

answer [1]

(b) Which one of the compounds is an alkane?

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

answer [1]

(c) Which one of the compounds is an addition polymer?

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

answer [1]

(d) Which one of the compounds is an unsaturated hydrocarbon?

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

answer [1]

[Total: 4]

13
BLANK PAGE

Question 6 starts on page 14.

PLEASE DO NOT WRITE ON THIS PAGE

6 Plastics contain polymer molecules.

(a) Phil has bought a new greenhouse.

Look at the greenhouse.



© P Hills

The windows are made from a plastic rather than glass.

One of the properties that makes this plastic suitable for making windows is that it is transparent.

Suggest **two** other properties of this plastic that make it suitable for making windows in a greenhouse.

1

2 [2]

(b) Gore-Tex[®] is a clothing material.

Gore-Tex[®] contains polymer molecules.

Gore-Tex[®] clothing is very useful because it is both breathable and waterproof.

Which of these statements about Gore-Tex[®] are correct?

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

Gore-Tex[®] is obtained from plants.

Gore-Tex[®] is made from nylon and PTFE.

Gore-Tex[®] is made of polyester and PTFE.

Gore-Tex[®] is made of PTFE only.

Gore-Tex[®] contains PTFE which has small holes that let out water vapour but do not let liquid water in.

[2]

[Total: 4]

7 Look at this railway locomotive.



© P Hills

The locomotive has a large engine.

The engine burns a fuel to release heat energy.

(a) What is the name of the **type** of chemical reaction that releases heat into the surroundings?

Put a **ring** around the best answer.

conduction

convection

cracking

endothermic

exothermic

[1]

(b) The owner of the locomotive wants to change the fuel the engine burns.

Two of the factors that the locomotive owner needs to consider are

- how much the fuel costs
- how much pollution the fuel makes.

Write about **two other** factors that the locomotive owner needs to consider.

.....

.....

.....

..... [2]

(c) Many of the fuels used today are fossil fuels.

The amount of fossil fuels being used is steadily increasing year on year.

Suggest why.

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

[Total: 4]

8 Methane is a hydrocarbon found in natural gas.

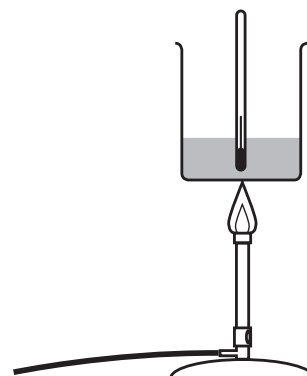
Alex and Zoe investigate the complete and incomplete combustion of methane.

They want to find out whether complete or incomplete combustion releases the most energy.

Look at the apparatus they use.

Each time Alex and Zoe use the Bunsen burner for one minute.

They use the energy released by the Bunsen burner to heat 100 g of water in the copper can.



In the first experiment the air hole of the Bunsen burner is closed. Incomplete combustion happens.

In the second experiment the air hole is open. Complete combustion happens.

Look at Alex and Zoe's results.

air hole	temperature of water at start in °C	temperature of water at finish in °C
closed	18	28
open	18	38

(a) When the air hole is closed the energy released is 4200 J.

What is the energy released when the air hole is open?

The specific heat capacity of water is 4.2J/g°C.

.....

.....

.....

.....

energy released is J [2]

(b) When the air hole is open methane, CH₄, reacts with oxygen, O₂, to make carbon dioxide and water.

Write the balanced symbol equation for this reaction.

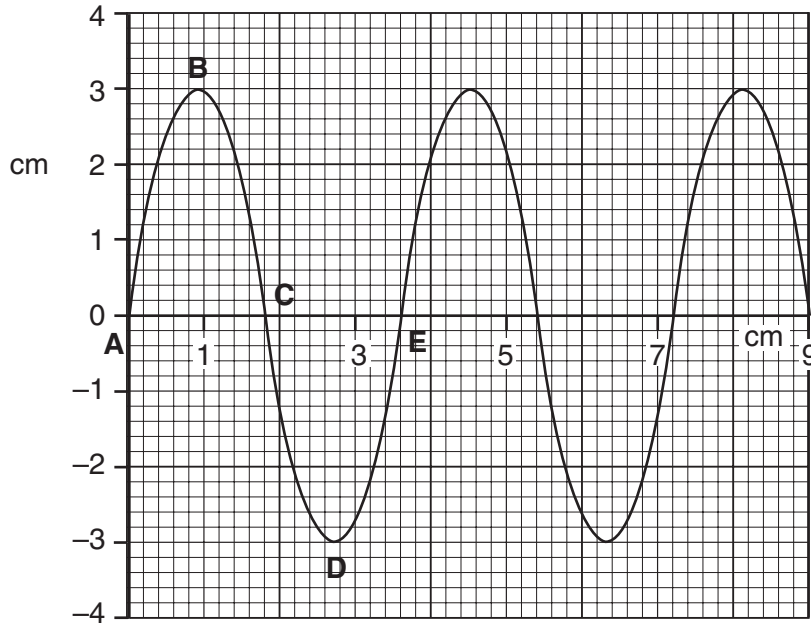
..... [2]

[Total: 4]

19
Section C

9 This question is about waves.

(a) Look at the diagram of a wave.



The diagram is drawn to scale.

What is the wavelength of the wave?

wavelength = cm [1]

(b) Wireless technology is being used more and more.

Write down the name of one piece of equipment that uses wireless technology.

..... [1]

(c) There are two types of signal used to transmit data.

One type is digital.

(i) Describe what is meant by a digital signal.

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

(ii) Radio communications use digital signals.

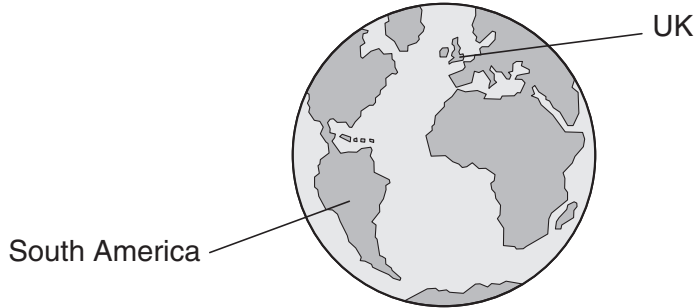
Write down **one** advantage of using digital signals in radio communications.

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

- (d) It is possible to transmit a radio signal from the UK to South America, even though the Earth is curved.

Explain how.

Drawing on this diagram may help your answer.



.....

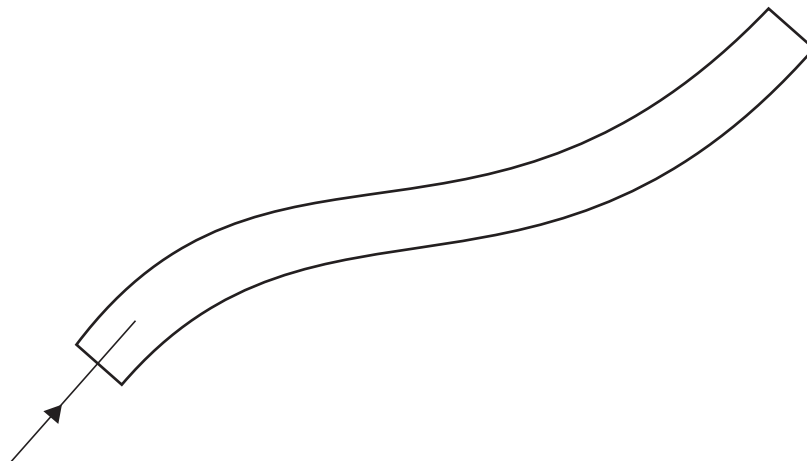
.....

..... [2]

- (e) Telephone signals are often transmitted through optical fibres.

Look at the diagram of a piece of optical fibre.

Light goes in at one end and comes out at the other end.



A ray of light is going into the fibre.

Use a ruler to draw its path along the fibre.

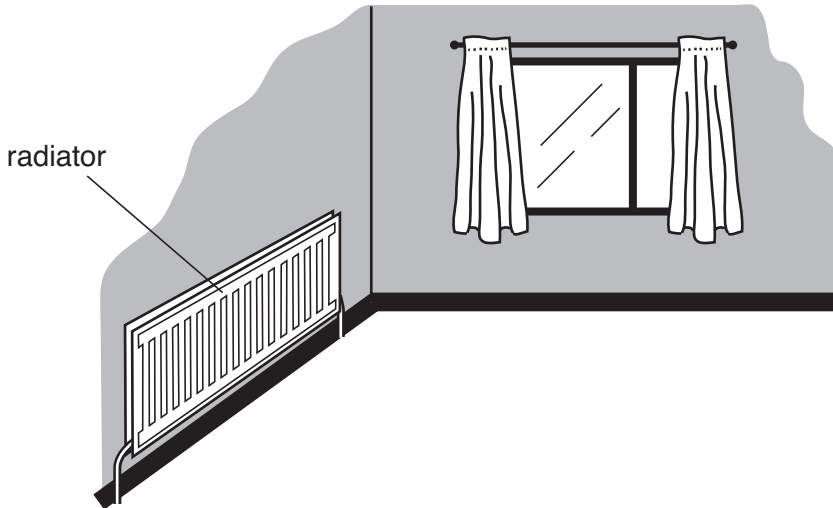
[2]

[Total: 8]

10 (a) James uses a radiator to heat his room.

The hot radiator is at one side of the room.

Look at the diagram.



The radiator warms the whole room.

Finish the paragraph, using one or more words in each space, to explain how.

The radiator has hot water inside. Heat transfers to the outside surface by the process of Air touching the radiator warms up and spreads round the room by This is because the air **expands** and becomes , rises and is replaced by cold air. [3]

(b) James puts insulation in his loft to keep his room warm.

James spends £150 on fitting the insulation in his loft.

His heating bills go down £75 each year.

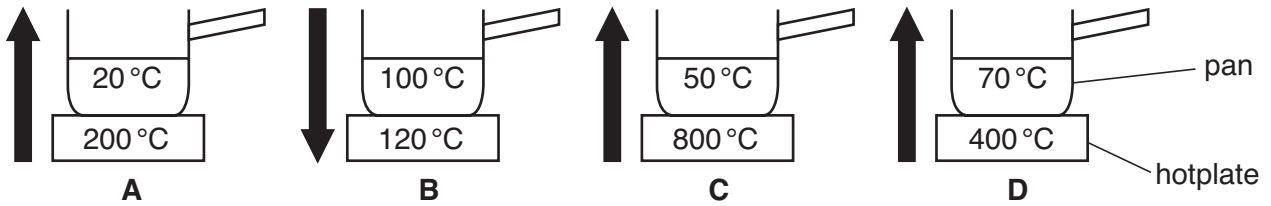
Calculate the pay back time for loft insulation.

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

[Total: 5]

11 (a) Look at the diagram of pans on some hot plates.

The arrows represent the flow of heat energy.



Which arrow is in the wrong direction for heat flow?

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

answer [1]

(b) The table shows four liquids and their specific heat capacities.

liquid	specific heat capacity J/kg °C
W	160
X	2100
Y	4200
Z	800

(i) 1 kg of each liquid is heated to 80 °C.

Which liquid will cool the quickest?

Choose from **W**, **X**, **Y** or **Z**.

answer [1]

(ii) Radiators have hot liquids inside them.

Which liquid is best for use inside a radiator to warm your house?

Choose from **W**, **X**, **Y** or **Z**.

answer

Explain your answer using information in the table.

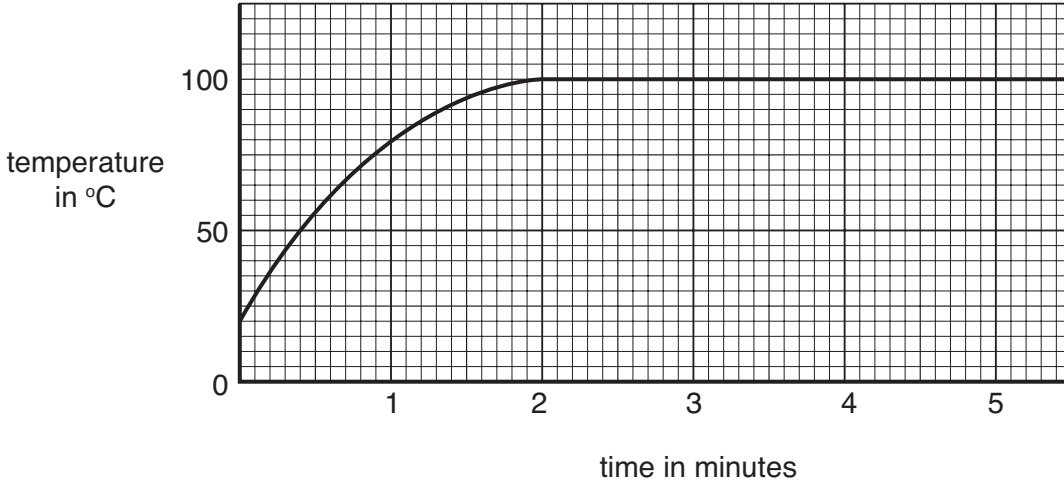
.....

[2]

(c) Polly heats some water.

She measures the temperature of the water every minute.

Look at the graph of her results.



After 2 minutes the temperature of the water stays at 100 °C.

The water is still gaining energy from the heater.

Explain why.

In your answer, write about

- what is happening to the water
- the molecules in the water
- the forces between the molecules.

.....

.....

.....

.....

..... [3]

[Total: 7]

END OF QUESTION PAPER

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The Periodic Table of the Elements

1	2	3	4	5	6	7	0										
7 Li lithium 3	9 Be beryllium 4	11 Na sodium 11	12 C carbon 6	13 Al aluminium 13	14 N nitrogen 7	15 P phosphorus 15	16 O oxygen 8	17 F fluorine 9	18 Ne neon 10								
19 K potassium 19	20 Ca calcium 20	23 Sc scandium 21	24 Ti titanium 22	25 V vanadium 23	26 Cr chromium 24	27 Mn manganese 25	28 Fe iron 26	29 Co cobalt 27	30 Ni nickel 28	31 Cu copper 29	32 Zn zinc 30	33 Ga gallium 31	34 Ge germanium 32	35 As arsenic 33	36 Se selenium 34	37 Br bromine 35	38 Kr krypton 36
37 Rb rubidium 37	38 Sr strontium 38	39 Y yttrium 39	40 Zr zirconium 40	41 Nb niobium 41	42 Mo molybdenum 42	43 Tc technetium [98]	44 Ru ruthenium 44	45 Rh rhodium 45	46 Pd palladium 46	47 Cd cadmium 48	48 In indium 49	49 Sn tin 50	50 Sb antimony 51	51 Te tellurium 52	52 I iodine 53	53 Xe xenon 54	54 Rn radon [222]
55 Cs caesium 55	56 Ba barium 56	57 La* lanthanum 57	72 Hf hafnium 72	73 Ta tantalum 73	74 W tungsten 74	75 Re rhenium 75	76 Os osmium 76	77 Ir iridium 77	78 Pt platinum 78	79 Au gold 79	80 Hg mercury 80	81 Tl thallium 81	82 Pb lead 82	83 Bi bismuth 83	84 Po polonium [209]	85 At astatine [210]	86 Rn radon [222]
87 Fr francium 87	88 Ra radium 88	89 Ac* actinium 89	104 Rf rutherfordium [261]	105 Db dubnium [262]	106 Sg seaborgium [266]	107 Bh bohrium [264]	108 Hs hassium [277]	109 Mt meitnerium [268]	110 Ds darmstadtium [271]	111 Rg roentgenium [272]	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

1	H hydrogen 1
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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