

Tuesday 24 January 2012 – Morning**GCSE GATEWAY SCIENCE
SCIENCE B****B621/02** Unit 1 Modules B1 C1 P1 (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

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 number of marks 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.
- The total number of marks for this paper is **60**.
- This document consists of **28** pages. Any blank pages are indicated.

2

EQUATIONS

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

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

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

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

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

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

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

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

3

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Question 1 begins on page 4.

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4

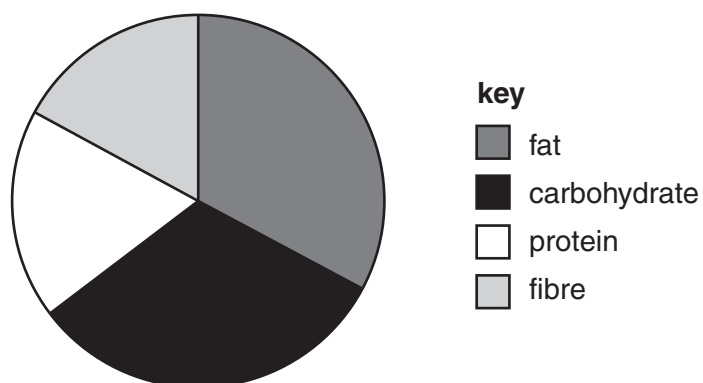
Answer **all** the questions.**Section A – Module B1**

- 1** Four people decide to go on four different diets.

The table shows each person's daily intake when they are on their diets.

person	energy in kJ	fat in g	carbohydrate in g	protein in g	fibre in g
Jilly	5406	120	16	62	16
Arthur	3570	12	154	32	62
Gazza	4692	78	76	44	40
Aqsa	5134	102	30	68	18

- (a)** The pie chart shows one person's diet.



Which person's diet is shown in the pie chart?

..... [1]

- (b)** Jilly has a body mass of 80 kg.

- (i)** Calculate Jilly's recommended daily average (RDA) protein intake.

Use the formula below to help you.

$$\text{RDA in g} = 0.75 \times \text{body mass in kg}$$

Jilly's RDA = g

[1]

5

(ii) Does Jilly's diet provide her with enough protein?

answer

Explain your answer.

..... [1]

(c) Jilly and Aqsa have high fat diets.

Finish the sentences about how fat is digested and absorbed.

Fat is digested by an enzyme called lipase.

Bile speeds up the rate of digestion by

.....

.....

The products of fat digestion are absorbed into the blood or into the [2]

[Total: 5]

- 2 Justin has some relatives who have Marfan syndrome.

He finds some information about the syndrome in a book.

Marfan syndrome is caused by a dominant allele.

This allele codes for a chemical called fibrillin.

People with Marfan syndrome have several symptoms.

One of these is a weakness in the wall of the aorta, the main artery in the body.

- (a) (i) Marfan syndrome is caused by a dominant allele.

What is an allele?

..... [1]

- (ii) What type of chemical is fibrillin?

Put a ring around the correct answer.

base DNA protein sugar

[1]

- (iii) People who have Marfan syndrome have to stop their blood pressure getting too high.

Write down **one** lifestyle change that can reduce blood pressure.

..... [1]

- (b) Justin's grandfather has Marfan syndrome but his mother and father do not.

Justin is worried that he might have inherited the syndrome.

What is the probability that Justin has inherited the syndrome?

Explain your answer.

.....

 [2]

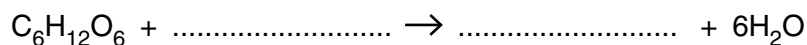
[Total: 5]

7

- 3 The muscles of an athlete running a race work hard.

The muscles use aerobic respiration to release energy from glucose ($C_6H_{12}O_6$).

- (a) Complete the balanced symbol equation for aerobic respiration.

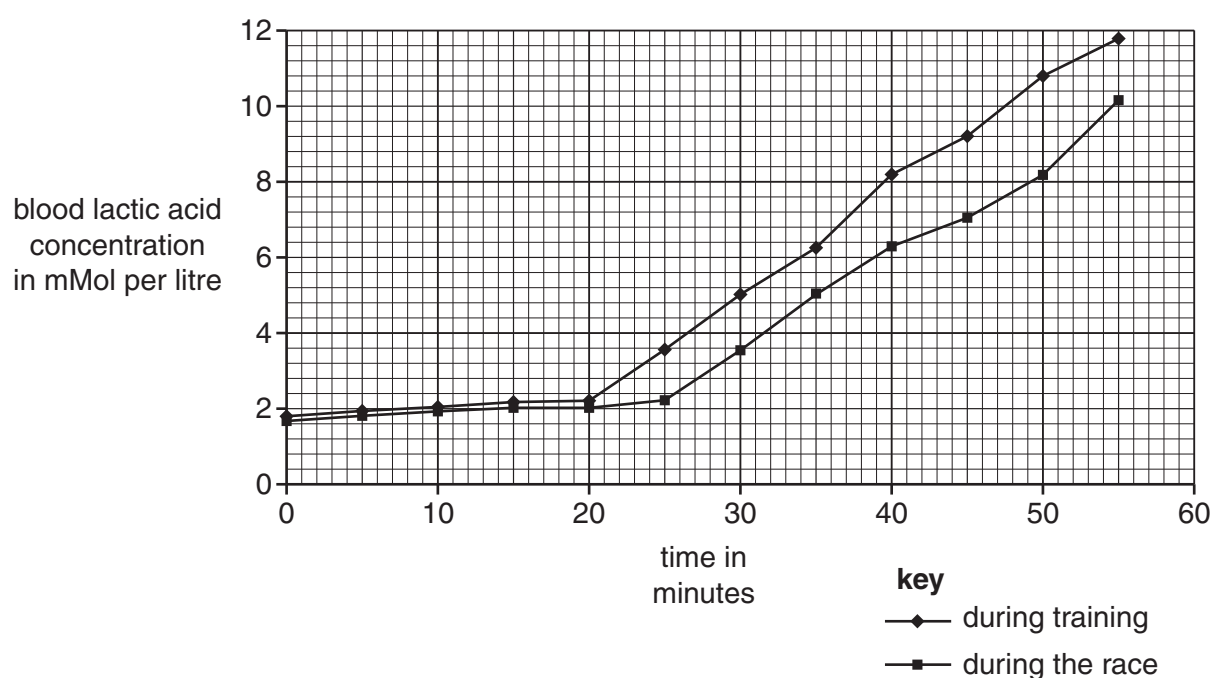


[2]

- (b) Glenn is training to run a marathon race.

When he runs, his muscles start to make lactic acid and this passes into his blood.

The graph shows the lactic acid concentration in Glenn's blood during his first training run and during the first part of the race.



Use the graph to explain why an athlete can run more efficiently when he has trained for a race.

.....

.....

..... [2]

- (c) Some athletes try to improve their performance by taking drugs.

Which type of drug is most likely to improve an athlete's performance?

Put a (ring) around the correct answer.

anabolic steroids

aspirin

LSD

temazepam

[1]

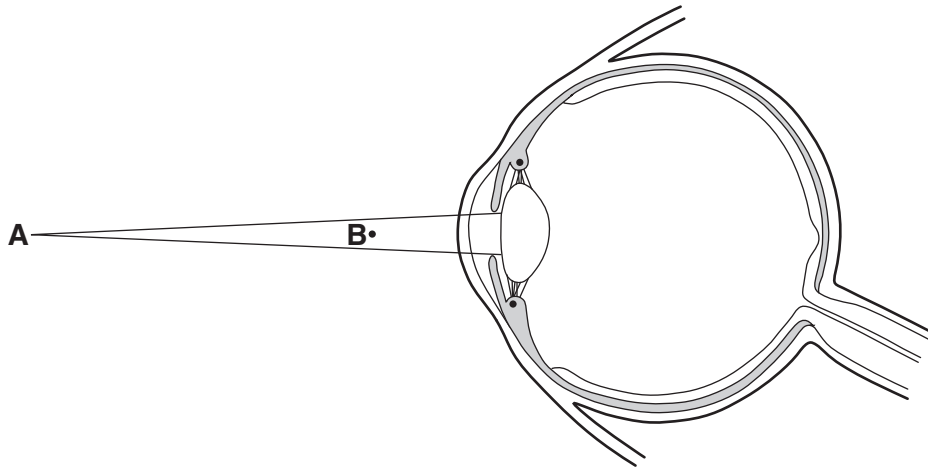
[Total: 5]

Turn over

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- 4 (a) Look at the diagram of the eye.



- (i) The eye focuses light from point **A**.

Draw lines on the diagram to continue the rays of light so that they are focused on the retina. [1]

- (ii) The eye now focuses on light from point **B**.

Describe the changes that occur in the eye to allow the light from point **B** to be focused on the retina.

.....

.....

.....

..... [2]

- (b) Some people have problems with their eyes.

These problems are caused by something wrong in the eyes.

Finish the table.

eye problem	what is wrong in the eyes
long-sight	
red-green colour blindness	

[2]

[Total: 5]

Section B – Module C1

5 Crude oil is used to make many substances.

(a) Crude oil is a fossil fuel.

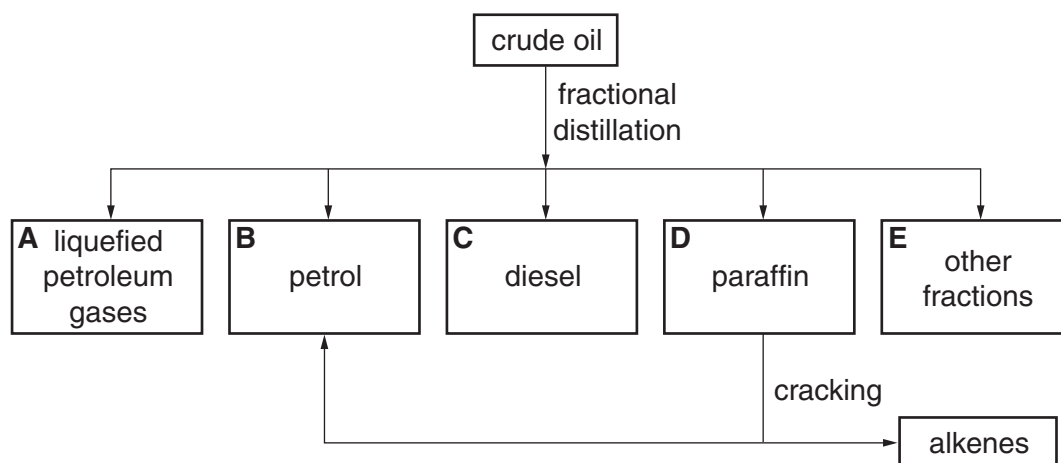
Fossil fuels are non-renewable.

Explain why.

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

(b) Look at the flow chart.

It shows some of the substances that can be made from crude oil.



(i) Fractional distillation separates crude oil into fractions.

Explain how.

Use ideas about boiling point, molecular size and intermolecular forces.

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

11

- (ii) One of the hydrocarbons in paraffin has the formula $C_{11}H_{24}$.

When this hydrocarbon is cracked it makes only **two** products.

One of the products has the molecular formula C_3H_6 .

What is the formula of the other product?

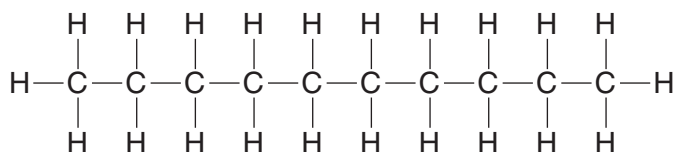
..... [1]

- (c) Each fraction contains hydrocarbon molecules.

Look at the table.

fraction	number of carbon atoms in each hydrocarbon molecule	boiling temperature in °C
liquefied petroleum gases (LPG)	1–4	below 30
petrol	5–9	30–175
paraffin	10–16	176–275
diesel	12–25	276–375

Look at the displayed formula for hydrocarbon **X**.



In which fraction is hydrocarbon **X** found?

Choose from the table.

answer [1]

[Total: 5]

- 6 Aircraft use a hydrocarbon fuel to power their jet engines.



- (a) One of the hydrocarbons in the fuel is called dodecane.

Write a **word equation** to show the **complete combustion** of dodecane.

..... [2]

- (b) The owners of the aircraft want to change the fuel the engines burn.

Two of the factors the owners need to think about are

- the energy released per kilogram
- the cost.

Write down two **other** factors the owners need to think about.

1

.....

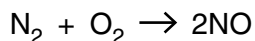
2

..... [2]

13

- (c) The jet engines of an aircraft make a pollutant called nitrogen monoxide, NO.

The temperature inside a jet engine is so high that nitrogen can react with oxygen.



Which one of the following sentences explains why this reaction is **endothermic**?

Put a tick (✓) next to the correct sentence.

The energy absorbed when making bonds is smaller than the energy absorbed when breaking bonds.

☐

The energy absorbed when making bonds is greater than the energy absorbed when breaking bonds.

☐

The energy released when making bonds is smaller than the energy absorbed when breaking bonds.

☐

The energy released when making bonds is greater than the energy absorbed when breaking bonds.

☐

The energy released when making bonds is greater than the energy released when breaking bonds.

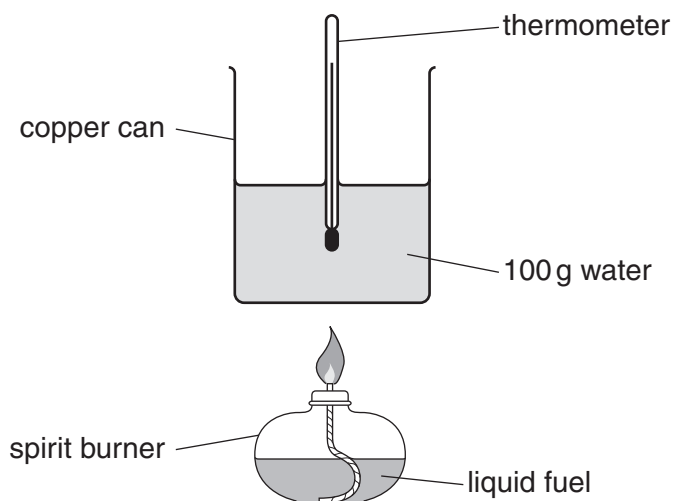
☐

[1]

14

(d) Cristina wants to compare the energy released by four different liquid fuels.

Look at the diagram of the apparatus she uses.



Each time she burns 2.0 grams of the liquid fuel.

She measures the temperature of the water at the start.

She measures the temperature again when all the fuel has burnt.

Look at her results.

fuel	temperature of water at start in °C	temperature of water at end in °C
A	20	46
B	18	46
C	21	47
D	23	39

Calculate the amount of energy released when 2.0 g of fuel **C** is burnt.

Use the equation

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

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

.....

.....

energy released = J

[2]

[Total: 7]

15

- 7 Many foods and drinks contain food additives.

Look at the bottle of mayonnaise.



The mayonnaise contains some food additives.

- (a) One of these additives has the molecular formula $C_7H_4O_2(NH_2)_2$.

How many atoms are there in one molecule of $C_7H_4O_2(NH_2)_2$?

..... [1]

- (b) The mayonnaise contains an **emulsifier**.

- (i) Write down the name of **another** food that contains an emulsifier.

..... [1]

16

(ii) Describe how an emulsifier helps to keep oil and water from separating.

Include a labelled diagram of a molecule of an emulsifier.

.....

.....

.....

.....

.....

..... [3]

(c) The mayonnaise bottle is made of a plastic.

Two properties of this plastic are

- it will not break when dropped
- it is non-biodegradable.

Write down one **other** property of the plastic that makes it suitable to make the bottle for the mayonnaise.

.....

..... [1]

[Total: 6]

17

- 8 The chemical name for baking powder is sodium hydrogencarbonate, NaHCO_3 .

Baking powder decomposes when it is heated.

It makes sodium carbonate, Na_2CO_3 , water and carbon dioxide.

- (a) Which one of the following can be used to test for carbon dioxide?

Choose from

alkene

bromine

burning splint

ester

lime water

answer [1]

- (b) Complete the balanced **symbol equation** to show what happens when baking powder is heated.

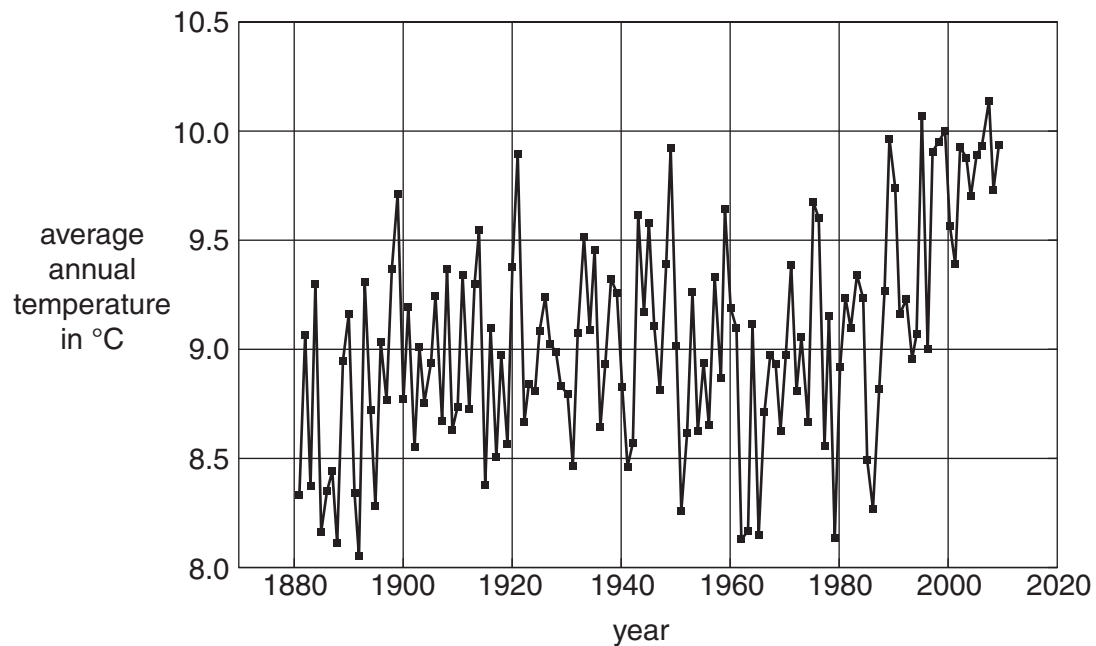
$2\text{NaHCO}_3 \rightarrow$ + + [1]

[Total: 2]

Section C – Module P1

9 Look at the graph.

It shows the average annual temperature recorded at one weather station.



(a) Some scientists think the information in the graph supports the idea of global warming.

Others disagree.

(i) Describe **one** feature of the graph that **supports** the idea of global warming.

.....
 [1]

(ii) Describe **one** feature of the graph that **does not support** the idea of global warming.

.....
 [1]

19

(b) Weather patterns are affected by natural phenomena and by human activity.

(i) Dust from a large volcano spreads as a layer around the Earth.

How will this affect the Earth's temperature?

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

(ii) Dust from a town centre factory can raise the temperature of the town.

Explain why.

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

[Total: 4]

10 Energy can be transferred by conduction, convection or radiation.

- (a) (i)** Energy cannot travel through a vacuum by conduction or convection.

Infrared waves can transfer energy through a vacuum by radiation.

Explain why.

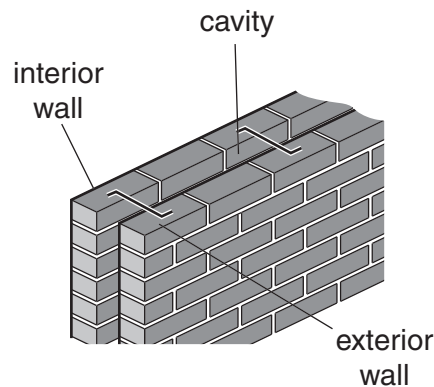
..... [1]

- (ii)** Tina wants to reduce energy losses from her home.

Explain how Tina can reduce energy loss by radiation from her home.

..... [1]

- (b)** The diagram shows the cavity between the outer and inner walls of Tina's home.



The cavity is filled with air.

- (i)** The air in the cavity becomes warm and rises.

Explain why the warm air rises.

..... [1]

21

(ii) Tina investigates ways of insulating her home.

She finds the following information.

insulation	installation cost in £	payback time in years
cavity wall insulation	250	2
double glazing	5000	50
draught proofing	100	4
loft insulation	250	1.7

She decides to buy **cavity wall insulation**.

Foam is injected into the wall cavity.

How much will she save on energy bills each year?

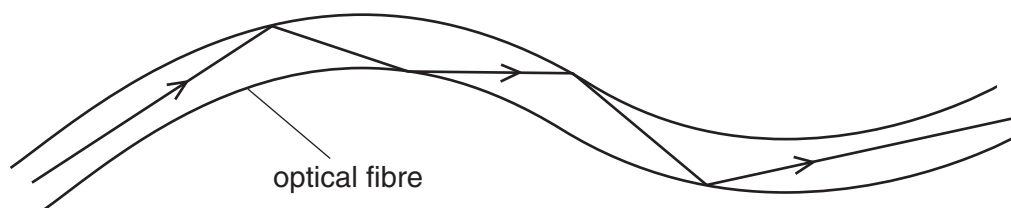
.....

answer £

[1]

[Total: 4]

- 11 Sam uses infrared radiation to transmit a voice message along an optical fibre.



- (a) The radiation is totally internally reflected at the boundary between the optical fibre and the air.

Why is the radiation **reflected**, rather than **refracted**, at the boundary?

.....
 [1]

- (b) The voice message is produced as an **analogue** signal.

It is changed into a **digital** signal before it is transmitted along the optical fibre.

- (i) Finish the sentences to describe the difference between an analogue signal and a digital signal.

An analogue signal

A digital signal
 [2]

- (ii) One advantage of using digital signals is that it allows **multiplexing**.

What is multiplexing?

.....
 [1]

- (iii) Describe **one other** advantage of using digital signals.

..... [1]

[Total: 5]

12 Microwave radiation is used to transmit mobile phone signals.

(a) One frequency used by mobile phones is 900 000 000 Hz.

The wavelength of the radiation is 0.333 m.

Calculate the speed of microwave radiation.

The equations on page 2 may help you.

.....

.....

.....

answer m/s [1]

(b) In built up areas, microwave transmitters are positioned close together.

They are often hidden in strange places.



Microwaves are also used to transmit messages to spacecraft millions of kilometres away.

Why must microwave transmitters be positioned close together in built up areas?

.....

.....

..... [2]

(c) Microwaves are used to cook food by heating the water in the food.

Microwave radiation from mobile phones **does not** produce the same heating effect inside people.

Explain why.

.....

.....

..... [2]

24

13 Match each definition to its correct physical quantity.

Complete the table.

Choose from this list.

efficiency

heat

power

temperature

definition	quantity
a measurement of energy	
a measurement of hotness	

[2]

[Total: 2]

END OF QUESTION PAPER

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The Periodic Table of the Elements

1	2	Key										3	4	5	6	7	0				
		relative atomic mass atomic symbol name atomic (proton) number																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

1	H	1
	hydrogen	

* 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.