Surname	Centre Number	Candidate Number
First name(s)		0

GCSE

3445U30-1

S23-3445U30-1

TUESDAY, 16 MAY 2023 – MORNING

APPLIED SCIENCE (Double Award)

UNIT 3: Food, Materials and Processes

FOUNDATION TIER

1 hour 30 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**10**	
2.	**11**	
3.	**12**	
4.	**10**	
5.	**13**	
6.	**5**	
7.	**14**	
Total	**75**	

3445U301
01

ADDITIONAL MATERIALS

In addition to this examination paper, you will require a calculator, a pencil and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

Question **4**(a) is a quality of extended response (QER) question where your writing skills will be assessed.

You are reminded to show all your workings. Credit is given for correct workings even when the final answer is incorrect.

The Periodic Table is printed on the back cover of the examination paper.

JUN233445U30101

Examiner only

Answer **all** questions in the spaces provided.

1. Ash dieback disease is a fungal infection that is common in ash trees in Wales.

The disease causes the leaves to blacken and wilt, so eventually the ash tree has no leaves.

The photographs show healthy ash leaves and those affected by ash dieback.

(a) Photosynthesis occurs in green leaves.

(i) Use word(s) from the box to complete the paragraph below. You may use each word once, more than once or not at all. [5]

stomata	nitrogen	chlorophyll	oxygen	glucose
water	carbon dioxide			

Leaves use ..... to absorb light energy.

They convert ..... and ..... into

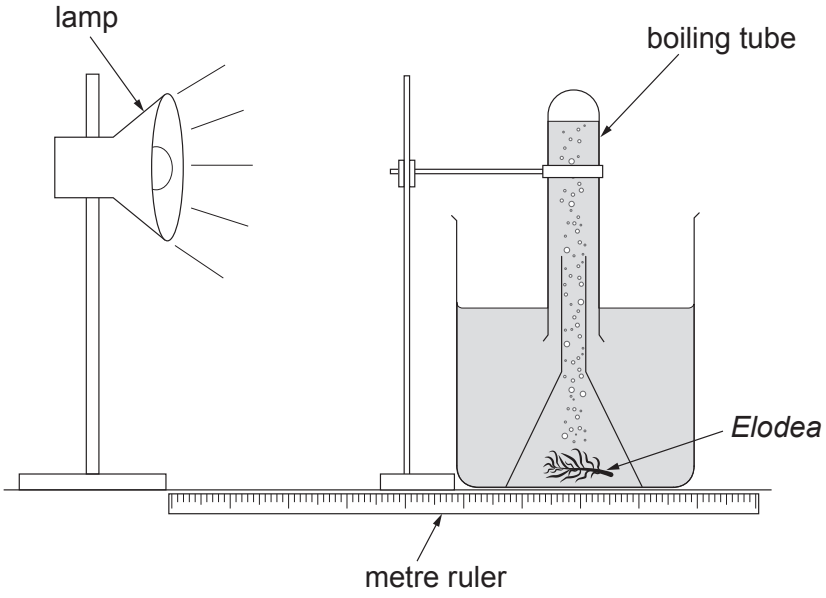
..... and .....

(ii) Complete the following sentence by underlining the correct word in the brackets. [1]

Ash dieback disease affects the growth of an ash tree as the leaves are unable to make **(food / water / nitrogen)**.

Examiner only

(b) The following apparatus is used to investigate how light intensity affects the rate of photosynthesis of an *Elodea* plant.



The method used is described below.

1. Add **one spatula** of sodium hydrogen carbonate to a beaker containing 200 cm^3 of water at 20°C, to supply carbon dioxide.
2. Place the *Elodea* in the beaker.
3. Completely fill a boiling tube with water and carefully place over the end of the funnel with the end under the water, clamp into place.
4. Place the lamp 5 cm away from the *Elodea*.
5. Start the stopwatch and record the **number of bubbles** of oxygen produced in **a few seconds**.
6. Repeat the experiment with the lamp 10 cm, 15 cm, 20 cm, 25 cm and 30 cm from the apparatus.

(i) Steps 1 and 5 could lead to uncertainties. In the table below, circle **one** improvement in each row that you would use. [3]

Current method	Improvement	
add **one spatula**	add 1 kg	add 1 g
record the **number of bubbles**	collect the gas in a beaker	collect the gas in a measuring cylinder
produced in **a few seconds**	produced in 1 minute	produced in 1 hour

(ii) State how you would change step 6 to investigate the effect of temperature on photosynthesis. [1]

.....

.....

10

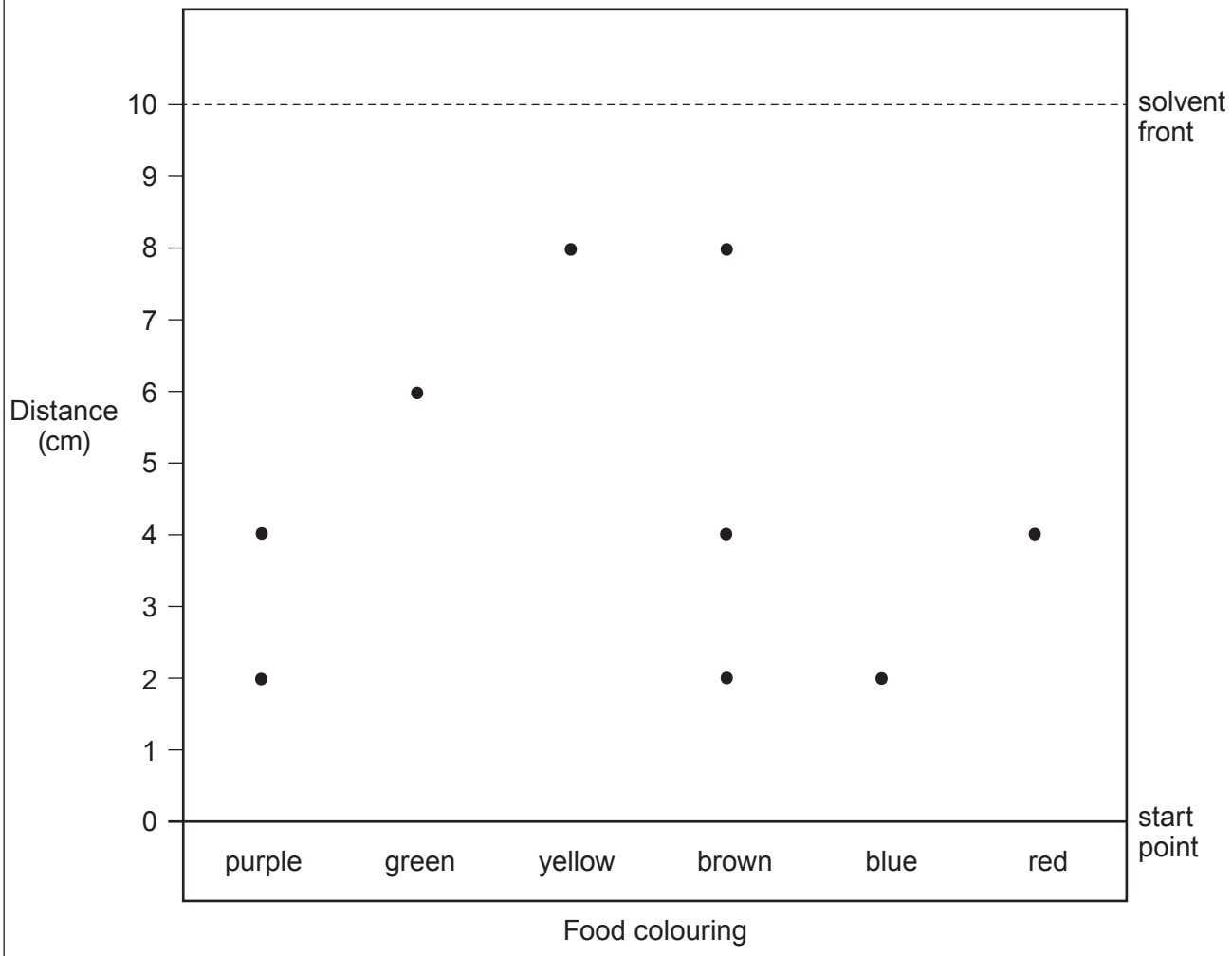
Turn over.

Examiner only

2. Analytical scientists work in a wide range of different industries and agencies.

(a) The Food Standards Agency (FSA) funded a project to analyse the colours used in food and drinks.

The diagram below shows a chromatogram of the dyes present in different food colourings.



(i) It was thought that the dye in the blue colouring would not be present in other colourings.
Explain whether you agree. [2]

.....

.....

Examiner only

(ii) Use the equation:

$$R_f = \frac{\text{distance travelled by substance}}{\text{distance travelled by solvent}}$$

to calculate the R_f value for the dye in the **red** colouring. [3]

R_f = ...

(b) Analytical scientists also identify unknown compounds.
There were three bottles, each containing a solution of one of the following compounds.

copper(II) sulfate	lithium carbonate	sodium chloride

(i) State which of these compounds would produce a yellow flame in a flame test. [1]

.....

(ii) I. State which of these compounds would produce bubbles of gas when added to hydrochloric acid. [1]

.....

II. The gas turns limewater milky. Name this gas. [1]

.....

(iii) 1 cm^3 of silver nitrate solution is added to three different test tubes, each containing a solution of one of the compounds in the box above.

I. State which of these compounds will give a white precipitate. [1]

.....

II. Complete the risk assessment below for silver nitrate. [2]

Hazard	Risk	Control measure
silver nitrate is irritant	could cause eye damage if splashes in the eyes when	....

3445U301 05

11

Examiner only

3. Hunterston B is a nuclear power station in Scotland.

(a) The reaction in the reactor is shown in the equation below.

$$^{1}_{0}n + {}^{235}_{92}U \longrightarrow {}^{141}_{56}Ba + \text{.....} Kr + 3\,{}^{1}_{0}n$$

(i) **Complete** the equation. [2]

(ii) Circle the part of the reactor that slows down neutrons so they can be absorbed by uranium nuclei. [1]

moderator fuel rods concrete

(iii) State how many neutrons are produced by the fission of each uranium nucleus. [1]

.....

(b) Nuclear reactor 3 at the Hunterston B power station was shut down after cracks were found in the graphite bricks. This made it difficult for the control rods to move up and down.

(i) Explain the role of control rods. [2]

.....

.....

.....

(ii) An unusual event, such as an earthquake, might move the damaged graphite bricks so that the control rods are unable to move. Explain why this is dangerous. [2]

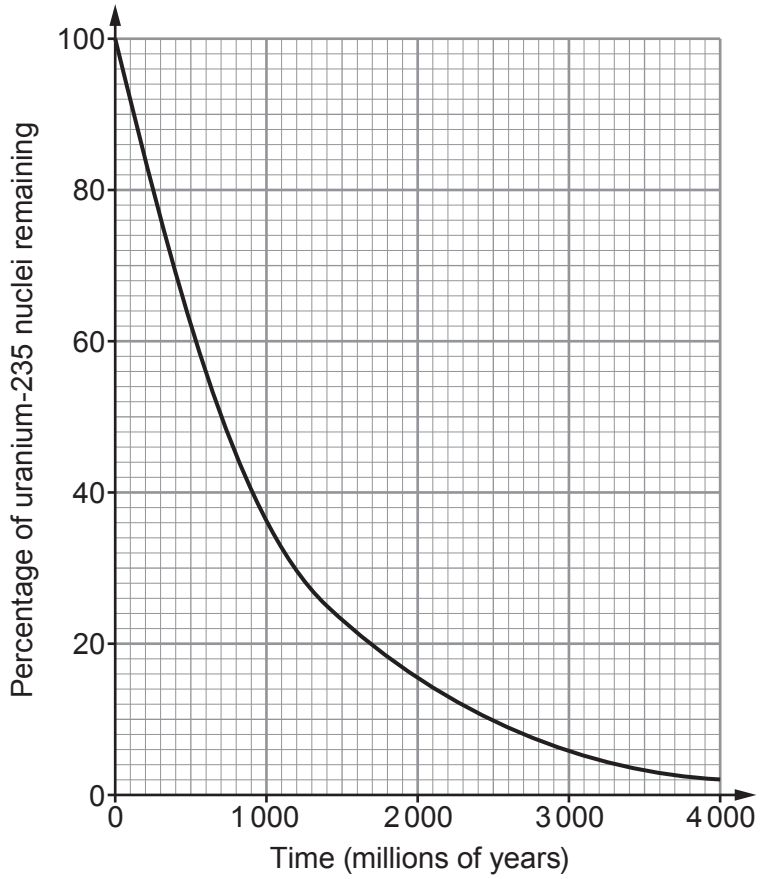
.....

.....

.....

Examiner only

(c) After Hunterston B power station is decommissioned, the uranium-235 in the fuel rods will continue to decay at the rate shown in the graph below.



(i) Use the graph to answer the following questions.

I. Find the time taken for the uranium-235 to decay from 100% to 50%. [1]

time = ... million years

II. State the half-life of uranium-235. [1]

half-life = ... million years

(ii) The table shows the percentage of uranium-235 nuclei remaining after different half lives. Complete the table. [2]

Number of half-lives	0	1	2	3	4
Percentage of uranium-235 nuclei remaining	100	.....	25	.....	6.25

12

3445U301
07

Examiner only

4. Heating is a common method used to preserve food.

(a) **State three** methods, **other than heating**, in which the growth of bacteria can be slowed down or stopped in food products.

Explain how each method works. [6 QER]

.....

.....

.....

.....

.....

.....

.....

.....

.....

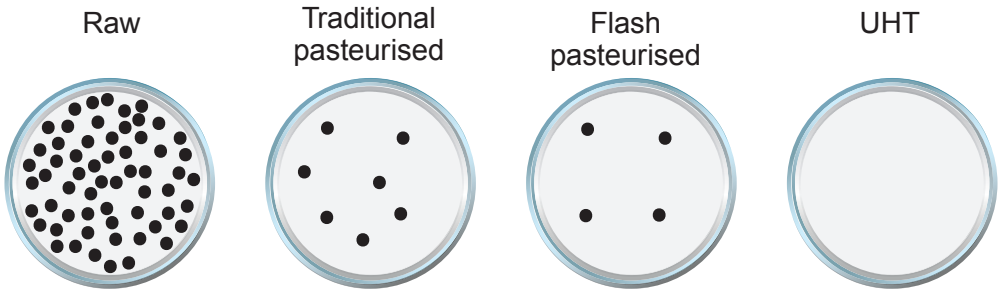
.....

.....

.....

Examiner only

(b) Scientists investigated four types of milk. They monitored the growth of bacterial colonies on agar plates using 0.1 cm^3 from each type of milk over two days. Their results are shown below.



Type of milk	Heat treatment	Number of bacterial colonies from 0.1 cm^3 of milk	Number of bacterial colonies in a 40 cm^3 serving
raw	none	60	24 000
traditional pasteurised	63°C for 30 minutes	7	.....
flash pasteurised	78°C for 35 seconds	.....	1 600
ultra-high temperature pasteurised (UHT)	135°C for 2 seconds	none	none

(i) Complete the table. [2]

Space for working

(ii) It is claimed that unopened UHT milk can be stored on supermarket shelves at room temperature for six months. Explain whether you agree with the claim. [2]

.....

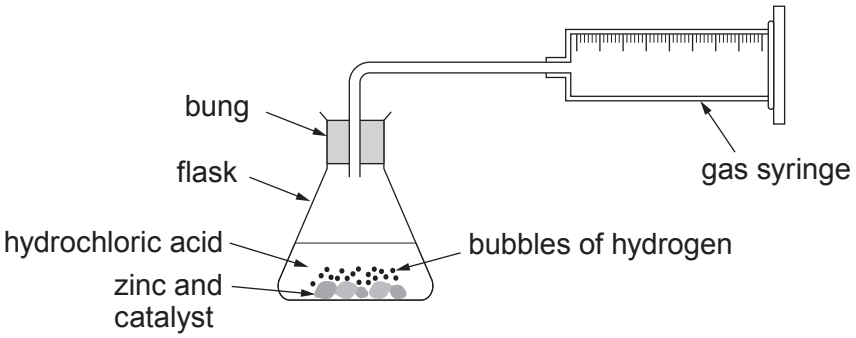
.....

.....

10

Examiner only

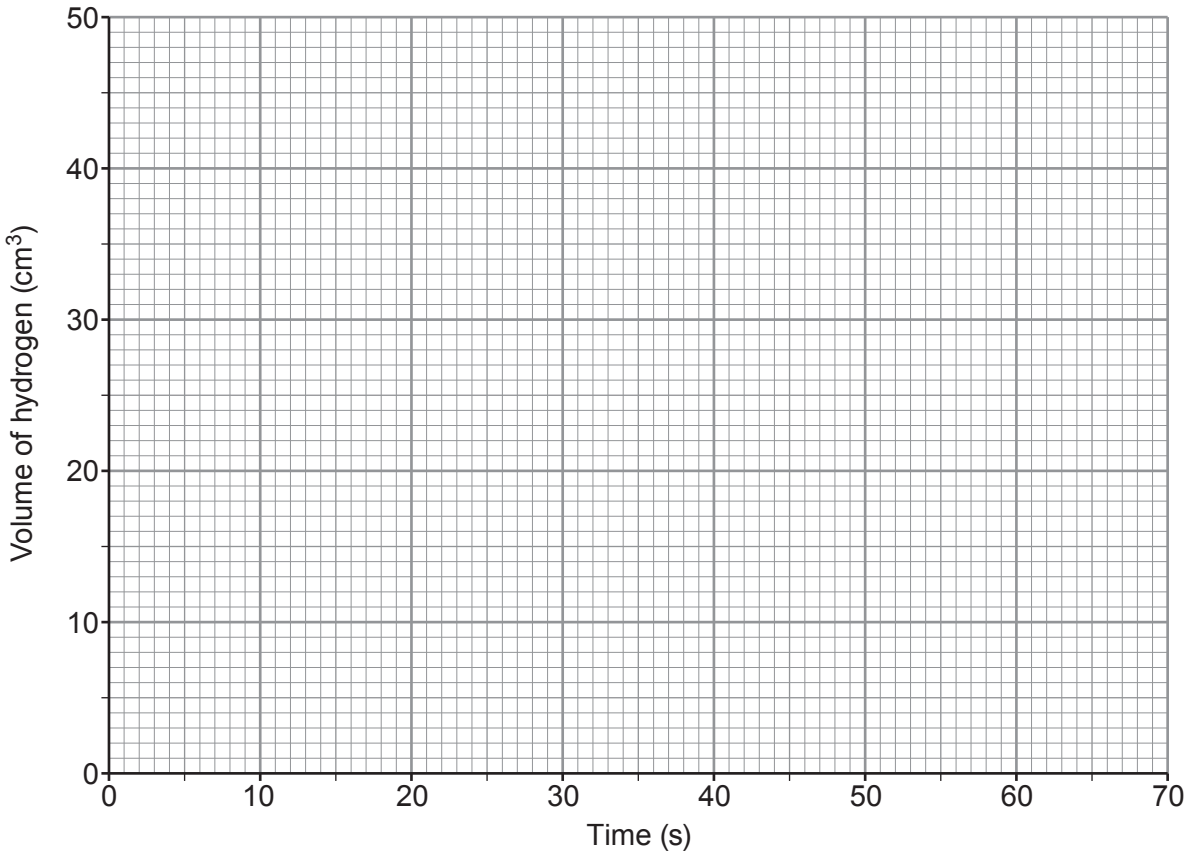
5. The diagram below shows apparatus that can be used to investigate the rate of the reaction between large zinc pieces and hydrochloric acid. A catalyst was also added to the flask.



Large pieces of zinc were placed in excess dilute hydrochloric acid and the volume of hydrogen produced was recorded every 15 seconds.
The results obtained are shown below.

Time (s)	0	15	30	45	60
Volume of hydrogen (cm^3)	0	28	40	48	48

(a) (i) Plot the results on the grid below and draw a suitable curve. [3]



Examiner only

(ii) Use your graph to answer the following questions.

I. Describe the relationship between volume of hydrogen produced and time. [2]

.....

.....

.....

II. State the volume of hydrogen collected at 25 s. [1]

volume = ... cm^3

III. At what time did the reaction stop? [1]

time = ... s

(b) (i) State the purpose of the catalyst. [1]

.....

(ii) The mass of catalyst added at the start of the experiment was 1.5 g.
State the mass of catalyst remaining after 60 s. [1]

mass = ... g

(iii) State how the **volumes in the table** would be different if the catalyst had not been added. [1]

.....

(c) (i) State how the **volumes in the table** would be affected by using the same mass of zinc **powder** instead of large pieces of zinc. [1]

.....

(ii) Explain how the **volumes in the table** would be affected if the original experiment was repeated at a higher temperature. [2]

.....

.....

.....

13

Examiner only

6. (a) State, in terms of electrons, the difference between ionic and covalent bonding. [2]

.....

.....

.....

(b) When magnesium reacts with oxygen, the ionic compound magnesium oxide is formed.

(i) The outer electrons of magnesium and oxygen are shown below. Draw arrows to show the transfer of electrons when magnesium oxide is formed. [1]

(ii) State the charges on the ions formed [2]

Mg ..... O .....

5

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

Examiner only

7. Inos is a Welsh caravan manufacturer based in Denbighshire.
The materials used to build modern caravans are very different to those used in early caravans.

Table 1 shows how the materials used in manufacturing the body of a caravan have changed over time.

Year	Materials used
1920	wood
1950	steel and wood
1970	aluminium and wood
2015	glass reinforced plastic (GRP), polyester

Table 2 shows information about some of the materials used to make the body of caravans.

Material		Density (g/cm^3)	Stiffness (GPa)	Melting Point (°C)	Strength (MPa)	Is it brittle?	Does it corrode?
wood		0.6			1 000	No	no but rots when wet
steel		7.8	210	1 357	1 200	No	yes producing rust
aluminium		2.7	69	660	90	No	yes producing a resistant coating
GRP	glass fibres	2.4	180	1 400	3 500	Yes	No
	epoxy resin	1.5			60	Yes	No
polyester		1.9	150	121	250	Yes	No

Use the information above to answer the following questions.

(a) Describe how the weight and strength of caravan bodies changed between 1920 and 1970. [4]

Weight: .....

.....

.....

Strength: .....

.....

.....

Examiner only

(b) (i) State **two** advantages of the materials used in 2015 over those used previously. [2]

1. .....

2. .....

(ii) State **one** disadvantage of the materials used in 2015 over those used previously. [1]

.....

(c) GRP is a common composite material, in which glass fibres are mixed with epoxy resin.

(i) A GRP panel contains a volume of 300 cm^3 of epoxy resin.

Use the equation: [3]

mass = density × volume

to calculate the mass of the resin.

mass = ... g

(ii) I. State the strength of glass fibre in N/cm^2. [2]

(1 MPa = 100 N/cm^2)

strength = ... N/cm^2

II. The cross-sectional area (csa) of a glass fibre is 0.00015 cm^2.

Use your answer in part (c)(ii)I. and the equation:

force = strength × csa

to calculate the force required to break it. [2]

force = ... N

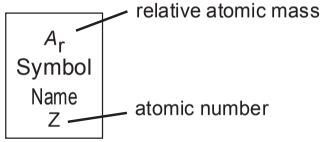
END OF PAPER

14

THE PERIODIC TABLE

1	2	Group									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
86 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 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	179 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	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

Key



16