

Surname	Centre Number	Candidate Number
First name(s)		0



GCSE

3445U10-1



FRIDAY, 16 JUNE 2023 – MORNING

APPLIED SCIENCE (Double Award)
UNIT 1: Energy, Resources and the Environment

FOUNDATION TIER

1 hour 30 minutes

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	10	
2.	14	
3.	9	
4.	12	
5.	11	
6.	8	
7.	11	
Total	75	

ADDITIONAL MATERIALS

In addition to this paper you will require a calculator 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. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

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

Question **3(b)** 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 given is incorrect.

A Periodic Table is printed on page 20.



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Answer **all** questions.

1. Ffion is investigating a neutralisation reaction between sulfuric acid and sodium hydroxide.

- (a) Use the correct words from the box to complete the **word** equation for this reaction below. [1]

sodium chloride	sodium nitrate	sodium sulfate
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sulfuric acid + sodium hydroxide \longrightarrow + water

- (b) In the experiment she monitors the change of pH using both a pH meter and an indicator.

The chart below shows the colour of phenolphthalein indicator at different pH.

pH scale	1	2	3	4	5	6	7	8	9	10	11	12	13	14
phenolphthalein	colourless								pale pink	pink				

- (i) The table below shows Ffion's results. Complete the table. [2]

Volume of sodium hydroxide added (cm ³)	pH meter reading	Phenolphthalein indicator colour
0	1.0	colourless
5	1.0	colourless
10	1.1	colourless
15	1.2	colourless
20	2.0
25	9.0	pale pink
30	13.0
35	14.0	pink
40	14.0	pink



- (ii) Use the information in the table to tick (✓) the boxes next to the **three** correct statements. [3]

Before any sodium hydroxide is added to the acid the phenolphthalein turns green.

The pH is lowest at the start of the experiment.

When 10 cm³ of sodium hydroxide has been added the solution is neutral.

As sodium hydroxide is added the pH rises.

The pH is highest at the end of the experiment.

When 40 cm³ of sodium hydroxide has been added the solution is acidic.

- (c) Sodium hydroxide (NaOH) contains the three elements sodium, hydrogen and oxygen.

- (i) Select the correct numbers from the box to complete the table below. [3]

1	2	8	11	12	16
---	---	---	----	----	----

Element	Number of protons	Number of neutrons	Number of electrons	Mass number
sodium	11	12	23
oxygen	8	8	16
hydrogen	1	0	1

- (ii) Sodium metal is found in Group 1 of the Periodic Table. Use the Periodic Table on page 20 to name **one** other metal found in this group. [1]

.....



2. The UK has been generating more energy using wind power over recent years.



- (a) Circle **one** renewable energy source below.

[1]

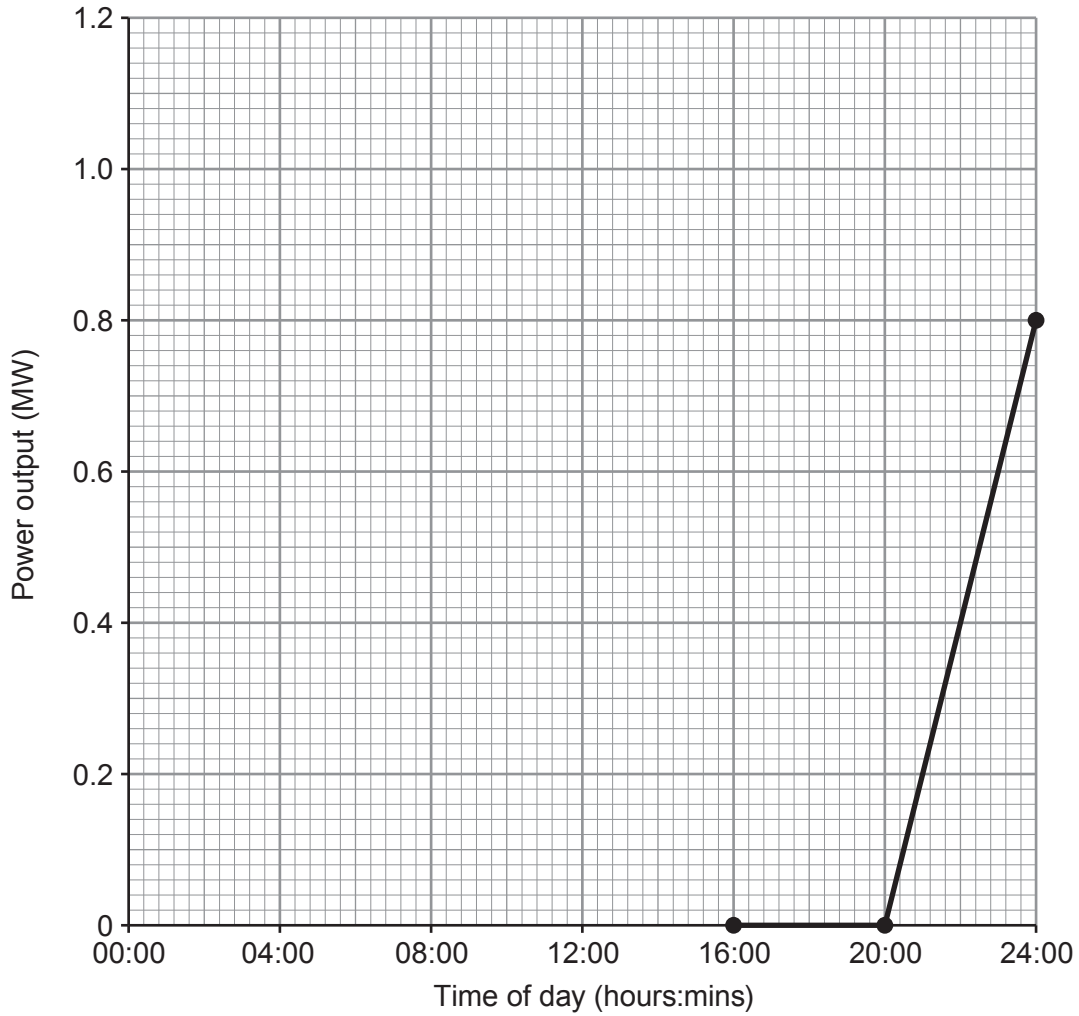
coal**gas****solar**

- (b) The information below shows the power output of a wind turbine in one day.

Time of day (hours:mins)	Power output of wind turbine (MW)
00:00	0.6
04:00	1.0
08:00	1.2
12:00	0.8
16:00	0.0
20:00	0.0
24:00	0.8



(i) Use the data from the table to complete the graph on the grid below and join the points with a ruler. The last three points have been plotted for you. [3]



(ii) State why the power generated by this wind turbine is not constant during this day. [1]

.....

.....

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(iii) Use the information to answer the following questions.

I. State the maximum power produced by the wind turbine during this day. [1]

maximum power = MW

II. State the time of day that the wind speed was greatest. [1]

time =

III. Determine between which hours the wind turbine did not generate any electricity. [1]

from: to:

(iv) David suggested that the wind turbine generated a power greater than 0.6 MW for 16 hours.

Add a horizontal line to your graph and use it to explain whether David was correct. [4]

.....
.....
.....
.....

(c) Last year this wind turbine had a mean power output of 0.6 MW. A typical nuclear power station has a continuous power output of 3600 MW.

Calculate how many wind turbines would be needed to generate the same power output as a nuclear power station. [2]

number of wind turbines =

14



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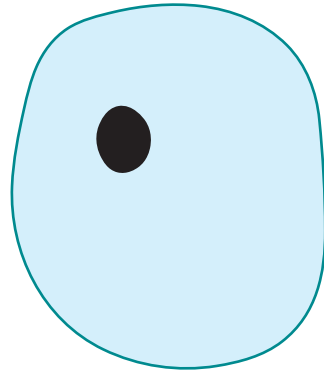
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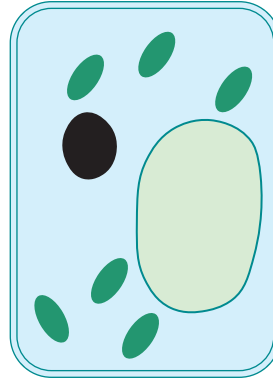


3. Clara is studying the structure and function of cells. The images below show animal and plant cells.

Animal cell



Plant cell



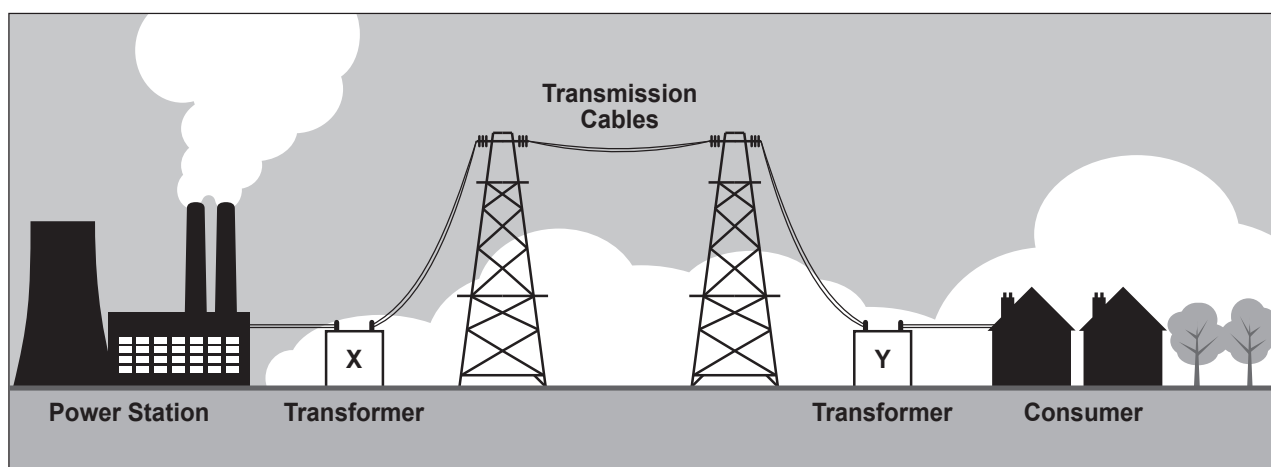
- (a) Complete the table below to show which parts are present in animal cells.

[3]

Part	Plant cells	Animal cells (✓ or ×)
cell wall	✓	×
cytoplasm	✓	✓
chloroplast	✓	×
nucleus	✓
cell membrane	✓
vacuole	✓



4. The diagram below shows part of the National Grid.



- (a) Complete the sentences about the National Grid by selecting the correct words from the box. Each word can be used once, more than once or not at all. [4]

faster reliable increases generates safely decreases

The National Grid makes sure that the electricity supply to consumers is

.....

Transformer X the voltage and
the current.

Transformer Y changes the voltage so that consumers can use it

..... in their homes.



- (b) Five electrical supply companies (**A**, **B**, **C**, **D** and **E**) each produce the same amount of electrical power.

The table below shows the percentage of electrical power output from each energy source by each company.

Percentage of electrical power output from each energy source (%)					
Energy source	Company A	Company B	Company C	Company D	Company E
coal	4.8	5.8	7.1	10.8	10.1
natural gas	63.0	55.5	9.6	63.0	46.0
nuclear	5.2	20.6	71.2	23.3	13.9
renewable	27.0	18.1	12.1	2.9	30.0

Use the table to answer the following questions.

- (i) State which energy company produces the most electrical power from coal. [1]

- (ii) State which company produces the most nuclear waste. [1]

- (iii) Calculate the **mean** percentage of electrical power output generated from **coal** by the five companies (**A**, **B**, **C**, **D** and **E**). [2]

mean percentage =

- (c) The carbon footprint of an energy supply customer can be an important factor when choosing a supply company.

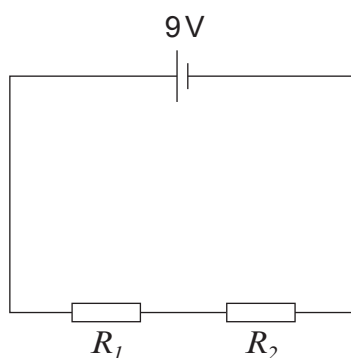
- (i) State what is meant by the term 'carbon footprint'. [2]

- (ii) A customer decides against using Company **A** since they believe that they have the highest carbon footprint from generating electricity.

Use information from the table to explain whether the customer is correct. [2]



5. Jamie is investigating an electrical circuit which has two **identical** resistors, R_1 and R_2 . The circuit that he built is shown below.



- (a) Complete the sentences by underlining the correct word(s) in the brackets.

(i) In this series circuit the current in R_1 is (**the same as / higher than / lower than**) the current in R_2 . [1]

(ii) In this series circuit the voltage across R_1 is (**the same as / higher than / lower than**) the voltage across R_2 . [1]

- (b) The voltage across R_1 is 4.5V.

(i) Each resistor was found to have a resistance of $2.25\ \Omega$.

I. Use the equation:

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

to calculate the current in R_1 . [2]

current = A

II. Use the equation:

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

to calculate the power developed in resistor R_1 . [2]

power developed in R_1 = W

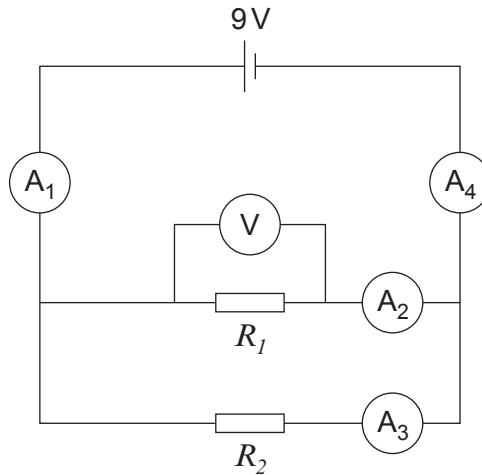


(ii) State the voltage across R_2 .

[1]

voltage across $R_2 = \dots\dots\dots$ V

(c) Jamie then built a parallel circuit using the same 2.25Ω resistors.



(i) State which ammeter (A_1 , A_2 , A_3 or A_4) measures the current through R_1 .

[1]

$\dots\dots\dots$

(ii) State the voltmeter reading across R_1 .

[1]

voltmeter reading = $\dots\dots\dots$ V

(iii) Ammeter A_2 reads 4 amps.

I. State the reading on ammeter A_3 .

[1]

ammeter reading = $\dots\dots\dots$ A

II. Calculate the reading shown on ammeter A_1 .

[1]

ammeter reading = $\dots\dots\dots$ A

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6. Sioned reacted sulfuric acid with zinc oxide (ZnO).
She followed the method below to form zinc sulfate.

1. Pour 50 cm³ of 1.0 mol/dm³ sulfuric acid into a conical flask.
2. Heat the sulfuric acid to 50°C.
3. Add 5 g of zinc oxide to the warmed acid and stir.
4. Repeat step 3 until the zinc oxide is in excess.

(a) The main hazard in this experiment is that 1.0 mol/dm³ sulfuric acid is an irritant.

(i) Describe **one** risk associated with using sulfuric acid. [1]

.....

.....

(ii) State a suitable control measure Sioned should carry out to reduce this risk. [1]

.....

.....

(b) **Circle** the correct formula in each bracket to complete the symbol equation for this reaction. [2]



(c) State **two** additional steps that Sioned needs to carry out to obtain pure zinc sulfate crystals. [2]

1.

.....

2.

.....

(d) Robert has calculated the relative formula mass of zinc oxide to be 97.
Use the Periodic Table on page 20 to explain if he is correct. [2]

.....



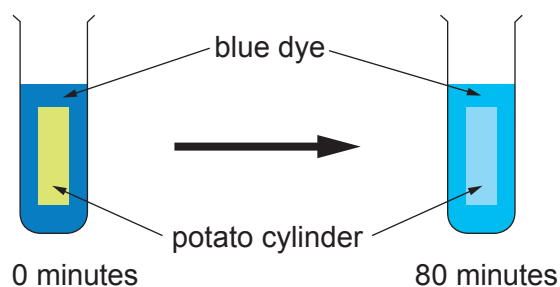
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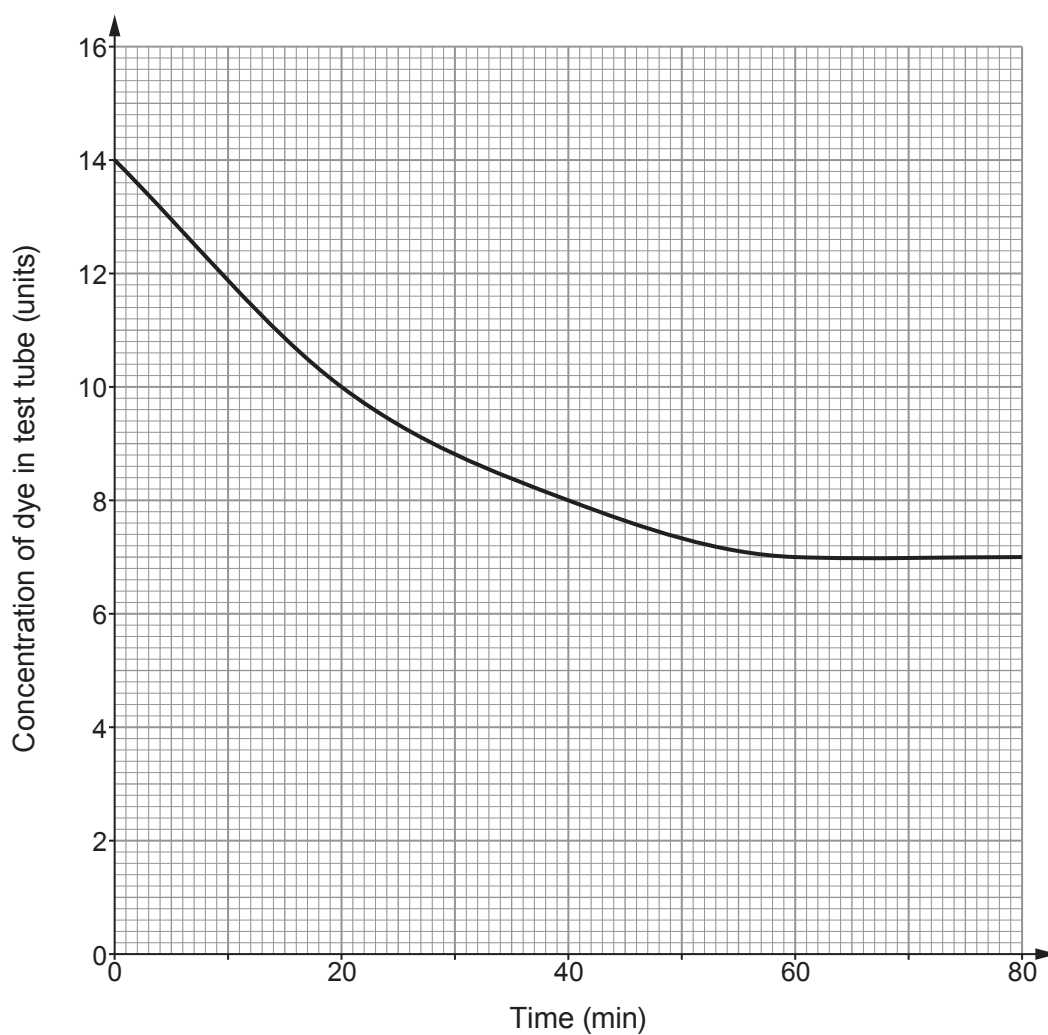


7. Several groups of students investigated the rate of diffusion of blue dye into potato by the method below.

1. Cut a cylinder of potato.
2. Place the cylinder in a test tube containing a solution of blue dye.
3. Put the test tube in a water bath at 20°C.
4. Measure the concentration of the dye after 20 minutes.
5. Continue to measure the concentration every 20 minutes up to 80 minutes.



The concentration of the dye left in the test tube after each 20-minute interval is shown on the graph below.



(a) (i) State the dependent variable in this experiment. [1]

.....

(ii) State **two** variables that should be controlled. [2]

1.

2.

(b) (i) State how the concentration of dye left in the test tube changed during the first 20 minutes. [1]

.....

(ii) Explain why this change occurred. [2]

.....

.....

.....

.....

.....

(c) One student suggests that the rate of diffusion is constant over the whole 80 minutes. Explain whether you agree. [3]

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.....

.....

(d) The students repeated the experiment in a water bath at 30°C. **Add another line** to the graph to show the expected results. [2]

END OF PAPER

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THE PERIODIC TABLE

1 2 3 4 5 6 7 0

Group

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
23 Na Sodium 11	24 Mg Magnesium 12	25 Mn Manganese 25	26 Fe Iron 26	27 Co Cobalt 27	28 Ni Nickel 28	29 Cu Copper 29	30 Zn Zinc 30	31 Ga Gallium 31	32 Ge Germanium 32
39 K Potassium 19	40 Ca Calcium 20	41 V Vanadium 23	42 Cr Chromium 24	43 Tc Technetium 43	44 Ru Ruthenium 44	45 Rh Rhodium 45	46 Pd Palladium 46	47 Ag Silver 47	48 Cd Cadmium 48
86 Rb Rubidium 37	87 Sr Strontium 38	89 Y Yttrium 39	90 Zr Zirconium 40	91 Nb Niobium 41	92 Mo Molybdenum 42	93 Tc Technetium 43	94 Ru Ruthenium 44	95 Rh Rhodium 45	96 Pd Palladium 46
133 Cs Caesium 55	137 Ba Barium 56	138 La Lanthanum 57	139 Ce Cerium 58	140 Pr Praseodymium 59	141 Nd Neodymium 60	142 Pm Promethium 61	143 Sm Samarium 62	144 Eu Europium 63	145 Gd Gadolinium 64
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89	228 Th Thorium 90	232 U Uranium 92	238 Pu Plutonium 94	244 Cm Curium 96	254 Fm Fermium 100	264 Fl Flerovium 114	289 Og Oganesson 118
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
70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	76 Se Selenium 34	77 Br Bromine 35	79 Kr Krypton 36	80 Rb Rubidium 37	81 Sr Strontium 38	82 Y Yttrium 39	83 Zr Zirconium 40
115 In Indium 49	119 Sb Antimony 51	122 Te Tellurium 52	125 I Iodine 53	127 Xe Xenon 54	131 Ba Barium 56	137 Rb Rubidium 37	138 La Lanthanum 57	140 Pr Praseodymium 59	141 Nd Neodymium 60
204 Tl Thallium 81	207 Pb Lead 82	208 Bi Bismuth 83	209 Po Polonium 84	210 At Astatine 85	210 Po Polonium 84	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83
101 Ru Ruthenium 44	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sb Antimony 51	122 Te Tellurium 52	125 I Iodine 53	127 Xe Xenon 54	131 Ba Barium 56
186 Re Rhenium 75	187 Os Osmium 76	188 Ir Iridium 77	192 Pt Platinum 78	195 Au Gold 79	197 Hg Mercury 80	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83
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	198 Hg Mercury 80	201 Hg Mercury 80
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89	228 Th Thorium 90	232 U Uranium 92	238 Pu Plutonium 94	244 Cm Curium 96	254 Fm Fermium 100	264 Fl Flerovium 114	289 Og Oganesson 118

Key

