

Surname	Centre Number	Candidate Number
First name(s)		0



GCSE

3445UB0-1



MONDAY, 10 JUNE 2024 – MORNING

APPLIED SCIENCE (Double Award)

UNIT 2: Space, Health and Life

HIGHER TIER

1 hour 30 minutes

ADDITIONAL MATERIALS

- Separate Resource Folder
- Calculator
- Pencil
- 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.

For Examiner's use only			
	Question	Maximum Mark	Mark Awarded
Section A	1.	19	
	2.	6	
Section B	3.	5	
	4.	6	
	5.	7	
	6.	10	
	7.	8	
	8.	7	
	9.	7	
	Total	75	

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INFORMATION FOR CANDIDATES

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

Question 7(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 given is incorrect.

You will need to refer to the separate Resource Folder to answer questions 1 and 2.

A Periodic Table is printed on page 24.



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Section A

Answer **all** questions.

Refer to the separate Resource Folder to answer questions **1** and **2**.

1. (a) Dave says the distances of each leg in a long-distance triathlon are all double those in a middle-distance triathlon.

Tom says the distances of each leg in an Olympic triathlon are double those in a sprint triathlon.

Use data from **Table 1** to explain whether Dave or Tom is correct. [2]

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- (b) Piera says Jake breathed in less air per minute at 4 minutes than at 3 minutes because his breathing rate was lower.

Petula disagrees because Jake's airflow per breath was greater at 4 minutes than at 3 minutes.

Use data from **Table 2**, and the equation below it, to explain whether you agree with Piera or Petula. [2]

.....

.....



(c) Use the information in **Table 4** and equations from pages 4 and 5 to answer the following questions.

(i) Calculate Malcolm's BMI.

[2]

BMI =

(ii) Calculate Malcolm's maximum heart rate.

[1]

maximum heart rate = bpm

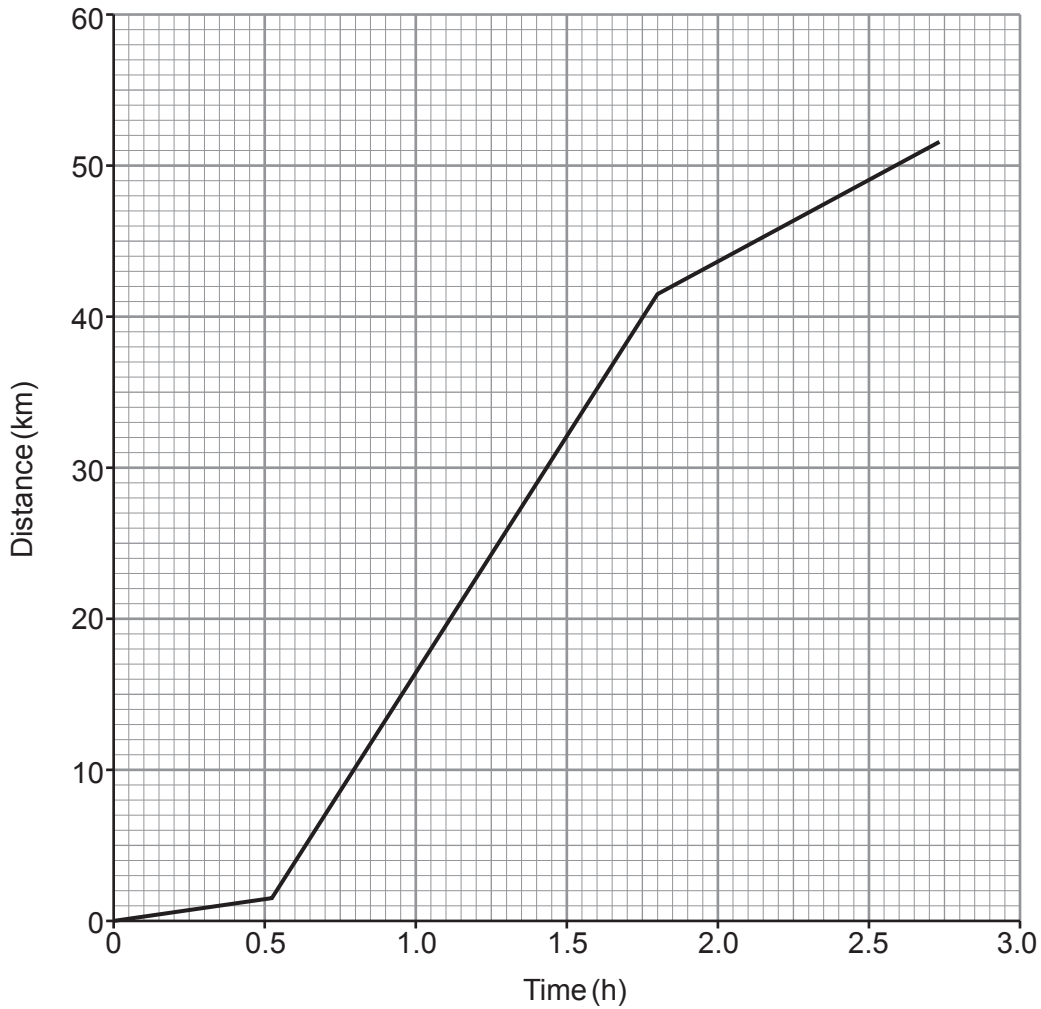
(d) Karen wants to exercise in the aerobic zone. Use the information in **Tables 3 and 4** and on page 4 to determine the range in heart rate she should aim for.

[1]

heart rate range is from bpm to bpm.



- (e) Data in the **Triathlon times** section (page 5) and **Table 1** was used to plot distance-time graphs for each of the triathlons described. There were three sections in each graph to show the swim, cycle and run legs. The graphs did not include transition times. One of the graphs is shown below.



Determine which type of triathlon is represented by the graph and give **two** reasons for your answer. [3]

Type of triathlon:

Reason 1:

.....

Reason 2:

.....



- (f) Use the information about Triathlon times on page 5, the information in **Table 1** and an equation on page 7 to calculate the mean speed during an Ironman triathlon. [3]

mean speed = km/h

- (g) When a triathlete mounts their bike they are travelling at 1.5 m/s. Use the information in **Table 5** and an equation on page 7 to calculate the acceleration along level ground in a cycle leg. [3]

acceleration = m/s²

- (h) It is thought that the higher the age group of the triathlete, the lower the mean speed in the cycle leg. Use data from **Graph 1** to explain whether this statement is true for all age groups. [2]

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2. Use the information in **Table 2** to answer the following questions.

- (a) Calculate the mean increase in heart rate per minute **during exercise**. [3]

mean increase in heart rate per minute = bpm

- (b) Calculate the time at which the heart rate returns to its resting value after exercise. Assume that the heart rate drops at a constant rate after exercise. [3]

time = minutes

6



Section B

Answer **all** questions.

3. Living things are classified using a system developed by Carl Linnaeus.

(a) There are 5 kingdoms. These include single-celled organisms and plants.

Name **two** other kingdoms.

[2]

..... and

(b) Linnaeus' system further ranked living things to a species level. This is illustrated below. Complete the sequence. [2]

kingdom → phylum → → order → → genus → species.

(c) *Panthera leo* is the scientific name for a lion.



State the advantage of using scientific names instead of common names.

[1]

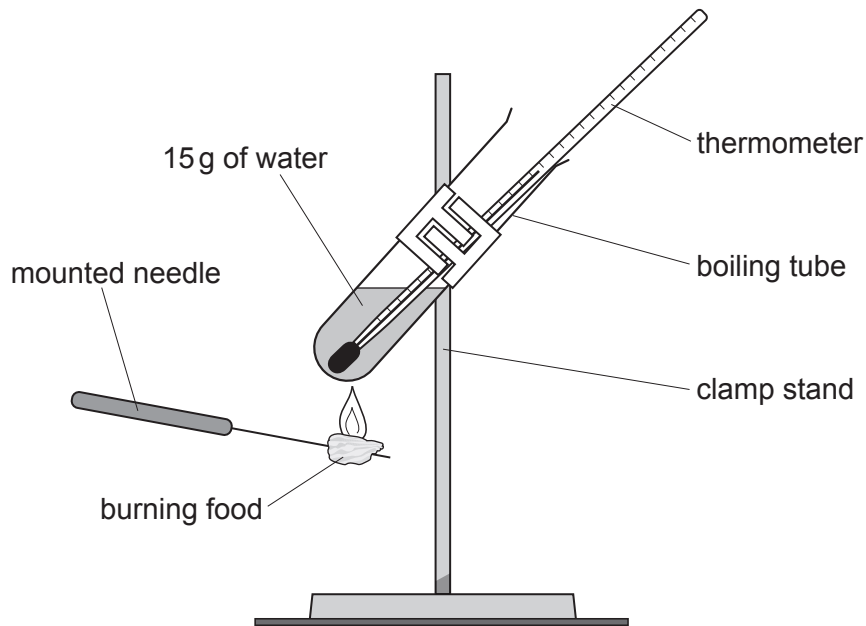
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4. Students were investigating the energy content of food. They heated 15 g of water with each sample of food.



Their results are shown in the table below.

Food	Mass of food burnt (g)	Initial water temperature (°C)	Final water temperature (°C)	Rise in temperature of water (°C)
bread	2.5	18	23	5
cheese	4.0	31	14
cornflakes	3.0	17	29	12
oatie biscuit	5.0	18	25	7

- (a) Complete the table.

[1]

- (b) Use the equation:

$$\text{energy released (J)} = \text{mass of water (g)} \times 4.2 \times \text{temperature increase (}^{\circ}\text{C)}$$

to calculate the energy released by the cheese.

[2]

energy released = J



- (c) Use the students' results to calculate the energy provided by a snack consisting of 20g of cheese and 15g of oatie biscuits. [3]

energy = J

6

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5. All drugs can have side effects. New drugs undergo testing before they can be prescribed by doctors.

(a) State the meaning of each of the following terms used in drug development.

(i) Blind study [1]

.....
.....

(ii) Double-blind study [1]

.....
.....

(iii) Placebo [1]

.....
.....

(b) Aspirin is a common treatment for patients suffering cardiovascular disease. State **one** positive and **one** negative effect of regularly taking aspirin. [2]

Positive:

.....

Negative:

.....



- (c) A painkiller has 196 possible side effects. The most common side effects and their occurrence are listed below.

Side effect	Occurrence (%)
nausea	12.5
headache	19.5
insomnia	20.7
anxiety	11.5

If there are 100 000 people being treated with this painkiller at any one time, calculate how many are likely to suffer from insomnia. [2]

number of people =



6. (a) The spectrum from a star is crossed by dark lines. This is called an absorption spectrum.

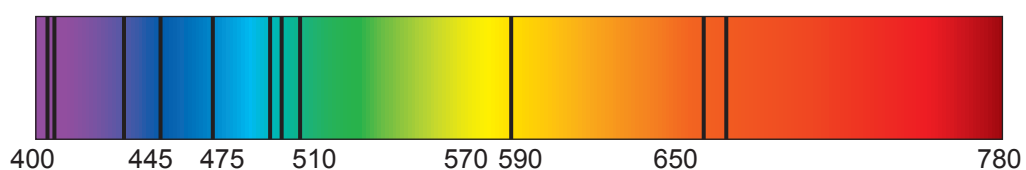
(i) Explain how an absorption spectrum is produced. [2]

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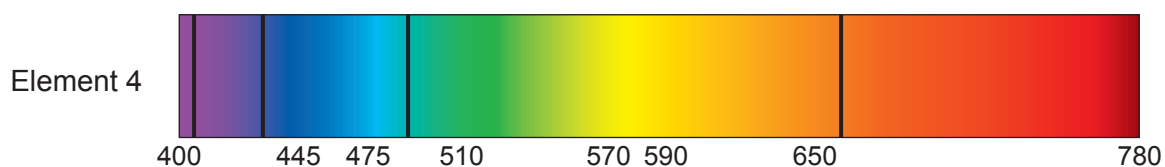
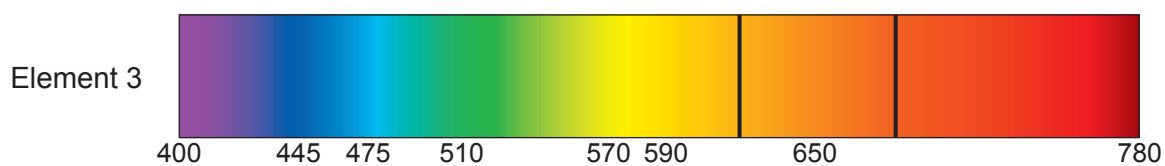
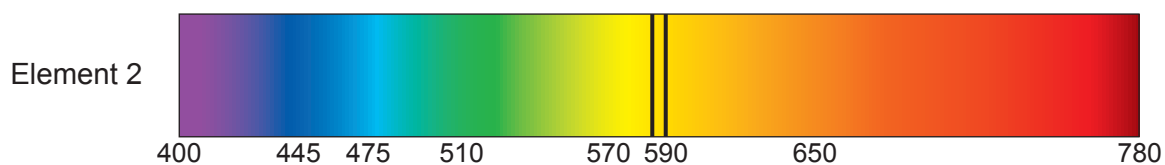
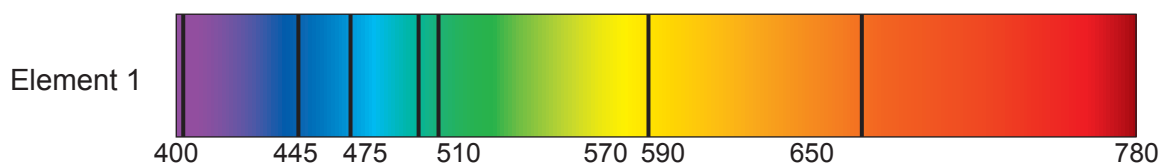
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(ii) An absorption spectrum from a star is shown below.



Here are absorption spectra for different elements.



Complete the table to show whether each element is present in the star.

[2]

Examiner
only

Element	Present in the star (Yes or No)
1
2
3
4

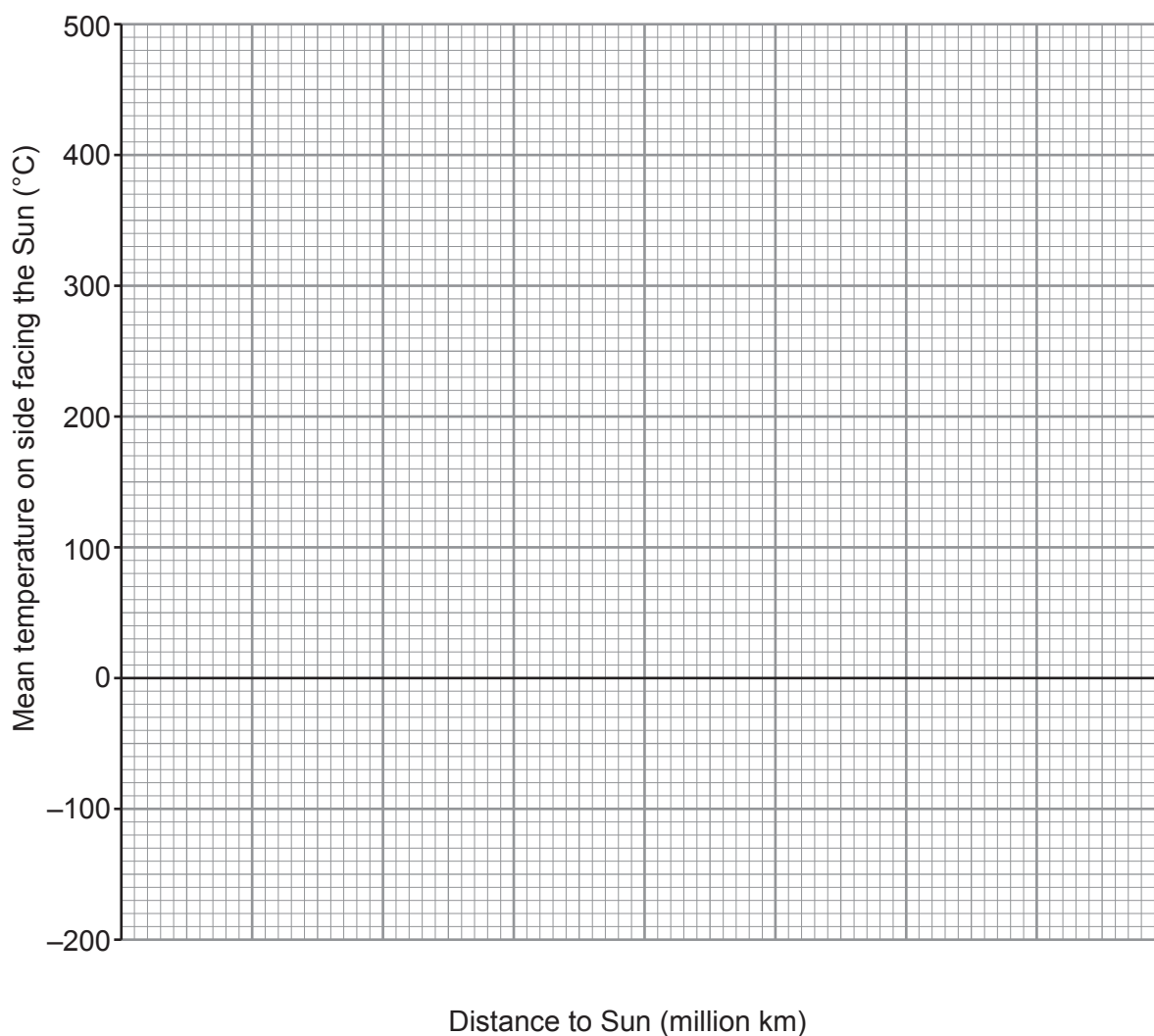


(b) The table gives information about some planets in our solar system.

Planet	Distance to Sun (million km)	Mean temperature on side facing the Sun ($^{\circ}\text{C}$)
Mercury	60	430
Venus	110	470
Earth	150	20
Mars	230	-20
Jupiter	780	-150

(i) Plot the data on the grid below.

[2]



(ii) Circle the anomalous point on the grid. [1]

(iii) Join the points with a smooth curve. [1]

(iv) Determine the distance from the Sun at which a planet would have a mean temperature to be 0°C . [1]

distance = (million km)

(c) Complete the diagram below to show the shape of the orbit of a comet around the Sun. [1]


Sun

10



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(b) The following chart is available to you.

Pollution level

Indicator species

A Clean water



Stonefly nymph (about 10 mm)



Mayfly nymph (about 20 mm)

B Some pollution



Freshwater shrimp (about 20 mm)



Caddis fly larva (about 10 mm)

C Moderate pollution

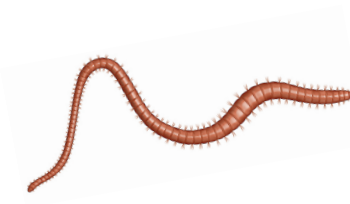


Water louse (about 10 mm)



Bloodworm (about 20 mm)

D High pollution



Sludgeworm (about 120 mm)



Rat-tailed maggot (up to 55 mm)

E Very High pollution – no life



Results from water sampling at two locations are given in the table below.

Species	Total in water sample	
	location 1	location 2
Stonefly nymph	0	0
Caddis fly larva	54	0
Water louse	2	0
Bloodworm	3	0
Sludgeworm	0	80
Rat-tailed maggot	1	65

Use the data in the table to compare the quality of water at the two locations. [2]

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8



8. The greenhouse effect is important to stabilise the conditions on Earth needed for life.

(a) Describe how the greenhouse effect occurs. [3]

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(b) State **two** ways an enhanced greenhouse effect has an impact on Earth. [2]

1.

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2.

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(c) State **two** ways humans can reduce their dependency on fossil fuels. [2]

1.

.....

2.

.....

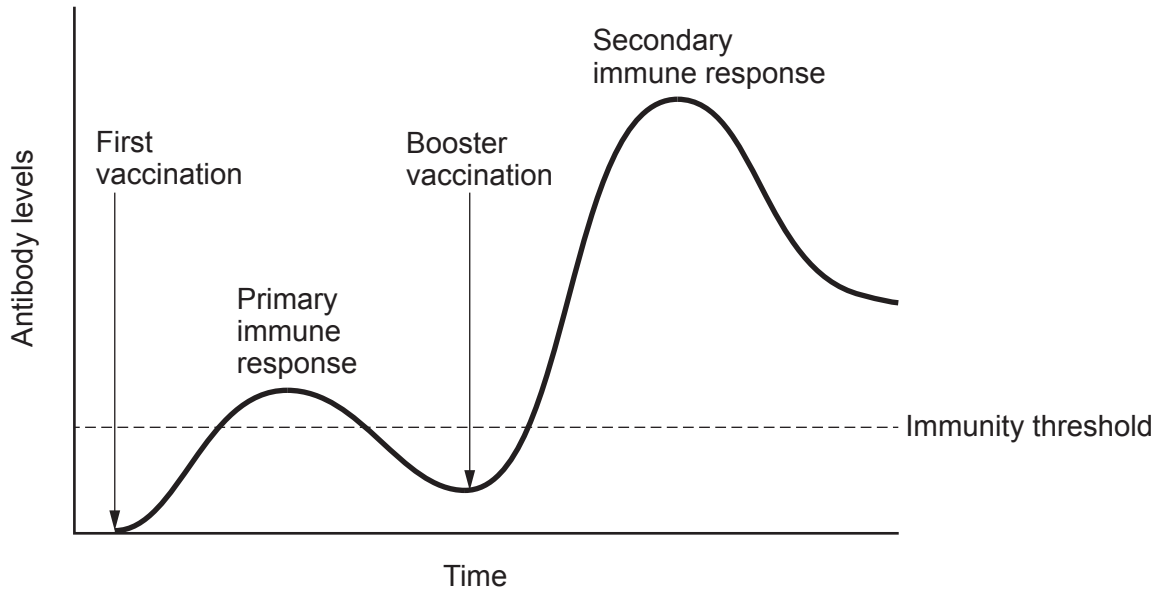
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7



9. Vaccines protect against disease.

(a) The graph below shows blood antibody levels following a first vaccination and a booster. Once antibody levels rise above a threshold value then there is immunity against the disease.



Compare the immune response following the initial vaccination and the booster vaccination.

[4]

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(b) Explain how a vaccine protects against specific illnesses.

[3]

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7



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THE PERIODIC TABLE

Group 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 O Oxygen 8	16 F Fluorine 9	17 Ne Neon 10
23 Sc Scandium 21	24 Mg Magnesium 12	27 Co Cobalt 27	28 Si Silicon 14	29 Ni Nickel 28	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	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	63.5 Cu Copper 29	70 Ga Gallium 31
86 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	99 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	108 Ag Silver 47	115 In Indium 49
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	179 Hf Hafnium 72	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	197 Au Gold 79	204 Tl Thallium 81
223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89	45 Sc Scandium 21	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	63.5 Cu Copper 29	70 Ga Gallium 31
			48 Ti Titanium 22	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	63.5 Cu Copper 29	70 Ga Gallium 31
			51 V Vanadium 23	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	63.5 Cu Copper 29	70 Ga Gallium 31
			52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	63.5 Cu Copper 29	70 Ga Gallium 31
			59 Nb Niobium 41	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	63.5 Cu Copper 29	70 Ga Gallium 31
			60 Mo Molybdenum 42	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	63.5 Cu Copper 29	70 Ga Gallium 31
			72 Hf Hafnium 72	75 Re Rhenium 75	76 Os Osmium 76	77 Ir Iridium 77	79 Au Gold 79	81 Tl Thallium 81
			73 Ta Tantalum 73	75 Re Rhenium 75	76 Os Osmium 76	77 Ir Iridium 77	79 Au Gold 79	81 Tl Thallium 81
			74 W Tungsten 74	75 Re Rhenium 75	76 Os Osmium 76	77 Ir Iridium 77	79 Au Gold 79	81 Tl Thallium 81
			78 Pt Platinum 78	78 Pt Platinum 78	78 Pt Platinum 78	78 Pt Platinum 78	79 Au Gold 79	81 Tl Thallium 81
			80 Hg Mercury 80	80 Hg Mercury 80	80 Hg Mercury 80	80 Hg Mercury 80	80 Hg Mercury 80	81 Tl Thallium 81
			82 Pb Lead 82	82 Pb Lead 82	82 Pb Lead 82	82 Pb Lead 82	82 Pb Lead 82	82 Pb Lead 82
			83 Bi Bismuth 83	83 Bi Bismuth 83	83 Bi Bismuth 83	83 Bi Bismuth 83	83 Bi Bismuth 83	83 Bi Bismuth 83
			84 Po Polonium 84	84 Po Polonium 84	84 Po Polonium 84	84 Po Polonium 84	84 Po Polonium 84	84 Po Polonium 84
			85 At Astatine 85	85 At Astatine 85	85 At Astatine 85	85 At Astatine 85	85 At Astatine 85	85 At Astatine 85
			86 Rn Radon 86	86 Rn Radon 86	86 Rn Radon 86	86 Rn Radon 86	86 Rn Radon 86	86 Rn Radon 86
			87 Fr Francium 87	87 Fr Francium 87	87 Fr Francium 87	87 Fr Francium 87	87 Fr Francium 87	87 Fr Francium 87
			88 Ra Radium 88	88 Ra Radium 88	88 Ra Radium 88	88 Ra Radium 88	88 Ra Radium 88	88 Ra Radium 88
			89 Ac Actinium 89	89 Ac Actinium 89	89 Ac Actinium 89	89 Ac Actinium 89	89 Ac Actinium 89	89 Ac Actinium 89
			90 Th Thorium 90	90 Th Thorium 90	90 Th Thorium 90	90 Th Thorium 90	90 Th Thorium 90	90 Th Thorium 90
			91 Pa Protactinium 91	91 Pa Protactinium 91	91 Pa Protactinium 91	91 Pa Protactinium 91	91 Pa Protactinium 91	91 Pa Protactinium 91
			92 U Uranium 92	92 U Uranium 92	92 U Uranium 92	92 U Uranium 92	92 U Uranium 92	92 U Uranium 92
			93 Np Neptunium 93	93 Np Neptunium 93	93 Np Neptunium 93	93 Np Neptunium 93	93 Np Neptunium 93	93 Np Neptunium 93
			94 Pu Plutonium 94	94 Pu Plutonium 94	94 Pu Plutonium 94	94 Pu Plutonium 94	94 Pu Plutonium 94	94 Pu Plutonium 94
			95 Am Americium 95	95 Am Americium 95	95 Am Americium 95	95 Am Americium 95	95 Am Americium 95	95 Am Americium 95
			96 Cm Curium 96	96 Cm Curium 96	96 Cm Curium 96	96 Cm Curium 96	96 Cm Curium 96	96 Cm Curium 96
			97 Bk Berkelium 97	97 Bk Berkelium 97	97 Bk Berkelium 97	97 Bk Berkelium 97	97 Bk Berkelium 97	97 Bk Berkelium 97
			98 Cf Californium 98	98 Cf Californium 98	98 Cf Californium 98	98 Cf Californium 98	98 Cf Californium 98	98 Cf Californium 98
			99 Es Einsteinium 99	99 Es Einsteinium 99	99 Es Einsteinium 99	99 Es Einsteinium 99	99 Es Einsteinium 99	99 Es Einsteinium 99
			100 Fm Fermium 100	100 Fm Fermium 100	100 Fm Fermium 100	100 Fm Fermium 100	100 Fm Fermium 100	100 Fm Fermium 100
			101 Mendelevium 101	101 Mendelevium 101	101 Mendelevium 101	101 Mendelevium 101	101 Mendelevium 101	101 Mendelevium 101
			102 Nobelium 102	102 Nobelium 102	102 Nobelium 102	102 Nobelium 102	102 Nobelium 102	102 Nobelium 102
			103 Lr Lawrencium 103	103 Lr Lawrencium 103	103 Lr Lawrencium 103	103 Lr Lawrencium 103	103 Lr Lawrencium 103	103 Lr Lawrencium 103
			104 Rutherfordium 104	104 Rutherfordium 104	104 Rutherfordium 104	104 Rutherfordium 104	104 Rutherfordium 104	104 Rutherfordium 104
			105 Dubnium 105	105 Dubnium 105	105 Dubnium 105	105 Dubnium 105	105 Dubnium 105	105 Dubnium 105
			106 Seaborgium 106	106 Seaborgium 106	106 Seaborgium 106	106 Seaborgium 106	106 Seaborgium 106	106 Seaborgium 106
			107 Bh Bohrium 107	107 Bh Bohrium 107	107 Bh Bohrium 107	107 Bh Bohrium 107	107 Bh Bohrium 107	107 Bh Bohrium 107
			108 Hs Hassium 108	108 Hs Hassium 108	108 Hs Hassium 108	108 Hs Hassium 108	108 Hs Hassium 108	108 Hs Hassium 108
			109 Mt Meitnerium 109	109 Mt Meitnerium 109	109 Mt Meitnerium 109	109 Mt Meitnerium 109	109 Mt Meitnerium 109	109 Mt Meitnerium 109
			110 Ds Darmstadtium 110	110 Ds Darmstadtium 110	110 Ds Darmstadtium 110	110 Ds Darmstadtium 110	110 Ds Darmstadtium 110	110 Ds Darmstadtium 110
			111 Rg Roentgenium 111	111 Rg Roentgenium 111	111 Rg Roentgenium 111	111 Rg Roentgenium 111	111 Rg Roentgenium 111	111 Rg Roentgenium 111
			112 Cn Copernicium 112	112 Cn Copernicium 112	112 Cn Copernicium 112	112 Cn Copernicium 112	112 Cn Copernicium 112	112 Cn Copernicium 112
			113 Nh Nihonium 113	113 Nh Nihonium 113	113 Nh Nihonium 113	113 Nh Nihonium 113	113 Nh Nihonium 113	113 Nh Nihonium 113
			114 Fl Flerovium 114	114 Fl Flerovium 114	114 Fl Flerovium 114	114 Fl Flerovium 114	114 Fl Flerovium 114	114 Fl Flerovium 114
			115 Mc Moscovium 115	115 Mc Moscovium 115	115 Mc Moscovium 115	115 Mc Moscovium 115	115 Mc Moscovium 115	115 Mc Moscovium 115
			116 Lv Livermorium 116	116 Lv Livermorium 116	116 Lv Livermorium 116	116 Lv Livermorium 116	116 Lv Livermorium 116	116 Lv Livermorium 116
			117 Ts Tennessine 117	117 Ts Tennessine 117	117 Ts Tennessine 117	117 Ts Tennessine 117	117 Ts Tennessine 117	117 Ts Tennessine 117
			118 Og Oganesson 118	118 Og Oganesson 118	118 Og Oganesson 118	118 Og Oganesson 118	118 Og Oganesson 118	118 Og Oganesson 118

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