Surname	Centre Number	Candidate Number
First name(s)		0

GCSE

S24-3445U10-1

3445U10-1

THURSDAY, 13 JUNE 2024 – 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.	**11**	
2.	**15**	
3.	**6**	
4.	**12**	
5.	**12**	
6.	**19**	
Total	**75**	

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ADDITIONAL MATERIALS

In addition to this paper you may 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** 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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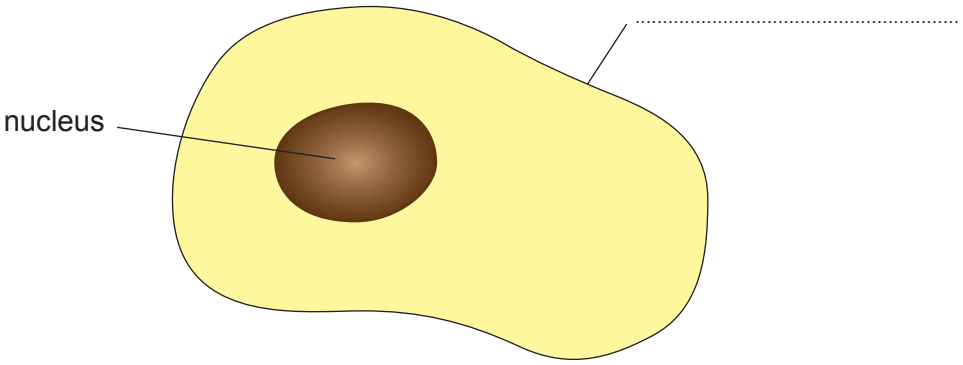
Answer **all** questions.

1. The diagram below shows an animal cell.

chloroplast	vacuole	cell membrane



(a) (i) Use the correct word(s) from the box to complete the labelling of the animal cell.[1]

(ii) Tick (✓) the box next to a structure found inside the nucleus. [1]

chloroplast ☐

chromosome ☐

cellulose ☐

(iii) Tick (✓) the box next to the correct statement about the function of the nucleus. [1]

gives structural support of the cell ☐

controls the activity of the cell ☐

the site of photosynthesis ☐

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(b) Cells are organised into tissues. Complete the following sentences by underlining the correct word in each bracket. [2]

Tissues are a collection of many (**different / similar / bigger**) cells.

Tissues work together to perform a (**smaller / particular / bigger**) function.

(c) The cell membrane controls the entry and exit of all substances into and out of the cell. Many substances are transported into the cell by diffusion.

(i) Complete the following sentence by underlining the correct word in each bracket. [2]

Diffusion is the movement of substances from a region of (**high / low / zero**) concentration to a region of (**higher / lower / negative**) concentration.

(ii) Oxygen is a gas that diffuses into the cell. Tick (✓) the box next to the gas that diffuses **out of** the cell. [1]

argon ☐

carbon dioxide ☐

helium ☐

(iii) I. The oxygen that diffuses into the blood is needed by all cells to release energy.

Circle the process that releases energy. [1]

excretion **respiration** **absorption**

II. Complete the equation for this process using the correct terms from the box. [2]

glucose	protein	sulfur	salt	carbon dioxide

..... + oxygen ⟶ ..... + water

11

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2. This question is about acids and alkalis. Lisa started filling in the following table.

Chemical name	Chemical formula	Colour with Universal Indicator	pH	Acid, alkali or neutral
sulfuric acid	H_2SO_4	red	1	acid
hydrochloric acid	HCl	red	.....	acid
calcium hydroxide	$Ca(OH)_2$	purple	12	alkali
sodium hydroxide	NaOH	.....	14	alkali
water	.....	green	7	.....

(a) Complete the table. [4]

(b) Lisa added magnesium to sulfuric acid. She recorded the temperature of the mixture during the reaction.

The word equation for this reaction is shown below.

magnesium + sulfuric acid ⟶ magnesium sulfate + hydrogen

The temperatures are shown in the table below.

Time (s)	Temperature (°C)
0	20
10	40
20	50
30	60
40	60
50	58

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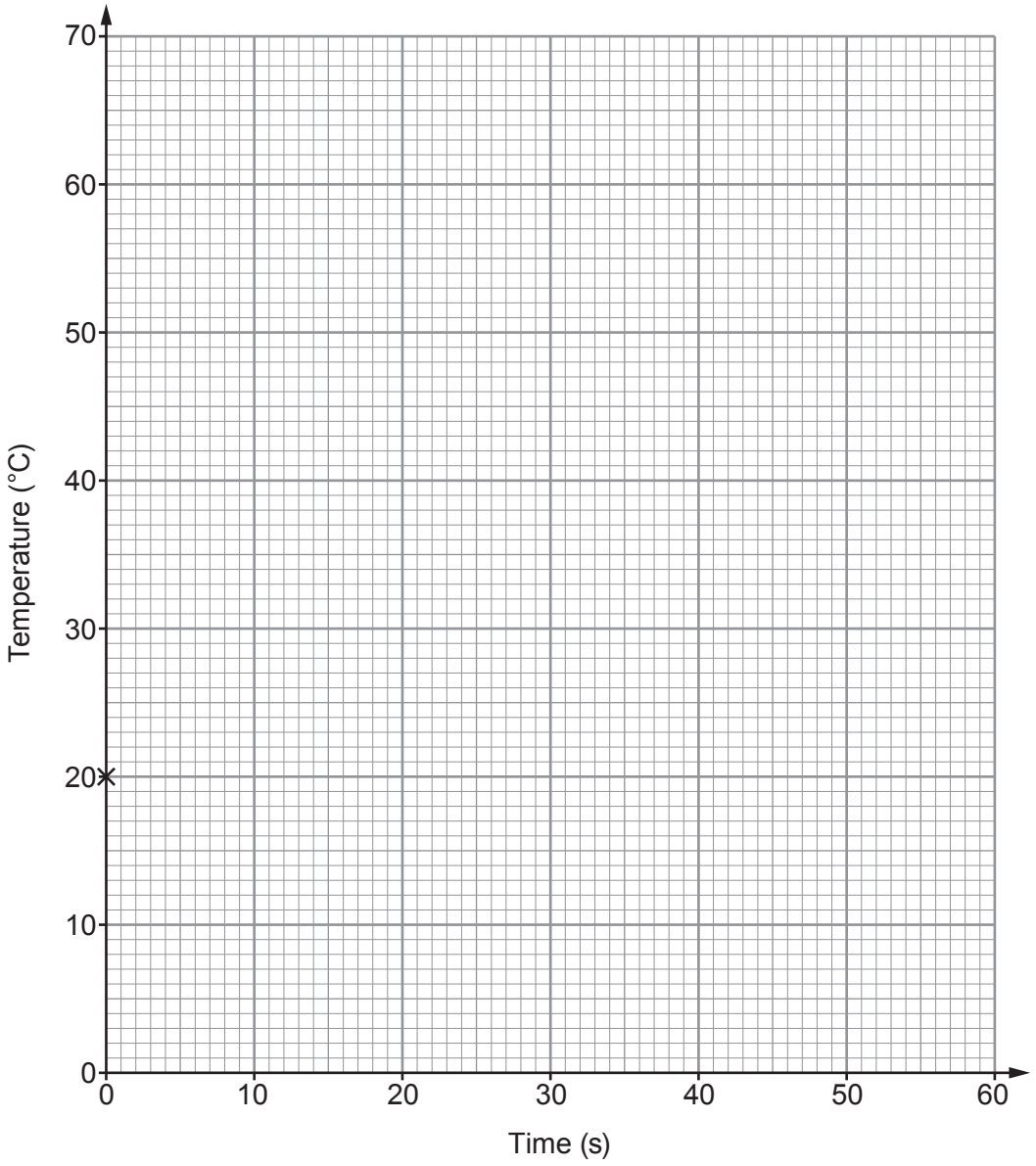
(i) Use the data in the table to plot a graph on the grid below and join the points with a ruler. The first point has been plotted for you. [3]



(ii) Calculate the temperature change during the first 20 seconds. [2]

temperature change = ... °C

Examiner only

(iii) Complete the following table to describe how the temperature changes over the 50 seconds. The first two rows have been completed for you. [3]

Time (s)	Temperature decreases	Temperature stays the same	Temperature increases
0–10			✓
10–20			✓
20–30			
30–40			
40–50			

(c) Sulfuric acid has the formula H_2SO_4.

Complete the following table to calculate the relative formula mass of H_2SO_4. [3]

Element	Number of atoms	Relative atomic mass (A_r)	Total mass of the element in H_2SO_4
hydrogen	2	1	.....
sulfur	1	32	.....
oxygen	4	16	64
		relative formula mass (M_r)	.....

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Examiner only

3. Digestion is a process whereby large food molecules are broken down into smaller molecules so they can be absorbed for use by the human body.

Describe the role of the enzyme amylase (carbohydrase) in the digestive system. [6 QER]

Include in your answer:
- where amylase is made
- how amylase works
- the conditions necessary for its action

6

Examiner only

4. (a) Welsh Water is responsible for supplying and maintaining safe water supplies in Wales. It monitors the composition of our drinking water.

The table below shows the composition of stream water supplying a reservoir in Wales. The samples were taken from three different streams.

Component	Concentration (units)		
	stream 1	stream 2	stream 3
sodium ions (Na^+)	5.0	5.0	5.0
potassium ions (K^+)	6.3	6.2	6.2
magnesium ions (Mg^{2+})	15.3	15.4	15.5
calcium ions (Ca^{2+})	50.4	50.1	50.1
chloride ions (Cl^-)	30.1	30.0	30.2
dissolved sulfur dioxide	6.0	8.2	10.0
dissolved carbon dioxide	0.6	0.9	1.6
pH	5.7	5.5	5.4

Use the information in the table to answer the following questions.

(i) State the name of **one** ion whose concentration is the same in each stream. [1]

.....

(ii) There is more dissolved sulfur dioxide in stream 3 than in stream 1.

I. Use the equation:

$$\% \text{ difference} = \frac{\text{concentration in stream 3} - \text{concentration in stream 1}}{\text{concentration in stream 3}} \times 100$$

to calculate the percentage difference between the dissolved sulfur dioxide in stream 1 and stream 3. [2]

percentage difference = ...

Examiner only

II. Complete the following sentence by underlining the correct term in the bracket.

An increase in dissolved sulfur dioxide makes the rainwater (**more acidic / become neutral / less acidic**). [1]

III. State how an increase in dissolved sulfur dioxide affects the pH of water. [1]

.....

(iii) A technician believes that streams 1, 2 and 3 have water of the same hardness. Use the data in the table to explain whether you agree with the technician. [3]

.....

.....

.....

.....

.....

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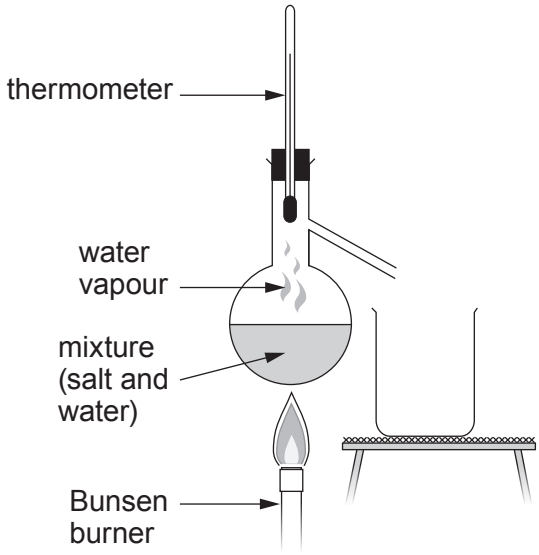
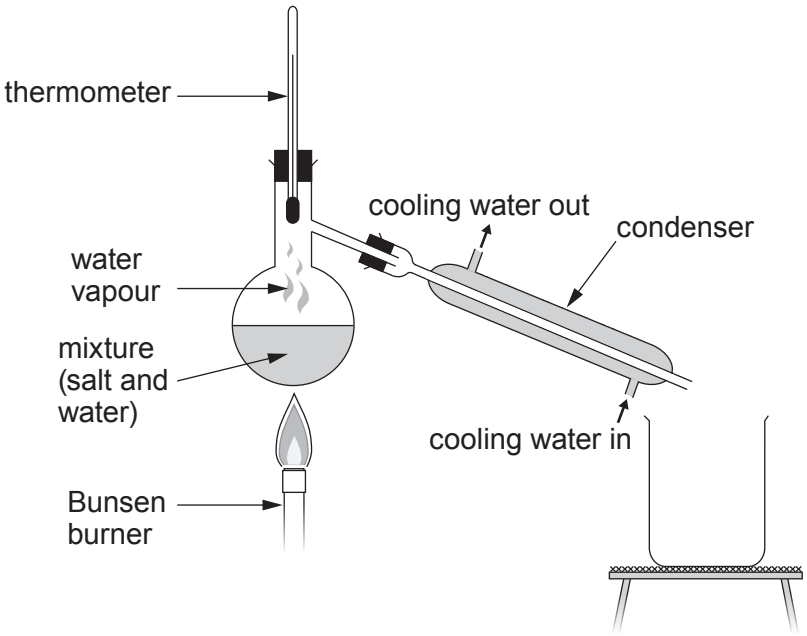
(b) When water is in short supply, seawater can be desalinated. In a school laboratory, distillation apparatus can be used to desalinate seawater. A student was given the choice of apparatus A or B.



Apparatus A



Apparatus B

Examiner only

(i) State the temperature that the thermometer will record during the desalination of water. [1]

..... °C

(ii) A student believes that she will collect more water using apparatus A than apparatus B.

Explain whether you agree. [2]

.....

.....

.....

(iii) South East England needs an alternative source of water to supply drinking water. One of the options is to build a desalination plant.

State **one** disadvantage of desalination of sea water. [1]

.....

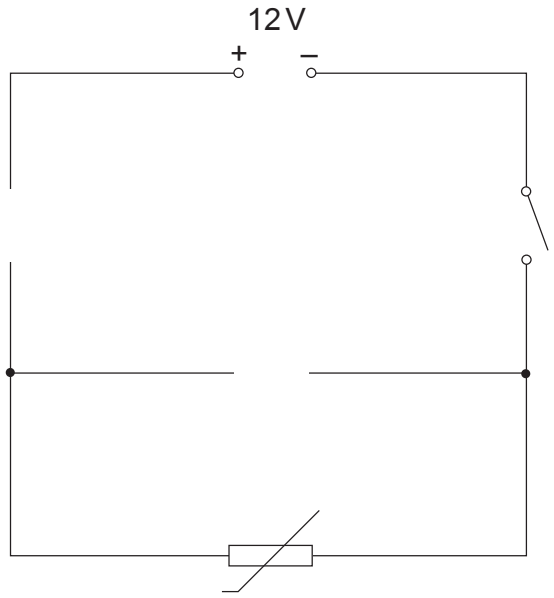
.....

12

Examiner only

5. Tommy and Arthur are investigating the effect of temperature on the resistance of a thermistor.

The circuit diagram drawn by Tommy is shown below.



(a) Complete the circuit above by adding:

(i) an **ammeter** to measure current through the thermistor. [1]

(ii) a **voltmeter** to measure voltage across the thermistor. [1]

(b) The results of Tommy's experiment are shown in the table below.

Temperature (°C)	Current (A)	Voltage (V)	Resistance (Ω)
0	0.05	12	240
20	0.10	12	120
40	0.20	12	60
60	0.40	12	30
80	0.80	12	15
90	1.1	12	

Use only the information in the table to answer the following questions.

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

.....

(ii) State a controlled variable in this experiment. [1]

.....

Examiner only

(c) Use the information in the table to answer the following questions.

(i) Estimate the **current** when the temperature is 100 °C. [2]

current = ... A

(ii) Use the equation:

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

to calculate the resistance of the thermistor at 90 °C. [2]

resistance = ... Ω

(iii) Tommy thinks that when he increases the temperature by 20 °C the resistance of the thermistor decreases by half every time. Use Tommy's results to explain whether you agree. [2]

.....

.....

.....

(iv) Arthur wants to know if the thermistor they used in the circuit would be suitable as a temperature sensor. The sensor must work between 20 °C to 60 °C and vary in resistance by at least 100 Ω.
Use Tommy's results to explain whether the thermistor would be suitable. [2]

.....

.....

.....

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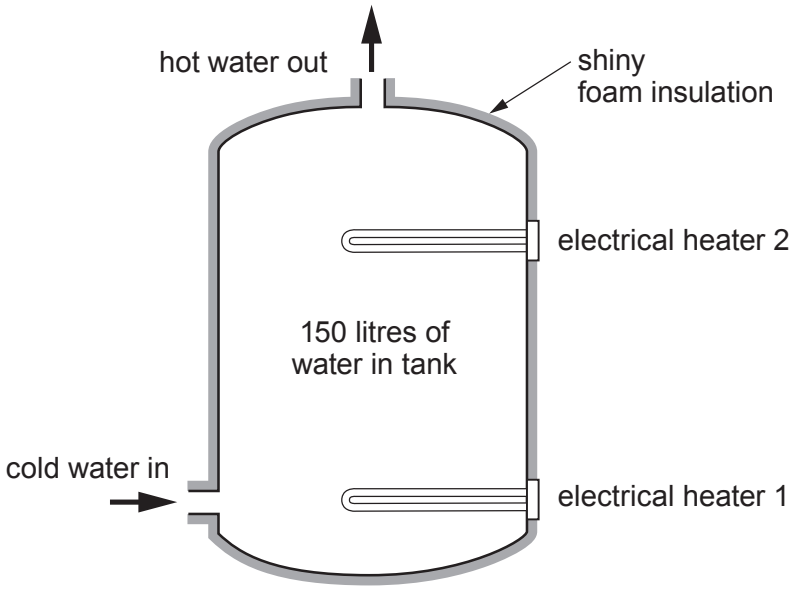
6. Paul lives in an apartment in central London. His electricity bill is £80 a month. Paul wants to replace his old electric boiler with a new one. A local plumbing company has suggested using a new boiler, the Redstar boiler, which has two electrical heaters. Paul will be able to use either heater to provide hot water after the boiler is installed.

Information about the Redstar boiler



Savings

Cost of boiler	£2500.00
Typical savings	£15.00 per month

Technical information on the two heaters in the Redstar boiler

Information	heater 1	heater 2
maximum volume of water that is heated by heater (litres)	150	50
time to heat this volume of water (hours)	3	0.5
total power supplied (kW)	2	4
power used to heat the water (kW)	1.6	3.6
efficiency (%)	80	
cost to heat the water (p)		44

(a) Use the information given about the boiler to answer the following questions.

(i) Calculate the expected payback time for the boiler in years. [3]

payback time = ... years

Examiner only

(ii) Use the equation:

$$\% \text{ efficiency} = \frac{\text{power usefully transferred}}{\text{total power supplied}} \times 100$$

to calculate the efficiency of **heater 2**. [2]

% efficiency = ...

(iii) Use the equations:

units used (kWh) = power (kW) × time (h)

total cost = cost of one unit × units used

to calculate the cost of the electricity to heat 150 litres of water using **heater 1**.

Cost per unit of electricity = 22 p [3]

cost = ...

(iv) Paul has estimated that he uses 40 litres of hot water per day.
He thinks that **heater 1** would be the best one to use every day.

Explain whether you agree with Paul. [2]

.....

.....

.....

Examiner only

(b) The water in London is known to be hard.

Explain how hard water could have affected Paul's old boiler. [2]

.....

.....

.....

(c) Heat energy can be transferred by conduction, convection and radiation.

(i) Explain how the shiny foam insulation used around the boiler helps to reduce heat loss. [2]

.....

.....

.....

.....

(ii) Explain how having the foam insulation layer around the boiler benefits the environment. [2]

.....

.....

.....

.....

(iii) Paul thinks that **heater 2** will not heat all the water in the boiler.

Use the diagram of the boiler to explain whether you agree. [3]

.....

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.....

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END OF PAPER

Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

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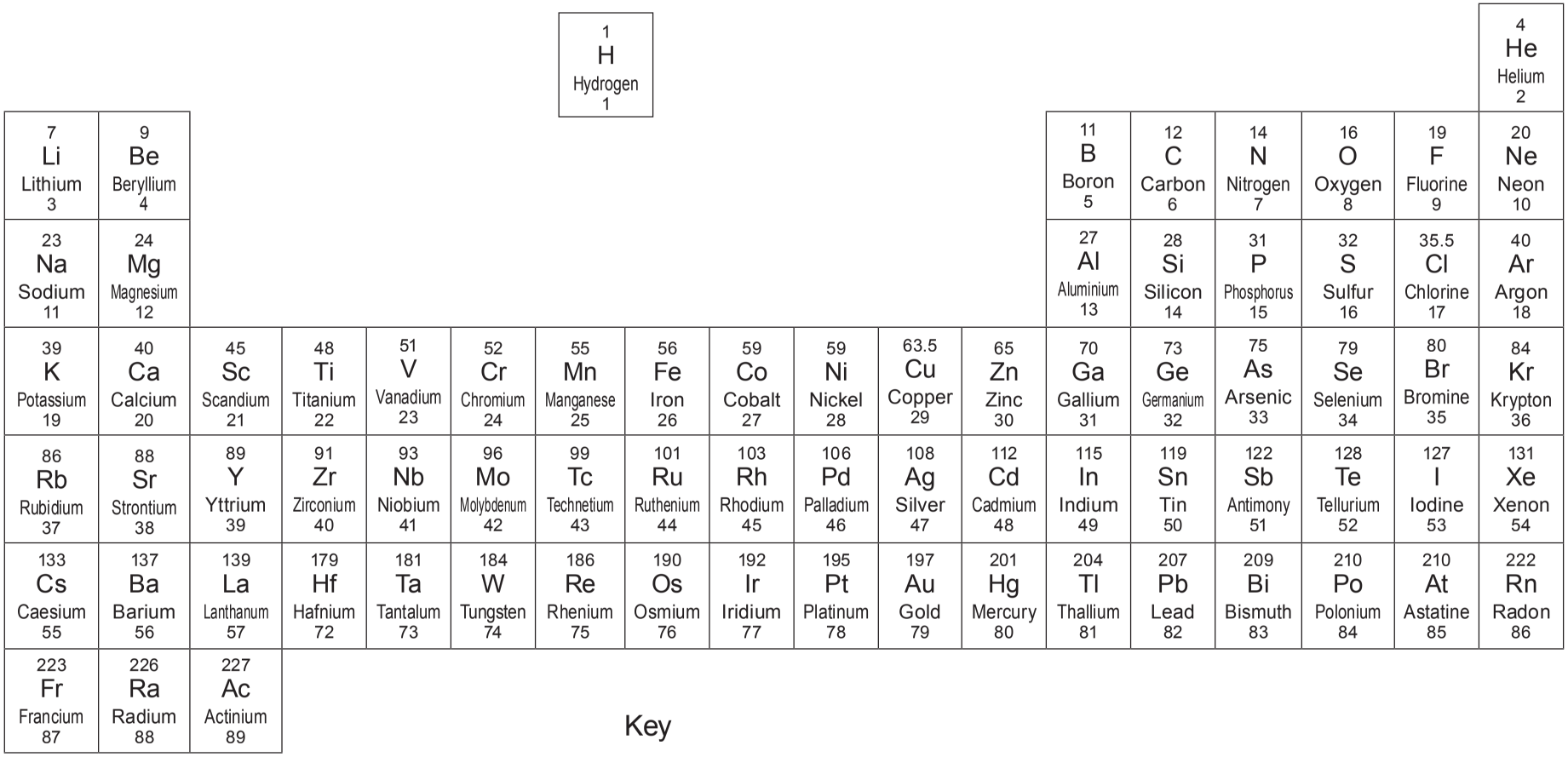
THE PERIODIC TABLE



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