

1. Which statement about the periodic table is **not** correct?

- A** Elements in the same group have similar **chemical** properties.
- B** The elements are ordered by increasing atomic mass.
- C** The elements are ordered by increasing atomic number.
- D** There is a repeating trend of **physical** and **chemical** properties across the periods.

Your answer

☐

[1]

2. The table shows the melting points of some of the elements in Period 3 of the periodic table.

Element	Al	Si	P <sub>4</sub>	S <sub>8</sub>
Melting point / °C	660	1410	44	119

Explain the melting points in terms of bonding and structure.

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[6]

3. Chlorine has the electron configuration  $[\text{Ne}]3s^23p^5$ .

Which statement(s) about chlorine is/are correct when it reacts in redox reactions?

- 1 It can gain one electron to form  $1-$  ions.
- 2 It can lose its  $3s^2$  electrons to form  $2+$  ions.
- 3 It can lose its  $3p^5$  electrons to form  $5+$  ions.

- A 1, 2 and 3
- B Only 1 and 2
- C Only 2 and 3
- D Only 1

Your answer

☐

[1]

4(a). This question is about periodicity and the reaction of some Group 2 metals.

Periodicity is the repeating trend in properties of elements across different periods in the periodic table.

- i. Complete the table below with the electron configurations and blocks.

	Group 2	Group 17 (7)
Period 2	Be $1s^2$ .....	F $1s^2$ .....
Period 3	Mg $1s^2$ .....	Cl $1s^2$ .....
Block	.....	.....

[3]

- ii. Use your answers to (i) to explain why electron configuration is an example of a periodic trend.

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[2]

- iii. Mg forms  $2+$  ions but C/ usually forms  $1-$  ions in their reactions. Explain why.

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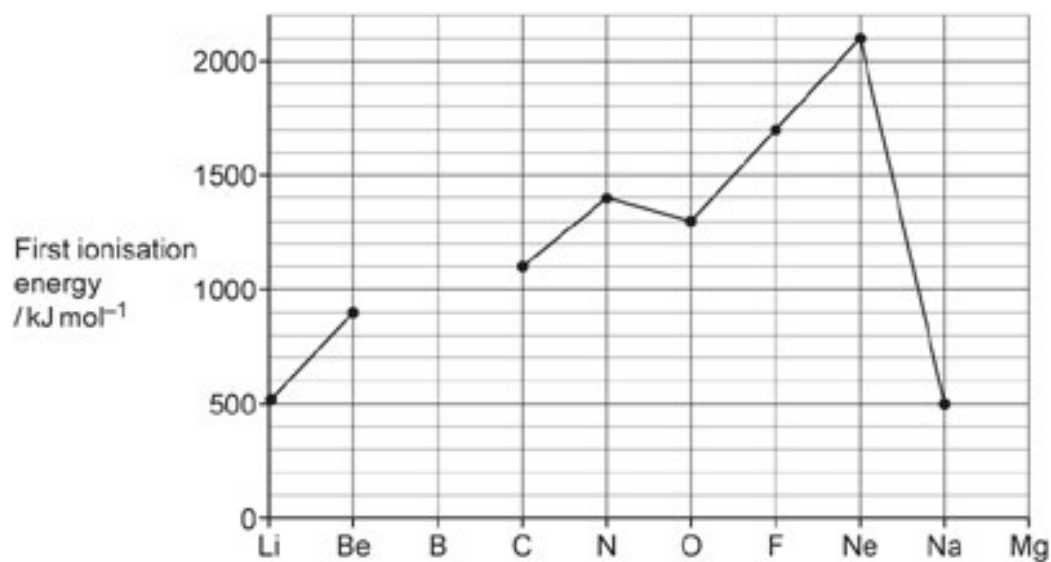
[2]

- iv. Magnesium reacts with oxygen in the air.

Write the equation for this reaction.

[1]

- (b). The graph shows the first ionisation energies for the elements Li to Be and for C to Na.



- i. Complete the graph by adding points for the missing values of B and Mg.

[2]

- ii. Write an equation, including state symbols, to represent the **second** ionisation energy of B.

[2]

**5(a).** This question is about the first 36 elements in the periodic table:

H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr

From these 36 elements **only**, write the symbol for the element(s) that fit each description.

The element in Period 2 with the successive ionisation energies shown below.

Ionisation number	1st	2nd	3rd	4th	5th	6th	7th	8th
Ionisation energy / kJ mol <sup>-1</sup>	1000	2251	3361	4564	7012	8496	27 107	31 671

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

**(b).** An element that is a solid at RTP with a simple molecular lattice structure.

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

**(c).** The element in Period 3 that exists in the solid state as a network of atoms bonded by strong covalent bonds.

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

**6.** This question is about energy changes.

The first and second ionisation energies of magnesium, Mg, and strontium, Sr, in Group 2 are given in the table below.

Element	First ionisation energy / kJ mol <sup>-1</sup>	Second ionisation energy / kJ mol <sup>-1</sup>
Mg	+738	+1451
Sr	+550	+1064

- Explain why the first ionisation energy of Mg is greater than the **first** ionisation energy of Sr.
- Explain why the second ionisation energy of Sr is greater than the **first** ionisation energy of Sr.

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[4]

7. Which element has the largest third ionisation energy?

- A Li
- B F
- C Ne
- D Na

Your answer

[1]

8. Successive ionisation energies, in  $\text{kJ mol}^{-1}$ , of an element in Period 3 of the periodic table are shown below.

1st	2nd	3rd	4th	5th	6th	7th	8th	9th
578	1817	2745	11578	14831	18378	23296	27460	31862

What is the formula of the oxide of the Period 3 element?

- A  $\text{Na}_2\text{O}$
- B  $\text{MgO}$
- C  $\text{Al}_2\text{O}_3$
- D  $\text{SiO}_2$

Your answer

[1]

9. The table below shows melting points and electrical conductivities of some elements in Period 3 and compounds they form.

Substance	Magnesium sulfide, MgS	Aluminium, Al	Silicon, Si	Phosphorus trichloride, $\text{PCl}_3$
Melting point / $^{\circ}\text{C}$	2000	660	1414	-94
Electrical conductivity		Good	Poor	
Type of lattice structure	Giant .....	..... .....	..... .....	..... .....

i. Complete the table above to show the type of lattice structure of each substance.

[4]

ii. Explain the following:

- MgS has a higher melting point than  $\text{PCl}_3$ .
- Al has a greater electrical conductivity than Si.

Melting points \_\_\_\_\_  
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 \_\_\_\_\_  
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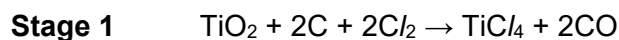
Conductivities \_\_\_\_\_  
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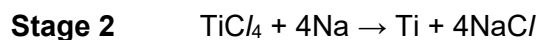
**10.** This question is about titanium (atomic number 22) and its compounds.

An ore of titanium contains impure  $\text{TiO}_2$ .

Titanium is manufactured from  $\text{TiO}_2$  in a two-stage process.



**Reaction 1.1**



**Reaction 1.2**

- i. The common name for  $\text{TiO}_2$  is titanium dioxide.

What is the systematic name of  $\text{TiO}_2$ ?

----- [1]

- ii. In **Reaction 1.2**, the percentage yield of titanium from  $\text{TiCl}_4$  is 72.0%.

Calculate the minimum mass, in kg, of sodium that is needed to produce 1.00 kg of titanium.

Give your answer to **3** significant figures.

mass of sodium = ..... kg **[4]**

- iii. **Reaction 1.2** produces a mixture of titanium and sodium chloride.

Suggest how titanium could be separated from this mixture at room temperature.

Explain your answer.

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**11.** Describe the structure and bonding and electrical conductivity of calcium in the solid state. You may wish to include a labelled diagram in your answer.

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-----**[4]**

**12.** Which element has the lowest melting point?

- A** S
- B** P
- C** C/
- D** Ar

Your answer ☐

**[1]**

**13.** The first four ionisation energies of a Period 3 element **X** are shown in the table.

Ionisation energy/kJ mol <sup>-1</sup>			
1st	2nd	3rd	4th
738	1451	7733	10 541

Element **X** is reacted with chlorine.

What is the formula of the chloride formed?

- A** XC/
- B** XCl<sub>2</sub>
- C** XCl<sub>3</sub>
- D** XCl<sub>4</sub>

Your answer ☐

**[1]**



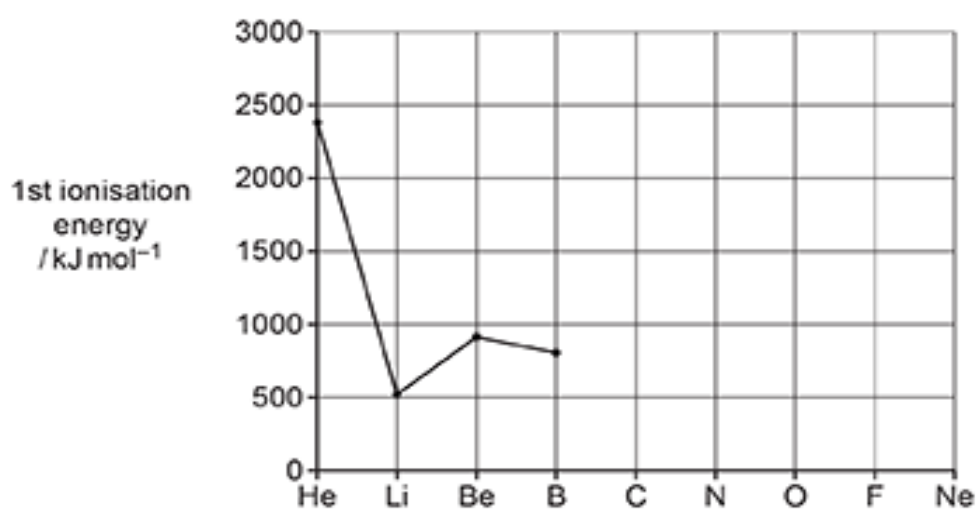
14. Which substance has a giant covalent lattice structure in its solid state?

- A potassium
- B silicon
- C sodium chloride
- D water

Your answer ☐

[1]

15(a). The graph shows the first ionisation energies for elements from helium, He, to boron, B, in the periodic table.



Complete the graph for C, N, O, F and Ne.

[2]

(b). Estimate the energy required to form **one** Li<sup>+</sup>(g) ion from one Li(g) atom.

Give your answer in kJ, in standard form, and to **two** significant figures.

energy = ..... kJ [1]

**(c).** Explain why the first ionisation energies of He and Be are both higher than the first ionisation energy of Li.

Explanation for He:

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Explanation for Be:

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[4]

**(d).** Explain why the first ionisation energy of Be is higher than the first ionisation energy of B.

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[2]

**16.** This question is about some Group 2 elements and their compounds.

Strontium and calcium both react with water.

i. Write an equation for the reaction of strontium with water.

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ii. Using oxidation numbers, explain why the reaction of strontium with water is a redox reaction.

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[2]

iii. Explain why calcium reacts more slowly with water than strontium does.

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[3]