3.1 The Periodic Table & Periodic Trends

Question Paper

Course	DP IB Chemistry
Section	3. Periodicity
Topic	3.1 The Periodic Table & Periodic Trends
Difficulty	Medium

Time allowed: 70

Score: /51

Percentage: /100

Question 1a

a) The periodic table displays the chemical elements, arranged in order of increasing atomic number. It is made up of groups and periods of elements.

State and explain the general trend in first ionization energy across a period of the periodic table.

[4 marks]

Question 1b

b) The general trend in first ionization energies stated in part (a) is seen across period 2 of the periodic table. However, boron and one other period 2 element deviate from this trend.

Identify this element and explain why it deviates from the general trend.

[3 marks]

Question 1c

c) State why nitrogen is classed as a p block element and give its full electron configuration.

[2 marks]

Question 1d

d) Identify the period 3 element that has the lowest melting point.
Explain your answer with reference to bonding and structure.

[3 marks]

Question 2a

a) The first ionization energy for all the elements is found in Section 8 of the IB data booklet.

(i) Define the term *first ionization energy* of an element.

(ii) Write the equation for the first ionization energy of aluminium.

[3 marks]

Question 2b

b) The table below shows successive ionization energies of an element **A**, found in period 3 of the periodic table.

Table 1

Number of electrons	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Ionization Energy (kJ mol^{-1})	1012	1907	2914	4964	6274	21268	25431	28972

Identify element **A**.

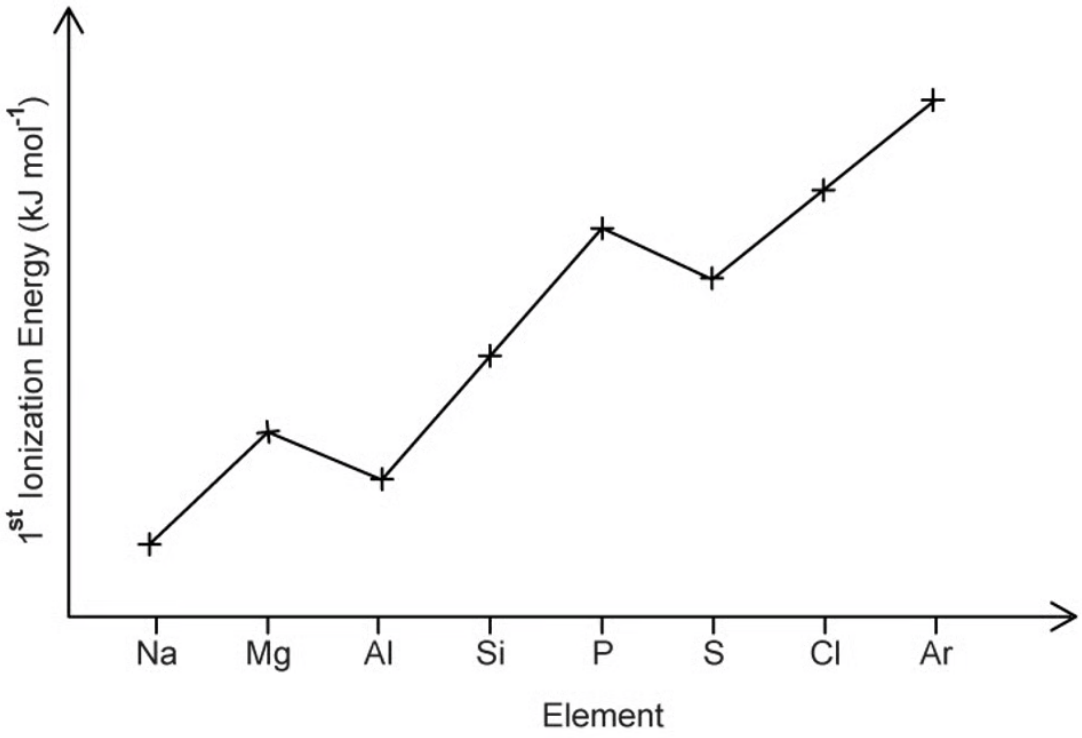
Explain your answer using data from **Table 1**.

[2 marks]

Question 2c

c) The graph below in **Figure 1** shows some information on the elements of period 3 of the periodic table.

Figure 1



State and explain the trend that this graph shows, including why there are values that deviate from the trend.

[5 marks]

Question 2d

d) Explain why the second ionization energy of aluminium is a larger value than the first ionization energy.

[1 mark]

Question 3a

a) This question is about the structure of the periodic table.

i) Throughout the early history of the periodic table scientists have attempted to order the elements according to different properties. State the property that is used to order the elements in the modern periodic table.

ii) Outline how the electron configuration of elements is related to their group and period in the periodic table.

[3 marks]

Question 3b

b) This question is about the element phosphorus.

i) State the group number, period number, and block of the element phosphorus.

ii) State the full electron configuration of the phosphide ion, P^{3-}.

[2 marks]

Question 3c

c) Outline why the atomic radius is seen to decrease across period 2 (from lithium to fluorine).

[2 marks]

Question 3d

d) Gallium forms an ion smaller than its element, whereas arsenic forms an ion larger than its element.
Explain these differences in ionic radius.

[3 marks]

Question 4a

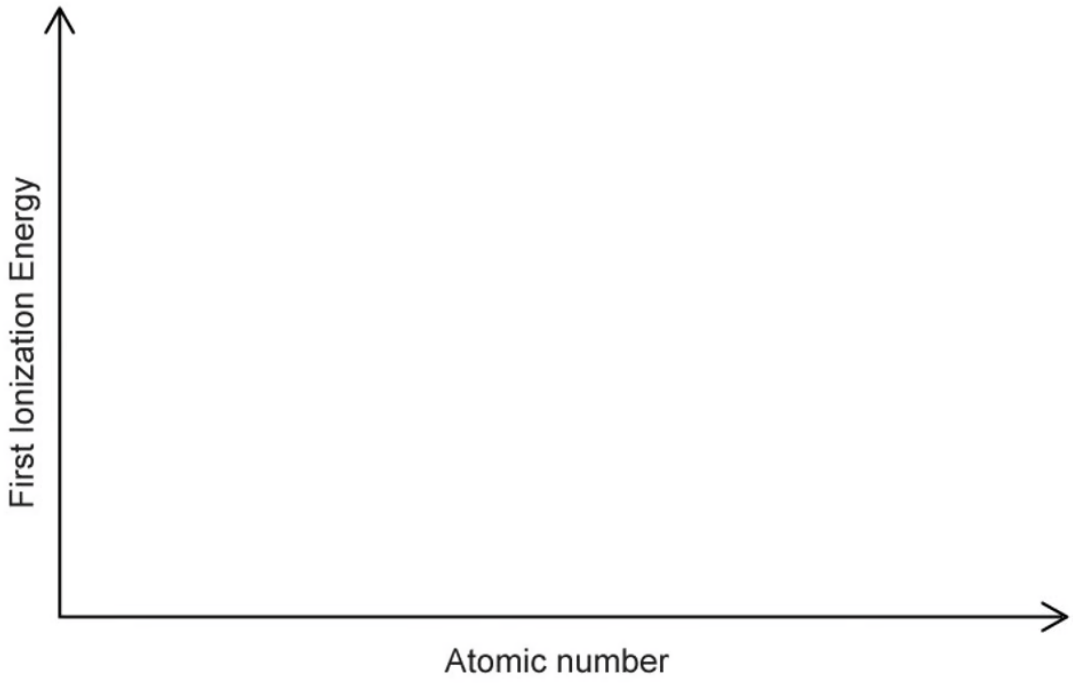
a) Bromine and selenium are both found in period 4 of the periodic table.
State and explain which of the two has a higher electronegativity.

[3 marks]

Question 4b

b) Sketch, on the axes shown below in **Figure 1**, a graph of the first ionization energy against atomic number for the elements of group 1.

Figure 1



Explain the trend in ionization energy down group 1.

[2 marks]

Question 4c

c) Discuss the similarities and differences between the trends in atomic radius and ionic radius down group 1 and group 17.

[3 marks]

Question 4d

d) State how the first ionisation energy of potassium differs from that of:

(i) Calcium

(ii) Rubidium

[2 marks]

Question 5a

a) Group 17 elements are known as highly electronegative non-metal elements.

i) Define the term *electronegativity*.

ii) State and explain the trend in *electronegativity* in group 17.

[2 marks]

Question 5b

b) Define the term *electron affinity* and write an equation to show the first *electron affinity* of bromine.

[2 marks]

Question 5c

c) State, with reasons, whether the first electron affinity of iodine is more or less exothermic than bromine.

[2 marks]

Question 5d

d) Suggest why the second electron affinity of oxygen is endothermic.

[2 marks]