1. Atomic Structure

1.1 Particles in the atom and atomic radius

Paper 2

Question Paper

1 **(a)** Complete Table 1.1 using relevant information from the Periodic Table.

Table 1.1

	nucleon number	proton number	number of electrons
Mg^{2+}	24		
Al^{3+}	27		

[2]

(b) State and explain the difference in the ionic radius of Al^{3+} compared to Mg^{2+}.

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..... [3]

2 **(b)** P^{3-}, S^{2-} and Cl^{-} have the same number of electrons.

(ii) State the trend in ionic radius shown by P^{3-}, S^{2-} and Cl^{-}.

Explain your answer.

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..... [2]

3 Calcium, magnesium and radium are Group 2 elements. Radium follows the same trends as the other members of Group 2.

(d) (i) $^{25}_{12}Mg$ is an isotope of magnesium.

Determine the number of protons and neutrons in an atom of $^{25}_{12}Mg$.

number of protons .....

number of neutrons .....

[1]

(ii) State the full electronic configuration of an atom of $^{25}_{12}Mg$.

..... [1]

4 Atoms with nuclei containing an odd number of protons tend to have fewer isotopes than those with an even number of protons.

(a) Gallium has two stable isotopes, ^{69}Ga and ^{71}Ga.

(i) Complete Table 1.1 to show the numbers of protons, neutrons and electrons in the two stable isotopes of gallium.

Table 1.1

isotope	number of protons	number of neutrons	number of electrons
^{69}Ga			
^{71}Ga			

[2]

5 Species such as NH_4^+, CO_3^{2-} and PO_4^{3-} are examples of molecular ions.

(b) Complete Table 1.1 to show the total numbers of protons and electrons in the molecular ions NH_4^+, CO_3^{2-} and PO_4^{3-}.

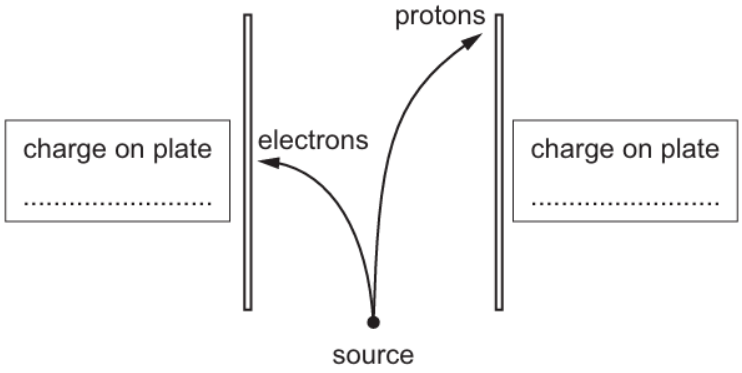
Table 1.1

molecular ion	total number of protons	total number of electrons
NH_4^+		
CO_3^{2-}		
PO_4^{3-}		

[3]

6 Atoms contain the subatomic particles electrons, protons and neutrons. Protons and electrons were discovered by observations of their behaviours in electric fields.

(a) The diagram shows the behaviour of separate beams of electrons and protons in an electric field.



(i) Complete the diagram with the relative charge of each of the electrically charged plates. [1]

(ii) On the diagram, draw a line to show how a separate beam of neutrons from the same source behaves in the same electric field. [1]

7 **(a)** Table 1 gives physical data for some of the Period 3 elements.

Table 1

atomic number, Z	11	12	13	14	15	16	17
bonding present in element	M						C
first ionisation energy / kJ mol^{-1}	494	736	577	786	1060	1000	1260
maximum oxidation number							+7
anionic radius / nm	–	–	–	0.271	0.212	0.184	0.181

(v) Explain the variation in anionic radius for the elements with atomic numbers 14 to 17.

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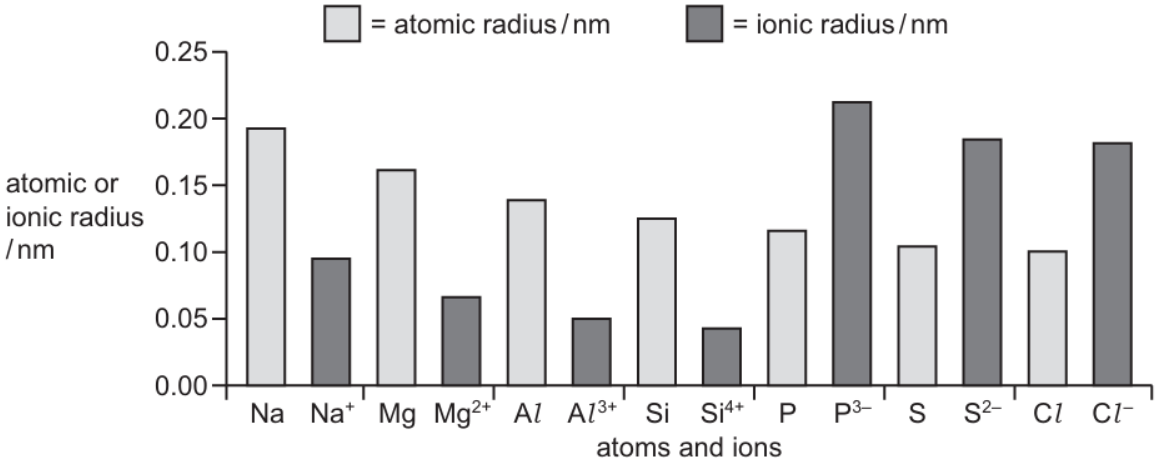
..... [2]

8 The elements in the third period exhibit periodicity in both their chemical and physical properties.

(a) A graph of the atomic and ionic radii across the third period is shown.



(i) Explain the decrease in atomic radius across the third period.

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(ii) Explain why, for sodium to silicon, the ionic radii are less than the atomic radii.

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..... [1]

(iii) Explain why, for phosphorus to chlorine, the ionic radii are greater than the atomic radii.

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..... [2]