

Answer ALL the questions. Write your answers in the spaces provided.

1. (a) Complete the electron configuration for carbon.

1s²

(1)

- (b) Explain how successive ionisation energy data could be used to confirm that carbon is in Group 4 of the Periodic Table.

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.....
.....

(1)

- (c) Draw a dot and cross diagram for a molecule of carbon tetrachloride, CCl₄, showing **outer electrons only**.

(2)

- (d) Explain how the following are achieved in a mass spectrometer.

- (i) Ionisation

.....
.....

(2)

- (ii) Deflection

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(1)



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blank

(e) (i) Define the term **relative isotopic mass**.

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.....
.....

(3)

(ii) Carbon consists of the isotopes ^{12}C , ^{13}C and ^{14}C . Chlorine consists of the isotopes ^{35}Cl and ^{37}Cl .

Use this data to calculate the maximum relative molecular mass of a molecule of carbon tetrachloride, CCl_4 .

(1)

(iii) Explain, in terms of sub-atomic particles, the meaning of the term **isotopes**.

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(2)

(iv) Why do isotopes of the same element have the same chemical properties?

.....
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(1)

(Total 14 marks)

Q1

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2. (a) Methane and poly(ethene) are both hydrocarbons.

(i) State the type of bond between carbon and hydrogen atoms in the molecules of both compounds.

..... (1)

(ii) State the type of **intermolecular** force present in **both** compounds.

..... (1)

(iii) Explain why poly(ethene) melts at a higher temperature than methane.

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.....
..... (3)

(b) Explain, in terms of its bonding, why magnesium has a high melting temperature.

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..... (2)



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(c) State the type of bonding present in sodium chloride. Draw a diagram to show its three-dimensional structure.

Type of bonding

Diagram

(3)

Q2

(Total 10 marks)

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5



Turn over

3. (a) Flame tests were performed on the following compounds of calcium and sodium.

(i) State the flame colour in each case:

calcium hydroxide

sodium hydroxide

(2)

(ii) Explain the origin of the colours obtained in flame tests.

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.....
.....

(3)

(b) Write an equation for each of the following reactions:

(i) Sodium with water

.....

(1)

(ii) Sodium oxide with water.

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(1)



Leave
blank

(c) Give TWO changes you would see when sodium is added to water.

.....

.....

(2)

(d) Potassium reacts with oxygen to give potassium superoxide.

Give the formula of potassium superoxide.

.....

(1)

Q3

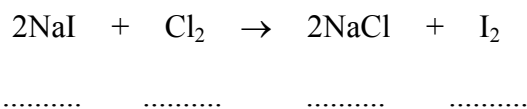
(Total 10 marks)

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4. (a) Sodium iodide reacts with chlorine to produce sodium chloride and iodine.

(i) State the oxidation numbers of the iodine and chlorine species in the spaces provided.



(2)

(ii) Use these oxidation numbers to explain why this reaction is a redox reaction.

.....

(2)

(iii) Calculate the maximum mass of iodine that could be produced from 30.0 g of sodium iodide.

(3)

(iv) Calculate the volume of chlorine gas required to produce this amount of iodine.

[1 mol of gas occupies 24 dm³ under the conditions of the experiment]

(1)



Leave
blank

(b) (i) Give the colour of iodine and its physical state at room temperature and pressure.

Colour

Physical state

(2)

(ii) Write an equation, including state symbols, to represent the process occurring when the first ionisation energy of iodine atoms is measured.

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(2)

(iii) Explain why the first ionisation energy of iodine is less than that of chlorine.

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(3)

Q4

(Total 15 marks)

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5. (a) (i) Explain why a water molecule does **not** have a linear shape.

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.....
.....

(2)

(ii) State the HOH bond angle in water and explain why it has this value.

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.....
.....

(2)

(b) (i) Draw the boron trichloride molecule, BCl_3 , making its shape clear. Mark in the bond angle on your diagram.

(2)



Leave blank

(ii) Explain why a B-Cl bond is polar.

.....
.....
(1)

(iii) Explain why a BCl₃ molecule is non-polar.

.....
.....
.....
.....
(1)

(iv) Name the strongest intermolecular force between boron trichloride molecules.

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(1)

(c) A compound of phosphorus and chlorine has the composition by mass shown below.

| Element | % by mass |
|---------|-----------|
| P | 14.9 |
| Cl | 85.1 |

Calculate the empirical formula of this compound.

(2)

Q5

(Total 11 marks)

TOTAL FOR PAPER: 60 MARKS

END





THE PERIODIC TABLE

Period **1** **2** **3** **4** **5** **6** **7** **0** Group

Period

| | | Key | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|----------|----------|--------------------------------|----|-----------|----|------|----|---------------|----|----|----|-----------|----|----|----|------------|---------|----|----|-----------|----------|--------------|----|----------|----------|------------|-----------|------------|-----------|------------|----|------------|------|-----------|----|----------|-----------|----|---------|-------|--------|-----------|----|-----------|--------|----|------------|----|--------|----|----|-----------|---------|----|----|----|-------------|--------|----|----|---------|-------------|----------|-----|----------|----|---------|------|---------|-----|----|-------------|----------|-----|-----|----|----------|--------|-----|-----|----|------------|-------|----|
| | | Molar mass g mol ⁻¹ | | Symbol | | Name | | Atomic number | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 1 | 1 | H | Hydrogen | 1 | 4 | He | Helium | 2 | | | | | 20 | Ne | Neon | 10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | 2 | 7 | Li | Lithium | 3 | 9 | Be | Beryllium | 4 | 11 | B | Boron | 5 | 12 | C | Carbon | 6 | 13 | Al | Aluminium | 13 | 14 | N | Nitrogen | 7 | 15 | P | Phosphorus | 15 | 16 | O | Oxygen | 8 | 17 | F | Fluorine | 9 | 18 | Ar | Argon | 18 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | 3 | 11 | Na | Sodium | 11 | 12 | Mg | Magnesium | 12 | 13 | Si | Silicon | 14 | 14 | P | Phosphorus | 15 | 15 | Al | Aluminium | 13 | 16 | S | Sulphur | 16 | 17 | Cl | Chlorine | 17 | 18 | Ar | Argon | 18 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | 4 | 19 | K | Potassium | 19 | 20 | Ca | Calcium | 20 | 21 | Sc | Scandium | 21 | 22 | Ti | Titanium | 22 | 23 | 23 | V | Vanadium | 23 | 24 | Cr | Chromium | 24 | 25 | Mn | Manganese | 25 | 26 | Fe | Iron | 26 | 27 | Co | Cobalt | 27 | 28 | Ni | Nickel | 28 | 29 | Cu | Copper | 29 | 30 | Zn | Zinc | 30 | 31 | Ga | Gallium | 31 | 32 | Ge | Germanium | 32 | 33 | As | Arsenic | 33 | 34 | Se | Selenium | 34 | 35 | Br | Bromine | 35 | 36 | Kr | Krypton | 36 | | | | | | | | | | |
| 5 | 5 | 37 | Rb | Rubidium | 37 | 38 | Sr | Strontium | 38 | 39 | Y | Yttrium | 39 | 40 | Zr | Zirconium | 40 | 41 | 41 | Nb | Niobium | 41 | 42 | 42 | Mo | Molybdenum | 42 | 43 | Tc | Technetium | 43 | 44 | Ru | Ruthenium | 44 | 45 | 45 | Rh | Rhodium | 45 | 46 | 46 | Pd | Palladium | 46 | 47 | 47 | Ag | Silver | 47 | 48 | Cd | Cadmium | 48 | 49 | 49 | In | Indium | 49 | 50 | 50 | Tl | Thallium | 50 | 51 | 51 | Pb | Lead | 50 | 52 | 52 | Tl | Thallium | 50 | 53 | 53 | I | Iodine | 53 | 54 | 54 | Xe | Xenon | 54 |
| 6 | 6 | 55 | Cs | Caesium | 55 | 56 | Ba | Barium | 56 | 57 | La | Lanthanum | 57 | 58 | 58 | Ce | Cerium | 58 | 59 | 59 | Pr | Praseodymium | 59 | 60 | 60 | Nd | Neodymium | 60 | 61 | 61 | Pm | Promethium | 61 | 62 | 62 | Sm | Samarium | 62 | 63 | 63 | Eu | Eurpium | 63 | 64 | 64 | Gd | Gadolinium | 64 | 65 | 65 | Tb | Terbium | 65 | 66 | 66 | Dy | Dysprosium | 66 | 67 | 67 | Ho | Holmium | 67 | 68 | 68 | Er | Erbium | 68 | 69 | 69 | Tm | Thulium | 69 | 70 | 70 | Po | Polonium | 70 | 71 | 71 | Lu | Lutetium | 71 | |
| 7 | 7 | 87 | Fr | Francium | 87 | 88 | Ra | Radium | 88 | 89 | Ac | Actinium | 89 | 90 | 90 | Th | Thorium | 90 | 91 | 91 | Pa | Protactinium | 91 | 92 | 92 | U | Uranium | 92 | 93 | 93 | Np | Nepthium | 93 | 94 | 94 | Pu | Plutonium | 94 | 95 | 95 | Am | Americium | 95 | 96 | 96 | Cm | Curium | 96 | 97 | 97 | Bk | Berkelium | 97 | 98 | 98 | Cf | Californium | 98 | 99 | 99 | Es | Einsteinium | 99 | 100 | 100 | Fm | Fermium | 100 | 101 | 101 | Md | Mendelevium | 101 | 102 | 102 | No | Nobelium | 102 | 103 | 103 | Lr | Lawrencium | 103 | |