

Past-paper walk-through

Particles in the atom and atomic radius ■ 1.1

eXercise

Questions in this set

- 9701/14 N25 Q1 ■ 1 mark
- 9701/14 N25 Q2 ■ 1 mark
- 9701/14 N25 Q3 ■ 1 mark
- 9701/22 N25 Q1 ■ 10 marks

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- **//** separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = “or words to that effect” – the wording need not match.

Question 1

9701/14 N25 ■ Q1 ■ 1 mark

- 1 Helium forms an ion ${}^3_2\text{He}^+$.

Three statements about this ion are listed.

- 1 It contains two protons.
- 2 It contains three neutrons.
- 3 It contains one electron.

Which statements are correct?

Question 1

- A** 1, 2 and 3 **B** 1 and 3 only **C** 2 and 3 only **D** 2 only

Solution 1

Answer: **B**

Why

- The subscript 2 is the proton number, so statement 1 is right.
- Neutrons = $3 - 2 = 1$, not three, so statement 2 is wrong.
- A +1 charge on 2 protons leaves 1 electron, so statement 3 is right.

Question 2

9701/14 N25 ■ Q2 ■ 1 mark

- 2** The table shows the first five ionisation energies of element X.

element	ionisation energy / kJ mol^{-1}				
	1st	2nd	3rd	4th	5th
X	736	1450	7740	10 500	13 600

Element X is in Period 3 of the Periodic Table.

What is element X?

A sodium

Question 2

- B** magnesium
- C** silicon
- D** argon

Solution 2

Answer: **B**

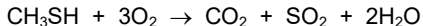
Why

- Look for the large jump: $1450 \rightarrow 7740$, between the 2nd and 3rd ionisation energies.
- That means two electrons come off easily and the third has to come from an inner shell.
- Two outer electrons in Period 3 is Group 2 – magnesium.

Question 3

9701/14 N25 ■ Q3 ■ 1 mark

3 Methanethiol, CH_3SH , burns as shown.



A sample of 10 cm^3 of methanethiol gas was reacted with 60 cm^3 of oxygen. Both samples were measured at room conditions.

What would be the final volume of the resultant mixture of gases measured at room temperature?

- A** 20 cm^3 **B** 30 cm^3 **C** 50 cm^3 **D** 70 cm^3

Solution 3

Answer: **C**

Why

- 10 cm^3 of CH_3SH needs 30 cm^3 of O_2 , so $60 - 30 = 30 \text{ cm}^3$ of oxygen is left over.
- The gaseous products are $10 \text{ cm}^3 \text{ CO}_2$ and $10 \text{ cm}^3 \text{ SO}_2$.
- At room temperature the water is a *liquid* and does not count:
 $30 + 10 + 10 = 50 \text{ cm}^3$.

Question 1

9701/22 N25 ■ Q1 ■ 10 marks

- 1 Manganese, Mn, and its compounds are widely used in many chemical reactions.
 - (a) Mn is usually found as a single isotope, manganese-55.
 - (i) Determine the number of protons, neutrons and electrons in an atom of manganese-55.

Question 1

[1]

(ii) Define isotopes.

Question 1

- (iii) A sample of manganese from the Moon is found to contain manganese-53 in addition to manganese-55.

State the two pieces of information needed to determine the relative atomic mass, A_r , of manganese in this sample.

Question 1

Question 1

[2]

(b) The shorthand electronic configuration of manganese is $[\text{Ar}] 3d^5 4s^2$.

(i) Complete the full electronic configuration of manganese.

..... $3d^5 4s^2$

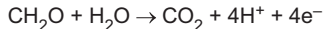
[1]

(ii) Deduce the total number of unpaired electrons in an atom of manganese.

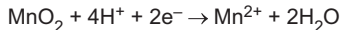
Question 1

- (c) Manganese(IV) oxide reacts with methanal, CH_2O , in acidic conditions to produce carbon dioxide. The movement of electrons to or from relevant species is shown in the following half-equations.

half-equation 1



half-equation 2



- (i) Identify the species that is reduced in half-equation 2. Explain your answer.

Question 1

(ii) The oxidation state of carbon in methanal is 0.

Calculate the oxidation state of carbon in carbon dioxide.

Question 1

- (iii) Construct the ionic equation for the reaction of manganese(IV) oxide with methanal in acidic conditions.

Question 1

[Total: 10]

Solution 1

(a)(i)

Mark scheme

- 25 protons 30 neutrons 25 electrons
- 1

(a)(ii)

Mark scheme

- (atoms of an element) with the same number of protons and different number of neutrons
- 1

Solution 1

(a)(iii)

Mark scheme

- M1 (relative) isotopic mass.
- OR (relative isotopic) mass of Mn-55 and Mn-53 **M2**
- (relative) abundance of each isotope
- 2

Solution 1

(b)(i)

Mark scheme

- $1s^2 2s^2 2p^6 3s^2 3p^6 (3d^5 4s^2)$
- 1

(b)(ii)

Mark scheme

- 5
- 1

Solution 1

(c)(i)

Mark scheme

- Mn / MnO₂ AND it gains electrons
- 1

(c)(ii)

Mark scheme

- (+)4
- 1

Solution 1

(c)(iii)

Mark scheme

- Due to an issue with question 1(c)(iii), the question has been removed from the question paper.
- N/A