

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?

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

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

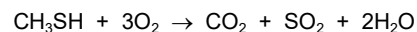
element	ionisation energy / kJ mol^{-1}				
	1st	2nd	3rd	4th	5th
X	736	1450	7740	10 500	13 600

Element X is in Period 3 of the Periodic Table.

What is element X?

- A** sodium
B magnesium
C silicon
D argon

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

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.

number of protons neutrons electrons [1]

(ii) Define isotopes.

.....
 [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.

1
 2 [2]

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

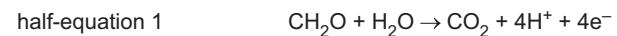
(i) Complete the full electronic configuration of manganese.

..... $3d^5 4s^2$ [1]

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

..... [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.



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

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

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

Calculate the oxidation state of carbon in carbon dioxide.

..... [1]

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

..... [2]

[Total: 10]