

1 What is the electronic configuration for the particle ${}_{13}^{27}\text{Al}^{+}$?

- A $1s^2 2s^2 2p^6 3s^1 3p^1$
 B $1s^2 2s^2 2p^6 3s^2$
 C $1s^2 2s^2 2p^6 3s^2 3p^2$
 D $1s^2 2s^2 2p^6 3s^2 3p^6 3d^7 4s^1$

1 What is the electrons in boxes notation for the Fe^{3+} ion?

- | | 3d | | | | | 4s |
|--------|----|---|---|---|---|----|
| A [Ar] | ↑↓ | ↑ | | | | ↑↓ |
| B [Ar] | ↑ | ↑ | ↑ | | | ↑↓ |
| C [Ar] | ↑↓ | ↑ | ↑ | ↑ | | |
| D [Ar] | ↑ | ↑ | ↑ | ↑ | ↑ | |

4 Which statement is correct?

- A The relative atomic mass of a ${}^{35}\text{Cl}$ atom is 35.5.
 B The relative molecular mass of O_2 is 16.0.
 C The relative formula mass of CaCO_3 is 100.1.
 D The relative isotopic mass of a ${}^{24}\text{Mg}$ atom is 24.3.

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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 $[\text{Ar}] 3d^5 4s^2$.

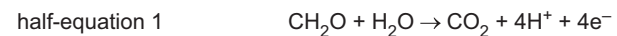
(i) Complete the full electronic configuration of manganese.

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