

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] <table border="1" style="display: inline-table; text-align: center; width: 100px;"><tr><td>↑↓</td><td>↑</td><td></td><td></td><td></td></tr></table> | ↑↓ | ↑ | | | | <table border="1" style="display: inline-table; text-align: center; width: 40px;"><tr><td>↑↓</td></tr></table> | ↑↓ |
| ↑↓ | ↑ | | | | | | | |
| ↑↓ | | | | | | | | |
| B | [Ar] <table border="1" style="display: inline-table; text-align: center; width: 100px;"><tr><td>↑</td><td>↑</td><td>↑</td><td></td><td></td></tr></table> | ↑ | ↑ | ↑ | | | <table border="1" style="display: inline-table; text-align: center; width: 40px;"><tr><td>↑↓</td></tr></table> | ↑↓ |
| ↑ | ↑ | ↑ | | | | | | |
| ↑↓ | | | | | | | | |
| C | [Ar] <table border="1" style="display: inline-table; text-align: center; width: 100px;"><tr><td>↑↓</td><td>↑</td><td>↑</td><td>↑</td><td></td></tr></table> | ↑↓ | ↑ | ↑ | ↑ | | <table border="1" style="display: inline-table; text-align: center; width: 40px;"><tr><td></td></tr></table> | |
| ↑↓ | ↑ | ↑ | ↑ | | | | | |
| | | | | | | | | |
| D | [Ar] <table border="1" style="display: inline-table; text-align: center; width: 100px;"><tr><td>↑</td><td>↑</td><td>↑</td><td>↑</td><td>↑</td></tr></table> | ↑ | ↑ | ↑ | ↑ | ↑ | <table border="1" style="display: inline-table; text-align: center; width: 40px;"><tr><td></td></tr></table> | |
| ↑ | ↑ | ↑ | ↑ | ↑ | | | | |
| | | | | | | | | |

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.

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

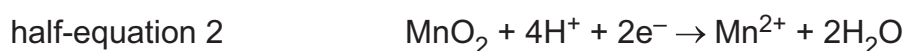
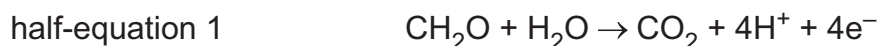
(i) Complete the full electronic configuration of manganese.

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