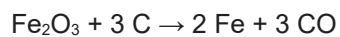


All questions are for separate science students only**Q1.**

This question is about displacement reactions.

Iron is extracted from iron oxide by a displacement reaction with carbon.

The equation for the reaction is:



- (a) Which substance in the equation is reduced?

Give **one** reason for your answer.

Answer in terms of oxygen.

Substance reduced _____

Reason _____

(2)

- (b) Which expression shows how to calculate the mass of carbon needed to produce 1 mole of iron from iron oxide?

Relative atomic mass (A_r): C = 12

Tick (✓) **one** box. (HT only)

$\frac{1}{3} \times 12 \text{ g}$

$\frac{3}{2} \times 12 \text{ g}$

$1 \times 12 \text{ g}$

$3 \times 12 \text{ g}$

(1)

3.3 Yield and Atom Economy of Chemical Reactions (H)

A student investigated displacement reactions of four different metals represented by **A**, **B**, **C** and **D**.

A, **B**, **C** and **D** are **not** the actual chemical symbols for the metals.

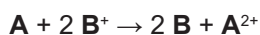
The student:

- added each metal to aqueous solutions of the metal nitrates
- observed whether a reaction took place.

The table below shows information about three of the reaction mixtures.

Reaction	Metal	Metal nitrate solution	Equation
1	A	BNO_3	$\text{A} + 2\text{BNO}_3 \rightarrow 2\text{B} + \text{A}(\text{NO}_3)_2$
2	C	$\text{A}(\text{NO}_3)_2$	$2\text{C} + 3\text{A}(\text{NO}_3)_2 \rightarrow 3\text{A} + 2\text{C}(\text{NO}_3)_3$
3	C	$\text{D}(\text{NO}_3)_2$	no reaction

(c) The ionic equation for **Reaction 1** is:



Why is this a redox reaction? (**HT only**)

Tick (✓) **one** box.

A gains electrons and **B**⁺ loses electrons.

A loses electrons and **B**⁺ gains electrons.

Both **A** and **B**⁺ gain electrons.

Both **A** and **B**⁺ lose electrons.

(1)

(d) Which of the four metals has the greatest tendency to form positive ions?

Use the table above.

Tick (✓) **one** box.

A

B

C

D

(1)

- (e) The nitrate ion has the formula NO_3^-

Which of the four metals could be aluminium?

Explain your answer.

Use the table above.

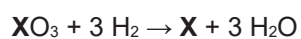
Metal _____

Explanation _____

(3)

- (f) Metal **X** is extracted from an oxide of metal **X** by reaction with hydrogen.

The equation for the reaction is:



The percentage atom economy for obtaining metal **X** by this method is 77.3%.

Calculate the relative atomic mass (A_r) of metal **X**. **(chemistry only)**

Relative atomic masses (A_r): H = 1 O = 16

Relative atomic mass (A_r) = _____

(4)

(Total 12 marks)