Mark schemes

Q1.

(a) (substance reduced) Fe_2O_3

allow iron oxide

1

(reason)
(Fe_2O_3) loses oxygen

MP2 is dependent upon MP1 being awarded

ignore Fe^{3+} gains electrons

1

(b) $\frac{3}{2} \times 12g$

1

(c) **A** loses electrons and $\mathbf{B}^+$ gains electrons

1

(d) **D**

1

(e) (metal) **C**

1

(explanation) aluminium forms ions with a charge 3+

allow aluminium forms Al^{3+} (ions)

1

(so) 3 nitrate ions are needed for 1 aluminium ion

allow (so) 3 nitrate ions are needed to balance the 3+ charge on 1 aluminium (ion)

1

(f) (percentage atom economy =)

$$\frac{A_r\mathbf{X}}{A_r\mathbf{X} + 54} \times 100 = 77.3$$

1

100 $A_r\mathbf{X}$ = 77.3 ($A_r\mathbf{X}$ + 54)

allow $A_r\mathbf{X}$ = 0.773 ($A_r\mathbf{X}$ + 54)

allow correct use of an incorrectly determined value of the M_r of the non-useful reactant atoms

1

22.7 $A_r\mathbf{X}$ = 4174.2

allow 0.227 $A_r\mathbf{X}$ = 41.742

1

$A_r\mathbf{X}$ = 184

allow 183.8854626 correctly rounded to at least three significant figures

1

alternative approach 1:

($3M_r$ H_2O = (3 × 16) + (6 × 1) =) 54
and (percentage = 100 - 77.3 =) 22.7% (1)

(total M_r of reactants =)
$\frac{100}{22.7} \times 54$ (1)

allow correct use of an incorrectly determined value for $3M_r$ H_2O and/or percentage of unwanted products

= 238 (1)

(A_r**X** = 238 - 54)
or
$\left(A_r\mathbf{X} = 238 \times \frac{77.3}{100}\right)$
= 184 (1)

allow correct use of an incorrectly determined value of total M_r of reactants and/or value for $3M_r$ H_2O

allow 183.8854626 correctly rounded to at least three significant figures

alternative approach 2:

($3M_r$ H_2O = (3 × 16) + (6 × 1) =) 54
and (percentage = 100 - 77.3 =) 22.7% (1)

$\left(\frac{1}{22.7} \times 54 =\right) 2.3788546$ (1)

allow correct use of an incorrectly determined value for $3M_r$ H_2O and/or percentage of unwanted products

2.3788546 × 77.3 (1)

allow correct use of an incorrectly determined value for 1% of the total M_r of reactants

= 184 (1)

allow 183.8854626 correctly rounded to at least three significant figures

[12]