Name of the Student:_____
Max. Marks : 27 Marks **Time : 27 Minutes**

Mark Schemes

Q1.

(a) **M1** $E_{\ominus}$ V^{3+} ($/V^{2+}$) > $E_{\ominus}$ Zn^{2+} (/ Zn)

OR EMF of reaction between V^{3+} and Zn = (+)0.50 V

M2 $E_{\ominus}$ V^{2+}(/V) < $E_{\ominus}$ Zn^{2+} (/ Zn)

OR EMF of reaction between V^{2+} and Zn = - 0.44 V

2

(b) Mg

Only

1

(c) EMF = (+) 0.78 (V)

Fe(s) l Fe^{2+}(aq) ll VO^{2+}(aq), H^{+}(aq), V^{3+}(aq) l Pt(s)

Allow Fe(s) l Fe^{2+}(aq) ll VO^{2+}(aq), V^{3+}(aq) l Pt(s)
Ignore state symbols

$Fe(s) \rightarrow Fe^{2+}(aq) + 2e^{-}$

Ignore state symbols

3

(d) **M1** n MnO_4^- = 29.43 × 10^{-3} × 0.0200 = 5.89 × 10^{-4} mol

M2 n V^{2+} = $5.89 \times 10^{-4} \times \frac{5}{3}$ = 9.81×10^{-4} mol

$M2 = M1 \times \frac{5}{3}$

M3 mass NH_4VO_3 = 9.81 × 10^{-4} × 116.9 = 0.1147 g

M3 = M2 × 116.9

M4 % purity = $\frac{0.1147 \times 100}{0.151} = 76.0$ %

$M4 = M3 \times \frac{100}{0.151}$

Allow 75.9 or 76.2 %
Answer to 3 significant figures

4

[10]

Q2.

(a) More shells
OR
more energy levels.

Allow Ca has 4 shells and Mg has 3 shells
Do not accept more outer shells
Ignore shielding
Ignore subshells/orbitals/more electrons

1

(b) $Mg(s) + H_2O(g) \rightarrow MgO(s) + H_2(g)$

State symbols required
Allow multiples

1

(c) **M1** (Ba is more reactive) because <u>outer/valence</u> electrons further from nucleus/less attracted to the nucleus/lost more easily

M2 Insoluble barium sulfate (is formed)
OR
$Ba + H_2SO_4 \rightarrow BaSO_4(s) + H_2$
M3 Barium sulfate prevents further reaction (with sulfuric acid)
OR
Barium gets coated with barium sulfate (so no more barium reacts)

3

(d) **M1** P = 100 000 Pa and V = 348×10^{-6} m^3

M2 $n = \frac{PV}{RT}$ or $\frac{100\,000 \times 348 \times 10^{-6}}{8.31 \times 298}$

M3 n = 0.01405 mol

M4 n metal nitrate = $0.01405 \times \frac{2}{5} = 5.62 \times 10^{-3}$ mol
M4 = M3 x $\frac{2}{5}$

M5 M_r metal nitrate = $\frac{0.832}{5.62 \times 10^{-3}} = 148(.0)$
M5 = 0.832 ÷ M4

M6 A_r of metal = 148.0 - (2 × 14 +2 × 48) = 24(.0) = Mg
M6 = M5 - 124 ***and*** *identity of a metal with 2+ oxidation state*

6

(e) **M1** $Na + Al + 2\ H_2 \rightarrow NaAlH_4$

M2 contains oppositely charged ions/ Na^+ and AlH_4^- ions

M3 strong <u>attraction</u> between (oppositely charged) ions

3

(f) $3\ NaOH + H_3PO_4 \rightarrow Na_3PO_4 + 3\ H_2O$
Allow multiples and ignore state symbols

1

(g) $Li^+ + CoO_2 + e^- \rightarrow Li^+(CoO_2)^-$
Allow $Li(CoO_2)$ as product

1

(h) The electrode reactions can be reversed (by applying a reverse potential)

Allow reaction is reversible (by applying a reverse potential)

1

[17]