

M1.D [1]

M2.D [1]

M3.D [1]

M4.A [1]

M5.D [1]

M6.C [1]

M7.B [1]

M8.C [1]

M9.D

- M10.** (a) most powerful reducing agent: Zn; 1
- (b) (i) reducing species: Fe^{2+} 1
- (ii) oxidising species: Cl_2 ; 1
- (c) (i) standard electrode potential 1.25 V; 1
- (ii) equation: $\text{Ti}^{3+} + 2 \text{Fe}^{2+} \rightarrow 2\text{Fe}^{3+} + \text{Ti} +$ balanced; 1
- correct direction; 1
- (d) (i) moles $\text{KMnO}_4 = 16.2 \times 0.0200 \times 10^{-3} = 3.24 \times 10^{-4}$; 1
- moles $\text{H}_2\text{O}_2 = \text{Moles KMnO}_4 \times 5 / 2 = 8.10 \times 10^{-4}$; 1
- 8.10×10^{-4} moles H_2O_2 in 25 cm^3
 $8.10 \times 10^{-4} \times 1000 / 25$ in $1000 \text{ cm}^3 = 0.0324 \text{ mol dm}^{-3}$; 1
- hence $\text{g dm}^{-3} = \text{mol dm}^{-3} \times M_r = 0.0324 \times 34 = 1.10$;
(penalise use of an incorrect H_2O_2 to KMnO_4 ratio by two marks) 1
- (ii) $PV = nRT$; 1
- hence $V = nRT / P$
 $= 8.10 \times 10^{-4} \times 8.31 \times 298 / 98000$; 1
- $= 2.05 \times 10^{-5}$; 1

units m³;

(mark consequentially to answers in (c)(i))

(allow correct answers with other units)

(answers to (c)(i) and (ii) must be to 3 significant figures;

penalise once only)

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[14]

M11.A

[1]

- M12. (a) reactants brought together / increased concentration on surface or increased collision frequency **(1)**
reactants must be correctly orientated **(1)**
reaction on the surface **(1)**
products desorbed **(1)**
example of a catalysed reaction (not a named process) **(1)**
a suitable catalyst for this reaction **(1)**

penalise incorrect second reactions and catalysts

If absorption too weak reactants not brought together **(1)**

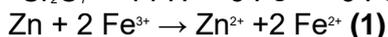
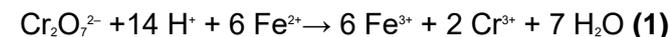
e.g. silver **(1)**

If adsorption too strong products not desorbed **(1)**

e.g. tungsten **(1)**

max 8

- (b) Equations:



Method

Titrate measured volume solution against K₂Cr₂O₇ **(1)**

Reduce same volume solution with zinc **(1)**

Filter off excess zinc **(1)**

Titrate total Feⁿ⁺ using K₂Cr₂O₇ **(1)**

Percentage $\text{Fe}^{3+} = 100 \times (\text{titre2} - \text{titre1}) / \text{titre 2}$
or equivalent (1)

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[15]

M13.D

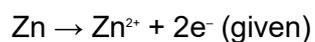
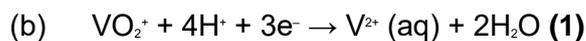
[1]

M14.A

[1]

- M15. (a) (i) Heterogeneous:- In a different phase to reactants (1)
Catalyst:- Increases reaction rate (1)
Alternative route or route described (1)
Lower E_a (1)
Unchanged at end of reaction (1) Max 4
- (ii) Feature:- QoL Variable oxidation states shown by vanadium (1)
Equations $\text{V}_2\text{O}_5 + \text{SO}_2 \rightarrow \text{V}_2\text{O}_4 + \text{SO}_3$ (1)
 $2\text{V}_2\text{O}_4 + \text{O}_2 \rightarrow 2\text{V}_2\text{O}_5$ (1)

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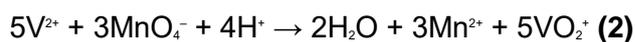


2

$$\text{Mol KMnO}_4 = \text{mv}/1000 = 0.0200 \times 38.5/1000 = 7.70 \times 10^{-4}$$
 (1)

Mole ratio MnO_4^- to V(II) = 3:5 deduced

or equation



$$\text{Mol V(II)} = 7.70 \times 10^{-4} \times 5/3$$
 (1) = 1.283×10^{-3}

$$\text{Mass V} = 1.283 \times 10^{-3} \times 50.9 \text{ (1)} = 0.0653 \text{ g}$$

$$\% \text{ V in sample} = 0.06532 \times 100/0.160 = 40.8 \text{ (1)}$$

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[15]

M16.D

[1]