Gateways School

**Electrode potentials & Redox**

**Revision PPQ Answers**

43 marks

**Q1.**

(a)    Diagram of an Fe3+ / Fe2+ electrode that includes the following parts labelled:  
Solution containing Fe2+ and Fe3+ ions

**1**

Platinum electrode connected to one terminal of a voltmeter

*Must be in the solution of iron ions (one type will suffice)*

**1**

Salt bridge

*Do not allow incorrect material for salt bridge and salt bridge must be in the solution (ie it must be shown crossing a meniscus)*

**1**

298 K and 100 kPa / 1 bar

**1**

all solutions unit / 1 mol dm−3 concentration

*Allow zero current / high resistance voltmeter as alternative to M4 or M5*

*Ignore hydrogen electrode even if incorrect*

**1**

(b)     Cu2+ + Fe → Cu + Fe2+

*Ignore state symbols*

**1**

Fe|Fe2+||Cu2+|Cu   correct order

*Allow Cu|Cu2+||Fe2+|Fe*

**1**

Phase boundaries and salt bridge correct, no Pt

*Allow single / double dashed line for salt bridge*

*Penalise phase boundary at either electrode end*

*Can only score M3 if M2 correct*

**1**

Copper electrode

*Allow any reference to copper*

**1**

(c)     *E*ϴ Au+( / Au) > *E*ϴ O2 ( / H2O)

*Allow E cell / e.m.f. = 0.45 V*

*Allow 1.68 > 1.23*

**1**

So Au+ ions will oxidise water / water reduces Au+

*QoL*

**1**

2Au+ + H2O → 2Au + O2 + 2H+

*Allow multiples*

**1**

(d)     *E*ϴ Ag+( / Ag) > *E*ϴ Fe2+( / Fe)

*Allow E cell / e.m.f. = 1.24*

*Allow 0.80 > −0.44*

**1**

And *E*ϴ Ag+( / Ag) > *E*ϴ Fe3+( / Fe2+)

*Allow E cell / e.m.f. = 0.03*

*Allow 0.80 > 0.77*

**1**

So silver ions will oxidise iron (to iron(II) ions) and then oxidise Fe(II) ions (further to Fe(III) ions producing silver metal)

*Allow Ag+ ions will oxidise iron to iron(III)*

**1**

**[15]**

**Q2.**

(a)     (i)      Co/Cobalt

*If Co or Cobalt not given CE = 0*

*ignore case in symbol for Co*

**1**

(+) 4

**1**

(+) 3

*Allow 4 and 3 in either order*

**1**

(ii)     Li → Li+ + e–

*Ignore state symbols*

*Allow e without -ve sign*

*Do not allow equilibrium sign*

**1**

(iii)     Platinum is a conductor

**1**

(Platinum is) unreactive/inert

*Ignore mention of surface area or catalyst*

*Allow 2 marks if two properties given on one answer line*

*Apply list principle to contradictions/wrong answers*

*Do not allow platinum resists corrosion*

**1**

(iv)    Li reacts with water/forms lithium hydroxide

*Allow water breaks down (or is electrolysed) on re-charge*

**1**

(b)     (i)      Pt│SO32– (aq), SO42– (aq)││ClO3– (aq), Cl–(aq)│Pt

*State symbols an ‘,’ not necessary*

*Allow | in place of ‘,’ NOT ‘,’ in place of |*

*Ignore H+ and H2O*

*Deduct one mark for each mistake (e.g. Pt missed twice counts as two mistakes)*

*Allow reverse order for whole cell*

*Pt | Cl–, ClO3– || SO42–, SO32– | Pt*

**2**

(ii)     ClO3– + 3SO32– → Cl– + 3SO42–

**1**

Oxidising agent ClO3–

**1**

Reducing agent SO32–

**1**

**[12]**

**Q3.**

(a)     most powerful reducing agent:   Zn;

**1**

(b)     (i)      reducing species:                            Fe2+

**1**

(ii)     oxidising species:                            Cl2;

**1**

(c)     (i)      standard electrode potential            1.25 V;

**1**

(ii)     equation: Tl3+ + 2 Fe2+ → 2Fe3+ + Tl +   balanced;

**1**

         correct direction;

**1**

(d)     (i)      moles KMnO4 = 16.2 × 0.0200 ×10–3 = 3.24 ×10–4;

**1**

moles H2O2 = Moles KMnO4 × 5 / 2 = 8.10 × –4;

**1**

8.10 × 10–4 moles H2O2 in 25 cm38.10 × 10–4 × 1000 / 25 in 1000 cm3 = 0.0324 mol dm–3;

**1**

hence g dm–3 = mol dm–3 × *M*r *=* 0.0324 × 34 = 1.10;

*(penalise use of an incorrect H*2*O*2 *to KMnO*4 *ratio by two marks)*

**1**

(ii)     PV = nRT;

**1**

hence V = nRT / P  
= 8.10 × 10–4× 8.31 × 298/98000;

**1**

= 2.05 × 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)*

**1**

**[14]**

**Q4.**

C

**[1]**

**Q5.**

D

**[1]**