

June 2013 F325 Unofficial Mark Scheme

AKA - THE BEST UNOFFICIAL MARK SCHEME KNOWN TO HUMANITY IN THE HISTORY OF EVER

I SECOND THIS

HELL YEAH!

(This document is **UNABLE** to be edited until later notice; if there are any issues or errors, please let me (Kat12395 on TSR) know, and I'll change it!)

Q1)

a) Define lattice enthalpy (2 Marks)

The enthalpy change accompanying the formation of one mole of an ionic compound from its gaseous ions under standard conditions.

b) Complete the Born-Haber cycle(2 marks)

- $\text{Ca}^{2+}(\text{g}) + \text{O}(\text{g}) + 2\text{e}^{-}$
- $\text{Ca}^{2+}(\text{g}) + \text{O}^{2-}(\text{g})$

c) Label the following on the Born-haber cycle: (3 Marks)

Formation (of $\text{CaO}(\text{s})$)

2nd electron affinity (of Oxygen (g))

Atomisation (of Oxygen (g))

d) Lattice enthalpy value - (2 marks)

$-3454 \text{ kJ mol}^{-1}$

e) What factors affect lattice enthalpy value? (3 Marks)

- Ionic Size / Radius
- Ionic Charge, thus Charge Density
- Greater the Electrostatic Attraction between oppositely charged ions, the more *exothermic* the value

Q2)

a) Define half life (1 mark)

The time taken for the concentration of a reactant to reduce by half.

b) Using the graph confirm the order (2 Marks)

- 1st order
- Constant half life (When concentration halves, time is 50-54s; when concentration halves again, time is 100-108s (same difference))
- Draw at least 2 half lives on the graph

c) If concentration is doubled, what is the effect on half life? (1 Mark)

- Half life is constant i.e. no effect

d) Find rate after 40 sec (3 Marks)

Tangent at 40 seconds, find gradient, units were $\text{mol dm}^{-3} \text{s}^{-1}$

e) Calculate rate constant (2 marks)

Rate found in d) divided by concentration at 40 seconds.

units = s^{-1}

Explain why H_2O is zero order (1 mark)

H_2O is in excess therefore concentration remains virtually constant.

$\text{H}_2 + \text{I}_2 \rightarrow 2\text{HI}$ Find K_c (5 marks)

= 16.8 (no units)

Increase Conc. H_2 ? Effect (2 marks) *Uncertain**

	H_2	I_2	HI
Greater	IIII		II
Fewer		II	
Same	II	IIII	IIII

le. A tally from everyone who helped with this M/S put different things. *Pot luck! This one we don't know!*

If temperature is increased, what happens to the value of K_c ? (1 Mark)

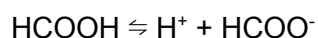
K_c decreases as the forward reaction is exothermic. K_c favours reactants shifting equilibrium to the left.

Value of K_c if concentration is changed (1 Mark)

K_c remains constant, it only changes when temperature changes

What is the definition for a buffer solution, suggest how equilibrium would be affected through methanoic acid (7 marks)

A buffer solution is a solution that minimises changes in pH on the addition of small amounts of acid or alkali.

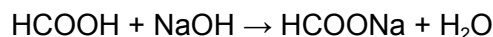


When an acid is added $\text{H}^+ + \text{HCOO}^- \rightarrow \text{HCOOH}$ equilibrium shifts to the LEFT

When an alkali is added $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$ equilibrium shifts to the right as more acid dissociates to make up for loss of H^+ ions

How does HCOOH and NaOH act as a buffer? Calculate the pH of buffer soln. (6 marks)

Excess of methanoate ions / weak acid, salt formed;



Work out moles through Concentration and Volume given, then:

$$\text{Conc} = \text{moles} \times 1000 / 1000$$

$$K_a \times \text{Acid} / \text{Salt} = [\text{H}^+]$$

$$-\log_{10} [\text{H}^+]$$

$$= \text{pH} = 3.99$$

Define standard electrode potential with standard conditions (2 Marks)

The *e.m.f.* of a *half cell* compared with the a *standard hydrogen half cell* under standard conditions. 1 mol dm^{-3} solutions, 298K temperature and 1 atm pressure (100kPa/101kPa).

pH of NaOH (2 Marks)

$$1 \times 10^{-14} / 0.450 = [\text{H}^+]$$

$$\text{pH} = -\log_{10} [\text{H}^+]$$

$$\text{pH} = 13.6$$

Mass of CO₂ absorbed by plants each year via photosynthesis (2 Marks)

Energy produced / Energy produced from smallest reaction...?

6 × Total energy produced / ΔH then convert to grams?

$$1.61 \times 10^{-14} ? \text{ (Value needs conf.)}$$

Calculate ΔS (2 Marks)

$$\Delta S = +218$$

Calculation of ΔG at 298 K (2 Marks)

$$+2879 - (-298 \times 256/1000) = +2955$$

Why is this reaction never feasible? (1 Mark)

ΔH is positive (+), TΔS is negative (-)

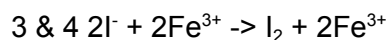
$$T\Delta S < \Delta H$$

ΔG will be > 0 at any temperature

Cell potential value between 1+2 (1 Mark)

$$\text{Edit: } 2.71 \text{ V}$$

Three reactions that are feasible together, using systems 3, 4 and 5 (3 Marks)



- Must be most positive that is reduced (gains electrons); most negative is oxidised (loses electrons)

electrons

- Electrons must have been balanced

Why may some of these reactions not take place (under Standard Conditions)? (2 marks)

- High activation energy
- Reaction may be too slow (due to the high activation energy..)
- Conditions may not be standard (may need to specify in terms of concentration etc.)

HCl and HClO⁻ have different pH values. Explain why and calculate these values (4 Marks)

HCl is a strong acid, completely dissociates in solution, HClO is a weak acid, partially dissociates in solution.

HCl = $-\log_{10} [H^+]$, pH = 0.85 mol dm⁻³

pH(HClO⁻) = 4.14 (Calculated from pK_a) $10^{-pK_a} = K_a$. $\sqrt{(K_a \times [HA])}$ $-\log[H^+]$

HCl → H⁺ + Cl⁻

Something to do with chlorine in acidic/alkaline conditions. Cl₂ reacts to form...(4 Marks)

- Using equation from the table given;
- Adding an acid, means H⁺ ions are added causing equilibrium to shift to the left, so the electrode potential gets more +ve.
- Similarly, adding an alkali causes the equilibrium to shift right, so the electrode potential decreases(?)

(We aren't sure on this one! No one is...)

Reaction of iron and chlorine before dissolved in water (1 Mark)

Fe³⁺ + 3Cl⁻ → FeCl₃

Ionic equation (1 Mark)

Fe³⁺ + 3OH⁻ → Fe(OH)₃

The equation for the reaction (2 Mark)

2[Fe(H₂O)₆]³⁺ + Zn → 2[Fe(H₂O)₆]²⁺ + Zn²⁺

What type of reaction is this? (1 Mark)

Redox

The equation for the reaction (2 Marks)

[Fe(H₂O)₆]³⁺ + 6CN⁻ → [Fe(CN)₆]³⁻ + 6H₂O

What type of reaction is this (1 mark)

Ligand Substitution

Role of NH₃ in Experiment 2? (1 Mark)

Acts as a base - proton acceptor

Neutralises acid to prevent it from reacting any further?

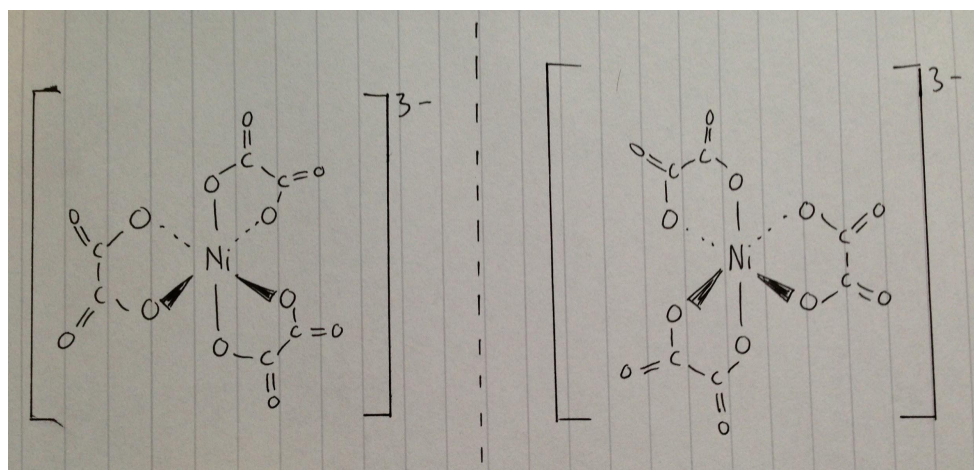
(Alternative - Oxidises the ligand?)

Electron Configuration of Nickel and Nickel 2+ (2 Marks)

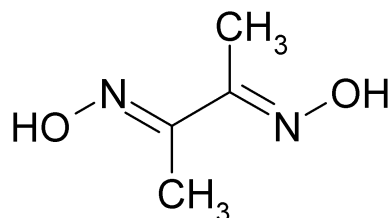
Ni: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^8 4s^2$

Ni²⁺: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^8$

Optical Isomers F and G? (3 Marks) (Not Ni, Fe!)



Structure of the mad bidentate ligand (2 Marks)



(Could also be the other isomer) (E)

Coordination number (1 Mark)

4

Why does Ni(DMG)₂ have no charge? (1 Mark)

Charges balance out; (needs conf / proper answer:L)

Reaction of ethanoic acid and aluminium (2 Marks)

Full: $6\text{CH}_3\text{COOH} + 2\text{Al} \rightarrow 2\text{Al}(\text{CH}_3\text{COO}^-)_3 + 3\text{H}_2$

Ionic: $6\text{H}^+ + 2\text{Al} \rightarrow 2\text{Al}^{3+} + 3\text{H}_2$

Oxidising agent (1 Mark)

IO_3^-

Formula of Ferrate(IV) ion (1 Mark)

FeO_4^{2-}

Redox equation (2 Marks)

$12\text{H}^+ + 5\text{Sn}^{2+} + 2\text{IO}_3^- \rightarrow 5\text{Sn}^{4+} + \text{I}_2 + 6\text{H}_2\text{O}$

Find the formula of the Hydrated Nickel(II) Salt: (7 Marks)

Hydrated nickel (II) salt formula:

$\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$

Marks accounted for: *(Good job guys!:-))*

100/100

Could be **72** for an A, although @ChemistryALevel on Twitter suggests **68** (*which would mean 85% for full UMS*).

Grade Boundaries: (**Jan 2013** - May go up or down depending on results bell curve)

A = 70

B = 63

C = 56

D = 50

E = 44