



NATIONAL SENIOR CERTIFICATE EXAMINATION
EXEMPLAR PAPER 2014

CHEMISTRY
MARKING GUIDELINES

Time:

200 marks

QUESTION 1

1.1	D	1.2	A	1.3	C	1.4	D	1.5	B
1.6	C	1.7	D	1.8	A	1.9	B	1.10	D

[10 × 2 = 20]**QUESTION 2**

2.1 2.1.1 A catalyst increases the rate of reaction ✓ without itself changing ✓ during the reaction. (2)

2.1.2 The reaction requires activation energy ✓ is required. ✓
OR energy needs to be given to system/is required ✓ to break bonds in reactants, ✓ before reaction can proceed. (2)

2.1.3 Reaction is exothermic ✓ so releases heat. ✓ (2)

2.1.4 The forward reaction produces more moles of gas than the reverse reaction ✓ thus by Le Chatelier the forward reaction is favoured ✓ by a reduction in pressure as the increase in no of moles gas will cause the system to oppose the change. ✓ (3)

2.2 2.2.1 A low temperature ✓ would favour the formation of product since the forward reaction is exothermic ✓ and by Le Chatelier, an exothermic reaction is favoured by lower temperature since exothermic reactions produce heat ✓ to oppose the change ✓ of lowering the temperature. (4)

2.2.2 (a) $K_c = \frac{[\text{NO}_2]^2}{[\text{NO}]^2 [\text{O}_2]}$ ✓✓ (2)

(b)	2NO + O ₂ ⇌ 2 NO ₂
Initially	20.83 12 0
Consumed	18 9
Equilibrium	2,83 ✓ 3 ✓ 18
Conc (✓ div by 2,5)	2.83/2.5 3/2.5 18/2.5
	1,13 1,2 7,2

$$K_c = \frac{[\text{NO}_2]^2}{[\text{NO}]^2 [\text{O}_2]}$$

$$= (7,2)^2 / ((1,13)^2 ((1,2) \text{ (substitution ✓)})$$

$$= 33,83 \text{ ✓} \quad (5)$$

(c) Yield is quite high ✓ since K_c is large ✓ (2)

(d) No effect ✓✓ (2)

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QUESTION 3

- 3.1 A state existing in a closed system ✓ where the rate of the forward reaction ✓ is equal to the rate of the reverse reaction. ✓ (3)
- 3.2 3.2.1 low pH (1)
- 3.2.2 pH 7 – 8 (2 marks) pH 6 – 9 (1 mark) (2)
- 3.2.3 $K_w = [\text{H}_3\text{O}^+][\text{OH}^-]$ ✓
If pH is low $[\text{H}_3\text{O}^+]$ is high ✓ hence from above expression for K_w $[\text{OH}^-]$ will be decreased. ✓ If $[\text{OH}^-]$ is decreased then the forward reaction will be favoured ✓ so as to counteract the change and produce more HOCl. ✓ (5)
- 3.2.4 It would burn the eyes; ✓✓ affect clothing ✓✓ corrode pipes ✓✓✓ react with cement and grouting ✓✓ affect hair detrimentally. ✓✓ (2)
- 3.3 3.3.1 $\text{Fe} + 2\text{HCl} \rightarrow \text{FeCl}_2 + \text{H}_2$ ✓ + H_2 ✓ balanced ✓
- 3.3.2 (a) Use a gas syringe ✓ to collect the gas produced ✓ and measure volume of gas ✓ with time ✓ using a stop watch. (4)
- (b) As temperature increases average kinetic energy of particles increases. ✓ This means that more particles will have energy > activation energy ✓ thus there will be more effective collisions ✓ (also /or there will be more collisions increasing the chances of effective collisions) (3)
- [23]**

QUESTION 4

- 4.1 4.1.1 A strong acid is one which ionizes ✓ fully ✓ (2)
- 4.1.2 $\text{H}_2\text{SO}_4 + 2 \text{H}_2\text{O} \rightarrow 2\text{H}_3\text{O}^+ (\text{✓ H}_3\text{O}^+) + \text{SO}_4^{2-} (\text{✓ SO}_4^{2-})$ ✓ balanced. (2)
- 4.1.3 Solution A. ✓ Since A is a diprotic acid it produces 2 H^+ ions per H_2SO_4 so will have a higher concentration ✓ of ions ✓ (conductivity increases with ion concentration) (3)
- 4.2 4.2.1 The results have a high level of precision ✓ since they are close together. ✓ (2)
- 4.2.2 A standard solution is one of which the concentration ✓ is precisely known. ✓ (2)
- 4.2.3 (a) Average volume 21.1 cm^3 ✓ (1)
- (b) No of moles $(\text{COOH})_2 = C \times V = 0,05 \times 0,025$ ✓
 Hence no of moles $\text{NaOH} = 2 \text{ ✓} \times 1,25 \times 10^{-3} \text{ mol}$
 $= 2,5 \times 10^{-3} \text{ mol ✓}$
 $C = n/V \text{ ✓}$
 $= \frac{2,5 \times 10^{-3}}{0,0211} \text{ ✓}$
 $= 0,118 \text{ mol.dm}^{-3} \text{ ✓}$ (5)
- 4.2.4 Phenolphthalein ✓ NaOH is a strong base ✓ while oxalic acid is a weak acid ✓ hence the end point pH will be in the basic range (>7) ✓ (4)
- 4.2.5 $n = m/M \text{ ✓✓}$ (to get this mark they must also give formula $C = n/V$)
 $= 1,40/40$
 $= 0,035 \text{ mol ✓}$
 $C = n/V$ (see above)
 $= 0,0375/0,25 \text{ ✓}$ (mark for converting to dm^3)
 $= 0,135 \text{ mol.dm}^{-3} \text{ ✓}$ (4)
- 4.2.6 The calculated concentration from the titration is lower than was expected. This is because the solid (1,40g) had already absorbed water ✓ when massed so the actual mass of NaOH was less than 1,4 g ✓ this the number of moles was also less and since $C = n/V \text{ ✓}$ if n is smaller, then C will be smaller. (3)

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QUESTION 5

- 5.1 C_nH_{2n+2} (2)
- 5.2 A family of organic compounds with the same general formula ✓ and functional group ✓ (2)
- 5.3 Van der Waal's forces/London Forces ✓ A force between temporary dipoles ✓ which form by chance in non-polar molecules and then induce dipoles ✓ in the adjacent molecules. The two temporary dipoles then attract. ✓ (4)
- 5.4 As mass increases and no. of electrons increase, the molecules form temporary dipoles more readily ✓ as there are more electrons and the electrons are more weakly held. ✓ Thus the overall attractive force is greater since there are more/stronger dipoles ✓ at any given time. (3)
- 5.5 diesel. (1)
- 5.6 5.6.1 A hydrocarbon with double or triple bonds ✓ between carbon atoms. ✓ (2)
- 5.6.2 $C_2H_4 + H_2O \rightarrow CH_3CH_2OH$ (OH ✓ CH_3CH_2 ✓) (3)
- 5.6.3 addition (1)
- [18]**

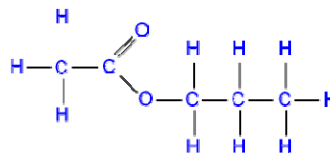
QUESTION 6

- 6.1 alcohol: A,B, C, E (3 out of 4)
Carboxylic acid: D (4)
- 6.2 6.2.1 ethanoic acid ✓✓ (2)
- 6.2.2 (a) A functional isomer has the same molecular formula ✓ but a different functional group. ✓ (2)
- (b) methyl methanoate ✓ ✓ correct functional group representation
✓ rest of structural formula correct (H and C)
✓ functional
- $$\begin{array}{c}
 \text{H} \quad \text{O} \quad \text{H} \\
 | \quad || \quad | \\
 \text{H}-\text{C}-\text{C}-\text{O}-\text{C}-\text{H} \\
 | \quad \quad | \\
 \text{H} \quad \quad \text{H}
 \end{array}$$
- (3)
- 6.3 hydrogen bonds ✓ (1)
- 6.4 methane has Van der Waal's forces/London forces ✓ between molecules while methanol has hydrogen bonds. ✓ The hydrogen bonds are much stronger ✓ than the van der Waal's forces so more energy has to be supplied ✓ to break the forces in methanol hence BPt is higher. (4)

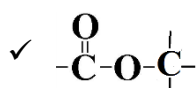
6.5 $2 \text{CH}_3\text{OH} + 3 \text{O}_2 \rightarrow 2\text{CO}_2 + 4\text{H}_2\text{O}$ (✓✓ – product formulae – ; ✓ – balancing) (3)

6.6 Compound C has long carbon chain ✓ giving the molecule a large non-polar part ✓ to it. Water is polar and will only mix with substances which are similarly polar. ✓ (3)

6.7 6.7.1 ✓ functional group
✓ length of both carbon chains and hydrogens (2)



6.7.2 ester ✓



(2)

6.8 ✓ 
propan-1-ol (2)

6.9 6.9.1 elimination/dehydration ✓ (1)

6.9.2 propane ✓✓ (2)

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QUESTION 7

7.1 loss ✓ of electrons ✓ (2)

7.2 nickel ✓✓ (2)

Nickel is a better reducing agent ✓ than copper so it is more likely to be oxidised ✓
hence will act as the anode. (2)

7.3

- Helps maintain electrical neutrality ✓
- Completes the circuit ✓
- Allows for a two-way flow of ions / electrical neutrality without the two half cell electrolytes mixing. ✓ (3)

7.4 No ✓ because the concentration of the solutions is less than the required 1 mol.dm^{-3} ✓ and the temperature is not 25°C ✓ which it needs to be in a standard cell. (3)

7.5 $C = \frac{n}{V} = \frac{m}{MV}$ ✓ (or two equations separately)
 $M = 183 \text{ g.mol}^{-1}$ ✓ value
 $m = CMV$
 $= 0,1 \times 183 \times 0,2$ ✓
 $= 3,66 \text{ g}$ ✓ (4)

7.6 7.6.1 $n = \frac{m}{M}$ (✓ formula) $= \frac{0,395}{63,5} = 6,22 \times 10^{-3} \text{ mol}$ ✓
 Same no of moles Ni lost
 Hence mass lost $= nM$
 $= 6,22 \times 10^{-3} \times 59$
 $= 0,367 \text{ g}$ ✓
 Hence new mass $= 10,27 - 0,367$
 $= 9,90 \text{ g}$ ✓ (4)

7.6.2 no of moles $e^- = 6,22 \times 10^{-3} \times 2$ ✓ (c/o error)
 $= 0,0124 \text{ mol}$ ✓

$$Q = N \times e^- = 0,0124 \times 6,02 \times 10^{23} \approx 1194 \text{ C}$$

$$I = \frac{Q}{t} \quad \checkmark \quad = 1194 / (40 \times 60) \quad \checkmark \quad (\text{convert minutes to seconds})$$

$$\approx 0,5 \text{ A} \quad \checkmark$$

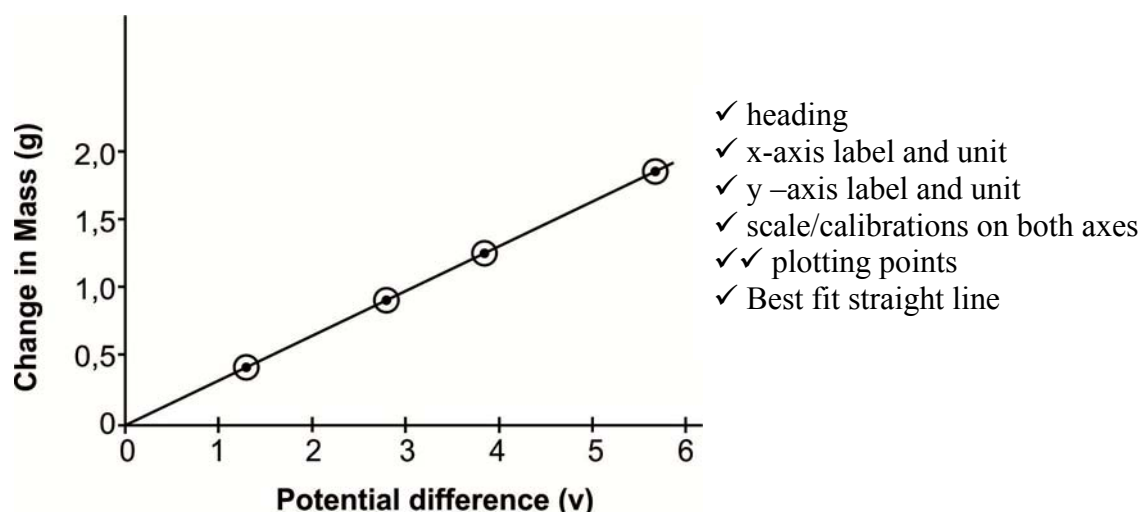
(6)
[26]

QUESTION 8

8.1 8.1.1 temperature; concentration of solution; nature and size/shape of electrodes; distance between electrodes. (3)

8.1.2 potential difference across electrodes. (2)

8.1.3 Graph showing relationship between change in electrode mass and potential difference for electrolysis of copper (II) chloride solution.



(7)

8.1.4 Graph is a straight line through origin ✓ (1)

8.1.5 The mass of copper deposited is directly proportional ✓ to the potential difference across ✓ the electrodes. (2)

8.2 8.2.1 Electrical energy to chemical energy ✓✓ (2)

8.2.2 silver ✓ (1)

8.2.3 $\text{Ag} \rightarrow \text{Ag}^+ + 1\text{e}^-$ ✓ one electron ✓ oxidation reaction. (2)

8.2.4 cathode (1)

8.2.5 (a) The spoon. (1)

(b) hydrogen (H_2) (1)

(c) $2\text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{H}_2 + 2\text{OH}^-$ ✓ water is a better oxidising agent ✓ than Na^+ so it will be reduced ✓ in preference to the Na^+ resulting in the formation of H_2 gas ✓ by above reaction. (4)

8.3 Extraction of aluminium from ore; ✓✓ electro refining of impure copper. ✓✓ (2)

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Total: 200 marks