edexcel

Edexcel GCE

Chemistry

6246/02

June 2006

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Results Mark Scheme

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Chemistry
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Section A

1 (a) (i) pink to colourless *NOT* clear
OR pink is decolourised
ALLOW pale red instead of pink
NOT "pink goes" *on its own*
NOT purple
NOT Red
NOT Magenta
NOT Cerise
NOT any of these in combination with pink
(1 mark)

(ii) 8 – **less** than 11 - *Any number or range within this range* **(1 mark)**

(b) *IGNORE SF in (b)*

(i) initial no. moles NaOH = $1.00 \times \frac{25.0}{1000} = 0.0250$ **(1)**

no. moles HCl used = $0.100 \times \frac{8.80}{1000} = 8.80 \times 10^{-4}$ **(1)**

no. moles Na OH left in 25 cm^3 = 8.80×10^{-4}
OR indication of 1:1 ratio **(1)**

no. moles NaOH left in 250 cm^3 = 8.80×10^{-3} **(1)**

no. moles NaOH used = $0.0250 - 8.80 \times 10^{-3} = 0.0162$ **(1)**

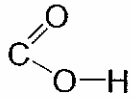
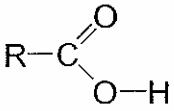
0.0162 with some working involving titre **(5)**

Units not required BUT incorrect units e.g. mol dm^{-3} loses the 5th mark **(5 marks)**

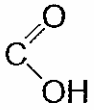
(ii) no. moles hydrolysed = $\frac{\text{(b)(i)}}{2}$ **(1)** = 8.1×10^{-3}
EITHER
mass of aspirin $8.1 \times 10^{-3} \times 180 = 1.458$ g **(1)**
% aspirin = $\frac{1.458}{1.50} \times 100 = 97.2$ % **(1)**
OR
Theoretical moles aspirin = $\frac{1.5}{180} = 8.33 \times 10^{-3}$ **(1)**
% aspirin = $\frac{8.1 \times 10^{-3}}{8.33 \times 10^{-3}} \times 100 = 97.2$ % **(1)**

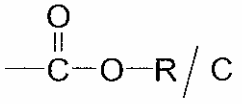
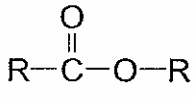
ALTERNATIVE METHOD
Theoretical moles aspirin = $1.5 = 8.33 \times 10^{-3}$ **(1)**
Theoretical moles NaOH = $2 \times 8.33 \times 10^{-3}$ **(1)** = 0.01667
% aspirin = $\frac{\text{(b)(i)}}{0.01667} \times 100 = 97.2$ % **(1)**
Mark consequentially but do not allow > 100 %
(3 marks)

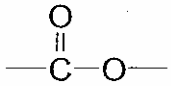
(c)

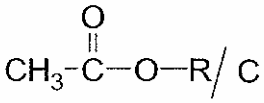
Carboxylic acid **and**  **(1)** *OR* 

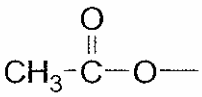
NOT "a carboxyl group"

ALLOW 

Ester **and**  **(1)** *ALLOW* 

ALLOW 





Only penalise C=O not shown once

(2 marks)

Total for question:12 marks

Section B

2 (a) **Molecular formula of D**

$C_5H_{10}O_2$ **(2)** with some correct working / deduction
e.g.

C $\frac{58.8}{100} \times \frac{102}{12} = 5$

H $\frac{9.8}{100} \times \frac{102}{1} = 10$

O $\frac{31.4}{100} \times \frac{102}{16} = 2$

OR
Use % to find empirical formula **(1)**
then use or refer to molar mass to deduce molecular formula **(1)**
……

E
Is propan-2-ol **(1)** *ACCEPT* name or formula
IF name and formula given, both must be correct

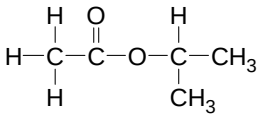
Must contain $CH_3CH(OH)$/be a secondary 2-ol/methyl secondary alcohol, as it gives iodoform ppt. **(1)** *Do not allow if methyl ketone included*
……

G
Is Iodoform/CHI_3 **(1) –** *stand alone mark*
IF name and formula given, both must be correct
……

F
Is the sodium salt of the acid/sodium ethanoate (produced by hydrolysis of the ester) **(1)**

(so is sodium ethanoate) with justification for number of carbon atoms e.g. must contain 5-3=2 carbon atoms **(1)**
ACCEPT name or formula
ALLOW **1 max (out of 2)** *if* "ethanoic acid + reasoning for number of C atoms"
……

D is

 / 1-methylethylethanoate / $CH_3COOCH(CH_3)_2$ / $CH_3CO_2CH(CH_3)_2$ **(1)**

ALLOW 2-propylethanoate

D is consequential on their unambiguous E + F
NOT just "propylethanoate" *unless correct formula given*

Equation

$CH_3COOCH(CH_3)_2 + NaOH \rightarrow CH_3COONa + (CH_3)_2CHOH$ **(1)**

NOT molecular formula for D
Consequential on their D
ALLOW $CH_3COOC_3H_7$ *for D and* C_3H_7OH *for E* **(9 marks)**
Candidates can identify D, E and F in the equation

(b) *ALLOW correct names or formulae for reagents. If both given, both must be correct*
Condition mark only scores if correct or nearly correct reagents

Step 1

CH_3Cl / CH_3COCl / any halogenoalkane/ any acylchloride **(1)**

+ (anhydrous) $AlCl_3$ / Al_2Cl_6 / $FeCl_3$ / Fe_2Cl_6 **(1)**
ALLOW other halides except FeI_3
If "RCl" plus correct condition ALLOW condition mark

Intermediate methylbenzene/$C_6H_5CH_3$ or other derived from their Freidel Crafts reagent **(1)**

If step 1 uses "HCOCl" **4 max** *with -1 for each error.*

Step 2

$KMnO_4$ /potassium manganate**(VII)**/ MnO_4^- **(1)**
ALLOW "potassium manganate, $KMnO_4$"

NaOH/alkaline/OH^-**(aq)** **and** heat/reflux **(1)**
NOT warm
ACCEPT specified temperature provided it is ≥ 100 °C

Step 3

Acid/acidify / H^+(aq)/named mineral acid **(1)**

ALTERNATIVE
Step 1
Br_2 *OR* any halogen **(1)**
$FeBr_3$ etc **(1)**
Intermediate bromobenzene **(1)**

Step 2
Mg **and** dry ether **(1)**

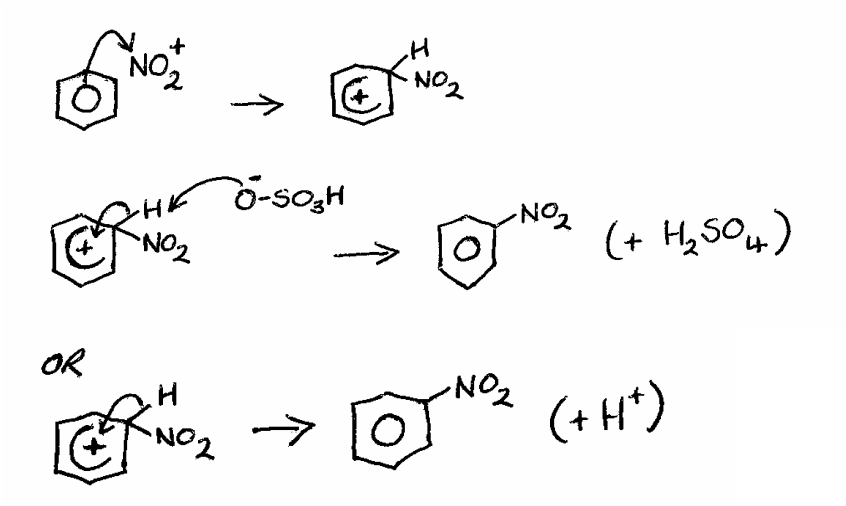
Step 3
(Solid) CO_2 **(1)**

Step 4
Acid/water **(1)**

(6 marks)

ALLOW any correct synthesis with –1 for each error or omission made. If synthesis does not work, mark as follows:
Start at beginning and mark until incorrect. Then start at end and mark until incorrect. Then award whichever "route" through gives the highest mark.

(c) $HNO_3 + H_2SO_4 \rightarrow H_2O + HSO_4^- + NO_2^+$ - *Can be shown in two stages*
OR
$HNO_3 + 2H_2SO_4 \rightarrow H_3O^+ + 2HSO_4^- + NO_2^+$ **(1)**

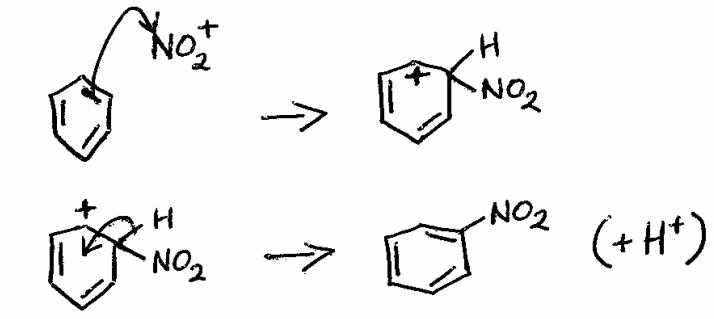


1st curved arrow from benzene ring of electrons **towards** N of NO_2^+ ion **(1)**
ALLOW the "+" anywhere on NO_2

Intermediate correctly drawn, including positive charge **(1)**

Curved arrow from C-H bond back into benzene ring **(1)**
IGNORE if towards the "+"
ALLOW HSO_4^- but arrow must start on O
ALLOW arrow from negative charge

ALTERNATIVE



1st curved arrow from double bond **towards** N of NO_2^+ ion **(1)**
ALLOW the "+" anywhere on NO_2

Intermediate correctly drawn, including positive charge **(1)**

Curved arrow from C-H bond back into benzene ring **(1)**
IGNORE if towards the "+"

(4 marks)

Total for question 19 marks

3 (a) **Temperature**

Q 975 – 1225 K *OR* 700-950 °C **(1)**

W *ALLOW any number or range within these values*

C*

(Forward) reaction is exothermic so the highest yield should be at low temperature **(1)** *OR reverse argument*

Rate is too slow at low temperature, so compromise **(1)**
NOT just "a compromise", *it must be related to rate*

Catalyst

Platinum (and rhodium) to give a fast rate at lower T

OR

Pt etc…. speeds up conversion to NO and not combustion to N_2 **(1)**
ALLOW Pt etc increases rate / lowers E_a

Pressure

2-10 atmospheres / 200 – 1000 kPa **(1) –** *stand alone*
ALLOW any number or range within these values

(Small) increase/very little difference in number of (gas) molecules/moles on r.h.s. so low pressure **(1)** - *stand alone*

OR

2-10 atmospheres / 200 – 1000 kPa **(1)**
ALLOW any number or range within these values

To push gases through **(1)** – *provided quoted or implied pressure* **(6 marks)**

(b) (i) $C_4H_4O_6^{2-} + 5H_2O_2 + 2H^+ \rightarrow 4CO_2 + 8H_2O$

1:5 ratio and no electrons in equation **(1)**
Rest correct i.e. H^+ and H_2O cancel **(1)** **(2 marks)**

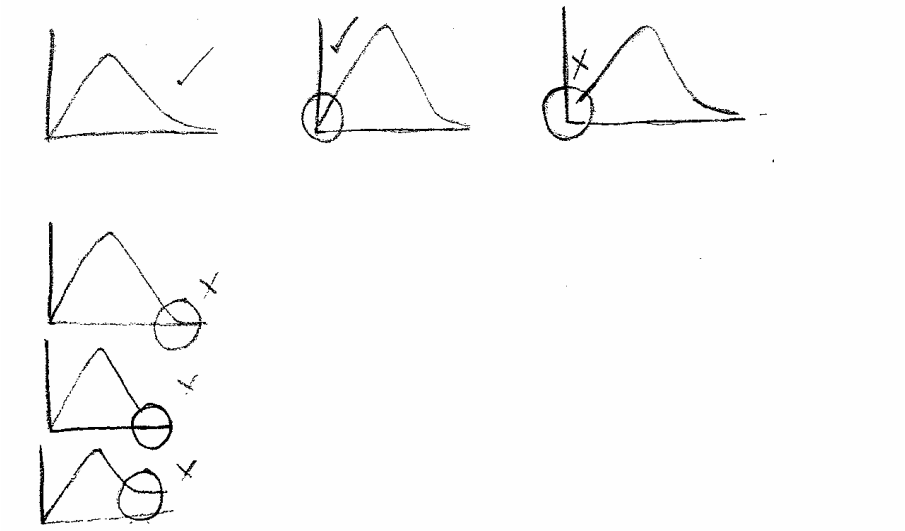
(ii) Rapid/fast effervescence (∴ rate has increased) **(1)**

Colour change to green and back to pink/original colour (∴ alternative route/ not used up) **(1)**
Do NOT allow if stated "it does not take part in reaction"
NOT just "back to pink"
NOT just "pink colour returns"
(3 marks)

They can change oxidation state easily/have variable oxidation states/can be illustrated **(1)**

(iii) **axes** both labelled correctly **(1)**
Q e.g. percentage/fraction/number of molecules (with energy E)
W for y-axis
C* e.g. energy/kinetic energy for x-axis *NOT* speed

shape of graph **(1)**
starts at the origin (and rises steeply)
peak skewed to left
asymptote (if line crosses the x axis do not award this mark)
All 3 needed
Do not award the mark if two or more curves are drawn for different temperatures.



Both activation energies shown well to the right of the peak **(1)**

Comment on relationship of area under curve to number of particles with $E \geq E_a$
e.g. more of molecules/collisions have energy greater than or equal to the activation energy/have enough energy to result in a reaction **(1)**

Therefore a higher frequency of collisions result in reaction
OR more (of the) collisions result in reaction
OR more successful collisions per unit time
OR more of the collisions are successful
OR greater proportion of the collisions are successful **(1)**– *stand alone*

NOT just " more successful collisions"

(5 marks)

(c)

no. moles O_2 = $\frac{100}{24000}$ **(1)**

= 4.17×10^{-3}

no. moles H_2O_2 = $2 \times 4.17 \times 10^{-3}$ **(1)**

= 8.33×10^{-3}

OR

24000 cm^3 O_2 from 2 mol H_2O_2 **(1)**

therefore 100 cm^3 from $2 \times \frac{100}{24000}$

= 8.33×10^{-3} mol **(1)**

Mark consequentially on moles of O_2

volume H_2O_2 = $8.33 \times 10^{-3} \times \frac{1000}{0.5}$

16.7 cm^3 **(1)**

$\frac{8.33 \times 10^{-3}}{0.5}$

= 0.0167 dm^3 **(1)**

*Answer **and** unit required for third mark*

IGNORE s.f.

Mark consequentially on moles of H_2O_2 **(3 marks)**

Total for question: 19 marks

4 (a) (i) $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ **(1)**

ΔH = (3 x –394) - (3 x –110) – (-822)
= -30 (kJ mol^{-1}) **(2)**

Multiply by 3 twice **(1)**
Correct answer with sign **(1)**

ALLOW consequential calculation if wrong stoichiometry
If O_2 given as product **1 max** *on consequential calculation* **(3 marks)**

(ii) (i) is more likely because the rate of a reaction between a solid and a gas will be faster than that between two solids

ALLOW
(i) is more likely because it is exothermic (and (ii) is endothermic)
OR
products in (i) are more thermodynamically stable relative to reactants than in (ii)

Consequential on (a)(i) **(1 mark)**

(b) (i) $K_p = \frac{pH_2^4}{pH_2O^4}$ **(1)** *"p's" are essential NO* [ ]

$= \frac{1.6^4}{1.2^4}$ = 3.16 / 3.2 and no units **(1)**

Consequential on K_p expression provided no Fe or Fe_3O_4 included **(2 marks)**

(ii) K_P decreases **(1)**
Q
W Because forward reaction release heat / exothermic
C* *OR* reverse reaction absorbs heat / endothermic **(1)**
Dependent on K_p decreases

Do not allow 2ND mark if decrease is explained in terms of position moving to the left, UNLESS moving is a consequence of K_p decreasing. **(2 marks)**

(c) *IGNORE state symbols*

X: $2H_2O + O_2 + 4e^{(-)} \rightarrow 4OH^-$ **(1)** *OR* ½ this *OR* multiples **(1)**

Y: $Fe \rightarrow Fe^{2+} + 2e^{(-)}$ / $Fe - 2e^{(-)} \rightarrow Fe^{2+}$ **(1)**
IF X and Y not identified **1 (out of 2)**

iron(**II**) hydroxide **(1)**
ALLOW $Fe(OH)_2$ / $[Fe(OH)_2(H_2O)_4]$ **(3 marks)**

(d) covalent bonds labelled **(1)**

dative bonds labelled *OR* shown as arrows **(1)**

ALLOW dot and cross diagram **(2)**

Structure with Fe-Fe bond does not score first two marks

Tetrahedral (around Fe) **(1)**
ALLOW good 3-D diagram dependent on 4 covalent/dative bonds around Fe

If Al_2Cl_6 ALLOW **max 2 (out of 3)**
Any mention of ionic **0 (out of 3)** **(3 marks)**

(e) (i) add (aqueous) sodium hydroxide / ammonia **(1)** *ALLOW* OH^-(aq)
red/brown/foxy red/red-brown/rust **ppt/solid (1)**

OR
add (aqueous) potassium hexacyanoferrate(II)/hexacyanoferrate(II) ions **(1)**
(Prussian) blue **ppt/solid (1)** – *ALLOW result for near miss spelling of reagent*

OR
add (aqueous) potassium thiocyanate **(1)**
blood red (solution) **(1)** *NOT* ppt **(2 marks)**

(ii) Fe^{3+} polarises the (OH bond in water) ligands **(1)**

$[Fe(H_2O)_6]^{3+} + H_2O \rightarrow [Fe(OH)(H_2O)_5]^{2+} + H_3O^+$
OR in words
e.g. deprotonation (of the ligand) **by** the (solvent) water **(1)**

the H_3O^+ / H^+(aq) ions make the solution acidic **(1) –** *stand alone*
(3 marks)

Total for question: 19 marks

Total for paper: 50 marks