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Edexcel GCE

Chemistry (Nuffield)

6254/01

June 2006

Results Mark Scheme

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Chemistry (Nuffield)

6254/01

1 **(a)** **Any 2**
Measure the loss in mass as a gas/carbon dioxide is given off **(1)**

Measure the concentration of the acid by titration
OR Carry out a titration with sodium hydroxide **(1)**
NOT "titration" on its own

Measure conductivity because 4 ions go to 3 ions/decrease in
ions/change in number of ions **(1)**

Measure pH because acid is used up /changes/concentration
changes/one reactant is acidic **(1)**

NOT dilatometry/nmr/x-ray crystallography/temperature
change/colorimetry/indicator/change in mass of $CaCO_3$ (2 marks)

  (b) Initially some carbon dioxide dissolves in the solution (until the solution
is saturated).
OR
Some CO_2 might escape whilst adding acid/before putting on bung   **(1 mark)**

 (c) **(i)** 88 (cm^3)   **(1 mark)**

    (ii)

95	72	**16**
125	79	**9**
155	84	**4**
185	87	**1**

                                                                 (1 mark)

    (iii) The concentration of the hydrochloric acid/HCl
OR [HCl]
NOT concentration of reactants   **(1 mark)**

(iv)
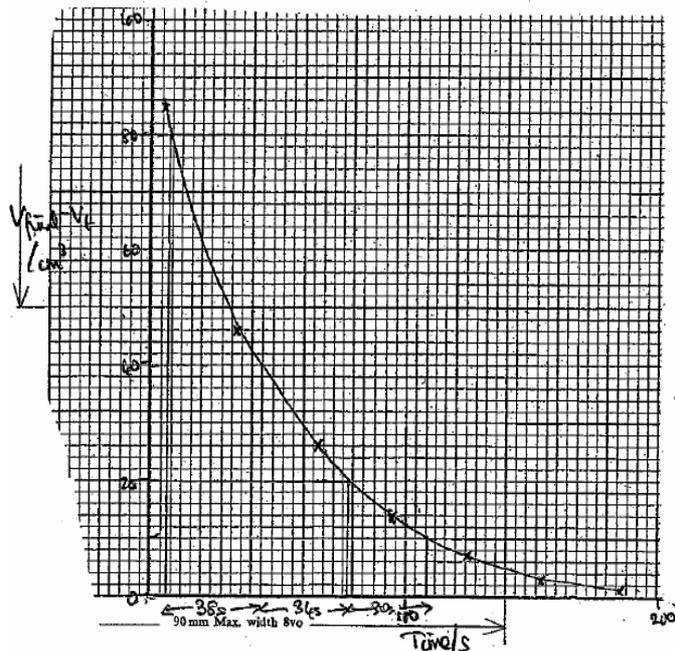
ALLOW extrapolated back
to between 88 and 100

points correctly plotted **(1)**
ALLOW TE for points

and reasonably smooth curve drawn **(1)**
NOT dot-to-dot   **(2 marks)**

(v)   three **successive** half-lives shown on the graph **(1)**
MUST start at defined volume   NOT 0s/85cm^3

all three values similar about 37s **(1)**
ALLOW 32-42 or show on graph
NOT 40, 80, 120

constant half-life / half-life not increasing means first order
reaction **(1)**
If only two half lives shown **max 2**
If in (v) zero/2nd order deduced **max 1** *for first part but TE*
allowed to parts (vi) and (vii)   **(3 marks)**

(vi)   rate = k[HCl]   If zero order
         OR rate =k[HCl]^1 rate = k
         OR rate =K[HCl]^1[CaCO$_3$]^0 *OR* rate = k[HCl]^0
         NOT rate = k[V$_{final}$-V$_t$]^1 If second order
                                                  rate = k [HCl]^2
                                                  NOT rate = k[CaCO$_3$]^1[HCl]^1 **(1 mark)**

(vii)   s^{-1} T.E
                                                  zero order – mol dm^{-3} s^{-1}
                                                  second order – dm^3 mol^{-1} s^{-1}

                                                                                              (1 mark)

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(d) **ΔS_{system}**

positive + some sensible reason eg gas given off **(1)**
as a mole of a gas given off and three moles including one solid becomes
three moles with no solid / gas more random than solid
OR
Gas more disordered than a solid

OR
Despite same number of moles/particles **(1)**

ΔS_{total}

positive + some reason **(1)**
e.g.
positive because reaction exothermic/favourable **(1)**

positive + good reason **(2)**
e.g
positive because reaction is spontaneous/goes to completion /feasible
OR ΔS_{surroundings} is positive because ΔH is negative/reaction exothermic
∴ ΔS_{total} positive **(2)**   **(4 marks)**
[provided ΔS_{system} shown positive earlier]

TOTAL 17 MARKS

2 (a) sodium ethanoate **(1)**
       NOT sodium methanoate
       NOT sodium ethoxide

       neutralisation / acid-base **(1)**
       If more than one answer given and one is incorrect **(0)**
       e.g. substitution neutralisation **(0)**   **(2 marks)**

   (b) 4-iodomethoxybenzene / 4-methoxyiodobenzene **(1)**
       ALLOW 4-iodo-1-methoxybenzene
       ALLOW 4-methoxy-1-iodobenzene
       NOT 4-iodine…..
       NOT 4-iodide…….

       <u>Elect</u>rophilic/electrophile **(1)**
       ALLOW reasonable spelling e.g. electrophyllic
       ALLOW correct diagram showing mechanism
       e.g. δ^+ δ^-
                  I — Cl
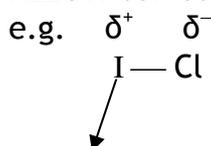
       Attacking benzene ring   **(2 marks)**

   (c) ethanamide **(1)**
       ALLOW ethan<u>e</u>amide
       nucleophilic/nucleophile **(1)**
       IGNORE if S_N1/S_N2 included but NOT "S_N1" on its own nor "S_N2" on its   **(2 marks)**
       own

   (d) Propan(e)(-)1,2,3(-)triol / glycerol **(1)**
       ALLOW glycerine
       ALLOW 1,2,3-propan(e)triol
       NOT prop – 1,2,3-triol
       NOT propan-1,2,3-ol

       Decanoic acid   **(1)**
       Hydrolysis/hydrolysation   **(1)**
       NOT condensation/hydration   **(3 marks)**

                                                                        Total 9 marks

3 **(a)** **(i)** arene /high C:H ratio/high C-H ratio/contain a benzene ring
/low H:C ratio
NOT alkene
NOT unsaturated **(1 mark)**

(ii) "aldehyde or ketone" / carbonyl group
ALLOW C=O
NOT double bonded oxygen **(1 mark)**

(iii) aldehyde
*If in (ii) "aldehyde or ketone" given, then ALLOW "not ketone"
in (iii)*
NOT can be oxidised **(1 mark)**

(iv) alkene / activated arene
ALLOW contains a carbon-carbon double bond/unsaturated
NOT enhanced arene/delocalised electrons/has a double
bond/benzene **(1 mark)**

(v) contains the same two groups/atoms on the same side (of a
double bond) / *OWTTE*
NOT trans isomer as well
[*The mark for (iv) might be seen here!*] **(1 mark)**

(vi) *Need not be displayed*

Benzene ring and cis alkene **(1)** *if whole molecule is C₉H₈O*
aldehyde **(1)** *aldehyde anywhere if whole molecule is C₉H₈O* **(2 marks)**

(b)   (i)   **Any 5**

Dissolve in the minimum volume **(1)**

of boiling/hot water **(1)**

Filter to remove insoluble impurities **(1)**

Cool to precipitate benzoic acid **(1)**

Filter off precipitate to leave impurities in solution **(1)**

Wash with (cold) solvent/water (to remove any remaining soluble impurities) **(1)**

dry between pieces of filter paper (to remove water/solvent) **(1)**

If "dissolve in boiling water, cool and filter" **2 max**
If method will not work **3 max**

(5 marks)

(ii)   a sharp melting point
OR mpt same as data book
MUST compare with data book value
NOT "measure melting point" *on its own*   **(1 mark)**

(c)   (i) $2C_6H_5CO_2H(s) + Na_2CO_3(aq) \rightarrow 2C_6H_5CO_2Na\ (aq) + H_2O(l) + CO_2(g)$

$H_2CO_3(aq)$
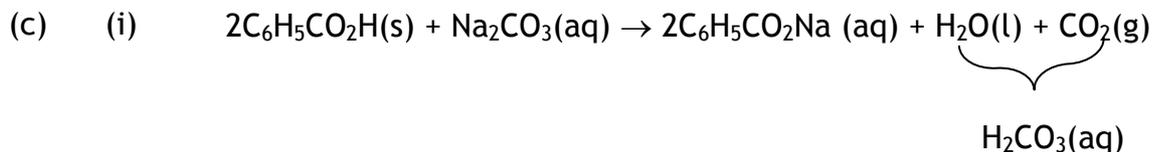
Formula and balancing **(1)**
State symbols **(1)**

All five state symbols must be correct and products must have correct formulae but not necessarily balanced or just a slip in formula

If $NaCO_3$ then if ALL state symbols are correct and formulae of products correct **1 max**

If $NaHCO_3$ as the product **max 2**   **(2 marks)**

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(ii) $C_6H_5CO_2H \rightleftharpoons/\rightarrow C_6H_5CO_2^- + H^+$ **(1)**
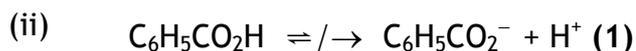
$$K_a = \frac{[C_6H_5CO_2^-] \times [H^+]}{[C_6H_5CO_2H]} \quad \textbf{(1)}$$

State symbols not required
ALLOW H_3O^+ in equation and K_a expression   **(2 marks)**

(iii)
$$K_a = 6.30 \times 10^{-5} = \frac{[H^+(aq)]^2}{0.001} \quad \textbf{(1)}$$

$[H^+]^2 \quad = \quad 6.30 \times 10^{-8}$
$[H^+] \quad = \quad 2.51 \times 10^{-4}$ **(1)** ⎤ *ALLOW TE if incorrect $[H^+]$*
$pH \quad = \quad 3.6/3.60/3.600$ **(1)** ◄─┘ *but correctly applied*
                                          $pH = -log[H^+]$

                                                                                (3 marks)

Correct answer with no working **(3)**

(d)   sodium / potassium benzoate
      OR formula
      NOT sodium hydroxide
      NOT sodium carbonate
      NOT sodium benzonate, sodium benzenoate, sodium ethanoate
      NOT $C_6H_5CO_2^-$
      If correct name given ignore partly drawn structures
      e.g.
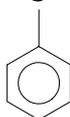
      OR $C_6H_5CO_2^-$ **(1 mark)**

4 (a) pentyl dichloroethanoate **(1)**
ALLOW 1,1 OR 2,2-
ALLOW pent-1-yl / *all one word*
NOT penten
NOT pentan
NOT pentanyl

ester **(1)**
ALLOW esther   **(2 marks)**

(b) (i) using a pipette remove a known volume (say 20 cm^3) **(1)**

remove some solution – either with a pipette
OR a known volume/ 20 cm^3

titrate with an alkali (such as sodium hydroxide) **(1)**

of known concentration **(1) -** *dependent on previous mark ie must have mentioned alkali*

IGNORE quenching

using a named indicator eg. phenolphthalein/methyl orange **(1)**
NOT litmus/universal indicator

Measure pH on its own 1 (out of 4)
But if calculation fully explained from pH can get full marks   **(4 marks)**

(ii)
$$K_c = \frac{[CHCl_2COOC_5H_{11}(l)]}{[CHCl_2COOH(l)] \times [C_5H_{10}(l)]}$$

State symbols not required   **(1 mark)**

(iii)   C$_5$H$_{10}$ 1.7 **(1)** $\frac{1.7}{0.3}$ = 5.67(5.7) *NOT* 5.66

                                                                                        (1) *for ÷ moles at eq*
CHCl$_2$COOC$_5$H$_{11}$ 0.6 **(1)** $\frac{0.6}{0.3}$ = 2   *by 0.3 in both cases*
                                                                                                                      (3 marks)

(iv) $K_c = \dfrac{\underline{0.6 / 0.3} \times 1.7 / 0.3}{1.33}$ **(1)** $= \dfrac{2}{1.33 \times 5.67}$

= 0.265 **(1)** dm^3 mol^{-1} / mol^{-1} dm^3 **(1)**

NOT dm^{-3}

ALLOW 0.27/0.26/0.264

Penalise 1 SF or 4SF or more SF but only take off 1 mark maximum in (iii) and (iv) for significant figure errors

ALLOW TE from expression in (ii)

TE using numbers for (iii) full marks possible

(3 marks)

TOTAL 13 MARKS

Total for paper: 60 Marks