

UNIT TEST C1 (6241)

Mark Scheme

JUNE 2001

- 6 (a) (i) • LiCl red/scarlet/crimson/carmine red **not** brick red/pink/orange red/yellow red **(1)**
 • NaBr orange/yellow**(1)**
 • KI
 lilac/purple/mauve/pink/violet/lavender**(1)** **(3)**
- (ii) • (Excited) Electrons**(1)**
 • Move down energy levels**(1)** **(2)**
- (b) (i) • LiCl white / steamy fumes
 • NaBr brown/orange vapour or liquid
 • KI purple vapour/dark solid or liquid or residue
 or KI dark solid or liquid or residue **(4)**
- (ii) $\text{LiCl(s)} + \text{H}_2\text{SO}_4\text{(l)} \rightarrow \text{LiHSO}_4\text{(s)} + \text{HCl(g)}$
 formulae **(1)**, states **(1)**
or $2\text{LiCl(s)} + \text{H}_2\text{SO}_4\text{(l)} \rightarrow \text{Li}_2\text{SO}_4\text{(s)} + 2\text{HCl(g)}$
 formulae **(1)**, states **(1)** **(2)**
- Total 11 marks**

- 7 (a) (i) Loss of electrons **(1)**
 (ii) A substance which gains/removes/accepts electrons **(1)**
 (iii) • Chlorine (is stronger oxidising agent) **(2)**
 • So it can accept electrons from Br⁻/so it can displace Br⁻/ so can oxidise Br⁻
- (b) (i) $3\text{OCl}^- \rightarrow \text{ClO}_3^- + 2\text{Cl}^-$ formulae + charges **(1)**,
 balancing **(1)** **(2)**
 (ii) Disproportionation **(1)**
- (c) (i) SO_2 : +4
 SO_4^{2-} : +6 **(2)**
 (ii) Oxidised because oxidation number of S becomes more positive/sulphur loses electrons
NB: Transferred error allowed in (c) (ii) **(1)**
 (iii) • Starch/any named non polar solvent:
 hexane, chloroform, volasil
 • Blue-black/purple **(2)**
- Total 12 marks**

- 8 (a) (i)
- Both covalent or diagram
 - Iodine molecular/described as molecular/a diagram
 - Diamond macromolecular or giant/a diagram
 - Iodine: **weak intermolecular forces** (to overcome)/or intermolecular van der waals forces/temporary dipoles **NB:** But not just weak forces
 - Diamond: **strong** (covalent) **bonds** to **break**/the (covalent) bonds require a lot of energy to break (5)
- (ii)
- Ions / ionic
 - Lattice/regular pattern/diagram
 - **Strong attraction** between **oppositely** charged ions/ Na^+ and Cl^- /cation and anion/a lot of energy needed to overcome attractions/strong electrostatic bonding between (3)
- (b)
- (Metal) ions
 - Delocalised electrons/sea of electrons
 - Mobile electrons (3)

Total 11 marks
Paper total 75 marks

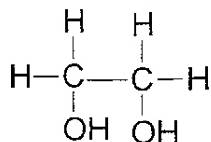
UNIT C2 (6242)

MARK SCHEME

JUNE 2001

- 1 (a) (i) Series of compounds with same general formula / differ by CH_2 (1)
 Similar chemical reactions / same functional group (1) [2]
 (ii) Alkenes [1]

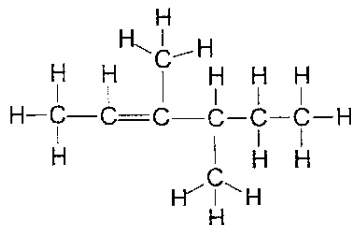
(b) (i)



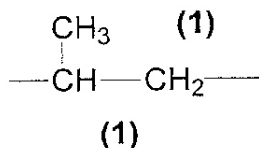
Full diagram (2)

If diagram not complete - Identification of correct product as $\text{CH}_2\text{OH} - \text{CH}_2\text{OH}$ can score (1)

- (ii) Correct hex2-ene framework (1)
 Correct 3,4-dimethyl (1)



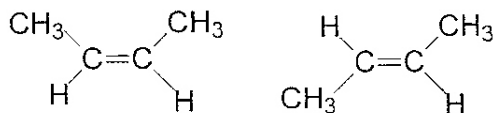
- (iii) CH_3CHCH_2 (1) correct repeating unit shape (1)



- (c) (i) Addition (1)
 Electrophilic (1) [2]
NOTE both answers are free standing
 (ii) Chloroethane (1) [1]
Not chloroethene

Total 12 marks

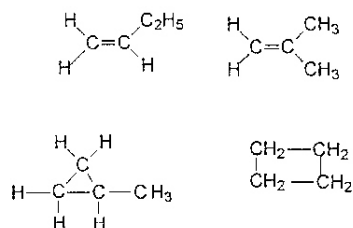
2 (a) (i)



(2) [2]

(ii) No rotation / restricted rotation around double bond (or this idea in their own words) [1]

(b) (i)



(1) [1]

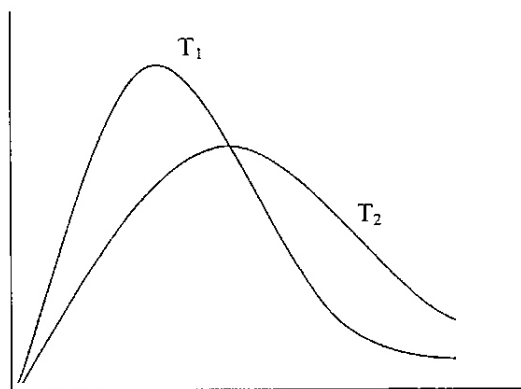
(ii) One end of C=C bond has 2 identical atoms / groups attached (1) [1]

or

no movement / no C=C (1)

Total 5 marks

- 3 (a) Diagram at T_1 , approximately correct shape which starts near origin and does not intersect the vertical axis or the horizontal axis (1)
At higher T_2 – flatter (1) and mode to right (1)



[3]

(b) Indication of activation energy **on diagram** to the right of both peaks (1)

Explanation of number past E_a point related to probability of reaction (1)

Higher T gives more molecules E_a (1)

more effective / successful collisions (1)

[4]

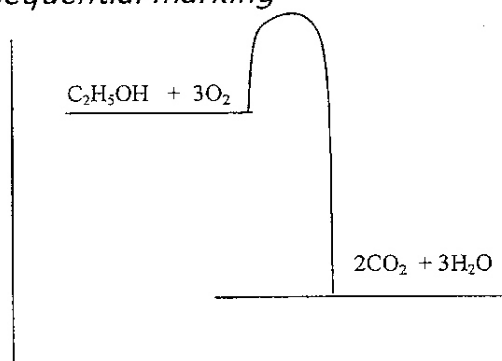
Total 7 marks

- 4 (a) Still reacting / rate of forward reaction and backward reaction equal / implication that forward and backward reactions are still taking place **(1)**
- [2]**
- But concentrations constant / no macroscopic changes **(1)**
- (b) **Temp** (Increases) Left / to SO_2 / to endothermic / lower yield **(1)**
- Press** Increases / faster **(1)** Right to SO_3 / to smaller number of molecules (*not volume*) **(1)**
- [3]**
- (c) (i) Increases rate / or suitable comment on rate **(1)**
- Moves position of equilibrium to endothermic side / or suitable comment on equilibrium such as reasonable yield / less SO_3 **(1)**
- Either** Compromise in which the rate is more important than the position of
or
 optimum temperature for catalyst to operate
or
 valid economic argument **(1)**
- [3]**
- (ii) Increases rate / more SO_3 / only needs small pressure to ensure gas passes through plant (*or similar idea in own words*) / high or reasonable yield obtained at 1 atm or at low pressure anyway **(1)**
- and**
 references to economic cost against yield benefit
 e.g increase in pressure would increase yield of product but the increase in yield would not offset the cost of increasing the pressure **(1)**
- [2]**

- (iii) Catalyst speeds up reaction **(1)** [1]
 (d) Vanadium (V) oxide / vanadium pentoxide / V_2O_5 **(1)** [1]
 (e) Any one use
production of fertilizers, detergents, dyes,
 paints, pharmaceuticals
 (in) car batteries, pickling metal [1]

Total 13 marks

- 5 (a) Enthalpy change / heat changes **(1)**
 is independent of route **(1)** [2]
 (b) • Enthalpy or heat change **for complete combustion / complete reaction** with oxygen / burning in **excess** air **(1)**
 • per **mole** of substance **(1)**
 • 1 atm or standard states **(1)** [3]
Ignore references to temperature
 (c) (i) $C-C + 5C-H + C-O + O-H + 3O=O +4719$ **(1)**
mark for process or answer
 $4C=O + 6O-H -5750$ **(1)**
mark for process or answer
 $H = +4719 -5750 = -1031 \text{ kJ mol}^{-1}$ **(1)**
Consequential marking ignoring units [3]
 (ii) Diagram showing an exothermic reaction and labelled 'products' and reactants/ equations **(1)**
 Showing energy barrier **(1)**
Consequential marking [2]



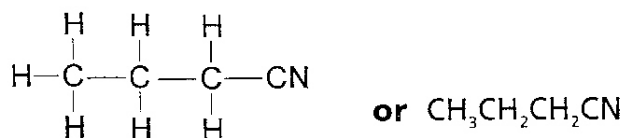
Total 10 marks

- 6 (a) $(280/2 = -)140$ **(1)**
- $5510 / 114$ **(1)** = $(-)48.3$ **(1)** **[3]**
Answer alone (2)
- (b) Mark reason first
- Eg. Hydrogen
- Less pollution **(1)**
 - Greater energy per unit mass **(1)**
 - renewable resource**(1)**
- Eg. Octane
- Liquid easily transported **(1)**
 - More readily available **(1)**
- [2]**
- The two reasons must relate to the **same** fuel –
 no mark for fuel itself
- (c) *The answer requires a disadvantage for the fuel
 chosen in part(b)*
- Hydrogen – needs to be made using electricity /
 idea of storage problems developed**(1)**
- Octane – (air) pollution **or** non-renewable **(1)**
- [1]**
Total 6 marks
- 7 (a) (i) **Anode** $2O^{2-} \rightarrow O_2 + 4e$ / or half or multiple /
 electrons on either side **(1)**
- Cathode** $Al^{3+} + 3e \rightarrow Al$ **(1)** **[2]**
- (ii) Anode / correct half equation / the one that
 loses electrons**(1)** **[1]**
Free standing answer
- (iii) Carbon reacts with oxygen **(1)**
 erodes / disappears / gas or CO_2 given off **(1)** **[2]**
- (iv) Too high a temperature needed / very high
 melting point **(1)**
 Expensive **(1)** **[2]**

- (b) (i) Lots of uses **(1)**
two examples of uses or two properties of aluminium **(1)**
or
 one particular large scale use of Al **with** a matching specific property **(Score 1 mark for each use tied to property to maximum of two examples)** **[2]**
- (ii) Electrolysis the most expensive step / production of aluminium is expensive **(1)**
 Recycling avoids expensive step / conserves resources of ore or energy **(1)**
The answer must be specific to aluminium. **[2]**

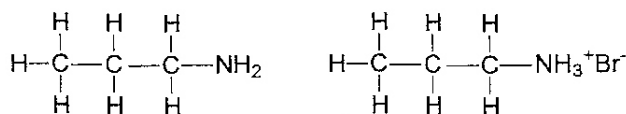
Total 11 marks

8 (a) (i)



[1]

(ii)



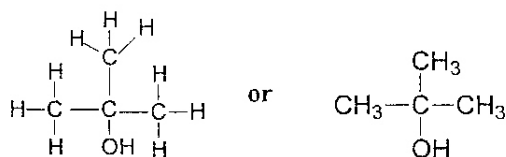
or



[1]

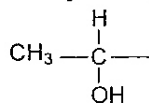
- (b) *Allow secondary, tertiary or quaternary amine*
 PCl_5 **(1)**
 Steamy / white / misty fumes / valid test for HCl
shows alcohol **(1)**
or
 acidified potassium dichromate **(1)**
 goes orange to green **shows** alcohol **(1)**
or
 acidified potassium manganate(VII) **(1)**
 goes from purple to colourless / decolorises
shows alcohol **(1)**
could be in alkali when colour will be green or brown
or
 any other plausible test to show presence of chloro group

- e.g hydrolysis with NaOH and acidify **(1)**
 add silver nitrate solution and result **(1)** **[2]**
 (c) (i) Methylpropan-2-ol **[1]**



- (ii) Acidified potassium dichromate / in dilute sulphuric acid / H_2SO_4 **(1)**
 warm **(1)**
 orange solution green with butan-2-ol **(1)**
 no change with 3° alcohol **(1)**
or
 iodoform test
 add iodine and NaOH or KI and NaClO **(1)**
 stand or warm **(1)**
 cream/ yellow ppt **(1)**
 only with butan-2-ol **(1)**
or
 Acidified or alkaline potassium manganate(VII) **(1)**
 warm **(1)**
 purple colour goes colourless or green / brown/ decolorised **(1)**
 only for butan-2-ol **(1)** **[4]**

- (iii) Butan-2-ol gives ketone / easily oxidised to the ketone **(1)**
 Methylpropan-2-ol not easily oxidised **(1)** **[2]**
or
 in the iodoform test identify the ppt as CHI_3 **(1)**
 explain that this needs



group to be present **(1)**

Some or all of the marks for this section may be given in part(ii)

Total 11 marks
Paper total 75 marks

UNIT TEST C3 (6243) Paper 3B

MARK SCHEME

JUNE 2001

1

- (a) *Three possible reasons*
Reason 1
Any fluctuations in temperature smoothed out / minimizes reading error / allows line of best fit to be drawn **(1)**
Reason 2
Able to allow for cooling effect / able to calculate more accurate **temperature** change / need to find highest temperature **(1)**
Reason 3
Reference to problem of how the experiment is carried out practically e.g. reaction slow / too much to do all at once **(1)** [2]
- Any 2**
- (b) Extrapolation of lower and upper temperatures at 3.5 min **(1)**
 ΔT correct to $\pm 1.0^\circ\text{C}$ according to candidate's method **(1)**
Consequential on sensible method of finding temp change between 3 and 4 minutes [2]
- (c) $\Delta H = -4.18 \times \text{candidate's } \Delta T$
 ΔH correctly calculated **(1)**
with consequentially correct sign and to 3 or 4 SF **(1)**
This is consequential on part (b)
The correct sign can be awarded even if answer wrong
Note 42 176 / 175.6
43 180 / 179.7
44 184 / 183.9
Fully correct answer **(2)** [2]

Total 6 marks

2

- (a) (i) To neutralise (potassium hydroxide) / to make sure the solution is acidic (as this is needed for test) **(1)**
Otherwise silver nitrate reacts with alkali / prevent formation of other ppts / remove anions that could react with the silver nitrate **(1)** [2]
- (ii) Cream / off white / pale yellow / buff **(1)**
AgBr **(1)** [2]
- (iii) Precipitate dissolves / (colourless) solution formed / ppt disappears **(1)** [1]

- (b) Reagent **(1)** PCl_5 / $\text{K}_2\text{Cr}_2\text{O}_7 + \text{H}_2\text{SO}_4$ / $\text{KMnO}_4 + \text{H}_2\text{SO}_4$ / Na / SOCl_2
 Observation **(1)** must relate to reagent chosen
 Formulae **(1)** May relate to product from the reagent or the organic compound
 PCl_5 (1)
 White/steamy/misty fumes/vapour/gas **(1)**
 HCl / chloro derivative ($\text{C}_4\text{H}_9\text{Cl}$) / POCl_3 **(1)**
 $\text{K}_2\text{Cr}_2\text{O}_7 + \text{H}_2\text{SO}_4$
 Orange to green
 $\text{CH}_3\text{CH}_2\text{COCH}_3$ / $\text{Cr}_2(\text{SO}_4)_3$ / K_2SO_4 / H_2O
 $\text{KMnO}_4 + \text{H}_2\text{SO}_4$
 Purple to colourless
 $\text{CH}_3\text{CH}_2\text{COCH}_3$ / MnSO_4 / K_2SO_4 / H_2O
Na
 Bubbling
 $\text{C}_4\text{H}_9\text{ONa}$ / H_2

[3]
Total 8 marks

- 3 (a) (i) $\text{Mr}(\text{C}_6\text{H}_{11}\text{OH}) = 100$ **(1)**
- $6.0 \div 100 = 0.06$ **(1)** **[2]**
- The answers to this part could appear in part (ii)*
Correct answer alone scores two marks
- (ii) $\text{Mr}(\text{C}_6\text{H}_{10}) = 82$ **(1)**
- Answer to (a)(i) $\times 82$ **(1)** = $0.06 \times 82 = 4.92$ g **[2]**
- (iii) $\frac{1.8}{\quad} \times 100\% = 36.6\%$ **(1)**
- Answer to (a)(ii)
Consequential
If candidate gets 36.6% with some working they should score five marks for part (a) **[1]**
- (b) BP of cyclohexene is lower BP of cyclohexanol is higher **(1)**
 so it distils off as it forms / comes over first / vaporises first / boils first / or details of method as to how the product could be distilled off first / cyclohexanol left behind **(1)** **[2]**
- (c) Carbon must come from cyclohexanol so using it up / comes from competing reaction / idea of breakdown of reactants so that not all reactants converted to desired product **(1)** **[1]**
- (d) Reference to taking care when adding water / add mixture to water **(1)**
 Wearing gloves / safety goggles / safety spectacles **(1)**
This is a stand alone mark **[2]**

- (e) Reagent: bromine (solution) / bromine water / Br₂
 or potassium manganate(VII) + sulphuric acid / sodium carbonate / sodium hydroxide (or correct formulae) **(1)**
 Result:
 Br₂ yellow/ red-brown/orange/orange-red / brown to colourless/ decolourised/ goes colourless *but not goes ' clear*
 KMnO₄ purple to colourless /decolourised/goes colourless / *not goes ' clear*
 or if alkaline conditions brown ppt/solid**(1)**

[2]

Total 12 marks

4

- (a) (i) *Note the improvement must be only to procedure II*
Any one Improvement:
 Use pipette / burette instead of measuring cylinder **(1)**
 Use larger beaker/ conical flask / use a lid or any valid method to reduce splashing or acid spray **(1)**
 Powder up limestone / stir mixture **(1)**
 Use more acid / check sufficient acid used**(1)**
- One reason matching suggested improvement**
 Pipette more accurate **(1)**
 Less chance of acid spray escaping **(1)**
 Speeds up reaction **(1)**
 Larger titres / if only just enough acid used titration will be very small / to ensure all the limestone reacted **(1)** [2]
- (ii) Choose titres 1 and 3 only **(1)** *Stand alone*
 Mean = 14.88 / 14.90 / 14.85 *allow 14.9 and 14.875* **(1)**
Correct answer scores 2 marks [2]
- (b) (i) $\frac{14.88^*}{1000} \times 0.100$ **(1)** = 0.001488
 * or other value calculated by candidate [1]
- (ii) Number of moles HCl transferred = answer to (i) **(1)**
 = 0.001488 [1]
- (iii) Number of moles HCl remaining = answer above x 10 **(1)**
 = 0.01488 [1]
- (iv) $\frac{50}{1000} \times 2.00 = 0.100$ **(1)** *Allow 0.1 at this point* [1]
- (v) Answer to (iv) – answer to (iii) **(1)** e.g. 0.100 – 0.01488 = 0.08512 [1]
- (vi) Answer to (v) ÷ 2 **(1)** e.g. 0.08512 ÷ 2 = 0.0425
 0.0425 x 100 **(1)** = 4.25 g [2]

- (vii) $\frac{\text{Mass of CaCO}_3}{\text{Mass of sample}} \times 100\%$ (1) e.g. $\frac{4.25}{5.24} \times 100\% = 81.1\%$ [1]
- (c) (i) C(1) [1]
- (ii) One from:
 missing end-point, leaking tap, not reading (meniscus)
 at eye-level / bubble below tap / not reading meniscus
 (correctly) / air lock below tap / funnel left in top of
 burette / burette not vertical / not reading level against
 a white background(1) [1]

Total 14 marks

5

*A possible scheme is given below followed by the penalties that are to be applied if the proposed scheme **does not work**. Reward alternative workable plans*

For overall plan being logical and sensible (1).

The HCl can be identified at several points and by several methods

Add NaOH to others and warm (1)

Gas turns red litmus blue from $(\text{NH}_4)_2\text{SO}_4$ (1)

Gas is ammonia (1) *Stand-alone mark*

Add $(\text{NH}_4)_2\text{SO}_4$ to remaining four solutions (1)

White ppt with BaCl_2 (1)

Add NaOH to remaining
four solutions (1)

White ppt with BaCl_2 (1)

Add BaCl_2 to remaining three solutions (1)

Two white ppts with Na_2SO_3 and Na_2SO_4 (1)

Remaining solution is HCl (1)

or add blue litmus made by using red litmus and ammonia or

NaOH(1) shows HCl(1)

or add NaOH and note an increase in temperature of the mixture

(1) shows HCl(1)

Add HCl to white ppts of Na_2SO_3 and Na_2SO_4 (1)

Na_2SO_3 dissolves (1)

Sulphur dioxide evolved (1) *Stand-alone mark*

Max (9) for tests results and conclusions.

Total 10 marks
Paper total 50 marks

- 1 (a) $\text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2 + \text{H}_2$ ignore state symbols (1)
- (b) Increases as group is descended (1)
(or the reverse – decrease as the group is ascended)
- (c) (i) • Energy/heat/enthalpy change/needed/required per mole
• for the removal of 1 electron
• Of gaseous atoms (wrong if candidate writes gaseous molecules, lose 1 mark)
 $\text{Ca}_{(g)} \rightarrow \text{Ca}_{(g)}^+ + \text{e}^-$
1 mark for formulae and charges
1 mark for state symbols (unless already stated 'gaseous') (4)
- (ii) • Decreases as group is descended, direction must be stated. If wrong trend is stated, then no further marks are awarded for this question)
• Because (outer) electron further from nucleus
• More shielded (3)

Total 9 marks

- 2 (a) (i) $2s^2 2p^6 3s^2 3p^4$ (allow subscripts) (1)
(ii) 16 (1)
- (b) (i) • Energy/heat/enthalpy change/released per 1 mole
• For the gain of 1 electron (3)
• Of gaseous atoms
- (ii) • (Negative) Electron and negative ion/anion (both) negative (2)
• Repulsion occurs

Total 7 marks

- 3 (a) • Fast/high energy/fired/bombard/electrons (electron gun) strike sample atoms (2)
 • Knocking out/ remove electron from sample atom (2)
- (ii) Electric field/charged plates/negative plates (1)
- (b) (i) $^{65}\text{Cu}^+$ if incorrect proton number is added, then the answer is incorrect (1)
 (ii) (2)(different) isotopes (or mass no. / neutron no. argument) (1)
 (iii) $(63 \times 69.1) + (65 \times 30.9)$ divided by $(69.1 + 30.9)$ (1) = 63.6/63.62/63.618 (1) (2)
- Total 7 marks**
- 4 (a) (i) C 80/12 : H 20/1 **NB:** just CH_3 is worth 1 mark (1)
 full marks for CH_3 plus the correct working out
 C 6.67/6.67 : H 20/6.67 (1)
 = 1 : 3 ie. CH_3 (1) (3)
- (ii) M.F. = $30/15 \times \text{CH}_3 = \text{C}_2\text{H}_6$ stand alone answer is not dependent on previous question (1)
- (b) (i) Moles propane = $110/44 = 2.5$ (1)
 Moles water = $4 \times 2.5 = 10.0$ (1)
 Mass water = $10.0 \times 18 = 180\text{g}$ (1) (3)
Note Correct answer alone scores full marks
- (ii) Moles oxygen = $5 \times 2.5 = 12.5$ (1)
 transferred error from (b) (i)
 Volume oxygen = $12.5 \times 24 = 300 \text{ (dm}^3\text{)}$ (1)
Correct answer alone full marks (2)
- Total 9 marks**
- 5 (a) For diagrams there must be some attempt at 3D
 • Octahedral diagram
 • Angle = 90°
 • repulsion between 6 bonding pairs or 6 bonding pairs as far apart as possible (3)
- (b) • trigonal pyramidal diagram
 • angle = $106^\circ - 108^\circ$
 • 3 bp and 1 lp (or shown by dot and cross diagram) **or** lp repels more than bp (3)
- (c) • tetrahedral diagram
 • angle = $109^\circ - 110^\circ$
 • repulsion between 4bp **or** 4 bonding pairs as far apart as possible (3)
- Total 9 marks**