

Mark Scheme (Results) January 2007

GCE

GCE Chemistry (6243/02)

| | EXPECTED ANSWER | ACCEPT | REJECT | MARK |
|---|--|---|--|----------------------|
| 1 | (a) Lilac (flame/colour) Ignore any references to blue glass | mauve/purple | Any other colour on its own or in combination with lilac | (1 mark) |
| | (b) Add nitric acid/HNO ₃ and silver nitrate (solution)/AgNO ₃ (aq) | given in either order If put these two in and then add ammonia allow | | (1 mark) |
| | (c) Sulphur dioxide/SO ₂ (1) Sulphite / sulphate(IV) / SO ₃ ²⁻ (1) | HSO ₃ ⁻ /hydrogen-sulphite | Error carried forward e.g CO ₂ | (2 marks) |
| | (d) White precipitate/solid/suspension | | Goes milky/cloudy | (1 mark) |
| | (e) Aluminium/Al/Devarda's Alloy (1) ignore any references to foil or powder or turnings and sodium hydroxide (solution)/NaOH((aq))/KOH((aq))(1) | given in any order | | (2 marks) |
| | (f) (red then) bleached/goes white/ goes colourless | | | (1 mark) |
| | | | | Total 8 marks |

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|---|--|---|---|--|--|---------------------------------|
| 2 | <i>Notes: candidates may achieve answer with two tests. If they carry out more than two tests penalise those tests that are wrong If minor error in the test allow correct observation e.g inaccuracy in formula</i> | | | | | |
| | | | Test | Observation | | |
| | | P | Any carbonate or Group 1 hydrogencarbonate as solid or in solution OR correct formula for above including anions ions | Gas evolved that turns limewater cloudy(1) | esterification i.e. Test: Add alcohol + conc. H ₂ SO ₄ (1) Obs: smell (1) Fizzing/effervescence/ bubbles | |
| | OR | P | Add magnesium (1) | Gas evolved burns (with 'pop') (1) | Fizzing/effervescence/ bubbles | Gas evolved |
| | OR | P | add blue litmus paper add litmus solution add pH indicator paper add universal indicator paper or solution Use pH meter (1) | (Blue litmus) goes red (1) goes red goes yellow/orange/red pH below 6 | | (2 marks) |
| | | Q | Add bromine water(1) Bromine in non-aqueous solvent or stated e.g hexane | (Brown/red-brown/orange solution) decolourised/goes colourless (1) | esterification i.e. Test: Add carboxylic acid + conc. H ₂ SO ₄ (1) Obs: smell (1) | Add PCl ₅ Bromine |
| | OR | Q | Add (acidified /alkaline) potassium manganate(VII)/permanganate OR Add(neutral) solution of potassium | (Purple solution goes) colourless if acidified green if alkaline | If not specified as acidic or alkaline or neutral, accept colourless or brown (ppt) for observation | (2 marks) |

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| | | manganate(VII)/permanganate(1) OR Heat with acidified /H ⁺ dichromate Cr ₂ O ₇ ²⁻ / CrO ₄ ²⁻ (solution) Note: If more than one test is given and both tests are reactions that P and Q would show but one test does not distinguish between P and Q, allow 1 mark. | brown (ppt) if neutral (1) goes green/blue | | Dichromate paper | |
| | | | | | | Total 4 marks |

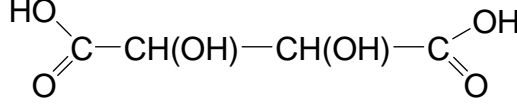
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|---|--|--|----------------------------|----------|
| 3 | Magnesium ions/ Mg^{2+} magnesium compound / contains magnesium OR NOT Ca^{2+} Ba^{2+} Sr^{2+} (ALL THREE) or Ca^{2+} Ba^{2+} Sr^{2+} ABSENT | Be ions/ Be^{2+} / beryllium compound / contains beryllium | Mg^+ | (1 mark) |
| | Iodine produced /contains iodine OR Z is an Iodide /iodide ions / I^- | | bromide iodine ions | (1 mark) |
| | MgI_2 Consequential marking: Allow cq on metal stated provided it is Group 2 and not barium No cq on halide | BeI_2 if Be^{2+} | Name e.g. magnesium iodide | (1 mark) |

Total 3 marks

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|---|-----------------|------|---|--------|---|---------------|
| 4 | (a) | (i) | <p>How it works (Liquid boils and) gas/vapour is condensed (in condenser and runs back) (1)</p> <p>Why it is used Reaction slow /reaction has high activation energy /increase rate / for more time/to enable reactants to be heated for a prolonged period (1)</p> <p>When using volatile liquids/ to prevent loss of materials / to prevent escape of reactants (and products)/ to minimise loss of reactants (and products)(1)</p> | | | (3 marks) |
| | | (ii) | <p>Apparatus Flask properly drawn and thermometer and heat (1)</p> <p>Condenser properly drawn with water jacket with correct water flow(1)</p> <p>Set up Top of still head closed and collection end open Thermometer at correct point in neck (still head) Condenser at angle (1) ALL THREE for 1 mark</p> <p>Ignore any attempts to draw a fractionation column and a dropping funnel in a side arm.</p> | | | (3 marks) |
| | (b) | | <p>Use a water bath/electric heater/electric hot plate/sand bath/ oil bath Ignore Keep away from naked flame / use a fume cupboard</p> | | Do not use a Bunsen (unless qualified with what should be used) | (1 mark) |
| | | | | | | Total 7 marks |

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| 5 | (a) (from) colourless (to) pink | pale red | (From) clear to..... <i>OR</i> ...to magenta/ purple/cerise | (1 mark) |
| | (b) The first titre is outside the 0.2 (cm ³) limit usually set for volumetric analysis <i>OR</i> the first titre is rough/trial | not concordant closest too far out /overshot | Very similar Not accurate | (1 mark) |
| | (c) 23.40 cm ³ | 23.4 | | (1 mark) |
| | (d) (i) $\frac{(25.00 \times 0.110)}{(1000)} = 0.00275 \text{ mol} / 2.75 \times 10^{-3} (1)$ | 0.0028 | 0.003 0.0027 | (1 mark) |
| | (ii) $\frac{(23.40 \times 0.235)}{(1000)} = 0.005499 \text{ mol} / 5.499 \times 10^{-3} (1)$ cq on (c) | 0.0055 | | (1 mark) |
| | (iii) $\frac{(\text{Answer (ii)})}{(\text{Answer (i)})} (1)$ ie $\frac{0.005499}{0.00275} = 2$ Cq on (i) and (ii) used to at least 2 sig figs. | | | (1 mark) |
| | (iv) 2 <i>consequential on (iii) as long as rounded to interger and sensible</i> <i>≥ .8 rounded up</i> <i>≤ .2 rounded down</i> | Allow mark if no answer to (iii) but (i) and (ii) are correct | Any number that is not an integer Any number > 4 | (1 mark) |

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|--|--|---|---|---|---|--|------------------------|-----------------|-----------------|---|---|---|-----|-----|---|---|---|--|--|-----------------------|--|---|----|--|--|--|---|--|--|--|--|----------------------------------|
| | <p>(e)</p> | <table border="1"> <tr> <td style="text-align: center;">C</td> <td style="text-align: center;">H</td> <td style="text-align: center;">O</td> </tr> <tr> <td style="text-align: center;">$\frac{32}{12}$</td> <td style="text-align: center;">$\frac{4}{1}$</td> <td style="text-align: center;">$\frac{64}{16}$</td> </tr> <tr> <td style="text-align: center;">= 2.67</td> <td style="text-align: center;">4</td> <td style="text-align: center;">4</td> </tr> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">1.5</td> <td style="text-align: center;">1.5</td> </tr> <tr> <td style="text-align: center;">2</td> <td style="text-align: center;">3</td> <td style="text-align: center;">3</td> </tr> </table> <p>Empirical formula mass = 75 (1) x 2 (1) Molar formula C₄H₆O₆</p> <p>Notes OR These are in the ratio 4 to 6 to 6 (1) which adds up to 150 molar mass(1) Molar formula C₄H₆O₆ OR C₁H_{1.5}O_{1.5} = 37.5 (1) x 4 = 150 (1) so Molar formula C₄H₆O₆</p> <p>If calculation stops at C₂H₃O₃ may be out of clip send to review.</p> | C | H | O | $\frac{32}{12}$ | $\frac{4}{1}$ | $\frac{64}{16}$ | = 2.67 | 4 | 4 | 1 | 1.5 | 1.5 | 2 | 3 | 3 | | | <p>(1)</p> <p>(1)</p> | <p>Calculation of percentages</p> <table border="1"> <tr> <td style="text-align: center;">I</td> <td style="text-align: center;">II</td> </tr> <tr> <td>% C = $\frac{48 \times 100}{150}$ = 32</td> <td>(C = $\frac{0.32 \times 150}{12} = 4$)</td> </tr> <tr> <td>% H = $\frac{6 \times 100}{150}$ = 4</td> <td>(H = $\frac{0.04 \times 150}{1} = 6$)</td> </tr> <tr> <td>% O = $\frac{96 \times 100}{150}$ = 64</td> <td>(O = $\frac{0.64 \times 150}{16} = 6$)</td> </tr> </table> <p>All correct (4) 2 correct (2) 1 correct (1)</p> | I | II | % C = $\frac{48 \times 100}{150}$ = 32 | (C = $\frac{0.32 \times 150}{12} = 4$) | % H = $\frac{6 \times 100}{150}$ = 4 | (H = $\frac{0.04 \times 150}{1} = 6$) | % O = $\frac{96 \times 100}{150}$ = 64 | (O = $\frac{0.64 \times 150}{16} = 6$) | | | <p>(4 marks)</p> <p>(1 mark)</p> |
| C | H | O | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $\frac{32}{12}$ | $\frac{4}{1}$ | $\frac{64}{16}$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| = 2.67 | 4 | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 1.5 | 1.5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | 3 | 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| I | II | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| % C = $\frac{48 \times 100}{150}$ = 32 | (C = $\frac{0.32 \times 150}{12} = 4$) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| % H = $\frac{6 \times 100}{150}$ = 4 | (H = $\frac{0.04 \times 150}{1} = 6$) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| % O = $\frac{96 \times 100}{150}$ = 64 | (O = $\frac{0.64 \times 150}{16} = 6$) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | <p>(f)</p> |  | | | | <p>COOHCH(OH)CH(OH)COOH OR HOOCCH(OH)CH(OH)COOH OR HOOC(OH)₂CH₂COOH OR COOHC(OH)₂CH₂COOH</p> | <p>CO₂H</p> | | <p>(1 mark)</p> | | | | | | | | | | | | | | | | | | | | | | | |

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| (g) | <p>First mark general statement about the larger volume means it is more accurate Second or both marks for justification based on data given</p> <p>First mark (Percentage/relative)error is less with large titre / error minimised/ reduces error(1)</p> <p>Second mark calculation (1) Calculation of percentage error e.g $\frac{0.05}{7.5} \times 100 = 0.67\%$ $\frac{0.05}{25} \times 100 = 0.2\%$</p> <p>If do both calculations correctly give both marks</p> | | | (2 marks) |
| | | | | Total 14 marks |

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| 6 | (a) | <i>IGNORE sig figs provided 2 or better in (i) and (ii)</i> | | | |
| | (i) | $\Delta T = 26 \text{ }^\circ\text{C}$ (1) STAND ALONE Heat change = $104 \times 26.0 \times 4.09 = 11060 \text{ J}$ (1) ignore sign at this point The second mark may be appearing in part (ii) | If use 100g answer is 1063(4) And gives 355 as the final answer If use 4 g gives 425.2 and gives 14.2 kJ mol^{-1} | | (2 marks) |
| | (ii) | Moles = $\frac{4.00}{133.5}$ (1) = 0.02996 $\frac{\text{Answer in (i)}}{\text{moles}} \times \frac{1}{1000}$ (1) = -369 (kJ mol^{-1}) (1) Error carried forward if wrong Mr | 0.03 -369 (kJ mol^{-1}) with some working (3) -369000 J mol^{-1} (max 2) | -369000 kJ mol^{-1} does not score 3 rd marking point | (3 marks) |
| | (b) | Record temp of water at intervals add solid (and stir), continue recording temperature (1) (Plot)graph(1) this could be implied Extrapolate back to time of adding solute (to find actual temperature change) (1) Note An annotated sketch graph showing clear time intervals and temperature plots a vertical line at correct point and evidence at what point the solid was added score all three marks | | Methods based on increasing insulation alone | (3 marks) |
| | | | | | Total 8 marks |

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| 7 | <p>Weigh crucible empty and with solid/ find mass of solid / take known mass of solid(1) Heat (,cool) and reweigh (1) Reheat and reweigh/ heat to constant weight / make sure no gas is being evolved (1)</p> <p>to ensure reaction is complete (1)</p> <p>Compare ratio of $\frac{\text{mass produced}}{\text{mass taken}}$ (1)</p> <p>If $\frac{106}{168}$ reaction I</p> <p>If $\frac{40}{84}$ reaction II</p> <p>If $\frac{62}{168}$ reaction III</p> <p>OR $\frac{\text{Mass taken}}{\text{mass produced}}$ (1)</p> <p>If $\frac{168}{106}$ reaction I etc</p> <p>OR</p> <p>Calculate actual mass of product or mass lost based on a stated mass taken e.g 10 g gives 6.7 or less of 3.3 10g gives 4.8 or loss of 5.3 10g gives 3.7 or loss of 6.3 (1) for calculation</p> <p>Relate answer to which solid taken (1)</p> <p>Could measure volume of gas produced but it breaks down if temp not above 100 °C max 3 (the first 3 marks) since this is not the question asked</p> | <p>Compare ratio of mass of product with mass of reactant (1)</p> <p>If rxn I: mass of product = $\frac{\text{mass of NaHCO}_3 \times 106}{2 \times 84}$</p> <p>If rxn II: mass of product = $\frac{\text{mass of NaHCO}_3 \times 40}{84}$</p> <p>If rxn III: mass of product = $\frac{\text{mass of NaHCO}_3 \times 62}{2 \times 84}$</p> <p>(1)</p> | <p>If say take <u>equal amounts</u> do not give first mark since this indicates a misunderstanding of the whole exercise.</p> | <p>(6 marks)</p> |