

Chemistry B (Salters)

Advanced GCE

Unit **F334**: Chemistry of Materials

Mark Scheme for June 2011

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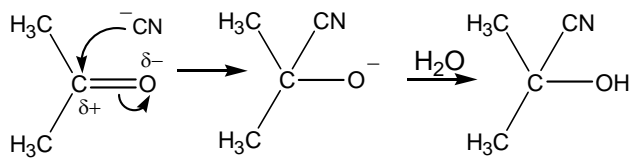
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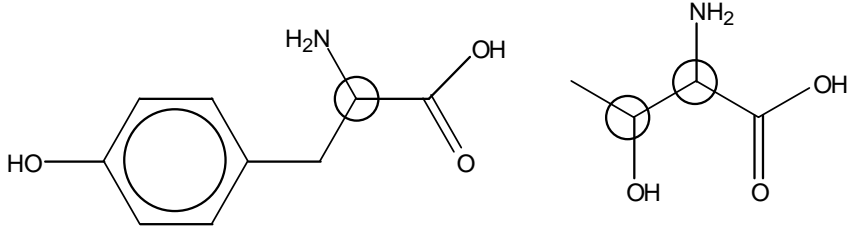
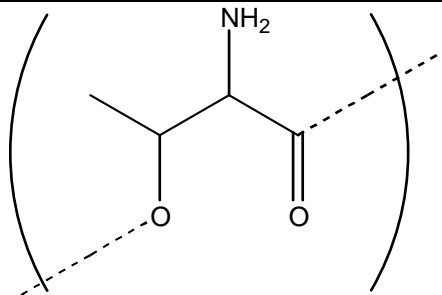
| Question | | | Answer | Mark | Guidance |
|----------|---|-----|--|------|--|
| 1 | a | i | ethanal ✓ | 1 | DO NOT ALLOW acetaldehyde |
| | | ii | acidified / H ⁺ ✓ dichromate / Cr ₂ O ₇ ²⁻ ✓ distil ✓ | 3 | IGNORE any sodium/potassium ions in formula/name ALLOW only sulfuric acid / H ₂ SO ₄ IGNORE fractional ALLOW distillation DO NOT ALLOW if reflux is also stated |
| | | iii | (strong) peak/trough at around 1720 (cm ⁻¹) / <i>anywhere</i> in region 1700-1725 indicates C=O (in carboxylic acid) (NOT PRESENT IN ETHANOL) ✓ (broad) peak/trough at around 3100 (cm ⁻¹) / <i>anywhere</i> in region 2500-3200 indicates O-H (in carboxylic acid) (NOT PRESENT IN COMPOUND A) ✓ ethanoic acid OR Compound B ✓ | 3 | OR no peak above 3200 (cm ⁻¹) OR in region of 3600-3640 (cm ⁻¹) for -OH in alcohol DO NOT ALLOW No peak/trough at 1050-1300 for C-O in alcohol (cm ⁻¹) <i>since peaks are present in this region</i> ALLOW no (strong) peak/trough at around 1720-1740 (cm ⁻¹) for aldehyde group in compound A DO NOT ALLOW a carboxylic acid ALLOW labels on peaks in spectrum |
| | | iv | Any suggestion that indicates that reflux/excessive heating took place / distillation of ethanal as it was formed did not take place OR excess acidified dichromate was used / acidified dichromate was not added slowly to ethanol ✓ (ethanol/ethanal was) <u>oxidised</u> further ✓ | 2 | |
| 1 | b | i | ester ✓ | 1 | |

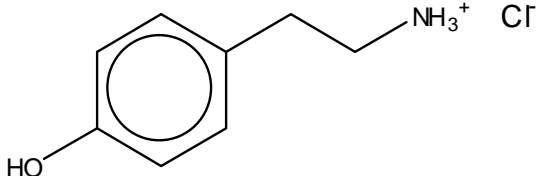
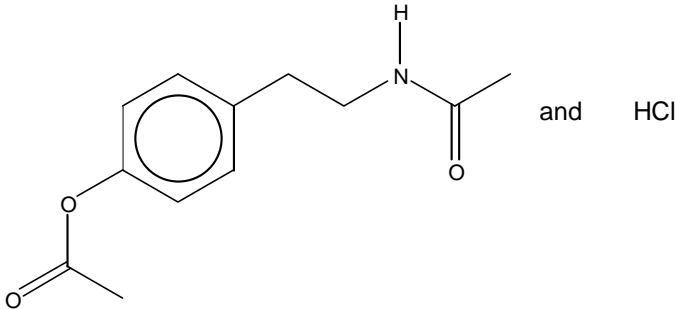
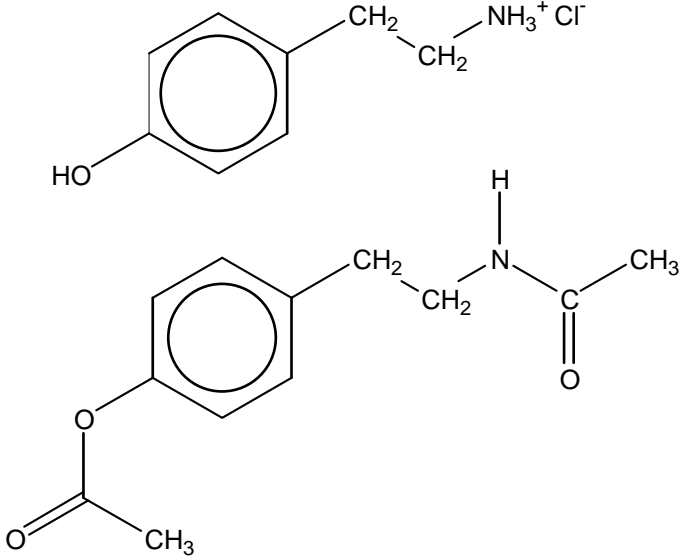
| Question | | Answer | Mark | Guidance |
|----------|-----|--|------|--|
| | ii | $\text{C}_2\text{H}_5\text{OH} + \text{CH}_3\text{COOH} \rightarrow \text{CH}_3\text{COOC}_2\text{H}_5 + \text{H}_2\text{O}$ ethanoic acid correct ✓ products correct ✓ | 2 | ALLOW any correct type of structural formulae |
| | iii | <u>concentrated</u> sulfuric acid OR H_2SO_4 ✓ act as catalyst OR speed up reaction rate OR absorb water ✓ | 2 | IGNORE references to activation enthalpy |
| | iv | reduces number of steps / increases atom economy OR could be cheaper OR could be faster OR reduces energy requirements OR can be carried out at low temperature OR can be reused ✓ | 1 | |

| Question | | Answer | Mark | Guidance |
|----------|---|---|------|--|
| 1 | c | <p>ANY 5 POINTS FROM THE FOLLOWING 6:</p> <p>1. enzymes (are proteins / polypeptides) with a specific / AW order / sequence of amino acids ✓</p> <p>2. if the DNA is damaged the primary structure of the protein / order of the amino acids in the enzyme will be altered / changed ✓</p> <p>3. so the tertiary structure/folding of chains of the enzyme will also alter / change ✓</p> <p>4. the active site (is part of the tertiary structure and) is where the reaction with the substrate takes place <i>AW</i> ✓</p> <p>5. an altered active site will not have the correct shape ✓</p> <p>6. and (interact with the substrate) by forming the correct / AW intermolecular bonds / forces ✓</p> <p>AWARD QWC MARK FOR altered/different active site linked to less/no reaction / enzyme does not work <i>AW</i> ✓</p> | 6 | <p>PLEASE ANNOTATE MARKS GIVEN WITH ✓ PUT ✓ for QWC next to 'pencil' icon</p> <p>1. enzymes have a sequence of amino acids</p> <p>2. damage to DNA leads to different amino acids / primary structure</p> <p>3. resulting in different tertiary structure</p> <p>4. reaction takes place / substrate fits in at active site</p> <p>5. active site shape alters</p> <p>6. substrate can not bind/interact with active site OR can not form substrate-complex ALLOW by binding/bonding differently</p> |
| | | | 21 | |

| Question | | | Answer | Mark | Guidance |
|----------|---|-----|--|------|---|
| 2 | a | i | <p>T_g of PMMA is above RT so will be brittle / not enough energy to break intermolecular bonds / chains can not move over each other ✓</p> <p>T_g of PMA is below RT so will be flexible/ rubbery / enough energy to break intermolecular bonds / chains can move over each other ✓</p> | 2 | IGNORE any reference to crystallinity |
| | | ii | chains in PMMA cannot move/slide over each other (easily) ORA ✓ | 1 | ORA Chains in PMA can move over each other (easily) ✓ |
| | | iii | add a plasticiser / copolymerisation / add a copolymer ✓ | 1 | DO NOT ALLOW cold-drawing |
| | b | i | <p>intermolecular bonds in propene are instantaneous (dipole) – induced dipole ✓</p> <p>intermolecular bonds in propanone are permanent (dipole) – permanent dipole ✓</p> <p>more energy/higher temperature for propanone required ✓</p> <p>because intermolecular bonds in propanone are stronger ORA ✓</p> | 4 | <p>DO NOT ALLOW id-id bonds</p> <p>ALLOW pd-pd bonds if an abbreviation is used for a second time</p> <p>ALLOW 1 mark if answer in terms of increased instantaneous – dipole induced dipole bonds (max mark is then 2)</p> |
| | | ii | hydrogen cyanide / cyanide ion ✓ | 1 | <p>ALLOW HCN / CN⁻</p> <p>ALLOW potassium cyanide / sodium cyanide OR KCN / NaCN</p> <p>IGNORE acid or alkali</p> |

| Question | | | Answer | Mark | Guidance |
|----------|---|-----|---|------|--|
| 2 | b | iii |  <p>curly arrows correct on propanone ✓ partial charges correct on C=O ✓ correct anion formed ✓ correct reaction with H₂O or H⁺ or HCN ✓</p> | 4 | ALLOW mechanism if HCN is shown attacking but arrow must come from H-CN bond Curly arrow from nucleophile MUST come from carbon in either CN ion or HCN ALLOW CN ⁻ for ion if arrow correct |
| | | iv | (cyanide ion is a nucleophile and) the lone pair/electrons (which attack the electron deficient carbon) are on C (not N) ✓ OR nucleophile is :CN ⁻ ✓ | 1 | ALLOW the negative charge is on C IGNORE any reference to triple bond in CN |
| | | v | few atoms wasted/high atom economy ✓ | 1 | ALLOW 100% / no waste |
| | c | i | (moderately) concentrated acid ✓ (heat under) reflux ✓ | 2 | ALLOW aqueous / dilute acid / H ⁺ and water DO NOT ALLOW conc. sulphuric acid or any form of alkali |
| | | ii | amide ✓ | 1 | IGNORE any qualification of amide i.e primary etc. IGNORE any given formulae DO NOT ALLOW peptide |
| | | iii | only F ✓ there are (2) different groups on each C (of the double bond) ✓ | 2 | marks are independent DO NOT ALLOW ...on each side of C=C |
| | | | | 20 | |

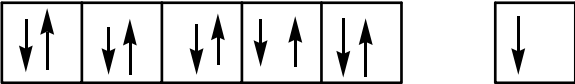
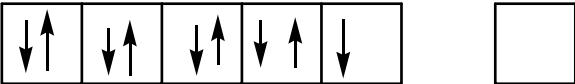
| Question | | Answer | Mark | Guidance |
|----------|---|---|------|--|
| 3 | a | <p>Tyrosine: <u>phenol</u> ✓ Threonine: <u>alcohol</u> ✓ add (neutral) FeCl₃ / iron(III) chloride ✓ Tyrosine: turns purple/violet AND Threonine remains yellow /does not change colour ✓</p> | 4 | <p>ALLOW orange BUT NOT brown alone for colour of FeCl₃</p> <p>ALLOW acidified dichromate ✓ – Threonine goes green AND Tyrosine remains orange / does not change colour ✓</p> |
| | b |  <p>Tyrosine: correct: 1 chiral centre ✓ Threonine correct: 2 chiral centres ✓</p> | 2 | |
| | c |  <p>1 mark for correct repeating unit ✓ ester ✓</p> | 2 | <p>IGNORE brackets and <i>n</i></p> <p>full structural / skeletal formula not required</p> <p>ALLOW multiple repeating units showing correct ester linkage</p> |

| Question | | | Answer | Mark | Guidance |
|----------|---|----|--|------|---|
| 3 | d | i | <p>with HCl</p>  <p>1 mark for -NH₃⁺ group correct ✓ 1 mark for rest of ion correct ✓</p> <p>with CH₃COCl</p>  <p>1 mark for each acyl group ✓✓ 1 mark for HCl (IGNORE number of HCl) ✓</p> | 5 | <p>ALLOW correct (full) structures but H's must be shown ALLOW -NH₃⁺ve ion without Cl⁻</p>  |
| | | ii | <p>phenols / phenol group / -OH group on tyramine will form ion / react with alkalis ✓</p> <p>ionic substances / salts are (more) soluble in water OR ions interact / bond / with water (molecules) OR ions are attracted to water (molecules) ✓</p> | 2 | ALLOW forms salts |
| | | | | 15 | |

| Question | | | Answer | Mark | Guidance |
|----------|---|----|---|------|--|
| 4 | a | | water / H ₂ O ✓ | 1 | |
| | b | i | <p>1. (fill) burette with KMnO₄ / MnO₄⁻ solution ✓</p> <p>2. use bulb / volumetric / graduated / 25 cm³ / 10 cm³ pipette for sodium ethanedioate ✓</p> <p>3. to place solution in flask / beaker and then acidify (and warm flask) ✓</p> <p>4. then add KMnO₄ / MnO₄⁻ solution slowly (AW) near end point ✓</p> <p>5. until permanent pink colour AW ✓</p> | 5 | <p>PLEASE ANNOTATE MARKS GIVEN WITH ✓</p> <p>QWC: Either burette or pipette must be spelled correctly to get both marks for 1 and 2;</p> <p>2. pipette must be qualified by type as shown OR by saying 'pipette a known / <i>stated</i> (e.g. 25 cm³) volume'</p> <p>for 1-4 ALLOW different ways of describing each solution, either by an appropriate name or formula</p> <p>3. If acid is named ONLY ALLOW sulfuric acid</p> <p>4. ALLOW alternatives – e.g. <i>swirling and use of white tile</i></p> <p>5. ALLOW pink colour persists / remains /is constant ALLOW 'pale pink/purple' BUT NOT 'purple' alone DO NOT ALLOW if indicator is used</p> <p>IF SOLUTIONS REVERSED 1 AND 2 score 1 mark only 5. becomes... permanent AW <u>colourless</u> solution So max mark = 4</p> <p>IGNORE any reference to rough titrations</p> |
| 4 | b | ii | <p>moles of sodium ethanedioate = 0.0500 x 250/1000 (= 0.0125) ✓</p> <p>mass = ((moles of ethanedioate) x 134) correctly evaluated (1.675(0) g) ✓</p> | 2 | <p>the marks are awarded for the working out given in bold</p> <p>ALLOW 2 - 5 sig. figs. ecf for moles in mass calculation</p> |

| Question | | | Answer | Mark | Guidance |
|----------|---|-----|---|------|---|
| | | iii | <p>1. moles of $\text{C}_2\text{O}_4^{2-} = \mathbf{0.0500 \times 10/1000}$ (= 0.000500) ✓</p> <p>2. moles of $\text{MnO}_4^- = \mathbf{2/5 \times 0.0500 \times 10.0/1000}$ (= 0.000200) ✓</p> <p>3. concentration = $2/5 \times 0.0500 \times 10/1000 \times \mathbf{1000/26.0}$ ✓</p> <p>4. = $\mathbf{0.00769 / 7.69 \times 10^{-3}}$ 3 significant figures ✓</p> | 4 | <p>the marks are awarded for the working out given in bold</p> <p>IF FINAL ANSWER IS INCORRECT PLEASE ANNOTATE MARKS GIVEN WITH ✓</p> <p>1. moles of $\text{C}_2\text{O}_4^{2-} =$ correct concentration x correct volume in dm^3</p> <p>2. moles of $\text{MnO}_4^- = 2/5 \times$ moles of $\text{C}_2\text{O}_4^{2-}$</p> <p>3. concentration = moles of $\text{MnO}_4^- \times 1000/26.0$</p> <p>4. must be to 3 significant figures</p> <p>ecf from 2 and 3</p> |
| 4 | c | i | <p>1. transition metal ion / Cu^{2+} reacts with one of reactants (to form a product) OR reacts to form an intermediate (compound) ✓</p> <p>2. oxidation state of the transition metal ion / Cu^{2+} changes OR metal ion can be oxidised or reduced OR metal ion can lose or gain electrons ✓</p> <p>3. new ion / intermediate then reacts to reform the original transition metal ion / Cu^{2+} <i>AW</i> OR form original oxidation state at end of reaction <i>AW</i> ✓</p> <p>4. activation enthalpy / energy for this reaction is lower than without the transition metal ion / Cu^{2+} ✓</p> | 4 | <p>PLEASE ANNOTATE MARKS GIVEN WITH ✓</p> <p>IGNORE any name / formulae given to the intermediate</p> <p>ALLOW transition metal ions have variable oxidation states</p> |
| | | ii | Homogeneous ✓ | 1 | |

| Question | | Answer | Mark | Guidance |
|----------|---|--------|------|---|
| | d | i | | |
| | | | 1 | |
| | | ii | | |
| | | | 3 | |
| | | iii | | |
| | | | 3 | ALLOW 2+ sig figs IGNORE time ⁻¹ |
| | | | 24 | |

| Question | | | Answer | Mark | Guidance |
|----------|---|----|--|------|---|
| 5 | a | i | <p style="text-align: center;">3d 4s</p> <p>Cu </p> <p>Cu²⁺ </p> <p>1 mark each ✓✓</p> | 2 | ALLOW single arrow in either direction |
| | | ii | Cu forms an <u>ion</u> with an incompletely/partly filled set of <u>d</u> orbitals / (sub) shells / energy levels ✓ | 1 | |
| | b | i | <p>the E^\ominus of oxygen/OH⁻ is more positive/less negative than that for Cu²⁺/Cu ORA ✓</p> <p><u>O₂/oxygen</u> will oxidise Cu / gain electrons from Cu (forming Cu²⁺) ✓</p> | 2 | <p>ORA The E^\ominus of Cu²⁺/Cu is less positive/more negative than oxygen/OH⁻</p> <p>DO NOT ALLOW more/less electronegative/electropositive</p> <p>DO NOT ALLOW higher/lower</p> <p>ORA</p> |
| | | ii | the E^\ominus of Fe ²⁺ /Fe is more negative/less positive than that for Cu ²⁺ /Cu so Fe reacts/corrodes instead of Cu AW ✓ | 1 | |
| | c | | <p>$\text{Fe}^{3+}(\text{aq}) + 3\text{OH}^{-}(\text{aq}) \rightarrow \text{Fe}(\text{OH})_3(\text{s})$</p> <p>equation correct ✓</p> <p>state symbols correct ✓</p> | 2 | EQUATION MUST BE BALANCED |

| Question | | Answer | Mark | Guidance |
|----------|---|---|-----------|----------|
| 5 | d | <p>EITHER barrier protection:</p> <p>Paint / grease / plastic coating / galvanising ✓ prevents copper reacting/corroding with oxygen/air AND water ✓</p> <p>OR sacrificial protection:</p> <p>coat with/strap on blocks of Mg or Zn / galvanise ✓ the more reactive Mg or Zn corrodes/reacts instead of Cu ✓</p> | | |
| | | | 10 | |

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