Department of Chemistry

Exam Questions for CfE Higher Chemistry

**MARK SCHEME**

Unit 2 Nature’s Chemistry



**2.1 Esters, Fats and Oils**

|  |  |  |
| --- | --- | --- |
| Question | Source | Answer |
| 1 | 2007 | D |
| 2 | 2013 | B |
| 3 | 2013 | A |
| 4 | 2010 | A |
| 5 | 2012 | B |
| 6 | 2012 | B |
| 7 | 2009 | A |
| 8 | 2009 | C |
| 9 | 2013 | C |
| 10 | 2010 | C |
| 11 | 2010 | D |

|  |  |  |
| --- | --- | --- |
| Q | Source | Correct |
| 12 | 2007 Q8 | **(a)** Ethanoic (acetic) acid **1**  **(b) (i)** Concentrated sulphuric acid (accept H2 SO4 with correct state symbol) **1**  **(ii)** answer to indicate use of condenser, eg paper towel soaked in cold water wrapped around (mouth of) test tube  **or** cold finger inserted inside test tube  **or** similar or use of cotton wool plug **1** |
| 13 | 2009 Q3 | **(a)** Any mention of separate layer or any mention of (ester) smell **1**  **(b)**  (accept equivalent full or shortened structural formula) **1** |
| 14 | 2011 Q4 | ½ mark for safe heating method (no flame)/water bath  ½ mark for condenser of some type  ½ mark for methanol and stearic acid or “reactants”  ½ mark for (concentrated) sulphuric acid in test tube  ½ mark for pouring the mixture into a carbonate solution or solid carbonate added after esterification **2**  (correctly labelled diagram acceptable) |
| 15 | 2007 Q14 | To increase melting point or to harden the spread or to turn an oil into a spreadable margarine or to prolong shelf-life **1** |
| 16 | 2008 Q2 | **(a)** esters **1**  **(b)** they react with hydrogen (or are hydrogenated)  **Or** they become (more) saturated (or less unsaturated)  **Or** they have fewer double bonds (or more single bonds)  **Or** the double bonds are broken **1**  **(c)** as an energy source (or more concentrated energy source than carbohydrates)  **or** provide essential fatty acids  **or** carry oil soluble vitamins  **or** good for health with reason given, eg lowers cholesterol **1** |
| 17 | 2011 Q9 | **(a)** Palm oil has lower degree of unsaturated/palm oil less unsaturated/palm oil more saturated/palm oil contains more saturates/fewer double bounds  **OR** Molecules in palm oil can pack more closely together **1**  “It” is taken to refer to Palm oil if ambiguous  **(b)** Polyunsaturated **1**  **(c)** Soap/emulsifying agent/detergent/washing/cleaning **1** |

**2.2 Proteins**

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| --- | --- | --- |
| Question | Source | Answer |
| 1 | 2013 | A |
| 2 | 2011 | C |
| 3 | 2007 | C |
| 4 | 2010 | D |
| 5 | 2012 | B |
| 6 | 2011 | B |
| 7 | 2008 | B |
| 8 | 2012 | C |
| 9 | 2007 | B |
| 10 | 2013 | D |
| 11 | 2008 | C |

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| --- | --- | --- |
| Q | Source | **Correct** |
| 12 | 2009 Q5 | **(a) (i)** amino acids **1**  **(ii)** breaking up (bonds in) a molecule by the addition of (the elements from) water  **1**  **(b)** ester **1** |
| 13 | Spec Q8 | **(a)** denaturing / denature / denatured **1**  **(b)** To prevent the temperature rising too high  **or** gentle method of heating or to prevent the protein structure changing  **or** to prevent denaturing of protein  **or** to prevent separation of protein and fat or mention of flammability **1**  **(c)** Correct drawing of any one of the three amino acids showing –NH2 and –COOH groups completed **1**  **(d) 1** |
| 14 | 2007 Q9 | **(a) (i)** One we need to get in the food we eat (from our diet)  **or** one that the body cannot manufacture (make) **1**  **(ii)** 11 **1**  **(b)** Peptide link correctly identified **1**  **(c)**    (Accept full or shortened structural formula) **1** |

**2.3 The Chemistry of Cooking**

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| Question | Source | Answer |
| 1 | 2012 | A |
| 2 | 2013 | C |

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| --- | --- | --- |
| Q | Source | Correct |
| 3 | 2013 Q12 | This is an open ended question  **1 mark:** The student has demonstrated a limited understanding of the chemistry involved. The candidate has made some statement(s) which is/are relevant to the situation, showing that at least a little of the chemistry within the problem is understood.  **2 marks:** The student has demonstrated a reasonable understanding of the chemistry involved. The student makes some statement(s) which is/are relevant to the situation, showing that the problem is understood.  **3 marks:** The maximum available mark would be awarded to a student who has demonstrated a good understanding of the chemistry involved. The student shows a good comprehension of the chemistry of the situation and has provided a logically correct answer to the question posed. This type of response might include a statement of the principles involved, a relationship or an equation, and the application of these to respond to the problem. This does not mean the answer has to be what might be termed an ‘excellent’ answer or a ‘complete’ one. |

**2.4 The Oxidation of Food**

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| Question | Source | Answer |
| 1 | Spec | B |
| 2 | 2007 | C |
| 3 | 2007 | C |
| 4 | 2009 | C |
| 5 | 2007 | A |
| 6 | 2007 | B |
| 7 | 2012 | B |
| 8 | 2013 | B |
| 9 | 2011 | B |
| 10 | 2012 | D |
| 11 | 2010 | B |
| 12 | 2009 | B |
| 13 | 2013 | C |
| 14 | 2011 | C |

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| --- | --- | --- |
| Q | Source | Correct |
| 15 | Spec Q3 | **(a)** glycerol or propane-1,2,3-triol or propan-1,2,3-triol or glycerine **1**  **(b)** fat molecules have fewer/no double bonds/more saturated  **OR** oil molecules have more double bonds/unsaturated (or similar) **1**  **(c)** oxygen or O2 **1** |
| 16 | 2008 Q11 | alcohols do not contain OH- (hydroxide) ions (or the OH in alcohols is not ionic)  **or** alkalis contain OH- (hydroxide) ions (or the OH is an ion in alkalis) **1** |
| 17 | 2007 Q2 | **(a)** Reforming **1**  **(b) 1** |
| 18 | 2009 Q3 | **(a)** ratio of oxygen:hydrogen atoms increased (or ratio of hydrogen:oxygen atoms decreased)  **or** removal of hydrogen **1**  **(b)** orange to green (or blue/green) **1** |
| 19 | 2007 Q13 | **(a)** Hydrogenation or addition **1**  **(b)** CH3 – CH2 – CH2 – CH2 – NH2  (Accept full or shortened structural formula) **1** |
| 20 | 2008 Q4 | **(a)** synthesis gas (syn gas) **1**  **(b)**    **or** CH3CH(CH3)CHO **1**  **(c) (i)** any mention of silver being formed (deposited), eg silver mirror **1**  **(ii**) in a water bath or no naked flames or use water heated in a kettle **1**  **(d)** primary **1** |
| 21 | 2008 Q16 | **(a)** **1**    **(b)** methanal or 2, 2-demethylpropanal or formaldehyde **1**  **(c)** water is not a product of the reaction  **Or** no small molecule produced  **Or** it is an addition reaction **1** |
| 22 | 2009 Q9 | **(a)**    **Or** Primary: hydroxyl group attached to C attached to two H atoms (or hydroxyl group attached to C attached to one C atom)  Secondary: hydroxyl group attached to C attached to one H atom (or hydroxyl group attached to C attached to two C atoms)  Tertiary: hydroxyl group attached to C attached to no H atoms (or hydroxyl group attached to C attached to three C atoms)  **or** correct answer in terms of oxidation **1**  **(b)** addition **1**  **(c)** pentan-3-one **1** |
| 23 | 2011 Q6 | **(a)**    correct full/shortened/partially shortened structural formula **1**  **(b)** triethanol amine has hydrogen bonds (½) (between the molecules)  triisopropyl amine molecules has van der Waals/or permanent dipole/permanent dipole attractions or doesn‟t have H-bonds (½)  H-bonds strong(er) (than the dipole/dipole) (½)  more energy/higher temp required (to overcome/break intermolecular forces) (½)  **2** |
| 24 | 2013 Q4 | **(a) (i)** Tollen’s or acidified dichromate or Fehling’s or Benedict’s (please note – although Benedict’s reagent would not work in practice, because it appears in Higher textbooks, revision guides and the PPA materials for the traditional Higher, it can be accepted) **1**  **(ii)** Carboxylic acid **1**  **(b) (i)** It keeps oil & water soluble materials mixed  Or Allow immiscible substances to mix  Or To allow fat and water to mix  Or To form a suspension **1**  **(ii)**    Any structural formula for glycerol **1**  **(c)** 6·7 (mg) – units not required **2**  A single mark is available if either of the following manipulations is correctly executed.  Correct use of percentage eg mass of chocolate = 28 × 17 /100g = 4·76 g  Correct use of proportion theobromine  eg mass of theobromine = 1·4 × a mass |
| 25 | 2013 Q11 | **(a) (i)**(anaerobic) fermentation or Anaerobic respiration **1**  **(ii)** 10·1 to 10·3 (% abv) **1**  **(b) (i)** 114 or 113·75 **1**  **(ii)** £3·30 **2**  (do not penalise for rounding at intermediate stages)  One mark is available if the candidate has either  Carried out a calculation to take into account the dilution of the whisky  e.g. used a scaling factor of 46/65  **or** Has correctly calculated the cost for a given volume of alcohol by use of the  e.g. used the scaling factor of 1300/195 |

**2.5 Soaps, Detergents and Emulsions**

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| Question | Source | Answer |
| 1 | 2013 | C |

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| Q | Source | **Correct** |
| 2 | 2012 Q14 | **(a)** Octadec-9,12,15-trienoic acid  Octadeca-9,12,15-trienoic acid  (allow the interchange of hyphens and commas) **1**  **(b) (i)** neutralization **1**  **(ii)** any mention that soaps have both hydrophobic/oil-soluble and hydrophilic/water-soluble parts (or alternative wording showing knowledge of these parts of the soap)  Correct identification of the parts of this soap which dissolve in water and oil, COO-/COONa/ O-Na+ and the hydrophobic part of the molecule, the hydrocarbon chain  Describe how this results in a ‘ball-like’ structure/globule (with the oil/grease held inside the ball) or micelle or mention of an emulsion.**3** |
| 3 | Spec Q5 | **(a)** Mention of OH groups being hydrophilic/soluble in water/ polar liquids **1**  mention of hydrocarbon chain being hydrophobic/insoluble in water/soluble in non-polarliquids/soluble in oil **1**  **(b)** 2·5 **1** |

**2.6 Fragrances**

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| --- | --- | --- |
| Question | Source | Answer |
| 1 | 2012 | A |
| 2 | 2013 | B |
| 3 | Spec | A |

|  |  |  |
| --- | --- | --- |
| Q | Source | **Correct** |
| 4 | 2012 Q4 | **(a)** (Geraniol has) hydrogen bonding (between its molecules)  **Or** there are stronger intermolecular bonds (in geraniol)  **Or** stronger van der Waals’ (in geraniol)  **Or** limonene only has London dispersion forces **1**  **(b)**  **(i)** aldehydes or alkanals **1**  **(ii)**    (Accept full or shortened structural formula) **1**  **(c)** This is an open ended question  **1 mark:** The student has demonstrated a limited understanding of the chemistry involved. The candidate has made some statement(s) which is/are relevant to the situation, showing that at least a little of the chemistry within the problem is understood.  **2 marks:** The student has demonstrated a reasonable understanding of the chemistry involved. The student makes some statement(s) which is/are relevant to the situation, showing that the problem is understood.  **3 marks:** The maximum available mark would be awarded to a student who has demonstrated a good understanding of the chemistry involved. The student shows a good comprehension of the chemistry of the situation and has provided a logically correct answer to the question posed. This type of response might include a statement of the principles involved, a relationship or an equation, and the application of these to respond to the problem. This does not mean the answer has to be what might be termed an “excellent” answer or a “complete” one. |
| 5 | Spec Q4 | **(a) (i)** butyl propanoate **1**  **(ii)** B > A > C **1**  **(b)**    **1**  **(c)** Any set of atoms consisting of 5 carbon atoms, four connected in a line with one branching from carbon 2 of this chain **1** |

**2.7 Skin Care**

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| --- | --- | --- |
| Q | Source | **Correct** |
| 1 | 2012 Q13 | **(a)** Initiation **1**  **(b)** •CH3 + •CH3 🡪 CH3CH3  **Or** F• + F• 🡪 F2 **1** |
| 2 | 2013 Q2 | It can react with radicals to form stable molecules  **Or** It can terminate radical (reactions)  **Or** It reacts with radicals to stop further radical reactions  **Or** It mops-up (free) radicals  **Or** It has an unpaired/free electron **1** |
| 3 | Spec Q2 | **(a)** H-Cl + H• **1 (both required)**  and H2 **1**  **(ii)** to prevent light/UV shining on sample **1**  **Or** To prevent initiation **1**  **Or** To prevent radicals from forming **1**  **Or** To prevent shattering **1**  **Or** To prevent premature explosion **1** |

**General Questions**

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| --- | --- | --- |
| Question | Source | Answer |
| 1 | 2007 | D |
| 2 | 2008 | D |
| 3 | 2008 | B |
| 4 | 2008 | A |
| 5 | 2010 | C |
| 6 | 2011 | A |
| 7 | 2011 | C |
| 8 | 2009 | A |
| 9 | 2009 | B |
| 10 | 2012 | A |
| 11 | 2013 | C |
| 12 | 2013 | D |
| 13 | 2011 | A |

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| --- | --- | --- |
| Q | Source | **Correct** |
| 14 | 2007 Q12 | **(a)** Structural formula (full or shortened) for 1,1-dichloroethane **1**  **(b)** Reagent A hydrogen, Reagent B chlorine, Reagent C hydrogen chloride or hydrochloric acid (Accept formulae) **1** |
| 15 | 2008 Q6 | **(a)(i)benze**ne does not (rapidly) decolourise bromine (solution or water)**1**  **(ii)**mention of delocalised electrons (in ring of C atoms)  **Or** C to C bonds are all of equal length  **Or** planar molecule  **or** bond angles of 120º  (any 2 points; ½ mark each) **1**  **(b)**reforming (or reformation) **Or** dehydrogenation**1** |
| 16 | 2010 Q15 | **(a)** x is O-H (½) y is C-H (½) **1**  **(b) (i)** condensation or esterification **1**  **(ii)** 2 peaks only: at 1705-1800 (½) and 2800-3000 (½)  (deduct ½ mark for each additional incorrect peak) **1** |
| 17 | 2011 Q7 | **(a)** C8H9NO2 (any order) **1**  **(b)** amino acids **1**  **(c)** 0·0225 or 0·022 or 0·023 (can be rounded to 0·02 if working shown) **1** |
| 18 | 2012 Q8 | **(a)** CH3CH2CH2CH2CH2CH2OH  Or hexan-1-ol or hexanol  Also accept structural formulae or names for hexan-2-ol or hexan-3-ol **1**  **(b)** The further away from the end of the chain the O atom is, the lower the flash point or similar **1** |
| 19 | 2012 Q15 | This is an open ended question  **1 mark:** The student has demonstrated a limited understanding of the chemistry involved. The candidate has made some statement(s) which is/are relevant to the situation, showing that at least a little of the chemistry within the problem is understood.  2 marks: The student has demonstrated a reasonable understanding of the chemistry involved. The student makes some statement(s) which is/are relevant to the situation showing that the problem is understood.  **3 marks:** The maximum available mark would be awarded to a student who has demonstrated a good understanding of the chemistry involved. The student shows a good comprehension of the chemistry of the situation and has provided a logically correct answer to the question posed. This type of response might include a statement of the principles involved, a relationship or an equation, and the application of these to respond to the problem. This does not mean the answer has to be what might be termed an ‘excellent’ answer or a ‘complete’ one. |
| 20 | 2013 Q6 | **(a) (i)** Carboxyl (group)  Or Carboxylic (acid) **1**  (**ii) 1**    **(iii)**    or shortened formula.  Charges not required but if shown, both +ve and –ve charges must be correct **1**  **(b)** 25 (minutes)  **Or** 8.0 to 8.4 (minutes) (units not required. Ignore incorrect units) **1**  **(c)** Volume = 31·5 cm3 or 31·5 ml or 0·0315 l or equivalent **3**  One mark is allocated to the correct statement of units of volume.  This is the mark in the paper earmarked to reward a candidate’s knowledge of chemical units. So volume = 31·5 or 0·0315 (2)  One mark is available if either of the following steps is correct  Calculation of mass of lidocaine eg 4·5 × 70 = 315 (mg)  Calculation of a volume of solution required eg a mass × 1/10 = a volume |
| 21 | 2012 Q9 | **(a)** ester link or carboxylate or ester **1**  **(b)** Correctly drawn amino acid structure **1**    **(c)** Essential **1** |
| 22 | 2013 Q13 | **(a)**    or equivalent 1,3-dimethylcyclohexane structure with both methyl groups in axial positions **1**  **(b) (i)** The bigger the group the greater the strain  **Or** The larger the (halogen) atom the greater the strain  **Or** The more atoms in a group, the greater the strain  **Or** Any other statement which is consistent with the values presented **1**  **(ii)** 7·6 (kJ mol–1) (Units not required, ignore incorrect units) **1** |