Lisachem Materials

Chemistry Physics Biology
Psychology

VCE CHEMISTRY 2005
FOOD CHEMISTRY
TEST UNIT 4

Time allowed: 50 minutes

Total marks: 40

SECTION A
Contains 12 multiple choice questions

SECTION B
4 Extended response questions

A data sheet and multiple choice answer sheet are provided. Answer extended response questions in the space provided. Use the marks and time allowed as a guide to how much time you should spend answering each question.

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PERIODIC TABLE

relative atomic number
symbol
name
relative atomic mass

																	2 He Helium 4.0
3 Li Lithium 6.9	4 Be Beryllium 9.0											5 B Boron 10.8	6 C Carbon 12.0	7 N Nitrogen 14.0	8 O Oxygen 16.0	9 F Fluorine 19.0	10 Ne Neon 20.2
11 Na Sodium 23.0	12 Mg Magnesium 24.3											13 Al Aluminium 27.0	14 Si Silicon 28.1	15 P Phosphorus 31.0	16 S Sulfur 32.1	17 Cl Chlorine 35.5	18 Ar Argon 39.9
19 K Potassium 39.1	20 Ca Calcium 40.1	21 Sc Scandium 44.9	22 Ti Titanium 47.9	23 V Vanadium 50.9	24 Cr Chromium 52.0	25 Mn Manganese 54.9	26 Fe Iron 55.9	27 Co Cobalt 58.9	28 Ni Nickel 58.7	29 Cu Copper 63.6	30 Zn Zinc 65.4	31 Ga Gallium 69.7	32 Ge Germanium 72.6	33 As Arsenic 74.9	34 Se Selenium 79.0	35 Br Bromine 79.9	36 Kr Krypton 83.8
37 Rb Rubidium 85.5	38 Sr Strontium 87.6	39 Y Yittrium 88.9	40 Zr Zirconium 91.2	41 Nb Niobium 92.9	42 Mo Molybdenum 95.9	43 Tc Technetium 98.1	44 Ru Ruthenium 101.1	45 Rh Rhodium 102.9	46 Pd Palladium 106.4	47 Ag Silver 107.9	48 Cd Cadmium 112.4	49 In Indium 114.8	50 Sn Tin 118.7	51 Sb Antimony 121.8	52 Te Tellurium 127.6	53 I Iodine 126.9	54 Xe Xenon 131.3
55 Cs Caesium 132.9	56 Ba Barium 137.3	57 La Lanthanum 138.9	72 Hf Hafnium 178.5	73 Ta Tantalum 180.9	74 W Tungsten 183.8	75 Re Rhenium 186.2	76 Os Osmium 190.2	77 Ir Iridium 192.2	78 Pt Platinum 195.1	79 Au Gold 197.0	80 Hg Mercury 200.6	81 Tl Thallium 204.4	82 Pb Lead 207.2	83 Bi Bismuth 209.0	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)
87 Fr Francium (223)	88 Ra Radium (226)	89 Ac Actinium (227)	104 Rf Rutherfordium (261)	105 Ha Hahnium (262)	106 Sg Seaborgium (266)	107 Ns Neilsbohrium (264)	108 Hs Hassium (269)	109 Mt Meitnerium (268)	110 Uun Ununnilium (272)	111 Uuu Unununium (272)	112 Uub Ununbium (277)		114 Uuq Ununquadium (289)				

Lanthanide series	58 Ce Cerium 140.1	59 Pr Praseodymium 140.9	60 Nd Neodymium 144.2	61 Pm Promethium (145)	62 Sm Samarium 150.3	63 Eu Europium 152.0	64 Gd Gadolinium 157.2	65 Tb Terbium 158.9	66 Dy Dysprosium 162.5	67 Ho Holmium 164.9	68 Er Erbium 167.3	69 Tm Thulium 168.9	70 Yb Ytterbium 173.0	71 Lu Lutetium 175.0
Actinide series	90 Th Thorium 232.0	91 Pa Protactinium 231.0	92 U Uranium 238.0	93 Np Neptunium 237.1	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (254)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (255)	103 Lr Lawrencium (256)

DATA SHEET

Physical Constants

F	= 96 500 C mol^{-1}
R	= 8.31 JK^{-1} mol^{-1}
V_m (STP)	= 22.4 L mol^{-1}
V_m (SLC)	= 24.5 L mol^{-1}

Ideal gas equation

$pV = nRT$

The Electrochemical Series

		$E°$ in volt
$F_2(g) + 2e^-$	$\rightarrow 2F^-(aq)$	+ 2.87
$H_2O_2(aq) + 2H^+(aq) + 2e^-$	$\rightarrow 2H_2O(l)$	+ 1.77
$Au^+(aq) + e^-$	$\rightarrow Au(s)$	+ 1.68
$MnO_4^-(aq) + 8H^+(aq) + 5e^-$	$\rightarrow Mn^{2+}(aq) + 4H_2O(l)$	+ 1.50
$Cl_2(g) + 2e^-$	$\rightarrow 2Cl^-(aq)$	+ 1.36
$O_2(g) + 4H^+(aq) + 4e^-$	$\rightarrow 2H_2O(l)$	+ 1.23
$Br_2(l) + 2e^-$	$\rightarrow 2Br^-(aq)$	+.1.09
$Ag^+(aq) + e^-$	$\rightarrow Ag(s)$	+ 0.80
$Fe^{3+}(aq) + e^-$	$\rightarrow Fe^{2+}(aq)$	+ 0.77
$I_2(s) + 2e^-$	$\rightarrow 2I^-(aq)$	+ 0.54
$O_2(g) + 2H_2O(l) + 4e^-$	$\rightarrow 4OH^-(aq)$	+ 0.40
$Cu^{2+}(aq) + 2e^-$	$\rightarrow Cu(s)$	+ 0.34
$CO_2(g) + 8H^+(aq) + 8e^-$	$\rightarrow CH_4(g) + 2H_2O(l)$	+ 0.17
$S(s) + 2H^+(aq) + 2e^-$	$\rightarrow H_2S(g)$	+ 0.14
$2H^+(aq) + 2e^-$	$\rightarrow H_2(g)$	0.00
$Pb^{2+}(aq) + 2e^-$	$\rightarrow Pb(s)$	- 0.13
$Sn^{2+}(aq) + 2e^-$	$\rightarrow Sn(s)$	- 0.14
$Ni^{2+}(aq) + 2e^-$	$\rightarrow Ni(s)$	- 0.23
$Co^{2+}(aq) + 2e^-$	$\rightarrow Co(s)$	- 0.28
$Fe^{2+}(aq) + 2e^-$	$\rightarrow Fe(s)$	- 0.44
$Zn^{2+}(aq) + 2e^-$	$\rightarrow Zn(s)$	- 0.76
$2H_2O(l) + 2e^-$	$\rightarrow H_2(g) + 2OH^-(aq)$	- 0.83
$Mn^{2+}(aq) + 2e^-$	$\rightarrow Mn(s)$	- 1.03
$Al^{3+}(aq) + 3e^-$	$\rightarrow Al(s)$	- 1.67
$Mg^{2+}(aq) + 2e^-$	$\rightarrow Mg(s)$	- 2.34
$Na^+(aq) + e^-$	$\rightarrow Na(s)$	- 2.71
$Ca^{2+}(aq) + 2e^-$	$\rightarrow Ca(s)$	- 2.87
$K^+(aq) + e^-$	$\rightarrow K(s)$	- 2.93
$Li^+(aq) + e$	$\rightarrow Li(s)$	- 3.02

Student Name…….

VCE Chemistry 2005 Food Test Unit 4

SECTION A

MULTIPLE CHOICE ANSWER SHEET

Instructions:

For each question choose the response that is correct or best answers the question.
Circle the chosen response on this answer sheet.
Only circle **one** response for each question.

Question 1.	A	B	C	D
Question 2.	A	B	C	D
Question 3.	A	B	C	D
Question 4.	A	B	C	D
Question 5.	A	B	C	D
Question 6.	A	B	C	D
Question 7.	A	B	C	D
Question 8.	A	B	C	D
Question 9.	A	B	C	D
Question 10.	A	B	C	D
Question 11.	A	B	C	D
Question 12.	A	B	C	D

VCE Chemistry 2005 Food Test Unit 4

SECTION A - [12 marks, 15 minutes]

This section contains 12 multiple choice questions.
For each question choose the response that is correct or best answers the question.
Indicate your answer on the answer sheet provided.
*(Choose only **one** answer for each question.)*

Question 1
What functional group undergoes hydrolysis during the digestion of carbohydrates?

A. Peptide.
B. Ester.
C. Amide.
D. Ether.

Question 2
What functional group or groups are formed as a result of the hydrolysis of a carbohydrate?

A. Carboxy and hydroxy groups.
B. Carboxy and amino groups.
C. Carboxy groups.
D. Hydroxy groups.

Question 3
Which of the following molecular formulae could represent a polyunsaturated fatty acid?

A. $C_{18}H_{32}O_2$.
B. $C_{18}H_{36}O_2$.
C. $C_{18}H_{34}O_2$.
D. $C_{18}H_{28}O_4$.

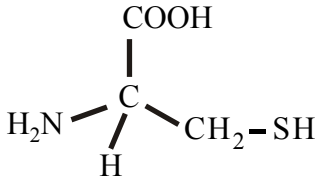
Question 4
Fats yield about 37 kJ g^{-1} compared with about 17 kJ g^{-1} for carbohydrates. Which one of the following best explains this observation?

A. Fats are larger molecules and have a higher molar mass.
B. Fats are less oxidised having a lower carbon:oxygen atom ratio than carbohydrates.
C. Carbohydrates are larger molecules and have higher molar masses.
D. Fats contain carbon-carbon double bonds that are more readily oxidised and this yields the higher energy.

Question 5
Which one of the following lists the molecules used by animals and plants to store carbohydrates?

	Animals	Plants
A.	Glycogen	Cellulose
B.	Starch	Glycogen
C.	Glycogen	Starch
D.	Glycogen	Cellulose and starch

Questions 6 and 7 refer to the following data.
The structure for the amino acid cysteine is shown below:



Question 6
When cysteine reacts with other amino acids to form a protein, condensation reactions will occur between

A. the $–NH_2$ and –SH groups.
B. the –SH and –COOH groups.
C. the $–NH_2$ and –COOH groups.
D. the $–NH_2$, -SH and –COOH groups.

Question 7
The sulfur atom on a cysteine unit in a protein could

A. lead to the formation of cross linkages with similar units in the protein and contribute to the tertiary structure of the protein.
B. contribute to the tertiary structure of the protein through electrostatic interactions with similar units in the protein.
C. contribute to the secondary structure of the protein as the result of hydrogen bonding.
D. lead to the formation of disulfide linkages with similar units in the protein and contribute to the primary structure of the protein.

Question 8
In the human body during digestion starch is

A. hydrolysed to form glucose by a single enzyme.
B. initially hydrolysed to form maltose that is then hydrolysed to form glucose.
C. initially hydrolysed to form sucrose that is then hydrolysed to form glucose.
D. initially hydrolysed to form sucrose that is then hydrolysed to form glucose and fructose.

Question 9
Which of the following processes would have the least direct effect on the level of carbon dioxide in the atmosphere?

A. Photosynthesis in plants.
B. The formation of limestone, $CaCO_3$.
C. The decay of animal and plant matter.
D. The dissolution of carbon dioxide in the oceans.

Question 10
A biochemist found that a certain enzyme became inactive when the temperature exceeded 65 ºC. This is most likely due to the protein becoming denatured as a result of

A. the hydrolysis of the protein at higher temperatures.
B. condensation reactions occurring producing a larger protein molecule.
C. protonation of -NH units in the structure at higher temperatures.
D. cross-linking between various parts of the protein molecule.

Question 11

Vitamin E is often added to margarine during its manufacture. Vitamin E is added because it

A. is a substance that will dissolve in lipids and can act as an antioxidant to prevent the margarine from becoming rancid during storage.
B. is a non-polar substance that can act as a surfactant to stabilise the water in oil emulsion.
C. is a surfactant that can stabilise the oil in water emulsion.
D. is a substance that can kill microbes and thereby act as a preservative to extend the shelf life of the product.

Question 12

Which one of the following nitrogen containing compounds would be **least** suitable for use as a crop fertilizer?

A. NH_4NO_3.
B. HNO_3.
C. $(NH_4)_2SO_4$.
D. H_2NCONH_2.

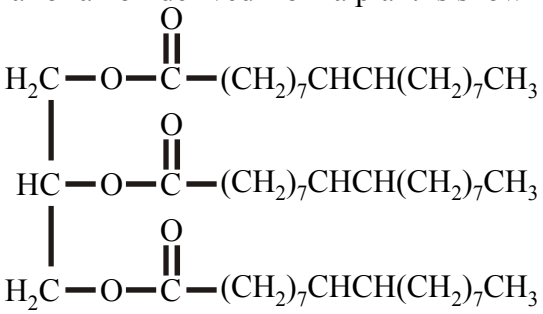
End of Section A

SECTION B - [28 marks, 35 minutes]

This section contains four questions, numbered 1 to 4.
All questions should be answered in the spaces provided.
The mark allocation and approximate time that should be spent on each question are given.

Question 1 - [9 marks, 11 minutes]

The semi-structural formula for an oil derived from a plant is shown below;



a. The addition of some bromine solution to a sample of this oil resulted in a decolouration of the bromine solution. Give an explanation for this observation.

1 mark

b. When this oil is digested in the human body what is the name of the functional group that undergoes reaction and what type of chemical reaction occurs in this process?

1 mark

c. What are the chemical formulae of the products that are formed as a result of the digestion of this oil?

1 mark

d. Write a chemical equation for the oxidation of the fatty acid that would be formed following the digestion of this oil?

2 marks

e. A 0.654 g sample of this fatty acid released 25.9 kJ of energy when it was burnt in a bomb calorimeter. Determine the ΔH for the oxidation reaction described in d. above.

3 marks

f. During digestion the body secretes bile into the digestive tract. What role does bile play in the digestion of an oil such as the one described?

1 mark

Question 2 - [7 marks, 10 minutes]

a. The following diagram shows some of the compounds that play a role in the nitrogen cycle.

$$N_2(g) \rightarrow NO(g) \rightarrow NO_2(g) \rightarrow NO_3^-(aq)$$

i. What is the main natural process that will convert nitrogen gas to nitrogen oxide?

1 mark

ii. Why would this process not provide sufficient fixed nitrogen in soils for the world's biological needs?

1 mark

b. i. What is another nitrogen containing species that can be produced from atmospheric nitrogen by a natural fixation process?

1 mark

ii. What is necessary to bring about this fixation process?

1 mark

c. What are two other methods that can add significant quantities of nitrogen containing compounds to the soil?

2 marks

d. How do plants use the nitrogen compounds that they obtain from the soil?

1 mark

Question 3 - [6 marks, 7 minutes]

Emulsifiers are a group of food additives that can be added to processed foods.

a. What are the requirements for a compound to act as an emulsifier?

1 mark

b. What are the two common types of emulsion that can be formed and how do they differ?

2 marks

c. Select one of the types of emulsions given in b. above and give two characteristics of this emulsion.

Emulsion type: _____

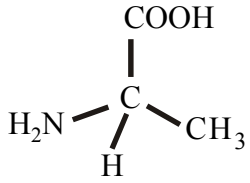
2 marks

d. How does the behaviour of the emulsifier differ between the two emulsion types?

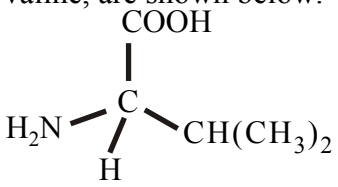
1 mark

Question 4 - [6 marks, 7 minutes]

The structures for the two amino acids, alanine and valine, are shown below.



alanine



valine

a. i. What is a zwitterion?

1 mark

ii. Draw the zwitterion structure for valine.

1 mark

b. i. Amino acids are soluble in water. Why is the structure for an amino acid in solution dependant on the pH of the solution?

1 mark

ii. Draw the structure that alanine would have in a high pH solution.

1 mark

c. Draw the structures for the two dipeptides that would be formed by combining the two amino acids.

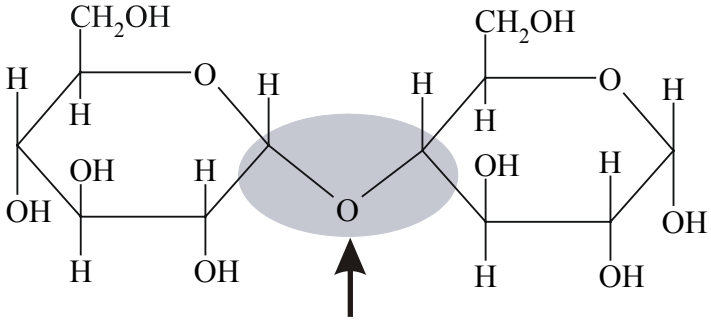
2 marks

End of Task

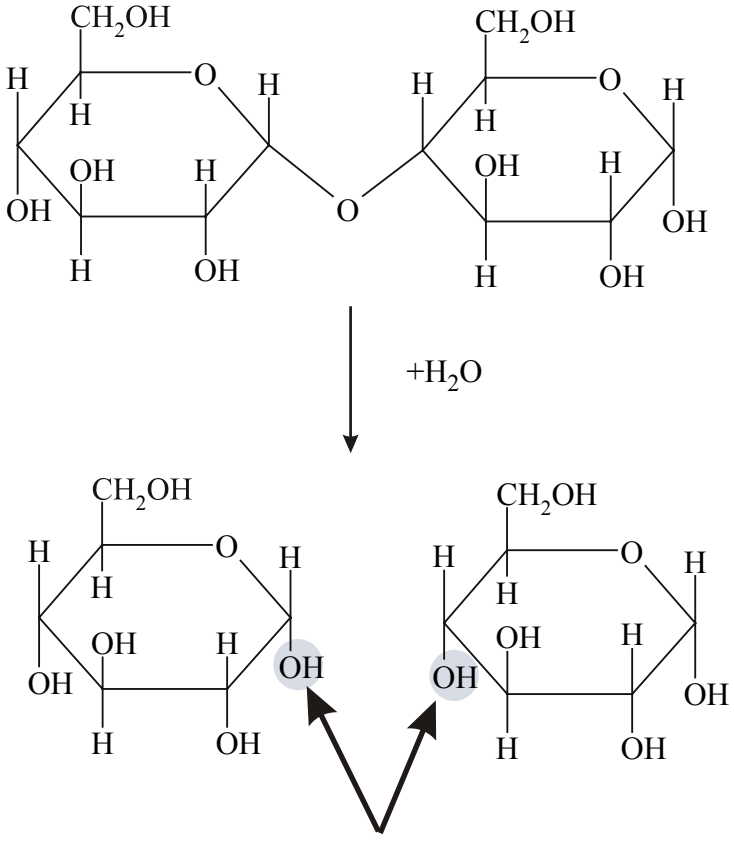
Suggested Answers VCE Chemistry 2005 Food Test Unit 4

SECTION A [1 mark per question.]

Q1 D The functional group hydrolysed during the digestion of carbohydrates is **the ether, C-O-C, functional group**.



Q2 D The functional groups formed when a carbohydrate is hydrolysed are **two hydroxy groups, -OH.**

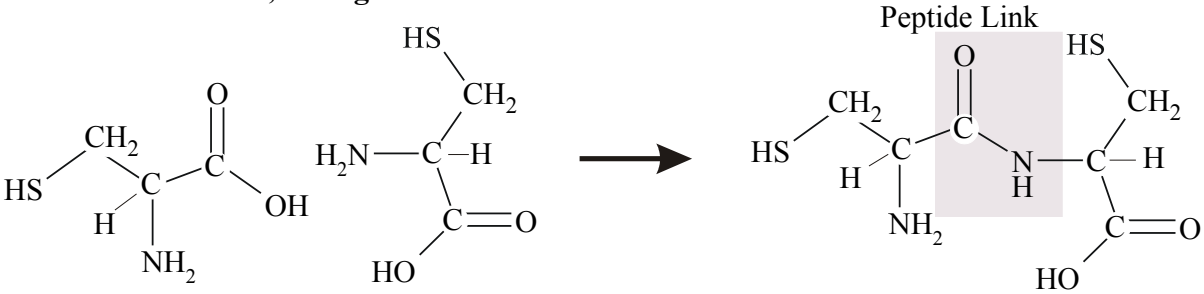


Q3 A Fatty acids have a carboxy, -COOH, group attached to a hydrocarbon chain. Therefore a fatty acid containing 18 carbon atoms will have a hydrocarbon chain containing 17 carbon atoms, because one carbon atom is associated with the carboxy group. Therefore a saturated C_{18} fatty acid would have the semi-structural formula; $CH_3(CH_2)_{16}COOH$ or $C_{17}H_{35}COOH$ to give a molecular formula of $C_{18}H_{36}O_2$.
Polyunsaturated fatty acids have two or more carbon-carbon double bonds. For each double bond there will be two less hydrogen atoms in the hydrocarbon chain. Therefore for a polyunsaturated fatty acid the molecular formula must have four or more hydrogen atoms less than that for the saturated fatty acid, therefore 32 or less hydrogen atoms. **$C_{18}H_{32}O_2$**.
Response D with 28 hydrogen atoms is not correct because there are four oxygen atoms.

Q4 B The best response is Response B.
Response A is not acceptable because some carbohydrates, such as starch have molar masses well in excess of fats.
Similarly response C is not acceptable because glucose is a monosaccharide and its molar mass is less than most fats.
Not all fats contain carbon-carbon double bonds, therefore response D is unacceptable.
Since most carbohydrates are based on the basic $C_6H_{12}O_6$ unit, compared to fats with a significant hydrocarbon chain component, fats therefore have a lower carbon:oxygen ratio than carbohydrates and hence are less oxidised.

Q5 C Both animals and plants store carbohydrates for later energy use by polymerising glucose. The storage molecule in animals is **glycogen**, while that in plants is **starch**. Plants use cellulose for their structures and not as an energy store.

Q6 C When amino acids form proteins the condensation reaction occurs between the **amino, -NH_2, group** and the **carboxy, -COOH, group** to form the **peptide, -NHCO-, linkage**.



Condensation reaction between two amino acids.

Q7 A The –SH group on cystine can form **disulfide links** with other similar groups in the protein and these contribute to the **tertiary structure** of the protein.

Q8 B During digestion the poly saccharide starch is first hydrolysed to form the disaccharide **maltose** then further hydrolysed to form the monosaccharide **glucose**.

Q9 B The process that would have the **least direct** effect on the level of carbon dioxide in the atmosphere is the **formation of limestone** as this process is due to the formation of sediments from corals, shells and marine animal skeletons.
Responses A and D both remove carbon dioxide from the atmosphere whereas response C releases carbon dioxide into the atmosphere.

Q10 D The activity of an enzyme is dependent on its shape (structure), as enzymaticly catalysed reactions are very specific and require the reacting substrate to bind to a site on the protein. When the enzyme has become deactivated then the protein has been denatured. Denaturation can result from either heating, altering the pH or the addition of various chemicals. Denaturation results in a change in the structure of the protein, and heating can lead to the formation of **disulfide links** between various parts of the protein and/or other protein chains. Heating will not significantly change the pH and as a result the structure will not be altered by protonation of the –NH groups.

Q11 A Vitamin E acts as an **antioxidant** when it is added to margarine. It is non-polar substance, therefore it will be soluble in the lipid based margarine that is a water in oil emulsion. Antioxidants prevent lipids from reacting with the air and becoming rancid on storage. This is especially important for unsaturated fats because the carbon-carbon double bonds readily oxidised.

Q12 B All four compounds could provide plants with nitrogen in a suitable form, however, HNO_3, nitric acid, would not be a good choice because of its acidity.

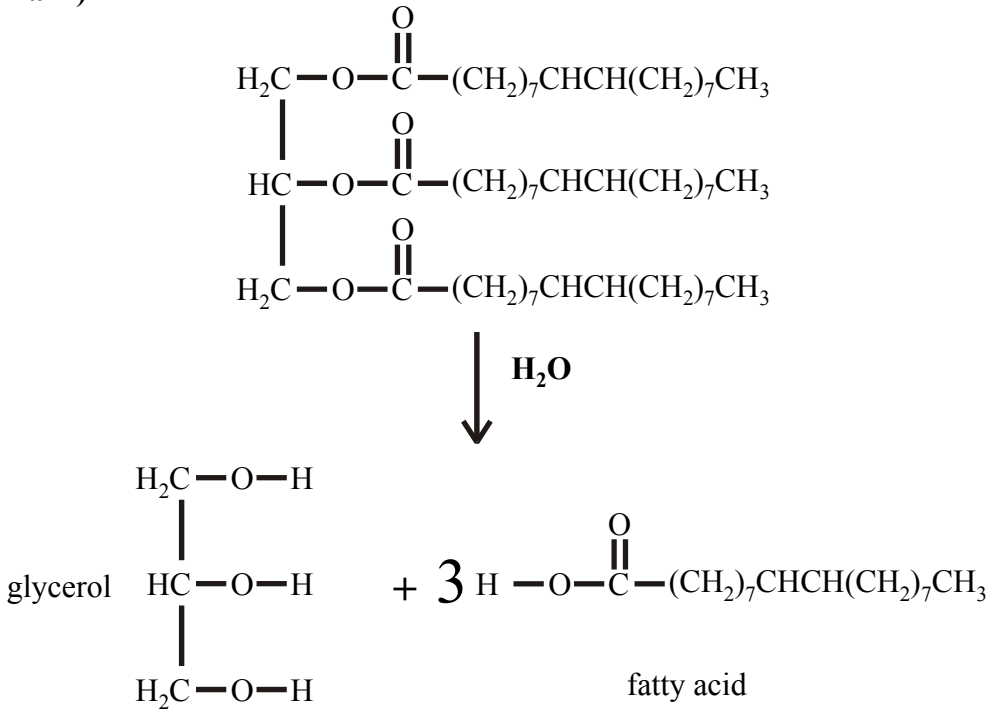
SECTION B

Question 1 - [9 marks, 11 minutes]

a. The decolouration of the bromine indicates that the bromine is reacting with the oil. Since the oil is made up from a **monounsaturated fatty acid**, one containing a **single carbon-carbon double bond**, the **bromine will react and undergo an addition reaction across the carbon-carbon double bond**. **(1 mark)**

b. When the oil is digested it will undergo a **hydrolysis** reaction involving the **ester functional group. (1 mark)**

c. The two product formed by the digestion of this oil are glycerol, **$CH_2(OH)CH(OH)CH_2(OH)$**, and the fatty acid, **$CH_3(CH_2)_7CHCH(CH_2)_7COOH$**. **(1 mark)**



d. $CH_3(CH_2)_7CHCH(CH_2)_7COOH = C_{18}H_{34}O_2$

The oxidation reaction for a fatty acid will produce carbon dioxide and water.

The chemical equation can be developed in steps.

1. Write the formulae for the reactants and products.
   $C_{18}H_{34}O_2 + O_2 \rightarrow CO_2 + H_2O$
2. Balance the number of carbon atoms: $C_{18} \Rightarrow 18CO_2$
   $C_{18}H_{34}O_2 + O_2 \rightarrow 18CO_2 + H_2O$
3. Balance the number of hydrogen atoms: $H_{34} \Rightarrow 17H_2O$
   $C_{18}H_{34}O_2 + O_2 \rightarrow 18CO_2 + 17H_2O$
4. Balance the number of oxygen atoms:
   In the products the number of oxygen atoms is $18\times2 + 17 = 53$ O atoms
   There are 2 O atoms in the fatty acid therefore need $53 - 2 = 51$ O atoms
   Since oxygen is a diatomic molecule, O_2 then $^{51}/_2$ molecules
   $C_{18}H_{34}O_2 + {}^{51}/_2O_2 \rightarrow 18CO_2 + 17H_2O$
5. Add states and multiply through by 2 to remove half oxygen molecules.
   $2C_{18}H_{34}O_2(s) + 51O_2(g) \rightarrow 36CO_2(g) + 34H_2O(l)$ (2 marks)
   $C_{18}H_{34}O_2(s) + {}^{51}/_2O_2(g) \rightarrow 18CO_2(g) + 17H_2O(g)$ would be acceptable.

Note: *The correct state for the fatty acid is not critical to the equation and would not be penalised by loss of mark.*

e. $M(C_{18}H_{34}O_2) = 18\times12.0 + 34\times1.0 + 2\times16 = 282$ g mol^{-1}

$n(C_{18}H_{34}O_2) = m(C_{18}H_{34}O_2)/M(C_{18}H_{34}O_2) = 0.654/282 = 2.32\times10^{-3}$ mol **(1 mark)**

2.32×10^{-3} mole of $(C_{18}H_{34}O_2)$ released 25.9 kJ of energy.

Energy released by 1 mole of $(C_{18}H_{34}O_2)$ will be $25.9/2.32\times10^{-3} = 1.12\times10^4$ kJ **(1 mark)**

Energy has been release therefore $\Delta H < 0$

If the equation given for d. above is:

$2C_{18}H_{34}O_2(s) + 51O_2(g) \rightarrow 36CO_2(g) + 34H_2O(l)$

This shows 2 mole of $(C_{18}H_{34}O_2)$ reacting therefore:

$\Delta H = -(2 \times 1.12\times10^4) =$ **-2.24×10^4 kJ mol^{-1} (1 mark)**

If the equation given for d. above is as shown below, then the answer required for the allocated mark will be:

$C_{18}H_{34}O_2(s) + {}^{51}/_2O_2(g) \rightarrow 18CO_2(g) + 17H_2O(g)$ then **$\Delta H = -1.12\times10^4$ kJ mol^{-1}**

f. The bile acts as a **surfactant** which would result in the **dispersion of the oil into smaller droplets in the aqueous environment**. This **increases the surface area** and as a consequence would lead to a **faster rate of reaction**. **(1 mark)**

Question 2 - [7 marks, 10 minutes]

a. i. The main natural process that results in the formation of nitrogen oxide from nitrogen gas is **lightning**. **(1 mark)**

ii. While lightning is a common occurrence the **amount of nitrogen oxide formed would be relatively small compared with the world's plant requirements**. In addition, the nitrogen oxide is converted to **nitrate ions** before it enters the soil, and as the compounds of this ion are very soluble they are **readily leached out of the soil** and away from the plants. **(1 mark)**

b. i. Either **ammonia, NH_3**, or the **ammonium ion, NH_4^+. (1 mark)**

ii. Atmospheric nitrogen can be converted into the ammonium ion by certain **micro-organisms, nitrogen fixing bacteria, that are present in the root nodules of certain plants such as legumes**. **(1 mark)**

c. A number of satisfactory answers are possible:
[Total mark allocation = 2 marks. One mark for each correct answer.]
The addition of industrially produced **synthetic fertilisers**. The Haber process is one method used to convert atmospheric nitrogen and hydrogen into ammonia.
The use of **fertilisers produced from animal waste**.
The **decay of plant and animal matter.**

d. **Plants convert the nitrogen containing compounds** that they absorb through their roots **into amino acids**. **(1 mark)**

Question 3 - [6 marks, 7 minutes]

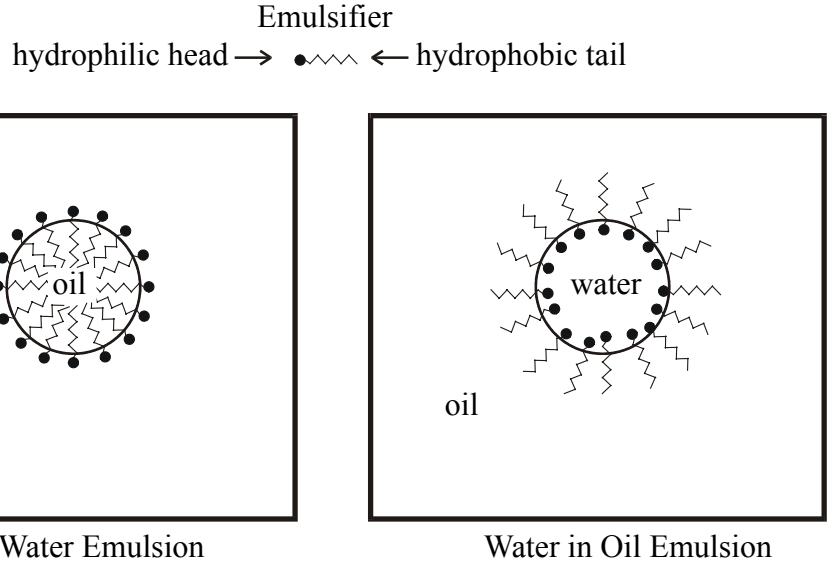
a. For a substance to be able to act as an emulsifier it must have one end of its structure that is **non-polar and hydrophobic** with the other end being **either polar or charged and hydrophilic. (1 mark)**

b. The two common emulsion types are:
Water in oil where the **water is the dispersed phase** and the oil is the main phase. **(1 mark)**
Oil in water where the **oil is the dispersed phase** and the water is the main phase. **(1 mark)**

c. **[Total mark allocation = 2 marks. One mark for each correct answer.]**

Emulsion Type	
Water in Oil	**Oil in Water**
Feels cool & watery.	Feels greasy or oily.
Soluble in water but insoluble in non-polar solvents.	Insoluble in water but soluble in non-polar solvents.
Will conduct an electric current.	Will not conduct an electric current.

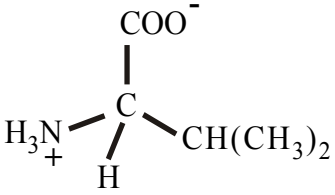
d. In an **oil in water emulsion,** the **hydrophobic tails of the emulsifier are in the oil droplets and the hydrophilic heads are on the surface** of the oil droplets, this changes the surface of the oil droplets from being hydrophobic to being hydrophilic.
In a **water in oil emulsion,** the **hydrophilic heads of the emulsifier are in the water droplets and the hydrophobic tails are on the surface** of the water droplets, this changes the surface of the water droplets from being hydrophilic to being hydrophobic. **(1 mark)**



Oil in Water Emulsion Water in Oil Emulsion

Question 4 - [6 marks, 7 minutes]

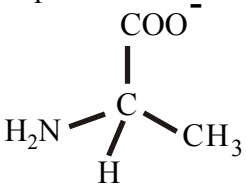
a. i. A **zwitterion is a dipolar ion** that contains both a positively and negatively charged site. **(1 mark)**



ii. valine zwitterion **(1 mark)**

b. i. An amino acid contains an **acidic carboxy, -COOH, group** that can donate protons and a **basic amino, -NH_2, group** that can accept protons. Therefore when dissolved in water an amino acid can both accept and donate protons, and hence its structure will vary depending on the pH **(1 mark).** The amino acid will accept a proton when the solution has a low pH (acting as a base). At high pH the amino acid will donate a proton (acting as an acid).

ii. At high pH the $[H^+(aq)]$ is low and the amino acid structure will have deprotonated carboxy group.



Alanine at high pH **(1 mark)**

c. The two possible structures for the dipeptides formed from alanine and valine will depend on which amino acid amino and carboxy groups undergo the condensation reaction.

[Total marks allocated = 2 marks. 1 mark each correct structure.]