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**Student name**

# CHEMISTRY
# Unit 3
# Trial Examination

## QUESTION AND ANSWER BOOK

**Total writing time: 1 hour 30 minutes**

### Structure of book

| Section | Number of questions | Number of marks |
|---|---|---|
| A | 20 | 20 |
| B | 9 | 63 |
| | **Total** | **83** |

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers, one scientific calculator.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape, mobile phones and/or any other unauthorised electronic devices.
- A copy of the official VCAA Data Book (printed or photocopied) can be brought into the trial examination.

### Materials supplied

- Question and answer book of 15 pages, with a detachable answer sheet for multiple-choice questions inside the front cover.

### Instructions

- Detach the answer sheet for multiple-choice questions during reading time.
- Write your **name** in the space provided above on this page and on the answer sheet for multiple-choice questions.
- All written responses should be in English.

### At the end of the examination

- Place the answer sheet for multiple-choice questions inside the front cover of this book.
- You may keep your copy of the VCAA Data Book.

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# *STAV Publishing*

## 2010

# CHEMISTRY

## Unit 3 Trial Examination

# MULTIPLE CHOICE ANSWER SHEET

| STUDENT NAME: | |
|---|---|

**INSTRUCTIONS:** **USE PENCIL ONLY**

- Write your name in the space provided above.
- Use a **PENCIL** for **ALL** entries.
- If you make a mistake, **ERASE** it – **DO NOT** cross it out.
- Marks will **NOT** be deducted for incorrect answers.
- **NO MARK** will be given if more than **ONE** answer is completed for any question.
- Mark your answer by **SHADING** the letter of your choice.

| | ONE ANSWER PER LINE | | | | | ONE ANSWER PER LINE | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | A | B | C | D | 11 | A | B | C | D | |
| 2 | A | B | C | D | 12 | A | B | C | D | |
| 3 | A | B | C | D | 13 | A | B | C | D | |
| 4 | A | B | C | D | 14 | A | B | C | D | |
| 5 | A | B | C | D | 15 | A | B | C | D | |
| 6 | A | B | C | D | 16 | A | B | C | D | |
| 7 | A | B | C | D | 17 | A | B | C | D | |
| 8 | A | B | C | D | 18 | A | B | C | D | |
| 9 | A | B | C | D | 19 | A | B | C | D | |
| 10 | A | B | C | D | 20 | A | B | C | D | |

## SECTION A – Multiple-choice questions

| Instructions for Section A |
|---|
| Answer all questions in pencil on the answer sheet provided for multiple-choice questions. |
| Choose the response that is **correct** or that **best answers** the question. |
| A correct answer scores 1, an incorrect answer scores 0. |
| Marks will **not** be deducted for incorrect answers. |
| No mark will be given if more than one answer is completed for any question. |

### Question 1

The sample with the greatest number of C atoms is

**A.** 0.10 mol of $C_6H_{12}O_6$

**B.** 20 g of $C_2H_4$

**C.** 20 L of $CO_2$ at 0°C and 1 atm

**D.** $1.0 \times 10^{23}$ molecules of $CH_4$

### Question 2

Genetic information is carried by a nucleic acid in the form of the

**A.** relative proportions of the four bases

**B.** acid strength of the nucleic acid

**C.** hydrogen bonds which hold the helix in place

**D.** specific sequences of the four bases

### Question 3

How many structural isomers are possible with the molecular formula $C_6H_{14}$?

**A.** 4

**B.** 5

**C.** 6

**D.** 7

### Question 4

Which of the following could undergo oxidation to a carboxylic acid when treated with an appropriate oxidant?

**A.** $CH_3CH_2CHO$

**B.** $CH_3CH(OH)CH_3$

**C.** $CH_3COOH$

**D.** $(CH_3)_3COH$

**Question 5**

The **high** resolution $^1H$ NMR spectrum of $C_2H_5Br$ would show

**A.** 2 peaks

**B.** 3 peaks

**C.** 5 peaks

**D.** 7 peaks

**Question 6**

Which of the following reactions is an example of a substitution reaction?

**A.** $C_3H_6 + HCl \rightarrow C_3H_7Cl$

**B.** $CH_3COOH + H_2O \rightarrow CH_3COO^- + H_3O^+$

**C.** $2\,C_6H_6 + 15\,O_2 \rightarrow 12\,CO_2 + 6\,H_2O$

**D.** $C_2H_5Cl + Cl_2 \rightarrow C_2H_4Cl_2 + HCl$

**Question 7**

A student wishes to determine the concentration of citric acid in fruit juice. The student titrates 20.00 mL samples of a standard sodium hydroxide solution with diluted fruit juice from a burette. Four experiments were carried out and the following titres were obtained:

19.55 mL, 20.35 mL, 20.30 mL, 20.35 mL.

The discrepancy in the first titration could be due to the student washing the

**A.** conical flask with sodium hydroxide solution only.

**B.** burette with water only.

**C.** pipette with sodium hydroxide solution only.

**D.** pipette with water only.

**Question 8**

How many mole of oxygen gas are required for the complete combustion of 0.5 mole of ethene?

**A.** 0.5

**B.** 0.75

**C.** 1.5

**D.** 3.0

**Question 9**

Which one of the following terms best describes the type of reaction in which a peptide link is formed between amino acids?

**A.** hydrolysis

**B.** condensation

**C.** substitution

**D.** addition

**Question 10**

The compound $CH_3CHO$ (ethanal) is an example of a group of compounds called aldehydes. Which of the following analytical techniques could be used to identify this?

**A.** Infrared Spectroscopy

**B.** Atomic Absorption

**C.** UV–Visible Spectroscopy

**D.** Gas Chromatography

**Question 11**

A polyunsaturated fat is hydrolysed. Glycerol and polyunsaturated acid are formed. Which one of the following is a possible formula for the acid?

**A.** $C_{16}H_{32}O_2$

**B.** $C_{18}H_{36}O_2$

**C.** $C_{20}H_{38}O_2$

**D.** $C_{24}H_{44}O_2$

**Question 12**

The molecule $HOCH_2CH_2COOH$ forms a polyester in which the average polymer molecule contains 500 monomer units. The approximate molar mass of the polymer, in g $mol^{-1}$, would be

**A.** 36 000

**B.** 43 000

**C.** 45 000

**D.** 53 000

**Question 13**

The number of distinct carbon atoms and hydrogen atoms respectively in the appropriate NMR spectra of hexane would be

**A.** 2 , 3

**B.** 3 , 2

**C.** 3 , 3

**D.** 6 , 6

**Question 14**

A 20.00 mL sample of sodium hydroxide solution which had been prepared some months previously was titrated with 0.1150 M hydrochloric acid, using phenolphthalein as indicator. This titration required 24.28 mL. A 20.00 mL sample of freshly prepared sodium hydroxide was titrated with 0.1150 M hydrochloric acid, using methyl orange as indicator. This time the titration required 26.40 mL of acid. Which of the following is the most likely cause of this difference?

**A.** phenopthalein is not a suitable indicator for the titration of hydroxide ions with acid.

**B.** the sodium hydroxide had absorbed carbon dioxide from the air, forming some sodium carbonate.

**C.** the difference shows the normal variation to be expected when two different indicators are used.

**D.** more acid is required when methyl orange is used as an indicator, because methyl orange reacts with hydrochloric acid.

**Question 15**

A sample of E-10 petrol is to be analysed for its ethanol content. Which of the following techniques is the most suitable analytical technique for this analysis?

**A.** Gas chromatography

**B.** NMR spectrometry

**C.** Atomic absorption spectroscopy

**D.** UV–visible spectroscopy

**Question 16**

Which of the following has hydrogen in the lowest oxidation state?

**A.** NaH

**B.** $H_2SO_4$

**C.** $NaHSO_4$

**D.** $H_2O_2$

**Question 17**

Which of the following could oxidise $I^-$ ions?

**A.** $H^+$ ions

**B.** $Fe^{2+}$ ions

**C.** Cu metal

**D.** $H_2O_2$

**Question18**

$NH_3(aq)$ is titrated with hydrochloric acid solution. At equivalence point, the pH of the solution is

**A.** less than 7

**B.** greater than 7

**C.** 7

**D.** unable to be determine without other information

**Question19**

A section of a DNA strand contains the following base pairs G-C, A-T, T-A, G-C, C-G. The number of hydrogen bonds needed to be broken to unwind this section of DNA would be

**A.** 5

**B.** 10

**C.** 12

**D.** 13

**Question 20**

The formula for the biofuel, methyl stearate can be represented as

**A.** $CH_3COO(CH_2)_{17}CH_3$

**B.** $HCOO(CH_2)_{17}CH_3$

**C.** $C_{17}H_{33}COOCH_3$

**D.** $C_{17}H_{35}COOCH_3$

**END OF SECTION A**

## SECTION B – Short answer questions

**Instructions for Section B**

Answer **all** questions in the spaces provided.

To obtain full marks for your responses you should

- give simplified answers with an appropriate number of significant figures for all numerical questions; unsimplified answers will not be given full marks.
- show all working in your answers to numerical questions. No credit will be given for an incorrect answer unless it is accompanied by details of the working.
- make sure chemical equations are balanced and that the formulas for individual substances include an indication of state; for example, $H_2(g)$; NaCl(s)

### Question 1

Salinity in soil is a serious problem across many areas of Victoria and indeed Australia. The sodium chloride in a 50.0 g sample of soil was dissolved in de-ionised water, filtered and then titrated with a solution of 0.4998 M silver nitrate. Using the titration data, the amount of sodium chloride in the soil sample was determined to be 1.58 per cent by mass.

Calculate a numerical value, in mL, of the volume of silver nitrate used in the titration and give your answer to the appropriate number of significant figures.

Total 4 marks

**Question 2**

Although hydrolysis of esters involves a reversible reaction, adequate precautions will result in a reaction which is sufficiently quantitative to permit determination of molecular mass. In a particular reaction, 0.308 g of an ester is reacted under reflux with 20.00 mL of 1.00 M sodium hydroxide solution. After cooling, phenolphthalein is added and the excess sodium hydroxide is back titrated with 0.513 M hydrochloric acid, 32.2 mL being required.

Assume the compound is saturated and contains only one ester grouping.

**a.** Calculate the molar mass of the ester.

4 marks

**b.** Determine the molecular formula of the ester.

2 marks

**c.** **i.** Draw the semi-structural formula for **all** possible esters with this molecular formula.

**ii.** If a multiplet is seen in the high resolution $^1$H NMR spectrum of the ester, select the ester from your response in **c. i.** that it must be.

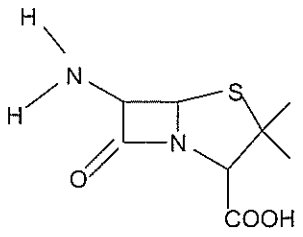
2 marks

Total 8 marks

**Question 3**

Penicillins are used to treat bacterial infections in animals.

A common form of penicillin has the structural formula shown in the diagram below:




**a.** How many carbon atoms is the amino group bonded to?

_____

1 mark

**b.** Explain why the arrangement of atoms around the nitrogen atom in this amino group is triangular pyramidal.

_____

_____

1 mark

**c.** Penicillin is usually given to animals in the form of its sodium salt. On the diagram above, make the change to the appropriate functional group to represent the salt including any charges.

1 mark

**d.** Explain why penicillin is given to animals in the form of its sodium salt rather than in its molecular form.

_____

_____

1 mark

**e.** The synthetic penicillin amoxycillin hydrolyses in a solution of sodium hydroxide.

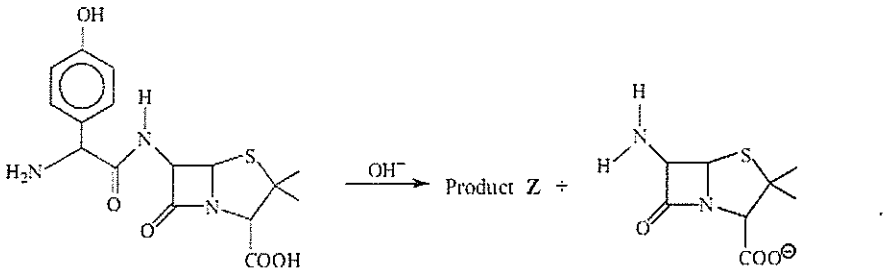
**i.** Calculate the mass of sodium hydroxide needed to prepare 1.00 L of solution of concentration 0.00500 M.

2 marks

**ii.** Determine the pH of this solution of sodium hydroxide.

1 mark

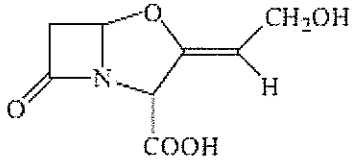
**iii.** The alkaline hydrolysis of amoxycillin results in the formation of two products, as shown in the diagram below:




Draw the structural formula of Product **Z**.

2 marks

**iv.** Amoxycillin is sometimes mixed with clavulanic acid. The structural formula of clavulanic acid is shown in the diagram below:




A solution of clavulanic acid is shaken with a solution of bromine. Explain what would happen and why?

2 marks

Total 11 marks

**Question 4**

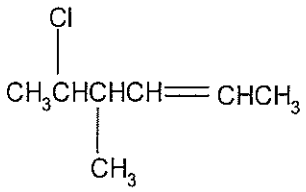
**a.** Write the semi-structural formula for

**i.** 2-methylbutanoic acid _____

**ii.** 3, 4 dichloropentan-2-ol _____

2 marks

**b.** Write the systematic name for the compound shown below.



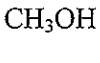
_____

1 mark

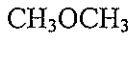
Total 3 marks

**Question 5**

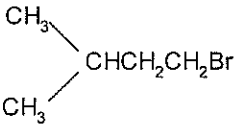
Complete the table below for the following compounds



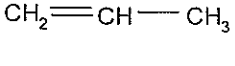
**A**



**B**



**C**



**D**

| Compound | Number of low resolution $^{1}H$ signals | Number of $^{13}C$ signals |
|---|---|---|
| **A** | | |
| **B** | | |
| **C** | | |
| **D** | | |

Total 4 marks

**Question 6**

Write an equation for the following processes (reagents should be shown above the arrow). No states are required in this instance.

**a.** conversion of chloroethane to ethylamine (ethanamine)

_____

2 marks

**b.** conversion of ethene to ethanol

_____

2 marks

**c.** conversion of ethanol into ethyl ethanoate

_____

2 marks

Total 6 marks

**Question 7**

A student was carrying out an investigation in which the method to produce a dry sample of a precipitate was designed, and the percentage yield obtained was determined.

The student mixed 10.0 mL of 0.0900 M $Na_2SO_4$ with 15.0 mL of 0.0800 M $Pb(NO_3)_2$. The precipitate was collected by vacuum filtration and allowed to dry to constant mass. The precipitate was then weighed and found to have a mass of 0.268 g.

**a.** Write a balanced chemical equation for the reaction

_____

2 marks

**b.** Determine which reactant was in excess. Show your reasoning.

_____

_____

_____

_____

2 marks

**c.** Calculate the theoretical mass of precipitate that the student should have obtained.

_____

_____

2 marks

**d.** Calculate the percentage yield obtained.

_____

1 mark

**e.** State a possible reason why only this percentage was obtained.

_____

1 mark

Total 8 marks

**Question 8**

An organic compound containing only carbon, hydrogen and oxygen was analysed.

**a.** When completely burnt in oxygen, 1.80 g of the compound produced 3.60 g of carbon dioxide and 1.472 g of water. Determine the empirical formula of the hydrocarbon.

4 marks

**b.** A separate 2.279 g sample of the hydrocarbon when vaporised in a 1.00 L vessel at 100° C exerted a pressure of 80.3 kPa. Determine the molecular formula of the compound.

2 marks

**c.** Name a substance that could have been dissolved in water to absorb the carbon dioxide.

1 mark

Total 7 marks

**Question 9**

A polypeptide is found to have the sequence of amino acids shown below

Tyr-Ala-Ala-Phe-Leu

**a.** Draw the structural formula (showing all bonds) of the species formed when alanine (Ala) reacts with a dilute solution of hydrochloric acid.

2 marks

**b.** When phenylalanine (Phe) is added to Ala two dipeptides can be formed. Draw the semi-structural formulae of **both** of these dipeptides.

_____

_____

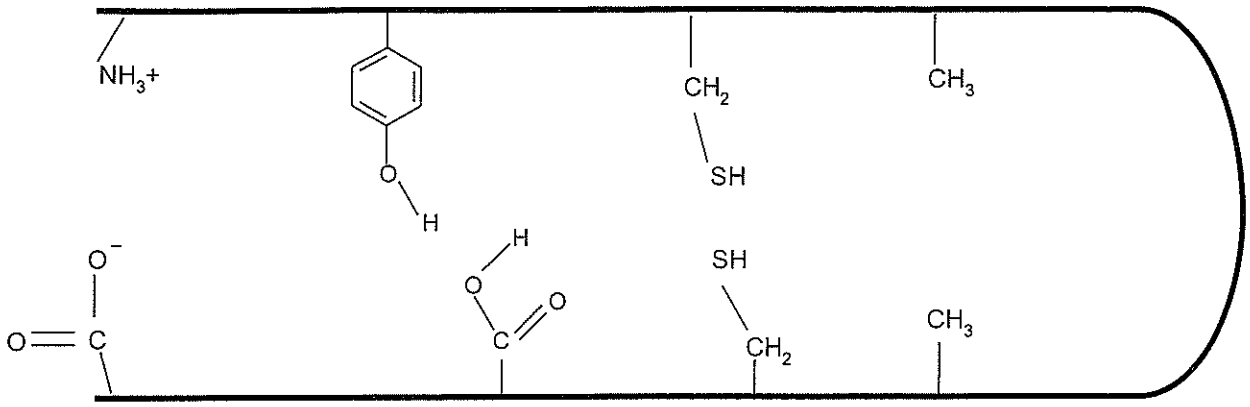
2 marks

**c.** Name the substance formed in addition to the dipeptide in the reaction described in part **b.**

_____

1 mark

**d.** Proteins formed in the body have a much longer amino acid sequence. The diagram below shows a section of one such protein.




**i.** Name all the bonding types (other than covalent) which are involved in holding this protein together.

_____

_____

**ii.** On the diagram, make any required alterations to show how covalent bonding could be used to hold some parts of the protein together.

**iii.** When this protein is heated above 70°C, its structure changes. Describe what happens during heating to the:

- secondary structure of the protein

_____

_____

- primary structure of the protein

_____

_____

7 marks

Total 12 marks

**END OF EXAMINATION**

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## SOLUTIONS BOOK

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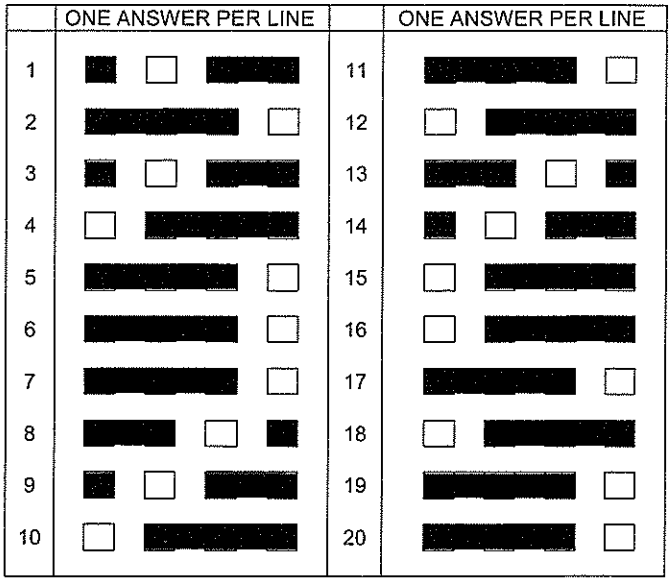
Use this page as an overlay for marking the multiple choice answer sheets. Simply photocopy the page onto an overhead projector sheet. The correct answers are open boxes below. Students should have shaded their answers. Therefore, any open box with shading inside it is correct and scores 1 mark.



**SECTION A (Total 20 marks)**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1.** | B | **2.** | D | **3.** | B | **4.** | A | **5.** | D |
| **6.** | D | **7.** | D | **8.** | C | **9.** | B | **10.** | A |
| **11.** | D | **12.** | A | **13.** | C | **14.** | B | **15.** | A |
| **16.** | A | **17.** | D | **18.** | A | **19.** | D | **20.** | D |

**Comments for Section A answers**

**Question 1**

A. $n(C) = 0.10 \times 6 = 0.60$ mol

B. $n(C_2H_4) = m/M = 20/28 = 0.714$ mol $\quad n(C) = 2 \times n(C_2H_4) = 1.43$ mol

C. $n(CO_2) = V/V_m = 20/22.4 \quad n(C) = n(CO_2) = 0.893$ mol

D. $n(CH_4) = N/N_A = 1.0 \times 10^{23} / 6.02 \times 10^{23} = 0.17$ mol $\quad n(C) = n(CH_4) = 0.17$ mol

**Correct answer is B.**

**Question 2**

The sequence of nitrogen bases form the basis of the genetic code. Genes are particular sequences of the bases. **Correct answer is D.**

**Question 3**

The isomers are

$CH_3CH_2CH_2CH_2CH_2CH_3$

$CH_3CH(CH_3)CH_2CH_2CH_3 \quad CH_3CH_2\,CH(CH_3)CH_2CH_3$

$CH_3CH(CH_3)CH(CH_3)CH_3 \quad CH_3C(CH_3)_2CH_2CH_3$ **Correct answer is B.**

**Question 4**

Only A has a structure which permits oxidation at the carbon which is on the right side of the molecule. This carbon is referred to as a primary carbon atom. **Correct answer is A.**

**Question 5**

In $CH_3CH_2Br$, there are two sets of non-equivalent protons. The 3 equivalent hydrogens of the $CH_3$ group will split the $CH_2$ signal into a quartet and the 2 equivalent hydrogens in the $CH_2$ will split the $CH_3$ into a triplet. Hence 7 peaks will be seen in the high resolution $^1H$ NMR. **Correct answer is D.**

**Question 6**

A is an addition reaction, B is ionisation, C is combustion or oxidation, D is substitution. In D, a second hydrogen atom has been replaced with a chlorine atom. **Correct answer is D.**

**Question 7**

A. Would require more diluted fruit juice so the discrepant titre would be higher.
B. This dilutes the fruit juice further, so the titre would be bigger.
C. This is correct technique and would not lead to a discrepancy.
D. This dilutes the sodium hydroxide so less fruit juice is required. **Correct answer is D.**

**Question 8**

$C_2H_4 + 3\ O_2 \rightarrow 2\ CO_2 + 2H_2O$ $n(O_2) / n(C_2H_4) = 3/1$ $n(O_2) = 3 \times 0.5 = 1.5$ **Correct answer is C.**

**Question 9**

The formation of a peptide link involves a condensation reaction to release a water molecule.
**Correct answer is B.**

**Question 10**

Infrared Spectroscopy could identify the presence of the C = O, carboxyl group. **Correct answer is A.**

**Question 11**

$C_{16}H_{32}O_2$ if saturated formula would be $CH_3(CH_2)_{14}COOH$ - atom match

$C_{18}H_{36}O_2$ if saturated formula would be $CH_3(CH_2)_{16}COOH$ - atom match

$C_{20}H_{38}O_2$ if saturated formula would be $CH_3(CH_2)_{18}COOH$ - two less H atoms, so mono-unsaturated

$C_{24}H_{44}O_2$ if saturated formula would be $CH_3(CH_2)_{22}COOH$ - four less H atoms so 2 C/C double bonds

**Correct answer is D.**

**Question 12**

499 ester links are created. Therefore 499 water molecules are lost

Mass would be 500 x 90 – 499 x 18 = 45 000 – 8982 = 36 018 **Correct answer is A.**

**Question 13**

Because of the 'symmetry' of the molecule, there are only 3 different carbon environments and 3 different hydrogen environments. **Correct answer is C.**

**Question 14**

Sodium hydroxide absorbs $CO_2$ from the atmosphere. The older sample would contain less mole of NaOH and therefore a lower titre would be required. **Correct answer is B.**

**Question 15**

GLC would be used to determine the ethanol content. **Correct answer is A.**

**Question 16**

NaH has H in -1 state $H_2SO_4$ has H in +1 state $NaHSO_4$ has H in + 1 state $H_2O_2$ has H in +1 state
**Correct answer is A.**

**Question 17**
$H_2O_2$ as an oxidant is the only suitable chemical which is higher than the reductant $I^-$ in the electrochemical series. **Correct answer is D.**

**Question 18**
At equivalence point, ammonim ion is formed and this is weakly acidic. Therefore the solution has a pH of less than 7 at equivalence point. **Correct answer is A.**

**Question 19**
GC or CG pairs have 3 H-bonds between them; AT/TA pairs have 2 H-bonds between them.
So this sequence has 3 + 2 + 2 + 3 + 3 = 13 H-bonds. **Correct answer is D.**

**Question 20**
Stearic acid is $C_{17}H_{35}COOH$ and methanol is $CH_3OH$.
The biofuel is an ester and has the formula $C_{17}H_{35}COOCH_3$. **Correct answer is D.**

**SECTION B – Short answer questions**

**Question 1 (4 marks)**

Let T = titre volume in mL $n(AgNO_3) = c \times V = 0.4998 \times T \times 10^{-3}$ **1 mark**

$n(Ag^+) = n(Cl^-) = n(AgNO_3)$ $n(Cl^-) = n(NaCl)$ **1 mark**

$m(NaCl) = n \times M = 0.4998 \times T \times 10^{-3} \times 58.5$

% NaCl (m/m) = 100 x m(NaCl) / m(sample) $1.58 = 100 \times 0.4998 \times T \times 10^3 \times 58.5 / 50.0$ **1 mark**

$T = 50.0 \times 1.58 / 100 \times 0.4998 \times 10^{-3} \times 58.5 = 27.0$ mL **1 mark (check sig fig)**

**Question 2 (8 marks)**

**a.** $n(HCl) = 0.513 \times 32.2 \times 10^{-3}$ mol = 0.0165 mol **1 mark**

$n(NaOH)_{left\ over} = n(HCl)$

$n(NaOH)_{initially} = c \times V = 1.00 \times 20.00 \times 10^{-3} = 0.0200$ mol **1 mark**

n(NaOH) reacting with ester = 0.0200 – 0.0165 = 0.0035 mol **1 mark**

n(ester) = n(NaOH) = 0.0035 (1:1 reaction)

$n = m/M \rightarrow M = m/n = 0.308 / 0.0035 = 88.0\ g\ mol^{-1}$ **1 mark**

**b.** the ester must have a formula $RCOOR^1$

COO has a mass of 44 so the residue hydrocarbon mass must be 44. **1 mark**

$CH_3CH_2CH_3$ is 44 **1 mark**

**c.** **i.** Possible semi-structures for the ester are

$CH_3COOCH_2CH_3$ or $HCOOCH_2CH_2CH_3$ or $CH_3CH_2COOCH_3$ **1 mark**

**ii.** Given that it has a multiplet in the $^1H$ NMR, its structure must be $HCOOCH_2\mathbf{CH_2}CH_3$ **1 mark**. The highlighted $CH_2$ will actually be split into 12 peaks.

**Question 3 (11 marks)**

**a.** The nitrogen in the amino group is bonded to one carbon **1 mark**

**b.** This nitrogen has 3 bonds and a lone pair. **1 mark** (This results in a triangular pyramidal shape.)

**c.** The COOH group becomes $COO^- Na^+$ **1 mark** **(The charges must be shown to get the mark.)**

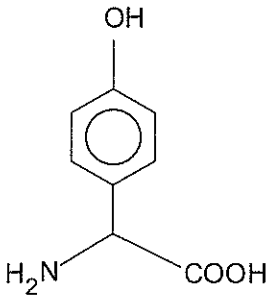
**d.** The penicillin salt is much more soluble. **1 mark**

**e.** **i.** $n(NaOH) = c \times V = 0.00500 \times 1.00 = 0.00500$ mol **1 mark**

$m(NaOH) = n \times M = 0.00500 \times 40.0 = 0.200$ g **1 mark**

**ii.** $pOH = -\log_{10}[OH^-] = -\log_{10} 0.00500 = 2.3$, $pH = 11.7$ **1 mark**

**iii.**




**2 marks**

**iv.** The bromine solution would decolourise. **1 mark**
It undergoes an addition reaction **1 mark** with the C/C double bond.

**Question 4 (3 marks)**

**a.** **i.** $CH_3CH_2CH(CH_3)\,COOH$ **1 mark**

**ii.** $CH_3CH(OH)CHClCHClCH_3$ **1 mark**

**b.** 5-chloro-4-methyl-hex-2-ene **1 mark** (accept 4-methyl-5-chloro)

**Question 5 (4 marks) ½ mark for each correct answer**

| Compound | Number of low resolution $^1H$ signals | Number of $^{13}C$ signals |
|---|---|---|
| A | 2 | 1 |
| B | 1 | 1 |
| C | 4 | 4 |
| D | 3 | 3 |

**Question 6 (6 marks)**

**1 mark** for correct formulae in equation, **1 mark** for reagents and both reagents must be given for the mark.

**a.** $CH_3CH_2Cl \xrightarrow{NH_3 \text{ followed by NaOH}} CH_3CH_2NH_2$

**b.** $C_2H_4 \xrightarrow{H^+ / H_2O} CH_3CH_2OH$

**c.** $CH_3CH_2OH \xrightarrow{CH_3COOH / \text{conc } H^+} CH_3COOCH_2CH_3$

**Question 7 (8 marks)**

**a.** $Na_2SO_4\,(aq) + Pb(NO_3)_2(aq) \longrightarrow PbSO_4\,(s) + 2NaNO_3(aq)$

**1 mark** for correct identification of precipitate, **1 mark** for balanced equation

**b.** $n(Na_2SO_4) = c \times V = 0.0900 \times 10.0 \times 10^{-3} = 0.900 \times 10^{-3}$ mol
$n(Pb(NO_3)_2) = c \times V = 0.0800 \times 15.0 \times 10^{-3} = 1.20 \times 10^{-3}$ mol **1 mark**
Since the reaction is 1:1 $Pb(NO_3)_2$ is in excess by $0.300 \times 10^{-3}$ mol **1 mark**

**c.** $n(PbSO_4) = n(Na_2SO_4)$ **1 mark** $m(PbSO_4) = n \times M = 0.900 \times 10^{-3} \times 303.3 = 0.273$ g **1 mark**

**d.** % yield $= 100 \times 0.273 / 0.268 = 102\%$ **1 mark**

**e.** The precipitate was not washed thoroughly with de-ionised water before it was dried to remove soluble impurities. **1 mark**

**Question 8 (7 marks)**

**a.** $m(C) = 12.0 \times 3.60 / 44.0 = 0.982$ g $n(C) = 0.982 / 12.0 = 0.0818$ mol **1 mark**

$m(H) = 2.0 \times 1.472 / 18.0 = 0.164$ g $n(H) = 0.164 / 1.0 = 0.164$ mol **1 mark**

$m(O) = 1.80 - m(C) - m(H) = 1.80 - 0.982 - 0.164 = 0.654$ g

$n(O) = 0.654 / 16.0 = 0.0409$ mol **1 mark**

$n(C) : n(H) : n(O) = 0.0818 : 0.164 : 0.0409 = 2.00 : 4.00 : 1.00$ EF is $C_2H_4O$ **1 mark**

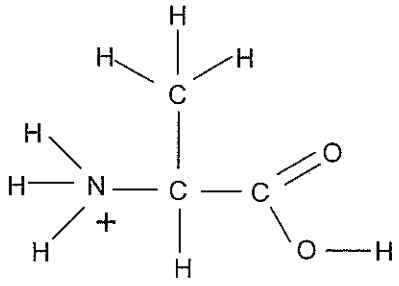
**b.** $PV = nRT = mRT/M$ $M = mRT / PV = 2.279 \times 8.31 \times 373 / 80.3 \times 1.00 = 88.0$ **1 mark**

The mass of the EF unit is 44.0 so the MF must be $C_4H_8O_2$ **1 mark**

**c.** Sodium hydroxide or potassium hydroxide – or any other soluble hydroxide. **1 mark**

**Question 9 (12 marks)**

**a.**



**1 mark** for showing all bonds correctly, **1 mark** for the cationic species correctly shown

**b.** Ala – Phe **$H_2NCH(CH_3)CO$**NHCH($CH_2C_6H_5$) COOH (Ala residue highlighted) **1 mark**

Phe – Ala $H_2NCH(CH_2C_6H_5)CO$**NHCH($CH_3$)COOH** (Ala residue highlighted) **1 mark**

**c.** Water (accept $H_2O$) **1 mark**

**d.** **i.** From the left

ion-ion bonds **1 mark**

hydrogen bonds **1 mark**

di-sulfide bonds **1 mark**

dispersion forces **1 mark**

**ii.** the disulfide link will be – S – S – **1 mark**

**iii.** hydrogen bonds are broken in the secondary structure **1 mark**

the covalent bonds in the primary structure are not affected **1 mark**

**END OF SUGGESTED SOLUTIONS**