

CHEMISTRY

Unit 3

Trial Examination

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.

	ONE ANSWER PER LINE		ONE ANSWER PER LINE
1	☒ ☐ ☒	11	☒ ☐ ☒
2	☒ ☐ ☒	12	☒ ☐ ☒
3	☒ ☐ ☐	13	☒ ☐ ☐
4	☒ ☐ ☐	14	☒ ☐ ☐
5	☒ ☐ ☒	15	☒ ☐ ☒
6	☒ ☐ ☐	16	☐ ☒ ☒
7	☐ ☒ ☒	17	☒ ☐ ☒
8	☒ ☐ ☒	18	☐ ☒ ☒
9	☒ ☐ ☒	19	☒ ☐ ☒
10	☒ ☐ ☒	20	☒ ☐ ☒

SECTION A (Total 20 marks)

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

Comments for Section A answers

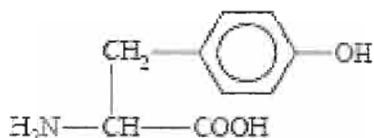
Question 1



Counting from the right gives the double bond at the 2nd C atom and the Cl on the 3rd C atom. **Correct answer is B.**

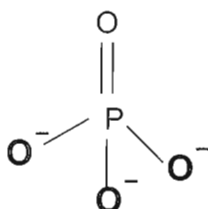
Question 2

From the data book the structure of tyrosine is shown below.



The benzene ring only has four H atoms but 6 C atoms. This gives 11 H atoms altogether. **Correct answer is C.**

Question 3



Each phosphate group bonds to two deoxyribose (sugar) units to make the backbone on DNA. This leaves one charged O atom. Hence DNA carries a negative charge. **Correct answer is D.**

Question 4

From the structures provided in the data book, guanine has the molecular formula $\text{C}_5\text{H}_5\text{N}_3\text{O}$ and cytosine has the molecular formula $\text{C}_4\text{H}_5\text{N}_3\text{O}$. This is a difference of CN_2 which is 40 g. **Correct answer is D.**

Question 5

Methanol is CH_3OH and stearic acid from the data book is $\text{CH}_3(\text{CH}_2)_{16}\text{COOH}$. The biofuel is the ester $\text{CH}_3(\text{CH}_2)_{16}\text{COOCH}_3$. **Correct answer is C.**

Question 6

$$n \text{ Mg(OH)}_2 \text{ in } 10 \text{ mL} = m/M = 400 \times 10^{-3} / 58.3 = 6.9 \times 10^{-3} \text{ mol}$$

$$n \text{ (OH}^-) \text{ in } 10 \text{ mL} = 2 \times n \text{ Mg(OH)}_2 = 13.8 \times 10^{-3} \text{ mol}$$

$$n \text{ (OH}^-) \text{ in } 1.0 \text{ L} = 13.8 \times 10^{-3} \times 1000 / 10 = 1.38 \text{ mol} = 1.4 \text{ mol}$$

Correct answer is D.

Question 7

$$n(\text{Cl}^-) = 0.250 \text{ mol} \quad n(\text{MgCl}_2) = 0.125 \text{ mol} \quad M(\text{MgCl}_2) = 95.3 \text{ g mol}^{-1}$$

$$m(\text{MgCl}_2) = n \times M = 0.125 \times 95.3 = 11.9 \text{ g} \quad \text{Correct answer is A.}$$

Question 8

$$n(\text{Zn}) = m/M = 3.27 / 65.4 = 0.0500 \text{ mol}$$

$$n(\text{H}_2) = n(\text{Zn})$$

Conditions given are at SLC. $V_m = 24.5 \text{ L mol}^{-1}$

$$V(\text{H}_2) = n \times V_m = 0.0500 \times 24.5 = 1.23 \text{ L. Correct answer is B.}$$

Question 9

$$n(\text{Zn}^{2+}) = n(\text{Zn}) \quad [\text{Zn}^{2+}] = n / V = 0.050 / 0.250 = 0.200 \text{ M} \quad \text{Correct answer is C.}$$

Question 10

Zn has been oxidised to Zn^{2+} . H^+ ions have been reduced to H_2 .

The reaction is a redox reaction. **Correct answer is C.**

Question 11

Draw out the structure of the ester. All of the individual groupings of the hydrogen nuclei are in different environments. There are four different ^1H environments. **Correct answer is C.**

Question 12

The molecule $\text{CH}_3\text{CH}_2\text{COOCH}_2\text{CH}_3$ is an ester formed from $\text{CH}_3\text{CH}_2\text{COOH}$ (propanoic acid) and HOCH_2CH_3 (ethanol). **Correct answer is C.**

Question 13

AAS uses a particular wavelength which is absorbed to determine quantitative information. Wavelengths absorbed are the same as wavelengths emitted. **Correct answer is D.**

Question 14

The indicator should change colour with the sharpest possible rise in pH. From the curve this looks like between 6 to 8.

From the data book

methyl red changes colour between 4.2 and 6.3

bromothymol blue changes colour between 6.0 and 7.6

phenol red changes colour between 6.8 and 8.4

phenolphthalein changes colour between 8.3 and 10

The only indicator that changes outside the entire range is phenolphthalein. **Correct answer is D.**

Question 15

The only base in the group is NaOH. **Correct answer is C.**

Question 16

Cl_2O_7 has Cl in oxidation state +7. HClO_4 has Cl in oxidation state +7. **Correct answer is A.**

Question 17

16 g of O_2 = $\frac{1}{2}$ a mole of molecules

1 g of H_2 = $\frac{1}{2}$ mol of H_2 but 1 mol of H atoms. Each H atom has one electron. ie 6.0×10^{23} ions

24 g C is 2 mol of C

1 mol of NaCl has 2 mol of ions. **Correct answer is B.**

Question 18

I is an addition reaction but can also be referred to as hydration as a water molecule is added across the double bond and II is an oxidation reaction. **Correct answer is A.**

Question 19

$n(\text{Na}) = m / M = 1051 \times 10^{-3} / 23.0 = 0.0457 \text{ mol}$ in 100 g $n(\text{Na}) = n(\text{NaCl}) = 0.0457 \text{ mol}$

$m(\text{NaCl}) = n \times M = 0.0457 \times 58.5 = 2.67$ in 100 g

in 1.0 g, $m(\text{NaCl}) = 0.0267 \text{ g}$. **Correct answer B.**

Question 20

The conical flask should not have been washed with base solution but with de-ionised water. More acid will be needed. The number of mole of base will be higher and therefore its concentration will appear higher. **Correct answer is C.**

SECTION B – Short answer questions

Question 1 (5 marks)

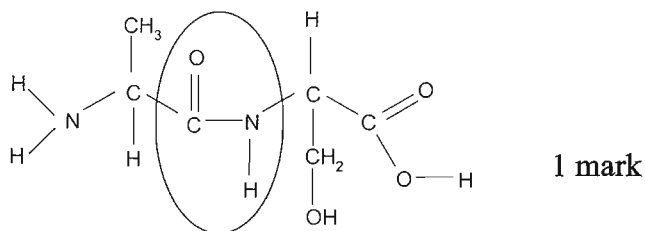
- a. i. +5 1 mark ii. $(\text{COOH})_2$ C is oxidised from +3 to +4 state 1 mark
- b. i. $(\text{COOH})_2 (\text{aq}) \rightarrow 2 \text{CO}_2 (\text{g}) + 2\text{H}^+(\text{aq}) + 2\text{e}^-$ 1 mark
- ii. $\text{BrO}_3^- (\text{aq}) + 6\text{H}^+(\text{aq}) + 6\text{e}^- \rightarrow \text{Br}^- (\text{aq}) + 3 \text{H}_2\text{O}(\text{l})$ 1 mark
- iii. $3(\text{COOH})_2 (\text{aq}) + \text{BrO}_3^- (\text{aq}) \rightarrow 6 \text{CO}_2 (\text{g}) + \text{Br}^- (\text{aq}) + 3 \text{H}_2\text{O}(\text{l})$ 1 mark

Question 2 (9 marks)

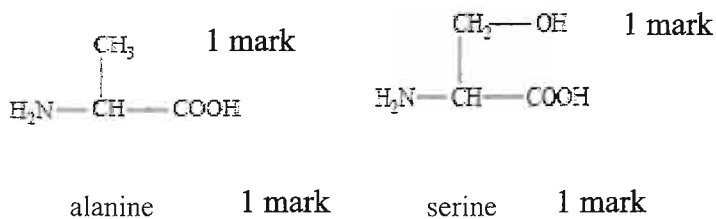
- a. The absorbance depends on concentration. The dependent variable is plotted on the y axis. 1 mark
- b. Correct plot of graph 2 marks ; labelling of axes 1 mark
- c. i. $1.24 \times 10^3 \text{ mg / L}$ 1 mark
- ii. therefore 124 mg in 100 mL 1 mark therefore 124 mg in original 1.35 g 1 mark
- iii. $\% \text{ Ni} = (124 \times 10^{-3}) \times 100 / 1.35 = 9.19 \%$ 1 mark
- d. All the light could have been absorbed giving a false reading. 1 mark

Question 3 (7 marks)

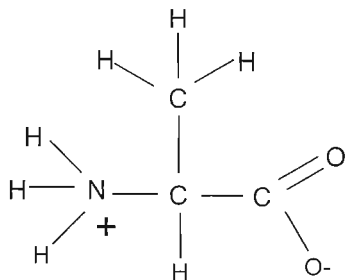
a.



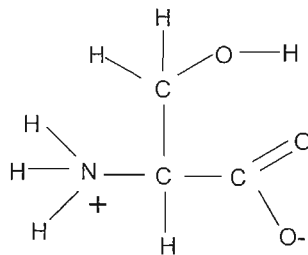
b.



c. i.

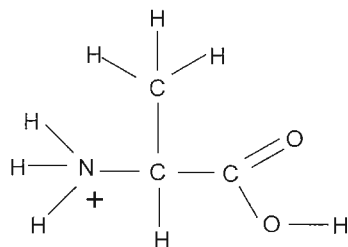


or

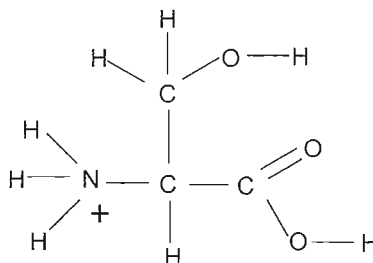


1 mark

ii.



or



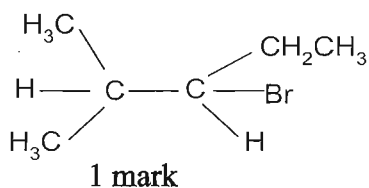
1 mark

Question 4 (6 marks)

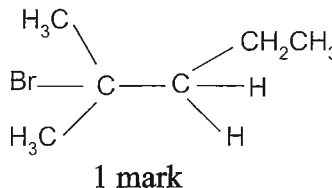
a. 2-methylpent-2-ene or 2-methyl-2-pentene 1 mark

b. Addition reaction. 1 mark

c.



1 mark



1 mark

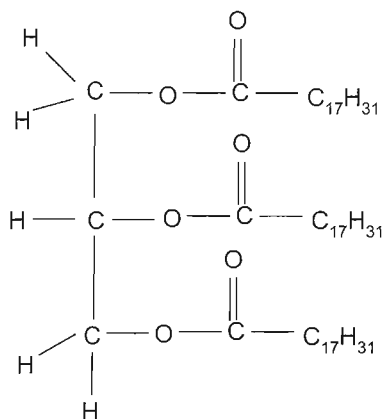
2-methyl-3-bromopentane 1 mark

2-bromo-2-methylpentane 1 mark

Question 5 (9 marks)

a. Glycerol shows only 2 peaks in the ^{13}C spectrum. 1 mark. Two of the carbons have identical environment 1 mark.

b.

correct overall structure 1 mark
all the relevant bonds shown 1 mark

- c. From the data book, linoleic acid has the formula $C_{17}H_{31}COOH$. Compared with stearic acid, $C_{17}H_{35}COOH$, which only has C/C single bonds, linoleic acid must have two C/C double bonds. **1 mark**
- d. $n(\text{triglyceride}) = m/M = 1.00 / 884 = 0.00113$ **1 mark**
 $n(Br_2) / n(\text{lipid}) = 6 / 1$ **1 mark** $n(Br_2) = 6 \times 1.00 \times 160 / 884 = 1.08 \text{ g}$ **1 mark**
- e. It would be approximately half of the previous answer as there are only three C/C double bonds. **1 mark**

Question 6 (8 marks)

- a. Oxidise propan-1-ol to propanoic acid using a suitable oxidising agent
1 mark for choosing to oxidise propan-1-ol and **1 mark** for $H^+ / Cr_2O_7^{2-}$ or equivalent
 $CH_3CH_2CH_2OH \rightarrow CH_3CH_2COOH$ **1 mark** for both correct semi-structural formulae
 concentrated H_2SO_4
 $CH_3CH_2COOH + HOCH_2CH_3 \rightarrow CH_3CH_2COOCH_2CH_3$
1 mark for the correct ester and **1 mark** for the **concentrated** sulfuric acid
 No need to balance equation. No need to write the structure of the alcohol in reverse.
 Note: A student who chooses to oxidise the incorrect alcohol but has everything else correct should score 4 marks
- b. Using fractional distillation **1 mark**
- c. The ester would have a $C=O$ stretch around 1700 cm **1 mark** but no broad OH stretch around 3300 cm.
 The ethanol would not have a $C=O$ stretch around 1700 cm but has a broad OH stretch around 3300 cm. **1 mark**

Question 7 (7 marks)

- a. $M(C_7H_6O_3) = 138 \text{ g mol}^{-1}$ $M(C_4H_6O_3) = 102 \text{ g mol}^{-1}$ $M(C_9H_8O_4) = 180 \text{ g mol}^{-1}$
1 mark for **all** the molar masses which need to be used for answering the question
 $n(C_7H_6O_3) = 3.00 / 138 = 0.0217 \text{ mol}$ $n(C_4H_6O_3) = 4.00 / 102 = 0.0392 \text{ mol}$
1 mark for calculating moles of **both** salicylic acid and acetic anhydride correctly.
1 mark for recognising that $C_7H_6O_3$ is the limiting reagent
 $n(C_7H_6O_3) = n(C_9H_8O_4)$ **1 mark**
 $m(C_7H_6O_3) = n \times M = 0.0217 \times 180 = 3.91 \text{ g}$ **1 mark**
- b. $\% \text{ yield} = 100 \times 2.0 / 3.91 = 51.2 \% = 51 \%$ **1 mark** (2 sf) **1 mark**

Question 8 (10 marks)

- a. The ester must have a molecular formula of $C_4H_8O_2$ 1 mark
- b. It could have the following semi structures
- i. $CH_3CH_2COOCH_3$ 1 mark
 - ii. $CH_3COOCH_2CH_3$ 1 mark
 - iii. $HCOOCH_2CH_2CH_3$ 1 mark
 - iv. $HCOOCH(CH_3)_2$ 1 mark
- c. The peak at 59 suggests a fragment of 29 has been lost – possibly $-CH_2CH_3$ 1 mark
could be circled in either i, ii, iii (accept any 2). If the student has looked at the whole spectrum they might conclude it can only be i. 1 mark
- d. 59 could be $(CH_3COO)^+$ 1 mark
57 could be $(CH_3CH_2CO)^+$ 1 mark
29 could be $(CH_2CH_3)^+$ 1 mark

There may be other possibilities. Accept any reasonable answer. Deduct a mark only once for omission of a positive charge.

Question 9 (5 marks)

- a. i. carbohydrates or polysaccharides 1 mark
- ii. starch or glycogen 1 mark
- b. i. oxidation or redox 1 mark
- ii. $C_6H_{12}O_6(aq) \rightarrow 2CO_2(g) + 2CH_3CH_2OH(aq)$ 1 mark + 1 mark for states

END OF SUGGESTED SOLUTIONS