

2010 UNIT 3 TRIAL MIDYEAR EXAM SOLUTIONS - UPDATED

Penalties : the usual ones! * max^m 1 mark off if incorrect numbers of significant figures are given
 * max^m 1 mark off if symbols of state are omitted
 * 1 mark off each time a unit is omitted from answer that requires a unit

SECTION A

Σ = 20

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

SECTION B

Σ = 60

* = 1 mark, */2 = ½ mark

(marks are allocated to working and not just the answer.)

Question 1 (1 + 1 + 2 + 2 + 2 = 8 marks) (Answers to correct sig figs - 3)

- a) $[H^+] = 10^{-pH} = 10^{-1.00} = \underline{0.100\text{ M}}$ *
 b) $n(H^+) = c \times V = 0.100 \times 20/1000 = \underline{0.00200\text{ mol}}$ *
 c) $n(OH^-) = n(H^+) = \underline{0.00200\text{ mol}}$ *
 $c(OH^-) = n/V = 0.00200/0.0158 = \underline{0.127\text{ M}}$ *
 d) $n(KOH) \text{ in } 500\text{ mL} = c \times V = 0.127 \times 500/1000 = \underline{0.0635\text{ mol}}$ *
 $m(KOH) \text{ in } 500\text{ mL} = n \times M = 0.0635 \times 56.1 = \underline{3.56\text{ g}}$ *
 e) mass water = mass of contaminated KOH - mass KOH
 $= 4.10 - 3.56 = \underline{0.54\text{ g}}$ *
 % water in contaminated sample = mass water/ mass contaminated sample x 100
 $= 0.54/4.10 \times 100/1 = \underline{13.2\%}$ * *(conseq related to ans for d)*

Question 2 (1 + 2 + 1 + 1 = 5 marks) (3 sig figs)

- a) $n(NaOH) = c \times V = 0.0988 \times 16.95/1000 = \underline{1.67 \times 10^{-3}\text{ mol}}$ *
 b) $n(\text{aspirin}) = n(NaOH) = \underline{1.67 \times 10^{-3}\text{ mol}}$ *
 $Mr(\text{aspirin}) 180\text{ g/mol}$
 $M(\text{aspirin}) = n \times M = 1.67 \times 10^{-3}\text{ mol} \times 180 = .301\text{ g} = \underline{301\text{ mg}}$ *
 c) Calculated result is **very close to stated manufacturers result** therefore there is a high level of quality control *
 d) Increasing amount of water will not change the number of mole of aspirin in the flask therefore there will be **no effect on the result.** * *(explanation required)*

Question 3 (1 + 2 + 2 = 5 marks)

- a) As the chain length (or molecular size) increases, the retention time increases. *
 b) The components have differing attractions to the stationary phase. *
 The components adsorb and desorb to the stationary phase by differing extents and therefore travel at different rates through the column.
 - OH and polarity of stationary phase could also be included in answer. *
 c) 40 mg (in 200ml) : 97.077 (peak area)
 $\times \text{mg} : 25.896$
 $x = 40 \times 25.896/97.077\text{ mg in } 200\text{ml} = \underline{10.7\text{ mg}}$ *
 mass (sample D) in 50 mL = $10.7 \times 50.0/200 = \underline{2.67\text{ mg}}$ *

Question 4 (1 + 2 + 3 + 2 = 8 marks)

- a) must be shown on graph */2, **0.33 – 0.35 μg /L** */2
 b) $c(\text{Hg}) \text{ in } 250\text{ mL flask} = \underline{0.34\text{ μg /L}}$
 $m(\text{Hg}) \text{ in } 250\text{ mL flask} = 250/1000 \times 0.34 = \underline{0.085\text{ μg}}$ *
 $m(\text{Hg}) \text{ in } 500\text{ mL flask} = 500/1 \times 0.085\text{ μg} = 43\text{ μg} = \underline{0.043\text{ mg}}$ *
 c) 0.043 mg was obtained in a 0.1373g sample.
 In mg/kg this = $0.043 / 0.1373 \times .001 = \underline{310\text{ mg/kg}}$ *

4c continued.... The concentration of mercury is **well above the recommended** maximum of 0.5 mg/kg and should not be traded commercially. *

- di mercury hollow cathode lamp. *
 dii Hg lamp emits specific wavelengths that can be absorbed by Hg in sample. *
 Absorbance can be used to determine concentration against a calibrated set of results.

Question 5 ((4 x 1) + 1 = 5 marks)

a Action	Calc result too low	No effect on result	Calc result too high
A. The volumetric flask had been washed previously with distilled water, but not dried.		√	
B. A 25.00 mL pipette was unknowingly used instead of a 20.00 mL pipette.			√
C. The mass of the fertiliser was recorded incorrectly. The recorded mass was 0.15 g less than the actual mass.	√		
D. The burette had been washed previously with distilled water only.			√

- b The sample of fertiliser solution transferred to the conical flask will be larger and contain more mole of Fe^{2+} ions. (*½)
 A greater volume of permanganate ions will be required making the mass of Fe^{2+} ions seem larger than they would be if 20.00 mL had been transferred. (*½)
 (Calculations are based on mole in 20.00 mL. Results will be 25% greater than expected).

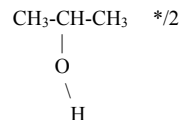
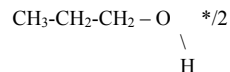
Question 6 ((4 x 1) + 2 + (1 + 1) = 8 marks)

(Note sequences I – IV can vary, answer to cii depends on sequence used)

- a I $\begin{array}{c} \text{O} \\ // \\ \text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-C} \\ \backslash \\ \text{O-H} \end{array}$ *
 All need to be structural
 Including $\text{CH}_3\text{-}$ and $\text{-CH}_2\text{-}$
 1 mark each
- II $\begin{array}{c} \text{O} \\ // \\ \text{CH}_3\text{-CH-CH}_2\text{-C} \\ | \quad \backslash \\ \text{CH}_3 \quad \text{O-H} \end{array}$ *
 Also requires bonds between O – H
 (-1 mark if omitted in all 4, - ½ in some)
- III $\begin{array}{c} \text{O} \\ // \\ \text{CH}_3\text{-CH}_2\text{-CH-C} \\ | \quad \backslash \\ \text{CH}_3 \quad \text{O-H} \end{array}$ *
- IV $\begin{array}{c} \text{CH}_3 \quad \text{O} \\ | \quad // \\ \text{CH}_3\text{-C-C} \\ | \quad \backslash \\ \text{CH}_3 \quad \text{O-H} \end{array}$ *
- b Compound X contains 4 different hydrogen environments *
 and 4 different C environments. *
- ci carboxylic acid II should be circled or the appropriate box for cii. *
- cii 3-methyl butanoic acid *

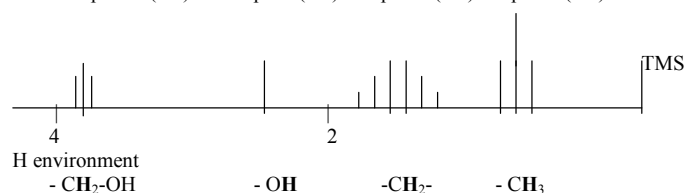
Question 7 ((1+2) + 1 + 2 + (½ + ½) + 2 = 9 marks)

- ai Addition reaction. Accept hydrolysis *
- aii Structure A or B
1-propanol */2 Structure B or A
2-propanol */2 (½ mark each)



O – H bond must be shown and CH₃- and -CH₂- must be 3 D structures.

- b The region above 1500 cm⁻¹ shows peaks related to the functional groups present in a molecule. */2
- Both molecules contain a O-H functional group, hence both show very similar peaks at 3000 – 3500 cm⁻¹. */2
- c Mr 29 due to CH₃CH₂⁺ ion. * (charge must be included)
- Structure A (1-propanol) could form this stable fragment. *
- di 3 */2 - 3 different C environments.
- dii 2 */2 - 2 C environments. The C in CH₃ at the ends of the molecule have the same environment. (note 2/3 if alcohols in different order)
- e 3 peaks (*/2) 1 peak (*/2) 6 peaks (*/2) 3 peaks (*/2)



Neighbour responsible

-CH₂- - -CH₂-X-CH₃ -CH₂-

Question 8 ((5 x 1) + 1 = 6 marks)

- a
- | | | | |
|---|--|-------------------------------|---------------|
| A | CH ₃ CH ₂ CH ₂ CH ₂ Cl | 1-chlorobutane | (½ mark each) |
| B | CH ₃ CH ₂ CHClCH ₃ | 2-chlorobutane | |
| C | CH ₃ CH ₂ CH ₂ CH ₂ OH | butan-1-ol or 1-butanol is ok | |
| D | CH ₃ CH ₂ CH ₂ COOH | butanoic acid | |
| E | CH ₃ CH ₂ CH ₂ COOCH ₃ | methyl butanoate | |
- b Fractional distillation as A and B will have different boiling points. *

Question 9 (1 + 1 + 1 = 3 marks)

- a sodium hydroxide or potassium hydroxide *
- b
- $$\text{CH}_3(\text{CH}_2)_7\text{CH=CH}(\text{CH}_2)_{11}\text{C} \begin{array}{c} \text{O} \\ || \\ \text{-O-CH}_2 \end{array}$$
- $$\text{CH}_3(\text{CH}_2)_7\text{CH=CH}(\text{CH}_2)_{11}\text{C} \begin{array}{c} \text{O} \\ || \\ \text{-O-CH} \end{array} \quad \text{* must be structural for ester bond}$$
- $$\text{CH}_3(\text{CH}_2)_7\text{CH=CH}(\text{CH}_2)_{11}\text{C} \begin{array}{c} \text{O} \\ || \\ \text{-O-CH}_2 \end{array}$$
- c
- $$\text{CH}_3(\text{CH}_2)_7\text{CH=CH}(\text{CH}_2)_{11}\text{C} \begin{array}{c} \text{O} \\ || \\ \text{-O-CH}_3 \end{array} \quad \text{* must be structural for ester bond}$$

Question 10 (1 + (1+1) + 1 = 4 marks)

- a
-
- (amino, peptide and carboxylic acid structure must be drawn)
- * must have bonds between N – H and O – H
- bi - peptide link *
- bii - on diagram *

- c
-
- * must have bonds between N – H and O – H

End of Answers