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) $[H^+] = 10^{-pH} = 10^{-1.00} =$ **0.100 M** *

b) $n(H^+)$= c x V = 0.100 x 20/1000 = **0.00200 mol** *

c) **$n(OH^-) = n(H^+) = 0.00200$mol** *
$c(OH^-)$= n/V = 0.00200/0.0158= **0.127 M** *

d) n(KOH) in 500 mL = c x V = 0.127 x 500/1000 = **0.0635 mol** *
m(KOH) in 500 mL = n x M = 0.0635 x 56.1 = **3.56 g** *

e) mass water = mass of contaminated KOH - mass KOH
= 4.10 - 3.56 = **0.54g** *
% water in contaminated sample = mass water/ mass contaminated sample x 100
= 0.54/4.10 x 100/1 = **13.2 %** * *(conseq related to ans for d)*

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

a n(NaOH) = c x V = 0.0988 x 16.95/1000 = **1.67×10^{-3} mol** *

b n(aspirin) = n(NaOH) = **1.67×10^{-3}** mol *
Mr(aspirin) 180 g/mol
M(aspirin) = n x M = 1.67 x 10^{-3} mol x 180 = .301 g = **301 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)
x mg : 25.896
x = 40 x 25.896/97.077 mg in 200ml = **10.7 mg** *
mass (sample D) in 50 mL = 10.7 x 50.0/200 = **2.67 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(Hg) in 250 mL flask = **0.34 µg /L**
m(Hg) in 250 mL flask = 250/1000 x 0.34 = **0.085 µg** *
m (Hg) in 500 mL flask = 500/1 x 0.085 µg = 43 µg = **0.043 mg** *

c 0.043 mg was obtained in a 0.1373g sample.
In mg/kg this = 0.043 / 0.1373 x .001 = **310 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)

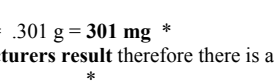
a Action	**Calc result too low**	**No effect on result**	**Calc result too high**
A. The volumetric flask had been washed previously with distilled water, but not dried.		√	
B. A 25.00 mL pipette was unknowingly used instead of a 20.00 mL pipette.			√
C. The mass of the fertiliser was recorded incorrectly. 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. (*/2)
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. (*/2)
(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)

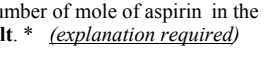
a I



*

All need to be structural
Including CH_3- and -CH_2-
1 mark each

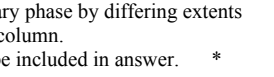
II



*

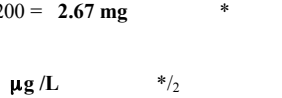
Also requires bonds between O – H (-1 mark if omitted in all 4, - ½ in some)

III



*

IV



*

b Compound X contains 4 different hydrogen environments *
and 4 different C environments. *

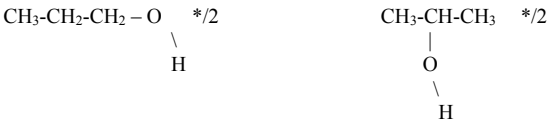
ci carboxylic acid II should be circled or the appropriate box for cii. *

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)



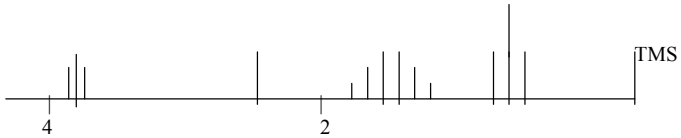
O – H bond must be shown and CH_3- and -CH_2- must be 3 D structures.

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 $CH_3CH_2^+$ 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 CH_3 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)



H environment
- C**H**$_2$-OH - O**H** -C**H**$_2$- - C**H**$_3$

Neighbour responsible
-CH_2- - -CH_2-X-CH_3 -CH_2-

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

a

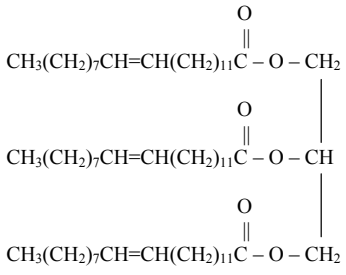
A	$CH_3CH_2CH_2CH_2Cl$	1-chlorobutane	
B	$CH_3CH_2CHClCH_3$	2-chlorobutane	(½ mark each)
C	$CH_3CH_2CH_2CH_2OH$	butan-1-ol or 1-butanol is ok	
D	$CH_3CH_2CH_2COOH$	butanoic acid	
E	$CH_3CH_2CH_2COOCH_3$	methyl butanoate	

b Fractional distillation as A and B will have different boiling points. *

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

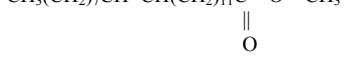
a sodium hydroxide or potassium hydroxide *

b



* must be structural for ester bond

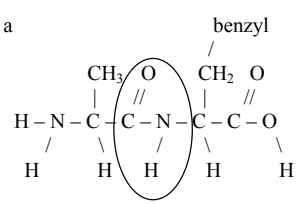
c



* must be structural for ester bond

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

a

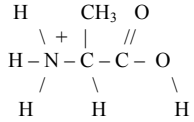


(amino, peptide and carboxylic acid structure must be drawn)

* 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