

CSE – MAY 2012

YEAR 12 CHEMISTRY

Written test 1

ANSWERS & SOLUTIONS BOOK

SECTION A – Multiple choice questions (20 marks)

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

EXPLANATION

1.	C	$M(\text{C}_{19}\text{H}_{39}\text{COOH}) = (20 \times 12 + 40 + 32) = 312$ $m(\text{one molecule}) = M / N_A$ $= 312 / 6.02 \times 10^{23}$ $= 5.18 \times 10^{-22} \text{ g}$
2.	B	$pV = nRT$ so $n = \frac{pV}{RT}$ $= \frac{101.3 \times 0.250}{8.31 \times 298}$ $m = n \times M$ $= \left(\frac{101.3 \times 0.250}{8.31 \times 298} \right) \times 44 = 0.45 \text{ g}$
3.	B	$27.60 - 0.15 = 27.45 \text{ mL}$
4.	D	Note that $\text{CH}_3\text{CH}_2\text{NH}_2$ is a semi-structural formula not a molecular formula.
5.	B	The components with the lowest boiling point will vapourise firstly as the distillation occurs and they will condense at the top of the column where it is coolest.
6.	D	Methyl red is red in an ammonium nitrate, NH_4NO_3 , solution which is acidic.
7.	A	A double bond is stronger than a single bond between carbon atoms and so stretching the double bond requires more energy.
8.	C	An absorbance of 0.17 corresponds to a reading from the graph of concentration 340 mg L^{-1} . $c(\text{original sample}) = \frac{340 \times 50.00}{10.0} = 1700 \text{ mg L}^{-1} = 1.7 \text{ g L}^{-1}$.
9.	C	Hydrolysis of aspirin will produce salicylic acid which has a hydroxyl group. The structure of the molecule that produces a peak at 2.3 can be found in the data book.
10.	C	Refer to data book to find structures.
11.	A	The size of a sample of DNA must be increased before analysis. This achieved with PCR.
12.	D	Arsenic is a metalloid which can be detected by AAS.
13.	B	Fragment C with more base pairs will be larger in size than A and so it will not move as far along the stationary phase. Origin 2 must have been the origin.
14.	B	Since $-2 \times 5 + -2 = -12$, and there are four Sb ions to balance the -12 charge. The oxidation number of each Sb ion is +3. For $\text{K}_2\text{C}_2\text{O}_4$ the oxidation number of each C = +3 to balance $(4 \times -2 + 2) = -6$.
15.	D	HPLC is the most suitable technique.
16.	A	Colours higher up the page show higher R_f values as the distance travelled is greater than those further down and $R_f = \text{Distance travelled} / \text{solvent front}$. Particles of higher colours spend less time adsorbed to the stationary phase.
17.	C	Note that the cyclic ring has 8 hydrogen atoms attached to it.
18.	A	Fermentation involves the production of an alkanol and carbon dioxide.
19.	A	The functional groups are -S-, -COOH (an acid group which will react with a base) and -NH ₂ (a basic group that will react with an acid).
20.	B	Glycerol is formed in the process of the hydrolysis of a triglyceride involving methanol.

SECTION B – Short answer questions (60 marks)**Question 1 (1 + 2 + 1 + 1 + 2 + 1 + 1 = 9 marks)**

- a. $\text{Sn}^{2+}(\text{aq}) \rightarrow \text{Sn}^{4+}(\text{aq}) + 2\text{e}^-$ 1 mark
- b. $\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + 14\text{H}^+(\text{aq}) + 6\text{e}^- \rightarrow 2\text{Cr}^{3+}(\text{aq}) + 7\text{H}_2\text{O}(\text{l})$ 2 marks
 $\text{Sn}^{2+}(\text{aq}) \rightarrow \text{Sn}^{4+}(\text{aq}) + 2\text{e}^- \times 3$
 $\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + 14\text{H}^+(\text{aq}) + 3\text{Sn}^{2+}(\text{aq}) \rightarrow 2\text{Cr}^{3+}(\text{aq}) + 7\text{H}_2\text{O}(\text{l}) + 3\text{Sn}^{4+}(\text{aq})$
- c. $n(\text{Sn}^{2+}(\text{aq})) = c \times V = 0.105 \times 0.0265 = 2.78 \times 10^{-3} \text{ mol}$ 1 mark
- d. $n(\text{Cr}_2\text{O}_7^{2-}(\text{aq})) = n(\text{Sn}^{2+}(\text{aq}))/3 = 9.28 \times 10^{-4} \text{ mol}$ 1 mark
- e. $n(\text{Cr}_2\text{O}_7^{2-}(\text{aq})) = n(\text{K}_2\text{Cr}_2\text{O}_7(\text{s})) = 9.28 \times 10^{-4} \text{ mol}$ 2 marks
 $m = n \times Mr = 9.28 \times 10^{-4} \times 294.2 = 0.273 \text{ g}$
- f. $\%(\text{K}_2\text{Cr}_2\text{O}_7(\text{s})) = 0.273 / 0.355 \times 100 = 76.9\%$ 1 mark
- g. The ions in sodium sulfate will not react with the dichromate ion but the Fe^{2+} ions will be oxidised to Fe^{3+} 1 mark

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

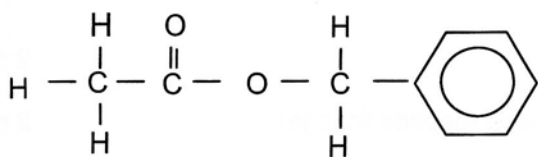
- a. $2\text{Al}(\text{s}) + 6\text{HCl}(\text{aq}) \rightarrow 2\text{AlCl}_3(\text{aq}) + 3\text{H}_2(\text{g})$ 1 mark
- b. $n(\text{HCl}) = c \times V = 1.50 \times 100/1000 = 0.150 \text{ mol}$ 2 marks
 $n(\text{Al})_{\text{reacted}} = 2/6 \times 0.150 = 0.0500 \text{ mol}$
 $m(\text{Al})_{\text{reacted}} = 0.0500 \times 27.0 = 1.35 \text{ g}$
 $m(\text{Al})_{\text{unreacted}} = 23.5 - 1.35 = 22.2 \text{ g}$
- c. $n(\text{H}_2(\text{g})) = 3/6 \times n(\text{HCl}) = 0.0750 \text{ mol}$ 2 marks
 $V(\text{H}_2(\text{g})) = 0.0750 \times 24.5 = 1.84 \text{ L}$

Question 3 (1 + 1 + 1 + 2 + 1 + 2 + 2 + 1 = 11 marks)

- a. Mass Spectrometry or percentage composition analysis 1 mark
- b. Alkanol and alkene 1 mark
- c. Decolourising of bromine or acidified potassium permanganate solutions 1 mark
- d. $\text{CH}_3\text{CH}_2\text{COCH}_3$ 2 marks
- e. 4 peaks 1 mark
- f. CH_3CH_2^+ 29 and CH_3CO^+ 43 2 marks
- g.
$$\begin{array}{ccccccc} \text{H} & \text{H} & & \text{H} & \text{H} & & \\ | & | & & | & | & & \\ \text{C} & = & \text{C} & - & \text{C} & - & \text{C} & - & \text{O-H} \\ | & & & | & | & & \\ \text{H} & & & \text{H} & \text{H} & & \end{array}$$
 2 marks
or any isomer of the above
- h. Isomers 1 mark

Question 4 (2 + 1 + 1 + 2 + 1 = 7 marks)

a.

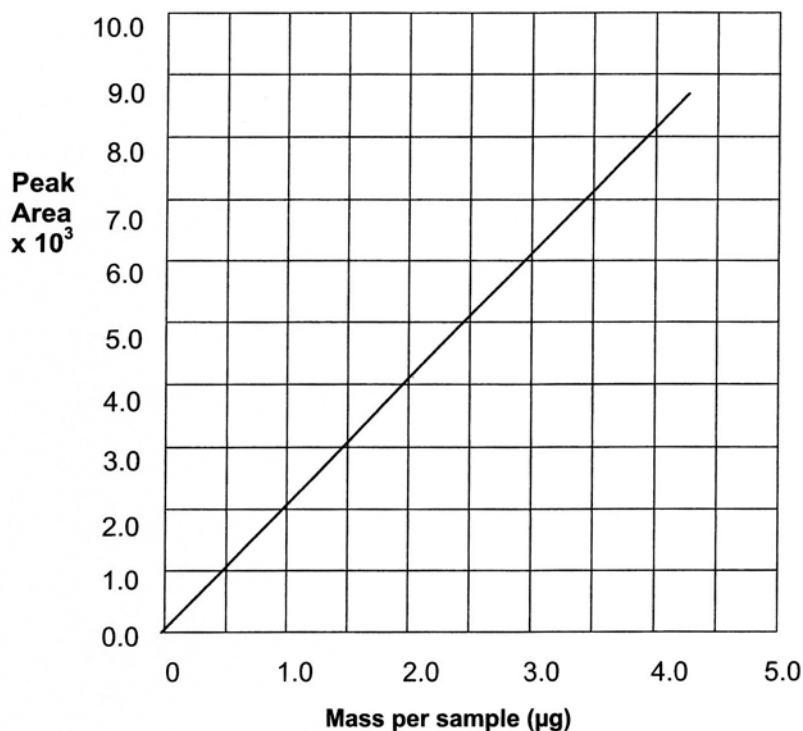


Reverse structural formula not acceptable because alkanol section should be drawn last. 2 marks

b. Water 1 mark

c. Benzyl ethanoate is heat stable and volatile 1 mark

d.



The mass of the unknown sample is 1.7 µg

e. By comparing retention times which should match the standard benzyl ethanoate solution or by 'spiking' the sample with benzyl ethanoate. 1 mark

Question 5 (1 + 3 = 4 marks)

a. $\text{CH}_3\text{COOCH}_3$ 1 mark

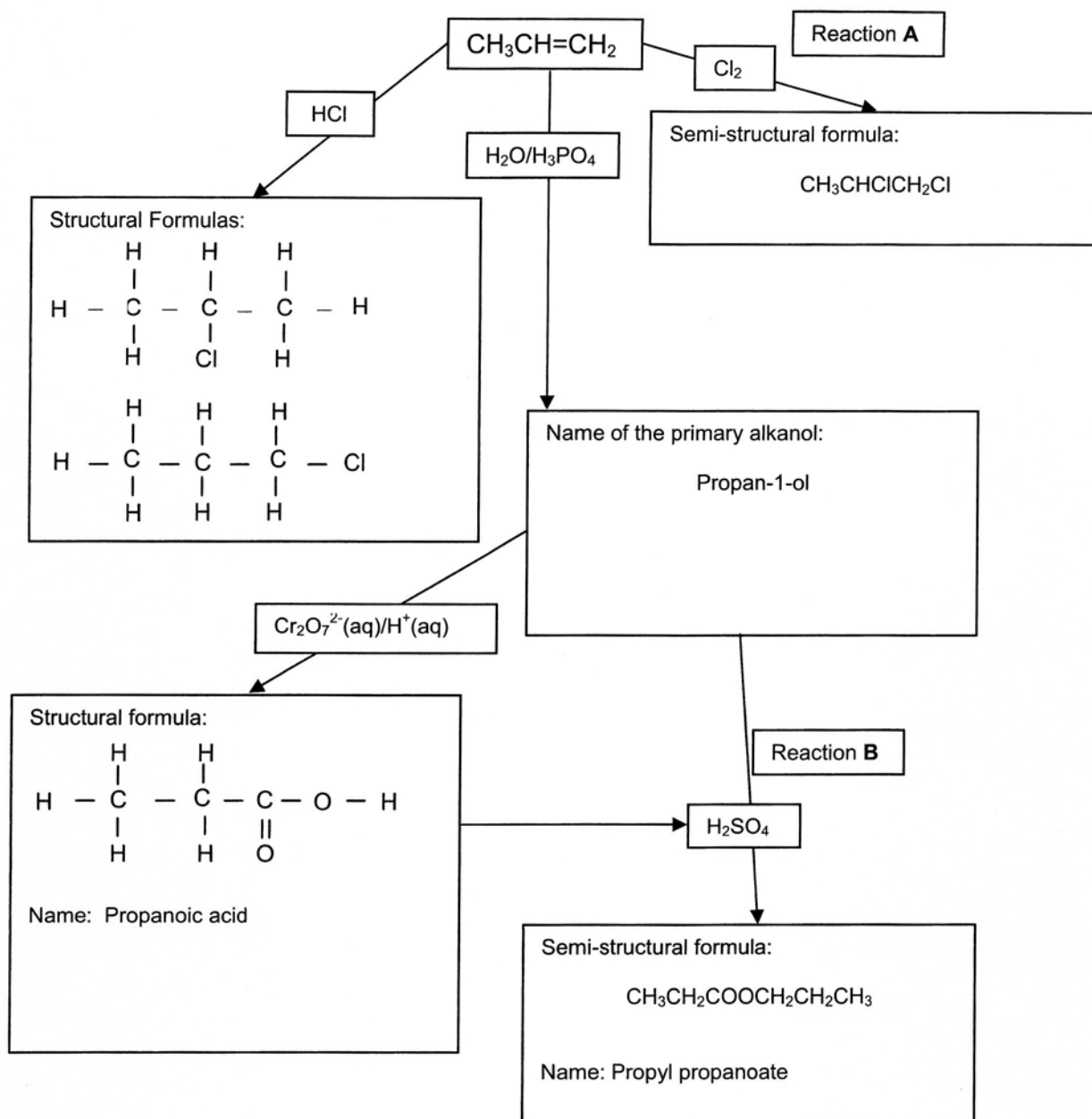
b. i. $\text{CH}_3\text{COOCH}_3^+$ or $\text{C}_3\text{H}_6\text{O}_2^+$ 1 mark

ii. 74 1 mark

iii. $\text{CH}_3\text{COOCH}_3^+ \rightarrow \underset{43}{\text{CH}_3\text{CO}^+} + \underset{31}{\text{OCH}_3}$ 1 mark

Question 7 (8 + 1 + 1 = 10 marks)

a.



- a. Addition reaction 1 mark
- b. Condensation or esterification 1 mark

Question 8 (1 + 2 + 1 + 1 = 5 marks)

- a. Oxidant due to removal of oxygen or decrease in oxidation state 1 mark
- b. $n(\text{aspirin}) = 1.80/180 = 0.0100 \text{ mol}$ $n(\text{aspirin}) = n(\text{amide}) = 0.0100 \text{ mol}$ 2 marks
 $m(\text{amide}) = 0.0100 \times 179 = 1.79 \text{ g}$
 $\% \text{ yield} = 1.10/1.79 \times 100 = 61.5\%$
- c. Incomplete reaction, side-reaction, loss of product during isolation/purification 1 mark
- d. Amide is polar like the carboxylic acid functional group and is more likely to have similar intermolecular bonding than a nonpolar $-\text{CH}_3$. 1 mark