CSE CENTRE FOR STRATEGIC EDUCATION
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IARTV

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**	$M(C_{19}H_{39}COOH) = (20 \times 12 + 40 + 32) = 312$ m(one molecule) = M / N_A $= 312/ 6.02 \times 10^{23}$ $= 5.18 \times 10^{-22}$ g
2.	**B**	$pV = nRT$ so $n = \frac{pV}{RT}$ $= \frac{101.3 \times 0.250}{8.31 \times 298}$ $m = n \times M$ $= (\frac{101.3 \times 0.250}{8.31 \times 298}) \times 44 = 0.45$ g
3.	**B**	27.60 – 0.15 = 27.45 mL
4.	**D**	Note that $CH_3CH_2NH_2$ 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(original sample) = $\frac{340 \times 50.00}{10.0}$ = 1700 mg L^{-1} = 1.7 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 × 5 + -2 = -12, and there are four Sb ions to balance the -12 charge. The oxidation number of each Sb ion is +3. For $K_2C_2O_4$ the oxidation number of each C = +3 to balance (4 × -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 = Distance travelled/ 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. $Sn^{2+}(aq) \rightarrow Sn^{4+}(aq) + 2e^-$ — 1 mark

b. $Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \rightarrow 2Cr^{3+}(aq) + 7H_2O(l)$ — 2 marks

$Sn^{2+}(aq) \rightarrow Sn^{4+}(aq) + 2e^- \times 3$

$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 3Sn^{2+}(aq) \rightarrow 2Cr^{3+}(aq) + 7H_2O(l) + 3Sn^{4+}(aq)$

c. $n(Sn^{2+}(aq)) = c \times V = 0.105 \times 0.0265 = 2.78 \times 10^{-3}$ mol — 1 mark

d. $n(Cr_2O_7^{2-}(aq)) = n(Sn^{2+}(aq)/3 = 9.28 \times 10^{-4}$ mol — 1 mark

e. $n(Cr_2O_7^{2-}(aq)) = n(K_2Cr_2O_7(s)) = 9.28 \times 10^{-4}$ mol — 2 marks

$m = n \times Mr = 9.28 \times 10^{-4} \times 294.2 = 0.273$ g

f. $\%(K_2Cr_2O_7(s)) = 0.273 / 0.355 \times 100 = 76.9\%$ — 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. $2Al(s) + 6HCl(aq) \rightarrow 2AlCl_3(aq) + 3H_2(g)$ — 1 mark

b. $n(HCl) = c \times V = 1.50 \times 100/1000 = 0.150$ mol — 2 marks

$n(Al)_{reacted} = 2/6 \times 0.150 = 0.0500$ mol

$m(Al)_{reacted} = 0.0500 \times 27.0 = 1.35$ g

$m(Al)_{unreacted} = 23.5 - 1.35 = 22.2$ g

c. $n(H_2(g)) = 3/6 \times n(HCl) = 0.0750$ mol — 2 marks

$V(H_2(g)) = 0.0750 \times 24.5 = 1.84$ 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

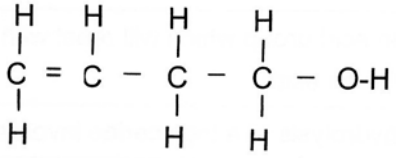
c. Decolourising of bromine or acidified potassium permanganate solutions — 1 mark

d. $CH_3CH_2COCH_3$ — 2 marks

e. 4 peaks — 1 mark

f. $CH_3CH_2^+$ 29 and CH_3CO^+ 43 — 2 marks

g. — 2 marks

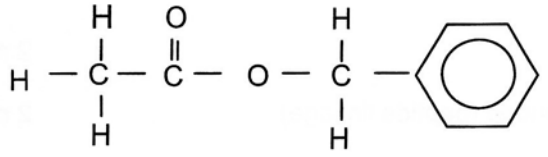


or any isomer of the above

h. Isomers — 1 mark

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

a.

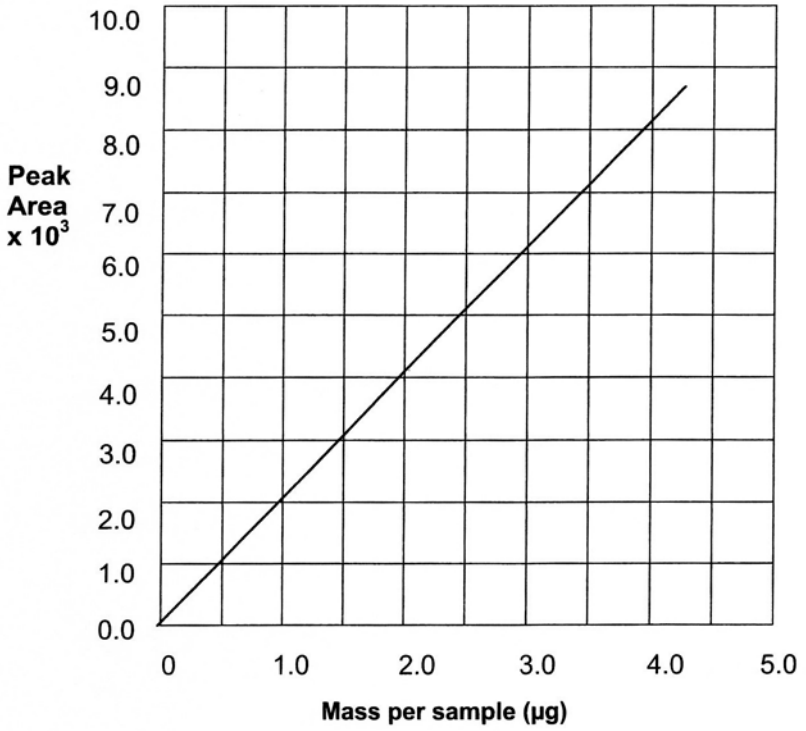


Reverse structural formula not acceptable because alkanol section should be drawn last. 2 marks

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. CH_3COOCH_3 1 mark

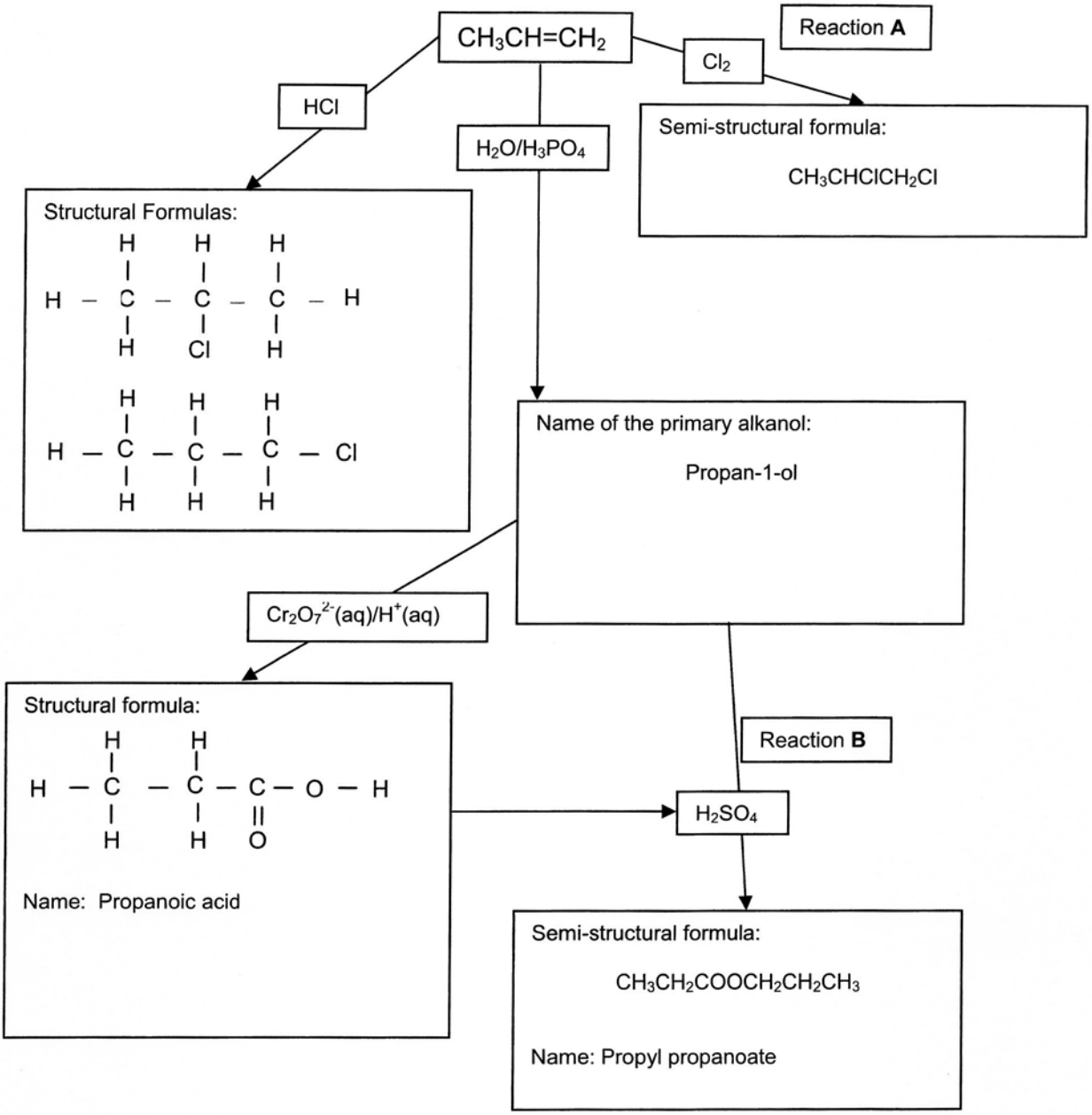
b. **i.** $CH_3COOCH_3^+$ or $C_3H_6O_2^+$ 1 mark

ii. 74 1 mark

iii. $CH_3COOCH_3^+ \rightarrow \underset{43}{CH_3CO^+} + \underset{31}{OCH_3}$ 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(aspirin) = 1.80/180 = 0.0100 mol n(aspirin) = n(amide) =0.0100 mol
m(amide)= 0.0100 x 179 = 1.79 g
% yield = 1.10/1.79 x 100 = 61.5% — 2 marks

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 -CH_3. — 1 mark