CSSA

# CATHOLIC SECONDARY SCHOOLS ASSOCIATION OF NSW
# 2020 TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION
# CHEMISTRY – MARKING GUIDELINES

## Section I
**20 marks**

**Questions 1-20** (1 mark each)

| Question | Answer | Outcomes Assessed | Targeted Performance Band |
|---|---|---|---|
| 1 | C | CH11/12-12 | 2-3 |
| 2 | D | CH12-12 | 2-3 |
| 3 | D | CH12-14 | 2-3 |
| 4 | A | CH12-5 | 3 |
| 5 | C | CH11/12-6, CH12-15 | 2-3 |
| 6 | D | CH12-13 | 3-4 |
| 7 | B | CH12-7 | 3-4 |
| 8 | D | CH12-6, CH12-14 | 3-4 |
| 9 | B | CH12-5, CH12-13 | 4 |
| 10 | B | CH12-13 | 4 |
| 11 | C | CH12-15 | 3-4 |
| 12 | C | CH12-12, CH12-15 | 4-5 |
| 13 | A | CH12-5 | 5-6 |
| 14 | A | CH12-5, CH12-13 | 4-5 |
| 15 | D | CH12-12 | 4-5 |
| 16 | A | CH11/12-5, CH11/12-6, CH12-14 | 4-5 |
| 17 | A | CH12-6, CH12-12 | 4-5 |
| 18 | B | CH12-6 | 4-5 |
| 19 | A | CH12-14, CH12-15 | 4-5 |
| 20 | C | CH12-12, CH11-11 | 5-6 |

## Section II
**80 marks**

**Question 21 (a)**(3 marks)
***Outcomes Assessed:*** **CH11/12-5, CH11/12-6, CH12-14, CH12-15**
***Targeted Performance Bands:*** **2-5**

| Criteria | Marks |
|---|---|
| • Correctly identifies both compounds<br>• Explains the solubility of both compounds<br>• Identifies the acidity of the acid | 3 |
| • Correctly identifies BOTH compounds | 2 |
| • Identifies ONE of the compounds that is water soluble | 1 |

***Sample Answer:***

Propanol, which contains the hydrophilic –OH group, and acetic acid, which contains the hydrophilic –COOH group, are both soluble in water. When acetic acid dissolves in water, the acidic hydrogen on the –COOH group ionises, making the solution acidic. So **A** is acetic acid and **D** is propanol.

**Question 21 (b)**(4 marks)
***Outcomes Assessed:*** **CH11/12-2, CH11/12-3, CH11/12-5, CH11/12-6, CH12-14, CH12-15**
***Targeted Performance Bands:*** **3-5**

| Criteria | Marks |
|---|---|
| • Outlines a suitable method, with approximate quantities<br>• Identifies suitable safety precautions, including one beyond PPE<br>• Identifies the expected results | 4 |
| • Outlines a suitable method, with approximate quantities<br>• Identifies a suitable safety precaution (may include PPE)<br>• Identifies the expected results | 3 |
| • Any TWO of the above points (may include PPE) | 2 |
| • Any ONE of the above points (may include PPE) | 1 |

***Sample Answer:***

The simplest method to distinguish between hexane and 1-hexene is to conduct a bromine water test:

1. Conduct the experiment in a fumehood (probably best to ask your teacher to conduct the experiment). They should be wearing safety glasses, a labcoat and using gloves.
2. Pour **B** and **C** into separate test tube to a height of 3 cm.
3. Add 1 cm of the orange bromine water and stir vigorously.
4. The test tube with hexane will still have orange, whereas the test tube containing 1-hexene should go completely clear.
5. Dispose of both solutions in an appropriate container for organic waste.

**Question 22 (a)** (2 marks)
***Outcomes Assessed:*** **CH11/12-5, CH11/12-7, CH12-12**
***Targeted Performance Bands:*** **2-3**

| Criteria | Marks |
|---|---|
| • Uses LCP and the reaction equation to provide a valid reason | 2 |
| • Provides a valid reason | 1 |

***Sample Answer:***

The theoretical yield assumes complete reaction has occurred. This is an equilibrium system, so completion does not occur. As the system achieves equilibrium, the rate of the forward and reverse reactions will be equal and concentrations of all species will be constant, as predicted by Le Chatelier's Principle.

**Question 22(b)** (3 marks)
***Outcomes Assessed:*** **CH11/12-5, CH11/12-6, CH12-12**
***Targeted Performance Bands:*** **3-5**

| Criteria | Marks |
|---|---|
| • Explains differences in terms of increased rate for C AND lower yield for C due to reverse reaction being favoured at higher temperature | 3 |
| • Explains differences in terms of increased rate for C OR lower yield for C due to reverse reaction being favoured at higher temperature | 2 |
| • Makes a comparison statement | 1 |

***Sample Answer:***

The reaction is exothermic in the forward direction. If the temperature of the system is increased it will favour the reverse reaction, resulting in a decreased yield, as is shown in the graph with line C. Increasing the temperature also increases the rate of reaction, so equilibrium will be achieved more quickly, as is also shown on the graph for line C.

**Question 23** (4 marks)
***Outcomes Assessed: CH11/12-6, CH12-13***
***Targeted Performance Bands:* 3-5**

| Criteria | Marks |
|---|---|
| • Correct equation, with states<br>• Correct calculation of mol of $H^+$ and $OH^-$<br>• Correct mol of excess converted to concentration<br>• Correct pH | 4 |
| • As above, with one major calculation error<br>• As above, but calculates pOH | 3 |
| • Correct equation<br>• Correct calculation of mol of $H^+$ and $OH^-$ | 2 |
| • Correct equation OR<br>• Correct calculation of mol of $H^+$ and $OH^-$ | 1 |

***Sample Answer:***

Eqn: $H_2SO_4\,(aq) + 2KOH\,(aq) \rightarrow K_2SO_4\,(aq) + 2H_2O\,(l)$

Total Volume = 0.055 L

Moles of $H^+$ = 2 x 0.15 x 030 = 0.0090 mol

Moles of $OH^-$ = 0.39 x 0.025 = 0.00975 mol

Excess moles $OH^-$ = $7.5x10^{-4}$ mol

$[OH^-]$ = $7.5x10^{-4}$ mol/0.055 = 0.0136 mol $L^{-1}$

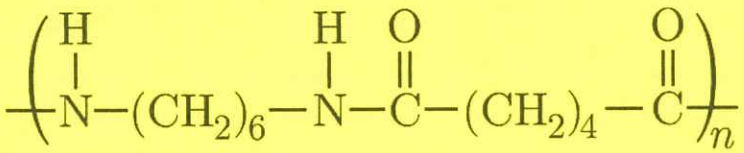
pOH = -log0.0136 = 1.865

pH = (14 – 1.8653..) = 12.13

**Question 24(a)** (1 mark)
***Outcomes Assessed:*** **CH11/12-6, CH12-14**
***Targeted Performance Bands:*** **3-4**

| Criteria | Mark |
|---|---|
| • Correctly draws the structure for the polymer | 1 |

***Sample Answer:***



**Question 24(b)** (3 marks)
***Outcomes Assessed:*** **CH12-14**
***Targeted Performance Bands:*** **3-4**

| Criteria | Marks |
|---|---|
| • Describes structure and relates to properties | 3 |
| • Describes structure OR properties | 2 |
| • Provides relevant information | 1 |

***Sample Answer:***

Nylon can be moulded or drawn into fibres to make fabric. It is strong, waterproof and resistant to attack by fungi and bacteria. Can be used for umbrellas, rope, fishing lines, dental floss, tents, carpet. Nylon is used when mechanical strength, rigidity and stability to heat and chemicals are required for example, pipes and machine parts.

**Question 25** (3 marks)
***Outcomes Assessed: CH11/12-6, CH11/12-7, CH12-13***
***Targeted Performance Bands:* 4-5**

| Criteria | Marks |
|---|---|
| • Correct equilibrium expression<br>• Correctly substituted values<br>• Correct answer | 3 |
| • Correct equilibrium expression<br>• Correctly substituted values<br>• Incorrect answer | 2 |
| • Correct equilibrium expression | 1 |

***Sample Answer:***

$K_a = [H_3O^+]\ [CH_3CH_2COO^-] / [CH_3CH_2COOH]$

$[H_3O^+] = 10^{-pH}$

$[H_3O^+] = 0.00012589 \text{ mol } L^{-1} = [CH_3CH_2COO^-]$

$[CH_3CH_2COOH] = 0.001 - 0.000126 = 0.000874 \text{ mol } L^{-1}$

$K_a = 1.82 \times 10^{-5}$

**Question 26 (a)** (5 marks)
***Outcomes Assessed:* CH11/12-5, CH11/12-6, CH12-13**
***Targeted Performance Bands:* 3-6**

| Criteria | Marks |
|---|---|
| • Identifies mol ratio of gallic acid to NaOH (1:1) from equation<br>• Correct moles of NaOH<br>• Correct moles of gallic acid<br>• Correct substitution and calculates concentration of gallic acid to 2 sig fig. | 5 |
| • As above but included outlier when calculating average volume | 4 |
| • As above with no equation and one error | 3 |
| • As above with two errors | 2 |
| • Identifies mol ratio of gallic acid to NaOH | 1 |

***Sample Answer:***

Eqn: $C_6H_2(OH)_3COOH(aq) + NaOH(aq) \rightarrow C_6H_2(OH)_3COONa(aq) + H_2O(l)$

Mol ratio of Gallic acid : NaOH is 1:1

Average titre = 9.1 mL (do not include the outlier)

Mole of NaOH = $0.0091 \times 0.012 = 0.00010920$ mol

Mole of Gallic = 0.0001092 mol

[gallic acid] = $0.000109210.25 = 0.004368 \text{ mol } L^{-1} = 0.0044 \text{ mol } L^{-1}$

**Question 26(b)** (2 marks)
***Outcomes Assessed:*** **CH11/12-6**
***Targeted Performance Bands:*** **4-5**

| Criteria | Marks |
|---|---|
| • Correct molar mass of tannic acid<br>• Correct mass of tannic acid in raisin | 2 |
| • Correct process with one error | 1 |

***Sample Answer:***

MM of Gallic acid = 170.118 g $mol^{-1}$

Tannic acid contains 5 monomers. Four molecules of water are eliminated.

Molar mass = (170.118 x 5) – (18.016x4) = 778.526 g $mol^{-1}$

Mass of tannic acid present = 778.526 x (0.001092/5) = 0.017 g.

**Question 27** (4 marks)
***Outcomes Assessed:*** **CH12-7, CH12-14**
***Targeted Performance Bands:*** **3-5**

| Criteria | Marks |
|---|---|
| • Uses a flowchart showing all correct reagents and processes<br>• Writes an appropriate chemical equation showing the production of the ester | 4 |
| • Uses a flowchart showing all correct reagents and processes | 3 |
| • Uses a flowchart showing some correct reagents and processes | 2 |
| • Provides relevant information | 1 |

***Sample Answer:***

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Reagents (see below) | Refluxed for 30-45 minutes | Ester mixture | Sodium carbonate and volume of water added | Ester + aqueous solution after escape of $CO_2$ | Aqueous layer removed using separating funnel | Mainly ester | Distill, optional | Purified ester |
| | **STEP 1** | | **STEP 2** | | **STEP 3** | | **STEP 4** | |

Propan-1-ol + hexanoic acid (using conc. sulfuric acid) is heated in reflux apparatus → ester is insoluble in water and can be separated using a separating funnel.

$CH_3CH_2CH_2OH + CH_3CH_2CH_2CH_2CH_2COOH \rightleftharpoons CH_3CH_2CH_2OOCCH_2CH_2CH_2CH_2CH_3 + H_2O$

**Question 28(a)** (3 marks)
***Outcomes Assessed:*** **CH12-12**
***Targeted Performance Bands:*** **3-6**

| Criteria | Marks |
|---|---|
| • Correctly calculates the molar solubility of silver bromide and shows all correct working | 3 |
| • As above with one error | 2 |
| • Showed some relevant understanding | 1 |

***Sample Answer:***

| | | | | | |
|---|---|---|---|---|---|
| ***Reaction*** | ***AgBr*** | ⇌ | $Ag^+$ | + | $Br^-$ |
| ***Initial*** | | | 0 | | 0.2 |
| ***Change*** | | | $+x$ | | $+x$ |
| ***Equilibrium*** | | | $x$ | | 0.2 |

$K_{sp} = [Ag^+] [Br^-]$

$5.35 \times 10^{-13} = [x] [0.2]$

$x = 5.35 \times 10^{-13}/0.20$

$x = 2.67 \times 10^{-12}$ molL$^{-1}$

**Question 28(b)** (3 marks)
***Outcomes Assessed:*** **CH12-12**
***Targeted Performance Bands:*** **4-6**

| Criteria | Marks |
|---|---|
| • Correctly used Le Chatelier's Principle to explain the decrease in solubility<br>AND<br>• References the 'Common Ion' effect | 3 |
| • Correctly used Le Chatelier's Principle to explain the decrease in solubility | 2 |
| • Showed some relevant understandings | 1 |

***Sample Answer:***

According to LCP a system in equilibrium will shift to minimise a change. The solution of sodium bromide already contains bromide ions (common ion) therefore if the concentration of bromide ions is increased, the reverse reaction will be favoured. This will result in the solubility of silver bromide decreasing.

**Question 29** (5 marks)
***Outcomes Assessed:*** **CH12-6, CH12-14**
***Targeted Performance Bands:*** **4-5**

| Criteria | Marks |
|---|---|
| • Uses correct equations to show the production of aldehydes and ketones from primary and secondary alcohols respectively<br>• Describes how carboxylic acid can be produced from primary alcohols using structural diagrams for primary and secondary alcohols<br>• Explains how to differentiate between a primary and secondary alcohol | 5 |
| • Uses correct equations to show the production of aldehydes and ketones from primary and secondary alcohols respectively<br>• Describes how carboxylic acid can be produced from primary alcohols using structural diagrams for primary and secondary alcohols | 4 |
| • Describes oxidation of primary AND secondary alcohols | 3 |
| • Describes oxidation of primary OR secondary alcohols | 2 |
| • Provides relevant information | 1 |

***Sample Answer:***

If the butanol was a primary alcohol it would have the following structure

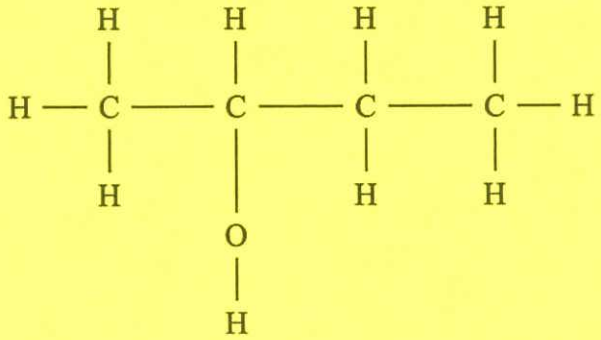
$HO-CH_2-CH_2-CH_2-CH_3$

Butanol can be oxidised by heating excess ethanol in acidified permanganate or dichromate. This forms an aldehyde (butanal) with the C=O bond on the first C. The aldehyde can be further oxidised to produce butanoic acid by heating under reflux. This can be distilled to separate the acid from the reaction mixture and can be tested using universal indicator or a pH probe or litmus. A pH <7 would be expected)

$CH_2OHCH_2CH_2CH_3 + MnO_4^-/H^+ \rightarrow CH{=}OCH_2CH_2CH_3$

$CH{=}OCH_2CH_2CH_3 + MnO_4^-/H^+ \rightarrow CH_3CH_2CH_2COOH$

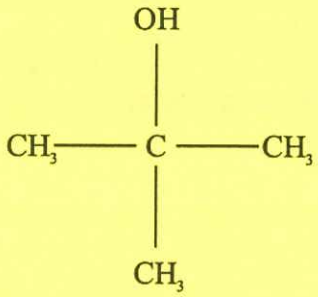
If butanol was a secondary alcohol it would have the following structure



The secondary alcohol can be oxidised by heating excess ethanol in acidified permanganate or dichromate this forms a ketone (butanone) with the C=O bond on the second C. This reaction cannot proceed further and can be tested using a pH probe or litmus. The pH should be higher than that of the products of a primary alcohol. (pH ~7)

$CH_3CHOHCH_2CH_3 + MnO_4^-/H^+ \rightarrow CH_3C{=}OCH_2CH_3 + H_2O$

A tertiary alcohol will have the following structure and will not readily undergo oxidation reactions.



**Question 30(a)**(2 marks)
***Outcomes Assessed:*** **CH12-15**
***Targeted Performance Bands:*** **2-3**

| Criteria | Marks |
|---|---|
| • Correctly identifies barium as the cation based on flame colour<br>AND<br>• Correctly identifies that copper(II) sulfate would probably not be a white solid | 2 |
| • Correctly identifies barium as the cation based on flame colour<br>OR<br>• Correctly identifies that copper(II) sulfate would not be a white solid | 1 |

***Sample Answer:***

The yellow-green flame probably indicates the presence of barium. Copper(II) sulfate is normally blue, not white (unless dehydrated, but it would then have turned the solution blue in (b)).

**Question 30(b)** (2 marks)
***Outcomes Assessed:*** **CH11/12-5, CH11/12-6, CH12-15**
***Targeted Performance Bands:*** **3-4**

| Criteria | Marks |
|---|---|
| • Correctly identifies that the white solid contained chloride ions<br>AND<br>• Provides a correct equation | 2 |
| • Correctly identifies that the white solid contained chloride ions<br>OR<br>• Provides a relevant equation | 1 |

***Sample Answer:***

Silver nitrate solution is often used to show the presence of chloride ions in a solution, because it forms a thick, white precipitate.

$Ag^{+}(aq) + Cl^{-}(aq) \rightarrow AgCl(s)$

**Question 30(c)** (3 marks)
***Outcomes Assessed:*** **CH11/12-5, CH11/12-6, CH12-15**
***Targeted Performance Bands:*** **3-6**

| Criteria | Marks |
|---|---|
| • Identifies that the mixture contains both magnesium chloride and barium chloride<br>• Identifies that the mixture does not contain copper(II) sulfate or barium sulfate | 3 |
| • Identifies that the mixture contains both magnesium chloride and barium chloride<br>OR<br>• Identifies that the mixture contains magnesium chloride OR barium chloride, AND that barium sulfate is not present | 2 |
| • Identifies that the mixture contains magnesium chloride OR barium chloride OR that barium sulfate is not present | 1 |

***Sample Answer:***

The colour showed that the solid did not contain copper(II) sulfate.

The flame test showed that the solid contained barium but the solid was soluble so the solid did not contain barium sulfate. The silver nitrate test showed that the solid contained chloride ions, so barium chloride was present.

Adding sodium hydroxide and forming a precipitate showed that magnesium ions were present (barium hydroxide should be soluble at those concentrations). Therefore, the mixture probably contained magnesium nitrate as well.

**Question 31** (5 marks)
***Outcomes Assessed:*** **CH12-6, CH12-14**
***Targeted Performance Bands:*** **5-6**

| Criteria | Marks |
|---|---|
| • Describes the structure of soaps AND detergents using diagrams<br>• Explains all observations of the student's experiment<br>• Explains the action of detergents to remove the oil stain | 5 |
| • Describes the structure of soaps AND detergents using diagrams<br>• Explains some observations of the student's experiment<br>• Explains the action of detergents to remove the oil stain | 4 |
| • Describes the structure of soaps OR detergents using diagram<br>• Describes observations of the student's experiment<br>• Describes the action of detergents to remove the oil stain | 3 |
| • Describes the structure of soaps OR detergents using diagrams<br>• Describes the action of detergents to remove the oils stains | 2 |
| • Provides relevant information | 1 |

***Sample Answer:***

Soap has a negative tail – this is attracted to the positive $Mg^{2+}$ ions in the water – forming a precipitate.

$2RCOONa^{-} + Mg^{2+}_{(aq)} \rightarrow (RCOO)_2Mg_{(s)} + 2Na^{+}_{(aq)}$

The formation of the precipitate reduces the amount of soap available for cleaning – hence the oil stain is not removed.

Detergents can be anionic, cationic or non-ionic. An anionic detergent will have similar effects as a soap due to the negative head. However, cationic and non-ionic detergents will not precipitate with the $Mg^{2+}$ and be more effective in removing the oil stain.


The detergent removes the oil stain through the production of micelles. Detergent has a hydrophobic tail and a hydrophilic head. The hydrophobic tail attaches to the non-polar oil molecules and the hydrophilic head is soluble in water. The soap molecules surround the oil.

The intermolecular attraction between the long hydrocarbon tails with the oil droplet and the hydrophilic head with the water molecules are strong enough to remove the oil droplet from fabric, leaving the oil droplet (micelles) suspended in the water.

**Question 32** (7 marks)
***Outcomes Assessed: CH12-7, CH12-13***
***Targeted Performance Bands:* 2-6**

| Criteria | Marks |
|---|---|
| • Extensive understanding of properties of a named primary standard<br>AND<br>• Describes correct preparation of a standard solution<br>AND<br>• Defines validity, reliability and accuracy<br>AND<br>• Justifies the use of a primary standard by linking to these definitions | 7 |
| • Thorough understanding of properties of primary standards<br>AND<br>• Describes correct preparation of a standard solution<br>AND<br>• Defines validity, reliability and accuracy<br>AND<br>• Justifies the use of a primary standard but no obvious link to these definitions<br>OR<br>• One of the definitions is not linked | 5-6 |
| • Good understanding of properties of primary standards<br>AND/OR<br>• Describes correct preparation of a standard solution<br>AND<br>• Defines validity, reliability and accuracy<br>AND<br>• Justifies the use of a primary standard but no obvious link to these definitions | 4 |
| • Good understanding of properties of primary standards<br>OR<br>• Describes correct preparation of a standard solution<br>AND<br>• Defines validity, reliability and accuracy | 3 |
| • Identifies a standard solution AND states a property of primary Standard | 2 |
| • Identifies a standard solution OR states a property of primary Standard | 1 |

***Sample Answer:***

A primary standard (eg Oxalic Acid) is a solid, with high purity, high molar mass, and is highly soluble. A known mass is dissolved in a beaker with a small volume of distilled/deionised water and transferred to a volumetric flask, washing the beaker several times and then filling the volumetric flask to the graduation line. The solution is mixed by inverting the stoppered flask several times.

Validity refers to the controlling of variables in the method and hence answering the Aim.

Accuracy is how close the results are to published or accepted results within the scientific community.

Reliability relates to obtaining similar results for multiple trials (concordance.)

Impact on validity. This method of producing a standard solution is a tested and accepted process for determining an unknown acid or base. If an incorrect standard is chosen, such as a partially insoluble salt, this will make the process and result invalid, as the calculated concentration of the standard solution will be incorrect. The correct procedure should be followed for a valid experiment

Impact on accuracy: If the mass of the primary standard is not correct, accuracy of the experiment is decreased. For a mass that is recorded too low, the analysed sample will be incorrectly high, if too much is added then analysed sample will be incorrectly low.

Impact on reliability. Reliability refers to recording consistent results when repeat trials are performed. The preparation of the standard solution has no effect on reliability. A titration should use the same solution batch, so there is enough for repeat trials.

**Question 33** (6 marks)
***Outcomes Assessed:*** **CH11/12-5, CH11/12-6, CH12-14, CH12-15**
***Targeted Performance Bands:*** **2-6**

| Criteria | Marks |
|---|---|
| • Identifies all spectra, with justification | 5-6 |
| • Identifies TWO spectra of the different types, with justification | 3-4 |
| • Identifies TWO spectra of the same type, with justification | 2 |
| • Correctly identifies ONE spectrum<br>OR<br>• Provides ONE piece of relevant information | 1 |

***Sample Answer:***

**A** and **B** are mass spectra. **A** has its largest mass peak at 46, corresponding to the molar mass of methanoic acid. **B** has its largest peak at 72, corresponding to the molar mass of pentane.

**C, D** and **E** are all carbon-13 spectra. **C** has 3 peaks, indicating 3 carbons with different environments. This could indicate pentane or 1-propanol. However, the peaks are spread out, as high as about 60 ppm (indicative of C-O), indicating that the structure is probably not an alkane but 1-propanol. **D** has only one peak, corresponding to one carbon or identical carbons. Only methanoic acid has one carbon, and no other compound has all identical carbons. So **D** is methanoic acid. **E** has two peaks, very widely split, indicating probably 2 carbons with very different environments, one is a low shift which is indicative of an alkane and the other is a large shift, probably similar to the C=O of an acid or ester. So **E** must be ethanamide.

**F, G** and **H** are infrared spectra. **H** has a very broad band at about 3000 $cm^{-1}$, indicative of an –OH group on an acid, so **H** is methanoic acid. **F** has a typical C=O peak at about 1700 $cm^{-1}$. Given that it isn't methanoic acid, this indicates **F** is ethanamide. **G** has a broad peak at about 3300 $cm^{-1}$, indicating a –OH bond of an alcohol, so **G** is 1-propanol.

**Question 34 (a)**(3 marks)
***Outcomes Assessed:*** **CH12-12**
***Targeted Performance Bands:*** **3-6**

| Criteria | Marks |
|---|---|
| • Correctly justifies the direction of equilibrium<br>AND<br>• Correctly calculates the concentrations for each substance<br>AND<br>• Substitutes correctly to calculate Q | 3 |
| • Correctly calculates the concentrations for each substance<br>AND<br>• Substitutes correctly to calculate Q | 2 |
| • Correctly calculates one concentration<br>OR<br>• Some relevant information | 1 |

***Sample Answer:***

$[A]=\frac{1.00}{0.250}=4.00\ molL^{-1}$

$[B]=\frac{2.00}{0.250}=8.00\ molL^{-1}$

$[C]=\frac{1.00}{0.250}=4.00\ molL^{-1}$

$[D]=\frac{2.00}{0.250}=8.00\ molL^{-1}$

$Q=\frac{(4)\times(8)^4}{(4)\times(8)^2}=64$

$Q > K_{eq}$ therefore the reaction will go towards left, favouring the reactant side.

**Question 34 (b)** (4 marks)
***Outcomes Assessed:*** **CH12-12**
***Targeted Performance Bands:*** **4-6**

| Criteria | Marks |
|---|---|
| • Correctly calculates the Keq and showing all working out<br>AND<br>• Used reference in the stimulus to justify their answer | 4 |
| • Provided substantially correct working out towards calculating $K_{eq}$ | 3 |
| • Provided some correct steps | 2 |
| • Showed some relevant understanding | 1 |

***Sample Answer:***

| ***Reaction*** | ***A*** | + | ***2B*** | ⇌ | ***C*** | + | ***4D*** |
|---|---|---|---|---|---|---|---|
| ***Initial*** | 4.00 | | 8.00 | | 4.00 | | 8.00 |
| ***Change*** | $+x$ | | $+2x$ | | $-x$ | | $-4x$ |
| ***Equilibrium*** | $4.00+x$ | | $8.00+2x$ | | $4.00-x$ | | $8.00-4x$ |

To solve for x:

$[A]$ at equilibrium = 5.56 $molL^{-1}$ = 4.00 + x

x = 5.56−4.00 = 1.56 $molL^{-1}$

Therefore,

[B] = $8.00+2x = 8.00+2(1.56) = 11.12$ $molL^{-1}$

[C] = $4.00-x = 4.00-1.56 = 2.44$ $molL^{-1}$

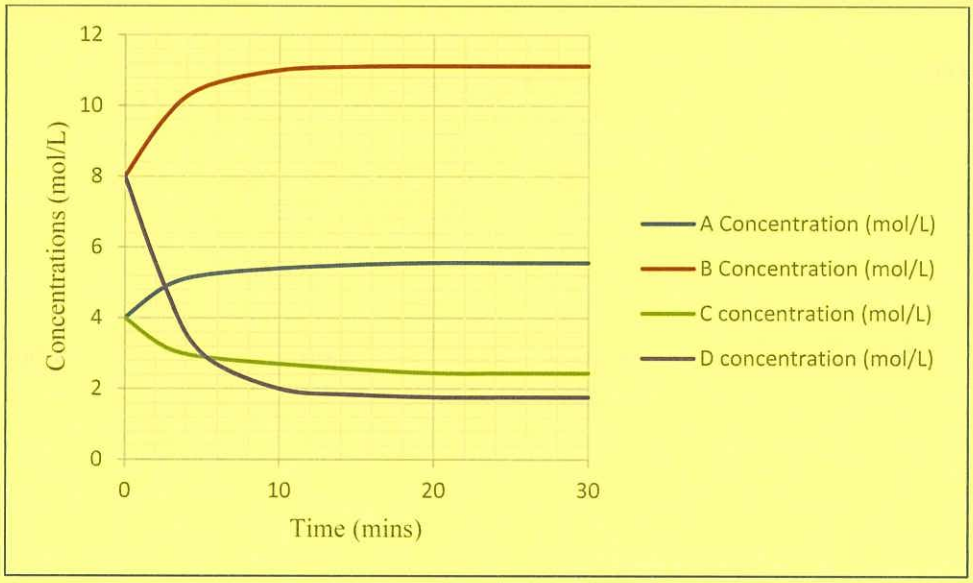
[D] = $8.00-4x = 8.00-4(1.56) = 1.76$ $molL^{-1}$

$K_{eq}=\frac{(2.44)(1.76)^4}{(5.56)(11.12)^2} = 0.034$, which matches the $K_{eq}$ given at the start.

**Question 34 (c)** (3 marks)
***Outcomes Assessed:*** **CH12-12**
***Targeted Performance Bands:*** **4-6**

| Criteria | Marks |
|---|---|
| • Correctly drawn THREE concentration/time graphs | 3 |
| • Correctly drawn TWO concentration/time graphs | 2 |
| • Correctly drawn ONE concentration/time graph | 1 |

***Sample answer:***



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