Neap:

HSC Trial Examination 2019

Chemistry

Solutions and marking guidelines

Section I

Answer and explanation	Syllabus content, outcomes and targeted performance bands
Question 1 **C** A closed system can transfer energy but not matter with its surroundings. An open system can transfer both energy and matter with its surroundings.	Mod 5 Static and Dynamic Equilibrium CH12–5 Band 2
Question 2 **B** Heating hydrated cobalt(II) chloride gives dehydrated cobalt(II) chloride, *X*, and water, *Y*.	Mod 5 Static and Dynamic Equilibrium CH12–5 Bands 3–4
Question 3 **A** Equilibrium constants are constant if the temperature is constant. Changing the temperature changes the equilibrium constant. Changing other variables does not change the value of the equilibrium constant.	Mod 5 Factors that Affect Equilibrium CH12–5, CH12–12 Bands 3
Question 4 **D** Precipitation reactions occur when (positive) cations and (negative) anions in aqueous solution combine to form an insoluble ionic solid called a precipitate. These insoluble solids will have a low solubility product (K_{sp}). Examining the solubility constants on the data sheet, the only substance with a very low solubility constant is barium sulfate ($K_{sp} = 1.08 \times 10^{-10}$), so this solution will precipitate.	Mod 5 Solution Equilibria CH12–6 Bands 3–4
Question 5 **C** Volume has no effect on the speed of particles. When volume is decreased the particles travel shorter distances before a collision takes place, so more collisions take place in a given time.	Mod 5 Static and Dynamic Equilibrium CH12–6 Bands 3–4
Question 6 **B** **B** is the only expression that corresponds to the definition $\text{pH} = -\log_{10}[\text{H}^+]$.	Mod 6 Using Brønsted–Lowry Theory CH12–6, CH12–13 Bands 3–4
Question 7 **B** $\text{Mg}(s) + 2\text{HCl}(aq) \rightarrow \text{H}_2(g) + \text{MgCl}_2(aq)$ $n(\text{Mg}) = \frac{\text{mass (Mg)}}{\text{atomic mass (Mg)}} = \frac{1.22}{24.31} = 0.05019 \text{ mol}$ $n(\text{H}_2) = n(\text{Mg}) = 0.05019 = \frac{\text{volume H}_2}{\text{molar volume}}$ $V(\text{H}_2) = 0.05019 \times 24.79 = 1.24 \text{ L} = 1240 \text{ mL}$	Mod 6 Properties of Acids and Bases CH12–6, CH12–13 Band 4
Question 8 **C** first dilution: 1 mL $\rightarrow$ 1000 mL (× 1000) second dilution: 100 mL $\rightarrow$ 1000 mL (× 10) total dilutions: 1000 × 10 = 10 000 $\therefore$ final $[\text{H}^+] = \frac{10}{10\,000} = 10^{-3}\text{mol}$ $\therefore \text{pH} = -\log_{10}[\text{H}^+] = -\log_{10}[10^{-3}] = 3.00$	Mod 6 Using Brønsted–Lowry Theory CH12–6, CH12–13 Bands 4–5

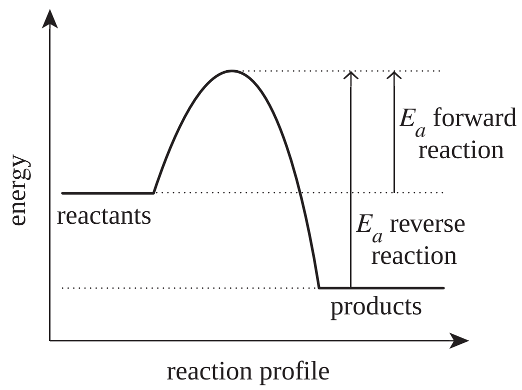
 TENCHEM_SS_19.FM

Answer and explanation	Syllabus content, outcomes and targeted performance bands
Question 9 **D** The diagrams for both acids show nine molecules in the same volume, hence both acid solutions have the same initial concentration. Only one of the nine molecules of acid *X* dissociates, so *X* is a weak acid. All nine molecules of acid *Y* dissociate (dissociates completely), so *Y* is a strong acid. *Note: The terms 'concentrated' and 'dilute' describe the amount of acid in the solution, NOT the degree of dissociation of the acids themselves.*	Mod 6 Using Brønsted–Lowry Theory CH12–6, CH12–13 Band 3
Question 10 **A** Conjugate acid–base pairs only differ by a proton (H^+). Only the pair $HF(aq)/F^-(aq)$ meets this criterion.	Mod 6 Using Brønsted–Lowry Theory CH12–6, CH12–13 Band 3
Question 11 **C** The molar mass of 4-hydroxybutanoic acid, $HO(CH_2)_3COOH$, is 104.11 amu. It will form a condensation polymer according to the reaction $(n + 2)HO(CH_2)_3COOH \rightarrow$ $HO(CH_2)_3CO(O(CH_2)_3CO)nO(CH_2)_3COOH + nH_2O$. molar mass of polymer = $(1000 \times 104.11) - (998 \times 18.106)$ = 85 986 amu The closest approximate molar mass is 8.6×10^4 g mol^{-1}.	Mod 7 Polymers CH12–6, CH12–13 Band 3
Question 12 **D** 2,2-dimethylbutan-1-ol has the condensed structural formula of $(CH_3)_3CH_2CH_2OH$, giving a total of 14 hydrogen in each molecule.	Mod 7 Nomenclature CH12–6, CH12–14 Bands 4–5
Question 13 **B** Hex-1-ene will add bromine to give 1,2-dibromohexane. Hex-2-ene adds bromine to give the isomeric 2,3-dibromohexane.	Mod 7 Products of Reactions Involving Hydrocarbons CH12–14 Bands 3–4
Question 14 **D** The CHOH of hexan-3-ol is oxidised to C=O in hexan-3-one.	Mod 7 Alcohols CH12–4, CH12–14 Band 3
Question 15 **D** The presence of a broad band between 3000 and 3500 cm^{-1} indicates the presence of an OH group. The strong absorbance at 1725 cm^{-1} indicates the presence of a carbonyl group (C=O). Ethanoic acid is the only option that would produce these absorbance bands.	Mod 8 Analysis of Organic Substances CH12–14 Band 3
Question 16 **A** Nylon is a polyamide and is held together by amide bonds.	Mod 7 Polymers CH12–14 Band 2
Question 17 **C** Isomers have different structural formulae but the same molecular formula. Cyclobutane has a molecular formula of C_4H_8 while butane has a molecular formula of C_4H_{10}. Therefore these two compounds are not isomeric.	Mod 7 Nomenclature CH12–13, CH12–14 Band 2

Answer and explanation	Syllabus content, outcomes and targeted performance bands
Question 18 **B** Pentan-3-one can be represented by the condensed formula $(CH_3CH_2)_2C{=}O$. There are only three different chemical environments in pentan-3-one, so three peaks will appear in its mass spectrum.	Mod 7 Analysis of Organic Substances CH12–14 Band 3
Question 19 **B** The lilac/pink flame test eliminates sodium compounds because they have a yellow flame test. A number of anions precipitate with barium ions. The formation of a gas with acid indicates the presence of a carbonate. Calcium carbonate is not soluble; since this compound dissolves in water, it is not calcium carbonate. This leaves potassium carbonate as the only possible answer.	Mod 7 Analysis of Inorganic Substances CH12–15 Bands 4–5
Question 20 **D** Methyl ethanoate results when ethanoic acid reacts with methanol, so *Z* must be ethanoic acid. This is produced by the oxidation of ethanol, so *Y* must be ethanol. Ethanol was produced by a substitution reaction involving chloroethane, so *X* must be chloroethane. Chloroethane was produced by the addition of HCl to ethene, so *W* must be ethene.	Mod 7 Analysis of Organic Substances CH12–14, CH12–15 Bands 4–6

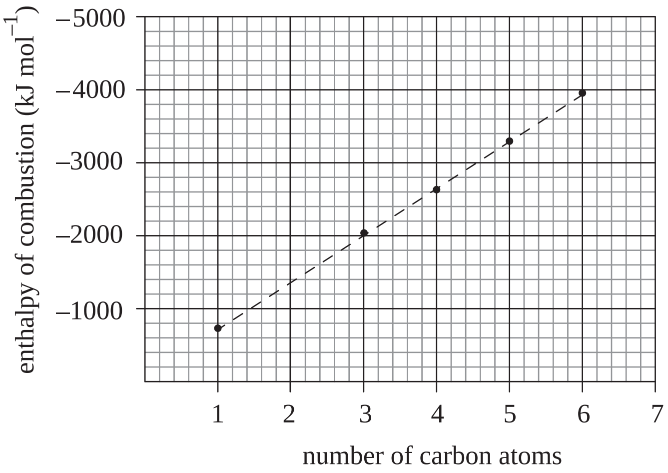
Section II

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 21	
(a) activation energy	Mod 5 Static and Dynamic Equilibrium CH12–15 Band 2 • Identifies the type of energy 1
(b) Energy is given to the surroundings (ΔH = –ve).	Mod 5 Static and Dynamic Equilibrium CH12–15 Band 2 • Gives energy change AND explanation. . 1
(c) Static equilibrium occurs when the reaction is complete and there is no reversible reaction occurring between reactants and products.	Mod 5 Static and Dynamic Equilibrium CH12–6, CH12–13 Bands 3–4 • Gives correct meaning 1
(d) The reaction goes from 2 moles of a solid and 1.5 moles of a gas to 1 mole of a solid. Entropy decreases; there are now fewer moles of solids present and fewer moles of gases present.	Mod 5 Static and Dynamic Equilibrium CH12–6, CH12–12 Bands 3–4 • Describes how entropy changes. AND • Gives quantities and physical states of reactants and products 2
	• Describes how entropy changes. 1
Question 22	
(a) $K_{eq} = \frac{[FeSCN^{2+}]}{[Fe^{3+}][SCN^-]} = \frac{[0.0932]}{[0.0184][0.0184]}$ $= \frac{0.0932}{0.000338}$ $= 275$ or 2.275×10^2	Mod 5 Calculating the Equilibrium Constant CH12–6, CH12–12 Bands 4–5 • Derives correct equilibrium expression. AND • Calculates equilibrium constant. 2
	• Derives correct equilibrium expression. . 1
(b) K_{eq} is a large value and hence the position of equilibrium will lie to the right (more products than reactants).	Mod 5 Calculating the Equilibrium Constant CH12–6, CH12–12 Bands 2–3 • Describes what the value of equilibrium constant indicates 1
(c) Iron(III) hydroxide would precipitate out (the data sheet gives $K_{sp} = 2.79 \times 10^{-39}$), decreasing [$Fe^{3+}$] ions. Le Châtelier's principle tells us that the system will react to minimise this change – that is, form more Fe^{3+} ions. This will drive the reaction to the left and remove $FeSCN^{2+}$ ions, hence the blood-red colour would fade.	Mod 5 Factors that Affect Equilibrium CH12–7, CH12–12 Bands 5–6 • Gives colour change AND gives an explanation. AND • Refers to Le Châtelier's principle 2
	• Gives colour change AND gives an explanation. OR • Refers to Le Châtelier's principle 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 23	
(a) The sodium chloride crystal lattice is composed of alternating positive (Na^+) and negative (Cl^-) ions. Water is polar and has both a relatively positive (δ^+) and a relatively negative (δ^-) end. Water molecules are in continuous motion and collide with the crystal lattice. The positively charged sodium ions in the crystal attract the relatively negative (δ^-) ends of the water molecules. The negatively charged chloride ions in the crystal attract the relatively positive (δ^+) ends of the water molecules. The action of the polar water molecules takes the crystal lattice apart, forming individual (solvated) sodium ions and chloride ions that are surrounded by water molecules. The opposite of this is association, where the solvated ions return to the lattice. When the rate of dissociation equals the rate of association, an equilibrium state occurs: $NaCl(s) \rightleftharpoons Na^+(aq) + Cl^-(aq)$	Mod 5 Solution Equilibria CH12–7 Bands 2–5 • Describes the dissociation. AND • Refers to the diagram. AND • Makes at least THREE additional relevant points. . . . . 3 • Describes the dissociation. AND • Refers to the diagram. AND • Makes at least TWO additional relevant points. . . . . 2 • Describes the dissociation. 1
(b) The formula is NaCl. The formula mass is 22.99 + 35.45 = 58.44 g mol^{-1}. moles of NaCl = $\frac{359}{58.44}$ = 6.14 $NaCl(s) \rightleftharpoons Na^+(aq) + Cl^-(aq)$ $K_{sp} = [Na^+][Cl^-] = [6.14][6.14] = 37.7$ (to three significant figures)	Mod 5 Solution Equilibria CH12–12 Bands 3–4 • Derives correct expression for solubility constant. AND • Calculates value accurately. . . . . 2 • Derives correct expression for solubility constant. 1
Question 24	
(a) For an exothermic reaction, the activation energy of the forward reaction must be less than the activation energy of the reverse reaction. This is an exothermic reaction; hence the E_a for the forward reaction (forming dinitrogen tetroxide) is less than the E_a for the reverse reaction (forming nitrogen dioxide).  *Note: A diagram is not required for full marks. It has been included for clarification.*	Mod 5 Static and Dynamic Equilibrium CH12–6, CH12–12 Bands 4–6 • Outlines forward reaction. AND • Outlines reverse reaction . . . . 2 • Outlines forward reaction. OR • Outlines reverse reaction 1

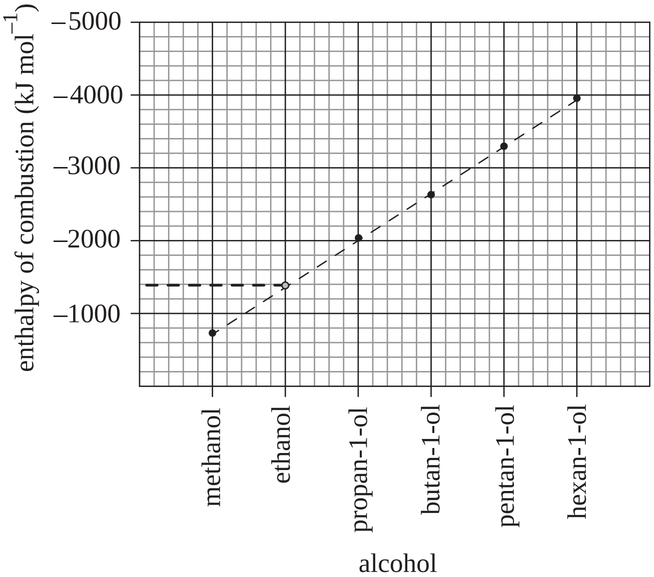
 TENCHEM_SS_19.FM

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
(b) Increasing the temperature would drive the position of equilibrium to the left (formation of nitrogen dioxide). Le Châtelier's principle states that the addition of heat to a reaction will favour the endothermic direction of a reaction as this minimises the increase in heat content of the system when the temperature is increased.	Mod 5 Static and Dynamic Equilibrium CH12–6, CH12–12 Bands 3–4 • Describes how increasing the temperature would affect the reaction. AND • Provides correct explanation 2
	• Describes how increasing the temperature would affect the reaction. OR • Provides correct explanation 1
Question 25	
(a) $K_{eq} = \frac{[HCO_3^-][H^+]}{[H_2CO_3]}$	Mod 6 Qualitative Analysis CH12–5, CH12–12 Band 2 • Writes a correct expression 1
(b) A buffer is usually a mixture of a weak acid and its salt. Buffering resists changes in the pH of blood (or other natural systems) when acids or bases are added. It does this because added H^+ ion reacts with the weak base (and hence is removed by reaction) and added OH^- reacts with the weak acid (and hence is removed by reaction). Therefore the change in concentration of H^+ is minimised by the buffer and pH change is also minimised. Many processes of natural systems will only take place within a narrow pH range. If the pH deviates too far from the optimum, then the system will not work as well as it should. In the case of human blood, illness will occur.	Mod 6 Qualitative Analysis CH12–7, CH12–12 Bands 3–4 • Defines buffering. AND • Relates buffering to blood or other relevant natural system. AND • Makes at least ONE additional relevant point 3
	• Defines buffering. AND • Relates buffering to blood 2
	• Defines buffering. OR • Relates buffering to blood 1
(c) $pH = -\log_{10}[H^+] \therefore [H^+] = 10^{-pH}$ $pH = 7.4 \therefore [H^+] = 10^{-7.4} = 3.98 \times 10^{-8}$ mol L^{-1}	Mod 6 Qualitative Analysis, Mod 6 Calculating the Equilibrium Constant CH12–6, CH12–12 Bands 3–4 • Calculates correct value AND shows working 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 26	
(a) $H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$ 1 mole of sulfuric acid (a diprotic acid) reacts with 2 moles of alkali to form 2 moles of water. $2H^+(aq) + 2OH^-(aq) \rightarrow 2H_2O(l)$ moles of water formed = moles of sodium hydroxide $= \frac{120}{1000} \times 0.500$ $= 0.0600$ mol heat change $(q) = mc\Delta T$ $= \frac{(120 + 60)}{1000} \times 4.18 \times 10^3 \times (26.3 - 24.2)$ $= 0.8 \times 4.18 \times 2.1 = 1.58$ kJ $\therefore \Delta H = \frac{-q}{n(\text{water})} = \frac{-1.58 \text{ kJ}}{0.06 \text{ mol}} = -26.3 \text{ kJ mol}^{-1}$ (exothermic)	Mod 6 Qualitative Analysis, Mod 7 Alcohols CH12–5, CH12–12 Band 2 • Gives balanced equation. AND • Performs the calculation. AND • Gives the correct answer. . . . . 3 • Gives balanced equation. AND • Performs the calculation OR gives the correct answer. . . . . 2 • Shows some understanding of the calculation. 1
(b) 	Mod 6 Qualitative Analysis, Mod 7 Alcohols CH12–3, CH12–5, CH12–7 Bands 3–4 • Labels axes. AND • Accurately plots points. AND • Draws a line of best fit . . . . 3 • Any TWO of the above points . . . . 2 • Any ONE of the above points. 1

Sample answer | **Syllabus content, outcomes, targeted performance bands and marking guide**

(c) The interpolated value for ethanol is shown on the graph below.



The enthalpy of combustion of ethanol is approximately –1400 kJ mol^{-1}. The molar mass of ethanol (CH_3CH_2OH) is 46.068 g mol^{-1}. The enthalpy of combustion of ethanol will equal approximately $-\frac{1400}{46.068} = -30.4$ kJ g^{-1}.

Mod 6 Quantitative Analysis
Mod 7 Alcohols
CH12–1, 2, 6, 7, 12 Bands 3–4

- Interpolates a value of between 1300 and 1400 kJ mol^{-1} as the correct molar enthalpy change from the graph.

AND

- Converts kJ mol^{-1} to kJ g^{-1} 2

- Any ONE of the above points 1

Question 27

X is a burette, *Y* is a pipette and *Z* is a conical flask.

The burette's role in a titration is to deliver a variable volume of a liquid. The pipette's role in a titration is to deliver a fixed volume of a liquid. The conical flask's role in a titration is to contain the indicator and the liquids from the pipette and burette.

Mod 6 Qualitative Analysis
CH12–13 Bands 2–4

- Identifies all THREE pieces of equipment.

AND

- Outlines the role of each 3

- Identifies TWO pieces of equipment.

AND

- Outlines the role of each 2

- Identifies ONE piece of equipment AND outlines its role.

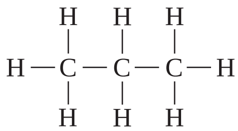
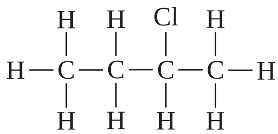
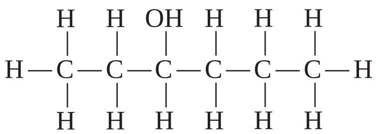
OR

- Identifies TWO or more pieces of equipment 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 28	
In 1887, Arrhenius suggested that all aqueous solutions of acids contained an excess of hydrogen (H^+) ions and all aqueous solutions of bases (alkalis) contained an excess of hydroxide (OH^- ions). His proposal was that H^+ and OH^- ions are formed when the acid or base ionises as it dissolves in water. In 1923, Brønsted and Lowry independently proposed that an acid is a proton donor and a base is a proton acceptor. Water need not be present using their definition and a base does not have to contain a hydroxide. All Arrhenius acids will also be Brønsted–Lowry acids. Not all Brönsted–Lowry acids will be Arrhenius acids.	Mod 6 Using Brønsted–Lowry Theory CH12–7, CH12–13 Bands 2–5 • Gives details of the Arrhenius model. AND • Gives details of the Brønsted–Lowry model. AND • Makes a comparison . . . . 3–4 • Gives details of the Arrhenius model. AND • Gives details of the Brønsted–Lowry model . . . . 2 • Gives details of the Arrhenius model. OR • Gives details of the Brønsted–Lowry model 1
Question 29	
The sample must be in aqueous solution. If supplied as a solid, it must be mixed with distilled/deionised water. One method is to use indicators. Indicators are chemicals that change colour over a specific pH range to help identify if a substance is acidic, neutral or basic. The advantage of using indicators is that they are relatively cheap and easy to use. A disadvantage is that one must use an indicator with a colour change that matches the actual pH of the substance. If the substance being tested is itself coloured, this can obscure the result. The second method is to use electronic means such as pH metres, a pH probe or data loggers. The advantage of using these is that they are much more accurate and work over a larger pH range. A disadvantage is that they are more costly and more complex to operate. They have to be calibrated (set to an accurate value) using buffer solutions of known pH.	Mod 6 Using Brønsted–Lowry Theory CH12–7, CH12–13 Bands 2–6 • Describes TWO methods in detail. AND • Identifies the advantages of the TWO methods. AND • Identifies the disadvantages of the TWO methods. . . . . 6 • Describes TWO methods. AND • Identifies the advantages of the TWO methods. OR • Identifies the disadvantages of the TWO methods. . . . . 4–5 • Describes TWO methods. AND • Identifies the advantages OR disadvantages of ONE method . . . . 3 • Describes TWO methods . . . . 2 • Provides some relevant details 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide

Question 30

Products	*Catalyst*
	Pt or Pd or Ni
	no catalyst
	H_2SO_4 or H_3PO_4

Note: The addition of hydrogen to propene will result in the formation of propane. The catalyst needed is nickel metal (or platinum or palladium). The addition of hydrogen chloride gas to but-2-ene will result in the formation of 2-chlorobutane. The addition of water to hex-3-ene will result in the formation of hexan-3-ol. The addition of water to an alkene requires an acid catalyst (H_2SO_4 or H_3PO_4).

Mod 7
Products of Reactions Involving Hydrocarbons
CH12–7, CH12–14 Bands 3–5

- Correctly completes all FIVE cells of the table. 5
- Correctly completes FOUR cells of the table 4
- Correctly completes THREE cells of the table 3
- Correctly completes TWO cells of the table 2
- Correctly completes ONE cell of the table. 1

Question 31

Esters are produced by refluxing the starting reagents – a carboxylic acid and alcohol – in the presence of a sulphuric acid catalyst.

Safety precautions include heating under reflux conditions to minimise risk of exposure to toxic chemicals, adding boiling chips and choosing a heating source to minimise the risk of fire.

Mod 7 Reactions of Organic Acids and Bases
CH12–2, CH12–3, CH12–14 Bands 2–6

- Identifies both reagents.

AND

- Identifies the catalyst.

AND

- Identifies a safe experimental procedure 3
- Any TWO of the above points. 2
- Any ONE of the above points 1

Question 32

$A = \varepsilon lc$

formulae weight of $KMnO_4$ = 158.04 g mol^{-1}

$\therefore c = [KMnO_4] = \frac{A}{\varepsilon l} = \frac{0.398}{22\ 400} \times 1 = 1.78 \times 10^{-5}$ mol L^{-1}

$\therefore$ moles of $KMnO_4 = 1.78 \times 10^{-5} \times 2.00 = 3.56 \times 10^{-5}$ mol

$\therefore$ mass of $KMnO_4 = 1.78 \times 10^{-5} \times 158.04 = 0.00563$ g

$$\text{ppm of } KMnO_4 = \frac{\text{mass of } KMnO_4}{\text{mass of sample}} \times 10^6$$

$$= \frac{0.00563}{50.00} \times 10^6 = 112 \text{ ppm}$$

Mod 8 Analysis of Inorganic Substances
CH12–6, CH12–15 Bands 4–5

- Calculates concentration.

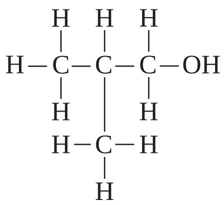
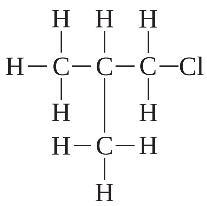
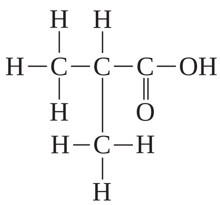
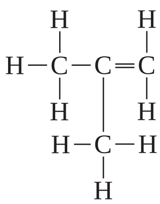
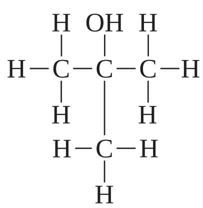
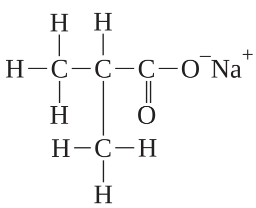
AND

- Calculates mass of pure $KMnO_4$.

AND

- Calculates ppm of $KMnO_4$ 3
- Any TWO of the above points. 2
- Any ONE of the above points 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 33	

	Structural formula	*Justification*
A	 2-methylpropan-1-ol	Compound *A* is a primary alcohol as oxidation of compound *A* produces an acid, compound *C*. The branched structure is indicated by the formation of the tertiary alcohol, compound *E*.
B	 1-chloro-2-methylpropane	Compound *B* is a chloroalkane formed by the replacement of OH with Cl in compound *A*.
C	 2-methylpropanoic acid	Compound *C* is the acid produced by the oxidation of compound *A*. This is confirmed by the production of CO_2 when reacted with carbonate ion.
D	 2-methylpropene	Compound *D* is the alkene produced from compound *A* through the dehydration reaction, which removes the OH and another H atom to form the double bond.
E	 2-methylpropan-2-ol	Compound *E* is a tertiary alcohol as compound *E* is not oxidised with strong oxidants.
F	 sodium 2-methylpropanoate	Compound *F* is the sodium salt of the acid.

Note: The names of the compounds are not required. They have been included as a guide.

Mod 7 Reactions of Organic Acids and Bases
CH12–5, CH12–7, CH12–14 Bands 5–6

- Correctly draws the structures of all of the compounds.

AND

- Provides justification for all of the structures 6

- Correctly draws most of the structures of the compounds.

AND

- Provides justification for most of the structures 4–5

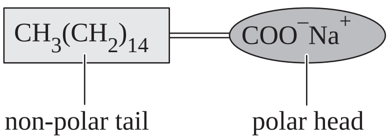
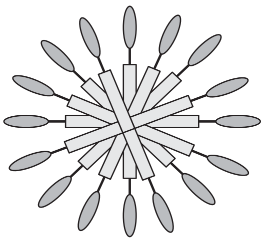
- Correctly draws some of the structures of the compounds.

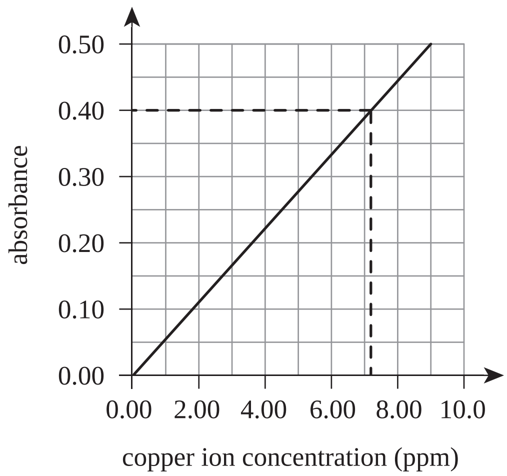
AND

- Provides justification for some of the structures 3

- Identifies some characteristics (functional groups) of some structures . . . 2

- Provides some relevant information 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 34	
(a) Water can only dissolve polar compounds like alcohols and some ionic compounds like sodium chloride. The addition of soap allows the resulting mixture to dissolve many non-polar substances. Soaps are the sodium or potassium salts of long-chain alkanoic acids. The carbon chain forms a non-polar tail and the carboxylate salt forms a polar head. Soaps form micelles in water with polar heads on the outside and non-polar tails on the inside. A micelle forms with the polar head groups on the outside of the micelle and the non-polar groups on the inside of the micelle. Fat and grease can dissolve into the non-polar interior of the micelle and form colloidal suspensions because of the polar head groups on the outside of the micelle.	Mod 7 Reactions of Organic Acids and Bases CH12–7, CH12–14 Bands 4–5 • Describes the structure of soap. AND • Explains how micelles dissolve greasy substances in water . . . . 2 • Any ONE of the above points 1
(b) For example, sodium stearate:  Micelle formed with polar heads on the outside: 	Mod 7 Reactions of Organic Acids and Bases CH12–7, CH12–14 Bands 4–5 • Draws a diagram to represent a micelle 1
Question 35	
(a) $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$	Mod 8 Analysis of Inorganic Substances CH12–6, CH12–15 Bands 2–3 • Gives correct ionic equation with solid state shown 1
(b) moles of AgCl $= \frac{\text{mass}}{\text{molar mass}}$ $= \frac{1.05}{(107.9 + 35.45)}$ $= 7.325 \times 10^{-3}$ mol mass of Cl^- $= 7.325 \times 10^{-3} \times 35.45 = 0.260$ g % of Cl^- $= \frac{\text{mass of } Cl^-}{\text{mass of sample}} \times 100$ $= \frac{0.260}{50.0} \times 100$ $= 0.520\%$	Mod 8 Analysis of Inorganic Substances CH12–6, CH12–15 Bands 2–3 • Calculates moles of silver chloride. AND • Calculates % mass of chloride ion in the sample . . . . 2 • Calculates moles of silver chloride 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 36	
The fourth absorbance value is not concordant with the other values and should not be included in determining the average value. average absorbance: $\frac{(0.37 + 0.39 + 0.40 + 0.34)}{4} = 0.40$ The graph is used to determine the concentration by interpolation as shown below.  The concentration of copper ions is 7.20 ppm.	Mod 8 Analysis of Inorganic Substances CH12–4, 5, 6, 15 Bands 2–3 • Calculates the correct average value in the range 7.00 to 7.40. AND • Interpolates a value from the graph. AND • Gives a final answer including units. . . . . 3 • Any TWO of the above points . . . . 2 • Any ONE of the above points. 1
Question 37	
The manufacture of compounds for use in the drug industry requires care be taken to ensure the final product is 100% pure. The final step in the manufacturing process should be an analysis to ensure purity. The purity of the final product may be the most important consideration when methanamide is produced for drug manufacture. Methanamide that is produced as an industrial solvent may not need to be 100% pure. Industrial solvents need to be economically competitive and the cost of production may be the most important consideration in this case. The cost of the sequence, while an important consideration when methanamide is used in drug manufacture, is not an overriding consideration for industrial solvents. An important consideration in both cases is the yield of the reactions involved in the manufacture. A high-yielding process is preferable to a low-yielding process. In both cases, the environmental impacts of the synthetic process must be taken into consideration. A process that does not affect the environment would be preferred to one that produces toxic by-products that are then released into the environment.	Mod 8 Analysis of Inorganic Substances CH12–4, CH12–7, CH12–14 Bands 4–6 • Comprehensively compares a range of factors . . . . 4 • Compares some factors. . . . . 3 • Identifies some factors . . . . 2 • Provides some relevant information 1

Sample answer	Syllabus content, outcomes, targeted performance bands and marking guide
Question 38	
The ^{13}C NMR indicates four different types of carbon. The 212 ppm peak is indicative of one carbonyl carbon, with the carbonyl being either an aldehyde or ketone. The peaks at 29 and 39 ppm are associated with carbons next to a carbonyl. The peak at 8 ppm is associated with a carbon adjacent to another unfunctionalised carbon. From this information, the compound is most likely either butanal or butanone. The highest peak in the mass spectrum occurs at an m/e of 72. If the compound contains only one oxygen, then 72 – 16 = 56 amu remains to be accounted for by carbons and hydrogens. The maximum number of CH_2 units can be determined by dividing through by 14 $\rightarrow \frac{56}{14} = 4$. From this information, the compound could be either butanone (a ketone) or butanal (an aldehyde). The peak at 57 represents a loss of 15 amu from the molecular ion and is due to a CH_3 group being cleaved from the molecular ion. The peak at 29 is almost certainly due to C_2H_5 (an ethyl group) and the peak at 57 is due to a [CH_3CH_2CO] fragmentation pattern. This strongly suggests that the compound is butanone. The infrared spectrum supports that the compound is a ketone or aldehyde, as the absorbtion at 1715 cm^{-1} in the infrared spectrum is also associated with a carbonyl group. The absence of any broad band between 2500 to 3000 cm^{-1} eliminates the possibility of NH or OH-containing compounds. The peak at 2985 cm^{-1} is expected for any compound containing C–H bonds. The peaks below 1500 cm^{-1} are in the fingerprint region of the infrared and provide less information about the functional group, or groups, in the molecule. Butanal would be easily oxidised by acidified permanganate. As no colour change was observed in the final chemical test, the compound is not butanal. The identity of compound *X* is therefore butanone.	Mod 8 Analysis of Inorganic Substances CH12–4, 5, 6, 15 Bands 4–6 • Analyses all the spectra to produce evidence regarding the identity of compound *X*. AND • Determines the importance of the results of the chemical test. AND • Correctly identifies compound *X* as butanone. . . . . 5 • Analyses some spectra to produce evidence regarding the identity of compound *X*. AND • Determines the importance of the results of the chemical test. AND • Correctly identifies compound *X* as butanone . . . . 3–4 • Correctly identifies compound *X* as butanone . . . . 2 • Provides some relevant information 1