EXAM MARKING KEY

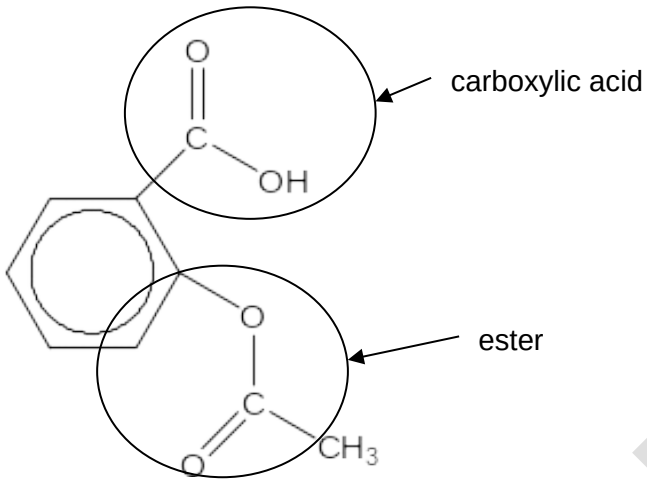
CHEMISTRY—ANALYTIC MARKING KEY 3A/3B PAPER
SECTION ONE

Question No	Answer
1	A
2	C
3	C
4	B
5	C
6	D
7	C
8	B
9	B
10	A
11	C
12	C
13	B
14	C
15	A
16	A
17	C
18	D
19	C
20	C
21	B
22	A
23	D
24	D
25	D

SECTION TWO

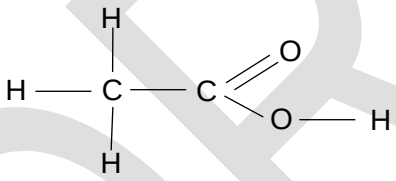
Question 1 ***[4 marks]***

(a) Circle and name the functional groups.



Mark	Description
2	Both functional groups circled and named
1	One functional group circled and named
1	Both functional groups circled and either not named correctly or not named
0	Question answered incorrectly or not attempted

(b) Draw structure of reactant 2

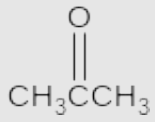
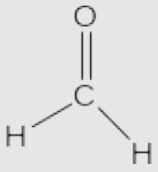
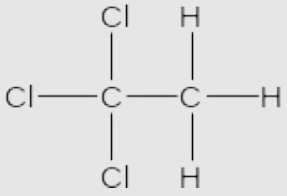
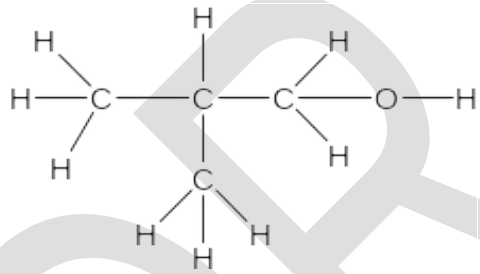
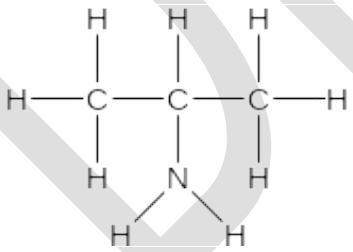
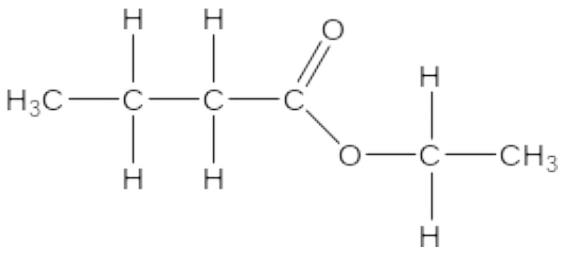


Mark	Description
2	CH_3COOH (or structure drawn)
1	CHOOH (incorrect answer but some merit)
0	Question answered incorrectly or not attempted.

Question 2 ***[7 marks]***

Complete the table by writing the systematic name in the last column or drawing the structure in the first column.

[Each response is worth 1 mark]

Structure	Common name	Systematic name
	Acetone	Propanone
CH_3COOH	Acetic acid	Ethanoic acid
	Formaldehyde	Methanal
	Liquid paper thinner	1,1,1-trichloroethane
	Isobutyl alcohol	2-methyl-propan-1-ol
	Isopropyl amine	Propan-2-amine
	Butanoic acid ethyl ester (strawberry odour)	Ethyl butanoate

Mark	Description
1 – 7	One mark for each correct answer
0	Question answered incorrectly or not attempted.

Question 3 ***[2 marks]***

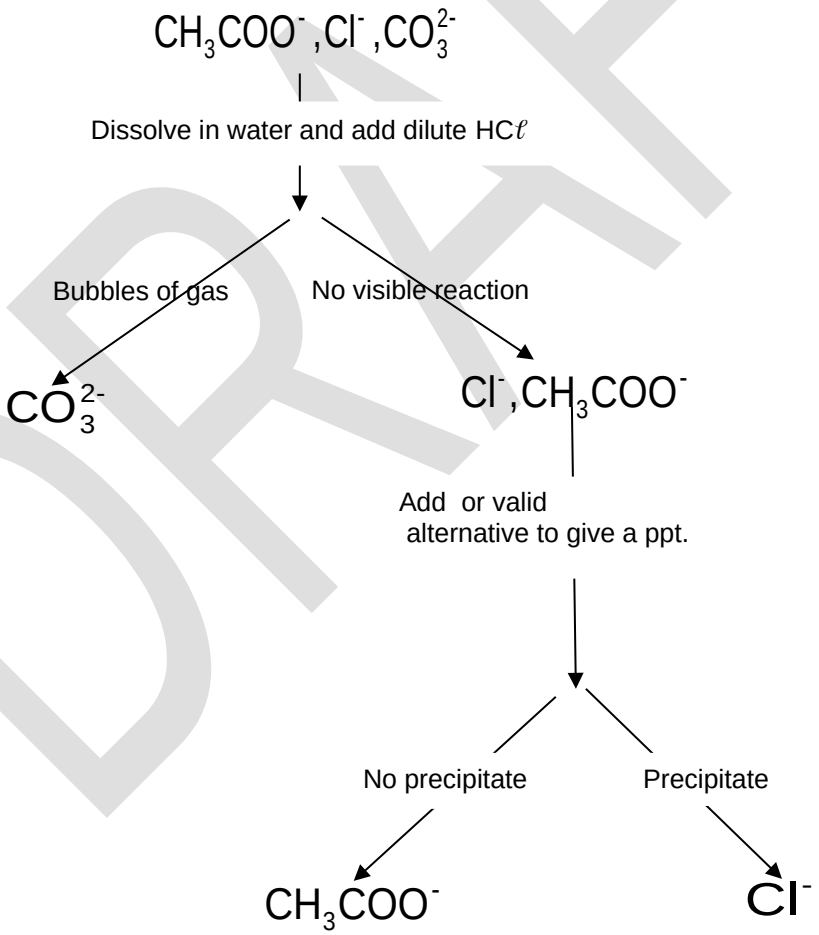
The characteristic odours of fish are due to the presence of amines. Amines are moderately strong bases. Explain, using an equation, how you could neutralise the fishy odour due to a primary amine.

Mark	Description
2	$CH_3CH_2NH_2 + H^+ \rightarrow CH_3CH_2NH_3^+$ uses correct formulae for reactants and product
1	uses generalised equation for amine RNH_2
0	Question answered incorrectly or not at all.

Question 4 ***[10 marks]***

From your knowledge of the solubility rules and reactions, describe what tests you could use to determine the identity of the salt. You must include any relevant observations and equations for each test in your answer. You may wish to use flowcharts, tables etc. to represent your answer. The third unknown can be determined by the process of elimination.

Example of flowchart



An alternative solution may involve the testing of the pH of the solutions of the salts.
The solution formed from the $C\ell^-$ ions will be neutral, the other two solutions will be basic.
The remaining two solutions could be identified by the addition of dilute hydrochloric acid as in the first step.

Mark	Description
10	All steps correct and the flow chart represented clearly
1 – 9	Marks allocated as indicated in the diagram above.
0	Question not answered correctly or not attempted.

Question 5 ***[19 marks]***

a) Complete the table

	1	2	3	4
Final reading (mL)	20.20	36.80	21.05	37.70
Initial reading (mL)	3.30	20.20	4.35	21.05
Titration volume (mL)	16.90	16.60	16.70	16.65

[1 mark]

(i) Calculate the average titration volume.

Mark	Description
2	16.65 mL
1	16.71 mL (have not recognised outlier value of 16.9mL)
0	Question answered incorrectly or not at all.

(ii) Calculate the number of moles of sodium hydroxide in the average titration volume.

Mark	Description
2	1.657×10^{-3} mol [1.663×10^{-3} mol if wrong value from (i) is used]
1	Calculation error
0	Question answered incorrectly or not at all.

$n(OH^-) = 0.0995(0.01665)$
$= 1.657 \times 10^{-3}$ mol

(iii) Calculate the concentration of acetic acid in the original vinegar solution. Express your answer in both mol L^{-1} and g L^{-1}

Mark	Description
5	0.414 mol L^{-1} and 24.9 g L^{-1}
4	If units missing or incorrect significant figures
	OR
1 – 5	Allocate marks as indicated in the working provided below.
0	Question answered incorrectly or not at all.

$n(CH_3COOH \text{ in } 20.00 \text{ mL}) = n(OH^-)$
$= 1.657 \times 10^{-3}$ mol **(1 mark)**

$n(CH_3COOH \text{ in } 100.0 \text{ mL}) = 1.657 \times 10^{-3} \times \frac{100.0}{20.0}$
$= 8.28 \times 10^{-3}$ mol **(1 mark)**
$= n(CH_3COOH)$ in 20.0 mL undiluted vinegar. **(1 mark)**

$c(CH_3COOH) = \frac{8.28 \times 10^{-3}}{0.02}$
$= 0.414$ mol L^{-1} **(1 mark)**

$c(CH_3COOH \text{ in g } L^{-1}) = 0.414(60.05)$
$= 24.9$ g L^{-1} **(1 mark)**

b) Describe three potential sources of error in this experiment and how you would minimise them.

Mark	Description
3	Any three acceptable sources of error and description of minimisation are required. e.g. inconsistent titre results – rinse conical flask with water OR burette with solution OR pipette with solution Titre value too high – use appropriate indicator.
2	Two sources of error with no explanation of minimising One source of error plus minimising description
1	One source of error
0	Question answered incorrectly or not at all.

c) Phenolphthalein is an appropriate indicator for this titration as the pH at which the end point occurs is 8.3. How would the calculated concentration of acetic acid compare to the actual value if methyl orange was used (which changes colour at 4.3)? Explain your answer using the terms end point and equivalence point.

Mark	Description
4	The end point would occur before the equivalence point A smaller volume of NaOH would be required to reach the end point or average titre would be smaller. This would result in the concentration of vinegar appearing lower than it really is.
3	A smaller volume of NaOH would be required. No mention of end point occurring before equivalence point.
2	A smaller volume of NaOH would be required.
1	Acetic acid concentration would seem lower.
0	Question answered incorrectly or not at all.

d) Describe an example where indicators are used outside the laboratory.

Mark	Description
2	Pools to monitor pH and chlorine concentration Soil chemistry – to monitor pH of soils Or any reasonable answer. (Answer must include some amount of description.)
1	Pool or soil Answer is one word or inadequate description
0	Question answered incorrectly or not at all.

Question 6 ***[23 marks]***

a) Explain in terms of the equations shown why the spray released from the gland of the bombardier beetle is hot.

Mark	Description
2	Reactions are exothermic, heat energy is produced and so temperature rises
1	Reaction is exothermic
0	Question answered incorrectly or not at all.

b) Refer to Equation 2 to explain why the spray released from the gland of the bombardier beetle sprays out of the back of the beetle very rapidly.

Mark	Description
2	Oxygen gas is produced rapidly and pressure builds up (or gas is forced out).
1	Oxygen is produced OR gas is forced out (or similar).
0	Question answered incorrectly or not at all.

c) A student investigates the effect of the concentration of hydrogen peroxide on the rate of the decomposition reaction (equation 2) in the laboratory. She adds a solid catalyst to hydrogen peroxide solution and measures the rate at which oxygen is given off.

(i) What TWO variables would you expect to control in this experiment?

Mark	Description
2	States two appropriate variables: • Mass of catalyst • Volume of hydrogen peroxide • Temperature of system.
1	One appropriate variable given.
0	Question answered incorrectly or not at all.

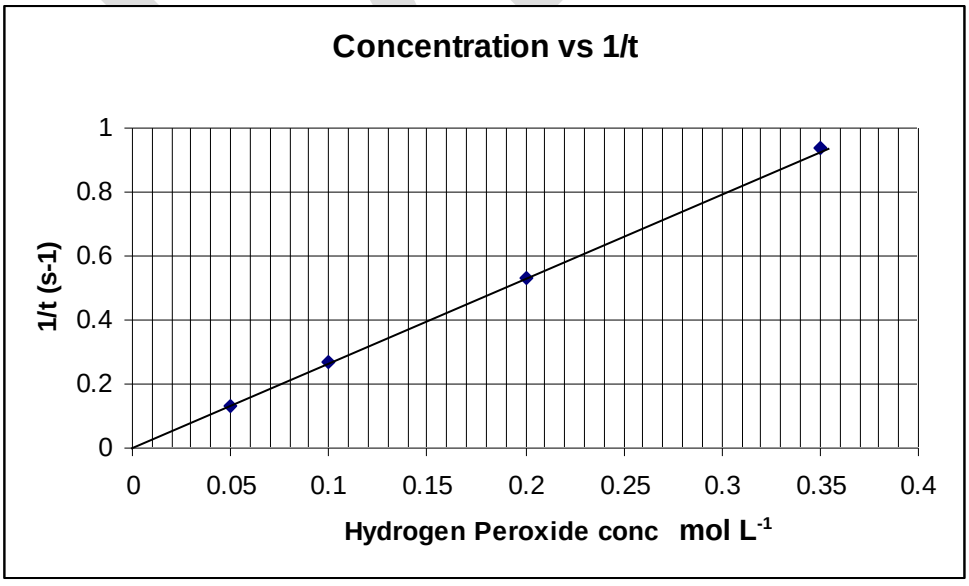
(ii) List ONE variable you have to measure and ONE other variable that you could measure to determine the rate of reaction.

Mark	Description
2	States time and one of two appropriate variables: • Loss of mass • Volume of oxygen produced.
1	States two variables but does not include time.
0	Question answered incorrectly or not at all.

(iii) Suggest an appropriate method for this experiment. You may include a diagram in your answer.

Mark	Description
5	Describes a method for measuring the dependant and independent variables and controlling other variables. An appropriate method or labelled diagram for collecting gas or measuring mass loss.
4	The method is appropriate for measuring the dependant and independent variables but little or no mention of control of other variables. An appropriate method or labelled diagram for collecting gas or measuring mass loss.
3	The method is appropriate for measuring the dependant and independent variables but other variables are not mentioned or the method for the collection of the gas evolved or the mass loss is not appropriate.
2	The method identifies measurable variables but the method described is flawed and is not likely to establish a cause and effect relationship.
1	Some apparatus shown correctly.
0	Question answered incorrectly or not at all.

d) (i) Plot the data on the graph.



Mark	Description
5	All five categories given: • All axes labelled correctly • Correct units on axes titles • Points plotted correctly • Line of best fit • Graph title.
4	4 of the five categories given, including line of best fit.
3	3 of the five categories given, but no line of best fit.
2	2 of the five categories given.
1	1 of the five categories given.
0	Question answered incorrectly or not at all.

(ii) Based on the data, write a conclusion for this experiment.

Mark	Description
2	As the concentration of hydrogen peroxide increases the rate of reaction increases. There is a direct relationship between the concentration of hydrogen peroxide and the rate of reaction.
1	As the concentration of hydrogen peroxide increases the rate of reaction increases. OR There is a direct relationship between the concentration of hydrogen peroxide and the rate of reaction.

(iii) Identify THREE potential sources of error in the experiment.

Mark	Description
3	Three appropriate potential sources of error stated, such as : • Beginning timing at the same point each time. • Gas collection (not allowing gas to escape). • Air is collected with oxygen .
2	Two appropriate sources of error stated.
1	One appropriate source of error stated.
0	Question answered incorrectly or not at all.

Question 7 ***[10 marks]***

a) Calculate the empirical formula.

Mark	Description
6	$C_6H_8O_7$
5	Student calculates correct ratio (1:1.33:1.167) but cannot convert to empirical formula.
3 – 4	Student calculates part way through calculation.
1 – 2	Student calculates number of moles of carbon dioxide and/or water.
0	Question incorrectly answered or not attempted.

$$n(CO_2) = \frac{1.900}{44.01}$$
$$= 4.32 \times 10^{-2} \text{ mol}$$
$$n(C) = n(CO_2)$$
$$= 4.32 \times 10^{-2} \text{ mol}$$
$$m(C) = 12.01 \times 4.32 \times 10^{-2}$$
$$= 0.518 \text{ g}$$

$$n(H_2O) = \frac{0.518}{18.016}$$
$$= 2.87 \times 10^{-2} \text{ mol}$$
$$n(H) = 2n(H_2O)$$
$$= 5.75 \times 10^{-2} \text{ mol}$$
$$m(H) = 1.008 \times 5.75 \times 10^{-2}$$
$$= 5.796 \times 10^{-2} \text{ g}$$

m(O) = 1.383 – 0.518 – 0.05796
= 0.807 g

$$n(O) = \frac{0.807}{16}$$
$$= 5.04 \times 10^{-2} \text{ mol}$$

	C	H	O
n	4.32×10^{-2}	5.75×10^{-2}	5.04×10^{-2}
Ratio	$\frac{4.32 \times 10^{-2}}{4.32 \times 10^{-2}} = 1$	$\frac{5.75 \times 10^{-2}}{4.32 \times 10^{-2}} = 1.333$	$\frac{5.04 \times 10^{-2}}{4.32 \times 10^{-2}} = 1.167$
x 6	6	8	7

Empirical formula = $C_6H_8O_7$

b) Determine the molecular formula if the molecular mass of citric acid is 192.1.

Mark	Description
2	192
1	Calculation error.
0	Question incorrectly answered or not attempted.

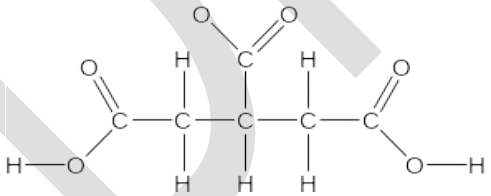
Empirical formula mass = (6 x 12.01) + (8 x 1.008) + (7 x 16.0)
= 192
Empirical formula mass = molecular mass

∴ Molecular formula = Empirical formula

= $C_6H_8O_7$

c) Draw a possible structural formula for citric acid given that one mole of citric acid reacts with three moles of potassium hydroxide

Mark	Description
2	Structure example below. Structure must contain correct number of carbon, hydrogen and oxygen and have three carboxylic acid groups.
1	Structure contains correct number of carboxylic acid groups but not the correct number of carbon or hydrogen.
0	Question incorrectly answered or not attempted.



Or any viable structure that shows a triprotic acid with the correct number of carbon, hydrogen and oxygen.

Question 8 ***[9 marks]***

a) Excess $HCO^-_{3(aq)}$ produced as a result of strenuous exercise is removed from the blood by the kidneys.

(i) Describe the immediate change in the pH of the blood.

Mark	Description
1	The pH of the blood initially decreases.

(ii) Explain the immediate change in the pH.

Mark	Description
2	The lowering of the hydrogen carbonate ion concentration shifts the equilibrium position of the carbonic acid/hydrogencarbonate reaction to the right, raising the concentration of hydrogen ions and lowers the pH of the blood.
1	The answer is just given in terms of an increase in hydrogen ion concentration

b) Hyperventilation, or rapid breathing, decreases the amount of carbon dioxide in the lungs. As a consequence the concentration of carbon dioxide dissolved in the blood also decreases

(i) Describe the immediate change in the pH of the blood.

Mark	Description
1	The pH of the blood initially increases.

(ii) Explain the immediate change in the pH.

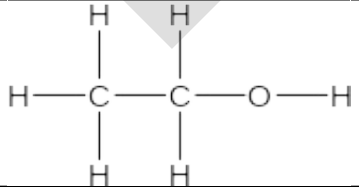
Mark	Description
2	As the partial pressure of $CO_{2(g)}$ is lowered the position of equilibrium between CO_2 and $H_2CO_{3(aq)}$ shifts to the left. This then shifts the position of the equilibrium in the carbonic acid/hydrogencarbonate ion buffer to the left lowering the concentration of hydrogen ions, and increases the pH of the blood.
1	The answer is given only in terms of the carbonic acid/hydrogencarbonate ion buffer.

(iii) Describe how the buffer system counteracts this change in pH.

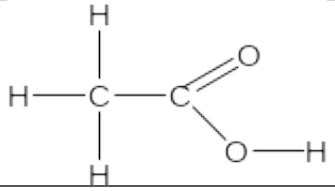
Mark	Description
3	The position of the equilibrium in the carbonic acid/hydrogencarbonate ion buffer shifts to the right, increasing the rate of the forward reaction and raises the concentration of hydrogen ions. The rate of the reverse reaction increases as the hydrogen ion concentration increases. This continues until the rate of the reverse reaction equals the rate of the forward reaction and equilibrium is re-established.
2	The position of the equilibrium in the carbonic acid/hydrogencarbonate ion buffer shifts to the right, increasing the rate of the forward reaction and raises the concentration of hydrogen ions. OR The answer is given in terms of Le Châtelier's principle. When the hydrogen carbonate and hydrogen ions are removed the position of the equilibrium shifts to the right to replace the hydrogencarbonate and hydrogen ions that have been removed
1	The equilibrium shifts to the right.

Question 9 ***[15 marks]***

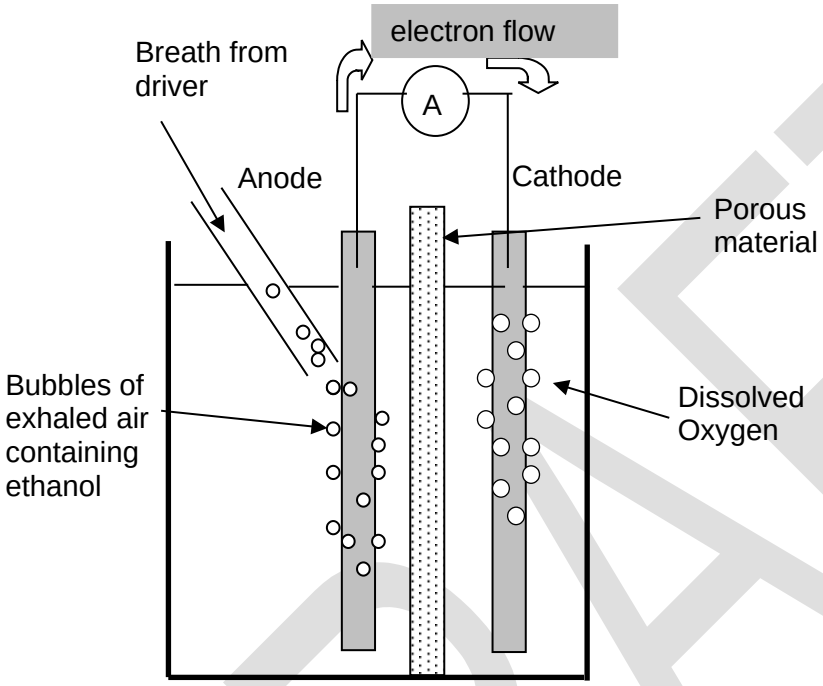
a) Draw the structural diagram of an ethanol molecule.

Mark	Description
1	
0	Question answered incorrectly or not attempted.

b) Draw structure of oxidation product (ethanoic acid)

Mark	Description
1	
0	Question answered incorrectly or not attempted.

c) Label electron flow on diagram



Mark	Description
1	Electron flow from anode to cathode through circuit
0	Question answered incorrectly or not attempted.

d) Write half-equation for anode reaction

Mark	Description
2	$CH_3CH_2OH + H_2O \rightarrow CH_3COOH + 4H^+ + 4e^-$
1	One error such as incorrectly balanced.
0	Question answered incorrectly or not attempted.

e) Write half-equation for cathode reaction

Mark	Description
2	$4H^+ + O_2 + 4e^- \rightarrow 2H_2O$
1	One error such as incorrectly balanced.
0	Question answered incorrectly or not attempted

f) Write full equation

Mark	Description
1	$CH_3CH_2OH + O_2 \rightarrow CH_3COOH + H_2O$ (or alternative that is correctly based on student's responses from e) and f) – follow through marks).
0	Question answered incorrectly or not attempted.

g) i) Write an equation for the reaction between ethanol and acidified potassium dichromate.

Mark	Description
2	$2Cr_2O_7^{2-} + 16H^+ + 3CH_3CH_2OH \rightarrow 4Cr^{3+} + 3CH_3COOH + 11H_2O$ or $Cr_2O_7^{2-} + 8H^+ + 3CH_3CH_2OH \rightarrow 2Cr^{3+} + 3CH_3CHO + 7H_2O$
1	One balancing error OR Student uses permanganate instead of dichromate but correctly balances equation.
0	Question answered incorrectly or not attempted.

(ii) Compare advantages and disadvantages of methods.

Mark	Description
3	Fuel cell breathalyser provides a quantitative reading of alcohol in breath, but may react with other things in breath. Dichromate method gives a fairly qualitative reading but is very portable and inexpensive method. (Or anything reasonable)
2	Only one method's advantages and disadvantages described or provided. Comparison limited.
1	No comparison attempted but an answer with some value.
0	Question answered incorrectly or not attempted.

h) Could the process described in (g) be used to detect tertiary alcohols? Give a reason for your answer.

Mark	Description
2	no tertiary alcohols cannot be oxidised by acidified oxidising agents.
1	no – but no reason given
0	Question answered incorrectly or not attempted

Question 10 ***[15 marks]***

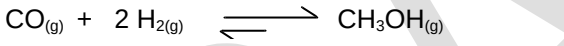
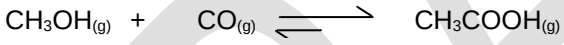
a) Acetic acid in the form of vinegar is suitable for human consumption. Suggest reasons why 0.1 mol L^{-1} acetic acid found vinegar can be consumed, but other acids such as 0.1 mol L^{-1} hydrochloric and 0.05 mol L^{-1} sulfuric acids should not be consumed.

Mark	Description
3	Vinegar is a dilute form of a weak acid and only partially ionises while HCl and H_2SO_4 are strong acids and are completely ionised $[H^+]$ is lowest in vinegar.
2	Acetic acid is a weak acid while HCl and H_2SO_4 strong
1	Acetic acid is a weak acid while HCl and H_2SO_4 are strong
0	Question answered incorrectly or not at all.

b) The most common deposit left in kettles is calcium carbonate. Write an equation to illustrate how acetic acid removes the calcium carbonate.

Mark	Description
2	$CaCO_3 + 2CH_3COOH \rightarrow Ca^{2+} + 2CH_3COO^- + CO_2 + H_2O$
1	$CaCO_3 + 2CH_3COOH \rightarrow Ca(CH_3COO)2 + CO_2 + H_2O$
1	One error (e.g. not balanced correctly)
0	Question answered incorrectly or not at all.

c) Using your understanding of rates and equilibrium, discuss both steps in the commercial production of acetic acid.

Mark	Description
9 – 10	An increased **rate** for this set of reactions would be favoured by: • **increase in temperature**, as particles move faster and collide more often and more particles have sufficient energy to react. (A graph showing the activation energy the kinetic energy distributions at two different temperatures could be included as a part of the answer.) • **increase in partial pressure** or concentration of gases would also increase rate as more particles mean greater chance of collision and therefore faster reaction rate. • **using a catalyst** will increase rate as it provides an alternative pathway with a lower activation energy. The catalyst increases the rate of both the forward and reverse reaction. (A diagram of an uncatalysed and catalysed reaction pathway could be included to illustrate the answer.) An increased **yield** would be favoured when the reaction is: • run at a **low temperature** as the reactions are exothermic. Exothermic reactions have a higher yield at lower temperatures • run at a **high pressure** as a high pressure favours the side with fewer number of gaseous particles The **actual reaction conditions** require a **compromise** on the temperature at which the process is carried out at. A low operating temperature would give a higher yield at a slower rate making the process uneconomic. Note:Answer may include the following reactions, but attainment of full marks is not dependent on their inclusion. The reactions which do not have to be included in the answer are:  Step 1  Step 2
8	Answer covers most points as given above but some linking of concepts missing. i.e. The process is discussed only in terms of rate
6 – 7	Student covers all essential points of rate and yield but does not specifically relate to given process or no equations or diagrams supplied.
4 – 5	Some points covered and explained.
2 – 3	Effect on rate and yield of conditions listed but either not explained or not correctly explained.
1	At least one viable point made.
0	Question answered incorrectly or not at all.

Question 11 ***[8 marks]***

From this information and your understanding of bonding and structure, identify the materials you would use. Explain your choices in detail.

Mark	Description
7 – 8	Answer includes materials chosen, the properties that were used to make the choice and the structure of the materials that explains the properties. For full marks there should be reference to the table of information and the answer should be constructed in a clear and coherent manner. Students may also indicate why materials were inappropriate, but this is not required for full marks.
5 – 6	Answer includes materials chosen and some linking between properties and structure. The structure explanations should be accurate.
3 – 4	Answer includes materials chosen and some linking between properties and structure. The structure explanations should have some accuracies and some deficiencies.
1 – 2	Answer includes materials chosen and one or two properties with no appropriate linking to structure or incorrect structure descriptions and explanation.
0	Question answered incorrectly or not at all

Question 12 ***[8 marks]***

a) A chemist needs to adjust the pH of a 25 000 L batch of waste water discharge that had a pH of 11.3, before releasing it into a stream. He estimated that he could do this by the addition of 420 L of 0.119 mol L^{-1} HCℓ solution. Determine the pH of the batch of waste water that was discharged into the stream
Equilibrium constant for water at 25°C $K_w = 1 \times 10^{-14}$

Mark	Description
6	Calculates • $[H^+]$ from pH • $[OH^-]$ using K_w • moles of OH^- in waste water • moles of excess H^+ • $[H^+]$ correctly adding volumes of solutions • pH.
1 - 5	1 mark per point, with follow through marking past the point of error.

$[H^+]$ = inverse log – 11.3
= 5.012×10^{-12}

$[OH^-]$ = $\frac{1 \times 10^{-14}}{5.012 \times 10^{-12}}$

= 1.995×10^{-3}

moles of OH^- = $25\,000 \times 1.995 \times 10^{-3}$

= 4.988×10^{1}

moles of H^+ added = $420 \times .0119$

= 4.998×10^{1}

moles of excess H^+ = 9.844×10^{-2}

$[H^+]$ = $\frac{9.844 \times 10^{-2}}{(25000 + 420)}$

= 3.872×10^{-6}

pH = $-\log (3.872 \times 10^{-6})$

= 5.41

b) Consider the information in the table. Is the pH of the treated waste water appropriate for release into a stream? Justify your answer.
(If you could not obtain a pH value in (a) above use a pH of 5.0.)

Mark	Description
2	A statement and a supporting argument such as: • The pH of the waste water is too low to be discharged into the water from an environmental viewpoint. • The number of moles of excess acid is only small (0.099 moles) and given the volume of water and the resulting dilution in the river this would have minimal environmental impact. • If the water was discharged into the alkaline river water it would be neutralised.
1	• The pH of the waste water is too low to be discharged into the water from an environmental viewpoint.
0	Question answered incorrectly or not at all.

Question 13 ***[9 marks]***

Water is often called the 'universal solvent'. The solubility of a number of substances is given in the table below.

Substance	Solubilities in water
Sodium bromide (NaBr)	**Soluble**
Methanol (CH_3OH)	**Miscible**
Bromine (Br_2)	**Slightly soluble**

Explain these solubilities in terms of the forces between:

(i) solvent molecules

(ii) particles in the solute

(iii) the solvated particles and the solvent

In your answer you should include equations and diagrams.

Mark	Description
9 (1 mark per point)	Solvent molecule is H_2O, this molecule has permanent dipoles. • H-bonding bonding occurs between molecules • diagram showing physical bond between the dipoles on adjacent water molecules NaBr • particles in solute are held together due to electrostatic attraction i.e. ionic bonds • the NaBr is able to dissolve because it is able to form ion – dipole attraction between ions and water molecules CH_3OH • H-bonding bonding occurs between methanol molecules • methanol molecules able to form H-bonds with water molecules • diagram showing physical bond between the dipoles on methanol and water molecules Br_2 • bromine is a diatomic molecule and the intermolecular forces between adjacent molecules are dispersion forces • bromine low solubility is due to the fact that very few bromine molecules have sufficient energy to overcome the strong intermolecular forces between the water molecules

Question 14 ***[10 marks]***

a) With reference to the table provided discuss the nature and relative strengths of the intermolecular forces in alcohols. You can use diagrams in your answer.

Mark	Description
6 (1 mark per point)	• all have H-bonds – diagram or explanation of H-bond • all have dispersion forces – temporary dipoles, diagram or explanation • H-bonds cause a higher boiling point than corresponding hydrocarbons – comparison methane/methanol or butane/butanol • dispersion forces increase with number of electrons – not molecular mass or chain length (correctly identify cause • H-bonding is stronger than dispersion force – compare boiling point of an alcohol to corresponding hydrocarbon • dispersion forces have a greater influence than H-bonding – increase of boiling point from methane to butane compared with methanol to butanol
3	Maximum of 3 if the answer only involves H-bonding
0	Question answered incorrectly or not at all.

b) Use your understanding of intermolecular forces to explain the differences between the boiling points of the following pairs of alcohols.

(i) methanol and 1-propanol

Mark	Description
2	• correctly identifies the intermolecular force responsible as dispersion forces • both have H-bonding, propanol has more atoms in the chain and hence more electrons producing stronger dispersion forces.
1	• identifies dispersion forces as cause, without explanation
0	Question answered incorrectly or not at all.

(ii) 1-butanol and 2-butanol

Mark	Description
2	• both alcohols have the same number of atoms - the difference is not due to dispersion forces. • the difference is due to the difference in the shape of the molecule due to the position of the alcohol • the position of the alcohol reduces the area of contact between adjacent molecules
1	• identifies the position of the alcohol as the cause, without explanation
0	Question answered incorrectly or not at all.

Question 15 ***[14 marks]***

A damp mixture of potassium iodide and potassium sulfate was dissolved in water and made up to 250.00 mL. 25.00 mL of this solution was treated with excess barium nitrate until no further precipitate formed. The solid was filtered and washed. It was then dried to a constant weight of 0.218 g.

A second 25.00 mL sample of the solution was treated with excess of lead nitrate solution until no further precipitate formed. The solid mixture of precipitates was filtered and washed. It was then dried to a constant weight of 0.607 g.

a) Write the precipitation reaction that occurred in step one

$$Ba^{2+}_{(aq)} + SO^{2-}_{4(aq)} \rightarrow BaSO_{4(s)}$$

Mark	Description
2	Writes the correct ionic equation.
1	Writes a molecular equation.
0	Question incorrectly answered or not attempted.

b) Write the TWO precipitation reactions that occurred in step two.

$$Pb^{2+}_{(aq)} + 2\,I^{-}_{(aq)} \rightarrow PbI_{2(s)}$$

$$Pb^{2+}_{(aq)} + SO^{2-}_{4(aq)} \rightarrow PbSO_{4(s)}$$

Mark	Description
4	Identifies correct products. Writes the correct ionic equation.
3 – 2	Writes two molecular equations. Writes one correct ionic equation.
1	Writes a molecular equation. Writes one correct ionic equation.
0	Question incorrectly answered or not attempted.

c) Calculate the masses of potassium iodide and potassium sulfate in the original sample.

Mark	Description
8	$m(K_2SO_4)$ = 1.63 g and m(KI) = 4.37 g
7	Allow for one mathematical error.
	Marks assigned as per guide below.
0	Question incorrectly answered or not attempted.

In the first precipitation reaction

$Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$

$n(BaSO_4) = \frac{0.218}{233.39}$

$= 9.34 \times 10^{-4}$ mol 1 mark

= $n(Ba^{2+})$ in 25 mL

$n(BaSO_4)$ in 250mL = $9.34 \times 10^{-4} \times 10$ 1 mark

= $n(K_2SO_4)$

$m(K_2SO_4) = 9.34 \times 10^{-3} \times 174.3$

= 1.63 g 1 mark

In the second set of precipitation reactions

(i) $Pb^{2+}_{(aq)} + SO^{2-}_{4(aq)} \rightarrow PbSO_{4(s)}$

Moles of $PbSO_{4(s)}$ in 25 mL = moles of SO_4^{2-} in 25 mL in the first solution 1 mark

= 9.34×10^{-4} moles

Mass of $PbSO_{4(s)}$ = $9.34 \times 10^{-4} \times 303.26$

= 0.283g 1 mark

Mass of $PbI_{2(s)}$ = (0.607 – 0.283) g

= 0.324g 1 mark

Moles of $PbI_{2(s)}$ = $\frac{0.324}{461}$

= 7.02×10^{-4}

Moles of I^- = $2 \times 7.02 \times 10^{-4}$

= 1.404×10^{-4} in 25 mL 1 mark

Moles of I^- in 250 mL = 1.404×10^{-3}

Mass of KI in damp mixture = $1.404 \times 10^{-3} \times 166$

= 2.33g 1 mark

ACKNOWLEDGEMENTS

SECTION TWO

Question 6 http://www.ocr.org.uk/Data/publications/specimen_assessment_materials/cquartetOCRTempFileY3R8iY3TBH.pdf

Question 9
EdWest. (2002). *Year 12 Chemistry examination*. Wembley, WA: Author.

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CHEMISTRY
Sample external written examination
Stage 3
Mapping questions to content

Course content	*Macroscopic properties of matter*	*Atomic structure and bonding*	*Chemical reactions*	*Acids and bases in aqueous solutions*	*Oxidation and reduction*	*Organic Chemistry*	*Applied chemistry*
Section 1 – Multiple choice							
Question							
1		✓					
2		✓					
3		✓					
4	✓	✓					
5	✓	✓					
6		✓		✓			
7					✓		
8					✓		
9					✓		
10				✓			
11				✓			
12				✓			
13				✓			
14				✓			
15				✓			
16				✓			
17					✓		✓
18						✓	
19						✓	
20						✓	
21						✓	
22			✓				
23			✓				
24			✓				
25			✓				
Section 2							
1						✓	
2						✓	
3						✓	
4			✓				
5				✓			✓
6			✓				✓
7			✓			✓	
8				✓			
9					✓	✓	✓
10			✓	✓			
11		✓					✓
12			✓	✓			✓
13	✓	✓					
14		✓					
15			✓				