CHEMISTRY
STAGE 3 SAMPLE EXAMINATION

Section 7 of the New WACE Manual: General Information 2006–2009 outlines the policy on WACE examinations.

Further information about the WACE Examinations policy can be accessed from the Curriculum Council website at http://newwace.curriculum.wa.edu.au/pages/about_wace_manual.asp.

The purpose for providing a sample examination is to provide teachers with an example of how the course will be examined. Further finetuning will be made to this sample in 2008 by the examination panel following consultation with teachers, measurement specialists and advice from the Assessment, Review and Moderation (ARM) panel.

Curriculum Council

Western Australian Certificate of Education, Sample External Examination

Question/Answer Booklet

CHEMISTRY
STAGE 3

Please place your student identification label in this box

Student Number: In figures | | | | | | | | |

In words _____

_____

Time allowed for this paper
Reading time before commencing work: Ten minutes
Working time for paper: Three hours

Material required/recommended for this paper

To be provided by the supervisor
Question/answer booklet
Separate multiple choice answer sheet
Data sheet

To be provided by the candidate
Standard items: Pens, pencils, eraser or correction fluid, ruler, highlighter
Special items: Scientific calculator

Important note to candidates
No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

This paper is for students who have completed Units 3A and 3B.

Structure of this paper

Section	Suggested working time	Number of questions available	Number of questions to be attempted	Percentage of paper	Marks
ONE Multiple choice	50 minutes	25	25	25	50
TWO	130 minutes	15	15	75	163
				Total marks	213

Instructions to candidates

1. The rules for the conduct of Curriculum Council examinations are detailed in the *Student Information Handbook*. Sitting this examination implies that you agree to abide by these rules.

2. Answer the questions according to the following instructions.
   Section One Answer **ALL** questions in the separate multiple choice answer sheet provided.
   Section Two Answer **ALL** questions in the spaces provided in this Question/Answer Booklet.

3. A blue or black ball point or ink pen should be used.

4. For full marks, chemical equations should refer only to those species consumed in the reaction and the new species produced. These species may be ions, molecules or solids.

SECTION ONE—MULTIPLE CHOICE [*50 marks*]

This section has **TWENTY FIVE** questions. Attempt **ALL** questions.

A SEPARATE multiple choice answer sheet is provided for you to answer questions in this section. Use a pencil (2B, B or HB) for all entries. For each question, shade the box which indicates your answer.

Allow approximately 50 minutes for this section.

Question 1
Which one of the following may have 19 protons, 20 neutrons and 19 electrons?

a) K
b) Ca
c) Y
d) Ca^{+}

Question 2
Which one of the following is the electron configuration of N^{3-}?

a) 2, 2
b) 2, 5
c) 2, 8
d) 2, 8, 3

Question 3
Which one of the following elements has the lowest first ionisation energy?

a) B
b) Be
c) K
d) Mg

Question 4
Which one of the following properties of ammonia is **not** related to the hydrogen bonding between molecules?

a) Freezing point
b) Molar mass
c) Solubility in water
d) Vapour pressure

Question 5
Which one of the following substances will have the highest melting point?

a) Carbon dioxide
b) Nitrogen dioxide
c) Silicon dioxide
d) Sulfur dioxide

Question 6
Which of the following 1.00 mol L^{-1} aqueous solutions will conduct electricity?

I hydrogen chloride
II ethanol
III ammonia
IV sodium nitrate

a) IV only
b) I and IV only
c) I, II and IV only
d) I, III and IV only

Question 7
In which one of the following does manganese have an oxidation state of +6?

a) Mn_2O_3
b) MnO_2
c) MnO_4^{2-}
d) MnO_4^-

Question 8
Which one of the following species is being oxidised?

$2BrO_3^-(aq) + 10I^-(aq) + 12H^+(aq) \rightarrow 5I_2(aq) + Br_2(aq) + 6H_2O(l)$

a) BrO_3^-
b) I^-
c) H^+
d) I_2

Question 9
Which one of the following reactions does **not** represent an oxidation-reduction reaction?

a) $2MnO_4^-(aq)+2H_2O(\ell)+ 3C_2O_4^{2-}(aq) \rightarrow 2MnO_2(aq) + 6CO_3^{2-}(aq) + 4H^+(aq)$
b) $Cr_2O_7^{2-}(aq) + H_2O(\ell) \rightarrow 2CrO_4^{2-}(aq) + 2H^+(aq)$
c) $2Br_2(aq) + N_2H_5^+(aq) \rightarrow N_2(g) + 5H^+(aq) + 4Br^-(aq)$
d) $6I^-(aq) + 14H^+(aq) + Cr_2O_7^{2-}(aq) \rightarrow 3I_2(aq) + 7H_2O(\ell) + 2Cr^{3+}(aq)$

Question 10
Which one of the following equations does **not** represent the donation and acceptance of protons?

a) $2H^+(aq) + 2e^- \rightleftharpoons H_2(g)$
b) $H^+(aq) + OH^-(aq) \rightleftharpoons H_2O(\ell)$
c) $H_2O_2(aq) + OH^-(aq) \rightleftharpoons HO_2^-(aq) + H_2O(\ell)$
d) $H_2C_2O_4(aq) + CO_3^{2-}(aq) \rightleftharpoons HC_2O_4^-(aq) + HCO_3^-(aq)$

Question 11
Which row in the table below correctly identifies the acidity, basicity or neutrality of the listed solutions?

	Sodium hydrogensulfate	**Potassium phosphate**	**Ammonium chloride**	**Magnesium nitrate**
(A)	Acidic	Acidic	Acidic	Basic
(B)	Neutral	Basic	Neutral	Acidic
(C)	Acidic	Basic	Acidic	Neutral
(D)	Basic	Neutral	Basic	Neutral

Question 12
Consider the following three statements (I–III) about neutralisation reactions.

I A neutralisation reaction is a reaction between an acid and a base.
II At the equivalence point of a neutralisation reaction the pH of the resulting solution will be 7.
III Neutralisation reactions always produce salts.

Which statement or combination of statements is always correct?

a) I only
b) I and II only
c) I and III only
d) I, II and III

Question 13
For the following equation:

$H_2SO_3(aq) + H_2O_2(aq) \rightarrow H_2SO_4(aq) + H_2O(\ell)$

Which one of the following statements is **true**?

a) Hydrogen peroxide is acting as an acid.
b) Hydrogen peroxide is acting as an acid and a base.
c) Hydrogen peroxide is acting as an oxidising agent only.
d) Hydrogen peroxide is acting as an oxidising and reducing agent.

Question 14
When the pH of a 0.01 mol L^{-1} solution of sulfuric acid is measured it is found to be significantly lower than the pH of a 0.01 mol L^{-1} solution of phosphoric acid. What is the reason for this?

a) Phosphoric acid is a triprotic acid, while sulfuric acid is only diprotic, therefore the concentration of hydrogen ions is higher in the phosphoric acid solution than in the sulfuric acid solution.
b) Phosphoric acid is a stronger acid than sulfuric acid, so the phosphoric acid is more likely to produce hydrogen ions in solution than the sulfuric acid.
c) Sulfuric acid is a stronger acid than phosphoric acid, so there are more hydrogen ions in the sulfuric acid solution than the phosphoric acid solution.
d) The sulfuric acid solution is more concentrated than the phosphoric acid solution, therefore there will be more hydrogen ions in the sulfuric acid solution than the phosphoric acid solution.

SEE NEXT PAGE

Question 15
Which of the following solutions can be added to 100.0 mL of a 0.2 mol L^{-1} NH_3 solution to produce a buffer?

I 100.0 mL of 0.20 mol L^{-1} NH_4Cl(aq)
II 50 mL of 0.20 mol L^{-1} HCl(aq)
III 100.0 mL of 0.20 mol L^{-1} HCl(aq)

a) I only
b) I and II only
c) II and III only
d) I, II and III

Question 16
Pure water undergoes self-ionisation according to the equation:

$2H_2O(\ell) \rightleftharpoons H_3O^+(aq) + OH^-(aq)$

The equilibrium constant for the reaction is:
1.0×10^{-14} at 25°C
5.5×10^{-13} at 100°C

Which one of the following statements is correct?

a) At 100°C the pH of water is less than 7, but the water is still neutral.
b) At 100°C the pH of water is less than 7, and therefore the water is acidic.
c) At 100°C the pH of pure water is greater than 7.0, and therefore the water is basic.
d) At 100°C the pH of water is greater than 7, and therefore the water is acidic.

Question 17
Potassium permanganate solution is standardised using the following procedure: sulfuric acid is added to 25.00 mL of a standard solution of oxalic acid (ethandioic acid) and the mixture warmed and titrated with potassium permanganate solution. Which one of the following will cause an error?

a) Leaving the conical flask (titration vessel) wet after rinsing with distilled water.
b) Rinsing the burette with distilled water, then with a little of the permanganate solution, and then filling it with the permanganate solution.
c) Rinsing the pipette with distilled water, then using it to dispense the oxalic acid solution.
d) Washing down the sides of the conical flask with distilled water from time to time during the titration.

Question 18
Which one of the following compounds will have geometric (cis/trans) isomers?

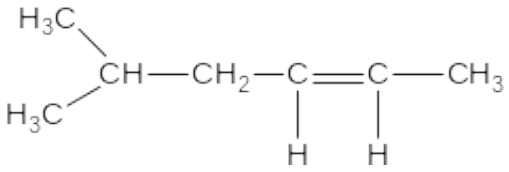
a) 1,1-dichloroethane
b) 1,2-dichloroethane
c) 1,1-dichloroethene
d) 1,2-dichloroethene

Question 19
What types of reactions will butane undergo?

I Substitution
II Addition
III Combustion

a) I only
b) I and II only
c) I and III only
d) I, II and III

Question 20
What is the correct name for the following formula?



a) 1, 1, 4, 4-tetramethylbutene
b) 1, 1, 4, 4-tetramethyl-3-butene
c) 5-methyl-2-hexene
d) 2, 5-dimethly-4-hexene

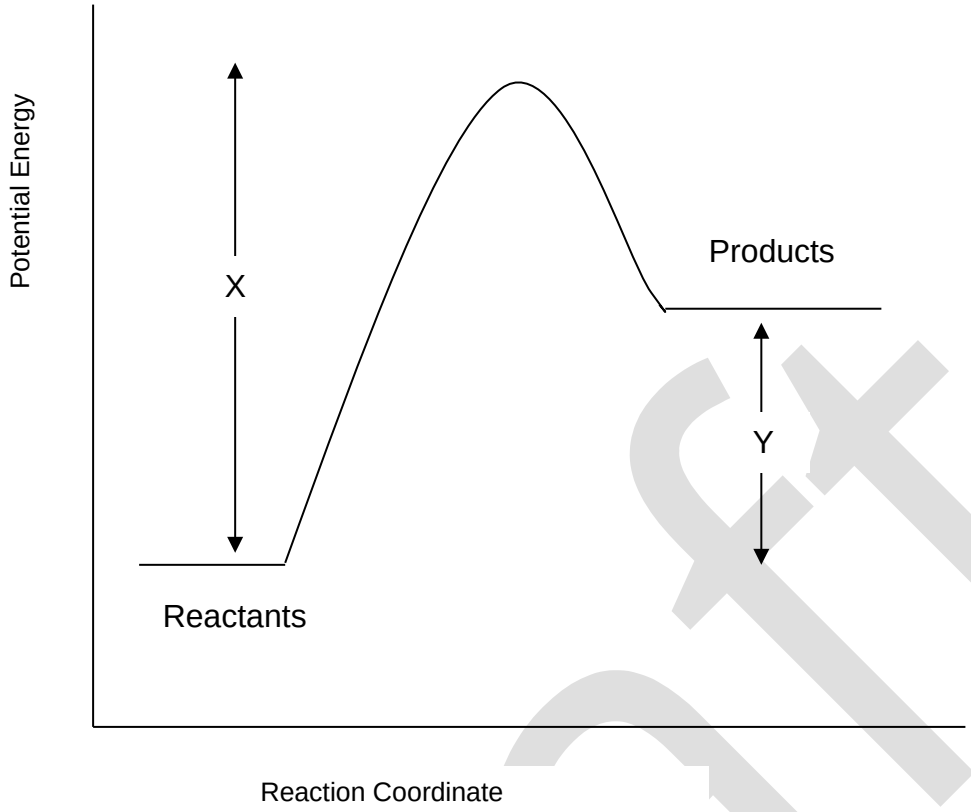
Question 21
In a series of experiments the following observations were made about a colourless liquid:

Experiment	**Observation**
A small amount of acidified potassium dichromate was added to the colourless liquid	No visible reaction
Liquid was added to sodium metal	Colourless, odourless gas evolved, silvery solid dissolved
Liquid was added to ethanol and heated with concentrated sulfuric acid	Fruity smell produced

Which one of the following substances would produce all of these observations?

a) 2-methyl-2-butanol
b) butanoic acid
c) 1-butanol
d) 2-butanol

Question 22
Consider the following potential energy diagram for a chemical reaction.



Which one of the following statements about this reaction is **incorrect**?

a) The reaction mixture will become hotter as the reaction proceeds.
b) The activation energy for the reverse reaction is X – Y.
c) The ΔH for the reverse reaction is –Y.
d) The forward reaction rate is likely to be slower than the reverse reaction rate.

Question 23
Which one of the following statements about the transition state in a chemical reaction is **false**?

a) The transition state corresponds to a point where bond breaking and bond forming is occurring.
b) The transition state is the highest energy state in the reaction.
c) The transition state is unstable and will only exist for a short period of time.
d) The transition state will be the same for a reaction whether a catalyst is used or not.

Questions 24 and 25 are about the following reaction:

$4NH_3(g) + 3O_2(g) \rightleftharpoons 2N_2(g) + 6H_2O(g)$ $\Delta H = -1267$ kJ

Three changes can be made to the reaction:

I adding a catalyst
II heating the mixture
III increasing the pressure.

Question 24
Which of the following changes will increase the yield of this reaction?

a) I only
b) II only
c) III only
d) None of the above

Question 25
Which of the following changes will increase the rate of the forward reaction?

a) I only
b) I and II only
c) I and III only
d) I, II and III

END OF SECTION ONE

SECTION TWO *[163 marks]*

This section has **15** questions. Attempt **ALL** questions in the spaces provided below.

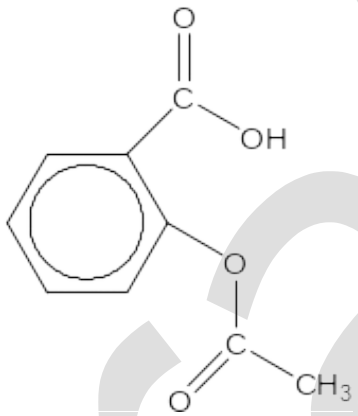
Any calculations are to be set out in detail. Marks will be awarded for correct equations and clear setting out, even if you cannot complete the calculation. Express numerical answers to three (3) significant figures and provide units where appropriate.

Information which may be necessary to answer questions is located on the separate Chemistry data sheet.

Allow approximately 130 minutes for this section.

Question 1 *[4 marks]*

(a) The structure of aspirin is given below.

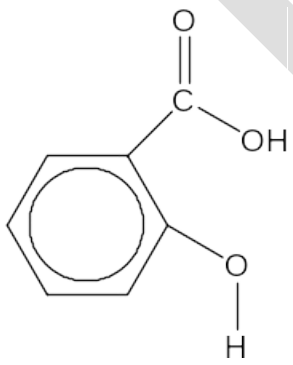


On the diagram above showing the structure of aspirin, circle and name the two functional groups present.

[2 marks]

(b) Aspirin can be produced by an esterification reaction. If one of the reactants is the structure shown below, draw the structure of an organic compound that would react with it to produce aspirin.

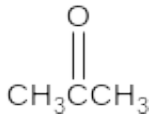
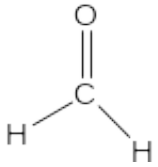
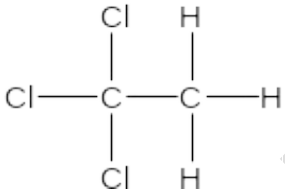
[2 marks]

Reactant 1	Reactant 2
	

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

The IUPAC (the body responsible for developing the systematic naming of organic compounds) recognises a number of common names for some organic compounds. In the table below are the structures and common names for eight compounds. 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	
CH_3COOH	Acetic acid	
	Formaldehyde	
	Liquid paper thinner	
	Isobutyl alcohol	2-methyl-propan-1-ol
	Isopropyl amine	Propan-2-amine
	Butanoic acid ethyl ester (strawberry odour)	Ethyl butanoate

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.

[2 marks]

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

A student preparing a mixture of salts to make a fertiliser is given a white salt that was one of the following:

potassium ethanoate, potassium chloride or potassium carbonate.

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 flow diagrams, tables etc. to represent your answer. The third unknown can be determined by the process of elimination.

[10 marks]

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

A sample of commercial vinegar was analysed for its ethanoic (acetic) acid content. A 20.0 mL sample of vinegar was diluted to 100 mL in a volumetric flask. Four 20.0 mL samples of the diluted solution were pipetted into conical flasks and titrated against a 0.0995 mol L^{-1} sodium hydroxide solution. The following results were obtained.

	1	2	3	4
Final reading (mL)	20.20	36.80	21.05	37.70
3.30	2.55	20.20	4.35	21.05
Titration volume (mL)				

(a) Complete the above table. *[1 mark]*

(i) Calculate the average titration volume. *[2 marks]*

(ii) Calculate the number of moles of sodium hydroxide in the average titration volume. *[2 marks]*

(iii) Calculate the concentration of acetic acid in the original vinegar solution. Express your answer in both mol L^{-1} and g L^{-1}. *[5 marks]*

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

[3 marks]

1. _____

_____

2. _____

_____

3. _____

_____

(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.

[4 marks]

_____

_____

_____

_____

_____

_____

_____

_____

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

[2 marks]

_____

_____

_____

_____

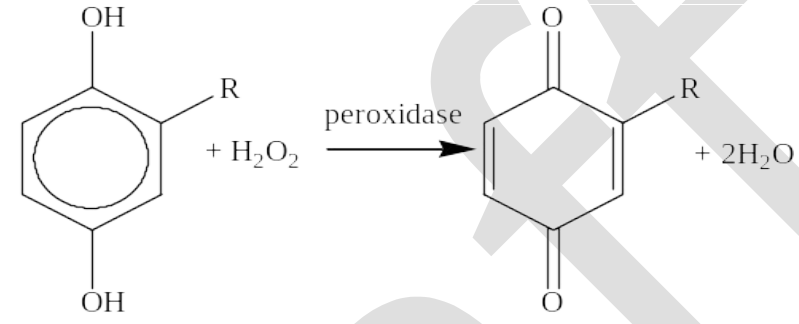
Question 6 ***[23 marks]***

The South American bombardier beetle has an unusual way of dealing with predators. When threatened, it releases an explosive spray of a boiling hot corrosive liquid containing benzoquinone

Inside the beetle there are two separate chambers: one containing a solution of hydroquinone and hydrogen peroxide, the other containing a mixture of two enzymes. Enzymes are biological catalysts.

When the beetle is attacked, the mixture of hydroquinone and hydrogen peroxide is released into the reaction chamber containing the enzymes. Exothermic reactions then occur to produce benzoquinone and oxygen which is released explosively as a hot spray from a gland on the tip of its abdomen.

The equations for the two reactions are given below:



hydroquinone benzoquinone

(R = H or CH_3)

(Equation 1)

$$2H_2O_2(\ell) \rightarrow 2H_2O(\ell) + O_2(g)$$

(Equation 2)

(a) Explain in terms of the equations shown above why the spray released from the gland of the bombardier beetle is hot. *[2 marks]*

(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.

[2 marks]

(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) List TWO variables you would expect to control in this experiment. *[2 marks]*

_____

_____

_____

_____

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

[2 marks]

Variable you **have to** measure_____

Variable that you **could** measure_____

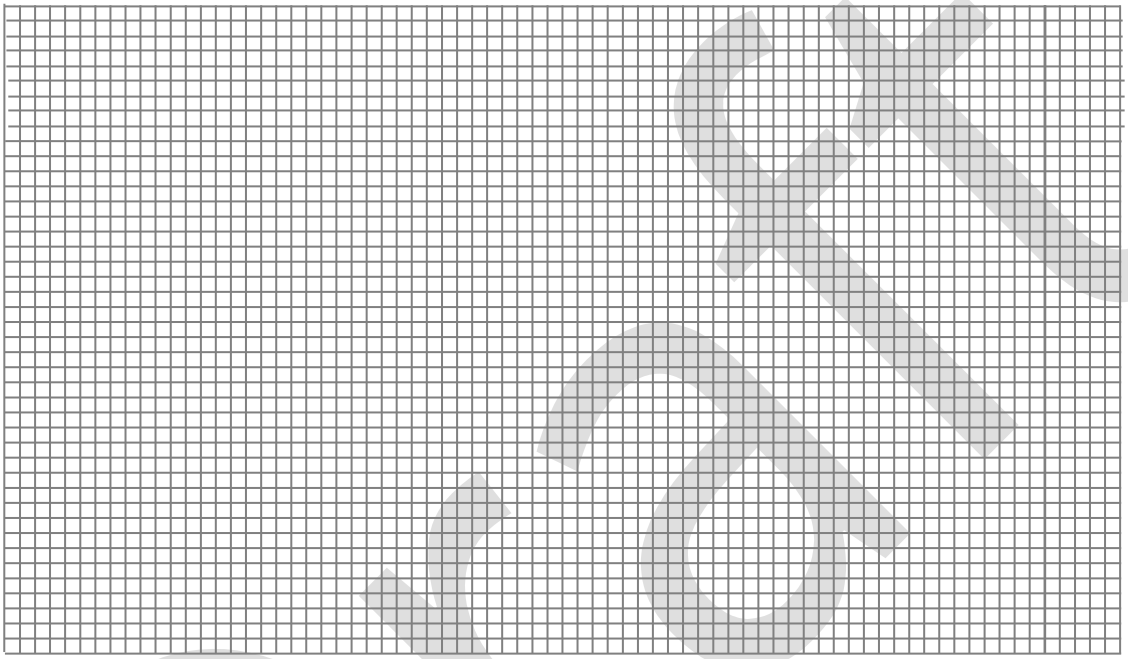
iii) Suggest an appropriate method for this experiment. You may include a diagram in your answer.

[5 marks]

(d) The table below shows the results of a series of experiments in which the initial rate of the reaction was found for different starting concentrations of hydrogen peroxide.

Hydrogen peroxide concentration (mol L^{-1})	Rate of decomposition (s^{-1})
0.05	0.13
0.10	0.27
0.15	0.41
0.20	0.53
0.25	0.75
0.35	0.94

(i) Plot the data on the graph paper. *[5 marks]*



(ii) Based on the data above, write a conclusion for this experiment. *[2 marks]*

(iii) Identify THREE potential sources of error in the experiment. *[3 marks]*

SEE NEXT PAGE

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

Citric acid, a carboxylic acid is responsible for the sour taste of lemon juice. This compound contains only carbon, hydrogen and oxygen.

When 1.383 g of anhydrous citric acid is burned in dry oxygen, 1.900 g of CO_2 and 0.518 g of H_2O are produced. Given this information and using sufficient working:

(a) Calculate the empirical formula of citric acid. *[6 marks]*
(b) Determine the molecular formula if the molecular mass of citric acid is 192.1. *[2 marks]*
(c) Draw a possible structural formula for citric acid given that one mole of citric acid reacts with three moles of potassium hydroxide. *[2 marks]*

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

The pH of blood is maintained through buffering. The major buffer system present in blood is based on a carbonic acid/hydrogencarbonate ion buffer. When carbon dioxide enters the blood stream, the following reaction occurs:

$$CO_{2(g)} + 2\ H_2O_{(\ell)} \rightleftharpoons H_2CO_{3(aq)} + H_2O_{(\ell)} \rightleftharpoons HCO^-_{3(aq)} + H_3O^+_{(aq)}$$

The presence of carbonic acid and hydrogencarbonate ions maintains the pH of blood to about 7.4.

(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. *[1 mark]*

(ii) Explain the immediate change in the pH. *[2 marks]*

(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. *[1 mark]*

(ii) Explain the immediate change in the pH. *[2 marks]*

(iii) Describe how the buffer system counteracts this change in pH. *[3 marks]*

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

Breathalysers work by analysing the amount of ethanol (C_2H_5OH) present in a driver's breath. Most modern breathalysers are based on fuel cell technology which is described below.

The fuel cell has two platinum electrodes with a porous acid-electrolyte material sandwiched between them. As the exhaled air from the driver flows past one side of the fuel cell, any alcohol in the breath is oxidised at the platinum electrode producing ethanoic acid (acetic acid), hydrogen ions and electrons.

The electrons flow through a wire between the platinum electrodes. The hydrogen ions move to the lower portion of the fuel cell and combine with dissolved oxygen and the electrons on the other side to form water.

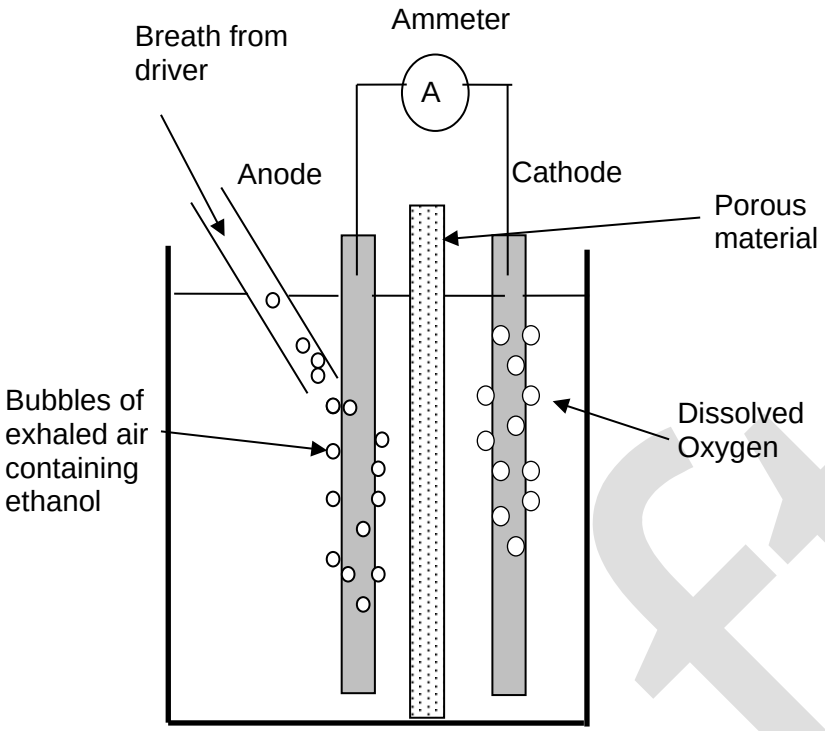
The more alcohol that is oxidised, the greater the electrical current. The current is fed into a microprocessor and a digital reading of the blood alcohol level is shown on a screen on the device.

(a) Draw the structural diagram of an ethanol molecule. *[1 mark]*

(b) Draw a structural diagram of the product formed by the complete oxidation of ethanol. *[1 mark]*

(c) On the fuel cell diagram, indicate the direction of the flow of electrons in the external circuit.

[1 mark]



(d) Write the half-equation for the reaction occurring at the anode. *[2 marks]*

(e) Write the half-equation for the reaction occurring at the cathode (assuming complete reduction).

[2 marks]

(f) Write an overall redox equation for the reaction occurring in the fuel cell.

[1 mark]

(g) An alternative method that was once used for testing the presence of alcohol was using the reaction of alcohol with acidified potassium dichromate ($K_2Cr_2O_7$) solution. The driver's exhaled breath was blown through a tube containing a solution of acidified dichromate. This caused a colour change as the dichromate was reduced to Cr^{3+} ions. The further down the tube the colour change occurred the greater the alcohol content of the exhaled breath. On the outside of the tube, there was a line indicating the point at which the blood alcohol content (BAC) exceeded 0.05%, the legal limit at which a person could drive a car.

i) Write an equation for the reaction between ethanol and acidified potassium dichromate. *[2 marks]*

ii) Compare the methods described in 9(a) and 9(g), giving advantages and disadvantages of each. *[3 marks]*

(h) Could the process described in 9(g) be used to detect tertiary alcohols? Give a reason for your answer. *[2 marks]*

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

Acetic acid (ethanoic acid) is the compound responsible for the sour taste and characteristic odour of vinegar. Vinegar can have a number of uses around the home. It can be used to remove the deposits left when tap water is boiled in kettles; it inhibits the growth of bacteria and so is used as a preservative. It is also used as flavouring in cooking and salad dressings.

Using the information above and your knowledge of chemistry, answer the following questions.

(a) Acetic acid in the form of vinegar is suitable for human consumption. Suggest reasons why 0.1 mol L^{-1} acetic acid found in 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.

[3 marks]

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

[2 marks]

The main commercial method for producing acetic acid is called the Monsanto process.
The first step of the process is the production of methanol.
The ΔH for this reaction is - 90.84 kJ mol^{-1}. Carbon monoxide and hydrogen react at 220 °C in the presence of a Cu/ZnO catalyst under a pressure of 50 atmospheres to produce methanol. This is considered to be a low pressure process when compared to the Haber process which operates at pressures up to 350 atmospheres.

The gaseous methanol using a suitable catalyst is then reacted with more carbon monoxide at 180^{o}C under a pressure of 30 – 40 atmospheres.
For this reaction ΔH = -135.31 kJ mol^{-1}. Under these conditions the reaction is very fast and produces a high yield.

(c) Using your understanding of rates and equilibrium, discuss both steps mentioned in 10(b) in the commercial production of acetic acid.

[10 marks]

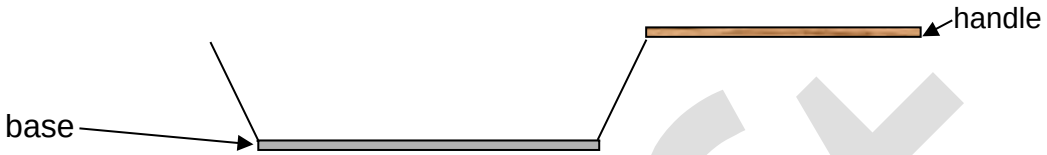
SEE NEXT PAGE

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

Thermal conductivity is a measure of a substance's ability to conduct heat.

A company wishes to develop a new frying pan with a non-stick surface. They investigate the properties of a number of substances which are given in the table below. From this information and your understanding of bonding and structure, identify the materials you would use to make the base and handle of the frying pan. Explain your choices in detail.

[8 marks]



Substance	Thermal conductivity	Malleability	Non-stick properties	Cost
Teflon (polytetrafluoroethylene)	Very poor	Poor	Excellent	Moderate
Diamond	Excellent	Poor	Good	High
Stainless steel	Moderate	Moderate	Moderate	Moderate
Aluminium	Good	Good	Moderate	Low
Copper	Good	Good	Moderate	Moderate
Silver	Good	Good	Moderate	High
Glass	Very poor	Poor	Poor	Low

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} $HC\ell$ solution. Determine the pH of the batch of waste water that was discharged into the stream.
Equilibrium constant for water at 25°C $K_w = 1 \times 10^{-14}$ *[6 marks]*

(b) Consider the information in the table below. 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)

Water source	pH
Acid rain	5.6
Ocean	8.8
Canning River at Armadale	7.9

[2 marks]

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. *[9 marks]*

SEE NEXT PAGE

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

Many alcohols are industrially important. They can be used as solvents, disinfectants, preservatives and as reactants in organic syntheses.

Up to C_{10}, the straight chain alcohols are colourless liquids with characteristic odours at room temperature. The longer chain alcohols are waxy solids. The boiling points of alcohols are considerably higher than for corresponding hydrocarbons. This is particularly true for the shorter chain alcohols. The table below gives the boiling points for some of the shorter chain alcohols.

Alcohol	Boiling point (°C)
Methanol	64.7
Ethanol	78.3
1-propanol	97.2
2-propanol	82.4
1-butanol	117.7
2-butanol	99.5

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

[6 marks]

(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
(ii) 1- butanol and 2- butanol *[4 marks]*

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. *[2 marks]*

(b) Write the TWO precipitation reactions that occurred in step two. *[4 marks]*

(c) Calculate the masses of potassium iodide and potassium sulfate in the original sample. *[8 marks]*

SEE NEXT PAGE

END OF PAPER

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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