



**Methodist Ladies' College
Semester 2 Examination, 2016**

Question/Answer Booklet

**CHEMISTRY
ATAR Year 12**

Student Name: _____

Teacher Name: _____

Time allowed for this paper

Reading time before commencing work: 10 minutes

Working time for paper: Three hours

Materials required/recommended for this paper

To be provided by the supervisor

This Question/Answer Booklet

Multiple-choice Answer Sheet

Chemistry Data Sheet

To be provided by the candidate

Standard items: pens (blue/black preferred), pencils (including colours),
sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: non-programmable calculators approved for use in the WACE
examinations

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

Structure of this paper

Section	Number of questions available	Number of questions to be answered	Suggested working time (minutes)	Marks available	Percentage of total exam	Your mark
Section One: Multiple-choice	25	25	50	25	25	
Section Two: Short response	13	13	60	74	35	
Section Three: Extended answer	5	5	70	81	40	
Total					100	

Instructions to candidates

1. The rules for the conduct of ATAR course examinations are detailed in the 2016 Year 12 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 on the separate Multiple-choice Answer Sheet provided. For each question, shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. If you make a mistake, place a cross through the square, then shade your new answer. Do not erase or use correction fluid/tape. Marks will not be deducted for incorrect answer. No marks will be given if more than one answer is completed for any question.

Sections Two and Three: Write your answers in this Question/Answer Booklet. Wherever possible, confine your answers to the line spaces provided. Use a black or blue pen for this section. Only graphs and diagrams may be drawn in pencil.
3. When calculating numerical answers, show your working or reasoning clearly. Express numerical answers to **three** significant figures and include appropriate units where applicable.
4. You must be careful to confine your responses to the specific questions asked and to follow any instruction that are specific to a particular questions.
5. Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.
 - Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
 - Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page



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number. Fill in the number of the questions that you are continuing to answer at the top of the page.

6. The Chemistry Data Sheet is **not** to be handed in with your Question/Answer Booklet.

Section One: Multiple-choice**25% (50 Marks)**

This section has **25** questions. Answer **all** questions on the separate Multiple-choice Answer Sheet Provided. For each question shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. If you make a mistake, place a cross through that square, do not erase or use correction fluid, and shade your new answer. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question

Suggested working time: 50 minutes

-
1. Which of the following solutions has the highest pH?
- (a) $1.0 \text{ mol L}^{-1} \text{CH}_3\text{COOH}$
 - (b) $0.1 \text{ mol L}^{-1} \text{CH}_3\text{COOH}$
 - (c) $0.1 \text{ mol L}^{-1} \text{HCl}$
 - (d) $1.0 \text{ mol L}^{-1} \text{HCl}$
2. Which of the following changes to pH and degree of ionisation take place when 50 mL of water is added to 50 mL of 0.1 mol L^{-1} ethanoic acid?
- | | pH | Degree of ionisation |
|-----|----------|----------------------|
| (a) | increase | decrease |
| (b) | decrease | increase |
| (c) | increase | increase |
| (d) | decrease | decrease |
3. Which of the following can produce a buffer solution when added to aqueous NH_4Cl ?
- (a) hydrochloric acid
 - (b) ethanoic acid
 - (c) potassium chloride
 - (d) ammonia
4. Which of the following indicators should be used in the titration of potassium hydroxide solution with propanoic acid solution?
- (a) phenolphthalein, endpoint pH range 8.0 – 10.0

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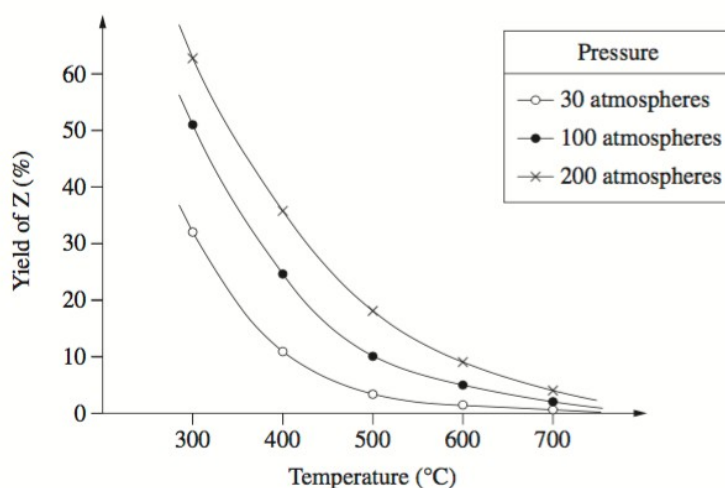
- (b) bromothymol blue, endpoint pH range 6.0 – 7.6
- (c) methyl red, endpoint pH range 4.2 – 6.2
- (d) methyl orange, endpoint pH range 3.1 – 4.4



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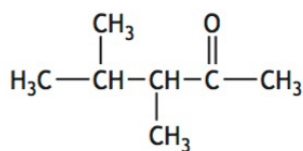
5. In a reversible reaction, equilibrium is reached when,
- the concentrations of reactants and products are constant
 - molecules of reactants cease to change into molecules of products
 - the concentrations of reactants and products are equal
 - the activation energy of the forward and reverse reaction are equal

6. This graph represents the yield of an equilibrium reaction at different temperature and pressure conditions inside a reaction vessel.



Which of the following reactions would produce the trends shown in the graph?

- $X(g) + Y(g) \rightleftharpoons 3Z(g)$ $H = +100 \text{ kJ}$
 - $X(g) + Y(g) \rightleftharpoons 2Z(g)$ $H = -100 \text{ kJ}$
 - $4X(g) + 2Y(g) \rightleftharpoons 3Z(g)$ $H = -100 \text{ kJ}$
 - $2X(g) + Y(g) \rightleftharpoons Z(g)$ $H = +100 \text{ kJ}$
7. The name of the compound with the structure shown below is:



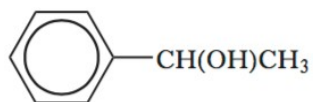
- 3,4-dimethylpentan-4-one
- 3,4-dimethylpentan-2-one

- (c) 2,3-dimethylpentan-2-one
- (d) 2,3-dimethylpentan-4-one

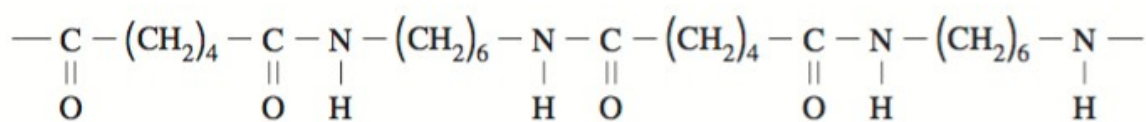


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8. Which of the following statements about the compound below is correct?



- (a) It reacts readily with bromine solution
 - (b) It can be oxidised to an aldehyde
 - (c) It can be oxidised to a ketone
 - (d) It is a primary alcohol
9. The diagram below represents a segment of the polymer nylon 6,6.

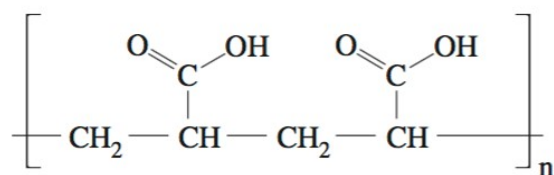


Which of the following represents the two monomers that are used to produce nylon 6,6.



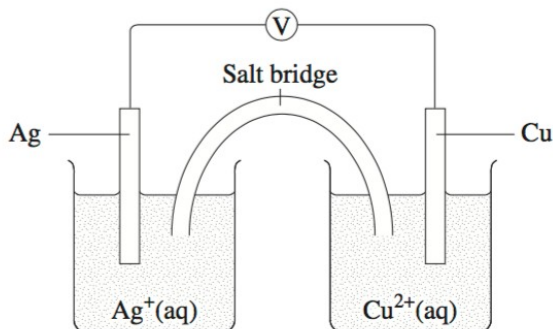
- (a) $\begin{array}{c} \text{HO} \\ \diagdown \\ \text{C} - (\text{CH}_2)_4 - \text{N} \begin{array}{l} \diagup \text{H} \\ \diagdown \text{H} \end{array} \\ \parallel \\ \text{O} \end{array}$ and $\begin{array}{c} \text{H} \\ \diagdown \\ \text{N} - (\text{CH}_2)_6 - \text{N} \begin{array}{l} \diagup \text{H} \\ \diagdown \text{H} \end{array} \\ \diagup \text{H} \end{array}$
- (b) $\begin{array}{c} \text{HO} \\ \diagdown \\ \text{C} - (\text{CH}_2)_4 - \text{C} \begin{array}{l} \diagup \text{OH} \\ \parallel \text{O} \end{array} \\ \parallel \\ \text{O} \end{array}$ and $\begin{array}{c} \text{H} \\ \diagdown \\ \text{N} - (\text{CH}_2)_4 - \text{C} \begin{array}{l} \diagup \text{OH} \\ \parallel \text{O} \end{array} \\ \diagup \text{H} \end{array}$
- (c) $\begin{array}{c} \text{HO} \\ \diagdown \\ \text{C} - (\text{CH}_2)_6 - \text{C} \begin{array}{l} \diagup \text{OH} \\ \parallel \text{O} \end{array} \\ \parallel \\ \text{O} \end{array}$ and $\begin{array}{c} \text{H} \\ \diagdown \\ \text{N} - (\text{CH}_2)_4 - \text{N} \begin{array}{l} \diagup \text{H} \\ \diagdown \text{H} \end{array} \\ \diagup \text{H} \end{array}$
- (d) $\begin{array}{c} \text{HO} \\ \diagdown \\ \text{C} - (\text{CH}_2)_4 - \text{C} \begin{array}{l} \diagup \text{OH} \\ \parallel \text{O} \end{array} \\ \parallel \\ \text{O} \end{array}$ and $\begin{array}{c} \text{H} \\ \diagdown \\ \text{N} - (\text{CH}_2)_6 - \text{N} \begin{array}{l} \diagup \text{H} \\ \diagdown \text{H} \end{array} \\ \diagup \text{H} \end{array}$

10. A portion of resin made from acrylic acid ($\text{CH}_2=\text{CHCOOH}$) is shown



Which type of reaction results in the formation of this polymer.

- (a) addition
 - (b) condensation
 - (c) dehydration
 - (d) esterification
11. In an electrolytic cell, the electrons flow:
- (a) from the cathode to the anode through the molten salt
 - (b) from the anode to the cathode via the external circuit
 - (c) directly from the reductant to the oxidant
 - (d) from the negative electrode to the positive electrode via the external circuit
12. A diagram of a simple cell is shown.



Which of the following occurs when the cell is in operation?

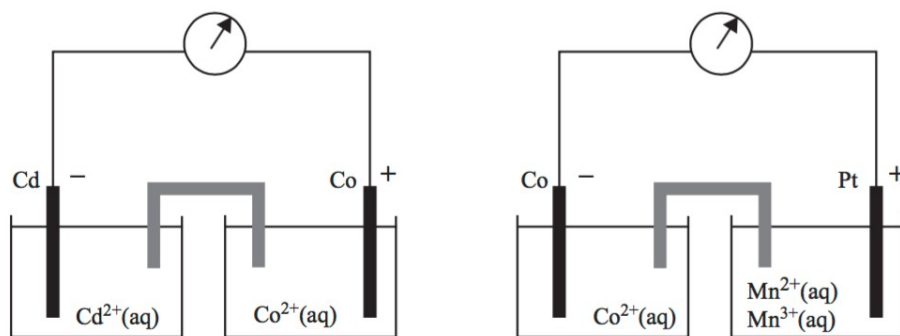
- (a) silver ions are formed in solution
- (b) the copper electrode increases in mass



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- (c) cations move towards the copper half cell
- (d) electrons travel from the copper electrode toward the silver electrode

13. Two standard galvanic cells are shown below.



On the basis of the polarity of the electrodes in these cells, which one of the following reactions would **not** be expected to occur spontaneously?

- (a) $\text{Co}^{2+}(\text{aq}) + \text{Cd}(\text{s}) \rightarrow \text{Co}(\text{s}) + \text{Cd}^{2+}(\text{aq})$
 - (b) $2\text{Mn}^{3+}(\text{aq}) + \text{Co}(\text{s}) \rightarrow 2\text{Mn}^{2+}(\text{aq}) + \text{Co}^{2+}(\text{aq})$
 - (c) $2\text{Mn}^{3+}(\text{aq}) + \text{Cd}(\text{s}) \rightarrow 2\text{Mn}^{2+}(\text{aq}) + \text{Cd}^{2+}(\text{aq})$
 - (d) $2\text{Mn}^{2+}(\text{aq}) + \text{Cd}^{2+}(\text{aq}) \rightarrow 2\text{Mn}^{3+}(\text{aq}) + \text{Co}(\text{s})$
14. Which of the following is/are redox reactions?
- (i) $\text{Ag}^+(\text{aq}) + \text{I}^-(\text{aq}) \rightarrow \text{AgI}(\text{s})$
 - (ii) $\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightarrow 2\text{CrO}_4^{2-}(\text{aq}) + 2\text{H}^+(\text{aq})$
 - (iii) $2\text{Ca}(\text{s}) + \text{O}_2(\text{g}) \rightarrow 2\text{CaO}(\text{s})$
- (a) (ii) only
 - (b) (iii) only
 - (c) (ii) and (iii)
 - (d) (i) only
15. Which of the following conditions affects the value of the equilibrium constant for a reaction.
- (a) temperature

- (b) pressure
- (c) catalyst
- (d) concentration



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16. A small increase in temperature sometimes produces a large increase in reaction rate. Which of the following statements is the **best** explanation for this?
- (a) the reaction must be endothermic
 - (b) the frequency of collisions increases
 - (c) the average kinetic energy of the colliding particles increases
 - (d) the activation energy decreases
17. Which of the following would you expect to hydrogen bond with methanamine?
- (i) water
 - (ii) ethanol
 - (iii) ammonia
- (a) (i) and (ii)
 - (b) (i), (ii) and (iii)
 - (c) (ii) and (iii)
 - (d) (i) and (iii)
18. An organic liquid is warmed with acidified potassium permanganate solution. The solution remains purple. The organic liquid is likely to be:
- (a) propan-2-ol
 - (b) 3-methylbutanal
 - (c) methylpropan-2-ol
 - (d) methylpropan-1-ol
19. Which one of the following statements about $1.00 \times 10^{-8} \text{ mol L}^{-1}$ nitric acid is correct?
- (a) such a solution cannot exist
 - (b) the pH is 6
 - (c) the pH is 8
 - (d) the pH is a little less than 7
20. A green powder dissolves in sulfuric acid producing a colourless gas. In a separate experiment the green powder on heating turns black. The green and black solids are most likely to be.



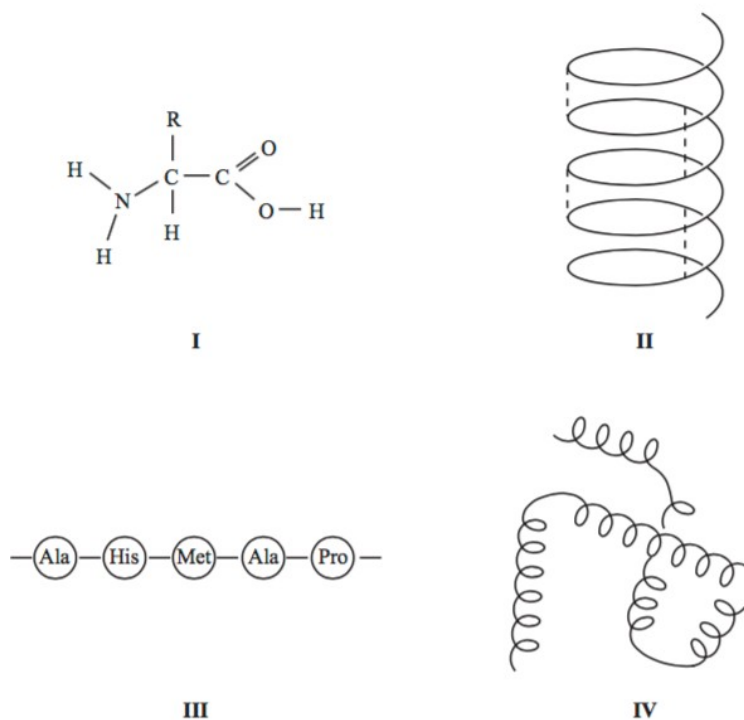
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- (a) copper(II) carbonate and carbon
- (b) nickel(II) carbonate and nickel(II) oxide
- (c) nickel(II) carbonate and carbon
- (d) copper(II) carbonate and copper(II) oxide

21. How many alkene isomers have the molecular formula C_4H_8 ?

- (a) 3
- (b) 4
- (c) 5
- (d) 6

22. A student's notes on protein structure included the following diagrams.



Which sketch best represents the primary, secondary and tertiary structure of proteins?

	primary	secondary	tertiary
(a)	III	II	IV
(b)	III	IV	II
(c)	I	II	IV
(d)	I	IV	II

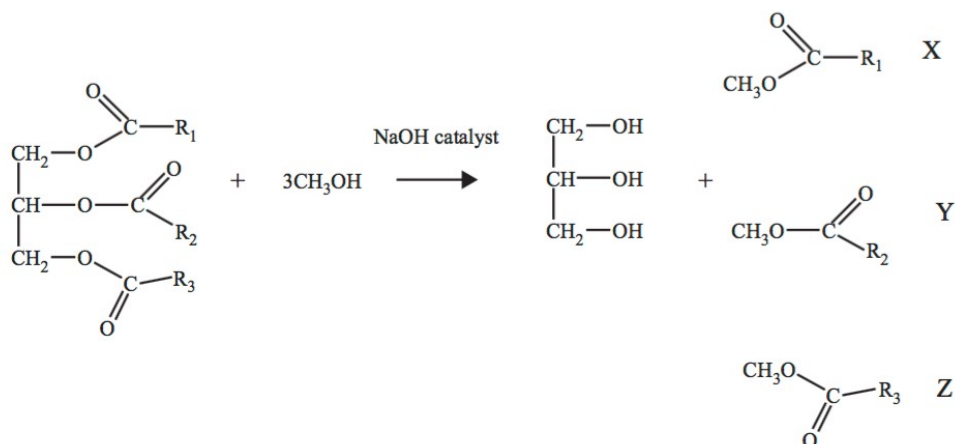
23. The tertiary structure of proteins may be maintained by:



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- (a) hydrogen bonding
- (b) ionic interactions
- (c) covalent bonds
- (d) all of the above

24. Palm oil is converted to biodiesel by the following reaction.



The mixture of the compounds X, Y and Z is used as *palm oil biodiesel*. The term that best describes the mixture of compounds in *palm oil biodiesel* is:

- (a) glycerols
 - (b) monoglycerides
 - (c) methyl esters
 - (d) fatty acids
25. Gold is not normally oxidised by oxygen but the cyanide ion assists in the oxidation by forming the aurocyanide ion, $\text{Au}(\text{CN})_2^-$. The overall redox equation is:



What is the E° value for the oxidation half-reaction of gold with cyanide ions?

- (a) 0.6V
- (b) 0.2V
- (c) -0.2V
- (d) -0.6V

END OF SECTION 1

Section Two: Short answer



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35% (74 Marks)

This section has eleven (13) questions. Answer all questions. Write your answers in the spaces provided.

Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.

- Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
- Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question(s) that you are continuing to answer at the top of the page.

Suggested working time: 60 minutes

Question 26

(5 marks)

When acidified solutions of oxalic acid, $\text{H}_2\text{C}_2\text{O}_4$, and sodium bromate, NaBrO_3 , are mixed together, carbon dioxide and bromide ions are formed as products.

- (a) Write the oxidation and reduction half equations, and the balanced redox equation.

(4 marks)

Oxidation
Reduction
Balanced Redox

- (b) Which species is the oxidant? _____

(1 mark)

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Question 27

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(6 marks)

Complete the table below by giving the structural formulae or naming the following organic substances.

IUPAC Name	Structural formula
	$\begin{array}{ccccccc} & \text{H} & \text{H} & \text{H} & & \text{O} & \\ & & & & & // & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - & \text{C} & \\ & & & & & \backslash & \\ & \text{H} & \text{H} & \text{H} & & \text{H} & \end{array}$
2-propyl ethanoate	
3-amino-2-methyl butanoic acid	
	$\left[\begin{array}{cc} \text{CH}_3 & \text{H} \\ & \\ - \text{C} & - \text{C} - \\ & \\ \text{H} & \text{H} \end{array} \right]_n$
	$\begin{array}{ccccccc} & \text{H} & \text{H} & \text{O} & & \text{H} & \\ & & & & & / & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - & \text{N} & \\ & & & & & \backslash & \\ & \text{H} & \text{H} & & & \text{H} & \end{array}$

trans 1,2 dichloropropene	
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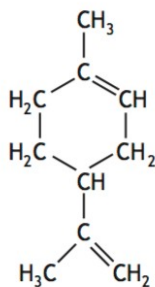
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Question 28



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Limolene is an essential oil which is added to some cleaning products to give them a lemon scent.



- (a) Determine the empirical and molecular formula of limolene.

(2 marks)

Empirical formula _____

Molecular formula _____

- (b) The concentration of limolene present in a cleaning product can be determined by titrating a solution of limolene dissolved in ethanol with bromine solution in the absence of UV light.

- (i) Name the type of organic chemical reaction taking place when limolene reacts with bromine solution.

(1 mark)

- (ii) Draw the structure of the organic product of this reaction.

(1 mark)

- (iii) Explain why the experiment was carried out in the absence of UV light? (1 mark)

- (iv) The titrator pipetted a 20.0 mL sample of limolene solution (colourless) into a conical flask and titrated with bromine solution until equivalence. No indicator was used. How would the titrator know when the equivalence point was reached?

(1 mark)

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Question 29

Compounds **A** and **B** are two organic isomers with the molecular formula $C_5H_{10}O_2$.

- **A** reacts with sodium carbonate solution.
- **B** has a 'fruity' odour.
- When **B** is heated with an acid solution, two new organic compounds, **C** and **D**, are formed.
- **C** has the molecular formula H_2CO_2 and is weakly acidic.
- **D** is found to **not** decolorise an acidified solution of potassium permanganate.

(a) Complete the table below with the name and structural formula of compounds **A** and **B**.
(4 marks)

Compound	IUPAC name	Structural Formula
A		
B		

(b) Draw and name an isomer of **D** that **would** decolorise an acidified solution of potassium permanganate.
(2 marks)

Question 30**(4 marks)**

Calculate the pH of a barium hydroxide solution prepared by weighing 6.63 g of pure barium hydroxide crystals, dissolving the solid in distilled water and making the volume up to 250 mL.

Question 31**(6 marks)**

Predict whether the following reactions are likely to occur spontaneously by determining the E° value of the reaction. Give observations where a reaction is predicted.

Reactants	E° value of the reaction	Observations if reaction is predicted to occur
a piece of cadmium metal is placed into a solution of silver nitrate		
Hydrogen sulfide gas is bubbled into bromine solution		
acidified hydrogen peroxide solution is mixed with cobalt nitrate solution		

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Question 32 (6 marks)

Complete the table by writing the name or formula for a substance that fits the description.

Description	Name or Formula
a primary standard substance that can be used to standardise a hydrochloric acid solution	
a weak diprotic acid	
an acid base indicator which turns colourless in $0.1 \text{ mol L}^{-1} \text{ HCl(aq)}$	
a species that will oxidise aqueous iron(II) ions	
the alcohol formed when fats and oils are hydrolysed	
the conjugate base of the HPO_4^{2-} ion	

Question 33

(3 marks)

Although iron is extensively used a major problem with iron objects is their tendency to corrode. Underground pipes are protected from corrosion by burying scrap magnesium underground and using a conducting wire connecting it to the iron pipes. Explain how this method prevents the corrosion of iron.

(3 marks)

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Question 34

- (a) The amino acid threonine exists as a zwitterion in aqueous solution at pH = 7. Complete the table below showing the structure of threonine at each pH.

(3 marks)

pH of solution	Structure
7	
9	
5	

- (b) Ionic interactions help to maintain the three dimensional shape of proteins. Explain why a pH change can denature a protein.

(3 marks)

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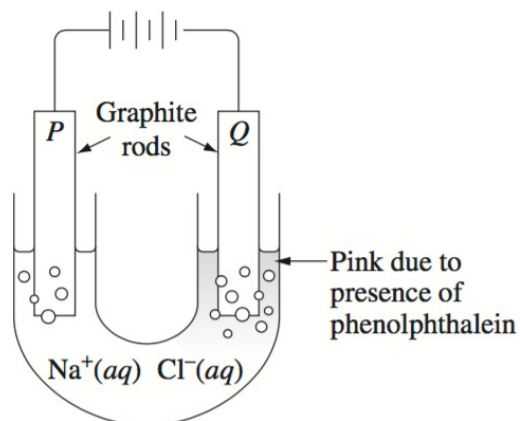
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Question 35

Consider the following electrochemical cell



- (a) Is this cell galvanic or electrolytic? Explain (2 marks)

- (b) Identify P and Q as either the anode or cathode. (1 mark)

P _____ Q _____

- (c) Give the half equations for the reactions occurring at each electrode. (2 marks)

Electrode P _____

Electrode Q _____

- (d) Why did the phenolphthalein turn pink? (1 mark)

- (e) If the sodium chloride solution was replaced with nickel(II) chloride solution would the products at each electrode be the same? Explain. (2 marks)

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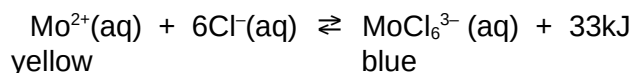
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Question 36

Molybdenum chloride (MoCl_2) is a yellow solid. When it dissolves in water, the molybdenum ions react with the chloride ions to form hexachloromolybdenum(III) ions which are blue in colour. The equilibrium mixture appears green in colour.



- (a) Complete the table below indicating, how the forward rate of reaction, concentration of $\text{MoCl}_6^{3-}(\text{aq})$ and moles of $\text{Cl}^{-}(\text{aq})$ are affected once equilibrium has been re-established when the system is subjected to the following changes.

Answer: increase \uparrow , decrease \downarrow , or no change NC.

(9 marks)

Change made to system	forward rate	concentration of $\text{MoCl}_6^{3-}(\text{aq})$	moles of $\text{Cl}^{-}(\text{aq})$
temperature is increased			
volume is doubled by the addition of water			
a few drops of concentrated silver nitrate solution is added			

- (b) Predict the observations for the equilibrium above when a few drops of concentrated silver nitrate solution is added.

(2 marks)

Question 37**(3 marks)**

Examine the following groups of substances and list them in order of increasing order according to the property stated.

- (a) **A** $\text{CH}_3\text{COOCH}_3$ **B** $\text{CH}_2\text{CH}_2\text{COOH}$ **C** $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$

Solubility in water

Lowest _____ Highest

- (b) **A** 1.0 mol L^{-1} sulfuric acid **B** 1.0 mol L^{-1} nitric acid **C** 1.0 mol L^{-1} ethanoic acid

pH

Lowest _____ Highest

- (c) **A** CH_3COCH_3 **B** CH_2CHCH_3 **C** $\text{CH}_3\text{CHOHCH}_3$

Boiling point

Lowest _____ Highest

Question 38**(4 marks)**

An aqueous solution of ammonium ethanoate solution is neutral but an aqueous solution of sodium ethanoate is basic. Use equations to assist your explanation.

(4 marks)

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End of Section Two

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Section Three: Extended answer



This section contains five (5) questions. You must answer all questions. Write your answers in the spaces provided.

Where questions require an explanation and/or description, marks are awarded for the relevant chemical content and also for coherence and clarity of expression.

Final answers to calculations should be expressed to **three (3)** significant figures and include appropriate units.

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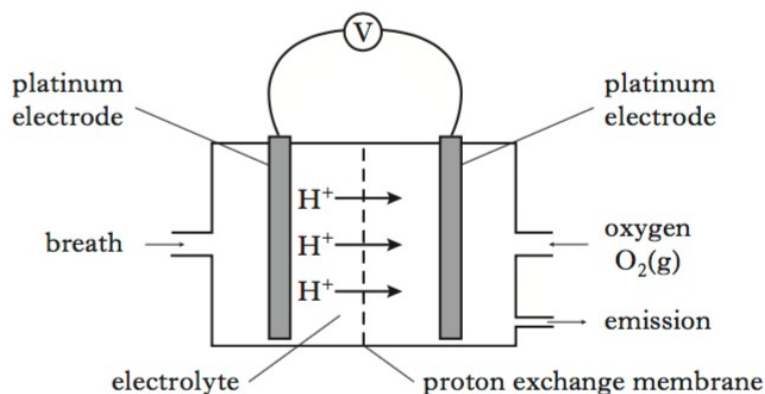
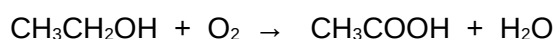
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Suggested working time: 70 minutes

Question 39

(14 marks)

The concentration of ethanol in a person's breath can be determined by measuring the voltage produced in a fuel cell. The overall reaction for the fuel cell is given below.



- (a) In the diagram above, identify which electrode is the anode and which is the cathode. (1 mark)
- (b) Why is it important that protons pass through the membrane but oxygen and ethanol are too large to pass through? (2 marks)

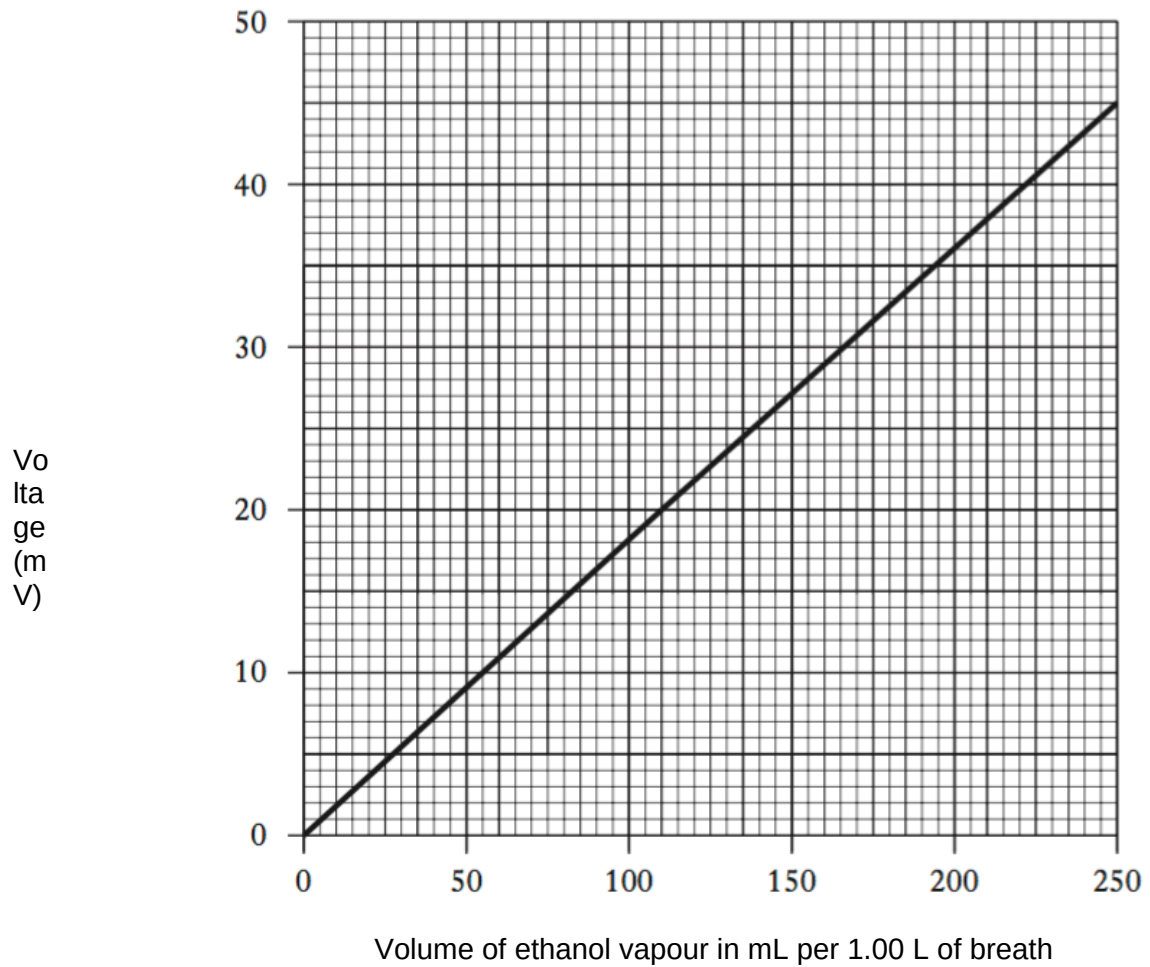
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- (c) Different ethanol vapour concentrations produce different voltages as is shown in the graph below.



Calculate the mass of ethanol in 1.00 L of a drink driving suspect's breath if a voltage of 20.0 mV was recorded at 27°C and 102 kPa.

(4 marks)

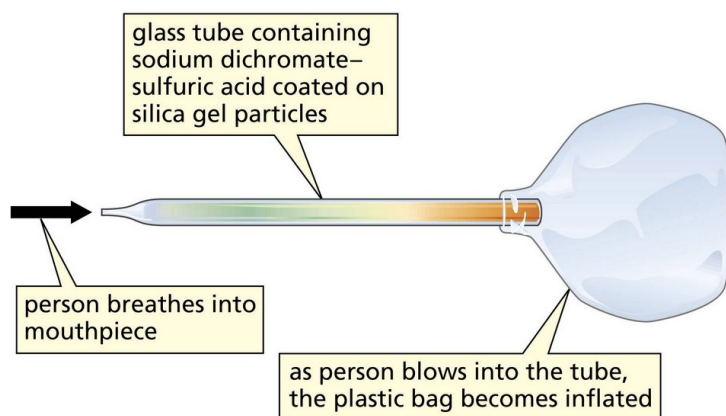
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- (d) In earlier forms of the breathalyser, police asked the person suspected of drink driving to blow through a glass tube containing acidified sodium dichromate crystals until the plastic bag fully inflated.



- (i) Write a balanced redox equation for the oxidation of ethanol with acidified dichromate solution. (3 marks)
- (ii) What colour change would be observed in the glass tube if the person had ethanol vapour in their breath? (1 mark)
- _____
- (iii) Why is sulfuric acid also present in the glass tubing? (1 mark)
- _____
- _____
- (iv) Could the sulfuric acid be replaced with hydrochloric acid in this breathalyser without affecting its reliability? Explain

11

11

(2 marks)

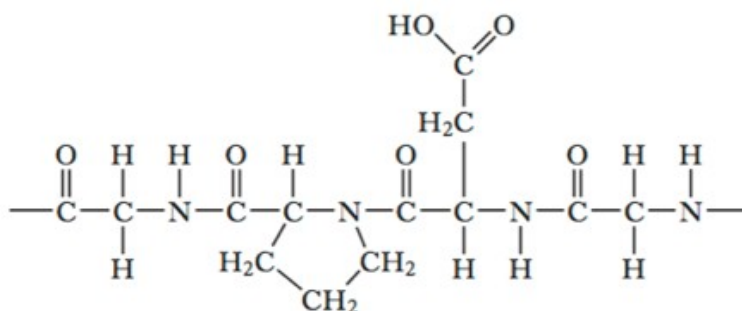
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Question 40



METHODIST
LADIES' COLLEGE
(22 marks)

Collagen is a protein that is found in muscle and the skin of animals. Part of the structure of collagen is shown below.



- (a) How many amino acid molecules have joined to form this section of protein?

(1 mark)

- (b) Partial hydrolysis of another peptide molecule gave a mixture of three smaller peptide molecules with the following amino acid sequences.

leu-gly-val

his-leu

gly-val-ser

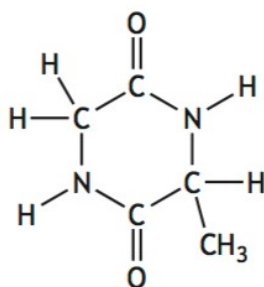
Write the amino acid sequence for the original peptide molecule.

(1 mark)

_____ - _____ - _____ - _____ - _____

- (c) Over the last decade several families of extremely stable peptide molecules have been discovered, where the peptide chain forms a ring.

- (i) A simple cyclic dipeptide is shown



On the structure above, draw lines through the bond(s) that would break on complete hydrolysis of this cyclic peptide.

(2 marks)

- (ii) With reference to your data book, name the two amino acids formed on complete acid hydrolysis.

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(2 marks)

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- (d) Alpha-amanitin is a highly toxic cyclic peptide found in death cap mushrooms. The lethal dose for humans is 100.0 mg per kg of body mass. 1.00 g of death cap mushroom contains 250.0 mg of alpha-amanitin. Calculate the minimum mass of death cap mushrooms that would contain the lethal dose for a 75.0 kg adult.

(2 marks)

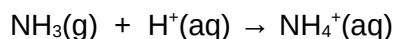


- (e) A crime scene toxicologist was investigating a suspicious death where the victim had been served a mushroom risotto. The toxicologist isolated and purified a cyclic peptide which she analysed to determine its identity.

Alpha-amanitin has the empirical and molecular formula $C_{39}H_{54}N_{10}O_{14}S$

On combustion analysis, 4.036g of the peptide formed 7.538g of carbon dioxide, 0.281g of sulfur dioxide and 2.136g of water vapour.

All the nitrogen in the 4.036 g sample was converted to ammonia, which was bubbled through 50.0 mL of 1.00 mol L⁻¹ hydrochloric acid solution.



The resultant solution required 30.50 mL of 0.200 mol L⁻¹ sodium hydroxide for complete neutralisation.

Determine the empirical formula of the cyclic peptide

(14 marks)

Working space.

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(18 marks)

LEGE

- (1 mark)

- (2 marks)

(2 marks)

conjugate base _____

conjugate acid _____

- (8 marks)

[illegible]

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Space for diagrams

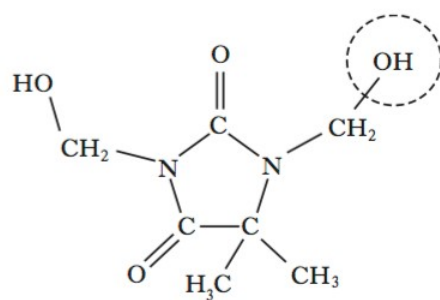


METHODIST
LADIES'
COLLEGE

- (d) Soaps like sodium stearate do not function well in hard water (water containing Ca^{2+} ions). Explain with the aid of an equation.

(2 marks)

- (e) Hair products contain a large variety of different chemicals. Hydantoins are used as preservatives in shampoos to kill any bacteria. A typical hydantoin is shown below.



Name the functional group circled _____

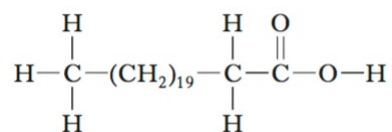
(1 mark)

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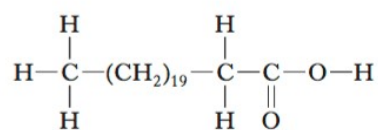
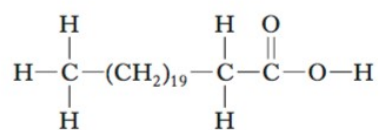
- (f) When conditioner containing behenic acid is applied to hair, the behenic acid molecules make intermolecular hydrogen bonds to the keratin protein molecules in hair.

The structure of behenic acid is:

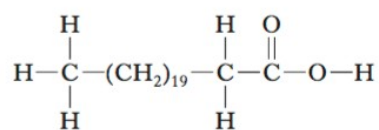
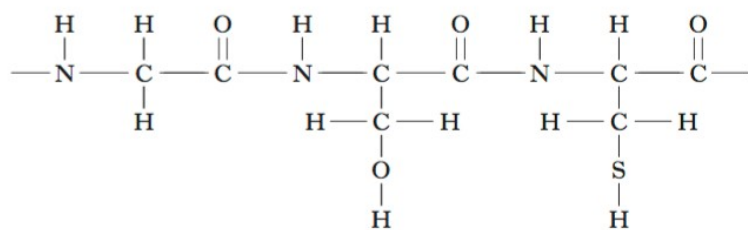


On the diagram below show **two** hydrogen bonds that could be made between a behenic acid molecule and the keratin(polypeptide). Include non-bonding pairs and partial charges on the atoms involved in the hydrogen bond.

(2 marks)



keratin



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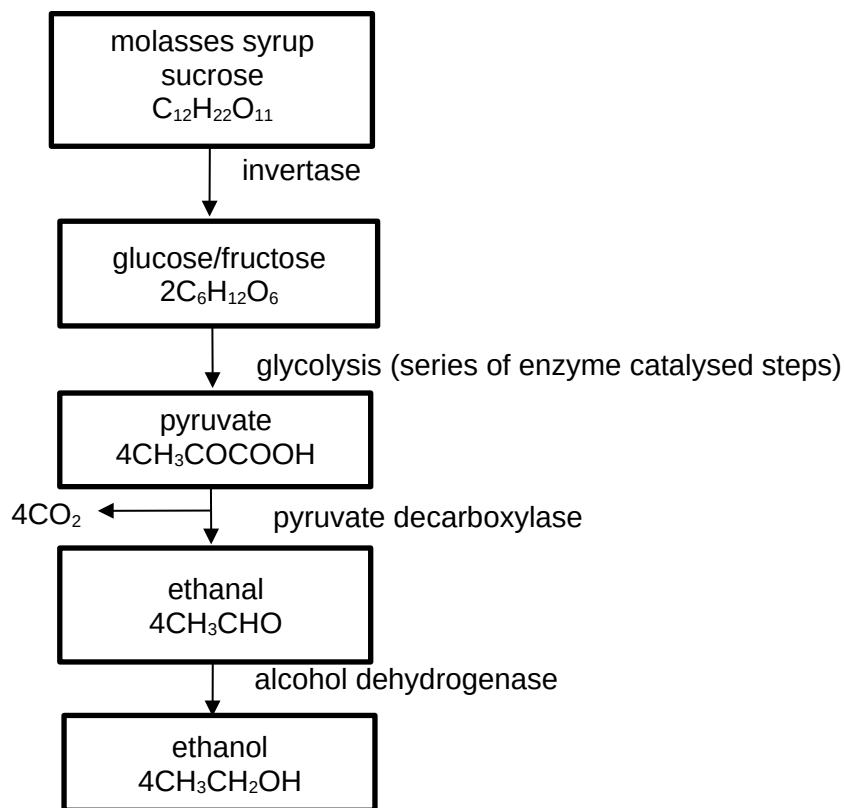


METHODIST
LADIES'
COLLEGE

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Question 42**(13 marks)**

In Northern Queensland, molasses syrup (a sugar rich product of the sugar refining industry) is used to produce ethanol by fermentation. This process uses the catalytic activity of several enzymes produced by yeast.



During the fermentation process, glucose is first converted into pyruvate. The pyruvate is then converted to ethanol in a two-step process.

- (a) If 445 kg of ethanol is produced in one day from 1.00 tonne of sucrose determine the efficiency of the process.

(5 marks)



- (b) The molasses is 72.3% sucrose. What mass of molasses is required to produce 445 kg of ethanol. (1 mark)

- (c) The ethanol solution produced is 11.0% by mass. Express this concentration as mol L^{-1} (each mL of solution has a mass of 1.00g) (2 marks)

- (d) Explain why the temperature for this process must be carefully considered and what the consequences would be if for example a much higher temperature was used. (2 marks)

- (e) The conversion of ethanal to ethanol is a reduction. Explain this in terms of oxidation numbers. (1 mark)

- (f) Discuss why this process for ethanol manufacture is described as 'green chemistry' (2 marks)

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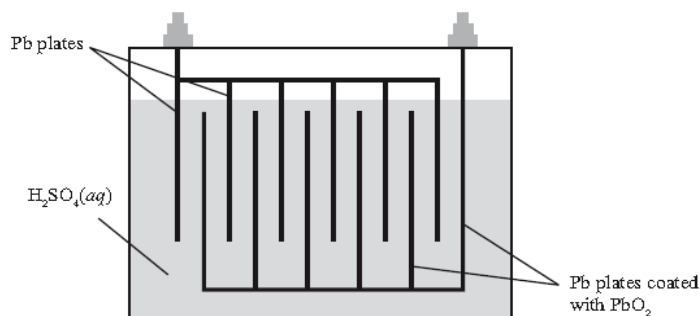
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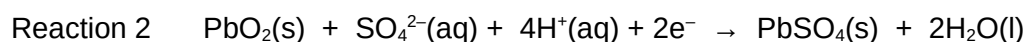
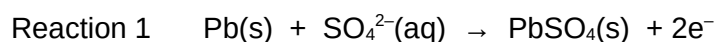
Question 43



The following diagram represents the lead-acid battery often used in motor cars.



The reactions occurring when the battery is operating are:



The lead acid battery comprises 6 identical cells in series and has a total voltage of 12 V. The volume of acid is 0.700 L

In a particular fully charged cell the sulfuric acid concentration is 4.50 mol L^{-1} . One of the anodes was weighed and after some time was reweighed and found to have increased in mass by 1.35 g.

- (a) Write the overall discharge equation. (1 mark)
- (b) Why did the anode increase in mass? (1 mark)
- (c) How many moles of sulfuric acid was consumed in total in each cell? (3 marks)

(d) Determine the concentration of sulfuric acid in the battery after this period of discharge.
(4 marks)

(e) Assuming that sulfuric acid's second ionisation is 10.0% determine the pH of the original 4.50 mol L^{-1} acid.
(3 marks)

(f) What feature of the lead acid battery allows it to be readily recharged? Explain.
(2 marks)

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1	B	11	B	21	D
2	C	12	D	22	A
3	D	13	A	23	D
4	A	14	?A?	24	C
5	A	15	A	25	A
6	C	16	C		
7	B	17	B		
8	C	18	C		
9	D	19	D		
10	A	20	D		