CHEMISTRY

UNITS 1&2

2021

WA Student Number: In figures

In words _____

_____

Circle your teachers name: ***Barnes*** ***Dhue*** ***Fagan*** ***Holyoake***

Lloyd ***Thompson*** ***Venter***

Time allowed for this paper

Reading time before commencing work: ten minutes
Working time: three hours

Materials required/recommended for this paper

To be provided by the supervisor:
This Question/Answer Booklet
Multiple-choice Answer Sheet
Chemistry Data Book

To be provided by the candidate:
Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, eraser, correction tape/fluid, ruler, highlighters

Special items: up to three calculators, which do not have the capacity to create or store programmes or text, are permitted in this ATAR course examination

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 material. 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 examination
Section One Multiple-choice	25	25	50	/ 25	/ 25
Section Two Short answer	7	7	60	/ 67	/ 35
Section Three Extended answer	5	5	70	/ 76	/ 40
					/ 100

Instructions to candidates

1. Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens.

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. Do not use erasable or gel pens. If you make a mistake, place a cross through that square, then shade your new answer. Do not erase or use correction fluid/tape. Marks will not be deducted for incorrect answers. 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.

3. When calculating numerical answers, show your working or reasoning clearly. Your working should be in sufficient detail to allow your answers to be checked readily and for marks to be awarded for reasoning. Express numerical answers to the appropriate number of 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 instructions that are specific to a particular question.

5. Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

6. The Chemistry Data Book is not to be handed in with your Question/Answer booklet.

Section One: Multiple-choice **25% (25 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. Do not use erasable or gel pens. If you make a mistake, place a cross through that square, then shade your new answer. Do not erase or use correction fluid/tape. 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 statements regarding an atom of neon-20 is correct?

   (a) The atomic number is 20.
   (b) The mass number is 20.
   (c) The number of neutrons is 20.
   (d) The number of electrons is 20.

2. Consider the equations below showing the behaviour of sulfurous acid when dissolved in water.

   I. $H_2SO_3(aq) \rightleftharpoons H^+(aq) + HSO_3^-(aq)$
   II. $HSO_3^-(aq) \rightleftharpoons H^+(aq) + SO_3^{2-}(aq)$

   Based on these equations which of the following conclusions can be made about sulfurous acid?

   (a) It is a strong diprotic acid.
   (b) It is a strong acid.
   (c) It is a weak diprotic acid.
   (d) It has a pH above 7.

3. Which of the formulae in the table below correctly match the names given?

	Name	Formula
(i)	dinitrogen tetroxide	N_2O_4
(ii)	strontium nitrite	$SrNO_2$
(iii)	lithium hydrogenphosphate	Li_2HPO_4
(iv)	iron(III) cyanide	$Fe_2(CN)_3$
(v)	sodium oxalate	Na_2O

   (a) (i) and (iv) only.
   (b) (ii) and (iii) only.
   (c) (i) and (iii) only.
   (d) (ii) and (v) only.

4. The aqueous solubility of a particular solute is being investigated. As the temperature of the water decreases, the solubility of the solute would likely **increase** if the solute

   (a) was a gas.
   (b) was a solid.
   (c) was polar.
   (d) was non-polar.

5. A student wrote three sentences describing the structure of graphite.

   I It consists of layers or sheets of **carbon** atoms which form flat hexagonal rings.
   II Each **carbon** atom is connected to three other **carbon** atoms by covalent bonds.
   III There are no covalent bonds existing between each layer of **carbon** atoms

   Which of these statements are correct?

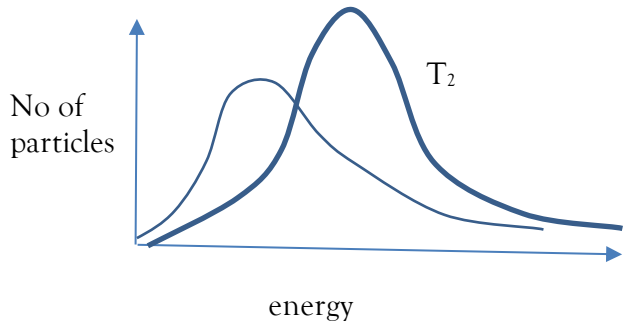
   (a) I only
   (b) I and II only
   (c) I and III only
   (d) I, II and III

6. Which pair of statements explains the increase in the rate of a reaction when the temperature is increased or a catalyst is added?

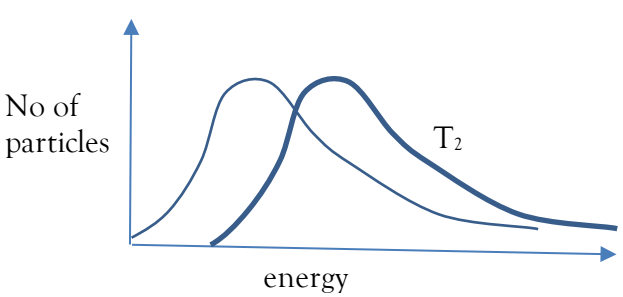
	Increasing temperature	**Adding a catalyst**
(a)	activation energy decreases	activation energy increases
(b)	change in enthalpy(ΔH) decreases	average kinetic energy of the particles increases
(c)	average kinetic energy of the particles increases	activation energy decreases
(d)	number of particles increases	change in enthalpy(ΔH) decreases

7. The sample of gas, in a closed system, is heated to a higher temperature, T_2. Four chemistry students were asked to draw the curve that represents the distribution of energy at this new temperature. They are shown below, which one is correct?

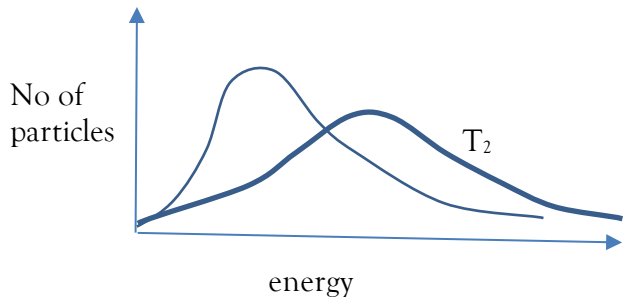
a)



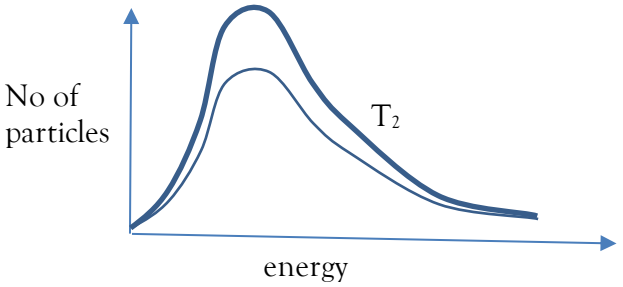
b)



c)



d)



8. Which of the following statements is/are correct for particles in the transition state of a chemical reaction?

(i) They can quickly form reactants.
(ii) They can quickly form products.
(iii) They have maximum enthalpy.

(a) (ii) only.
(b) (i) and (ii) only.
(c) (ii) and (iii) only.
(d) All of (i), (ii) and (iii).

Questions 9, 10 and 11 relate to the information provided in the partially completed table below.

	Symbol	Number of protons	Number of neutrons	Number of electrons
V	^{22}Na		11	
W		15	15	15
X	$^{22}Na^{+}$	11		
Y	$^{31}P^{3-}$			18
Z		13		10

9. Which two species are isotopes?

(a) V and X.
(b) W and Y.
(c) X and Z.
(d) V and Z.

10. Which two species have the same electron configuration?

(a) V and X.
(b) W and Y.
(c) X and Z.
(d) V and Z.

11. The radius of

(a) V is less than that of W.
(b) X is less than that of Z.
(c) Y is less than that of W.
(d) X is less than that of V.

12. Consider the chemical reaction below.

$$2\ SO_2(g) + O_2(g) \rightarrow 2\ SO_3(g)$$

Which of the following changes would **not** increase the rate of reaction?

(a) Increasing the concentration of $SO_2(g)$ in the system.
(b) Increasing the volume of the system.
(c) Increasing the temperature of the system.
(d) Adding an appropriate catalyst to the system.

13. The semi-structural formula of 4,4-dimethylpent-2-ene is

(a) $(CH_3)_3CCH_2CHCH_2$
(b) $CH_3C(CH_3)_2CH(CH_3)CH_3$
(c) $CH_3CHCHC(CH_3)_2CH_3$
(d) $CH_3CH_2CH(CH_3)CH(CH_3)CH_3$

14. Which one of the following substances will have the highest boiling point?

(a) methane (CH_4)
(b) ethane (CH_3CH_3)
(c) dichloroethane (CH_3CHCl_2)
(d) dichloromethane (CH_2Cl_2)

Questions 15 and 16 relate to the information below.

Four (4) beakers labelled W, X, Y and Z, were known to contain the following 0.5 mol L^{-1} solutions; $Na_2S(aq)$, $K_2CO_3(aq)$, $ZnCl_2(aq)$ and $Pb(NO_3)_2(aq)$.

In order to find the identity of the solutions, samples were taken from each of the beakers and mixed. The table below shows which samples were mixed, as well as the corresponding observations.

	W	X	Y
X	white solid formed		No visible reaction
Y	white solid formed	no visible reaction	
Z	white solid formed	white solid formed	grey solid formed

15. The formula of the grey solid produced when samples from beakers Y and Z were mixed is

(a) $Pb(NO_3)_2$.
(b) $PbCl_2$.
(c) $PbCO_3$.
(d) PbS.

16. The results in the table demonstrate that $ZnCl_2(aq)$ was in beaker

(a) W.
(b) X.
(c) Y.
(d) Z.

17. A sample of juice was being analysed by high-performance liquid chromatography (HPLC) to confirm whether citric acid was present. Subsequently, the results of the analysis were compared to a calibration curve to determine the concentration of citric acid in the juice.

In order for the data to be reliable, the HPLC conditions used for the citric acid analysis must be the same as those used to produce the citric acid calibration curve. These are referred to as 'controlled variables'.

Which of the following is **not** a variable that needs to be controlled in this investigation?

(a) The stationary phase.
(b) The mobile phase.
(c) The pressure applied.
(d) The amount of sample loaded.

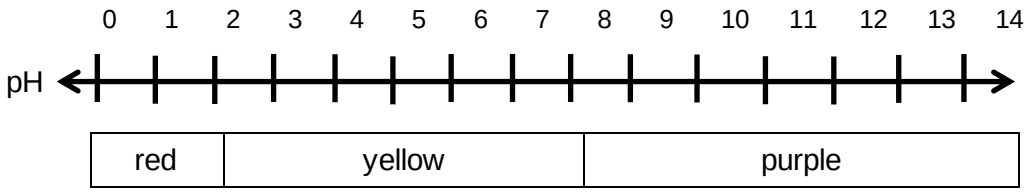
18. Which one of the following does **not** have an electron configuration of 2,8,8?

(a) Ar
(b) Al^{3+}
(c) Cl^{-}
(d) Ca^{2+}

19. Activation energy is the

(a) minimum amount of energy released in a chemical reaction.
(b) maximum amount of energy released in a chemical reaction.
(c) minimum amount of energy required for a chemical reaction to occur.
(d) maximum amount of energy required for a chemical reaction to occur.

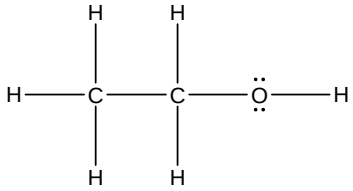
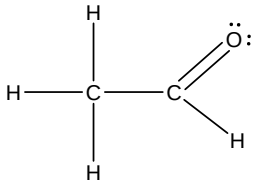
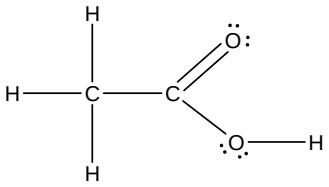
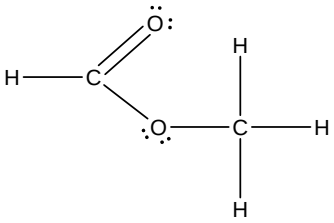
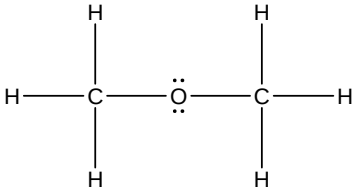
20. Metacresol purple is a pH indicator exhibiting three (3) different colours, as shown in the diagram below.



Which of the solutions below would be **least** likely to turn yellow, when several drops of metacresol purple are added to it?

(a) $H_2O(l)$
(b) $NH_3(aq)$
(c) NaCl (aq)
(d) NaOH(aq)

21. Which of the organic substances below would exhibit dipole-dipole forces but **not** hydrogen bonding between molecules in a pure sample?

(i)	
(ii)	
(iii)	
(iv)	
(v)	

(a) (i) and (v) only.
(b) (ii) and (iv) only.
(c) (ii), (iii) and (v) only.
(d) (ii), (iv) and (v) only.

22. Which one of the following rows correctly classifies each substance?

	Hydrogen peroxide (H_2O_2)	**Ethanoic acid (CH_3COOH)**	**Ammonium carbonate ($(NH_4)_2CO_3$)**
(a)	Non–electrolyte	Strong electrolyte	Weak electrolyte
(b)	Non–electrolyte	Weak electrolyte	Strong electrolyte
(c)	Weak electrolyte	Strong electrolyte	Weak electrolyte
(d)	Weak electrolyte	Non–electrolyte	Strong electrolyte

Questions 23 and 24 refer to the following three (3) organic reactions.

(i) $CH_3CHCHCH_3 + H_2O \rightarrow$ **X**

(ii) $CH_3CH_3 +$ **Y** $\rightarrow CH_2ClCH_3 + HCl$

(iii) $CH_3CH_2CH_2Br + NaOH \rightarrow CH_3CH_2CH_2OH +$ **Z**

23. Which of the following options correctly identifies substances X, Y and Z?

	X	**Y**	**Z**
(a)	$CH_3CH_2CHOHCH_3$	Cl_2	NaBr
(b)	$CH_3CHOHCH_2CH_3$	HCl	NaBr
(c)	$CH_3CHOHCH_2CH_3$	Cl_2	HBr
(d)	$CH_3CH_2CH_2CH_2OH$	HCl	Br_2

24. Which of these would be classified as a substitution reaction?

(a) (i) only.
(b) (ii) only.
(c) (i) and (iii) only.
(d) (ii) and (iii) only.

25. Which one of the following processes is exothermic?

(a) melting gold
(b) evaporating water
(c) freezing carbon dioxide
(d) boiling water

End of Section One

Section Two: Short answer **35% (67 marks)**

This section has **seven (7)** questions. Answer **all** questions. Write your answers in the spaces provided.

Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 60 minutes.

Question 26 **(10 marks)**

For each of the following

i. Write a **balanced ionic equation** (including state symbols).
ii. Describe the expected observations for the reaction.

(a) A small amount of aluminium carbonate powder is slowly added to an excess of nitric acid solution. (6 marks)

Equation:

Observations:

_____

_____

(b) Adding a small amount of iodine water to an excess of liquid oct–2–ene. (4 marks)
Equation:

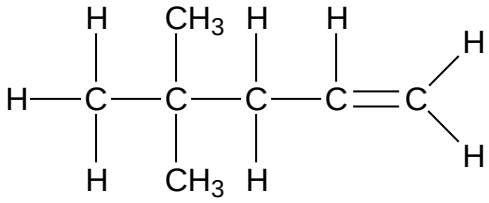
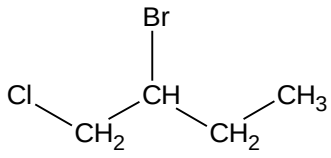
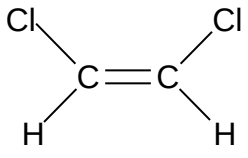
Observations:

_____

_____

Question 27 **(7 marks)**

Complete the table below

Name of organic molecule	Structural formula
2 – methylhex–1–ene	
1,3 – dichlorobenzene	
Trans-pent-2-ene	
	
	$CH_2C(CH_3)CH_2CH_2CHBrCH_2CH_3$
	
	

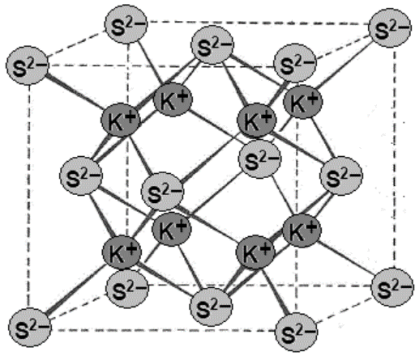
Question 28 **(12 marks)**

(a) Complete the table below. (12 marks)

Name of molecule	**Lewis Structure**	**Shape**	**List of <u>ALL</u> intermolecular forces present between molecules**
Methanal H_2CO			
Chloramine $H_2NC\ell$			
Sulfur dioxide SO_2			
Carbon tetrafluoride CF_4			

Question 29 **(15 marks)**

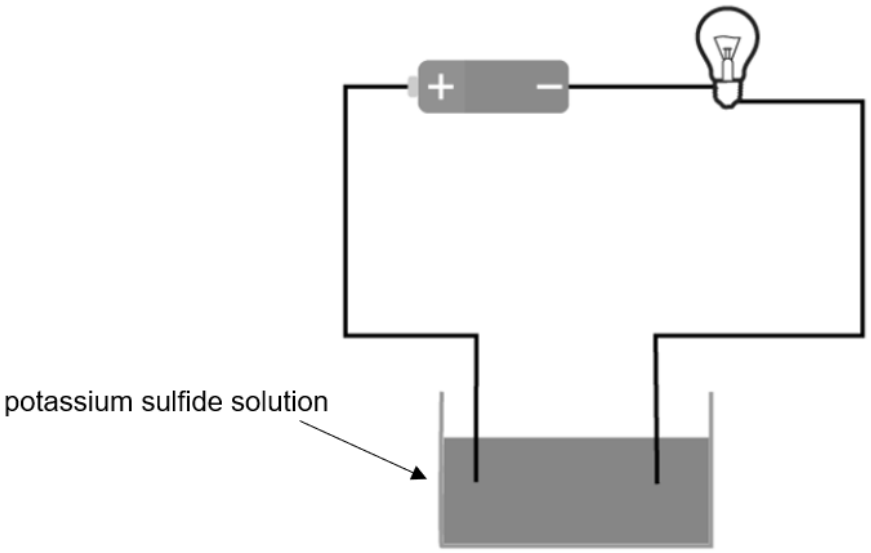
Below is a simplified representation of the lattice structure of solid potassium sulfide.



(a) Describe, in terms of all the forces formed and forces broken, the process of solid potassium sulfide dissolving in water. (4 marks)

(b) Explain, in terms of breaking of existing bonds and forming of new bonds, why this process of dissolving solid potassium sulfide in water causes the temperature of the water to decrease. (4 marks)

(c) Explain why the solution of potassium sulfide can conduct electricity when the following apparatus is used to test its conductivity. (3 marks)



(d) Explain why dissolving the same amount (in mole) of hydrogen sulfide gas (H_2S) in water produces a solution that has a lower conductivity than that of K_2S. (4 marks)

Question 30 **(5 marks)**

Phosphorus pentachloride reacts with water to produce a mixture of phosphoric and hydrochloric acids, as shown in the chemical equation below.

$$PCl_5(s) + 4\,H_2O(l) \rightarrow H_3PO_4(aq) + 5\,HCl(aq)$$

(a) Describe why both the products of this reaction are classified as 'acids' according to the Arrhenius theory. (1 mark)

_____

_____

(b) Define a 'weak' acid, and identify which of the products is classified as weak. (2 marks)

_____

_____

_____

_____

(c) Define a 'monoprotic' acid, and identify which of the products is classified as monoprotic. (2 marks)

_____

_____

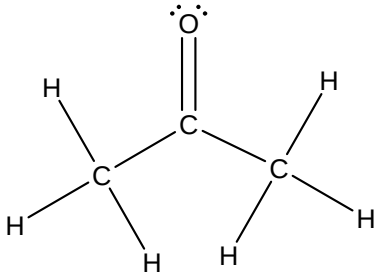
_____

_____

Question 31 **(9 marks)**

Thin layer chromatography (TLC) can be used to detect the presence of preservatives in different cosmetics. A glass plate coated in polar silica gel is used as the stationary phase. The mobile phase is a benzene-propanone (8:2) mixture.

(a) Complete the following table regarding the components of the mobile phase. (3 marks)

	Benzene	Propanone
Structural diagram		
'Polar' or 'non-polar' substance		

Using the conditions described above, several preservatives were analysed by TLC. Once separated, the preservatives were visualised by UV detection. The retention factor values were calculated using the formula;

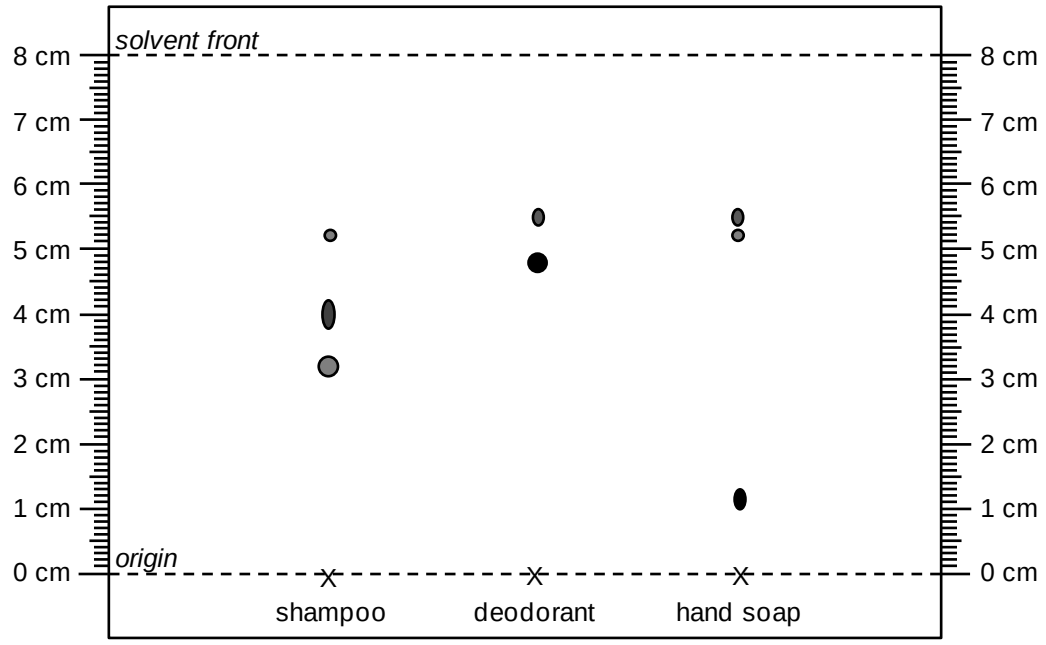
$$\text{Retention factor } (R_f) = \frac{\text{distance travelled by component}}{\text{distance travelled by solvent}}$$

The results of this analysis are provided in the table below.

Preservative	R_f
Dichlorophene	0.50
Fluorosan	0.56
Hexachlorophene	0.14
Salicylanilide	0.65
Tribromsalan	0.60
Chlorhexidine acetate	0.40
Phenylphenol	0.68

(b) Which of these preservatives is the most polar? Justify your answer. (4 marks)

Three cosmetic products; shampoo, deodorant and hand soap; were then analysed by TLC under identical conditions. A diagram of the resultant TLC plate is provided below.



(c) Which cosmetic product is most likely to contain tribromsalan? (1 mark)

(d) Give one (1) reason that it cannot be known for certain that tribromsalan is in this cosmetic product. (1 mark)

Question 32 **(9 marks)**

Hydrogen peroxide is a colourless solution which decomposes into water and oxygen gas under standard laboratory conditions.
The enthalpy change for this reaction is given as; $\Delta H = -196$ kJ mol^{-1} of hydrogen peroxide.

(a) Write a balanced thermochemical equation representing this reaction. (3 marks)

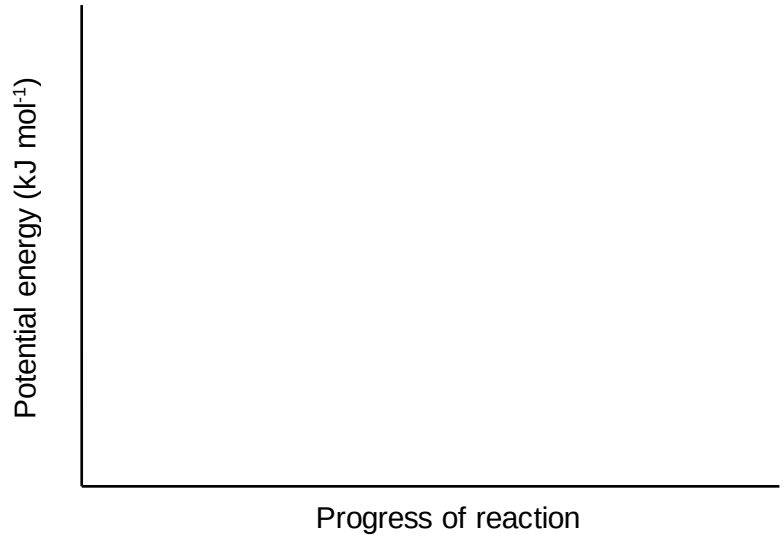
(b) Suggest one (1) method for measuring the rate of this reaction. (1 mark)

_____

_____

The rate of this reaction can be greatly enhanced by adding some solid manganese(IV) oxide catalyst to the hydrogen peroxide solution. The activation energy, in the presence of the catalyst, is 23 kJ mol^{-1}.

(c) On the axes below, sketch an energy profile diagram for the catalysed and uncatalysed reactions. Label the enthalpy change and the activation energy. (4 marks)



(d) Suggest one (1) method, not related to the manganese(IV) oxide catalyst, that would further increase the rate of this reaction. (1 mark)

_____

_____

End of Section Two

Section Three: Extended answer **40% (76 marks)**

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

Where questions require an explanation and/or description, marks are awarded for the relevant chemical content and also for coherence and clarity of expression. Lists or dot points are unlikely to gain full marks.

Final answers to calculations should be expressed to the appropriate number of significant figures and include appropriate units where applicable.

Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 70 minutes.

Question 33 **(15 marks)**

The Sabatier process was developed in 1897 by the French chemist Paul Sabatier. In this reaction, carbon dioxide and hydrogen gas are converted to methane and water vapour as shown in the chemical equation below.

$$CO_2(g) + 4\,H_2(g) \rightarrow CH_4(g) + 2\,H_2O(g)$$

The Sabatier process is conducted at a temperature of approximately 400 °C and a pressure of 30 atmospheres (i.e. 30 times atmospheric pressure).

(a) Explain, in terms of the collision theory, why using a high temperature increase the rate of the reaction. (4 marks)

Much of Sabatier's ground breaking work focused on the mechanisms of catalysis. Whilst there are now several different metal catalysts routinely used in the Sabatier process, the original catalyst was nickel metal.

(b) Explain, in terms of the collision theory, how the inclusion of a metal catalyst affects the rate of this reaction. (3 marks)

_____

_____

_____

_____

_____

_____

In 1912, Sabatier won the Nobel Prize for Chemistry for the discoveries he had made regarding the use of **finely divided** catalysts. Today, ongoing research into the role of metal nanoparticle catalysts is providing exciting advancements in many areas of chemistry.

(c) Define a nanoparticle. (1 mark)

_____

_____

_____

(d) Explain, in terms of collision theory, the advantage of using nickel in nanoparticle form compared to bulk nickel. (2 marks)

_____

_____

_____

_____

_____

_____

The Sabatier process is used by NASA on board the International Space Station, to produce water for the crew. The chemical equation for the Sabatier process is provided again below, for convenience.

$$CO_2(g) + 4\,H_2(g) \rightarrow CH_4(g) + 2\,H_2O(g)$$

The carbon dioxide exhaled by the astronauts is collected and reacted with hydrogen gas that forms as a by-product of a different on-board reaction. The water vapour is cooled and condensed into a liquid. This produces 2495 kg of water each year.

(e) Calculate the total mass of carbon dioxide that must be exhaled by the astronauts each year, in order to produce this mass of water. State your answer to the appropriate number of significant figures. (5 marks)

This page has been left blank intentionally

Question 34 **(17 marks)**

Floatation tanks (float tanks, sensory deprivation tanks) are lightless, soundproof tanks containing a salt solution which is dense enough to enable the user to float. Float tanks are said to provide benefits such as relaxation and pain relief, as well as improved sleep, circulation and immunity.

Float tanks contain around 1000 L of salt solution. This solution contains a very high concentration of Epsom salts, $MgSO_4.7H_2O(s)$, which is maintained at 35 °C. The resulting $MgSO_4(aq)$ solution is designed to be just under saturation point. If too little salt is added, the solution will not be dense enough to allow the user to float. If too much salt is added, crystals of solute form and may block water filtering equipment.

(a) Distinguish between a saturated and an unsaturated solution. (2 marks)

_____

_____

_____

_____

_____

A particular float tank company prepared a tank containing 1000 L of salt solution. This solution had a density of 1.27 kg L^{-1} and was known to be composed of 30.0% $MgSO_4$ by mass.

(b) Calculate the concentration of the $MgSO_4(aq)$ solution in moles per litre. (5 marks)

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(c) Calculate the mass of Epsom salts, $MgSO_4.7H_2O(s)$, that would have been dissolved to produce this solution. (2 marks)

The solubility of $MgSO_4.7H_2O(s)$ at 35 °C is known to be 113 g per 100 mL.

(d) Prove that this float solution is unsaturated. Show all workings. (3 marks)

To ensure that health and safety standards are upheld, the salt solution used in float tanks is periodically treated with chemicals such as chlorine, bromine or UV light.

(e) Suggest a reason these treatments may be performed on the salt solution. (2 marks)

The float tank company decided to use bromine, $Br_2(l)$, to treat the salt solution described above. Industry guidelines state that the concentration of bromine must be maintained at 6 ppm.

(f) Calculate the mass of bromine that should be present in 1000 L of salt solution. (2 marks)

_____

_____

_____

_____

_____

_____

The pH of the salt solution must also be monitored and should fall between 6.8 and 7.6.

(g) define the term pH? (1 mark)

_____

_____

Question 35 **(12 marks)**

'Hardness' in water is caused by dissolved calcium compounds. When heated some of these decompose and solid calcium carbonate can form as follows:

$$Ca(HCO_3)_2(aq) \rightarrow CaCO_3(s) + 2\ H_2O(\ell) + 2\ CO_2(g)$$

This calcium carbonate can build up as 'fur' inside containers. It can be removed by reaction with hydrochloric acid.

(a) Calculate the mass of calcium carbonate that would be produced from 10 000.0 L of water containing calcium hydrogen carbonate at a concentration of 0.356 g L^{-1}.
(Assume 100% of the calcium hydrogen carbonate decomposes). (5 marks)

_____

_____

_____

_____

_____

_____

(b) Calculate the minimum volume of 10.0 mol L^{-1} hydrochloric acid solution that would be required to remove all of this solid calcium carbonate from the container. (3 Marks)

_____

_____

_____

_____

_____

(c) In a second container it was found that 600.0 g of calcium carbonate had built up inside. 1.85 L of the 10.0 mol L^{-1} hydrochloric acid was added to remove the 'fur' from the containers, but this was too much acid. Calculate the moles of excess acid. (4 marks)

This page has been left blank intentionally

Question 36 **(17 marks)**

Sulfuric acid is used at the electrolyte in car batteries.

(a) Using the example of sulfuric acid explain what is meant by a strong acid. Use an equation in your answer. (3 marks)

(b) The concentration of sulfuric acid in a car battery is found to be 2.15 mol L^{-1}. A car battery contains 0.650 L of sulfuric acid.

(i) Calculate the mass of sulfuric acid in the car battery. (3 marks)

(ii) Assuming the density (d=m/V) of the acid in the battery is 1.07 g mL^{-1} calculate the concentration of the sulfuric acid as a percentage by mass. (2 marks)

(c) The car battery was damaged and 0.300 L of the acid leaked onto the floor of the garage. 475 mL of a solution of 2.75 mol L^{-1} sodium hydroxide was used to neutralise the acid. Show by calculation that this was just enough to neutralise all the spilt acid. (4 marks)

(d) Powdered aluminium oxide was then sprinkled over the area of the spillage to remove any excess chemicals. Aluminium oxide is an amphoteric substance, which means it can act as an acid or a base.

(i) Explain why aluminium oxide is the substance chosen to complete the clean-up process (2 marks)

(ii) Use your knowledge of reaction rates to explain why the aluminium oxide was used in a powdered form. (3 marks)

Question 37 **(15 marks)**

The first periodic table of the elements was designed by the Russian chemist Dmitri Mendeleev, and was published in 1869. The periodic table arranges the elements according to recurring trends.

The seven rows of the periodic table are called periods. Consider the elements in period 3, as shown below.

Na	Mg	Al	Si	P	S	Cl	Ar

(a) What feature do these period 3 elements have in common? (1 mark)

_____

_____

_____

As you move from left to right across period 3, both the first ionisation energy and electronegativity of the elements increase.

(b) Define 'first ionisation energy' and 'electronegativity', and explain the increasing trend observed in each. (5 marks)

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Now consider the *chlorides* of the period 3 elements;

$NaCl$	$MgCl_2$	$AlCl_3$	$SiCl_4$	PCl_3	SCl_2	Cl_2

The first three of these chloride compounds are considered to exhibit ionic bonding, whilst the latter four are classified as covalent compounds.

(c) Use the concepts of ionisation energy and electronegativity to explain why NaCl is an ionic substance, whilst Cl_2 is a covalent substance. (4 marks)

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(d) Explain why Cl_2 is the only one of these covalent compounds to contain non-polar bonds. (2 marks)

_____

_____

_____

_____

_____

(e) Explain why $SiCl_4$ is classified as a non-polar molecule, despite containing polar bonds. Include the Lewis structure of $SiCl_4$ in your answer. (3 marks)

Lewis structure:

_____

_____

_____

_____

_____

_____

End of questions

Spare answer page

Question number: _____

Teacher	Questions	Mark		%
	1-25			/25
JV	26,27			
MD	28,30			
AB	31,32			
JT	29		67	
TOTAL Part B				% B /35
SH	33			
SH	34			
SF	35			
SF	36			
BL	37		76	
TOTAL Part C				% C /40
		Total %		