

***SAMPLE EXAM - ANSWERS******11 Chemistry – Semester 2 Examination 2017******NAME \_\_\_\_\_******TIME ALLOWED FOR THIS PAPER****Reading time*                      10 minutes*Working time*                      3 hours

*It is recommended that candidates spend the reading time mainly reading the Instructions to Candidates, and Parts 2 and 3.*

***MATERIAL REQUIRED/RECOMMENDED FOR THIS PAPER******TO BE PROVIDED BY THE SUPERVISOR***

*This Question/Answer Booklet  
Separate Multiple Choice Answer Sheet  
Chemistry Data Sheet*

***TO BE PROVIDED BY THE CANDIDATE***

*Standard Items – pens, pencils, eraser or correction fluid, ruler  
Special Items – calculators satisfying the conditions set by the Curriculum Council*

***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 your supervisor **BEFORE** reading any further.*

**Structure of this paper**

<i>Section</i>	<i>Suggested working time</i>	<i>Number of questions available</i>	<i>% of paper</i>	<i>Marks</i>
<i>ONE</i> <i>Multiple choice</i>	<i>40 minutes</i>	<i>25</i>	<i>25</i>	<i>50</i>
<i>TWO</i> <i>Short response</i>	<i>75 minutes</i>	<i>18</i>	<i>40</i>	<i>80</i>
<i>THREE</i> <i>Extended response</i>	<i>65 minutes</i>	<i>6</i>	<i>35</i>	<i>70</i>
			<i>100</i>	<i>200</i>

**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.

*Section Three*      Answer all questions in the spaces provided in this Question/Answer Booklet

3. A blue or black ballpoint or ink pen should be used.
4. Additional information which may be necessary to answer questions is located on the separate Chemistry data sheet.

**SECTION ONE - Multiple Choice [50 marks]**

This section has twenty five (25) questions. Attempt all questions.  
Answer all questions on the separate Multiple Choice Answer Sheet.  
Each question in this part is worth 2 marks.  
Suggested working time : 45 minutes.

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1. Which of the following has the greatest solubility in water?

- (a) Zn
- (b)  $\text{BaSO}_4$
- (c) AgCl
- (d) NaOH

2. Which of the following statements related to the Kinetic Theory best explains the process of diffusion?

- (a) Particles are relatively widely spaced and they move rapidly in straight lines.
- (b) Collisions between particles are perfectly elastic and the average kinetic energy of the particles depends only on temperature.
- (c) The energy of the particles depends upon temperature and they are widely spaced apart.
- (d) The particles move in straight lines with negligible forces of attraction between them.

3. The vapour pressures of some common liquids at  $25^\circ\text{C}$  are given in the table below:

Substance	Vapour pressure (kPa)
water	2.50
pentane	57.0
ethanol	10.0
acetone	32.0

Use the above information where appropriate to help determine which of the following statements is true.

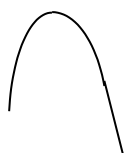
- (a) The vapour pressures of these substances will be less than these values under standard temperature conditions.
- (b) The boiling point of acetone is lower than the boiling point of ethanol.
- (c) The intermolecular forces between water molecules are weaker than the intermolecular forces between pentane molecules.
- (d) The boiling points of the organic substances above are independent of atmospheric pressure and only depend on the length of the carbon chain.

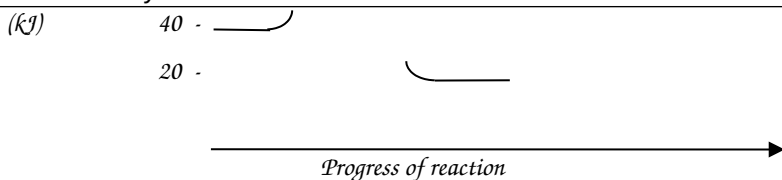
4. Which of the following statements about gas pressure, volume and temperature is correct?
- (a) For a constant mass of a gas at a constant temperature, its volume decreases as its pressure increases.
- (b) Equal volumes of gases always contain equal numbers of particles.
- (c) For a constant mass of gas at a constant pressure, if its temperature is decreased, its volume will increase.
- (d) As the temperature of a gas is decreased, its pressure will increase, thus ensuring the conservation of its energy.
5. Which one of the following species contains a different number of electrons from the others?
- (a)  $\text{N}_2$
- (b)  $\text{C}_2\text{H}_2$
- (c)  $\text{HCN}$
- (d)  $\text{O}_2^{2-}$
6. Which one of the following has a noble gas electron configuration?
- (a)  $\text{H}^+$
- (b)  $\text{Cl}^-$
- (c)  $\text{K}$
- (d)  $\text{H}^-$
7. Which of the following best describes why metals conduct electricity?
- (a) In a metal lattice, metal atoms are not tightly bonded together.
- (b) In a metal lattice, metal ions are moving.
- (c) In a metal lattice, metal atoms have delocalized electrons.
- (d) In a metal lattice, the metal atoms are locked in fixed positions.
8. In which of the following is the bonding ionic?
- (a) Ice
- (b) Hydrogen chloride gas
- (c) Solid silicon dioxide
- (d) Solid magnesium oxide

9. Below is a potential energy diagram for the generalized reaction:



Potential energy 80 -  
60 -





Which of the following statements is true?

- (a) The activation energy for this reaction is 80 kJ.
- (b) The  $\Delta H$  for this reaction is 20 kJ.
- (c) This reaction is endothermic.
- (d) Using a catalyst would increase the rate of the above reaction.

10. Which of the following statements about activation energy is **not** true?

- (a) It is the minimum energy that is required by colliding reactants for a chemical reaction to take place.
- (b) It can be considered to be an energy barrier or resistance that has to be overcome in order to produce a reaction.
- (c) Endothermic reactions have higher activation energies than exothermic reactions.
- (d) Chemical reactions with a smaller activation energy tend to progress at a faster rate than those with higher activation energies.

11. The rate of a chemical reaction can best be defined as:

- (a) Reactants changing into products.
- (b) The observable change in quantity of a reactant with time.
- (c) The change in mass of reactants.
- (d) The energy of the products minus the energy of the reactants.

12. Consider the reaction:



Increasing the pressure of this system causes the rate of reaction to increase. Which of the following statements best explains this observation?

- (a) The average kinetic energy of the reactant molecules increases.
- (b) The number of reactant molecules with energies greater than the activation energy increases.
- (c) The volume increases, there is more of the reacting gases and so the rate of reaction increases.
- (d) The particles will collide more often.

13. Which one of the following solutions is a weak acid?

- (a) Hydrochloric acid.  
 (b) Citric acid.  
 (c) Sulfuric acid.  
 (d) Nitric acid.

14. Which of the following correctly describes the shape and polarity of the molecule given?

	<b>Molecule</b>	<b>Shape</b>	<b>Polarity</b>
(a)	$\text{PBr}_3$	trigonal planar	polar
(b)	$\text{CH}_2\text{F}_2$	tetrahedral	polar
(c)	$\text{PBr}_3$	pyramidal	non-polar
(d)	$\text{CH}_2\text{F}_2$	pyramidal	non-polar

15. Which of the following trends apply to the oxides of period three elements as you move from left to right across the periodic table?

- (a) Their molar mass increases.  
 (b) They become more acidic.  
 (c) They are more reactive with water.  
 (d) They become less reactive in general.

16. Which of the following statements about acids and bases is incorrect?

- (a) Acids taste sour.  
 (b) Acids react with bases to form water.  
 (c) Bases can be corrosive.  
 (d) Acids feel slippery.

17. Which of the following statements regarding electronegativity are **true**?

- (i) Electronegativity increases across the periods  
 (ii) Electronegativity increases down the groups  
 (iii) Fluorine is the most electronegative element  
 (iv) Electronegativity is a measure of an atom's power to attract an electron  
 (v) Group 18 elements are the most electronegative elements

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

18. Which of the following lists contains molecules that have only dispersion forces as their most significant type of intermolecular force?

- (a)  $\text{CH}_4$ ,  $\text{N}_2$ ,  $\text{SO}_2$ ,  $\text{CO}_2$   
 (b)  $\text{O}_2$ ,  $\text{CS}_2$ ,  $\text{CBr}_4$ ,  $\text{He}$   
 (c)  $\text{CO}_2$ ,  $\text{F}_2$ ,  $\text{CO}$ ,  $\text{CH}_4$   
 (d)  $\text{Ne}$ ,  $\text{H}_2\text{O}$ ,  $\text{CS}_2$ ,  $\text{CBr}_4$

19. Compare an atom of phosphorus (P) and an atom of sulfur (S). Which of the following statements is correct?

- (a) P has a larger atomic radius because it has a lower nuclear charge
- (b) S has a larger atomic radius because it has more protons and electrons
- (c) P has a smaller atomic radius because its nucleus is smaller
- (d) S has a smaller atomic radius because it is a more stable atom

20. Which of the following solution combinations would produce a green precipitate when mixed together?

- (a)  $\text{NaCl}$ ,  $\text{Ni}(\text{NO}_3)_2$ ,  $\text{KCH}_3\text{COO}$ ,  $\text{AgNO}_3$
- (b)  $\text{Cr}(\text{NO}_3)_3$ ,  $\text{KCl}$ ,  $\text{Na}_2\text{CO}_3$ ,  $\text{NH}_4\text{NO}_3$
- (c)  $\text{NH}_4\text{Cl}$ ,  $\text{NaCH}_3\text{COO}$ ,  $\text{Ni}(\text{NO}_3)_2$ ,  $\text{FeCl}_2$
- (d)  $\text{CuSO}_4$ ,  $\text{NaNO}_3$ ,  $\text{KCH}_3\text{COO}$ ,  $\text{CrCl}_3$

21. Which of the following lists contains only unsaturated hydrocarbons?

- (a) Ethanol and ethyne.
- (b) Ethene and ethyne.
- (c) Ethane and ethanoic acid.
- (d) Ethanol and ethanoic acid.

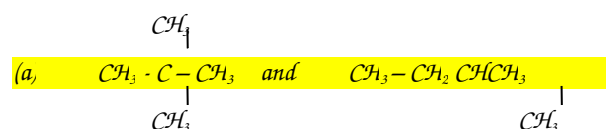
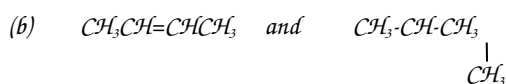
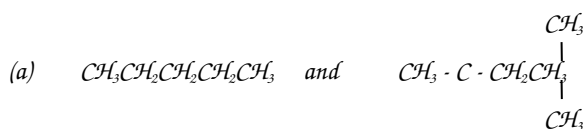
22. Which of the following statements is true about hydrocarbons undergoing incomplete combustion?

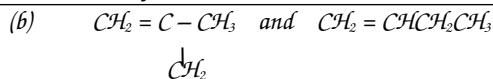
- (a) They burn with a flame that is hard to see.
- (b) Only carbon dioxide and water are produced.
- (c) Unsaturated hydrocarbons are always produced.
- (d) Carbon is produced in the form of a black sooty flame.

23. When pent-1-ene reacts with bromine water, which of the following is the correct product?

- (a) 1-bromopentane
- (b) 2-bromopentane
- (c) 1,2-dibromopentane
- (d) 2,3-dibromopentane

24. Which of the following are isomeric pairs?





25. How many isomers exist for  $\text{C}_5\text{H}_{12}$ ?

- (a) 1  
 (b) 2  
 (c) 3  
 (d) 4

### END OF SECTION 1

### SECTION TWO – Short answers

[88 marks]

Section Two contains seventeen (17) questions. Attempt all questions in the spaces provided.

In this section, unless asked to write molecular equations, chemical equations should refer only to those species consumed in the reaction and the new species produced.

Suggested working time : 70 minutes.

#### Question 26

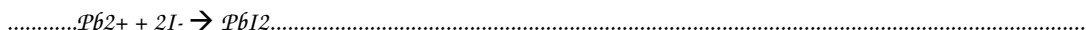
(6 marks)

Write balanced equations for any reactions that occur in the following procedures.  
 If no reaction occurs, write "no reaction".

(a) A solution of hydrochloric acid is added to an aqueous solution of sodium carbonate [2 marks]



(b) Solutions of potassium iodide is combined with lead II nitrate [2 marks]



(c) Chlorine water is added to ethane. [2 marks]



#### Question 27 (4 marks)

Write observations for any reactions that occur in the following. Equations are not required.

(a) Copper II sulfate solution is added to sodium hydroxide solution [2 marks]

.....blue solution added to a colourless solution producing a blue precipitate.....

(b) Dilute ethanoic acid is added to solid nickel oxide. [2 marks]

.....colourless solution is added to a grey solid producing colourless bubbles and a green solution.....



**Question 28 (5 marks)**

Write formulas for the following:

- (a) Calcium sulfide..... $\text{CaS}$ .....
- (b) Potassium dichromate..... $\text{K}_2\text{Cr}_2\text{O}_7$ .....
- (c) Iron (II) fluoride..... $\text{FeF}_2$ .....
- (d) Aluminium carbonate..... $\text{Al}_2(\text{CO}_3)_3$ .....
- (e) Phosphorus pentachloride..... $\text{PCl}_5$ .....

**Question 29 (5 marks)**

Name the following:

- (a)  $\text{N}_2\text{O}_4$ .....dinitrogen tetroxide.....
- (b)  $\text{SnO}_2$ .....tin IV oxide.....
- (c)  $\text{CrO}_4^{2-}$ ... chromate .....
- (d)  $\text{CH}_4$ .....methane.....
- (e)  $\text{NH}_4\text{NO}_2$ .....ammonium nitrite.....

**Question 30 (4 marks)**

For each of the following, describe briefly a test and an observation by which you could distinguish between the substances listed. You must indicate which of the two substances tested gives rise to the observation. No equations are necessary.

- (a) Sodium chloride solution and sodium sulfate solution. [2 marks]

Test: ...add  $\text{Ba}^{2+}$  .....

Observation: ..... - NR with sodium chloride, white ppt with sodium sulfate

.....

- (b) Solid calcium carbonate and solid calcium oxide. [2 marks]

Test: ..... add

$\text{HCl}$ .....

Observation: ..... carbonate fizzes, oxide just dissolves.....

.....

**Question 31 (6 marks)**

For each substance listed in the table below, draw the electron dot diagrams

Substance	Electron dot diagram showing all
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	<i>valence electrons</i>
<i>Aluminium sulfide</i>	
<i>Hydrogen peroxide</i>	
<i>Carbonate ion</i>	

**Question 32 (3 marks)**

Element A has the ground state electron configuration 2, 4 and element B has the ground state electron configuration 2, 7.

(a) When element B forms an ion, what is its electron configuration?

2 8.....

[1 mark]

(b) What is the most likely formula of a compound formed between A and B?

AB<sub>4</sub>.....

[1 mark]

(c) What type of compound is formed between A and B?

covalent.....

[1 mark]

**Question 33 (6 marks)**

Complete the following table for these substances found in and around the home.

<i>Substance</i>	<i>Type of bonding</i>	<i>Use of substance</i>	<i>Property which allows substance to be used in that way.</i>
<i>Lead</i>	<i>metallic</i>	<i>sinkers</i>	<i>High density</i>
<i>Graphite</i>	<i>Covalent network</i>	<i>pencils</i>	<i>Layers peel off easily</i>

**Question 34 (5 marks)**

- (a) Group II elements are called the alkaline earth metals. What are the electron configurations of the first three alkaline earth metals?

[2 marks]

.....22 282 288

- (b) Explain why their chemical properties are similar.

[2 marks]

Same number of valence electrons.....

- (c) Give one chemical property these elements have in common.

[1 mark]

Form 2+ ion, react with acid.....

**Question 35 (6 marks)**

Using appropriate examples explain the differences between:

- (a) A concentrated acid and a dilute acid.

[3 marks]

Conc acid has a high concentration of acid eg 10M HCl, dilute has low concentration of acid eg 0.1M HCl.....

(b) A strong base and a weak base.

[3 marks]

Strong base forms 100% ions eg  $\text{NaOH}$ , weak base is less than 100% eg  $\text{NH}_3$ .....

**Question 36 (2 marks)**

Write an equation for the hydrogen sulfide ion acting as a base when it reacts with hydronium ions.

.....

**Question 37 (6 marks)**

Predict which member of each pair will have the higher boiling point and give the reason why

(a)  $\text{CH}_4$  or  $\text{CH}_2\text{Cl}_2$  Higher BP \_\_\_\_\_ Reason \_\_\_\_\_

Polar molecule has higher MP than non-polar due to stronger intermolecular forces – dipole-dipole Vs dispersion \_\_\_\_\_ 2 marks)

(b)  $\text{F}_2$  or  $\text{Cl}_2$  Higher BP \_\_\_\_\_ Reason \_\_\_\_\_

Larger molecular has greater dispersion forces due to more electrons \_\_\_\_\_ 2 marks)

(c)  $\text{HF}$  or  $\text{HCl}$  Higher BP \_\_\_\_\_ Reason \_\_\_\_\_

$\text{HF}$  has H bonding which is stronger than dipole-dipole \_\_\_\_\_ 2 marks)

**Question 38 (8 marks)**

For each molecule or ion listed in the table below

(i) Draw the electron dot diagram representing all valence shell electron pairs as “ ”

For example, water  $\text{H} \quad \text{O} \quad \text{H}$

(ii) Name the shape of each molecule or ion.

(iii) State the polarity for the second and third examples (yes/no)

Molecule or ion	Structure formula (showing all valence electrons)	Name of shape	Polar?
Nitrate ion			
Phosphorus trichloride			
Boron trihydride			

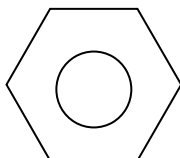
**Question 38 (2 marks)**

Name the following compounds:



3,3dimethyl pentane.....

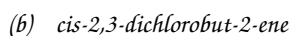
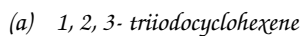
(b)



benzene.....

**Question 39 (4 marks)**

Draw structural formulas for the following compounds:



**Question 40 (3 marks)**

(a) Name two acidic oxides which make rain acidic

[2 marks]

Carbon dioxide, sulfur dioxide, sulfur trioxide, nitrogen dioxide .....

(b) Throughout Australian rural regions, soil acidification has become a major problem.

In the last few years, the amounts of agricultural lime ( $\text{CaCO}_3$ ) and dolomite [ $\text{CaMg}(\text{CO}_3)_2$ ] added to the soil has increased tenfold.

In chemical terms, how does the use of lime and dolomite correct the problem of soil acidity?

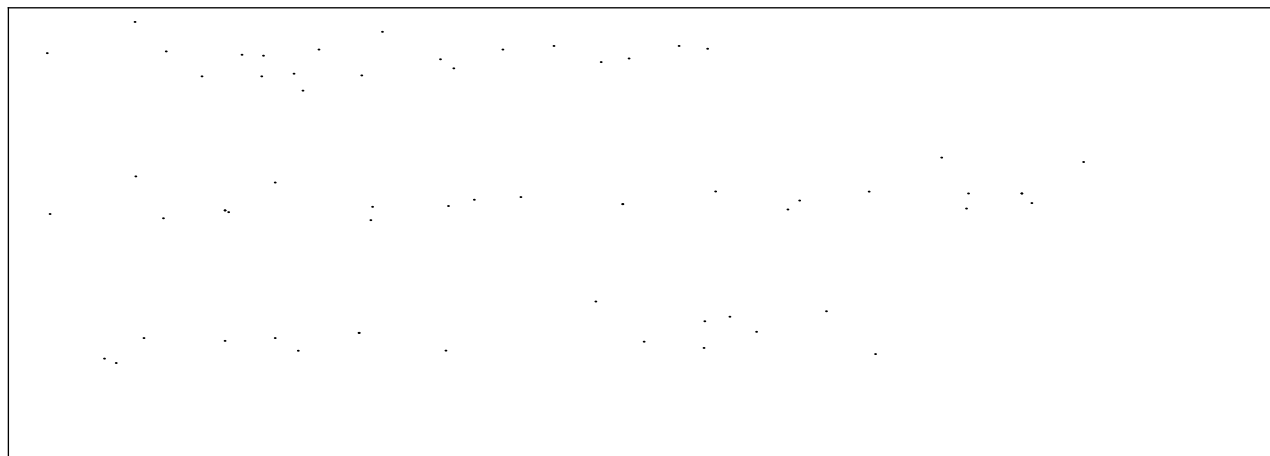
[1 mark]

.....  
Both are basic due to the carbonate which reacts with the acid  
.....

**Question 41 (3 marks)**

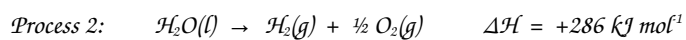
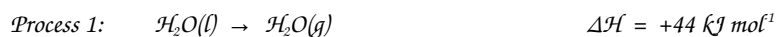
Vitamin C is a water-soluble vitamin that helps the body fight infection. Humans cannot produce this vitamin and it is best obtained from fruits and vegetables in their diet. The results of an analysis of vitamin C showed that it has an empirical formula of  $\text{C}_3\text{H}_4\text{O}_3$  and an approximate formula mass of 180.

Use this information to determine the molecular formula of vitamin C.



**Question 42 (10 marks)**

Consider the four processes represented below:



(a) (i) What type of changes are occurring in processes 1 and 2? [2 marks]

1 is a change of state, 2 is decomposition.....

(ii) Explain the difference in  $\Delta H$  between these processes. [2 marks]

It takes much more energy to break covalent bonds than the weak intermolecular bonds during a phase change .....

.....

.....

.....

(b) What do the  $\Delta H$  values in processes 3 and 4 demonstrate?

[2 marks]

.....  
*About the same amount of energy is needed to melt iron and silicon*  
.....  
.....  
.....

(c) (i) After studying the above data, a student wrote the following comment in his notes:

*"As water boils, water molecules break apart to release hydrogen molecules and oxygen molecules".*

Do you agree or disagree with this comment? Explain your answer.

[2 marks]

*Boiling water does not break it into its elements – just the molecules gain more energy and move away from each other.*.....  
.....  
.....  
.....

(ii) Explain the difference between boiling and evaporation.

[2 marks]

.....  
*Evaporation occurs when there are some molecules with high enough energy to become gaseous. Boiling occurs when the vapour pressure of the gas equals atmospheric temperature.*  
.....  
.....  
.....

**END OF SECTION 2**



**SECTION THREE – Extended Answer****(68 marks)**

Section three has FIVE (5) questions. Attempt all questions in the spaces provided below.

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 calculations. Express numerical answers to three (3) significant figures and provide units where appropriate.

Suggested working time : 60 minutes.

**Question 43 (17 marks)**

Prior to their investigation proper, a group of Stage 2 chemistry students did a preliminary test by placing 5.00 g of zinc into a 250 mL beaker containing 100.0 mL of 2.00 mol L<sup>-1</sup> hydrochloric acid.

- (a) Write a balanced ionic equation for the reaction which occurs in the beaker. [1 mark]

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- (b) (i) How many mole of zinc were placed into the beaker? [1 mark]

.....  
.....  
.....

- (ii) How many mole of hydrochloric acid were in the beaker? [1 mark]

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.....  
.....

- (c) Identify the limiting reagent. [2 marks]

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.....  
.....  
.....

- (d) What mass or volume of the limiting reagent would need to be added to the beaker to ensure that neither reagent was in excess?

[3 marks]

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After the conclusion of the investigation, the students produced the following results table:

$[\text{HCl}]$ (mol L <sup>-1</sup> )	Time (min)					$V_{\text{(gas)}}$ (mL)
	2	4	6	8	10	
2.0	9.10	15.00	18.06	18.75	19.01	
1.0	4.00	8.03	11.51	13.01	13.70	

- (e) What do you think was the aim / hypothesis behind the investigation?

[1 mark]

.....

.....

- (f) For the investigation, identify:

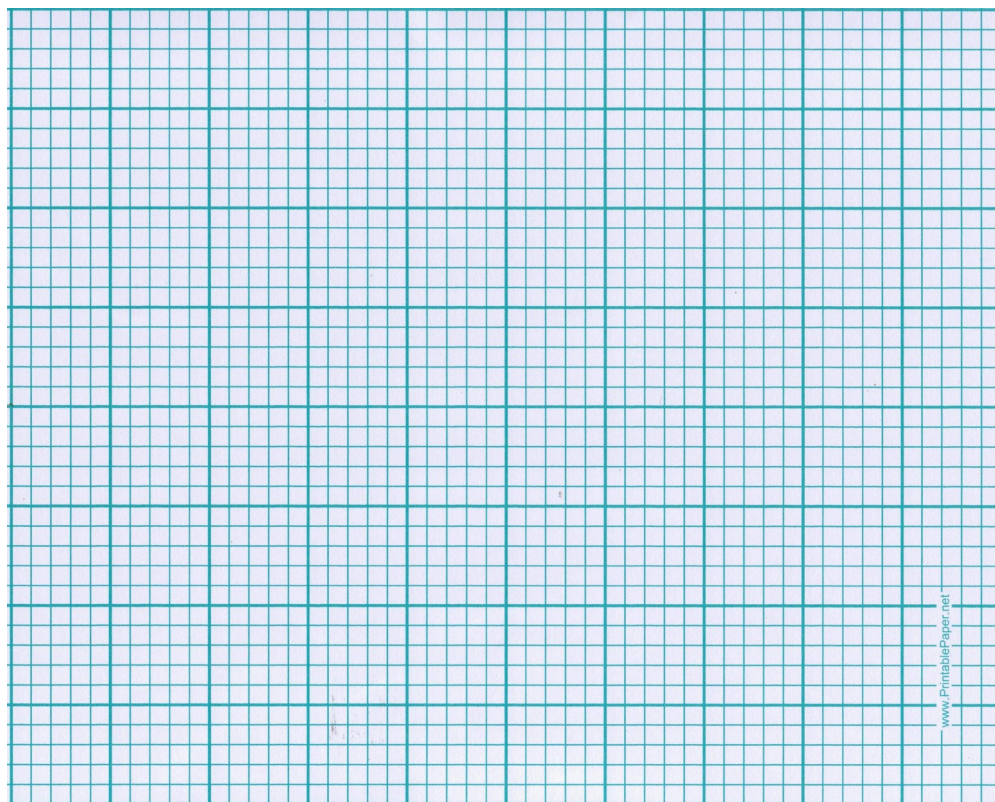
(i) the independent variable.....

(ii) the dependent variable.....

[2 marks]

(g) Graph the results of the investigation on the graph paper supplied below:

[5 marks]



(h) What do these results say about the rate of chemical reactions over time?

[1 mark]

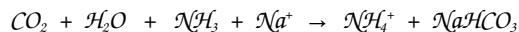
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**Question 44 (10 marks)**

Sodium carbonate can be prepared industrially by the following sequence of steps:

Step 1: Calcium carbonate (limestone) is heated until it decomposes into calcium oxide and carbon dioxide.

Step 2: The carbon dioxide produced in step 1 is passed into a solution of ammonia and concentrated sodium chloride.



Step 3: The sodium hydrogencarbonate is washed, filtered and dried and then heated to produce carbon dioxide and water as by-products.

- (a) Write a balanced molecular equation for what is occurring in Step 1. [1 mark]

.....

If the limestone was 80.0 % pure and 120 kg was heated initially, answer the following questions:

- (b) How many mole of calcium carbonate were there initially? [3 marks]

.....

.....

.....

- (d) What volume of carbon dioxide, measured at STP would be produced in step 1 of the process? [2 marks]

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- (e) What mass of sodium carbonate would be produced overall given the conditions mentioned? [4 marks]

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**Question 45 (12 marks)**

When a 1.802 g sample of unknown substance Y (which contains C, H and O only) was completely burnt in excess oxygen gas, the products were 3.52 g of carbon dioxide and 1.80 g of water.

- (a) Determine the empirical formula of Y. [8 marks]

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- (b) It was found that when the same mass of sample Y was vaporised at STP, it occupied a volume of 448 mL. Determine the molecular formula of Y. [3 marks]

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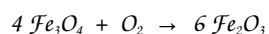
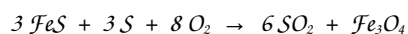
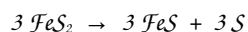
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**Question 46 (8 marks)**

The roasting process for pyrite ( $\text{FeS}_2$ ) in order to obtain iron oxide for the extraction of iron is as follows:



- a. How many mole of iron III oxide is produced from one mole of pyrite? [2]

- 
- b. If 1.00 tonne ( $10^6$  g) of pyrite is roasted during this process what mass of iron III oxide is produced if the process is only 80% efficient?  
[5]

**Question 47 (12 marks)**

(a) Draw and name two possible isomers of dibromoethane.

[4 marks]

The structural formulas of two isomers of dibromoethene are as follows:



(b) (i) What is the name given to describe isomers like these?

..... [1 mark]

(ii) Why is this type of isomerism possible in alkenes?

[1 mark]

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.....

(iii) Explain how isomers like these are named.

[2 marks]

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(iv) Draw and name the other isomer of dibromoethene.

[2 marks]

(d) Write the equation for the complete combustion of ethane.

[2 marks]

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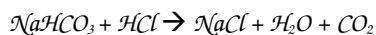
**Question 48 (9 marks)**

A student was given the task of determining the percentage purity of a sodium hydrogencarbonate sample. The student reacted the sample with excess concentrated hydrochloric acid in a small beaker and obtained the following results:

Mass of sample of impure sodium hydrogencarbonate.....1.454 g  
Initial mass of beaker + excess acid before reaction.....10.086 g  
Final mass of beaker and contents after reaction.....10.989 g

You may assume that the difference between the initial and final mass of the beaker and its contents is due to the mass of the sample added minus the mass of gas evolved.

The equation for the reaction is –



- (i) Calculate the mass of gas evolved. [1 mark]

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- (ii) Calculate the mass of sodium hydrogencarbonate present in the impure sample. [2 marks]

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- (iii) Determine the percentage purity of the sample. [2 marks]

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- (b) The student decided to increase the rate of the reaction by heating the acid in the flask to 60°C.

- (i) Use the collision theory to explain how a temperature increase actually increases the rate of the reaction.

[2 marks]

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(ii) Suggest two other realistic methods of increasing the rate of reaction.

[2 marks]

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***END OF PAPER***

