Student Name:

Class:

SYDNEY BOYS HIGH SCHOOL

YEAR 11 CHEMISTRY

ASSESSMENT TASK 3

FINAL EXAMINATION

SEPTEMBER 2020

INSTRUCTIONS

- Reading time – 5 minutes.
- Working time – 2 hours.
- Write using black pen.
- Draw diagrams using pencil.
- For questions in Section II, show all relevant working in questions involving calculations.
- NESA approved calculators may be used.

Total marks: 75

Section I – Multiple Choice Questions (20 marks)

- Attempt questions 1 – 20.
- Use Multiple Choice Answer Grid Provided.
- Allow about 30 minutes for this section.

Section II – 55 marks

- Attempt questions 21 – 31.
- Answer all questions in this booklet.
- Allow about 1 hour and 30 minutes for this section.

Section I – Multiple Choice Questions. 20 Marks

Attempt Questions 1 – 20.

Use the Multiple Choice Answer Grid provided.

Clearly mark one answer only per question.

Allow about 30 minutes for this section

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1. A sample of hydrogen gas had a volume of 1.3L at 25°C and 100kPa.
What would the volume be at 150°C and 100kPa?

A. 100 kPa
B. 7.8 L
C. 1.8 L
D. 273 kPa

2. Which one of the following statements correctly identifies a characteristic of an alpha particle?

A. Alpha particles have high penetrating ability.
B. Alpha particles are attracted towards the negative plate in an electric field.
C. Alpha particles are attracted towards the positive plate in an electric field.
D. Alpha particles are light, negatively charged particles.

3. Metallic crystal lattices have high melting and boiling points because

A. The mobile electrons are tightly packed inside the metallic crystals.
B. The mobile electrons move in one direction to produce electric current.
C. It requires a considerable amount of energy to overcome the strong attractive force between the positive metal ions and the mobile electrons.
D. When the metal ions are heated, the mobile electrons have greater kinetic energy and collide more often.

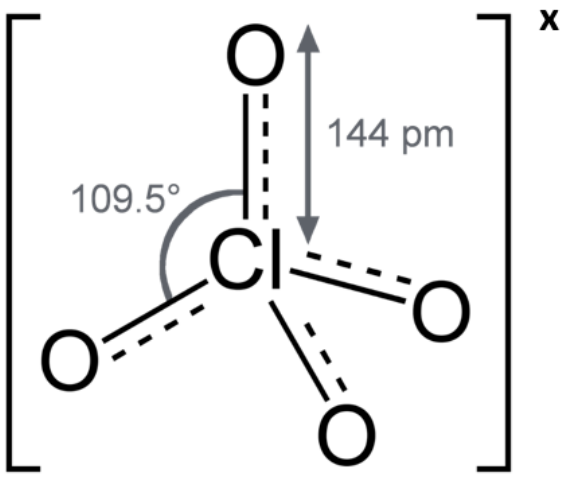
4. The solubility of calcium sulfate is 0.205g /100 g of water at 25°C.

60.0mL of 0.50 $molL^{-1}$ calcium nitrate is added to 40.0mL of 1.0 $molL^{-1}$ potassium sulfate.

What mass of calcium sulfate precipitate could be filtered from the 100 mL mixture?
(assume this has a mass of 100g).

A. 3.9 g
B. 4.1 g
C. 5.2 g
D. 5.4 g

Question 5 and 6 relate to the diagram below, showing the geometry and bond length in the perchlorate ion, where "x" represents the charge on the ion.



5. Which molecule below has a molecular shape most similar to that of the perchlorate ion?

A. ammonia

B. methane

C. boron trichloride

D. hydrogen fluoride

6. The molar mass of the compound lead (II) perchlorate is 406.1 g mol^{-1}.

Based on this information, what is the value of "x" (ie the charge on the perchlorate ion)?

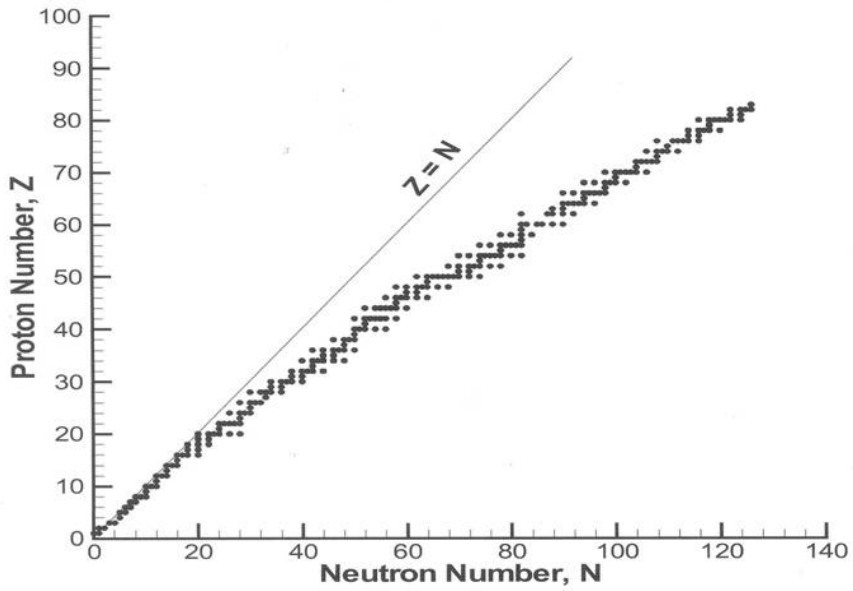
A. -4

B. -2

C. -1

D. +2

7. Using the stability zone graph below, which element is radioactive?



A. $^{40}_{20}\text{Ca}$

B. $^{100}_{60}\text{Nd}$

C. $^{20}_{10}\text{Ne}$

D. $^{13}_{6}\text{C}$

8. Which of the following correctly provides criteria required for a chemical reaction to occur?

A. The reactants must be heated.

B. The reactants must react at standard temperature and pressure.

C. The reactants must collide with sufficient energy and correct orientation.

D. The reactants collide with the walls of the container with sufficient energy.

9. 21.3g of chlorine gas reacts with 5.40g of an element "X", to form the chloride of X, with the formula XCl_3.

Identify the relative mass of element "X"?

A. 10.81

B. 26.98

C. 69.72

D. 114.82

10. Solid Iron (III) oxide reacts with carbon monoxide gas to produce solid iron and carbon dioxide gas. Which one of the following is the correctly balanced equation for this reaction?

A. $Fe_2O_{3(s)} + 3CO_{(g)} \rightarrow 2Fe_{(s)} + 3CO_{2(g)}$

B. $Fe_2O_{3(s)} + CO_{(g)} \rightarrow Fe_{(s)} + CO_{2(g)}$

C. $Fe_2O_{3(s)} + CO_{(g)} \rightarrow 2Fe_{(s)} + 2CO_{2(g)}$

D. $Fe_2O_{3(s)} + 2CO_{(g)} \rightarrow 3Fe_{(s)} + 2CO_{2(g)}$

11. The name given to the heat required to raise the temperature of the unit mass of a given substance by a given amount (usually 1°C) is

A. Latent heat of fusion

B. Percentage efficiency of combustion

C. Heat of dissociation

D. Specific heat capacity

12. Combustion reactions may be self-sustaining. This means that once started, they continue on their own, releasing heat energy to the environment. Why is this the case?

A. $\Delta H > E_a$

B. $\Delta H < E_a$

C. $\Delta H = 0$

D. $E_a = 0$

13. A student heats a 5.0g block of two different metals, M1 and M2, using the same experimental conditions. She discovers that the temperature of M1 increases more than that of M2. What can she deduce from this observation?

A. M1 must be a more reactive metal than M2.

B. M1 must be a less reactive metal than M2.

C. The specific heat capacity of M1 must be lower than that of M2.

D. The specific heat capacity of M1 must be higher than that of M2.

14. Freezing water is an example of which of the following processes?

A. Endothermic reaction
B. Exothermic reaction
C. Hydration reaction
D. Gibbs reaction

15. Identify the correct statement below.

A. If ΔH is negative and ΔS is positive then a given reaction will always be spontaneous.
B. If both ΔH and ΔS are negative then a given reaction will always be spontaneous.
C. If ΔH is positive and ΔS is negative then a given reaction will always be spontaneous.
D. If both ΔH and ΔS are positive then a given reaction will always be spontaneous.

16. "Equal volumes of gases contain equal number of molecules"

Which of the following scientists formulated the above Law?

A. Jacques Charles
B. Robert Boyle
C. Amedeo Avogadro
D. Joseph Louis Gay-Lussac

17. When a solution is diluted, which of the following quantities remains the same?

A. Amount of solvent
B. Amount of solute
C. Molarity of the solution
D. Concentration of the solution

18. What will be the concentration of a solution made by dissolving 8g of glucose ($C_6H_{12}O_6$) in 250mL of distilled water?

A. 36.36 mol L^{-1}
B. 0.18 mol L^{-1}
C. 0.36 mol L^{-1}
D. 1.8 mol L^{-1}

19. Element X forms an ionic chloride of formula XCl_3, element Y forms a molecular hydride of formula H_2Y. Predict the formula of the compound formed between X and Y.

A. XY

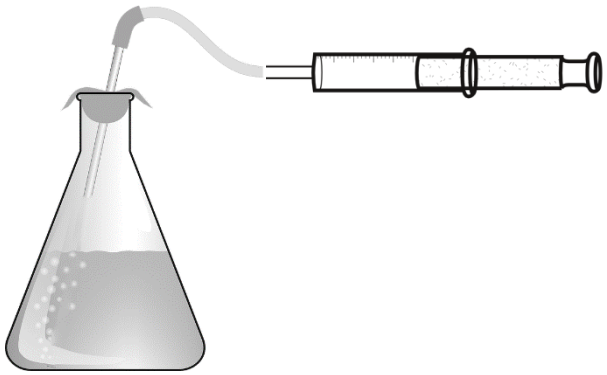
B. X_3Y_2

C. X_2Y

D. X_2Y_3

20. The apparatus shown below can be used to measure the rate of some chemical reactions by allowing the volume of a gas produced to be measured.

For example, hydrogen gas is produced when a reactive metal such as zinc reacts with dilute nitric acid.



How does the rate of hydrogen gas production vary if a piece of aluminium metal is added to excess nitric acid at different temperatures?

A. As the temperature of the acid increases the rate of the reaction increases.

B. As the temperature of the acid increases the rate of the reaction decreases.

C. The rate of the reaction is constant, regardless of the temperature of the acid.

D. The rate of the reaction is highest for a moderate temperature. It slows as the temperature is increased or decreased.

End of Multiple Choice Questions

Name: Class:

Year 11 Chemistry

Section II Answer Booklet
55 marks
Attempt Questions 21–34
Allow about 1 hours and 30 minutes for this section

Question 21 (4 marks)

Mr Jones provided 8g of a mixture of sand, salt and iron filings to his Year 11 Chemistry students. He instructed his students to separate the three components and weigh each component.

(a) Write a method that the students can use to separate the mixture provided to them. **3**

(b) The students found that the weight of all the three components did not add up to 8g. Provide a reason for this error. **1**

Question 22 (4 marks)

"Potassium and bromine are the two most reactive elements in Period 4 of the Periodic Table, but they are highly reactive for different reasons related to their unique atomic structure." **4**

Explain this statement and outline the reasons for the reactivity of potassium and bromine gas.

Question 23 (4 marks)

Alex placed a zinc electrode in copper chloride solution contained in a beaker.

(a) Identify the type of reaction between zinc and copper chloride. **1**

(b) For the reaction in part (a) **3**

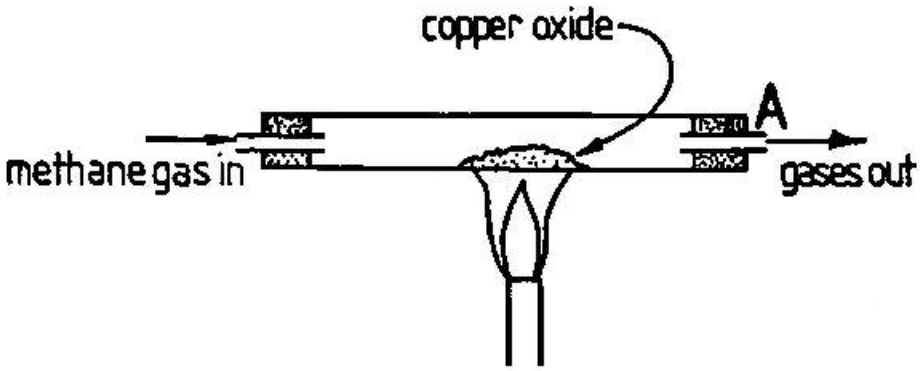
i) Write the oxidation half reaction.

ii) Write the reduction half reaction.

iii) Net redox reaction

Question 24 (5 marks)

The diagram shows methane gas passing over heated copper(II) oxide reacting to produce copper metal and gaseous products of carbon dioxide and water vapour which leave the apparatus at A



(a) Write the balanced formulae equation for the reaction of copper(II) oxide with methane (CH_4). **1**

(b) If 23.4g of copper(II) oxide is completely reacted, calculate the mass of copper metal formed. **2**

(c) Calculate the percentage of copper in the copper(II) oxide sample. **1**

(d) Calculate the volume of CO_2 produced at 25°C and 100 kPa from 23.4g of copper(II) oxide. **1**

Question 25 (3 marks)

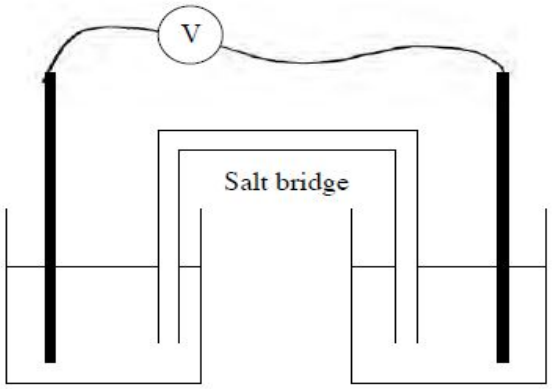
Calculate the number of zinc ions in 20g of $Zn(OH)_2$. **3**

Question 26 (5 marks)

A galvanic cell is constructed using the following information:

$$Cu \mid Cu^{2+} \mid\mid Fe^{2+}, Fe^{3+} \mid C$$

using the apparatus outlined in the diagram below.



(a) Label the diagram above to show the: **3**

- (i) element each electrode is made from
- (ii) anode and its polarity
- (iii) cathode and its polarity
- (iv) direction of electron movement
- (v) electrolyte species (ignoring spectator ions)
- (vi) direction of anion and cation movement

(b) Calculate the voltage produced by this cell under standard conditions. **1**

(c) Identify a suitable chemical for use in the salt bridge. **1**

Question 27 (4 marks)

(a) Calculate the temperature required to heat a sample of oxygen gas at 0°C in order to triple its volume at constant pressure. **2**

(b) 0.25 moles of neon gas is placed in a 1.0 L container at 100kPa and 0°C temperature. 0.25 moles of argon gas is placed in 3L container at unknown pressure and 25°C temperature. Calculate the gas pressure in the argon container. **2**

Question 28 (2 marks)

Calculate the enthalpy change for the following combustion reaction for benzene. **2**

$$C_6H_{6(l)} + \frac{15}{2} O_{2(g)} \rightarrow 3H_2\,O_{(l)} + 6CO_{2(g)}$$

Standard enthalpy of formation:

$C_6H_{6(l)}$ = +49 kJ mol^{-1}
$CO_{2(g)}$ = -393 kJ mol^{-1}
$H_2O_{(l)}$ = -285 kJ mol^{-1}

Question 29 (3 marks)

A student added 1.0 g of ammonium nitrate to 100.0 g of water in a calorimeter. The temperature of water changed from 21.6 °C to 20 °C. Calculate the enthalpy of dissolution. **3**

Question 30 (3 marks)

(a) Define activation energy **1**

(b) Use energy profile diagram to explain the role of catalysts in a rate of reaction. **2**

Question 31 (6 Marks)

A student investigates the rate of the reaction between hydrochloric acid and sodium thiosulfate by adding excess acid to varying concentrations of sodium thiosulfate. The equation for the reaction is:

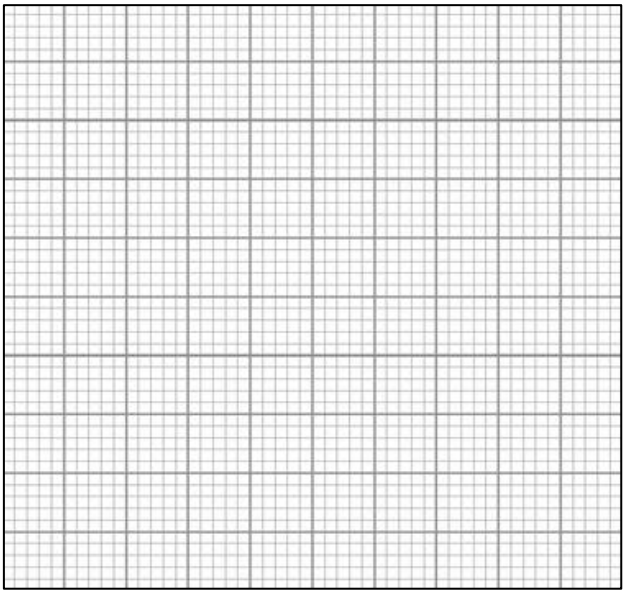
$$2HCl_{(aq)} + Na_2S_2O_{3(aq)} \rightarrow S_{(s)} + SO_{2(g)} + 2NaCl_{(aq)}$$

Reaction time is measured using a stopwatch, and based on production of $S_{(s)}$.

Concentration of $Na_2S_2O_3$ ($molL^{-1}$)	Reaction time (s)
0.03	160
0.06	60
0.09	35
0.12	27
0.15	23

(a) Identify a variable that must be controlled to ensure the validity of this experiment. **1**

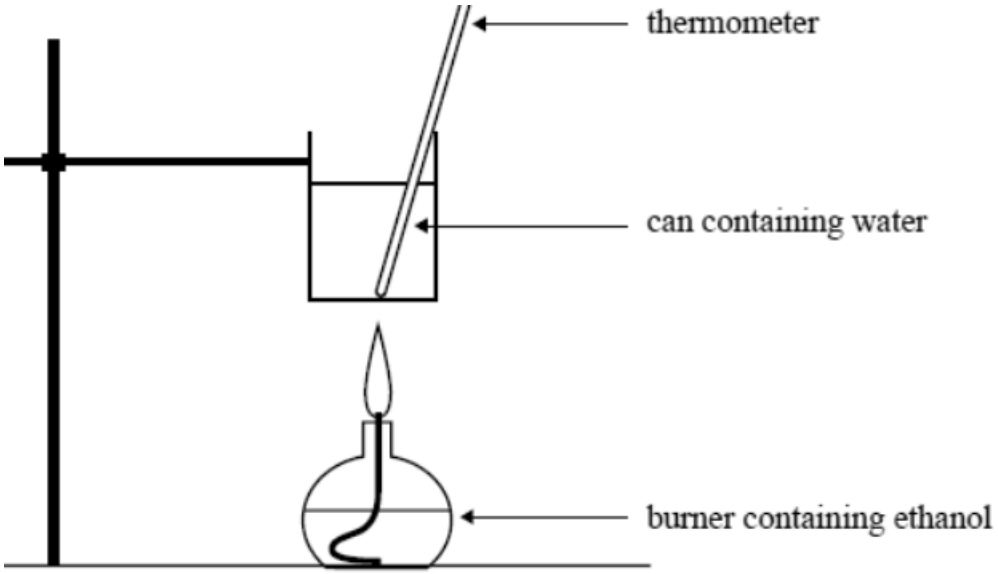
(b) Graph the data using the grid below. **3**



(c) Use Collision Theory to explain the shape of your graph. **2**

Question 32 (3 marks)

A chemistry student set up the following equipment to measure the heat of combustion of ethanol. Pure ethanol was used as the fuel in the spirit burner.



(a) In order to calculate the heat of combustion of ethanol, what measurements must the student make? **1**

(b) In the experiment the student found that the combustion of 0.30 g of ethanol produced an energy change of 5.2 kJ. Calculate the experimental molar heat of combustion for ethanol. **1**

(c) The accepted value for the heat of combustion of ethanol, 1364 kJ mol^{-1} is higher than the value obtained experimentally. Account for the difference between the two values. **1**

Question 33 (5 marks)

Ammonium nitrate ($NH_4NO_{3(s)}$) is often used as an explosive in quarrying iron ore in Western Australia. When heated gently in a sand bed it decomposes quietly to form nitrogen (I) oxide and gaseous water. When it explodes it produces nitrogen, oxygen and gaseous water.

For (a) and (b) use the table below.

Substance	$\Delta H_f°$ (kJ mol^{-1})
$NH_4NO_{3(s)}$	-365
$H_2O_{(g)}$	-242
$N_2O_{(g)}$	+ 82

(a) Using the table of standard enthalpies of formation above, calculate the enthalpy change which occurs when one mole of ammonium nitrate decomposes quietly. **2**

(b) Using the table of standard enthalpies of formation above, calculate the amount of energy liberated when 5 kg of ammonium nitrate is decomposed explosively. **3**

Question 34 (4 marks)

Gun powder, a mixture of saltpetre, sulfur and charcoal explodes according to the equation:

$2KNO_{(s)} + S_{(s)} + 3C_{(s)} \rightarrow N_{2(g)} + 3CO_{2(g)} + K_2S_{(s)}$

(a) Calculate the change in entropy for the reaction using the information in the table below. The reaction is carried out at a constant temperature of 25°C. **2**

Formula	**ΔS°** (J K^{-1} mol^{-1})
$KNO_{(s)}$	133
$S_{(s)}$	32
$C_{(s)}$	6
$N_{2(g)}$	192
$CO_{2(g)}$	214
$K_2S_{(s)}$	115

(b) Determine if the reaction is spontaneous by calculating the Gibbs free energy for the gun powder reaction above using the data in the table below. The reaction is carried out at a constant temperature of 25°C. **2**

Formula	ΔH_f° (kJ mol^{-1})
$KNO_{(s)}$	-495
$S_{(s)}$	0
$C_{(s)}$	0
$N_{2(g)}$	0
$CO_{2(g)}$	-394
$K_2S_{(s)}$	-376

Working out space

End of Paper