Smith's Hill High School

Promoting excellence in a spirit of trust and co-operation

STUDENT NAME: ……

TEACHER: ……

2022
Year 11
Preliminary examination

Chemistry

General Instructions

- Reading time – 5 Minutes
- Working time –2 Hours
- Write using black or blue pen
- Write your name at the top of every page
- For questions in Section II, show all relevant working in questions involving calculations
- NESA approved calculators may be used.
- There is extra writing space at the end. Clearly indicate on each question it is used.

Total Marks - 70

Section I
20 Marks
- Attempt Questions 1-20
- Allow about 35 mins for this section

Section II
50 Marks
- Attempt Questions 21-32
- Allow about 1 hours & 25 mins for this section

This paper MUST NOT be removed from the exam room

Name: _____

Name: _____

Chemistry

Section I – 20 marks
Attempt Questions 1-20
Allow about 35 minutes for this section

Use the multiple-choice answer sheet provided for Questions 1-20

---

1. Identify the element that has an electron configuration of $1s^2\ 2s^2\ 2p^6$:

   A. He
   B. Na
   C. O
   D. Ne

2. Which of the following is an example of a correctly balanced nuclear equation?

   A. $^{213}_{83}Bi \rightarrow\ ^{4}_{2}He\ +\ ^{210}_{81}Tl$

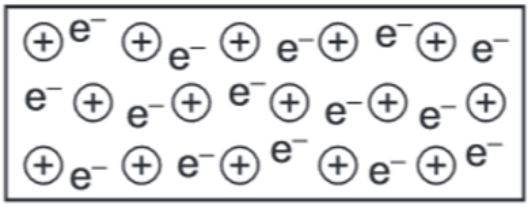
   B. $^{131}_{53}I \rightarrow\ ^{0}_{-1}e\ +\ ^{131}_{54}Xe$

   C. $^{60}_{27}Co \rightarrow\ ^{59}_{28}Ni\ +\ ^{0}_{-1}e$

   D. $^{213}_{83}Bi \rightarrow\ ^{222}_{86}Rn\ +\ 2\ ^{0}_{-1}e$

Name: _____

3. A student drew the following model to represent the structure of a pure substance at the particle level.



Which of the following properties would you expect this substance to display based on the model above?

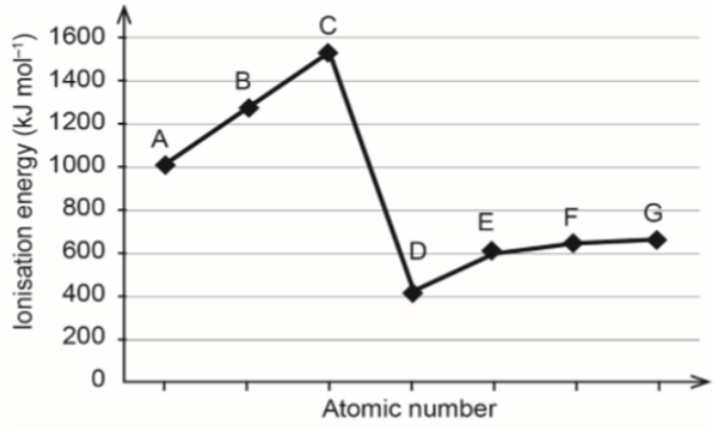
A. It would have a low melting point.

B. It would be a brittle solid at room temperature.

C. It would conduct electricity as a solid but not as a liquid.

D. It would be able to be drawn into a thin wire.

4. The first ionisation energy of consecutive elements (labelled A to G) of the Periodic Table is shown below.



Which of the following would be the most likely formula of a compound formed between 2 of the elements represented in the plot?

A. BC

B. A_2D

C. EB_2

D. AD

Name: _____

5. The structural formula for the compound hydrogen chloride may be represented by:

H - Cl

Which of the following shows the correct molecular shape, polarity and intermolecular force associated with a molecule of this compound?

	Shape	*Polarity*	*Strongest intermolecular force*
A.	Linear	Polar	Dipole-Dipole
B.	Planar	Polar	Hydrogen bonding
C.	Linear	Polar	Hydrogen bonding
D.	Planar	Non-polar	Dipole-Dipole

6. The molecular compound XH_3 has three bonding pairs of electrons and one non-bonding pair of electrons around the central atom of X.

What is the shape of XH_3?

A. Triangular planar

B. Tetrahedral

C. Linear

D. Pyramidal

7. Which of the following correctly identifies the number of moles of sodium sulfate in a solution made by dissolving 25g of sodium sulfate in 250mL of water?

A. 0.176

B. 0.000704

C. 43.99

D. 0.21

Name: _____

8. Which of the following contains the greater number of oxygen atoms?

   A. 3 moles of O_3 gas

   B. 100g of O_2 gas

   C. 150g of SO_2 gas

   D. 200g of solid Cr_2O_3

9. How much CH_4 remains after 10.0 g of CH_4 reacts completely with 15.0 g of O_2 according to the following equation?

   $$CH_4\,(g) + 2O_2\,(g) \rightarrow CO_2\,(g) + 2H_2O\,(g)$$

   A. 3.76 g

   B. 6.24 g

   C. 5.00 g

   D. 2.50 g

10. A 100 mL sample of helium exerts a pressure of 1 atm at 10°C. The volume of the container is reduced to 50 mL and the temperature is increased to 20°C. The pressure now exerted by the helium, in atmospheres, is closest to:

    A. 0.5

    B. 1

    C. 2

    D. 4

11. A compound contains 56.3% phosphorus and 43.7% oxygen by mass.

    Which of the following is the molecular formula of this compound?

    A. P_4O_6

    B. P_3O_2

    C. P_2O_5

    D. PO_2

Name: _____

12. Cobalt(II) chloride dissolves in water to produce a pale pink solution. What is the chloride ion concentration in a solution made from 0.44g of cobalt(II) chloride dissolved in 500.0 mL of water?

A. 35.45 mol/L

B. 0.0034 mol/L

C. 0.0068 mol/L

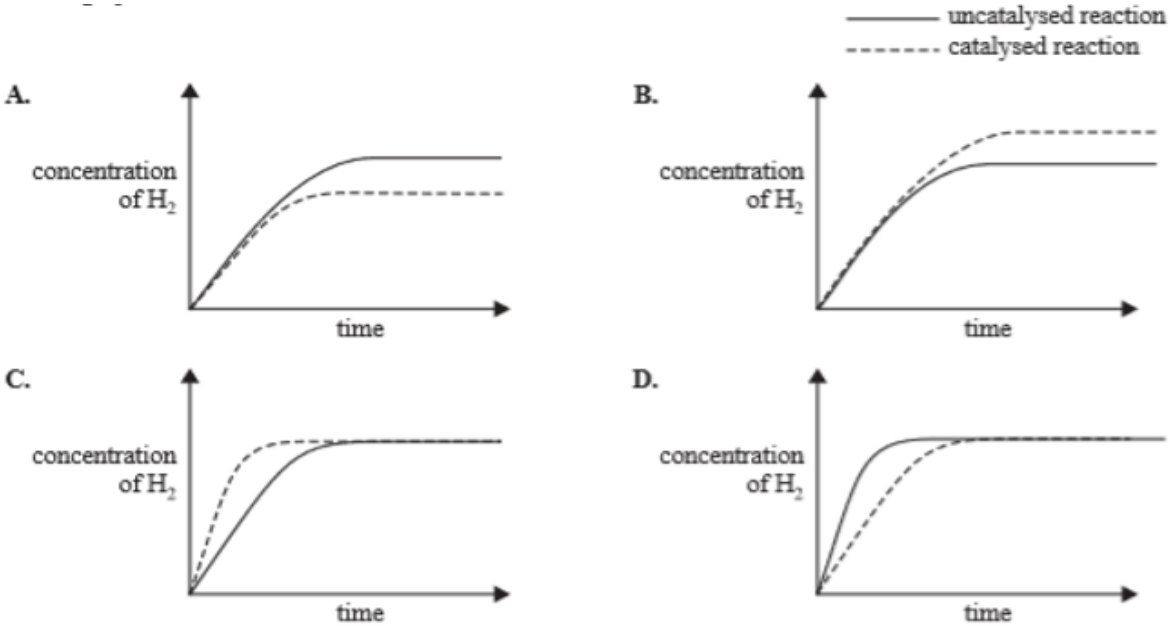
D. 0.014 mol/L

13. Which one of the following correctly identifies the products when sulfuric acid is reacted with potassium hydroxide, potassium carbonate and magnesium ribbon?

	Potassium hydroxide	*Potassium carbonate*	*Magnesium*
A.	Salt and hydrogen	Salt, water and carbon dioxide	Salt and oxygen
B.	Salt and hydrogen	Salt and carbon dioxide	Salt and hydrogen
C.	Salt and water	Salt, water and carbon dioxide	Salt and oxygen
D.	Salt and water	Salt, water and carbon dioxide	Salt and hydrogen

Name: _____

14. In a series of tests, a reaction which produces hydrogen gas is carried out in a sealed container. The temperature and volume of the container are not changed. The change in hydrogen concentration with time between an uncatalysed and a catalysed reaction is represented by a graph.



Which of the above graphs is correct?

A. A

B. B

C. C

D. D

15. Which of the following metals will displace iron from a solution containing iron (II) ions?

A. Lead

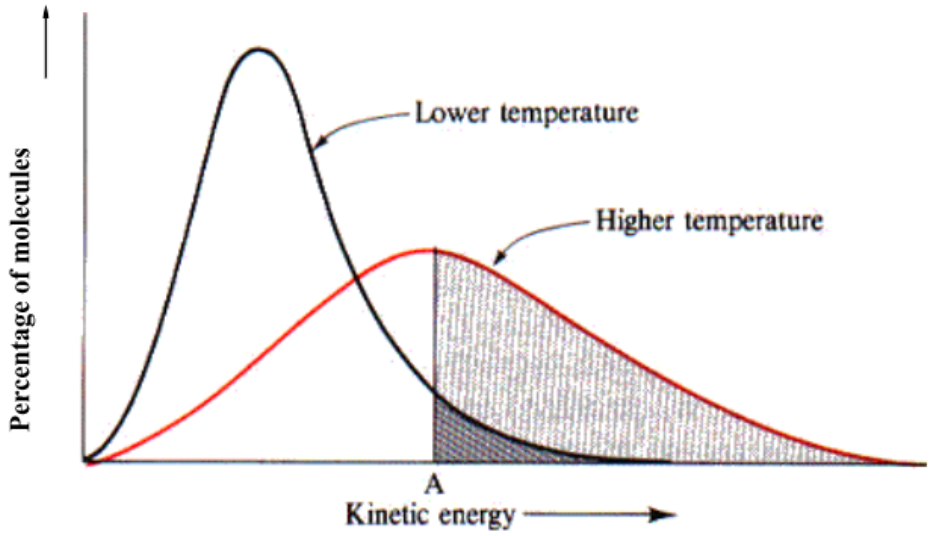
B. Copper

C. Magnesium

D. Tin

Name: _____

16. A Maxwell-Boltzmann Distribution is **a probability distribution used for describing the speeds of various particles within a stationary container at a specific temperature**. This is depicted by the graph shown below.



Which of the following are correct interpretations of the graph above?

I – A high percentage of molecules have a low average kinetic energy at low temperatures.

II – At high temperatures, there is a greater range of kinetic energy of molecules than at low temperatures.

III – At low temperatures, a smaller proportion of molecules have energy at or above the activation energy, **A**, for a reaction.

A. I, II and III

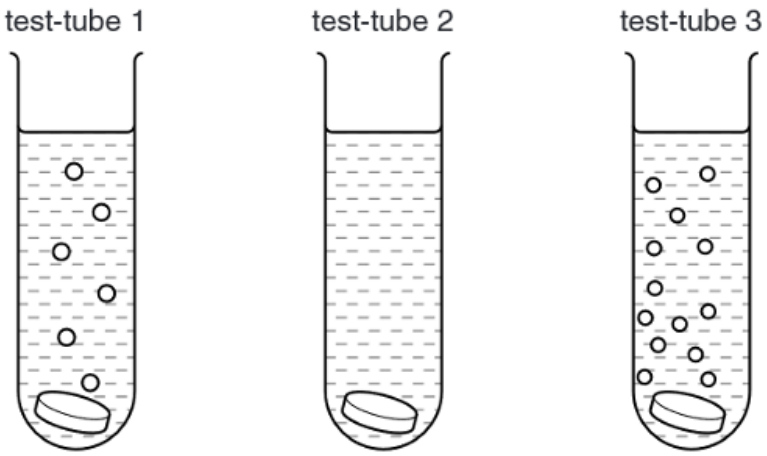
B. I and II only

C. I and III only

D. II and III only

Name: _____

17. The diagrams below show what happens when three different metals are placed into test tubes containing 0.1M hydrochloric acid.

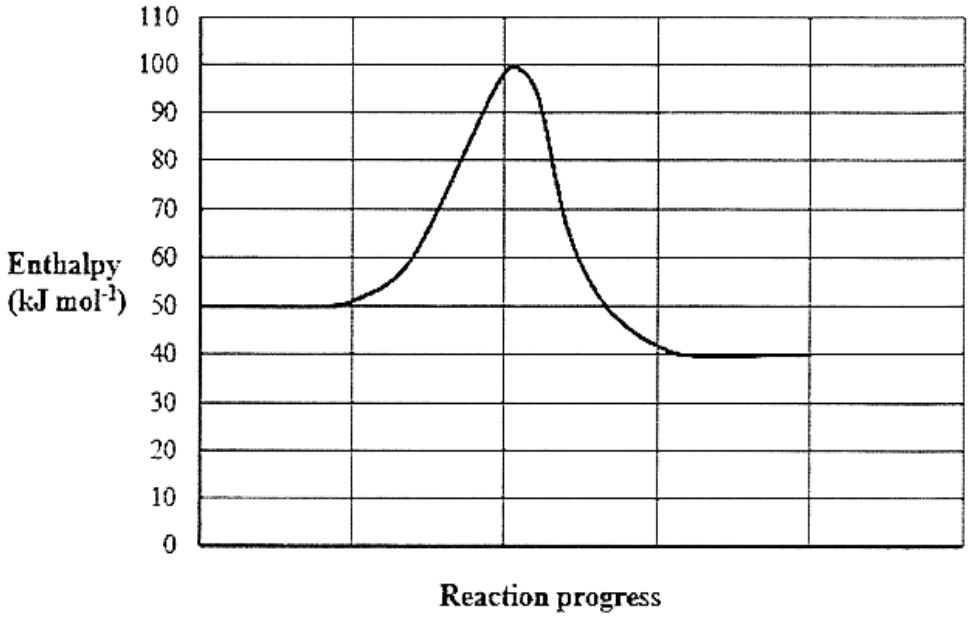


Which of the following alternatives identifies the metals which could have been added to each test tube?

	Test tube 1	**Test tube 2**	**Test tube 3**
A.	Magnesium	Lead	Iron
B.	Zinc	Copper	Silver
C.	Iron	Silver	Magnesium
D.	Calcium	Tin	Zinc

Name: _____

18. A reaction has the energy profile diagram shown below:



Which of the following represents the energy profile of the REVERSE reaction?

	Final product energy *(kJ mol^{-1})*	*ΔH* *(kJ mol^{-1})*	*Activation energy* *(kJ)*
A.	40	+10	50
B.	50	+10	60
C.	50	−10	60
D.	40	−10	50

19. Which one of the following is correct for an exothermic reaction?

A. Energy 'enters' the reaction system

B. The reaction system is absorbing heat from the surroundings

C. The total chemical energy of the products of a chemical reaction is greater than the total chemical energy of the reactants

D. The total chemical energy of the products of a chemical reaction is less than the total chemical energy of the reactants

Name: _____

20. Hydrogen gas reacts with chlorine gas to form hydrogen chloride gas.

$$H_2(g) + Cl_2(g) \rightarrow 2HCl(g) \qquad \Delta H° = -184 \text{ kJ mol}^{-1}$$

Bond	*Bond energy (kJ mol^{-1})*
H – H	436
H – Cl	431

What is the Cl – Cl bond enthalpy for this reaction?

A. 1114 kJ mol^{-1}

B. 652 kJ mol^{-1}

C. 610 kJ mol^{-1}

D. 242 kJ mol^{-1}

Name: _____

Section II – 50 marks

Attempt Questions 21-32

Allow about 1 hour and 25 minutes for this section.

Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.

Show all relevant working in questions involving calculations.

Extra writing space is provided at the end of the paper. If you use this space, clearly indicate which question you are answering.

Question 21 (2 marks)

Ammonium Sulfate $(NH_4)_2SO_4$ is widely used as a sulfur fertiliser. Calculate the percentage of Sulfur in ammonium sulfate. **2**

……..……

……..……

……..……

……..

Question 22 (2 marks)

Draw a Lewis dot diagram for an ammonia molecule. **2**

Name: _____

Question 23 (6 marks)

Consider the species listed below.

	Name	***Element or compound***	***Type of solid structure (molecule, ionic lattice, covalent network, metallic lattice)***
I	silicon dioxide	SiO_2	covalent network
II	ammonia	NH_3	molecule
III	copper	Cu	metallic lattice
IV	sulfur dioxide	SO_2	molecule
V	methane	CH_4	molecule

(a) Which of the above substances would you expect to have the highest melting point? Explain your reasoning. **2**

……..……

……..……

……..……

……..

(b) Substances II, IV and V have lower boiling points than the other substances listed, yet these three substances still differ considerably in their boiling points.

Predict the order of the boiling points of these molecules. Explain your prediction. **4**

……..……

……..……

……..……

……..

……..

……..

……..

Question 24 (3 marks)

A solution of barium chloride is added to a solution of silver nitrate which reacts to produce a white precipitate of silver chloride.

(a) Write a net ionic equation showing the formation of the precipitate. **1**

……..

(b) Calculate the number of moles of each ion remaining in the final solution after 1.75 mol of barium chloride solutions reacts with 2.70 mol of silver nitrate solution. **2**

……..

……..

……..

……..

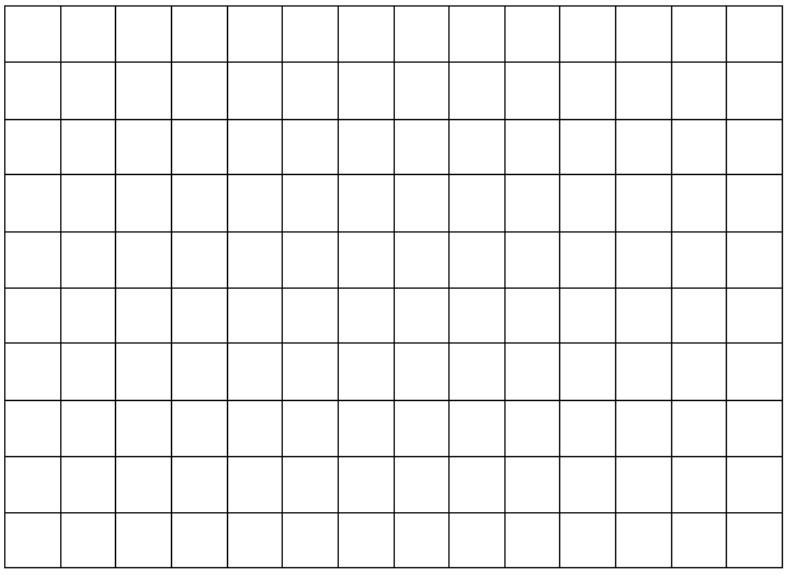
Name: _____

Question 25 (6 marks)

The following data was collected by Year 11 students when they reacted zinc granules with 1.0 mol L^{-1} hydrochloric acid.

Time (s)	*Volume of gas collected (mL)*
0	0
15	1.5
30	2.7
45	3.2
60	3.9
75	4.1
90	4.2
105	4.3
120	4.3

(a) Plot the data from the table on the graph below. **3**



Question 25 continued on next page

Name: _____

Question 25 (continued)

(b) Identify and explain the trend shown in your graph from the previous page. **3**

……..……

……..……

……..……

……..

……..

Question 26 (6 marks)

12.8 g of propane, and 32.4 g of oxygen are reacted together to form carbon dioxide and water according to the following balanced equation:

$$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$$

(a) Find the limiting reagent for this reaction. **4**

……..…….

……..…….

……

……..…….

……..…….

……

……..

(b) What is the mass of the excess reagent? **2**

……

……..…….

……..…….

……

Name: _____

Question 27 (5 marks)

(a) A student prepared 250.0mL of a standard aqueous solution of potassium nitrate, by adding distilled water to 12.64g of pure KNO_3.

Describe the steps required to make this standard solution and calculate its concentration. **4**

……..……

……..……

……..……

……..

……..

……..

……..

……..

(b) Calculate the volume of the water that must be added to a 50.0mL sample of the prepared standard solution to produce a concentration of 0.200 mol L^{-1}. **1**

……..……

……..……

Question 28 (2 marks)

Outline TWO chemical processes that Aboriginal and Torres Strait Islander peoples use to remove toxins from food items. **2**

……..……

……..……

……..……

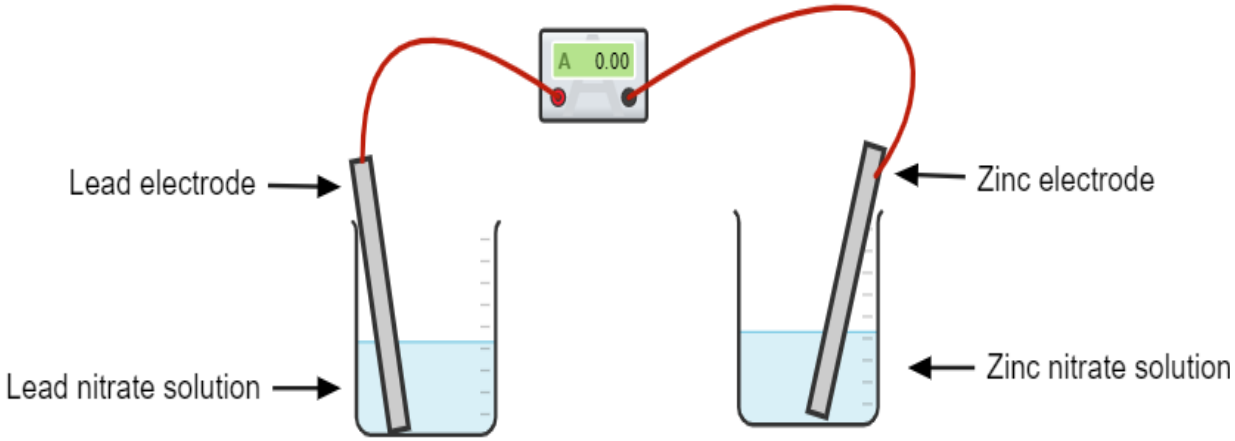
……..

……..

Name: _____

Question 29 (4 marks)

A student set up a zinc-lead galvanic cell as shown in the diagram below.



The student, however, could not obtain any current as indicated by the ammeter.

(a) On the diagram above, clearly draw and label the important part of the galvanic cell that the student has forgotten. **1**

(b) Assuming that the student can add the missing part, write the oxidation and reduction half-equations and determine the EMF (E°) for the cell. **3**

……..……

……..……

……..……

……..

……..

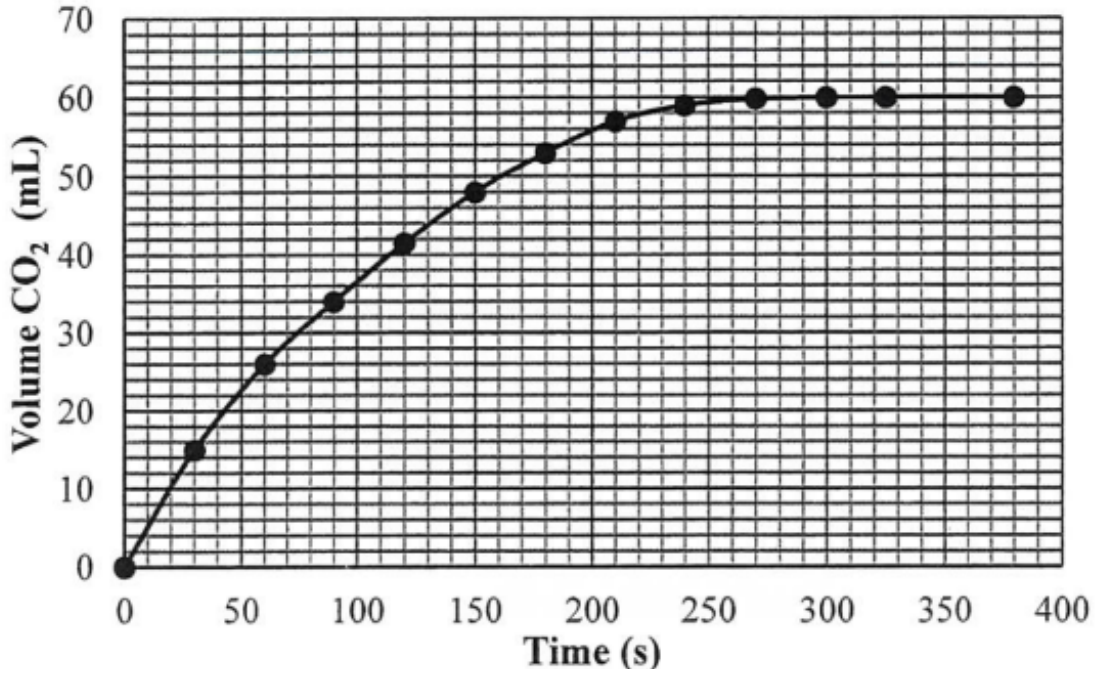
……..

Name: _____

Question 30 (7 marks)

A student conducted an experiment at 25℃ and 100 kPa to measure the rate of reaction when powdered calcium carbonate reacts with hydrochloric acid.

Data was collected and a graph of volume of the gas produced versus time was drawn.



(a) Write a balanced chemical equation for this reaction **1**

……..

(b) Using data from the graph, calculate the mass of calcium carbonate that had reacted after 220 seconds. **2**

……..……

……..……

……..……

……..

Question 30 continued on next page

Name: _____

Question 30 (continued)

(c) Compare the rate of reaction between 30 and 60 seconds and between 180 and 210 seconds. Explain the difference between these two rates in terms of collision theory. **3**

……..……

……..……

……..……

……..

……..

……..

(d) Outline the test used to identify the gas produced in this reaction. **1**

……..……

Question 31 (3 marks)

Consider the following reaction:

$$HNO_2\ (l) + NaCl\ (s) \rightarrow HCl\ (g) + NaNO_2\ (s)$$

Calculate the ΔH° value for the reaction above using the information below relating to the enthalpy changes for the 4 reactions as listed. **3**

	ΔH° (kJ)
$NO\ (g) + NO_2\ (g) \rightarrow N_2O\ (g) + O_2\ (g)$	– 43.0
$NO\ (g) + NO_2\ (g) + Na_2O\ (s) \rightarrow 2NaNO_2\ (s)$	– 427.0
$2NaCl\ (s) + H_2O\ (l) \rightarrow 2HCl\ (g) + Na_2O\ (s)$	+ 507.0
$2HNO_2\ (l) \rightarrow N_2O\ (g) + O_2\ (g) + H_2O\ (l)$	+ 34.0

……..……

……..……

……..……

……..

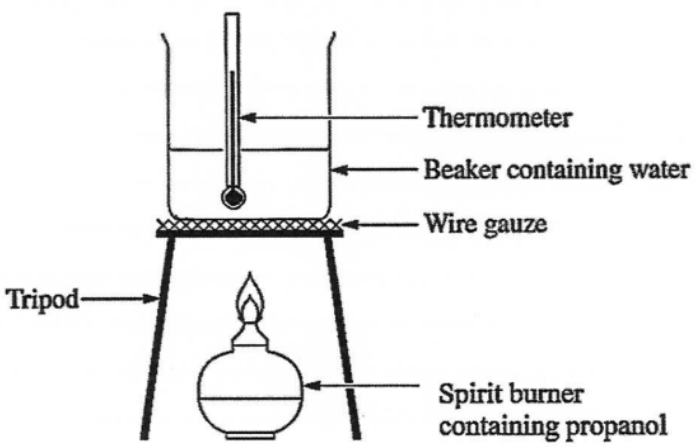
……..

……..

Name: _____

Question 32 (4 marks)

A student used the apparatus shown to heat 250mL of water.



(a) During this experiment, the mass of the spirit burner containing propanol (C_3H_7OH), decreased from 296.52 g to 295.83 g.
Given that the heat of combustion of propanol is 33.6 kJ g^{-1}, calculate the maximum possible change in the temperature of the water. **3**

……

……

……

……

……

……

(b) Outline why, in practice, the change in the temperature of the water would be significantly lower than the one calculated. **1**

……

……

End of paper

Name: _____

Extra Writing Space – *clearly identify question*

Name: _____

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Name: _____

Extra Writing Space – *clearly identify question*

Name: _____

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Name: _____

Class/Teacher: ……

2022

PRELIMINARY EXAMINATION

Chemistry

Multiple Choice Answer Sheet (Attempt ALL questions)

1.	A ◯	B ◯	C ◯	D ◯
2.	A ◯	B ◯	C ◯	D ◯
3.	A ◯	B ◯	C ◯	D ◯
4.	A ◯	B ◯	C ◯	D ◯
5.	A ◯	B ◯	C ◯	D ◯
6.	A ◯	B ◯	C ◯	D ◯
7.	A ◯	B ◯	C ◯	D ◯
8.	A ◯	B ◯	C ◯	D ◯
9.	A ◯	B ◯	C ◯	D ◯
10.	A ◯	B ◯	C ◯	D ◯
11.	A ◯	B ◯	C ◯	D ◯
12.	A ◯	B ◯	C ◯	D ◯
13.	A ◯	B ◯	C ◯	D ◯
14.	A ◯	B ◯	C ◯	D ◯
15	A ◯	B ◯	C ◯	D ◯
16.	A ◯	B ◯	C ◯	D ◯
17.	A ◯	B ◯	C ◯	D ◯
18.	A ◯	B ◯	C ◯	D ◯
19.	A ◯	B ◯	C ◯	D ◯
20.	A ◯	B ◯	C ◯	D ◯