Name: _____

Please highlight/circle your teacher's name

Mrs R. Campbell

Mrs J. Kennedy

Mr C. Le Bescont

Mrs S. Mathis

Mrs A. Thorne

PYMBLE LADIES' COLLEGE

SEMESTER 2, 2020

YEAR 11 CHEMISTRY

EXAMINATION

READING TIME: 5 minutes

TIME ALLOWED: 2 HOURS

TOTAL MARKS: 90

DIRECTIONS TO CANDIDATES

Write your name in the space at the top of the page where indicated and circle your teacher.

PART A: 20 multiple choice questions, each worth one mark.

Indicate your answers on the multiple choice answer sheet.

PART B: Extended response questions (Total of 70 marks).
Marks for each question are indicated.
Answer each question in the space provided.

A separate Periodic Table and Data Sheet are provided.

PART A

Total Marks – 20
Attempt ALL questions

Select the alternative that best answers the question.
Mark your answers on the Multiple Choice Answer Sheet provided.

[Allow about 25 minutes for this part]

Question 1.
What does the pressure of an ideal gas depend on?

A. The shape of the molecule
B. The shape of the container
C. The molecular mass of the particle
D. The number of molecules of gas in the vessel

Question 2.
Propane burns in pure oxygen to produce carbon dioxide and water as shown by the following unbalanced equation:

$$C_3H_8 + __ O_2 \rightarrow __CO_2 + __H_2O$$

How many moles of oxygen react with 1 mole of propane?

A. 3
B. 4
C. 5
D. 7

Question 3.
Which statement is true for most ionic compounds?

A. They are coloured
B. They have high melting points
C. They conduct electricity in the solid state
D. They malleable and soft

Question 4.

$^{211}_{83}Bi$ is an isotope of bismuth. What does each atom contain?

A. 83 neutrons
B. 211 electrons
C. 83 protons and 128 neutrons
D. 128 protons and 128 electrons

The following periodic table is for Question **5** and **6**.

Groups

I	II										III	IV	V	VI	VII	VIII
P															Q	
	R											S				

Question 5

In the periodic table above, where would the metal with a valency of 2 be found?

A. P
B. Q
C. R
D. S

Question 6.

What is the formula of the compound formed by R and Q?

A. RQ_2
B. R_2Q
C. RQ
D. R_2Q_7

Question 7.

When listed in decreasing order of strength (strongest first), what is the correct order of the following?

A. dispersion forces→ hydrogen bond→ covalent bond
B. covalent bond → hydrogen bond → dispersion forces
C. covalent bond→ dispersion forces→ hydrogen bond
D. hydrogen bond→ covalent bond → dispersion forces

Question 8.

Which of the following equations correctly represents the reaction of sulfuric acid and sodium hydroxide?

A. $H_2SO_4(aq) + NaOH(aq) \rightarrow NaSO_4(aq) + H_2O(l)$
B. $H_2SO_4(aq) + 2NaOH(aq) \rightarrow NaSO_4(aq) + 2H_2O(l)$
C. $H_2SO_4(aq) + NaOH(aq) \rightarrow Na_2SO_4(aq) + H_2O(l)$
D. $H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$

Question 9.
Which features best describe covalent molecular substances?

A. Rigid solids, many conduct electricity in the aqueous or molten state
B. Gases, liquids or soft low melting point solids at room temperature
C. Hard solids with high melting points, commonly non-conductors of electricity
D. Conduct electricity in the solid state, malleable and ductile

Questions **10** and **11** refer to the following information.

Some chemistry students were investigating the relationship between concentration and rate of reaction. In the investigation, different concentrations of hydrochloric acid were added to a sodium thiosulfate solution to produce solid sulfur. This reaction was represented by the following equation.

$$2H^+(aq) + S_2O_3^{2-}(aq) \rightarrow SO_2(g) + S(s) + H_2O(l)$$

A piece of paper with a cross drawn on it was placed under the reaction vessel. The time taken for the cross to disappear due to the formation of the solid sulfur was measured.

Question 10.
What is the independent variable?

A. Concentration of hydrochloric acid
B. Total volume of the mixture
C. Rate of reaction
D. Time taken for cross to disappear

Question 11.
When several laboratory groups pooled their data, one group's results were consistently higher than other groups. How should the students process their results?

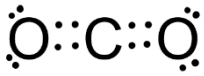
A. Use the average of all the results to ensure validity
B. Use the average of all the results to ensure reliability
C. Ignore the results from the group that was consistently higher and average the rest of the results to ensure validity
D. Ignore the results from the group that was consistently higher and average the rest of the results to ensure reliability

Question 12.
You used flame tests to study emission spectra of certain metals. Which statement is correct about why elements release light?

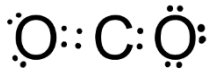
A. Electrons release energy as they move from high to low energy levels
B. Electrons release energy as they move from low to high energy levels
C. Electrons absorb energy as they move from high to low energy levels
D. Electrons absorb energy as they move from low to high energy levels

Question 13.
Which diagram correctly represents the Lewis dot diagram for carbon dioxide?

A. 

B. 

C. 

D. 

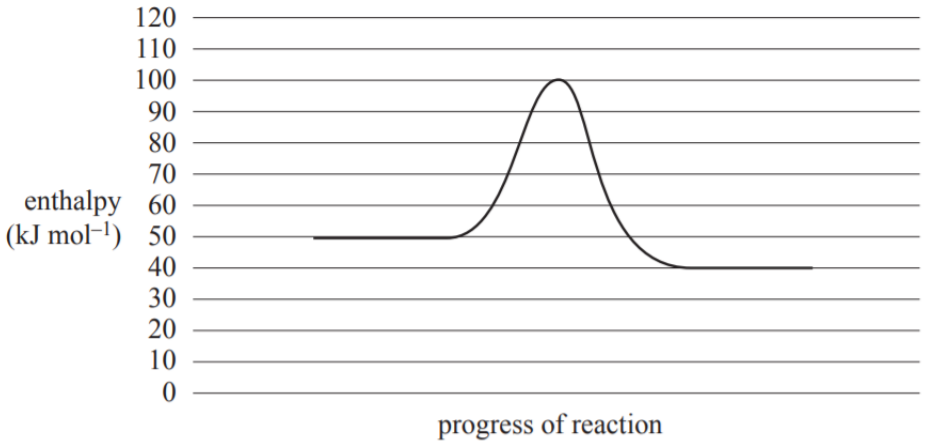
Question 14.
Why does a catalyst increase the rate of reaction?

A. A catalyst increases the enthalpy of the reaction
B. A catalyst absorbs energy from the reactants
C. A catalyst increases the average kinetic energy of the system
D. A catalyst provides an alternative pathway for the reaction with a lower activation energy

Question 15.
A sample of Fe_3O_4 contains 0.30 moles of iron atoms. What mass of oxygen is in the sample of Fe_3O_4?

A. 6.4 g
B. 4.8 g
C. 3.2 g
D. 1.6 g

Question 16.
A reaction has the energy profile shown below



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

	Final product energy ($kJ\ mol^{-1}$)	ΔH ($kJ\ mol^{-1}$)	Ea ($kJ\ mol^{-1}$)
A.	40	+ 10	100
B.	50	+ 10	50
C.	40	- 10	50
D.	50	- 10	100

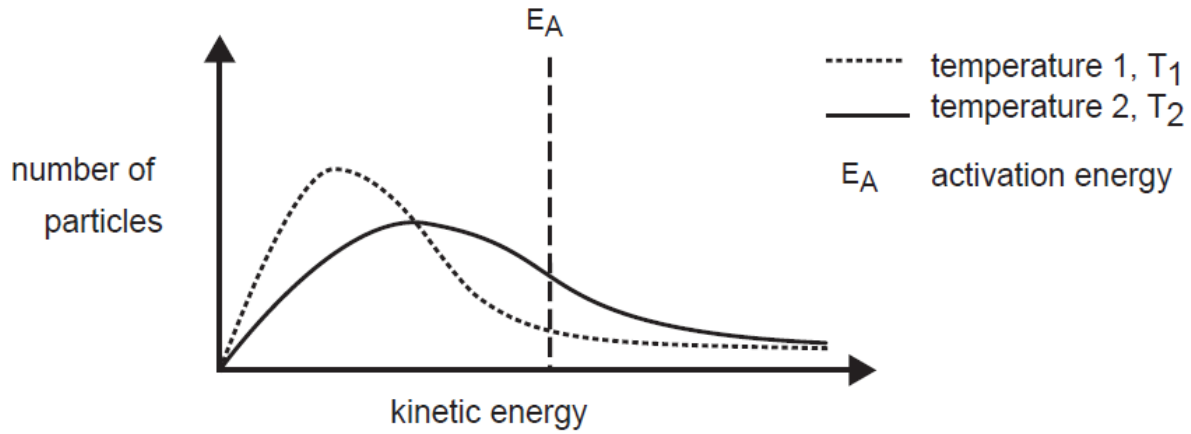
Question 17.
Three metals, A, B and C, were tested to compare their reactivity. Samples of each metal were placed separately into test tubes each containing a nitrate solution of the other metal ions. The following results were obtained.

	A(s)	**B(s)**	**C(s)**
$A^{2+}(aq)$		No visible reaction	Solid A forms
$B^{2+}(aq)$	Solid B forms		Solid B forms
$C^{2+}(aq)$	No visible rection	No visible reaction	

From these results, which shows the correct order of the metals arranged from most reactive to least reactive?

A. C > A > B
B. B > C > A
C. B > A > C
D. A > B > C

Question 18.
The diagram below represents the distribution of the kinetic energy of reactant particles at two different temperatures.
Assume that the areas under the curves are equal.



From this diagram it can be concluded that

A. at T1 a greater number of particles have sufficient energy to react. T1 is greater than T2.
B. at T1 a greater number of particles have sufficient energy to react. T2 is greater than T1.
C. at T2 a greater number of particles have sufficient energy to react. T1 is greater than T2.
D. at T2 a greater number of particles have sufficient energy to react. T2 is greater than T1.

Question 19.
Which of the following group contain species that have the same number of electrons?

A. F^-, Cl^-, Br^-, I^-
B. Rb^+, Kr, Sr^{2+}, Br^-
C. F^-, O^{2+}, N^{3-}, Na^+
D. Na, Mg, Al, Si

Question 20.

Molybdenum, Mo, is present in each of the following species: MoO_2 $Mo_2O_7^{2-}$ $HMoO_4^{2-}$
Which of the following lists these species in order of increasing oxidation number of molybdenum?

A.	$HMoO_4^{2-}$	MoO_2	$Mo_2O_7^{2-}$
B.	$Mo_2O_7^{2-}$	$HMoO_4^{2-}$	MoO_2
C.	MoO_2	$HMoO_4^{2-}$	$Mo_2O_7^{2-}$
D.	$Mo_2O_7^{2-}$	MoO_2	$HMoO_4^{2-}$

PART B

Total marks – 70

Attempt ALL questions

Show all relevant working in questions involving calculations.

[Allow about 1 hour and 40 minutes for this part]

Question 21. (5 marks)

a) Americium-241 (Am-241) is an alpha emitter with a half-life of 432 years.

Write a balanced nuclear equation for the decay of americium-241. **1**

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b) If the initial sample of Am 241 is 0.003 g how long would it take for 0.00075 g of the radioactive isotope to remain? **2**

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c) Explain why smoke detectors containing Am-241 are safe to handle. **2**

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Question 22 (5 marks)

Caffeine is an organic molecule found in tea, coffee and energy drinks. It is a stimulant that also can be taken in tablet form. Pure caffeine is a white odourless powder that tastes bitter and contains carbon, hydrogen, nitrogen and oxygen.

The percent composition was determined to be 49.48% carbon, 5.19% hydrogen, 28.85% nitrogen and the remainder oxygen. The mass of one mole of this substance is 194.19 g mol^{-1}

a) Calculate the empirical formula. Show all working. **3**

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a) Calculate the molecular formula. Show all relevant working. **2**

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Question 23 (11 marks)

A student used the following equipment, together with a number of 1kg masses, to gather first-hand data to verify one of the '*gas laws'*.



The masses were placed on top of the syringe to increase the pressure.

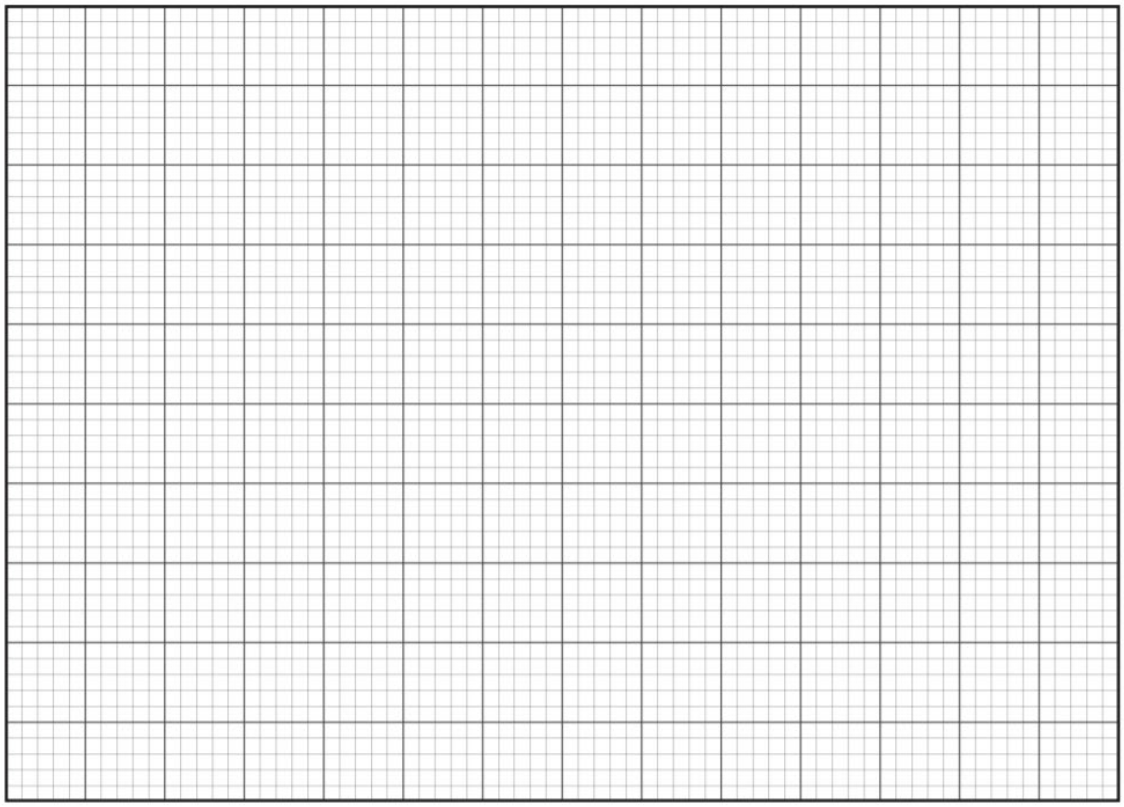
The data they collected are shown in the table below.

Pressure (kPa)	**Volume of gas inside the syringe (L) x 10^{-2}**				
	Trial 1	Trial 2	Trial 3	Average Volume	$\frac{1}{V}$ of average volume
0.79	8.0	8.2	7.9		
1.1	5.7	5.9	6.0		
1.2	5.4	7.1	5.5		
1.6	3.8	4.0	3.9		

Complete the final two columns of the table to determine average volume and $\frac{1}{V}$ for each pressure. **3**

Question 23 continues on page 11

a) Plot the pressure of the gas against the $\frac{1}{V}$ on the grid below **4**



b) Use the graph to predict the volume the gas will occupy at a pressure of 1.4 kPa.

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c) Identify the relationship between pressure and volume. Use the ideal gas equation from your data sheet to show how the data collected supports the ideal gas law. **2**

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Question 24 (9 marks)

When a sodium reacts with chlorine gas solid sodium chloride is formed. In this process electrons are transferred from the sodium to the chlorine. The reaction produces a bright yellow light and a great deal of heat energy.

a) Write a balanced equation to show this reaction. Include states. **2**

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b) Identify whether this reaction is classified as endothermic or exothermic. **1**

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c) Sodium and chlorine are two elements in the third period of the periodic table.

i. Use your knowledge of bonding to explain why sodium is a solid, but chlorine is a gas at room temperature. **4**

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ii. The following table shows the electronegativity of sodium and chlorine.

Element	Sodium	Chlorine
Electronegativity	0.93	3.16

Using the data provided explain why the bonds formed in the reaction between sodium and chlorine are ionic rather than covalent. **2**

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Question 25 (10 marks)

a) Complete the table below by choosing **one** molecule from the following list to match each description. **5**

BF_3 CO_2 NH_3 H_2 $CHBr_3$ CO CH_4

Description	**Molecule**
A diatomic molecule with only dispersion forces between its molecules	
A molecule that is tetrahedral and polar	
A molecule that is tetrahedral and non-polar	
A molecule that is trigonal pyramidal and has hydrogen bonding between its molecules	
A molecule that is linear and polar	

b) X is a white solid that melts at 784 °C to form a colourless liquid. The solid crystal shatters when hammered and does not conduct electricity unless melted.

Y is a shiny grey solid that sublimes at 3600 °C, it is used in pencils, electrodes and as a dry lubricant. It will conduct electricity when solid.

i. Classify the type of bonding present in crystals of X. **1**

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ii. Classify the type of structure present in Y. **1**

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iii. Explain why X conducts electricity when melted but not solid and Y conducts electricity when solid. **3**

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Question 26 (10 marks)

The simplified solubility rules below may help you to answer this question.

General Rule	Exceptions
all Group I, nitrate and ammonium compounds are soluble	none
most chlorides are soluble	silver and lead (insoluble)
most sulfates are soluble	barium and lead (insoluble) calcium and silver (sparingly soluble)
most hydroxides are insoluble	group I, ammonium and barium compounds (soluble) calcium (slightly soluble)
most carbonates are insoluble	group I and ammonium compounds

When 200.0 mL of 1.500 mol L^{-1} solution of barium chloride is added to 250.0 mL of 2.500 mol L^{-1} solution of silver nitrate a white precipitate is formed.

a) Write a full (neutral species) balanced equation for this reaction. Include states. **2**

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

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c) Determine the limiting reagent. Show all working. **2**

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d) Calculate the mass of precipitate formed. **2**

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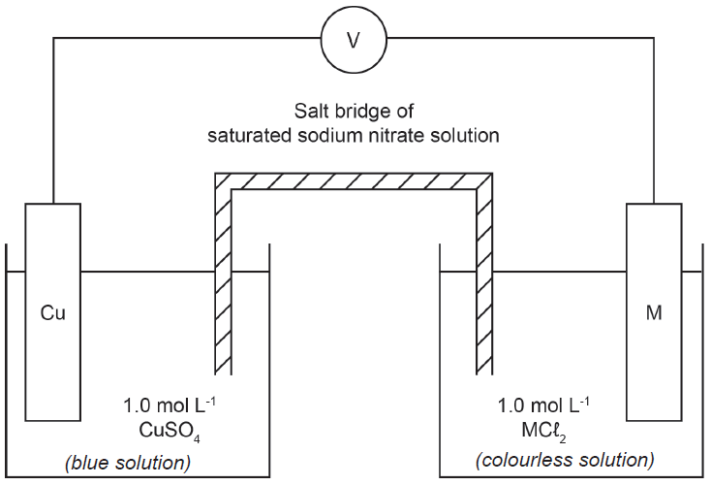
Question 26 continues on page 16

e) Determine the final concentration of nitrate ions in solution. **3**

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Question 27 (13 marks)

The diagram below represents a simple galvanic cell set up at 25°C.



One electrode/electrolyte pair is Cu/Cu^{2+}. The other electrode is of an unknown metal, represented as M/M^{2+}.

It was observed, that over time, the unknown metal electrode reduced in size and the solution remained colourless.

a) On the **diagram above**. Label the anode, cathode, negative and positive terminal and the direction of electron flow. **3**

b) Write a chemical equation to show the reaction at the anode of the cell. **2**

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c) List two observations that would be expected in the Cu/Cu^{2+} cell. **2**

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d) Identify 2 reasons for needing a salt bridge. **2**

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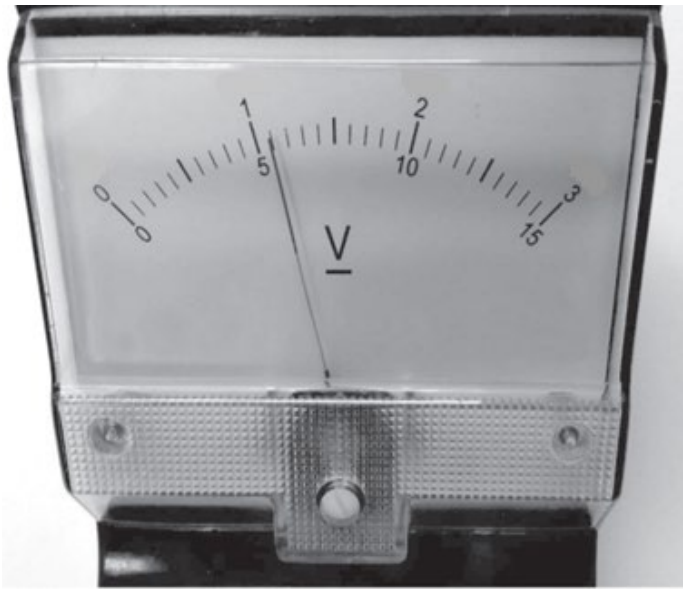
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Question 27 continues on page 17

Question 27 continued

Below is a photograph of the voltmeter attached to the diagram of the cell shown above. There are two scales on the voltmeter.

The scale being used is the one with the range from 0 to 3 volts.



e) i. What is the reading on the voltmeter? **1**

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ii. Using the voltmeter reading and the data sheet, predict the identity of the unknown metal. Clear reasoning, including a calculation, must be provided. **3**

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Question 28 (7 marks)

Recently in Beirut, a massive explosion occurred because 2750 tonnes (2.75×10^9 g) of ammonium nitrate caught fire.

Explosions occur where a solid produces gas at an extremely fast rate.

The chemical reaction for this explosion is as follows:

$$2NH_4NO_{3(s)} \rightarrow 2N_{2(g)} + O_{2(g)} + 4H_2O_{(g)}$$

a) Classify this type of reaction. **1**

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b) How many moles of ammonium nitrate was involved in this reaction? **2**

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c) How many moles of **gases** were produced? **2**

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d) What **total volume** of gas was produced in this explosion? Assume this reaction occurred at 25°C and 100 kPa. **2**

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End of examination

Extra Writing Space