
Student Number

Barker College

2019 YEAR 11 PRELIMINARY EXAMINATION

Chemistry

AM TUESDAY 10TH SEPTEMBER

120 copies

Section I – Multiple Choice
Choose the best response and fill in the response oval completely

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Start Here →

1	A ○	B ○	C ○	D ○	11	A ○	B ○	C ○	D ○
2	A ○	B ○	C ○	D ○	12	A ○	B ○	C ○	D ○
3	A ○	B ○	C ○	D ○	13	A ○	B ○	C ○	D ○
4	A ○	B ○	C ○	D ○	14	A ○	B ○	C ○	D ○
5	A ○	B ○	C ○	D ○	15	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 ○					

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Student Number

Barker College

2019 YEAR 11 PRELIMINARY EXAMINATION

Chemistry

Staff Involved:

- AXC
- NJD
- DLM
- RJP
- KMT*

AM TUESDAY 10TH SEPTEMBER

TIME: 2 hours

120 copies

General Instructions:

- Reading time – 5 minutes
- Working time – 2 hours
- Write using black pen
- Draw diagrams using pencil
- NESA approved calculators may be used
- A separate Periodic Table and Data Sheet are provided with this paper
- For questions in Section II, show all relevant working in questions involving calculations

Total marks:
75

Section I – 15 marks (pages 3 - 10)

- Attempt Questions 1 – 15
- Allow about 25 minutes for this section

Section II – 60 marks (pages 11 - 25)

- Attempt Questions 16 - 26
- Allow about 1 hour and 35 minutes for this section

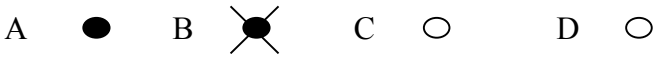
Section I: Multiple Choice

15 marks
Attempt Questions 1 – 15
Allow about 25 minutes for this part
Use the multiple-choice answer sheet

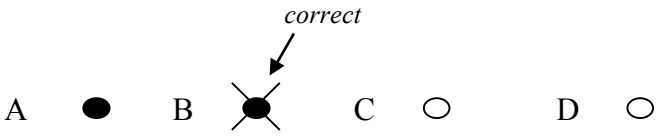
Sample 2 + 4 = A 2 B 6 C 8 D 9

A ⬭ B ⬭ C ⬭ D ⬭

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.



If you change your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word *correct* and drawing an arrow as follows.



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1. The chemical properties of an element are influenced mainly by the number of

   A. neutrons in the nucleus of its atoms.

   B. valence electrons of its atoms.

   C. occupied electron shells of its atoms.

   D. protons and neutrons in the nucleus of its atoms.

2. Which of the following methods could be used to separate and collect water from a mixture of salt and water?

   A. Distillation

   B. Centrifugation

   C. Filtration

   D. Separating funnel

3. The formula for strontium iodate is $Sr(IO_3)_2$. What would be the formula for sodium iodate?

   A. $NaIO_3$

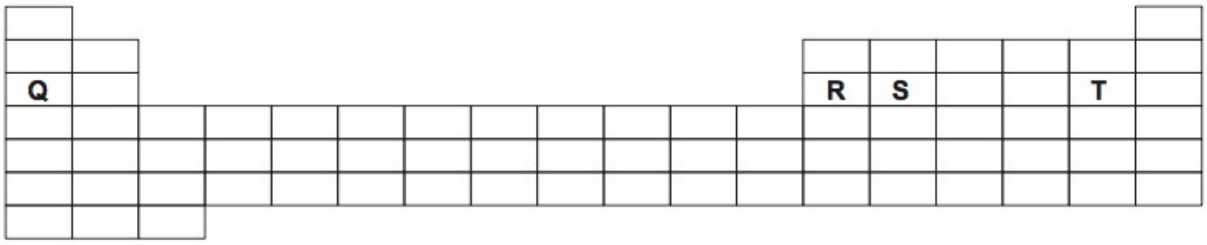
   B. $Na(IO_3)_2$

   C. Na_2IO_3

   D. $Na_2(IO_3)_2$

4. A section of the periodic table has had the chemical symbols replaced by letters.

   Which element is most likely to exist as molecules?



   A. Q

   B. R

   C. S

   D. T

5. Silicon dioxide does not conduct electricity. Which of the following **best** explains this observation?

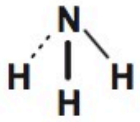
   A. It has delocalised valence electrons.

   B. It consists only of non-metal atoms.

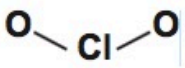
   C. All of the valence electrons are involved in covalent bonds.

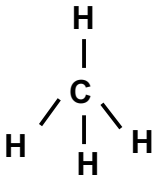
   D. It is a covalent network substance.

6. Which of the following substances would you expect to have the highest boiling point?

   A. ammonia 

   B. hydrogen chloride 

   C. chlorine dioxide 

   D. methane 

7. What mass of hydrochloric acid is required to react completely with 2.0 g of magnesium metal?

   A. 1.0 g

   B. 3.0 g

   C. 4.0 g

   D. 6.0 g

8. A student investigating displacement reactions combined the following metals and solutions.

Experiment No.	*Metal*	*Solution*
1	Zinc	Copper (II) sulfate
2	Copper	Magnesium nitrate
3	Iron	Silver nitrate
4	Magnesium	Lead nitrate

In which experiment would the student record that no reaction had occurred?

A. 1
B. 2
C. 3
D. 4

9. The ability of an atom in a chemical bond to draw electrons towards itself is the definition of:

A. electron density
B. electronegativity
C. ionisation energy
D. dipole moment

10. Which one of the following molecules is polar?

A. CH_3F
B. CF_4
C. CH_4
D. CO_2

11. Two chemical reactions and their corresponding ΔH values are given below:

$$2Cu(s) + O_2(g) \rightarrow 2CuO(s) \qquad \Delta H = -312\ kJ/mol$$

$$2Cu(s) + \tfrac{1}{2}O_2(g) \rightarrow Cu_2O(s) \qquad \Delta H = -170\ kJ/mol$$

What is the value of ΔH for the reaction below?

$$2CuO_{(s)} \rightarrow Cu_2O_{(s)} + \frac{1}{2}O_{2(g)}$$

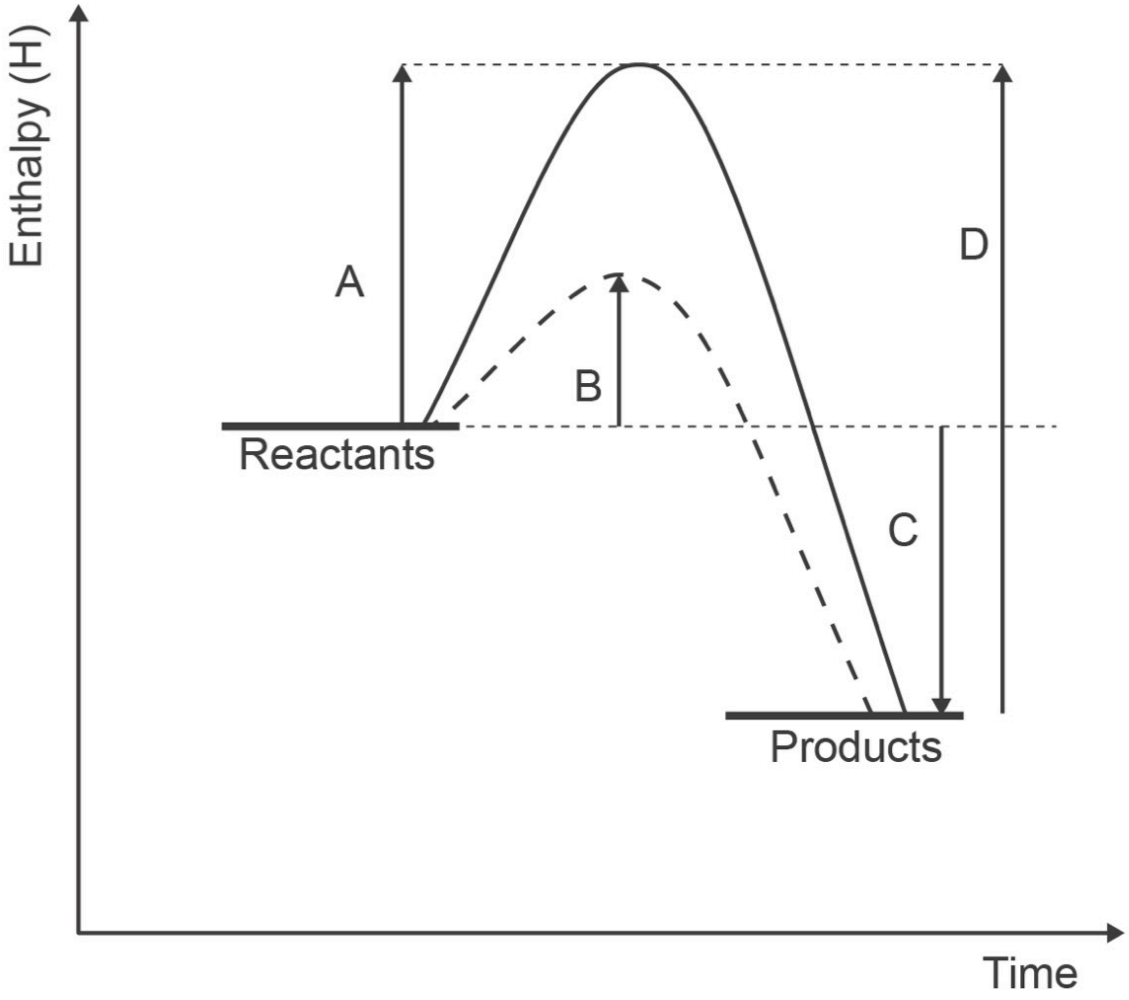
A. +284 kJ/mol

B. +142 kJ/mol

C. -142 kJ/mol

D. -284 kJ/mol

12. Look at the energy profile below for a chemical reaction.



Which arrow represents the change in enthalpy as reactants are converted to products?

A. A

B. B

C. C

D. D

13. The successive ionisation energies for an element, X, are shown below.

Equation for process	Ionisation energy ($kJ\ mol^{-1}$)
$X(g) \rightarrow X^{+}(g) + e^{-}$	1012
$X^{+}(g) \rightarrow X^{2+}(g) + e^{-}$	1903
$X^{2+}(g) \rightarrow X^{3+}(g) + e^{-}$	2914
$X^{3+}(g) \rightarrow X^{4+}(g) + e^{-}$	4958
$X^{4+}(g) \rightarrow X^{5+}(g) + e^{-}$	6276
$X^{5+}(g) \rightarrow X^{6+}(g) + e^{-}$	21270
$X^{6+}(g) \rightarrow X^{7+}(g) + e^{-}$	25400
$X^{7+}(g) \rightarrow X^{8+}(g) + e^{-}$	29860

The element **most** likely to be X is

A. aluminium

B. nitrogen

C. chlorine

D. lithium

14. The simplified solubility rules are:

Anion	*Cation*	
	Soluble	*Insoluble*
nitrates	all	
acetates	all	
chlorides	most	Ag^+, Pb^{2+}
sulfates	most	Ba^{2+}, Ca^{2+}, Pb^{2+}, Ag^+
sulfides	Group 1, NH_4^+, Group 2	most
hydroxides	Group 1, NH_4^+, Ba^{2+}	most
carbonates	Group 1, NH_4^+	most

Samples of four solutions *W*, *X*, *Y* and *Z* were added to solutions of sodium chloride, sodium sulfate and sodium hydroxide. The results are shown in the table below.

	NaCl	*Na_2SO_4*	*NaOH*
W	precipitate	precipitate	no precipitate
X	precipitate	no precipitate	precipitate
Y	no precipitate	no precipitate	no precipitate
Z	precipitate	precipitate	precipitate

Which solutions could have been, in order, lead nitrate and potassium nitrate?

A. *W* and *X*

B. *Z* and *Y*

C. *X* and *Y*

D. *Y* and *W*

15. When hydrochloric acid is added to aluminium sulfide, the highly toxic gas hydrogen sulfide is produced. The equation for this reaction is

$$Al_2S_{3(s)} + 6HCl_{(aq)} \rightarrow 2AlCl_{3(aq)} + 3H_2S_{(g)}$$

If excess hydrochloric acid is added to 0.200 mol of aluminium sulfide, then the volume of hydrogen sulfide produced at standard room temperature and pressure (25°C and 100 kPa) will be:

A. 4.5 L

B. 4.9 L

C. 13.6 L

D. 14.9 L

End of Section I

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Student Number

2019 YEAR 11
PRELIMINARY EXAMINATION

Chemistry

Section II
Answer Booklet

60 marks
Attempt Questions 16 – 26
Allow about 1 hour and 35 minutes for this section.

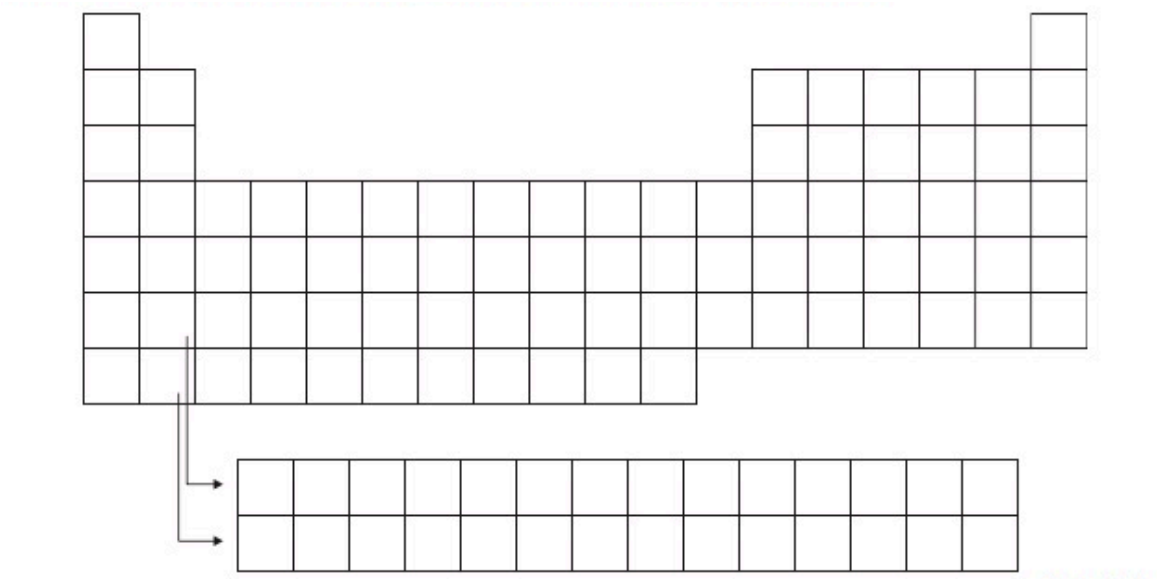
Instructions

- 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 back of this booklet. If you use this space, clearly indicate which question you are answering.

Student Number

Question 16 (7 marks)

(a) On the diagram below, indicate the s, p, d and f block groups of elements. **2**



(b) Use spdf notation to write the electron configuration for the following:

(i) Sodium ion …… **1**

(ii) Chlorine atom…… **1**

(c) Using your knowledge of periodic trends, list the FOUR elements calcium, lithium, iodine and fluorine in order of increasing atomic radius. **1**

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(d) Naturally occurring chlorine atoms exist as one of two isotopes.

Isotope	*Abundance (%)*
^{35}Cl	77.5%
^{37}Cl	22.5%

The atomic weight given for chlorine on the periodic table is 35.45 g/mol.

Using chlorine as an example, define the term 'isotope' and explain how this atomic weight is calculated. **2**

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Student Number

Question 17 (4 marks)

Consider the data in the table below:

Compound	*Melting Point (°C)*
Sodium chloride	801
Water	0
Methane	-182

Explain the difference in the melting points of these THREE compounds. **4**

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Student Number

Question 18 (2 marks)

A student is given a 1.0 L bottle which contains a 6.0 M solution of hydrochloric acid. What volume of this solution will she require to prepare 250 mL of a hydrochloric acid solution with a concentration of 0.80 M ? **2**

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Student Number

Question 19 (7 marks)

A galvanic cell is constructed using two half cells. One half cell consists of an aluminium electrode in an appropriate electrolyte solution. The other half cell consists of a nickel electrode in an appropriate electrolyte solution.

Current will flow from one electrode to the other electrode when the cell is completed using a voltmeter and a salt bridge (KNO_3).

(a) Write relevant half equations and a balanced net ionic equation for the overall cell reaction. **2**

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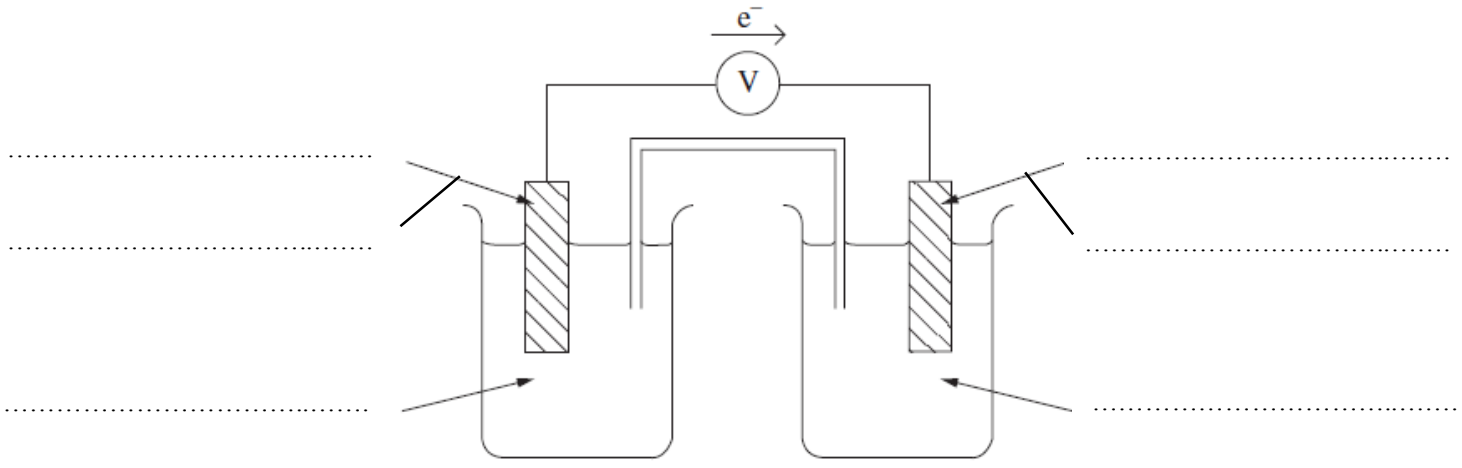
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(b) Calculate the standard cell potential (EMF). **1**

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(c) Identify the anode, cathode, metals and appropriate half-cell electrolytes by labelling the following diagram. **3**



(d) On the diagram, indicate the direction of ion flow through the salt bridge. **1**

Student Number

Question 20 (5 marks)

A scuba diver at a depth where the pressure was 253 kPa and the temperature was 11.0 °C exhaled an air bubble of volume 20.5 mL.

The air bubble rose to a level where the pressure was 105 kPa and the temperature was 15.0 °C.

(a) Calculate the volume of the air bubble at this new depth. **2**

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(b) If the air bubble contained 79.0 % nitrogen gas by volume, determine the number of **nitrogen molecules** in the bubble. **3**

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Student Number

Question 21 (7 marks)

Zinc reacts with dilute nitric acid to form zinc nitrate and a gas. A chemist weighed out 5.856 g of zinc metal and added it to 200.0 mL of a 1.00 M solution of nitric acid.

(a) Write a balanced equation for this reaction, including states. **2**

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(b) Showing all calculations, determine the limiting reagent. **2**

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(c) Calculate the theoretical mass of zinc nitrate which could be formed in this reaction. Ensure that your answer is expressed to the appropriate number of significant figures. **2**

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(d) The chemist isolated 14.34 g of zinc nitrate from this reaction. Calculate the percentage yield. **1**

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Student Number

Question 22 (4 marks)

When heated, calcium carbonate decomposes to form calcium oxide and carbon dioxide gas.

$$CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2(g)}$$

(a) Using the standard enthalpies of formation in the table, calculate the enthalpy change associated with the decomposition of calcium carbonate. **2**

Substance	$\Delta H°_f$ (kJ mol^{-1})
$CaCO_3(s)$	–1207
$CaO(s)$	–636
$CO_2(g)$	–393

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(b) The standard change in entropy for this reaction is ΔS^o = 161 J/K/mol. Calculate the temperature (in Kelvin) above which this reaction becomes spontaneous. **2**

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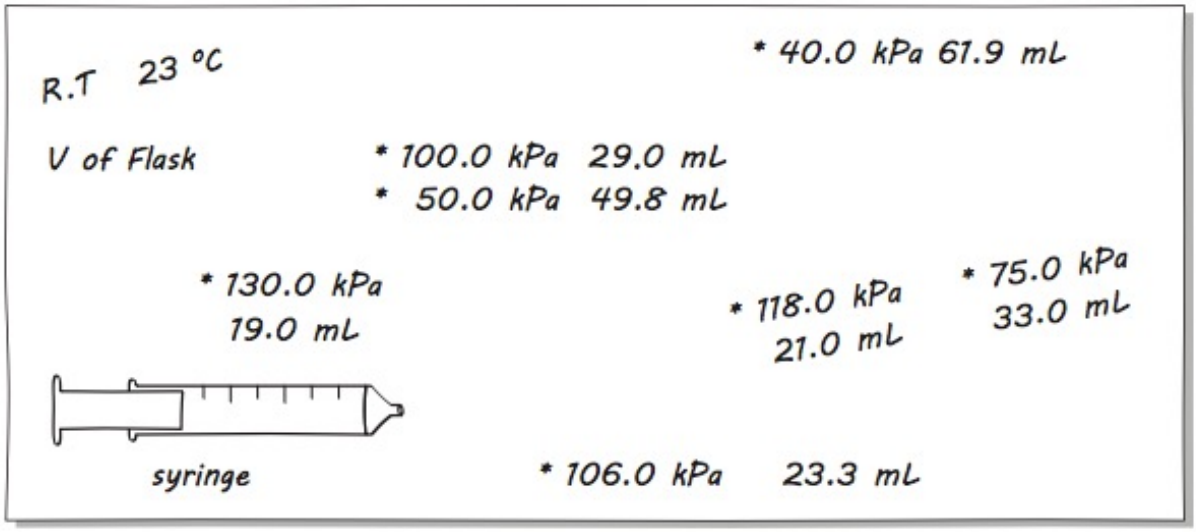
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Student Number

Question 23 (8 marks)

Below are the rough laboratory notes of a Chemistry student investigating the relationship between volume and pressure of a gas.



(a) Organise the data into a table. **2**

(b) On the graph paper provided on the next page, plot a graph of pressure versus volume. **3**

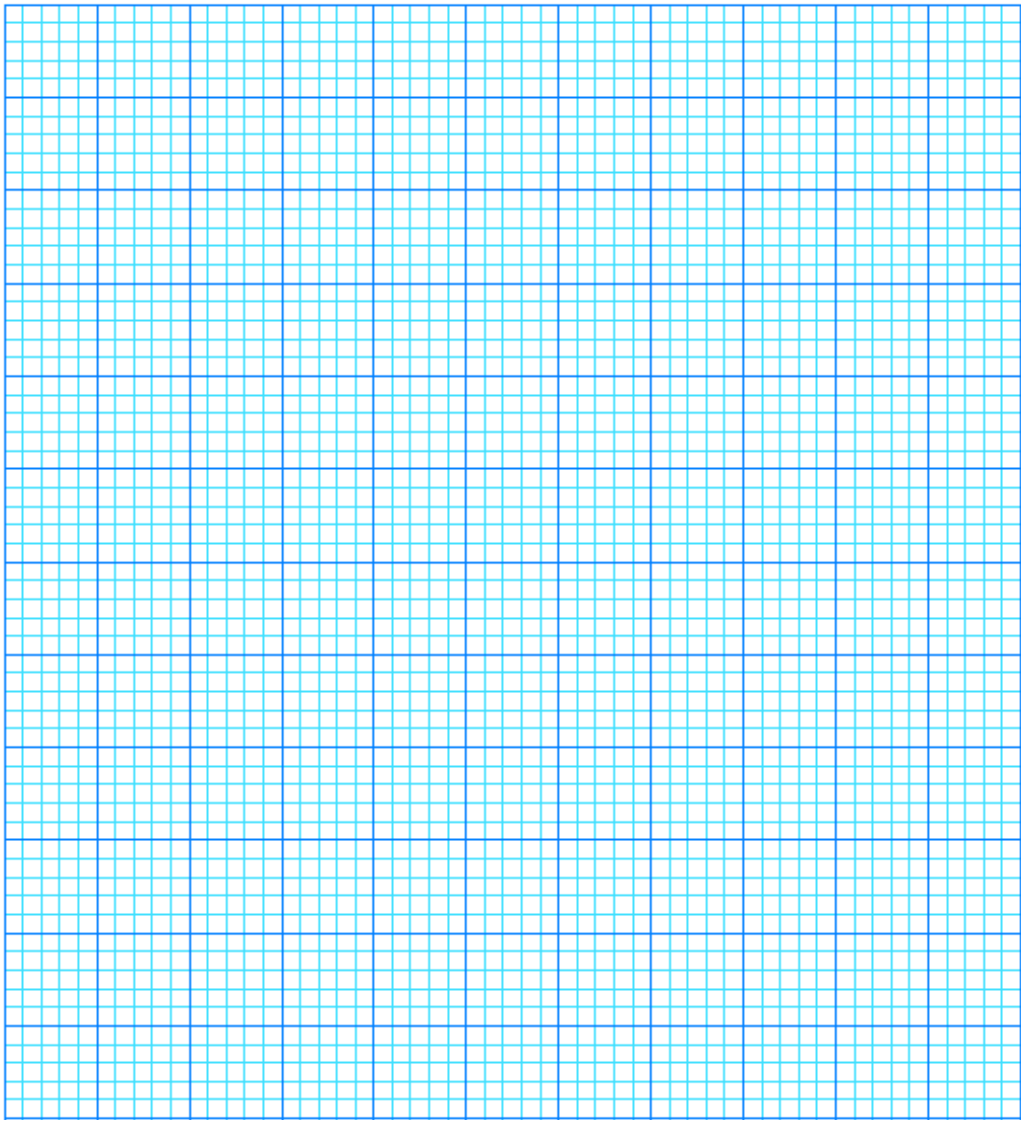
(c) Use the graph to determine the volume of gas when the pressure was 120.0 kPa. **1**

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Question 23 continues on page 20

Student Number

Question 23 (continued)



(d) Name and explain the relationship indicated by the gas law which relates to this experiment. **2**

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End of Question 23

Student Number

Question 24 (5 marks)

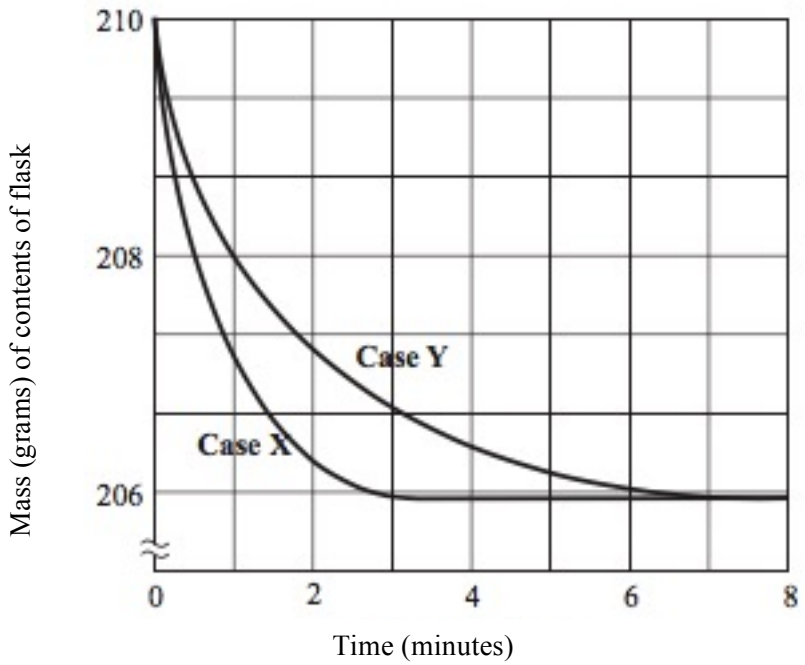
The reaction of solid calcium carbonate with hydrochloric acid can be described by the equation:

$$CaCO_{3(s)} + 2HCl_{(aq)} \rightarrow CaCl_{2(aq)} + CO_{2(g)} + H_2O_{(l)}$$

The rate of this reaction can be studied by continuously measuring the mass of the reaction mixture in an open vessel.

Case X deals with 10.0 g of **small** calcium carbonate crystals with a 200.0 g solution containing 0.25 mol of hydrochloric acid.
Case Y deals with 10.0 g of **large** calcium carbonate crystals with a 200.0 g solution containing 0.25 mol of hydrochloric acid.

The results of the experiments are displayed in the following graph:



(a) Explain why this method can be used to compare the rate of the reaction between Case X and Case Y. **2**

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Question 24 continues on page 22

Student Number

Question 24 (continued)

(b) With reference to the experimental data and collision theory, explain what effect crystal size has on the rate of a reaction? **3**

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End of Question 24

Student Number

Question 25 (7 marks)

Butane is an important fuel, particularly for portable camping stoves. To minimise the load carried, a camper decided to carry only the mass of butane needed to generate 600 kJ of energy for heating water.

Butane (C_4H_{10}) undergoes combustion with oxygen gas to produce carbon dioxide and water.

(a) Calculate the mass of butane required to generate 600 kJ of energy, given that the enthalpy of combustion for butane is -2874 kJ/mol. **3**

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(b) Calculate the mass of water that can be heated from 27 °C to boiling (100 °C) using 600 kJ of energy. **2**

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Question 25 continues on page 24

Student Number

Question 25 (continued)

(c) The camper found that although all of the butane had been used, the water had not reached boiling point. Give TWO reasons why the mass of butane was not enough to heat the water to boiling point. **2**

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End of Question 25

Student Number

Question 26 (4 marks)

Caffeine, a stimulant found in coffee, contains the following elements by percentage mass.

49.5% C, 5.15% H, 28.9% N and 16.5% O.

(a) Determine the empirical formula of caffeine. **3**

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(b) Caffeine has a molecular weight of 194 g/mol. Determine the molecular formula of caffeine. **1**

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End of Paper

Student Number

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Student Number

Section II Extra writing space
If you use this space, clearly indicate which question you are answering.