

DAPTO HIGH SCHOOL



2009 Preliminary Course Examination

Chemistry

General Instructions

- Reading time – 5 minutes
- Working time – 2 hours
- Write using black or blue pen
- Draw diagrams using pencil
- Approved calculators may be used
- Write your student number and/or name at the top of every page

Total marks – 75

Section I – Pages 2–8

Total marks (15)

- Attempt Questions 1 – 15
- Allow about 30 minutes for this section

Section II – Pages 9–19

Total marks (60)

- Attempt Questions 16 – 29
- Allow about 1 hour and 30 minutes for this section

This paper MUST NOT be removed from the examination room

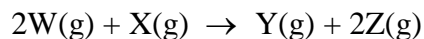
STUDENT NUMBER/NAME:

Section I**Total marks (15)****Attempt Questions 1 – 15****Allow about 30 minutes for this section**

Select the alternative A, B, C or D that best answers the question and indicate your choice with a cross (X) in the appropriate space on the grid below.

	A	B	C	D
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1. In the reaction



1.2 L of W reacted with excess X. What volume of Y was produced? (All gas volumes measured at the same temperature and pressure.)

- (A) 3.6 L
(B) 2.4 L
(C) 1.2 L
(D) 0.6 L
2. The table below shows the mass and volume of a sample of 4 solids, W-Z.

Substance	Mass of sample (g)	Volume of sample (cm ³)
W	1.00	1.00
X	2.50	2.72
Y	6.90	5.45
Z	10.45	7.80

Which letter correctly identifies the sample which could be ice?

- (A) W
(B) X
(C) Y
(D) Z
3. To obtain the salt from a sample of seawater in a school laboratory, the most basic equipment a student would need to use is:
- (A) a Bunsen burner and an evaporating basin.
(B) a Bunsen burner and a distillation flask.
(C) a filter funnel and filter paper.
(D) a centrifuge.
4. Aluminium ore is called bauxite and the aluminium mineral is alumina or aluminium oxide. The correct formula for aluminium oxide is:
- (A) Al_2O_3
(B) Al_3O_2
(C) AlO
(D) AlO_2

5. Consider three metals: J, L and M

- J reacts with dilute nitric acid, but not with water
- L does not react with dilute nitric acid or water
- M reacts with cold water.

The order of *increasing* reactivity of these metals is:

- (A) J, M, L
- (B) M, J, L
- (C) L, J, M
- (D) L, M, J

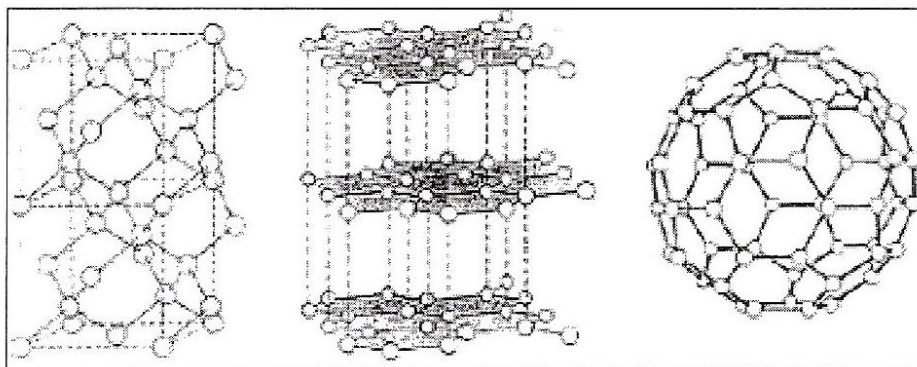
6. Which is the correctly balanced equation?

- (A) $\text{FeS} + \text{HCl} \rightarrow \text{FeCl}_2 + \text{H}_2\text{S}$
- (B) $\text{Cu} + 4\text{HNO}_3 \rightarrow \text{Cu}(\text{NO}_3)_2 + 2\text{NO}_2 + 2\text{H}_2\text{O}$
- (C) $\text{Al}_2(\text{SO}_4)_3 + 4\text{NaOH} \rightarrow 2\text{Al}(\text{OH})_3 + 2\text{Na}_2\text{SO}_4$
- (D) $\text{Cu}(\text{OH})_2 \rightarrow \text{CuO} + 2\text{H}_2\text{O}$

7. W, X, Y and Z are elements, each of which has only one possible valency. They are able to form a total of 4 ionic compounds upon combination. The formulae of three of them are: XZ, WZ₃ and X₂Y. What is the formula of the other compound?

- (A) WY
- (B) WY₂
- (C) WY₃
- (D) W₂Y₃

8. The models below show the same type of atom in three different structural arrangements.



These different structures are examples of:

- (A) Isotopes
- (B) Isomers
- (C) Allotropes
- (D) Fullerenes

9. Which of the following correctly associates an alloy with one of its uses and properties?

	Alloy	Property	Associated use
(A)	Solder	Low melting point	Joining metals
(B)	Stainless steel	Electrical conductivity	Electrical wiring
(C)	Steel	High melting point	Construction material
(D)	Brass	Ductility	Musical instruments

10. Which of the following would you expect to be least soluble in water?

- (A) ammonia
- (B) potassium nitrate
- (C) silicon dioxide
- (D) oxygen

11. Rebecca was carrying out an experiment to separate out components of a mixture which consisted of sugar, water, iron filings and wood shavings. She used filtration, evaporation and a magnet to separate the four components of the mixture. Her results are summarised in the table below:

Mass of sample	10.5 g
Mass of iron filings	3.2 g
Mass of filter paper	0.9 g
Mass of filter paper plus residue	2.9 g
Mass of evaporating basin	28.3 g
Mass of evaporating basin plus solution before heating	33.6 g
Mass of evaporating basin plus crystals after heating	30.6 g

The percentage of sugar in the mixture is closest to:

- (A) 19%
- (B) 22%
- (C) 31%
- (D) 50%

12. A small sample of an unknown ionic solution, X, was added to three test tubes. Different test reagents were present in each test tube:

Reagent 1: sodium sulfate

Reagent 2: silver nitrate

Reagent 3: lead (II) nitrate

General rule	Exceptions
All nitrates are soluble	None
All acetates are soluble	None
All ammonium compounds are soluble	None
All group I compounds are soluble	None
Most chlorides are soluble	Silver and lead (insoluble)
Most sulphates are soluble	Barium and lead (insoluble) Calcium and silver (sparingly soluble)
Most hydroxides are insoluble	Group I compounds (soluble) Calcium (slightly soluble)
Most carbonates are insoluble	Group I and ammonium compounds (soluble)
Most phosphates are insoluble	Group I and ammonium compounds (soluble)

A precipitate formed in each test tube. Using the solubility rules above, determine which one of the following could be X?

- (A) sodium carbonate
- (B) copper sulfate
- (C) magnesium nitrate
- (D) barium chloride

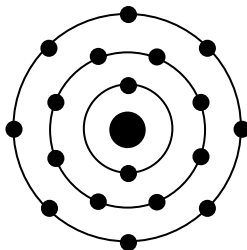
13. A chemistry student set out to determine the heat of solution of sodium hydroxide.

She added 5.00g of the solid to 100mL of water and recorded the maximum temperature change. She repeated the experiment three times. Her textbook told her that the accepted value is -45 kJ/mol, and she obtained 50% of this value using her own data.

What average temperature change did the student measure in her experiment?

- (A) 6.8°C
- (B) 13.5°C
- (C) 0.25°C
- (D) 135°C

14. The diagram below shows an electron dot structure of an ion of charge -3 .



The number of protons in the nucleus of this ion is:

- (A) 15
 - (B) 16
 - (C) 17
 - (D) 18
15. Which of the following substances are members of a homologous series?
- (A) C_3H_8 , C_5H_{12} , C_7H_{16}
 - (B) C_3H_8 , C_3H_6 , C_3H_4
 - (C) C_3H_6 , C_4H_{10} , C_5H_8
 - (D) C_3H_4 , C_4H_8 , C_5H_{12}

End of Section I

Section II

Total marks (60)

Attempt Questions 16 – 29

Allow about 1 hour and 30 minutes for this section

Answer the questions in the spaces provided.

Show all relevant working in questions involving calculations.

Question 16 (4 marks)

Marks

Explain the differences between a physical and a chemical change, using your investigation of water as an example.

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Include particle diagrams to illustrate your answer

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Question 17 (2 marks)**Marks**

Many metal hydroxides undergo thermal decomposition to produce the metal oxide and water. For example:



Calculate the mass of aluminium oxide that would be produced if 3.21 g of aluminium hydroxide is decomposed.

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Question 18 (4 marks)

Water has a number of unique physical properties.

Explain how the structure and bonding in water is able to account for TWO identified properties of water. Include an appropriate diagram/s with your answer.

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Question 19 (5 marks)**Marks**

The density of a number of liquid alkanes is show below, but the data for undecane is missing.

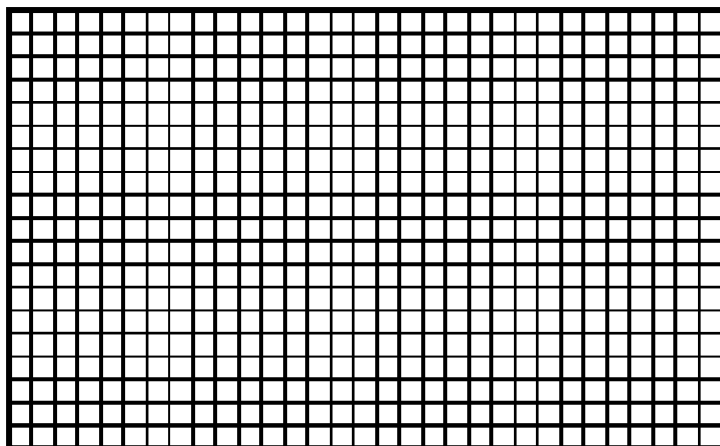
Alkane	Formula	Density (gmL ⁻¹)
Pentane	C ₅ H ₁₂	0.63
Hexane	C ₆ H ₁₄	0.66
Heptane	C ₇ H ₁₆	0.69
Octane	C ₈ H ₁₈	0.70
Nonane	C ₉ H ₂₀	0.72
Decane	C ₁₀ H ₂₂	0.73
Undecane		0.74

- (a) Use the table to predict the molecular formula of undecane.

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- (b) Draw a graph to allow you to estimate the density of C₁₂H₂₆.

4

The density of C₁₂H₂₆ =

Question 20 (5 marks)**Marks**

- (a) Use a Lewis electron dot diagram to represent the compound formed between aluminium and chlorine.

2

- (b) Boron trichloride (BCl_3) and ammonia (NH_3) both consist of molecules with one central atom surrounded by 3 other atoms. However, their molecular shapes are different.

Use appropriate diagrams and text to account for this difference.

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Question 21 (4 marks)

Marks

Organising the elements has been a goal of chemists over the last two hundred years.

Outline the contributions of Dobereiner, Newlands and Mendeleev to this work.

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Question 22 (4 marks)

Marks

- (a) Name the piece of glassware below.

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- (b) Outline how a student could use the above glassware to produce 250.0 mL of a 0.015 mol L⁻¹ copper (II) nitrate solution.

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Include the appropriate calculation and working with your answer.

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Question 23 (3 marks)

Marks

- (a) Determine the mass of sodium chloride that a student would need to add to 250mL of water to make a 2 mol L^{-1} solution.

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- (b) Calculate the number of Na^+ ions that would be present in 100 mL of that solution.

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Question 24 (4 marks)**Marks**

The following table shows the boiling point of some alkanes in common, everyday usage.

Alkane	Boiling Point (°C)
Methane	-161.5
Propane	-42.1
Butane	-0.5
Octane	125.7

(a) Draw the structure of butane. 1

(b) Explain the trend shown by the data in the table. 3

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Question 25 (6 marks)**Marks**

Copper II Carbonate is a green powder which decomposes on heating.

- (a) Describe how you would carry out the thermal decomposition of Copper II Carbonate.

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In your description, include:

- the apparatus you would use
- one safety procedure
- a balanced symbolic equation
- a test you could apply to identify the gas produced

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- (b) Explain why repeating the test for the gas would make the results more reliable.

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Question 26 (5 marks)**Marks**

A student was provided with the following information to help them distinguish between three oxides, “XO”, “YO” and “ZO”.

	Electrical conductivity in the solid state	Electrical conductivity in the liquid (molten) state
“XO”	No	Yes
“YO”	No	No
“ZO”	No	No

On the basis of this, the student concluded that XO was a metallic oxide and hence ionic, and that YO and ZO were non-metal oxides and hence molecular.

Assess the accuracy of the student’s conclusion.

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Question 27 (4 marks)**Marks**

Explain why first ionisation energy and atomic radius show opposite trends for the first 20 elements.

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Question 28 (3 marks)

A student is asked to determine whether lead (II) chloride is soluble in water. They collect a small amount of solid lead (II) chloride and add it to 2 mL of water in a test tube.

After mixing, the student observes that the white powder remains at the bottom of the test tube.

- (a) Outline a *different* procedure that the student could follow to determine the relative solubility of lead (II) chloride.

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- (b) Identify one aspect of the above procedure which would reduce the impact of the investigation on the environment.

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Question 29 (7 marks)**Marks**

Acids are important in many industrial processes, because of their reactions with metals and bases, and their role as catalysts in some reactions.

- (a) Identify a metal which would be suitable for making pipes for transferring dilute sulfuric acid from place to place in a chemical plant. **1**

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- (b) Write a chemical equation to show the reaction between dilute sulfuric acid and aluminium metal. **1**

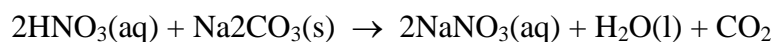
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- (c) The reaction in (b) involves the transfer of electrons. Write two half equations to show this. **2**

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- (d) Nitric acid reacts with sodium carbonate in the following way:



A student adds 0.88 g of sodium carbonate to 125 mL of 0.12 M nitric acid in a measuring cylinder.

She notices that the volume of the mixture does not change.

Calculate the concentration of sodium nitrate in the mixture. **3**

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End of Section II

End of Paper