YEAR 13 CHEMISTRY

GENERAL CHEMISTRY

1. **Green chemistry aims to**

   A. Design chemical products and process that maximize profits.

   B. Design safer chemical products and processes that reduce or eliminate the use and generation of hazardous substances.

   C. Design chemical products and processes that work most efficiently.

   D. Utilize non-renewable energy.

2. **Environmental benefits of green chemistry include**

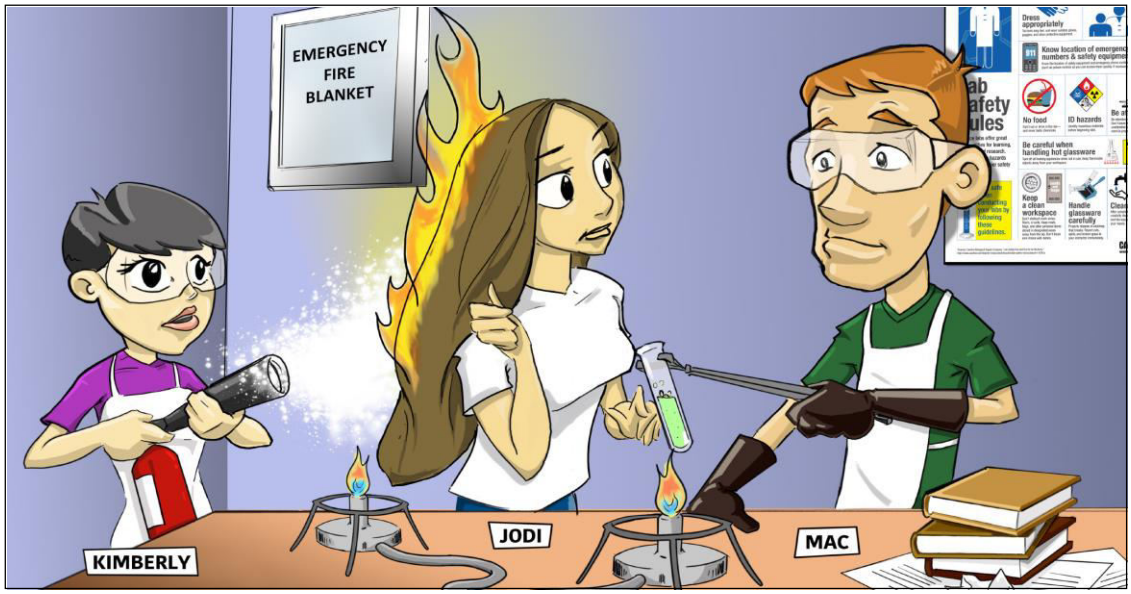
   A. Fewer raw materials and natural resources used.

   B. Cleaner production technologies & reduced emissions.

   C. Smaller quantities of hazardous waste to be treated and disposed of.

   D. All of the above.

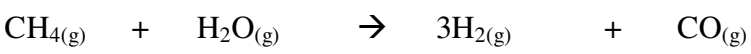
3. Consider the diagram given below.



   i. **Identify** two unsafe practices shown in the diagram above.

ii. State how you can **overcome** the two unsafe practice mentioned in (i) above.

4. What is the purpose of **eye wash fountain**?
5. Describe what is an **independent variable**?
6. **Hydrogen** can be manufactured by reacting methane with steam.



$$CH_{4(g)} + H_2O_{(g)} \rightarrow 3H_{2(g)} + CO_{(g)}$$

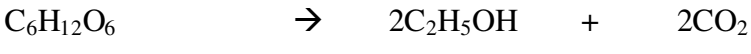
Calculate the **atom economy for the reaction.**

7. Consider the diagram given below.

iii. **Identify** two unsafe practices shown in the diagram above.

iv. State how you can **overcome** the two unsafe practice mentioned in (i) above.

8. What is the purpose of **refluxing**?
9. Give an **importance** of determining the melting point of a substance.
10. Calculate the **atom economy for producing ethanol from glucose** using the equation below.



$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$$

11. Identify the **difference in procedure** for carrying out distillation and reflux.
12. A Year 13 student prepared some Salicylic acid in the laboratory. As part of his experiment, he needed to determine the melting point of the acid sample that he prepared.

a. How is the determination of **melting point** useful in the experiment?

b. Explain the **effect of mixing** a small amount of **sand** on the melting point of the salicylic acid prepared.

ATOMIC STRUCTURE AND BONDING

1. Antimony (Sb) contains $^{121}_{51}Sb$ and $^{123}_{51}Sb$. If its relative atomic mass is 121.8, determine the percentage abundance of each isotope.

2. A sample of iron was found to contain the isotopes ^{54}Fe, ^{56}Fe and ^{57}Fe. The relative abundance of these isotopes is given in the table below.

ISOTOPE	RELATIVE ABUNDANCE (%)
^{54}Fe	5.8
^{56}Fe	91.6
^{57}Fe	2.6

Calculate the relative atomic mass of iron in this sample.

3. An **unknown element X** has two isotopes, ^{69}X and ^{71}X. The percentage abundance of ^{69}X and ^{71}X are 60 % and 40 % respectively.

Calculative its **relative atomic mass** and identify the **symbol** of the **unknown element X**.

4. Naturally occurring copper is composed of 72.5% ^{63} Cu and 27.5% ^{X} Cu. Calculate the atomic mass of ^{X} Cu if the relative atomic mass of copper is 63.5.

5. Copper occurs naturally in two isotopes, ^{63}Cu and ^{65}Cu.

   (i) Account for the difference in the relative atomic masses of the two isotopes of copper in terms of their atomic composition.

   (ii) If the relative abundance of ^{63}Cu and ^{65}Cu is 27.5% and 72.5%, respectively, calculate copper's relative atomic mass (A_r).

6. A meteorite was found to contain three isotopes of element **X**. A mass spectrometer gave the following information about these isotopes.

Molecular mass	24.0	25.0	26.0
Relative Abundance (%)	64.2	20.3	15.5

Calculate the relative atomic mass of **X**.

7. How does a hydrogen bond form?
8. Write the equation that represents the standard heat of ionisation of a nitrogen atom.
9. Explain why the first ionisation energy of aluminium is less than that of magnesium.
10. The electron configuration of a neutral atom Z, is $1s^2\ 2s^2\ 2p^4$. Write the set of four quantum numbers for the outermost electrons of Z.
11. Draw the Lewis structure for carbonate ion, PO_4^{3-} and predict its shape.
12. Arrange the atoms of elements Mg, N, Cs and F in order of increasing electronegativity.
13. Naturally-occurring boron is composed of 19.8% of ^{10}B and 80.2% of ^{11}B. The relative atomic mass of ^{10}B is 10.0129 and that of ^{11}B is 11.0093. Calculate the **average atomic mass** of boron.
14. Quantum numbers are used to describe the orbitals in which the electrons can be found.

    i. **Name** the quantum number that describes the main energy levels.

    ii. **Draw** and **describe** the shape (electron cloud) of a 'p' orbital.

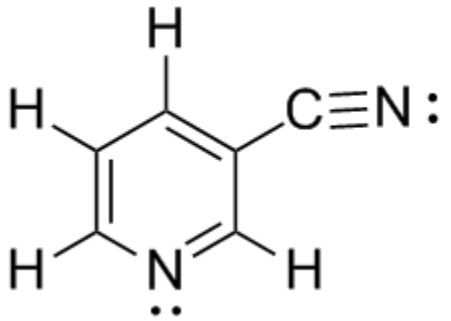
15. Consider the successive ionisation energies of element **Z**.

Element	Ionisation Energies ($kJ\ mol^{-1}$)			
	1st	2nd	3rd	4th
Z	738	1 450	7 732	10 550

    i. Which **group** of the Periodic Table does element Z belong to?

    ii. Give an **explanation** to your answer in (i) above.

16. Draw the Lewis structure of **sulphate ion (SO_4^{2-}).**
17. Identify **one property** typical of all ionic solids.
18. State the number of **sigma** and **pi** bonds in the following:



STATES OF MATTER

1. The combustion of carbon monoxide is given by the equation

$$2CO_{(g)} + O_{2(g)} \longrightarrow 2CO_{2(g)}$$

A mixture of 100 mL of carbon monoxide and 40 mL oxygen is ignited. Calculate the volume of the three gases remaining after the reaction, measured at the same temperature and pressure.

2. Zinc reacts with sulphur according to the equation:

$$Zn_{(s)} + S_{(s)} \xrightarrow{\text{heat}} ZnS_{(s)}$$

35.0 g of zinc was mixed and heated with 40.0 g of sulphur until the reaction was complete.

Which reactant is the limiting reagent?

3. A mixture of gases contains 0.24 moles of methane (CH_4), 0.57 moles of ethane (C_2H_6) and 0.33 moles of propane (C_3H_8).

If the total pressure exerted by the three gases is 4.80 atmospheres, calculate the partial pressure of ethane, C_2H_6.

4. An athelete prepared a glucose drink before training by dissolving 30 g of glucose in 154 g of water.
   i. Determine the mole fraction of glucose ($C_6H_{12}O_6$) in the drink.
   ii. Calculate the molality of the glucose drink.

5. Some oxygen gas was collected over water at 20°C and 101.3 kPa and was found to occupy 30 mL.
   Calculate:

   i. the **partial pressure** of the oxygen gas. [SVP of water at 20°C = 2 kPa]

ii. the **volume** that the gas would occupy at STP.

iii. the **mass** of oxygen gas collected. [R = 8.314 $JK^{-1}mol^{-1}$]

6. 11.11 g of urea (NH_2CONH_2) was dissolved in 100 g of water. Calculate the **molarity** and **molality** of the solution.

7. Hydrogen peroxide decomposes according to the following equation.

$$2H_2O_{2(aq)} \longrightarrow 2H_2O_{(\ell)} + O_{2(g)}$$

Calculate the volume of oxygen produced at 30ºC and 91 kPa when 10 g of hydrogen peroxide decomposes. [R = 8.314 $Jmol^{-1}K^{-1}$]