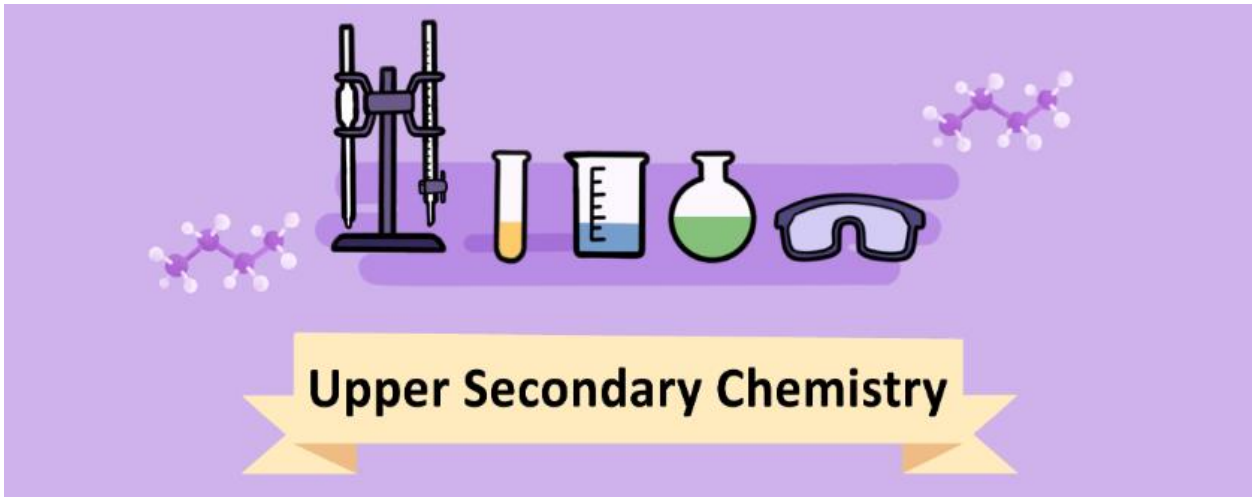


END-OF-YEAR HOLIDAY ASSIGNMENT

Pure Chemistry
SEC 3E

NAME: _____ ( ) CLASS: _____

This is a revision of lower secondary science and preparation for Sec 3 Chemistry.
Place a tick in the table when you complete the sections.

- Read chapters 1, 2 and 5 of the Chemistry textbook
- Complete SLS lessons (by 15 Dec)
- Complete worksheets

	Chapter	Textbook chapter	SLS lessons	Worksheets	Mark
1	Experimental Chemistry • apparatus and gas collection				/15
	• separation and purification techniques				/20
2	The Particulate Nature of Matter • Kinetic Particle Theory				/25
5	Elements, Compounds and Mixtures				/20

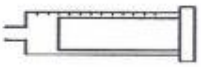
CHAPTER 1: EXPERIMENTAL TECHNIQUES

APPARATUS & GAS COLLECTION

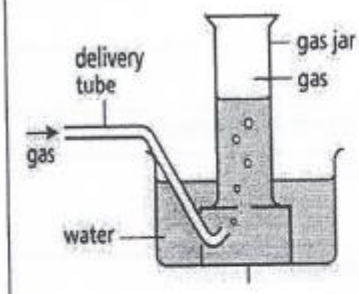
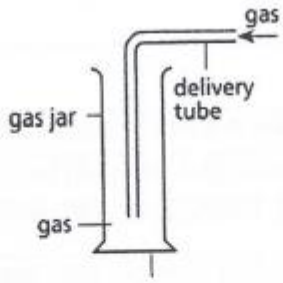
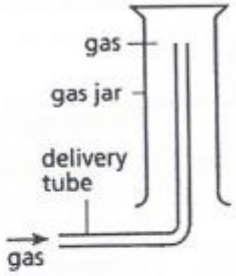
(a) name appropriate apparatus for the measurement of time, temperature, mass and volume; including burettes, pipettes, measuring cylinders and gas syringes

(b) suggest suitable apparatus, given relevant information, for a variety of simple experiments, including drying and collection of gases and measurement of rates of reaction (drying agents will be limited to calcium oxide, concentrated sulfuric acid and fused calcium chloride)

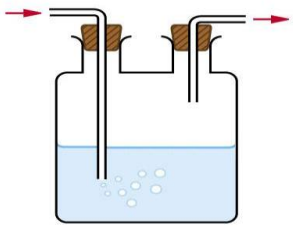
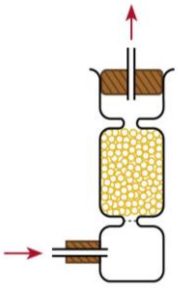
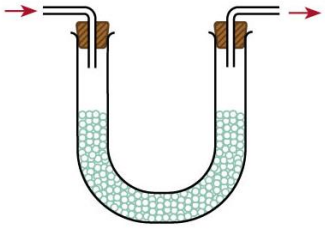
Apparatus for measurement

physical quantities	name and symbol of SI unit	other units	apparatus used
mass	kilogram(kg)	gram(g)	electronic balance
time	second(s)	minute(min)	stopwatch
temperature	Kelvin(K)	degree Celsius(°C)	thermometer
volume	cubic metre (m^3)	cubic centimetre (cm^3) milli-litre (ml) litre (l)	<u>volume of liquids</u> 1. measuring cylinder measures to the nearest 0.5 cm^3 e.g. 12.0 cm^3, 50.5 cm^3  2. pipette *accurately* measures out **<u>fixed</u>** volumes of liquids e.g. 20.0 cm^3 or 25.0 cm^3  3. burette *accurately* measures out volume of liquid to nearest 0.05 cm^3 e.g. 24.00 cm^3, 12.45 cm^3, 34.10 cm^3  ** Beaker is only used to measure *approximate* volumes of liquids or for boiling of liquids.** e.g. approximately 100 cm^3, 200 cm^3, 250 cm^3
			<u>volume of gases</u> gas syringe 

Gas collection methods

		
Displacement of water	**Downward delivery**	**Upward delivery**
Property of gases: **Insoluble in water** or slightly soluble in water	Property of gases: (a) Denser than air	Property of gases: (a) Less dense than air
gases: carbon dioxide (CO_2), oxygen (O_2), hydrogen (H_2)	gases chlorine gas (Cl_2), hydrogen chloride gas (HCl)	gases: ammonia gas (NH_3)

Drying agents to dry gas

Concentrated sulfuric acid to dry acidic gas e.g. chlorine, hydrogen chloride 	Quicklime (calcium oxide) to dry alkaline gas e.g. ammonia 	Fused calcium chloride which is suitable for most gases 

Complete the questions below.

1 Name the apparatus that is suitable for:

(a) collecting 50.0 cm^3 of oxygen gas

[1]

(b) measuring out 25.0 cm^3 of sulfuric acid

[1]

(c) measuring accurately 32.50 cm^3 of sodium hydroxide

[1]

(d) clamping a burette

[1]

(e) measuring 3.50 g of copper(II) sulfate crystals

[1]

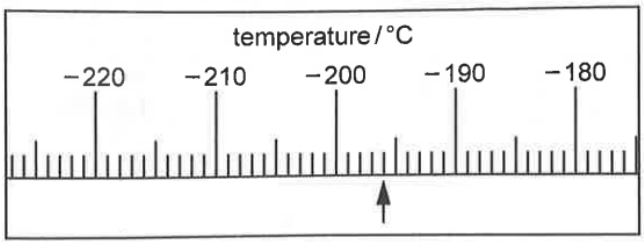
(f) measuring the time it takes for a reaction to complete

[1]

2 Name three key apparatus required for dissolving 5 g of sodium chloride in 100 cm^3 of water

[3]

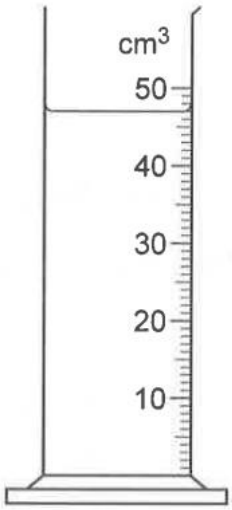
3 Temperatures below zero can be measured using a thermometer.
Part of the thermometer scale is shown below.



Record the reading shown by the arrow. _____ °C

[1]

4 What is the volume of liquid shown in the measuring cylinder?



Volume = _____ cm^3

[1]

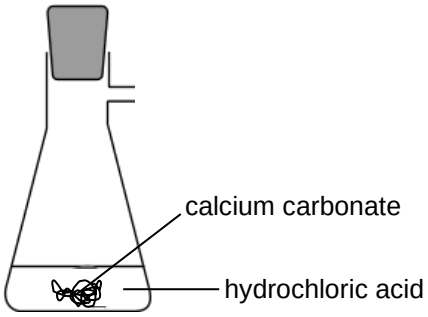
5 The method of collecting a gas depends on the physical properties of the gas.
State these two properties.

1.

2.

[2]

6 Carbon dioxide is given off when calcium carbonate reacts with hydrochloric acid. Complete and label the diagram below to show how the volume of carbon dioxide produced can be collected and measured.



[2]

SEPARATION & PURIFICATION TECHNIQUES

(a) describe methods of separation and purification for the components of mixtures, to include:
  (i) use of a suitable solvent, filtration and crystallisation or evaporation
  (ii) sublimation
  (iii) distillation and fractional distillation
  (see also 11.1(b))
  (iv) use of a separating funnel
  (v) paper chromatography

(b) suggest suitable separation and purification methods, given information about the substances involved in the following types of mixtures:
  (i) solid-solid
  (ii) solid-liquid
  (iii) liquid-liquid (miscible and immiscible)

(c) interpret paper chromatograms including comparison with 'known' samples and the use of R_f values

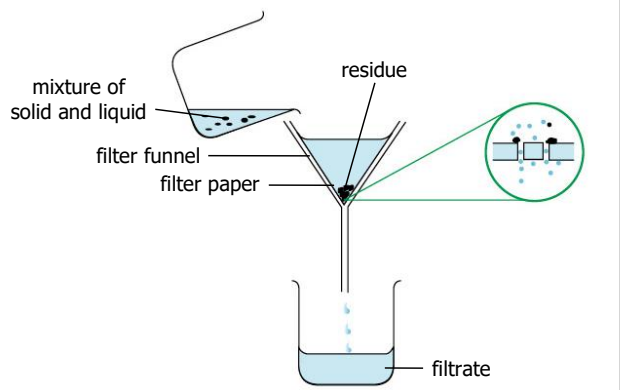
(d) explain the need to use locating agents in the chromatography of colourless compounds

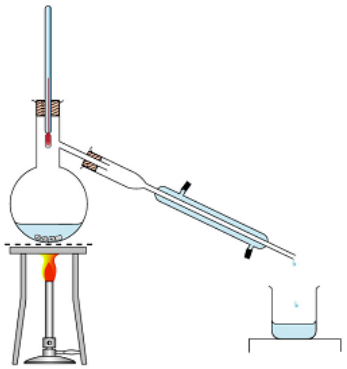
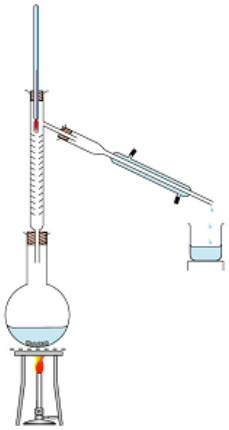
(e) deduce from given melting point and boiling point data the identities of substances and their purity

(f) explain the importance of measuring the purity in substances used in everyday life, e.g. foodstuffs and drugs

Complete the table below by filling in the blanks.

No	Term	Definition
1.	Pure substance	is made up of one single element or compound and not mixed with other substances. Pure substances have f_____ melting and boiling points. Impurities will l_____ the melting point of a substance and raise its b_____ point. There will be a range of temperatures at which it melts or boils.
2.	Mixture	is made up of two or more substances that are not c_____ c_____.

3.	_____	is used to separate insoluble solid particles (residue) from a liquid (filtrate). 
4.	Evaporation to dryness	is used to obtain a soluble solid (residue) from a solution by heating the solution until all the water has boiled off. The soluble solid must not d_____ upon strong heating.
5.	_____	is the substance that is dissolved in a solvent to form a solution.
6.	_____	is the liquid that dissolves the solute to form a solution.
7.	Crystallisation	is used for obtaining a pure solid sample from its saturated solution. This is the method to use when substances can decompose on heating Steps for crystallisation: 1. Heat solution to s_____ 2. C_____ solution to allow for crystals to form 3. F_____ to collect crystals 4. Wash crystals with a small volume of cold d_____ water 5. Dry crystals between pieces of filter paper
8.	Saturated solution	refers to the solution whereby no more additional solid can be dissolved in the solution.
9.	miscible	A liquid that can be dissolved in another liquid. e.g. alcohol is miscible in water
10.	immiscible	A liquid that is insoluble in another liquid. e.g. oil is immiscible in water
11.	Use of separating funnel	A method used to separate _____ liquid mixtures with different densities.
12.	Sublimation	A method where a solid mixture to separate solid that sublimes and collected on a cooled surface.

13.	_____ distillation	is used to separate a pure liquid (distillate) from a solution. • The liquid with the lower boiling point will distil out first • The bulb of the thermometer must be placed at the entrance of the condenser to provide the most accurate temperature of the gaseous substance that will be condensed and distilled out • Boiling chips smoothen out the boiling • Cold water enters from bottom leave at top to ensure that all vapour is condensed. (maximize the cooling effect) 
14.	_____ distillation	is used to separate a mixture of miscible liquids with different b_____ p_____. There is an additional fractionating column containing many glass beads which provides a large surface area for the condensation of vapour. 
15.	_____	is the method of separating two or more components that have different s_____ in the same solvent. This method can also be used to identify the presence or absence of substances. More soluble substances will travel f_____ away from the start line.
16.	Chromatogram	is the chromatography paper with the separated components.
17.	R_f value	R_f value = $\frac{\text{distance travelled by the substance}}{\text{distance travelled by the solvent}}$
18.	Locating agent	A chemical that reacts with colourless spots on the chromatogram to produce coloured spots.

Complete the questions below.

1 State the most suitable method for the following processes:

(a) to obtain pure water from soft drinks _____[1]

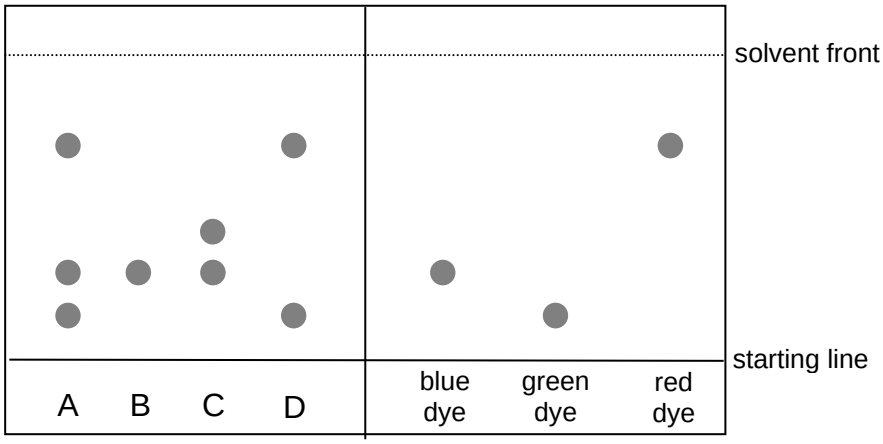
(b) to separate kerosene from crude oil _____[1]

(c) to separate tea leaves from tea _____[1]

(d) to obtain pure sugar from sugar solution _____[1]

(e) to obtain oxygen from liquified air _____[1]

2 The diagram below shows a chromatography obtained using solutions of three single dyes (blue, green and red) and four other solutions (**A**, **B**, **C** and **D**).



(a) Which solution(s) **A, B, C** or **D**

(i) is a pure substance? _____[1]

(ii) contains green and red dyes only? _____[1]

(iii) contains a dye other than blue, green and red dyes? _____[1]

(b) Calculate the R_f value of red dye.

[1]

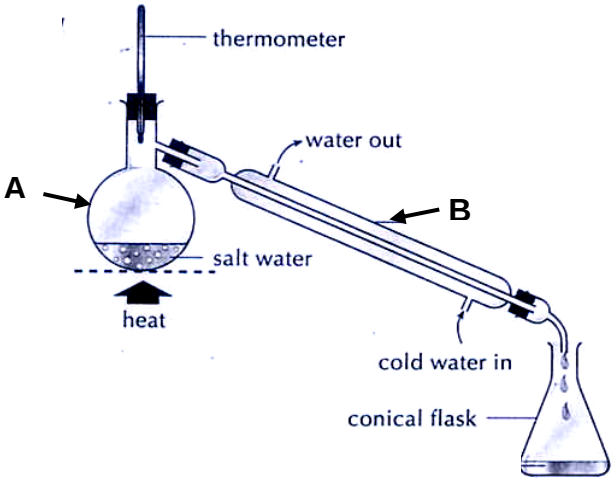
(c) In some experiments, a locating agent is sprayed onto the chromatogram. What is the purpose of doing this?

[1]

(d) Chromatography is used in the assigned laboratories in countries where the Olympic games are held. Why is this necessary?

[1]

3 The diagram below shows apparatus that is used to obtain pure water from sea water.



(a) Name the state change that is taking place in **A**.

[1]

(b) What is the purpose of apparatus **B**?

[1]

(c) What temperature does the thermometer show when water is being distilled out?

[1]

(d) Briefly describe how you could find out whether the water collected in the conical flask is pure.

[1]

4 Glauber's Salt is a white solid that is soluble in water. It is found in the ground mixed with sand. Describe how you would obtain pure and dry crystals of Glauber's Salt from this mixture. (Hint: There are 7 key steps.)

[5]

Chapter 2: Kinetic Particle Theory

(a) describe the solid, liquid and gaseous states of matter and explain their interconversion in terms of the kinetic particle theory and of the energy changes involved
(b) describe and explain evidence for the movement of particles in liquids and gases (treatment of Brownian motion is not required)
(c) explain everyday effects of diffusion in terms of particles, e.g. the spread of perfumes and cooking aromas; tea and coffee grains in water
(d) state qualitatively the effect of molecular mass on the rate of diffusion and explain the dependence of rate of diffusion on temperature

Complete the table below by filling in the blanks.

No	Term	Definition
1	Kinetic particle theory	It states that all matter is made up of tiny particles and that these particles are in constant random motion.
2	_____	A process by which a solid takes in heat to change to a liquid. Melting point is the temperature at which a solid becomes a liquid.
3	_____	A process by which a liquid gives out heat to change to a solid. Freezing point is the temperature at which a liquid becomes a solid.
4	_____	A process by which a liquid takes in heat to change to a gas. Boiling point is the temperature at which a liquid becomes a gas.
5	_____	A process by which a liquid takes in heat to change to a gas at temperature below boiling point at the surface of the liquid.
6	_____	A process by which a gas gives out heat to change its physical state to a liquid.
7	_____	A process by which a solid takes in heat to change to a gas without going through the liquid state.
8	_____	It is the movement of the particles from a region of higher concentration to a region of lower concentration.

During a change in state, the temperature remains constant.

- During melting and boiling, energy is taken in by the particles to o_____ the forces of a_____ between particles.
- During freezing and condensation, energy is given out as the particles are attracted to each other.

Complete the table about the three states of matter.

	Solid	Liquid	Gas
Shape, Volume, Compressibility	Fixed shape, fixed volume, cannot be compressed	No fixed shape, fixed volume, cannot be compressed	No fixed shape, no fixed volume, can be compressed
Draw a diagram to show the arrangement of particles			
Forces of attraction			
Arrangement			
Motion of particles			
Energy (kinetic) of particles	Very low	Low	High

Complete the questions below.

1 Fill in the blanks. [2]

(a) We are able to detect perfume from a distance because of the process of _____.

(b) The change of state from a solid directly to a gas without melting is called _____.

(c) Heat energy is _____ during the processes of melting and boiling; while heat energy is _____ durng the processes of freezing and condensation.

2 The boiling and melting points of the four substances are given in the table below.

substance	melting point / ^{o}C	boiling point / ^{o}C	physical state at 20 ^{o}C	physical state at -100 ^{o}C
ethane	-183	-89		
nitrogen	-210	-196		
iodine	114	184		
titanium	1941	3287		

(a) Complete the table by stating the physical states of each substance at 20 ^{o}C and -100 ^{o}C. [4]

(b) Which substance exists in the liquid state over the largest range of temperature?

[1]

(c) Draw the arrangement of particles in titanium at

(i) 2890 ^{o}C

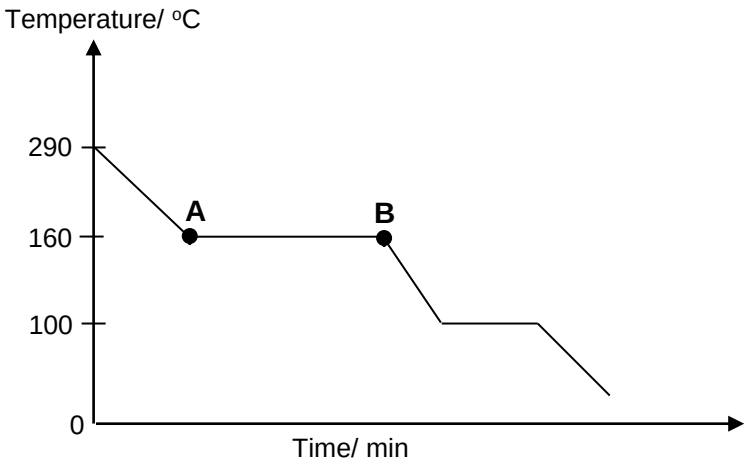
(ii) 3500 ^{o}C

[2]

(d) Describe the arrangement and movement of the particles of titanium at room temperature.

[2]

3 Study the cooling curve for substance **X**.



(a) Name the process happening at point **A** to **B**. _____[1]

(b) Name the states of matter present at point **A** to **B**. _____[1]

(c) When **X** condenses, the temperature stays constant. Explain.

[2]

4 Diamond is a form of carbon. Carbon changes its state from solid to liquid at 3527 ^{o}C, and changes its state from liquid to gas at 4300 ^{o}C.

Sketch a graph of temperature (y-axis) against time (x-axis) to show how the temperature changes when carbon is heated from 1500 ^{o}C to 5000 ^{o}C,

Tips:
- Use pencil and ruler
- Label the axis with the physical quantity and unit
- Include axis marking for key data points

[3]

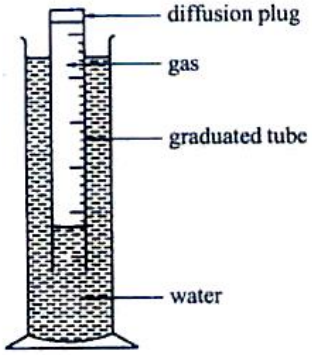
5 State how two factors affect the diffusion of gases.

1.

2.

[2]

6 The diagram below shows an apparatus for measuring the rates of diffusion of gases. The times taken for 100 cm^3 of some gases at room temperature and pressure to diffuse from this apparatus are shown in the table.



Gas	Time/s
CO	132
Cl_2	211
CH_4	100
N_2	?
O_2	141

(a) Which gas diffuses the fastest? _____[1]

(b) Why does the gas in (a) diffuse the fastest?

[1]

(c) Suggest the time that nitrogen would take to diffuse out of the apparatus.

[1]

(d) Name a gas which diffuses faster than any of the gases shown in the table.

[1]

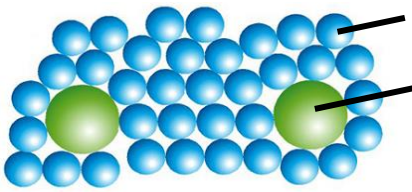
(e) Why is this apparatus unsuitable for finding the rate of diffusion of ammonia?

[1]

CHAPTER 5: ELEMENTS, COMPOUNDS & MIXTURES

(a) describe the differences between elements, compounds and mixtures
(b) describe the general physical properties of metals as solids having high melting and boiling points, malleable and good conductors of heat and electricity
(c) describe an alloy as a mixture of a metal with another element, e.g. brass; stainless steel
(d) identify representations of metals and alloys from diagrams of structures

Complete the table below by filling in the blanks.

No	Term	Definition
1	_____	is a pure substance that cannot be broken down into two or more simpler substances by chemical processes.
2	_____	are the smallest particles of an element that have the chemical properties of that element.
3	_____	is a group of two or more atoms that are chemically joined together.
4	_____	is a pure substance containing two or more elements that are chemically combined in a fixed ratio.
5	_____	is made up of two or more substances that are not chemically combined.
6	_____	It is a m_____ of a metal with one or a few other elements. 

Differences between a compound and a mixture:

	compound	mixture
separation	can be separated into its constituents by _____ _____	can be separated into its constituents by _____ _____
properties	_____ from its constituents	_____ as its constituents
energy change	usually there is energy change	usually no energy change
composition	constituents are combined in a _____	constituents are combined in _____

Complete the questions below.

1 Circle the molecule that contains more atoms.

a) HC*l* or POBr

b) C_3H_8 or C_2H_5OH

c) CH_3COOH or C_6H_6

[2]

2 Circle the molecule that contains more types of elements.

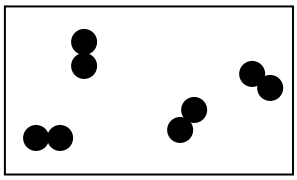
a) HC*l* or POBr

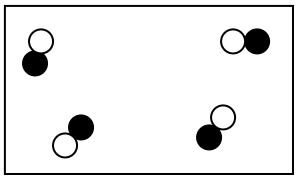
b) C_3H_8 or C_2H_5OH

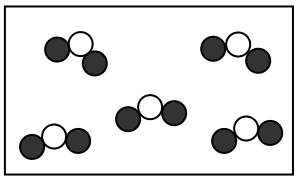
c) CH_3COOH or C_6H_6 [2]

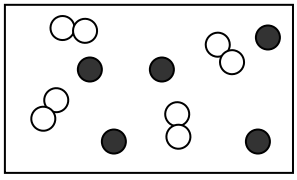
3 Identify the description that best represents each diagram and write the correct description in the corresponding blank.

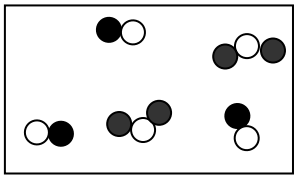
A mixture of compounds	An element	A mixture of elements
A compound made up of two atoms	A compound made up of three atoms	

a)  _____

b)  _____

c)  _____

f)  _____

e)  _____

[5]

4 Classify the following as elements, compounds or mixtures.

(a) air _____

(b) iodine _____

(c) sodium _____

(d) brass _____

(e) water _____

(f) ammonia _____

(g) sodium chloride _____

(h) steel _____

[8]

5 Draw a diagram representation of nitrogen (N_2) gas.
(use ◯ to represent nitrogen atoms)

[1]

6 Draw a diagram representation of carbon dioxide (CO_2) gas.
(use ◯ to represent carbon atoms and ● to represent oxygen atoms)

[1]

7 Draw a diagram representation of a mixture of chlorine (Cl_2) and helium (He) gas.
(use ◯ to represent chlorine atoms and ● to represent helium atoms)

[1]