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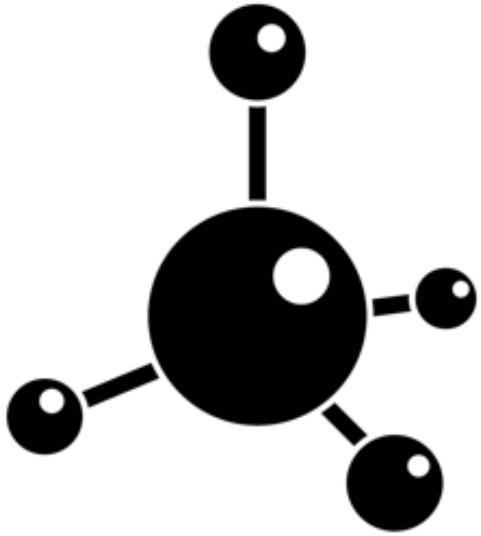

Grade 10 Chemistry

QUESTIONS

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CLASSIFICATION OF MATTER

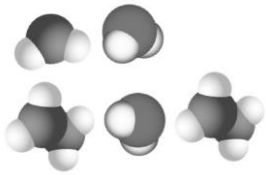
EXAM LEVEL QUESTIONS

1.1. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**

1.1.1. From the list below, choose the label best suited to each picture that follows. Labels may be used more than once.

- element
- mixture of compounds
- compound
- mixture of elements and compounds
- mixture of elements

1.1.1.1.



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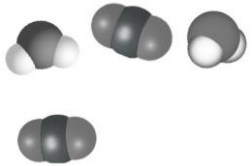

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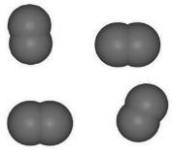

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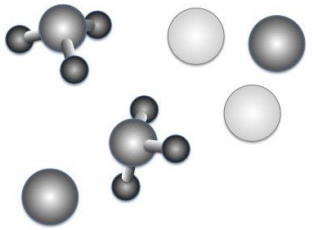
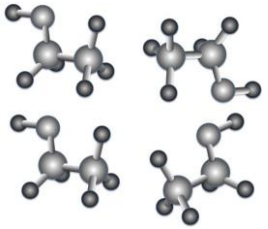
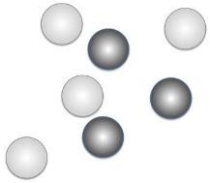


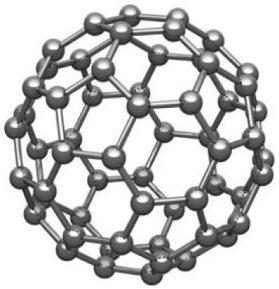
1.1.1.5.



1.1.1.6.



1.1.1.7.



1.1.2. In each case, determine if the substance is **PURE**, or if it is a **HOMOGENEOUS** or **HETEROGENEOUS MIXTURE**:

1.1.2.1. soda water
1.1.2.2. coffee with milk and sugar
1.1.2.3. carbon dioxide gas
1.1.2.4. oil and vinegar
1.1.2.5. concrete
1.1.2.6. concentrated swimming pool acid
1.1.2.7. copper
1.1.2.8. sugar mixed with sand

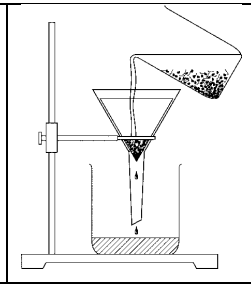
1.2. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Use the list of separation methods below and answer the questions that follow:

Chromatography; decanting; separating funnel; fractional distillation; evaporation; filtration.

1.2.1. What is a homogenous mixture?
1.2.2. Using the list, name 3 methods suitable for the separation of a homogenous mixture?
1.2.3. What is a heterogeneous mixture?
1.2.4. Using the list, name 3 methods suitable for the separation of a heterogeneous mixture?

1.2.5. State the name of the separation method illustrated in the image below.

A



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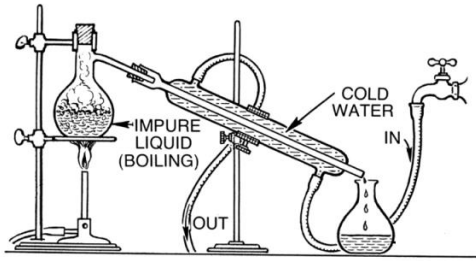
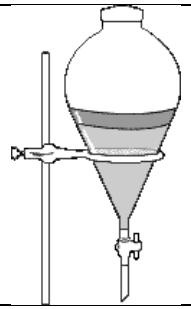


B



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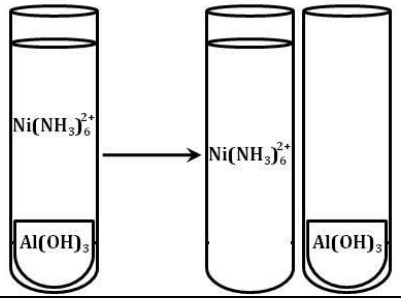


1.3. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Read the descriptions and classify the substances as either heterogeneous or homogenous mixtures, elements or compounds

1.3.1. A white solid that is broken down into a silver liquid and a gas when an electric current is passed through it.
1.3.2. A grey solid that cannot be broken down by chemical or physical means.
1.3.3. A combination of an insoluble carbonate and water.
1.3.4. A sugar solution.
1.3.5. A gas that contains the elements nitrogen and hydrogen in ratio 1:3.

1.4. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Use examples to differentiate between:

1.4.1. A homogenous and a heterogeneous mixture.
1.4.2. An atom and a compound.
1.4.3. A mixture and a compound

1.5. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Match the information in column B with that in column A. Write down only the term from column B next to number of the question.

Column A	**Column B**
1.5.1. The ability of a metal to bend without breaking	K_2SO_3
1.5.2. A sulphate	malleability
1.5.3. A combination of substances in which the components can be clearly distinguished	compound
1.5.4. Brass, a mixture of copper and zinc	$MgSO_4$
	homogenous mixture
	heterogeneous mixture
	alloy

1.6. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Name the separation method that can be used to separate the following mixtures:
1.6.1. Two liquids with different boiling points
1.6.2. Sand and water
1.6.3. Sulphur and iron filings

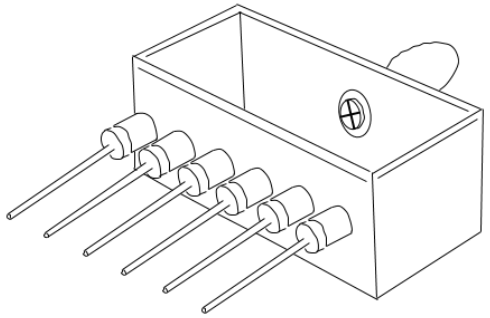
1.7. Consider the following everyday/household substances:

fizzy cooldrink (e.g. Fanta)	graphite for a clutch pencil
sugar crystals	dishwashing liquid
salt solution	bicarbonate of soda
vinegar	granite counter top
air	

1.7.1. From the list of items above, write down:
1.7.1.1. TWO homogeneous mixtures
1.7.1.2. TWO heterogeneous mixtures
1.7.1.3. TWO compounds
1.7.1.4. TWO elements

1.8. Mixtures can be separated by two physical techniques, namely fractional distillation and filtering.
1.8.1. Explain the process of fractional distillation.
1.8.2. List two areas where fractional distillation is used.

1.9. In order to study the thermal conductivity of different materials, learners choose to use a Ingenousz Conductivity Apparatus. The apparatus, shown below, has a container where boiling water is poured into and rods of different material types attached.



Learners use Vaseline to secure a thumb-tack on the end of each rod. When hot water is poured into the container, the heat is transferred through the rods, melting the Vaseline. The learners record the time taken for the thumb-tack to fall of the end of the rod, indicating that heat has reached the end of the rod. The results obtained were tabulated below:

Material	**Time taken (s)**
Copper	62
Aluminium	87
Stainless steel	147
Lead	105
Graphene	45
Wood	No result

1.9.1. Name the following variables for this experiment:
1.9.1.1. Dependant
1.9.1.2. Independent
1.9.1.3. Controlled
1.9.2. Explain the concept of thermal conductivity.
1.9.3. Rank the materials from most to least thermal conductive.

1.9.4. With reference to the Kinetic Molecular Theory, explain how the following changes could influence the time taken for heat transfer in aluminium:
1.9.4.1. Density
1.9.4.2. Length

The learners noticed that the wood did not warm up on the end, and therefore no result was obtained.

1.9.5. What name is given to materials that do not allow heat energy to flow through it.

1.10. A group of students are tasked with classifying a collection of different material as metals, metalloids or non-metals.

1.10.1. Use the list of descriptions to classify the materials.

	Description	Metal, metalloid or non-metal
1	Mostly low melting points and boiling points	
2	Brown gas at room temperature	
3	Malleable, silver material	
4	Brittle, yellow material	
5	high ionization energy	
6	form anions through electron gain	
7	reacting with oxygen in the air to form oxides	
8	Forms allotropes	
9	high thermal conductivity	
10	Shiny and lustrous	
11	Group I and II elements	
12	Electrical conductivity increases with temperature	
13	Inert gas	
14	dull appearance	
15	Brittle, black solid that can conduct electrical current	
16	Most electronegative element	
17	poor conductors of heat and electricity	
18	malleable and ductile	
19	high electronegativity	
20	Forms metallic bonds	
21	Used in semi-conductors	
22	Forms covalent bonds	
23	Element with the highest electronegativity	
24	Group 17 element	
25	look like metals but behave largely like non-metals	
26	high electrical conductivity	
27	form cations through electron loss	
28	Magnetic	

1.10.2. Write down the name of the elements described above by:
1.10.2.1. Description 4
1.10.2.2. Description 15
1.10.2.3. Description 23

1.10.3. Description 8 refers to allotropes. Explain what allotropes are.

NAMES AND FORMULAE

EXAM LEVEL QUESTIONS

2.1. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Balance the following equations, using symbol form:
2.1.1. $AgNO_3 + BaCl_2 \rightarrow AgCl + Ba(NO_3)_2$
2.1.2. Copper is dissolved in nitric acid to form copper(II) nitrate and hydrogen gas
2.1.3. Silver nitrate reacts with magnesium chloride to form silver chloride and magnesium nitrate.
2.1.4. Ozone reacts with nitrogen monoxide to form nitrogen dioxide.

2.2. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
2.2.1. How many atoms are in each of the following substances? **Example: $2H_2O$ = 6 atoms**
2.2.1.1. $2NH_3$
2.2.1.2. $Ca_3(PO_4)_2$
2.2.2. Write down the **chemical names** of the following compounds:
2.2.2.1. Na_2CO_3
2.2.2.2. $ZnSO_4$
2.2.2.3. $KC\ell O_3$
2.2.2.4. $Pb(NO_3)_2$
2.2.2.5. $NH_4C\ell$

2.2.2.6. $K_2Cr_2O_7$
2.2.2.7. $Ca(OH)_2$
2.2.3. Write down the chemical formulae of the following:
2.2.3.1. sulfuric acid
2.2.3.2. ethanoic acid
2.2.3.3. potassium hydroxide
2.2.3.4. marble
2.2.3.5. ammonia

2.3. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Nitrogen dioxide is a reddish-brown toxic gas that has a sharp odour and is a prominent air pollutant. Nitrogen dioxide is just one of many pollutants that are formed by the burning of fossil fuel.
2.3.1. Give the formula for nitrogen dioxide.
2.3.2. What type of bond will exist between the nitrogen and oxygen atoms? Explain how these bonds are formed.
2.3.3. Draw the Lewis diagram of:
2.3.3.1. N_2
2.3.3.2. O_2

2.4. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Another common nitrogen compound is NH_3, which is often used for cleaning products.
2.4.1. Give the common name for NH_3
2.4.2. Draw the Lewis diagram of NH_3
2.4.3. Write the chemical formula of the ammonium ion.
2.4.4. Determine the formula if the ammonium ion combines with
2.4.4.1. hydroxide
2.4.4.2. sulphate
2.4.4.3. dichromate
2.4.4.4. chlorine

2.5. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
2.5.1. Write down the name for each of the following acids.
2.5.1.1. HCl
2.5.1.2. HNO_3
2.5.1.3. H_2SO_4
2.5.1.4. H_2CO_3
2.5.1.5. CH_3COOH
2.5.2. Write down the formula for each of the following compounds.
2.5.2.1. sodium sulphite
2.5.2.2. mercuric oxide
2.5.2.3. ammonium sulphate
2.5.2.4. iron (III) sulphate
2.5.2.5. potassium nitrate
2.5.3. Write the formulae and names for:
2.5.3.1. Bicarbonate of Soda
2.5.3.2. Caustic potash (KOH)
2.5.3.3. Slaked lime
2.5.3.4. Epsom salts

2.6. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Provide the formulae of the following substances:
2.6.1. lithium nitrate
2.6.2. ammonium oxide
2.6.3. iron(III) chloride
2.6.4. magnesium sulphate
2.6.5. potassium permanganate
Provide the Lewis structure of the following substances:
2.6.6. phosphorous trichloride
2.6.7. carbon dioxide

2.7. Write the chemical formulae of the compounds in each of the boxes to complete the table below. Use the anions and cations that intersect to work out the formula. Zinc chloride has been included as an example, at the intersection between zinc and chlorine.

	Iron (II)	Iron (III)	Silver	Mercury	Gallium	Lead	Zinc
Acetate							
Chloride							$ZnCl_2$
Sulphate							
Oxide							
Nitrate							
nitride							

KINETIC THEORY OF MATTER.

EXAM LEVEL QUESTIONS

3.1. Name the change of state occurring in each of the following processes:

3.1.1. Thawing snow
3.1.2. Drying clothes
3.1.3. Misting-up windows
3.1.4. Frost forming on grass on cold, clear nights
3.1.5. Oil bubbling in a deep fat fryer
3.1.6. Casting (pouring) metals in a mould

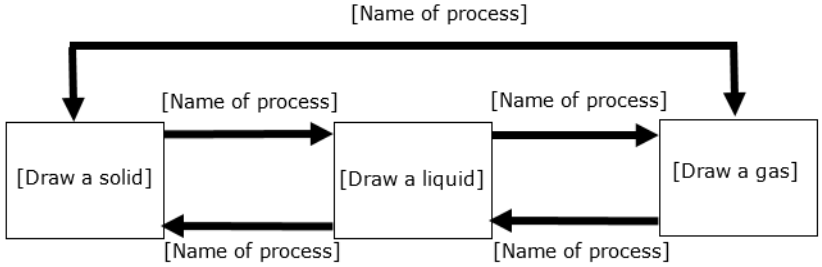
3.2.

3.2.1. Describe what happens to the particles as you increase the temperature of a solid.
3.2.2. Describe what happens to the particles as a solid melts to become a liquid
3.2.3. Why does the temperature remain constant while a solid changes to a liquid?

3.3.

3.3.1. Describe what happens to the particles of a liquid as you increase the temperature.
3.3.2. What effect does this heating have on the forces of attraction between the molecules?
3.3.3. What happens to the particles of a gas if you heat them up?

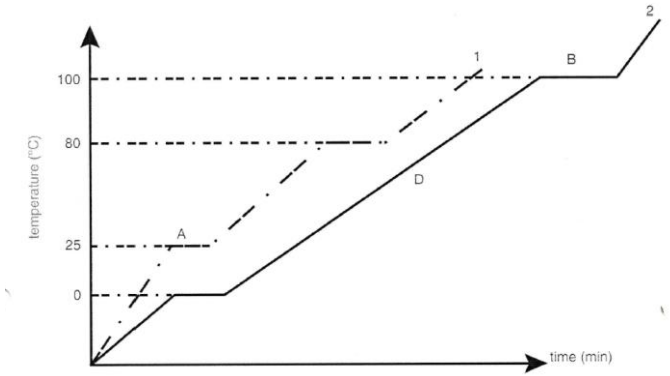
3.4. Copy and complete the diagram by adding the names of the missing processes and drawing sketches as directed.



3.5. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**

The following graph represents the change in temperature for two different solids (1 and 2) which are heated over time.

3.5.1. In which phase is substance 2 at 40° C?
3.5.2. At which temperature will substance 2 melt?
3.5.3. Explain what takes place at A.
3.5.4. Name the phase change that takes place at B.
3.5.5. With reference to the energy change taking place, explain why the temperature remain constant at B, but not at D?
3.5.6. Which curve on the graph, 1 or 2, represents the substance with the weakest intermolecular forces? Give a reason for your answer.



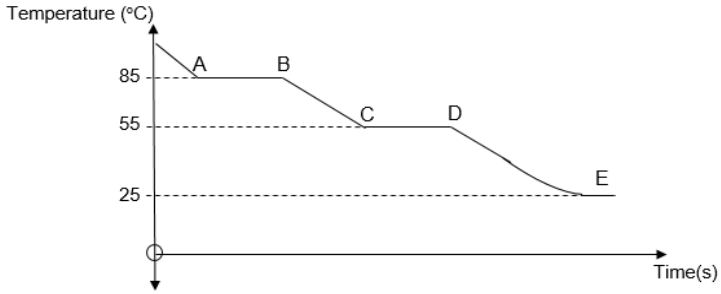
3.5.7. How does the average kinetic energy of the particles of substance 1 and 2 compare at 90°C?

3.6. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Use the following table of melting and boiling points to answer the questions that follow.

Substance	Melting point (°C)	Boiling point (°C)
A	0	100
B	-115	-85
C	-49	-2
D	-83	20
E	-78	-33
F	-89	-67
G	-101	-35
H	-7	58
I	114	183

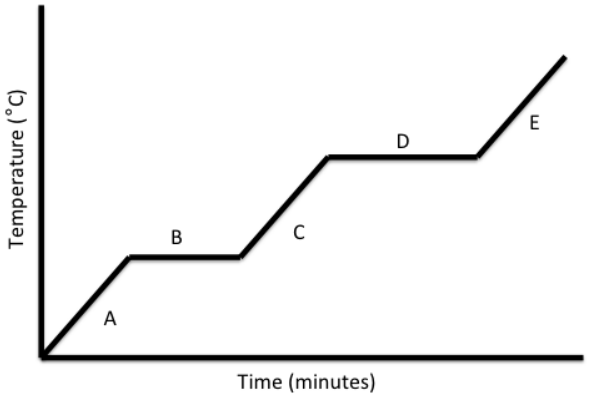
3.6.1. Which substance(s) is a liquid at room temperature (25°C)?
3.6.2. Which substance(s) is a gas at -80°C?
3.6.3. Which substance has the strongest intermolecular forces? Provide a reason for your answer.
3.6.4. Write down the letter of the substance that represents water (H_2O).
3.6.5. Which substance is most likely an ionic compound? Give a reason for your answer.
3.6.6. Compare the behaviour of the molecules of substance D and H at 40°C.

3.7. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
The cooling curve of a substance is shown below



3.7.1. What is the boiling point of this substance?
3.7.2. What is the melting point of this substance?
3.7.3. Give the name of the specific process that takes place between A and B.
3.7.4. Is the process that you mentioned in 4.7.3 an exothermic or endothermic process?
3.7.5. Explain fully why the temperature remains constant between C and D
3.7.6. Explain fully why the temperature remains constant at E.

3.8. Based on this graph, would you say that the substance is a pure substance? Explain your
answer shortly.
Use the heating curve diagram below and answer the questions that follow:



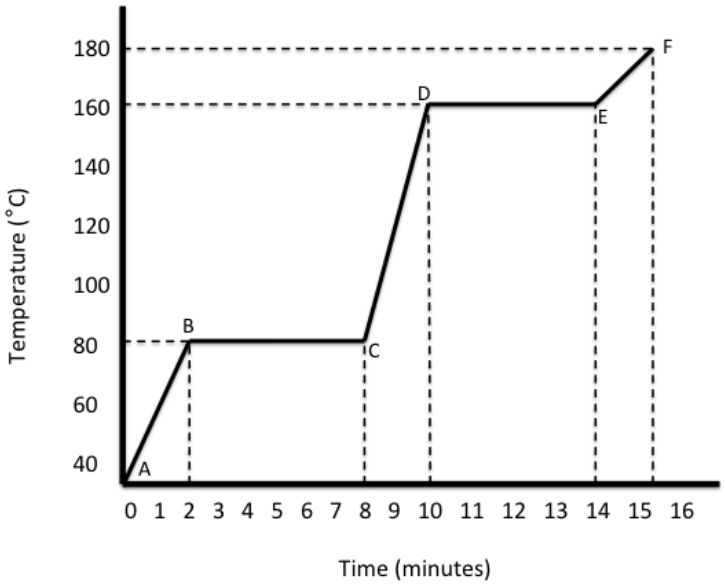
3.8.1. State the phases of the substance at A, C and E.

B and D represents a phase change during which the temperature remains constant.

3.8.2. Name the phase changes that take place at B and D.

3.8.3. Describe the particle behaviour in terms of their kinetic and potential energy at each of the sections A to E.|

3.9. Use the graph below to answer the questions that follow:



3.9.1. At which point (or between which points) on the graph

3.9.1.1. does the substance have no definite shape and the molecules are moving freely?

3.9.1.2. does the substance have a fixed shape?

3.9.1.3. is there no change in kinetic energy?

3.9.1.4. does the substance undergo evaporation?

3.9.1.5. is the substance in both the solid phase and the liquid phase?

3.9.1.6. do the molecules have the highest average kinetic energy?

3.9.2. Now answer the following additional questions from the above graph:

3.9.2.1. What is the boiling point of the substance?

3.9.2.2. What is the melting point of the substance?

3.9.2.3. How long does it take for the substance to change from a solid to a liquid?

3.9.2.4. How long does the beaker contain some of the substance in liquid form?

3.10. The table below shows the boiling and melting points of substances A to D.

SUBSTANCE	BOILING POINT(°C)	MELTING POINT(°C)
A	-188	-210
B	443	130
C	80	-118
D	184	90

3.10.1. Define the term boiling point.

3.10.2. From the table above, write down the phase for each substance at:

3.10.2.1. 100°C

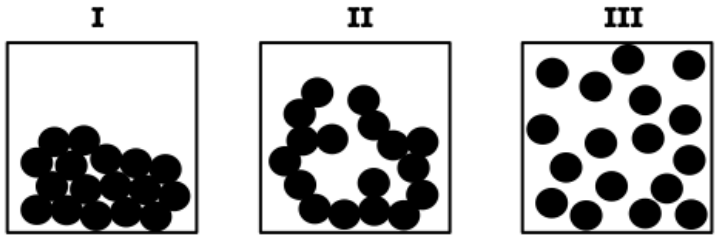
3.10.2.2. 25°C

3.10.2.3. 0°C

3.10.3. Write down the melting and boiling point of pure water at sea-level.

3.10.4. Explain what the triple-point of water refers to.

3.10.5. Which ONE of the following diagrams represents the PARTICLE ARRANGEMENT of substance C at -100 °C? Write down only I, II or III.



THE ATOM

EXAM LEVEL QUESTIONS

4.1. Complete the following table

Element	Z(number of protons)	Number of neutrons	Nuclide symbol	A (Mass Number)
hydrogen	1	4.1.1.	4.1.2	4.1.3
aluminium	13	27	4.1.4	4.1.5
2.1.6	10	11	4.1.7	4.1.8
2.1.9	4.1.10	4.1.11	$^{59}_{27}Co$	4.1.12
Iodine	53	4.1.13	4.1.14	127

4.2. Give the number of protons, neutrons and electrons in the following:

4.2.1. $^{25}_{12}Mg$

4.2.2. $^{39}_{19}K^{+}$

4.2.3. $^{75}_{33}As^{3-}$

4.2.4. $^{133}_{55}Cs$

4.3. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**

4.3.1. Draw the Aufbau diagram of a beryllium atom.

4.3.2. Give the electron configuration of a beryllium ion.

4.3.3. The following questions are based on Oxygen

4.3.3.1. How many valence electrons does Oxygen have?

4.3.3.2. What is the valency of Oxygen?

4.3.3.3. Draw the Bohr diagram for an oxide ion.

4.4. Consider the following substances/elements and answer the questions below.

$^{16}_{8}A$ $^{13}_{6}B$ $^{14}_{6}C$ $^{27}_{13}D^{3+}$

4.4.1. Which two of these substances/elements have the same number of protons?

4.4.2. Which two of these atoms or two ions have the same number of neutrons?

4.4.3. Give three similarities between elements 'B' and 'C'.

4.4.4. Give the term used to describe 'B' and 'C'.

4.4.5. In which group is the ion found in?

4.5. Lithium has the following isotopes: $^{6}_{3}Li$ and $^{7}_{3}Li$

4.5.1. Define the term 'isotope'.

4.5.2. The natural abundance of the isotopes is as follows

7,5 % of $^{6}_{3}Li$ 92,5 % of $^{7}_{3}Li$

Calculate the relative atomic mass of lithium.

4.5.3. How many electrons does a lithium atom have?

4.5.4. Write the electronic configuration of the Li^{+} ion.

4.5.5. Write an equation to show the formation of the Li^{+} ion.

4.6. An element X consists of the following four types of atoms:

$^{54}_{26}X$ $^{56}_{26}X$ $^{57}_{26}X$ $^{58}_{26}X$

4.6.1. What are the four types of atoms of X called?

4.6.2. Name element X.

4.6.3. How many electrons are found in each of the atoms?

4.6.4. How do the chemical properties of these four atoms compare? Give a reason.

4.6.5. In which period is element X found in?

4.6.6. Silver has 46 known isotopes but only two occur naturally. Given the following spectrometric data:

$^{107}_{47}Ag$ has an abundance of 51,84%;

$^{109}_{47}Ag$ has an abundance of 48,16 %;

Find the relative atomic mass of silver.

4.7. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**

4.7.1. In which group is chlorine found?

4.7.2. Draw the distribution of electrons of chlorine using Bohr diagram.

4.7.3. Show the electron distribution of a chloride ion using an Aufbau diagram.

4.7.4. Chlorine's mass number is 35,5. Why is the number not a whole number?

4.8. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**

4.8.1. What is similar and different about the following atoms:

$^{3}_{1}H$ and $^{3}_{2}He$

4.8.2. An element with atomic number 92 has isotopes with relative atomic masses of 235 and 238 respectively. What are the compositions of the nuclei of each of these isotopes?

4.9. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**

Nitrogen occurs in nature as two stable isotopes: $^{14}_{7}N$ and $^{15}_{7}N$. Old Paul Roos student Stefan Meiring Naudé discovered the nitrogen-15 isotope. The majority of the nitrogen in nature is nitrogen-14 and the nitrogen-15 isotope is often used in medical research.

4.9.1. Provide the Aufbau Diagram of Nitrogen.

4.9.2. Suppose that the nitrogen-14 isotope occurs 90% of the time in nature and that the Nitrogen-15 isotope occurs only 10% of the time. Calculate the relative atomic mass of Nitrogen.

4.9.3. Will the chemical properties of Nitrogen-14 and Nitrogen-15 differ from each other? Give a reason for your answer.

4.9.4. What is the valency of nitrogen?

4.10. Oxygen is a non-metallic element with an atomic number of 8 and can exist as isotopes.

4.10.1. Define the term:

4.10.1.1. Atomic number

4.10.1.2. Isotope

4.10.2. Natural oxygen has 2 abundant stable isotopes; $^{16}_{8}O$, $^{18}_{8}O$.

4.10.2.1. Write down the sp-notation for O-18

4.10.2.2. If the relative atomic mass of oxygen is 16,04. Calculate percentage of O-16 in natural oxygen.

4.10.3. Oxygen gas (O_2) consists of molecules.

Write down the:

4.10.3.1. Number of valence electrons in an oxygen atom.

4.10.3.2. Type of bonding in oxygen molecules.

4.10.3.3. Lewis structure for the oxygen molecule.

4.10.4. Calcium reacts with oxygen to form calcium oxide.

4.10.4.1. Draw the Aufbau diagram for a calcium ion.

4.10.4.2. Write down the chemical symbols of the particles found in calcium oxide crystals

PERIODIC TABLE

EXAM LEVEL QUESTIONS

5.1. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**

Steven picks up a brittle black solid that he calls element Z. He noted that it can conduct electricity. His friend informs him that another form of element Z exists, which is a clear solid that is very hard. This form is used in expensive jewellery.

5.1.1. Identify element Z.

5.1.2. State whether element Z is a metal, non-metal or metalloid. Give a reason for your answer with reference to the properties of element Z.

5.1.3. Give one word for forms of the same element that have different physical and chemical properties.

5.1.4. Explain why the two forms of element Z have completely different properties.

5.2. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**

Neon exists in nature as 3 stable isotopes. These isotopes and their respective abundance are as follows:

Ne-20 (90,60%)
Ne-21 (0,20%)
Ne-22 (9,20%)

5.2.1. Calculate the relative atomic mass of Ne.

5.2.2. Explain the similarities and differences between these isotopes.

5.2.3. Would these isotopes have similar chemical properties? Give a reason for your answer

5.3.

5.3.1. Complete the table below:

Element	Mg	Ga
Valency	5.3.1.1	5.3.1.4
Formula of compound formed with bromine	5.3.1.2	5.3.1.5
Formula of compound formed with oxygen	5.3.1.3	5.3.1.6

5.4. Consider the following elements

Al, Na, Ar, Cl, Mg

5.4.1. Which element is found as a diatomic gas?

5.4.2. What is similar about all these elements?

5.4.3. Arrange the metals in order of increasing reactivity.

5.4.4. Which element will form an oxide with the formula X_2O_3?

5.5. Refer to the following elements: F, Cl, Br, I

5.5.1. To which group do these elements belong to ?

5.5.2. Give the name of this group?

5.5.3. Arrange the elements in order of decreasing melting points.

5.5.4. These elements tend to have a high electron affinity. How many electrons do they receive in order to form an ion.

5.5.5. Using a Lewis diagram, show the formation of a floride ion.

5.5.6. Why do halogens form ions?

5.6.

5.6.1. Do group 2 elements form positive or negative ions?

5.6.2. Write out an equation to show the formation of the Mg ion.

5.6.3. Is a Mg ion smaller or larger than a Mg atom? Explain.

5.7. Identify the following element.

5.7.1. Largest element in Period 3.

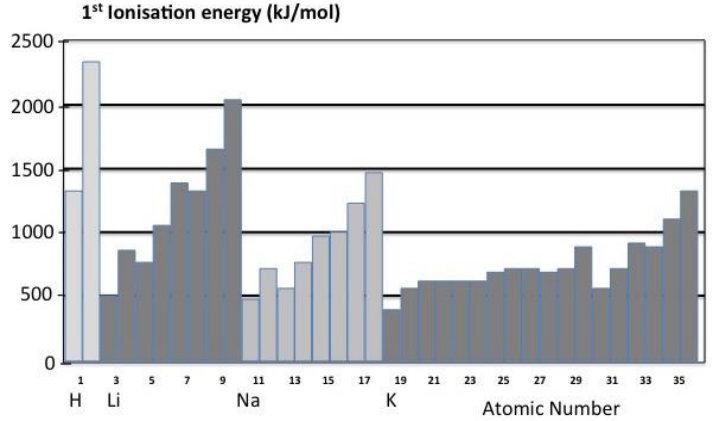
5.7.2. Softest metal in Period 2.

5.7.3. Poisonous yellowish-greenish gas at room temperature in period 2.

5.7.4. Has a octet of electrons in its valence shell in period 4.

5.7.5. A halogen that is liquid at room temperature.

5.8. Refer to the graph below and answer the questions that follow:



5.8.1. Explain what is meant by first ionisation energy.

5.8.2. In which group does the elements in each period with the highest energy appear?

5.8.3. Why does the group in 2.8.2 have such high ionisation energies?

5.8.4. Describe the general trend of ionisation across period 2.

5.8.5. In which energy level are the valence electrons of Li and Be found in?

5.8.6. Explain why Beryllium has a greater ionisation energy than Lithium.

5.8.7. Explain why Boron's ionisation energy is lower than Beryllium.

5.8.8. Why is Neon's ionisation energy higer than Argon's ionisation energy?

5.9. Refer to the table below and answer the questions that follow

	Na	Mg	Al
First Ionisation energy	502 $kJ.mol^{-1}$	744 $kJ.mol^{-1}$	584 $kJ.mol^{-1}$

5.9.1. Explain what is meant by first ionisation energy.

5.9.2. In which period can the above elements be found?

5.9.3. Account for the difference in ionisation energy between

5.9.3.1. Na and Mg
5.9.3.2. Mg and Al

5.10. Consider the information given in the table below. All values for ionization energies are in kJ/mol.

Element	1st ionization energy	2nd ionization energy	3rd ionization energy	4th ionization energy
A	419	3052	4420	5877
B	578	1817	2745	11577
C	738	1451	7733	10543
D	900	1757	14849	21007
E	1314	3388	5301	7469
F	1402	2856	4578	7475

Data source:
http://en.wikipedia.org/wiki/Ionization_energies_of_the_elements_(data_page)

5.10.1. Define the term *ionization energy*.
5.10.2. Which of the elements in the table above is likely to form an ion with a charge of 3+? Explain your answer.
5.10.3. Which element is likely to have one valence electron?
5.10.4. Which two metal elements are in the same group? To which group do they belong?
5.10.5. Which element is a non-metal? Explain your choice of answer.

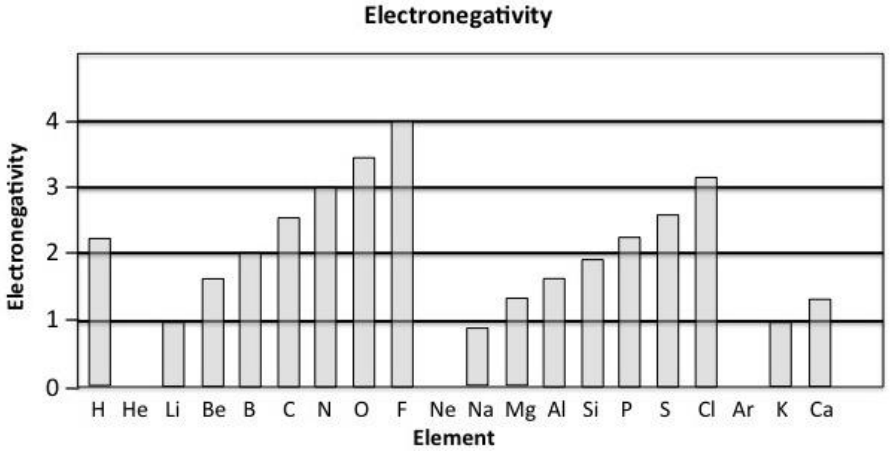
5.11. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
The Periodic Table of elements is now an indispensable tool in chemistry.
5.11.1. What name is given to the vertical columns in the periodic table?
5.11.2. What name is given to the horizontal rows in the periodic table?
5.11.3. In which group will the following be found:
5.11.3.1. Alkali Earth metals
5.11.3.2. Noble gases
5.11.4. How many valence electrons does each of the following have?
5.11.4.1. halogens
5.11.4.2. aluminium
5.11.5. In which period and group does the element fall that has the following electron configuration?
5.11.5.1. $[Ne]3s^2 3p^2$
5.11.5.2. $1s^2 2s^2 2p^3$
5.11.6. Calculate the relative molecular mass of the following substances. Show all calculations:
5.11.6.1. NH_4OH
5.11.6.2. $Cu(NO_3)_2$
5.11.6.3. Iron (II) oxide
5.11.6.4. Potassium permanganate
5.11.7. Name the elements that are:
5.11.7.1. diatomic
5.11.7.2. liquid at room temperature

5.12. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
5.12.1. Consider the following table with ionisation energy (E_i) values in $kJ \cdot mol^{-1}$:

	Li	Be	B	C	N
E_{i1}	520	899	801	1 089	1 402
E_{i2}	7 295	1757	2 427	2 353	2 857
E_{i3}	11 815	14 848	3 660	4 620	4 578
E_{i4}		21 006	25 025	6 222	7 475

5.12.1.1. What is meant by term *ionisation energy*?
5.12.1.2. How does the ionisation energy change (INCREASE, DECREASE or REMAIN THE SAME)
5.12.1.2.1. Moving right across the same period
5.12.1.2.2. Moving down the same group
5.12.1.3. Explain why Li does not have a fourth ionization energy (E_{i4}) value?

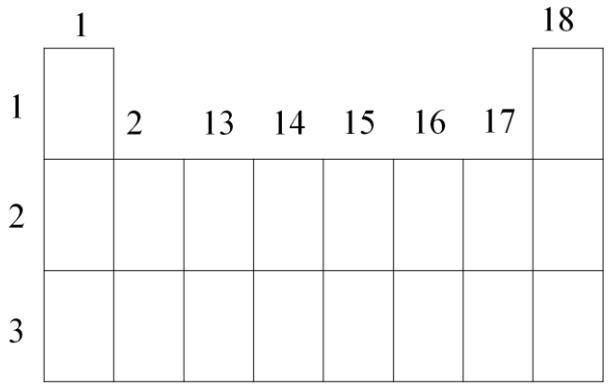
5.13. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
The variation in electronegativity values of the first 20 elements are represented by the following graph:



5.13.1. All the noble gases have an electronegativity of 0 and are at the bottom of the graph. Explain why this is so.
5.13.2. Which element is the most electronegative one on the periodic table?

5.14. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Like electronegativity, the electron affinity of noble gases is 0.
5.14.1. Define the term *electron affinity*.
5.14.2. Explain why noble gases will have an electron affinity of zero.

5.15. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Copy the table below and complete by writing only the letter into the appropriate block.



A has 3 protons in its nucleus.
B has 6 valence electrons and is in period 2.
C is a noble gas with the smallest radius.
D is the most reactive halogen.
E and C are in the same period.
F is a metalloid in period 2.
G has the same electron structure as B^{2-}.
H is more reactive than A (they are in the same group)
I has an electron configuration of $1s^2 2s^2 2p^6 3s^2$
J is the most abundant element in air (makes up 78% of atmospheric air)

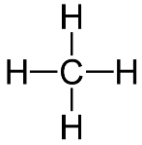
CHEMICAL BONDING

EXAM LEVEL QUESTIONS

6.1. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Write down the chemical formula for each of the following compounds.
6.1.1. aluminium sulphide
6.1.2. copper (II) chloride
6.1.3. iron(III) phosphate

6.2. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Name the following compounds.
6.2.1. NH_4NO_3
6.2.2. Li_2SO_4
6.2.3. SO_3

6.3. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Methane has the following molecular structure:



6.3.1. What kind of bond exists between carbon and a hydrogen atom? Explain your answer.
6.3.2. Is methane a polar or nonpolar molecule? Explain.

6.4. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Consider Magnesium and Chlorine:
6.4.1. How many valence electrons does each atom have?
6.4.2. Using Lewis Diagrams, show the formation of the cation and the anion when magnesium and chlorine bond chemically.
6.4.3. What force keeps the ions together in the crystal lattice?
6.4.4. In which ratio are the cations and anions found in the crystal lattice?
6.4.5. Name this compound.

6.5. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
The atoms of two elements P and Q are represented below:

P: $1s^2 2s^2 2p^2$ **Q: $1s^2 2s^2 2p^4$**

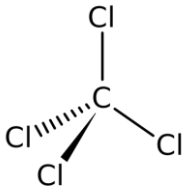
6.5.1.1. Identify the elements P and Q.
6.5.1.2. What type of chemical bond forms when P combines with Q?
6.5.1.3. Draw Lewis structures to show the formation of the bond between P and Q.
6.5.1.4. What type of chemical bond forms when Q combines with potassium metal?
6.5.1.5. Write the name of the compound that forms when Q combines with potassium metal.
6.5.2. Draw the energy level diagram (Aufbau diagram) for the aluminium ion.
6.5.3. How many valence electrons are found in the aluminium atom?
6.5.4. Give the number of core electrons in the lithium atom.

6.6. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Four hypothetical elements P, Q, R and S are described in the table below.

Element P (non-metal)	Element Q	Element R	Element S
1 valence electrons	2 valence electron	6 valence electrons	7 valence electrons

Use these four hypothetical elements when answering the questions below:
6.6.1. What type of bond will occur between elements Q and S?
6.6.2. Use Lewis notation to illustrate the formation of a compound between P and R.
6.6.3. What type of bond will occur between elements P and S?
6.6.4. Use Lewis diagrams to illustrate the formation of a compound between R and S.
6.6.5. What type of bond would form between two atoms of R?
6.6.6. Which three elements can exist as diatomic molecules?

6.7. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Examine the following molecular structure.

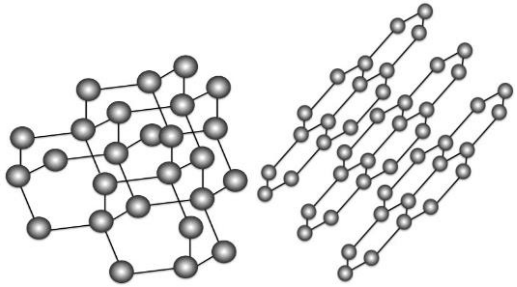


6.7.1. Define the term electronegativity.
6.7.2. Draw the Lewis structure of the above molecule and indicate the Octet Rule for each atom with a circle.
6.7.3. Consider the following statement: "*Carbon tetrachloride is a polar molecule*"
Do you agree or disagree with the above statement? Justify your answer.

6.8. Fill in the table by writing down the question number and the correct answer next to it.

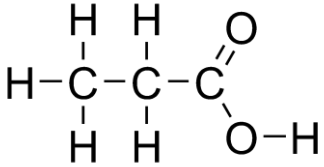
Type of Solid	**Network (atomic lattice)**	**2.8.1.**	**Metal**
Distinguishing Property	hard	Brittle	2.8.2
Composite Particles	2.8.3	2.8.4	Positive metal ions (atomic kernels)
Type of Bond between particles	2.8.5	Ionic bond	2.8.6
Example	Quartz (SiO_2)	2.8.7	copper

6.9. Carbon can be found in atomic lattices at room temperature as diamond and graphite



6.9.1. What is the name given to different physical forms of the same element?
6.9.2. Of the two diagrams, choose which corresponds to the bonding in diamond and which corresponds to the bonding in graphite.
6.9.3. Explain why graphite conducts electricity and diamonds do not.
6.9.4. Why is diamond used as cutting tool?

6.10. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Consider the following molecule:



6.10.1. How many valence electrons does each C atom have?
6.10.2. How many unpaired electrons does a single O atom have?
6.10.3. Draw the Lewis Diagram of
6.10.3.1. a single C atom
6.10.3.2. a single O atom
6.10.3.3. a single H atom
6.10.4. Which type of intra-molecular bonding is present in this molecule?
6.10.5. Is every bond in this molecule polar? Give a reason for your answer.
6.10.6. Write down the formula of this molecule.

6.11. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
From the following list of solids, choose suitable examples which can be associated with the statements below.

ice diamond sodium iodine sodium chloride

6.11.1. A network solid consisting of covalently bonded atoms.
6.11.2. A diatomic solid.
6.11.3. An excellent conductor of electricity only in the molten state.
6.11.4. An excellent conductor of electricity both in liquid and solid phase.
6.11.5. A network consisting of ions.
6.11.6. Strong electrostatic forces between ions and delocalized electrons.
6.11.7. Is less dense in the solid phase and is more dense in the liquid phase.
6.11.8. An allotrope of carbon.

6.12. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Magnesium fluoride is a solid that is transparent for light of different wavelengths and therefore has commercial uses in the field of optics. It is even sometimes used in telescopes.
6.12.1. Define the concept "ionisation energy".
6.12.2. Explain, by making use of Lewis diagrams, how magnesium fluoride forms from magnesium and fluorine. Also include the final formula of magnesium fluoride as part of your answer.
6.12.3. Complete the following paragraph by choosing the correct word in brackets. You only have to write down the question number and the correct word.

The physical properties of substances are explained by the type of bonding that exists between the particles. The type of bonding that is found between the particles of magnesium fluoride is (6.12.3.1. ionic/covalent/metallic). The melting point of

magnesium fluoride is (6.12.3.2. high/low) in comparison with the melting point of water. Magnesium fluoride is a (6.12.3.3. good/poor) conductor of electricity in the solid phase and a (6.12.3.4. good/poor) conductor of electricity in the liquid phase.

6.13. The physical properties of four different substances are compared to one another and the following table is compiled. When answering the questions below, a letter may be used more than once. *Use only the letters A, B, C and D when answering the questions.*

SUBSTANCE	MELTING POINT (°C)	CONDUCTIVITY
A	-180	Poor conductor
B	1263	Poor conductor as solid, but good conductor as liquid
C	800	Good conductor as solid and liquid
D	2200	Poor conductor as solid and liquid

6.13.1. Which type of bonding is probably found between the particles of C?
6.13.2. Which type of forces are probably found between the particles of B?
6.13.3. Which type of substance is D probably?
6.13.4. In which substance would you expect to find delocalised electrons?
6.13.5. List the substances in which the atoms are held together with covalent bonds.

PHYSICAL AND CHEMICAL CHANGE

EXAM LEVEL QUESTIONS

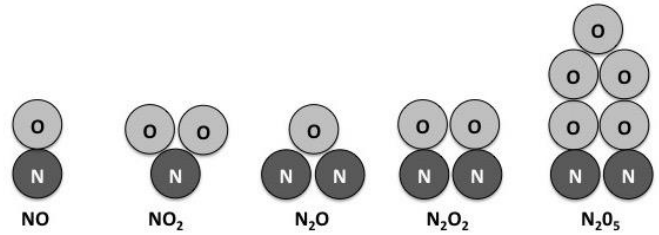
7.1. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Complete the table below:

	Volume	Shape	Spaces between particles	Forces between particles	Arrangement of particles	Movement of particles
Gas	Depends on container		Far apart			
Liquid		Depends on container				Slide past each other switching places.
Solid	Fixed				Close together. Fixed positions in a set pattern.	

7.2. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Sodium and chlorine are very dangerous elements in their pure form. Table salt contains these two elements but is safe to eat. Explain.

7.3. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Thabo burns a piece of magnesium which has a mass of 1 gram. He weighs what is left and found the mass was 1,8 grams.
2.3.1 What type of chemical reaction has occurred?
2.3.2 How could you explain this?

7.4. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
When lightning strikes, a huge amount of energy is transmitted through the air. Nitrogen molecules reacts with oxygen molecules to form the different nitrous oxides (NOx) shown.



7.4.1. Draw Lewis diagrams for oxygen and nitrogen.
7.4.2. What does the first ratio below the molecule show?
7.4.3. What does the second ratio below the molecule show?
7.4.4. Write balanced chemical reactions to show how NO and N_2O_5 are formed.
7.4.5. Which NOx has the most energy stored in its bonds? Explain.

7.5. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
When methane (CH_4) reacts with oxygen, water and carbon dioxide are formed.
7.5.1. Write a balanced equation for the reaction.
7.5.2. The change is _____.
7.5.3. Represent the reaction by drawing pictures of the molecules involved.
7.5.4. How many oxygen atoms are there in one oxygen molecule?
7.5.5. Complete the following table:

	Reactants before	**→**	**Products after**
Word equation			
Chemical equation			
Atoms	C: H: O:		C: H: O:
Mass of all atoms			

7.6.
7.6.1. Define the term *exothermic*.
7.6.2. Use the tables of bond energies below to determine whether the reactions that follow are endothermic or exothermic reactions.

Bond	C-H	O-H	C-C	C-O	H-H
Energy (kJ .mol^{-1})	410	460	348	358	431

Bond	O=O	N-H	N≡N	C=O	O-O
Energy (kJ .mol^{-1})	495	391	945	745	

7.6.2.1. decomposition of hydrogen peroxide to form water and oxygen
7.6.2.2. combustion of methane to form H_2O and CO_2
7.6.2.3. decomposition of ammonia to form H_2 and N_2

7.7. Write out the chemical equations for each of the following reactions and then balance the equations.
7.7.1. sodium + oxygen → sodium oxide (A)
7.7.2. sodium nitrate → sodium nitrite + oxygen (B)
7.7.3. hydrogen iodide → hydrogen + iodide (C)
7.7.4. carbon + oxygen → carbon dioxide (D)
7.7.5. copper + sulfuric acid → copper sulphate + sulphur dioxide +water (E)

7.8. Write only A, B, C, D or E. Which reactions in question 4.7 would you classify as:
7.8.1. Synthesis
7.8.2. Decomposition reactions.

7.9. Lithium burns in oxygen with a bright red flame to produce a white solid, lithium oxide.
7.9.1. Name the type of chemical bonding in:
7.9.1.1. Lithium
7.9.1.2. magnesium oxide
7.9.2. Is the reaction between lithium and oxygen a PHYSICAL or CHEMICAL change? Give a reason for the answer.
7.9.3. Write down a balanced equation for the reaction between lithium and oxygen.

7.9.4. Use the law of conservation of mass to show that mass is conserved during the reaction.

Lithium is also very reactive in water, forming lithium hydroxide and hydrogen gas.
7.9.5. Name the type of chemical bonding in hydrogen gas.
7.9.6. Write down a balanced equation for the reaction between lithium and water.

7.10. Rewrite and balance the following chemical equations.
7.10.1. $Mg + HCl \rightarrow MgCl_2 + H_2$
7.10.2. $BiCl_3 + H_2S \rightarrow Bi_2S_3 + HCl$
7.10.3. $KClO_3 \rightarrow KCl + O_2$
7.10.4. $AgNO_3 + MgCl_2 \rightarrow AgCl + Mg(NO_3)_2$
7.10.5. $Al + CuSO_4 \rightarrow Al_2(SO_4)_3 + Cu$

REACTIONS IN AQUEOUS SOLUTIONS

EXAM LEVEL QUESTIONS

8.1. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
What 2 conditions must be satisfied before a substance will conduct electricity?

8.2. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
For each of the following substances predict whether it will conduct electricity, giving reasons.
NB – prediction must be done based on what you KNOW. It is not a random guess.

Substance	Prediction	Reason
Water - distilled		
Water – tap		
Copper wire		
NaCl in aqueous solution		
Xylene – made of molecules with covalent bonds		
Sulphur		

8.3. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
The conductivity of each substance may be tested using a circuit made up of 2 cells connected to an ammeter. The liquids can be connected into the circuit using carbon electrodes.
Draw a circuit diagram of the circuit.

8.4. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Write a description of why charges move when aqueous solutions of ionic substances conduct electricity. Please include a diagram with your explanation.

8.5. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
The electrical conductivity of four different magnesium chloride solutions was tested. The concentrations of the solutions were 10mol.dm^{-3}, 20mol.dm^{-3}, 40mol.dm^{-3} and 80mol.dm^{-3}. The current through each solution was measured and found to be 0,013A, 0,025A, 0,040A and 0,051A respectively. The distance between the electrodes and the voltage applied was kept constant.
8.5.1. Name the independent and dependent variables.
8.5.2. List two variables which were controlled. (kept constant)
8.5.3. Draw a table of the results.
8.5.4. Plot a graph showing the relationship between the concentration vs. current.
8.5.5. Write a justified conclusion of the experiment.
8.5.6. Write an equation showing the dissolution of the magnesium chloride.

8.6. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Consider the following reactions A and B:
A: $2\ Mg + O_2 \rightarrow 2\ MgO$
B: $2\ NaI_{(aq)} + Cl_{2(g)} \rightarrow 2\ NaCl_{(aq)} + I_{2(g)}$
8.6.1. Rewrite reaction A showing the subscripts for the phases.
8.6.2. Which of the reactions is an ion exchange reaction? Explain.
8.6.3. Which of the reactions is a redox reaction? Explain.
8.6.4. How would you test to see which anions are present in the products of Reaction B?

8.7. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
A precipitate is a solid that is formed in solution when a chemical reaction forms an insoluble substance. Listed below are 3 sets of mixtures that will result in the formation of a precipitate. For each of the mixtures, state the formula as well as colour of the precipitate

	Mixtures	**Precipitate Formula**	**Colour of precipitate**
8.7.1	Lead nitrate and potassium chloride		
8.7.2	Sodium carbonate and calcium chloride		
8.7.3	Sodium bromide and silver nitrate		

8.8. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
A chemistry student makes up an ammonium carbonate solution; using a ammonium carbonate crystals and tap water she notices that the solution is not quite clear. She concludes that ammonium carbonate is not very soluble. Is her conclusion correct or not? Explain your answer fully.

8.9. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
The student then needs to make a sodium iodide solution. She sees some 'water' standing in a beaker on the lab bench. She adds a spatula of sodium iodide powder to this 'water' and to her amazement the solution turns into a bright yellow. With the aid of an ionic equation explain what mostly likely happened.

8.10. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Which of the following mixtures will have a better conductivity as an electrolyte if all solutions have a concentration of 0,1mol·dm^{-3}? Give a reason for your answer.
Mixture A: sodium chloride and sodium hydroxide.
Mixture B: Aluminium nitrate and sodium hydroxide.

QUANTITATIVE ASPECTS

EXAM LEVEL QUESTIONS

9.1. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
9.1.1. Calculate the percent by mass of NITROGEN present in ammonium phosphate [$(NH_4)_3PO_4$].
9.1.2. What is the molar mass of hexane (C_6H_{14})?
9.1.3. How many molecules of hexane are there in 4,3g of this compound?

9.2. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Determine the empirical formula of a compound that is 29,0% sodium, 40,5% sulphur, and 30,4 % oxygen by weight.

9.3. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
A sample containing 5 g of Li_2CO_3 is dissolved into water and the solution is made up to a total volume of 100 cm^3.
Calculate:
9.3.1. The number of moles of Li_2CO_3 which is in 5g.
9.3.2. The concentration of solution that is formed.

9.4. $Na + Cl_2 \rightarrow NaCl$
9.4.1. Balance the above equation.
9.4.2. 2 mol of Na react. What mass of NaCl will be formed?
9.4.3. 2 mol of Na react. What mass of chlorine must be present to react with the Na?
9.4.4. What volume of chlorine reacts with 2,5 mol of sodium at STP?

9.5. Magnesium reacts with hydrochloric acid according to the following word equation:

magnesium + hydrochloric acid → magnesium chloride + hydrogen gas

Calculate the volume of hydrogen gas (at STP i.e. 0°C and 101.3 kPa) produced from the reaction of 14,6 g of hydrochloric acid.

9.6. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Thermite is a composition of a metal powder and a metal oxide that causes an exothermic reaction known as the thermite reaction. When aluminium powder is mixed with manganese (IV) oxide powder and the mixture is ignited, extremely high temperatures of up to 2500°C are caused. The unbalanced equation for this reaction is:

$$Al\ (s) + MnO_2\ (s) \rightarrow Al_2O_3\ (s) + Mn\ (l)$$

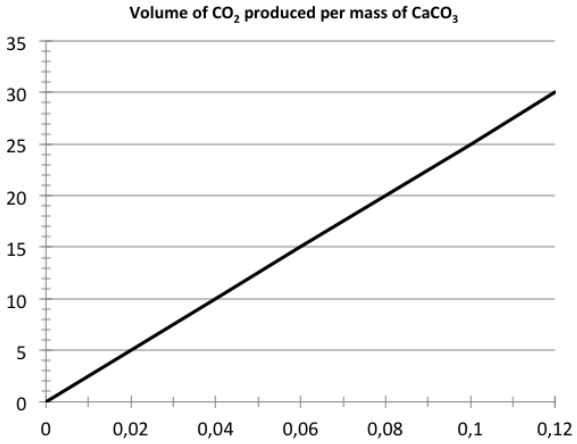
9.6.1. What is the meaning of the Roman numeral (IV) in the name of manganese (IV) oxide?
9.6.2. Balance this equation.
9.6.3. Give the Law of Conservation of Mass in words.
9.6.4. Prove that the Law of Conservation of Mass is valid for the balanced equation.

9.7. Calcium carbonate, $CaCO_3$, reacts with dilute hydrochloric acid, HCl, according to the following balanced equation: .

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O\ (l)$$

9.7.1. The above reaction is an example of an acid-base reaction. Define the term acid-base reaction.

The graph below shows the relationship between the volume of carbon dioxide gas, CO_2(g)formed and the mass of PURE calcium carbonate.



9.7.2. From the graph, determine the volume of CO_2(g) produced when 0,064 g of PURE $CaCO_3$ (s) reacts.
9.7.3. Rennies, a tablet used to neutralize stomach acid, has a mass of 0,5g and contains mainly calcium carbonate which reacts with dilute hydrochloric acid in the stomach to produce carbon dioxide gas. The concentration of hydrochloric acid in the stomach is 0,15mol·dm^{-3}.
9.7.3.1. Define the term concentration of a solution.

It is found that 30 cm^3 of CO_2(g) is formed when one antacid tablet completely reacts.

9.7.3.2. Use the information in the graph and calculate the percentage $CaCO_3$(s) in one antacid tablet.
9.7.3.3. Calculate the volume of hydrochloric acid that will be neutralized by ONE antacid tablet.

9.8. Hydrogen, H_2(g), and nitrogen, N_2(g), react to form ammonia, NH_3(g). The reaction that takes place is represented by the following equation:

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$

9.8.1. Define the term *1 mol*
9.8.2. How many moles of ammonia will be produced from 3mol of hydrogen gas?
9.8.3. Initially 15cm^3 of nitrogen and 30cm^3 of hydrogen are mixed in a container. The temperature and pressure remain constant.
Calculate the volume of gas that will remain in the container after the reaction is completed.

In another experiment, 80 g of hydrogen gas reacts with nitrogen gas to form ammonia.
Calculate the:
9.8.4. Number of moles of nitrogen gas reacted.
9.8.5. Volume of the hydrogen gas used at STP.

9.9. Sodium thiosulphate, $Na_2S_2O_3$(s), reacts with 400cm^3 of hydrochloric acid solution, HCl(aq), of concentration of 0,15mol·dm^{-3} according to the following equation:

$$Na_2S_2O_3(s) + HCl(aq) \rightarrow NaCl(aq) + S(s) + SO_2(g) + H_2O(l)$$

9.9.1. Rewrite the equation as a balanced equation.

9.9.2. Calculate the number of moles of HCl(aq) added to the sodium thiosulphate.
9.9.3. Caculate:
9.9.3.1. The volume of $SO_2(g)$ that will form from the reaction.
9.9.3.2. The mass of the sulphur precipitate.
9.9.3.3. The concentration of sodium chloride in the 400cm^3 solution.
The reaction can be used to extract sulphur from sodium thiosulfate.
9.9.4. Determine the mass of sodium thiosulfate required to form 50g of sulphur in excess hydrochloric acid

9.10. Propane is a combustible gas that can be used as a fuel source. Propane will burn in oxygen according to the equation:

$$C_3H_8(g) + O_2(g) \rightarrow CO_2(g) + H_2O\ (l)$$

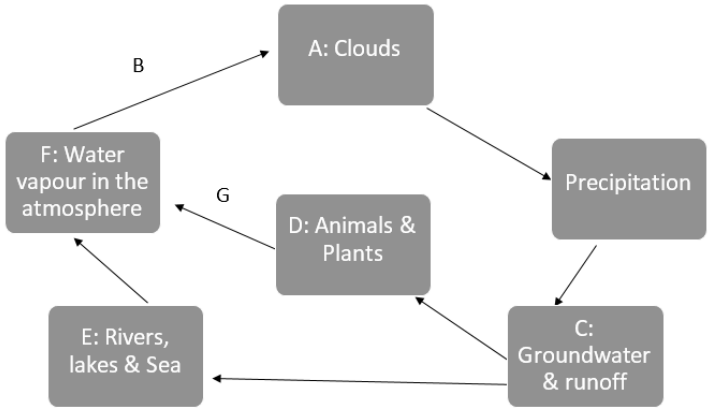
9.10.1. Rewrite the equation above as a balanced equation.

9,48g of propane was burned in excess oxygen.
9.10.2. Determine:
9.10.2.1. The number of propane particles that reacted with oxygen.
9.10.2.2. The volume of oxygen that reacted with the propane.
9.10.2.3. The mass of all the products.

HYDROSPHERE

EXAM LEVEL QUESTIONS

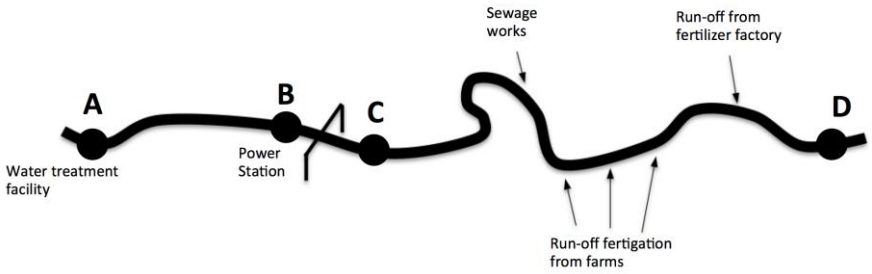
10.1. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
The representation below indicates the key parts of the water cycle as well as the processes between them.



10.1.1. Which system is the water cycle a part of?
10.1.2. State 2 other systems with which the water cycle interacts.
10.1.3. Explain the process of precipitation.
10.1.4. Name the phase change that takes place at B?
10.1.5. Name the process that takes place at G.
10.1.6. Name the 4 types of precipitation.
10.1.7. Is energy absorbed or released during condensation? Give a reason for your answer.
10.1.8. Is evaporation a physical or chemical change? Explain your answer fully.

The water available in block E is divided into rivers, lakes and seas. Sea water makes up a large percentage of the earth.
10.1.9. Explain why many countries experience water crisis despite the abundance of sea water.

10.2. A worked memo is available for this question at **http://tinyurl.com/ScienceClinicYoutube**
Water samples were collected at sites A, B, C and D in a river, as shown on the diagram below.

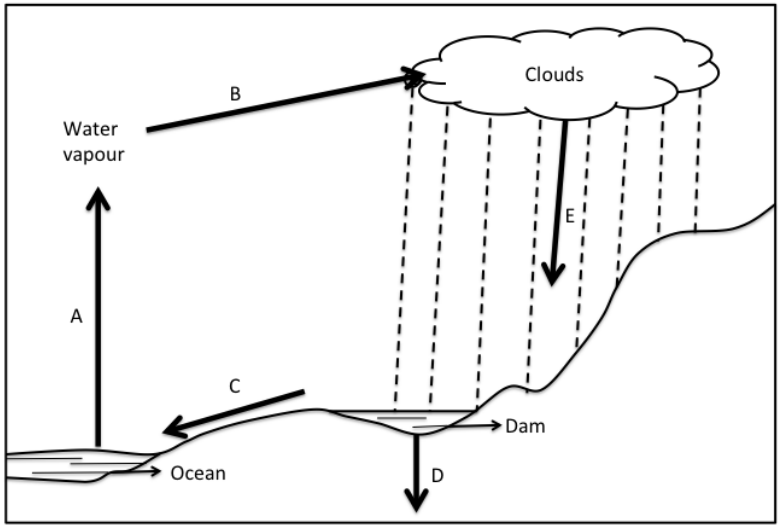


The results of the tests carried out on these samples are shown in the table below:

Test	Sample A	Sample B	Sample C	Sample D
Temperature (°C)	12	13	20	15
Dissolved oxygen (ppm)	18	18	10	5
pH	7	6	6	8.5

10.2.1. The dissolved oxygen is measured in 'ppm'. What does 'ppm' stand for?
10.2.2. There is a small town between points A and B. Suggest why the town's water supply is taken from point A upstream from the town, and not further down the river.
10.2.3. Provide a possible reason for the increase in water temperature between point B and C.
10.2.4. A dam wall has been built between point B and C. Explain the ecological effects of the dam wall.
10.2.5. Provide a possible reason for a decreased pH in the area around the power station.
10.2.6. Why is there an increase in the pH at D?
10.2.7. Researchers have noticed that there are very few fish in area D. Provide 2 possible reasons for the decrease in fish populations.
10.2.8. The town planners are aware of a large amount of workers moving into the city to work at the factories and farms, and they want to minimise the effect of an informal settlement on the environment. Given that informal settlements could contaminate the river, suggest a possible location for its establishment and provide reasons for your answer.
10.2.9. The run-off from the farms and fertilizer factory cause eutrophication in the river. Explain the effects of eutrophication on the river ecosystem.

10.3. The water cycle in the diagram below links the hydrosphere to the other global systems. The letters P, Q, R and S indicate some of the processes which take place in the water cycle.



10.3.1. Briefly explain the term hydrosphere.
10.3.2. Name the processes labelled:
10.3.2.1. A
10.3.2.2. B
10.3.2.3. C
10.3.2.4. E
10.3.3. Write down ONE advantage of process D.
10.3.4. The building of dams has several advantages and disadvantages for humans and the environment. State TWO of these disadvantages.
10.3.5. Name the other 3 global systems that the hydrosphere interacts with.

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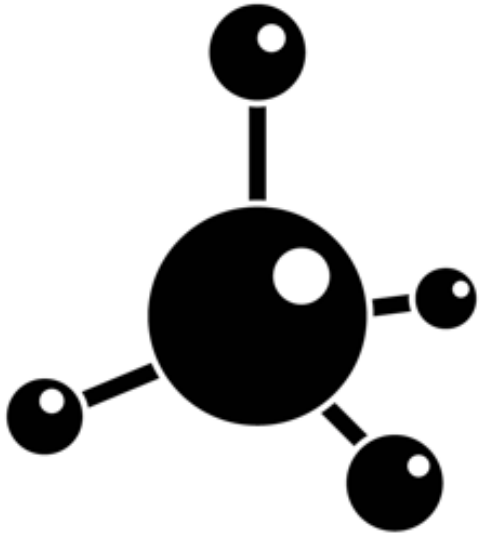

Grade 10 Chemistry

MEMORANDUM

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CLASSIFICATION OF MATTER

EXAM LEVEL QUESTIONS

1.1.

1.1.1.

1.1.1.1. Mixture of compounds
1.1.1.2. Mixture of compounds
1.1.1.3. Element
1.1.1.4. Mixture of elements and compounds
1.1.1.5. Compound
1.1.1.6. Mixture of elements
1.1.1.7. Element

1.1.2.

1.1.2.1. Heterogeneous
1.1.2.2. Homogeneous
1.1.2.3. Pure
1.1.2.4. Heterogeneous
1.1.2.5. Homogeneous
1.1.2.6. Pure
1.1.2.7. Pure
1.1.2.8. Heterogeneous

1.2.

1.2.1. A homogeneous mixture is a mixture in which the constituent components can't be distinguished.
1.2.2. Chromatography
Fractional distillation
Evaporation
1.2.3. A heterogeneous mixture is a mixture in which the constituent components can be clearly distinguished.
1.2.4. Filtration
Separating funnel
Distillation
Decanting
1.2.5. A: Filtration
B: Separating Funnel
C: Distillation
D: Decanting

1.3.

1.3.1. Compound
1.3.2. Element
1.3.3. Heterogeneous
1.3.4. Homogeneous
1.3.5. Compound

1.4.

1.4.1. In heterogeneous mixtures, the components can be clearly distinguished (any applicable example), while in a homogeneous mixture all parts of the system are uniform (any applicable example).
1.4.2. An atom is a single, indivisible matter particle that exists on its own (any applicable example) and a compound is a combination of chemically bonded elements (any applicable example).
1.4.3. A mixture is a combination of substances not bonded together (any applicable example) while a compound is substances that are chemically bonded (any applicable example).

1.5.

1.5.1. Malleability
1.5.2. $MgSO_4$
1.5.3. Heterogeneous mixture
1.5.4. Alloy

1.6.

1.6.1. Fractional Distillation
1.6.2. Filtration
1.6.3. Magnetic separation

1.7.

1.7.1.

1.7.1.1. Salt solution
Air
Dishwashing liquid
1.7.1.2. Fizzy drink and granite

1.7.1.3. sugar
Vinegar
Bicarbonate of soda
1.7.1.4. Graphite

1.8.

1.8.1. Process of evaporation and splits liquid into its fractions by means of boiling point and then condensation.
1.8.2. Fractional distillation is used to separate crude oil.
Fractional distillation can be used to separate two or more miscible liquids.

1.9.

1.9.1.

1.9.1.1. Time taken
1.9.1.2. Material used
1.9.1.3. Length of the rod
Thickness of the rod

1.9.2. Thermal conductivity is the ability of a substance to transfer heat energy through a material.
1.9.3. Graphene
Copper
Aluminium
Lead
Stainless steel
Wood

1.9.4.

1.9.4.1. If the density is increased, aluminium will be more conductive because of the tight arrangement of particles. According to the Kinetic Molecular Theory, temperature and thermal energy is due to the kinetic energy of a substance. If the density is increased and the molecules are more tightly packed, kinetic energy is transferred more effectively. This will cause the time taken for heat transfer through aluminium to decrease.
1.9.4.2. According to the Kinetic Molecular Theory, temperature and thermal energy is due to the kinetic energy of a substance. If the length is increased, the distance that kinetic energy has to be transferred will increase, causing the time taken for heat transfer through aluminium to increase.

1.9.5. Thermal insulator

1.10.

1.10.1.

	Description	Metal, metalloid or non-metal
1	Mostly low melting points and boiling points	Non-metal
2	Brown gas at room temperature	Non-metal
3	Malleable, silver material	Metal
4	Brittle, yellow material	Non-metal
5	high ionization energy	Non-metal
6	form anions through electron gain	Non-metal
7	reacting with oxygen in the air to form metal oxides	Metal
8	Forms allotropes	Non-metal
9	high thermal conductivity	Metal
10	Shiny and lustrous	Metal
11	Group I and II elements	Metal
12	Electrical conductivity increases with temperature	Metalloid
13	Inert gas	Non-metal
14	dull appearance	Non-metal
15	Brittle, black solid that can conduct electrical current	Non-metal
16	Most reactive element	Non-metal
17	poor conductors of heat and electricity	Non-metal
18	malleable and ductile	Metal
19	high electronegativity	Non-metal
20	Forms metallic bonds	Metal
21	Used in semi-conductors	Metalloid
22	Forms covalent bonds	Non-metal
23	Element with the highest electronegativity	Non-metal
24	Group 17 element	Non-metal
25	look like metals but behave largely like non-metals	Metalloid
26	high electrical conductivity	Metal
27	form cations through electron loss	Metal
28	Magnetic	Metal

1.10.2.
- 1.10.2.1. Sulphur
- 1.10.2.2. Carbon
- 1.10.2.3. Fluorine

1.10.3. Allotropes are different forms of the same element that have different physical and chemical properties due to their specific atomic arrangements.

Names and Formulae

EXAM LEVEL QUESTIONS

2.1.

2.1.1. $2AgNO_3 + BaCl_2 \rightarrow 2\ AgCl + Ba(NO_3)_2$

2.1.2. $Cu + 2HNO_3 \rightarrow Cu(NO_3)_2 + H_2$

2.1.3. $2AgNO_3 + MgCl_2 \rightarrow 2\ AgCl + Mg(NO_3)_2$

2.1.4. $O_3 + 3NO \rightarrow 3NO_2$

2.2.

2.2.1.
- 2.2.1.1. 8
- 2.2.1.2. 13

2.2.2.
- 2.2.2.1. sodium carbonate
- 2.2.2.2. zinc sulphate
- 2.2.2.3. potassium chlorate
- 2.2.2.4. lead (II) nitrate
- 2.2.2.5. ammonium chloride
- 2.2.2.6. potassium dichromate
- 2.2.2.7. calcium hydroxide

2.2.3. Write down the chemical formulae of the following:
- 2.2.3.1. H_2SO_4
- 2.2.3.2. CH_3COOH
- 2.2.3.3. KOH
- 2.2.3.4. $CaCO_3$
- 2.2.3.5. NH_3

2.3.

2.3.1. NO_2

2.3.2. Covalent bonds. Electrons in the outer orbitals are shared between two non-metals.

2.3.3.

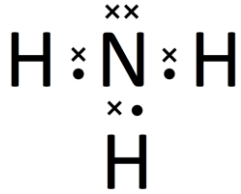
2.3.3.1.

2.3.3.2.

2.4.

2.4.1. Ammonia :

2.4.2.



2.4.3. NH_4^+

2.4.4.
- 2.4.4.1. NH_4OH
- 2.4.4.2. $(NH_4)_2SO_4$
- 2.4.4.3. $(NH_4)_2Cr_2O_7$
- 2.4.4.4. NH_4Cl

2.5.

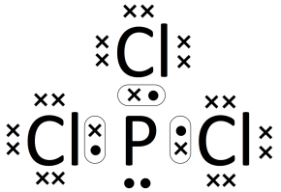
2.5.1.
- 2.5.1.1. Hydrochloric acid
- 2.5.1.2. Nitric acid
- 2.5.1.3. Sulfuric acid
- 2.5.1.4. Carbonic acid
- 2.5.1.5. Ethanoic acid

2.5.2.
- 2.5.2.1. Na_2SO_3
- 2.5.2.2. HgO
- 2.5.2.3. $(NH_4)_2SO_4$
- 2.5.2.4. $Fe_2(SO_4)_3$
- 2.5.2.5. KNO_3

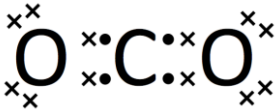
2.5.3.
- 2.5.3.1. $NaHCO_3$
- 2.5.3.2. K_2CO_3
- 2.5.3.3. $Ca(OH)_2$
- 2.5.3.4. $MgSO_4$

2.6. Provide the formulae of the following substances:
- 2.6.1. $LiNO_3$
- 2.6.2. $(NH_4)_2O$
- 2.6.3. $FeCl_3$
- 2.6.4. $MgSO_4$
- 2.6.5. $KMnO_4$

2.6.6. Lewis structure:



2.6.7. Lewis structure:



2.7.

	Iron (II)	Iron (III)	Silver	Mercury	Lead	Zinc
Acetate	$(CH_3COO)_2Fe$	$(CH_3COO)_3Fe$	CH_3COOAg	CH_3COOHg	$(CH_3COO)_2Pb$	$(CH_3COO)_2Zn$
Chloride	$FeCl_2$	$FeCl_3$	AgCl	HgCl	$PbCl_2$	$ZnCl_2$
Sulphate	Fe_2SO_4	$Fe_2(SO_4)_3$	Ag_2SO_4	Hg_2SO_4	Pb SO_4	Zn SO_4
Oxide	FeO	Fe_2O_3	Ag_2O	Hg_2O	PbO	ZnO
Nitrate	$Fe(NO_3)_2$	$Fe(NO_3)_3$	$AgNO_3$	Hg NO_3	$Pb(NO_3)_2$	$Zn(NO_3)_2$
nitride	Fe_3N_2	FeN	Ag_3N	Hg_3N	Pb_3N_2	Zn_3N_2

KINETIC THEORY OF MATTER

EXAM LEVEL QUESTIONS

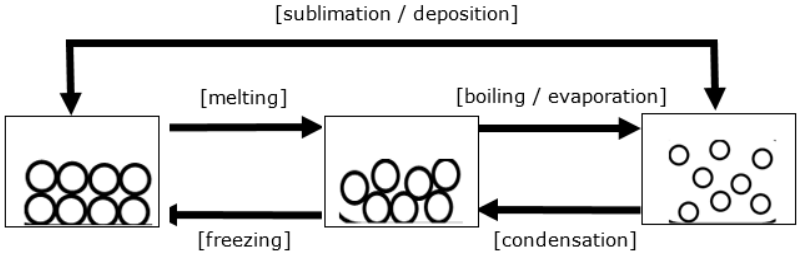
3.1.
- 3.1.1. Melting
- 3.1.2. Evaporation
- 3.1.3. Condensation
- 3.1.4. Deposition
- 3.1.5. Boiling
- 3.1.6. Freezing

3.2.
- 3.2.1. Vibrate about their fixed positions even faster.
- 3.2.2. Particles have enough energy to overcome the forces of attraction and start swapping places with their neighbours.
- 3.2.3. The kinetic energy remains constant because the particles are not moving faster. The potential energy increases , because they are more free to move around.

3.3.
- 3.3.1. They swap places even faster.

3.3.2. The hotter the material, the more energy the particles have, the more they can overcome the forces of attraction, hence they can move further apart to where the forces of attraction are less.
3.3.3. They move around even faster.

3.4.



3.5.

3.5.1. Liquid
3.5.2. 0°C
3.5.3. Substance 1 is changing phase from a solid to a liquid.
3.5.4. Evaporation
3.5.5. At B, the phase change is taking place and there is a change in potential energy. The kinetic energy remains constant. At D, the kinetic energy is increasing
3.5.6. Substance represented by Curve 1, since it has the lowest boiling point.
3.5.7. They have the same average E_k.

3.6.

3.6.1. A and H
3.6.2. B
3.6.3. I it has the highest MP and BP
3.6.4. A
3.6.5. I strongest IMF/ Highest MP and BP
3.6.6. D will be a gas and molecules will be further apart than H, which will stilll be a liquid and its molecules will be closer together than D. They will have the same E_k

3.7.

3.7.1. 85°C
3.7.2. 55°C
3.7.3. condensation
3.7.4. Exothermic
3.7.5. Intermolecular forces are re-established.
Heat is released / The re-establishment of intermolecular forces is exothermic.
OR: The potential energy of the particles decrease while the kinetic energy of the particles remain the same.

3.7.6. Room temperature is reached. There is no temperature difference between the environment and the substance. Thus no exchange of energy takes place.
3.7.7. Yes, the substance is a pure substance. During the phase changes there is no change in temperature. This must mean that only one substance is present- the one that is undergoing the phase change.

3.8.

3.8.1. A: Solid
C: Liquid
E: Gas
3.8.2. B: Melting
D: Evaporation
3.8.3. A: The particles increase in kinetic energy; they start to vibrate more vigorously as the temperature increases.
B: The kinetic energy remains constant; the energy that is added causes an increase in potential energy. The particles separate slightly from each other as they change from solid to liquid phase.
C: The particles increase in kinetic energy; they start to vibrate more vigorously as the temperature increases.
D: The kinetic energy remains constant; the energy that is added causes an increase in potential energy. The particles separate from each other as they change from liquid to gaseous phase.
E: The particles increase in kinetic energy; they start to vibrate more vigorously and move further from each other as the temperature increases. The particles collide with the container that they are in, and the collisions increase in force as temperature increases.

3.9.

3.9.1.

3.9.1.1. E to F

3.9.1.2. A to B

3.9.1.3. B to C AND D to E

3.9.1.4. D to E

3.9.1.5. B to C

3.9.1.6. F

3.9.2.

3.9.2.1. 160°C

3.9.2.2. 80°C

3.9.2.3. 6 minutes

3.9.2.4. 12 minutes

3.10.

3.10.1. The temperature at which the vapour pressure of a liquid is equal to the external atmospheric pressure.

3.10.2.

3.10.2.1. A:Gas
B:Solid
C:Gas
D:Liquid

3.10.2.2. A:Gas
B:Solid
C:Liquid
D:Solid

3.10.2.3. A:Gas
B:Solid
C:Liquid
D:Solid

3.10.3. MP: 0°C
BP: 100°C

3.10.4. The single combination of pressure and temperature at which liquid water, solid ice, and water vapor can coexist.

3.10.5. II

THE ATOM

EXAM LEVEL QUESTIONS

4.1. Complete the following table:

4.1.1. 0

4.1.2. H_1^1

4.1.3. 1

4.1.4. Al_{13}^{27}

4.1.5. 27

4.1.6. Neon

4.1.7. Ne_{10}^{21}

4.1.8. 21

4.1.9. Cobalt

4.1.10. 27

4.1.11. 32

4.1.12. 59

4.1.13. 74

4.1.14. I_{53}^{127}

4.2. Give the number of protons, neutrons and electrons in the following

4.2.1. 12 p^+ ; 13 n^0 ; 12 e^-

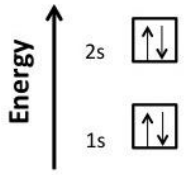
4.2.2. 19 p^+ ; 20 n^0 ; 18 e^-

4.2.3. 33 p^+ ; 42 n^0 ; 36 e^-

4.2.4. 55 p^+ ; 78 n^0 ; 55 e^-

4.3.

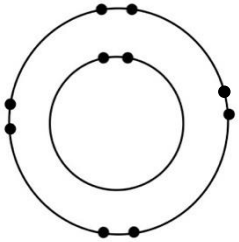
4.3.1. Number of electrons are spinning in the opposite directions orbitals labelled



4.3.2. $1s^2$

4.3.3.

4.3.3.1. 6
4.3.3.2. -2
4.3.3.3. Pairing, the correct number of electrons, two shells



4.4.

4.4.1. B and C
4.4.2. A (16-8=8) and C(14-6=8)
4.4.3. The same number of protons in each atom
They are the same element
Same number of electrons in a neutral atom or both non-metals.
4.4.4. Isotopes
4.4.5. Group 3A or 13

4.5.

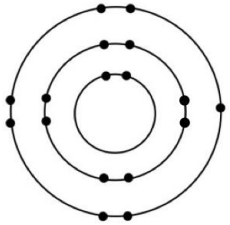
4.5.1. Atoms of the same element differing only in the number of neutrons or mass numbers
4.5.2. Relative atomic mass = (7,5/100 x 6) + (92,5/100 x 7) = 6,925
4.5.3. 3 electrons
4.5.4. $1s^2$
4.5.5. $Li \rightarrow Li^+ + e^-$

4.6.

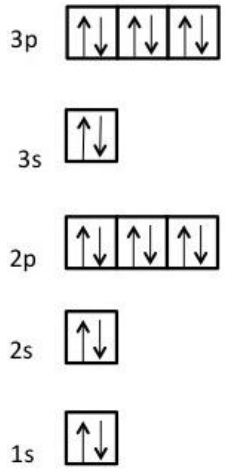
4.6.1. Isotopes
4.6.2. Iron - do not accept symbol
4.6.3. 26 electrons
4.6.4. They are the same. Chemical properties are not determined by the structure of the nucleus or the number of neutrons but by the electron structure.
4.6.5. Period 4
4.6.6. Relative atomic mass = (51,84/100 x 107) + (48,16/100 x 109) = 107,96

4.7.

4.7.1. 7
4.7.2. Pairing, the correct number of electrons



4.7.3.



4.7.4. Chlorine has isotopes and hence the relative atomic masses of elements are not always whole numbers but rather an average of the combined isotopes.

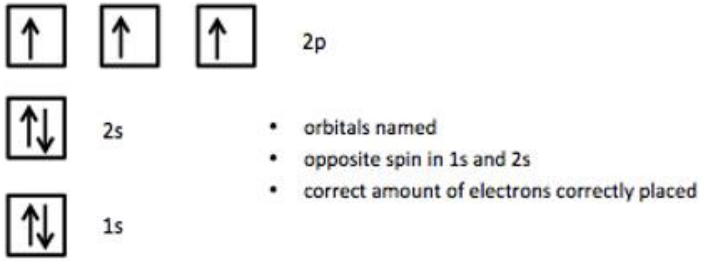
4.8.

4.8.1. Similar: they both have same mass number or number of nucleons
Different: they have different number of
Protons: H=1, He=2
Electrons: H=1, He=2
Neutrons: H=2, He=1

4.8.2. An element with atomic number 92 has isotopes with relative atomic masses of 235 and 238 respectively. What are the compositions of the nuclei of each of these isotopes?
Nucleus of Uranium- 235 : 92 protons, 143 neutrons and 235 nucleons.
Nucleus of Uranium- 238 : 92 protons, 146 neutrons and 238 nucleons.

4.9.

4.9.1.



4.9.2. Relative atomic mass = 14 x 90/100 + 15 x 10/100 = 14,1

4.9.3. No, the chemical properties of the isotopes will not differ. They have the same amount of valence electrons (also accept "same amount of electrons").

4.9.4. Three

4.10.

4.10.1.

4.10.1.1. The number of protons in the nucleus of an atom

4.10.1.2. Atoms with the same number of protons but different mass numbers

4.10.2.

4.10.2.1. $1s^2 2s^2 2p^4$

$$RAM = \frac{16\times x}{100} + \frac{18\times(100-x)}{100}$$

$$16{,}04 = \frac{16x+1800-18x}{100}$$

4.10.2.2.

$$1604 = -2x + 1800$$
$$-196 = -2x$$
$$x = 98$$
$$\therefore \%\ abundance\ of\ {}^{16}_{8}O = 98\%$$

4.10.3.

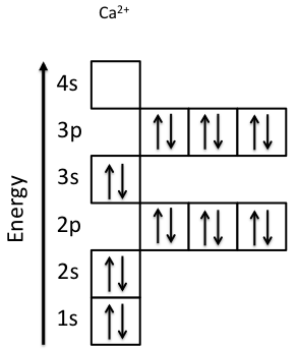
4.10.3.1. 6

4.10.3.2. Covalent bonding

4.10.3.3.

4.10.4.

4.10.4.1.



4.10.4.2. Ca^{2+} and O^{2-}

PERIODIC TABLE

EXAM LEVEL QUESTIONS

5.1.

5.1.1. Carbon

5.1.2. Non-metal Element Z is brittle and black while metals are malleable and silver.

5.1.3. Allotrope

5.1.4. The structure in which carbon bonds is different to the structure of diamonds, resulting in different properties

5.2.

5.2.1. $$A = \frac{(90{,}60\times20)+(0{,}20\times21)+(9{,}20\times22)}{100}$$
$$= 20{,}19$$

5.2.2. Same number of protons, different number of neutrons, different mass number, same atomic number, same number of electrons.
5.2.3. Yes, their number of electron are the same and will undergo the same bonding.

5.3.

5.3.1.

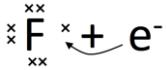
5.3.1.1. +2
5.3.1.2. $MgBr_2$
5.3.1.3. MgO
5.3.1.4. +3
5.3.1.5. $GaBr_3$
5.3.1.6. Ga_2O_3

5.4.

5.4.1. Chlorine
5.4.2. All found in period 2
5.4.3. Al,Mg,Na
5.4.4. Al – Al_2O_3

5.5.

5.5.1. 7
5.5.2. Halogens
5.5.3. I,Br,Cl,F
5.5.4. 1
5.5.5.

Step 1: 

Step 2: 

5.5.6. Halogens have a high electronegativity and attract single electrons in order to obtain a full orbital structure, which is more stable.

5.6.

5.6.1. Positive
5.6.2. $Mg \rightarrow Mg^{2+} + 2e$ or $Mg - 2e \rightarrow Mg^{2+}$
5.6.3. Smaller. The Mg ion has lost an entire energy level

5.7.

5.7.1. Na
5.7.2. Li
5.7.3. Cl
5.7.4. Kr
5.7.5. Br.

5.8.

5.8.1. The energy needed to remove the first electron from an atom in a gaseous phase.
5.8.2. Group 8
5.8.3. The outer orbitals are completely filled and the atoms are stable.
5.8.4. As you move across the period, the ionization energy increase.
5.8.5. Second energy level.
5.8.6. There is a stronger nuclear attraction to the valence electrons in Be **,** therefore Be has a higher ionisation energy.
5.8.7. B has a lower ionisation energy as there is one valence electron in the p orbital which is higher in energy than the 2s orbital in Beryllium. The 2p electron in boron is slightly more distant from the nucleus than the 2s, and is partially screened by the $2s^2$ electrons as well as the core electrons. It therefore needs less energy for removal than Beryllium.
5.8.8. Ne's valence electrons are found in the 2nd energy level while Ar's valence electrons are found in the third energy. Ne experiences a greater nuclear attraction to its valence electrons and hence will require greater ionisation energy. Ar's nuclear attraction is weaker to its valence electrons as its valence electrons are found in the third energy level. The valence electrons in Ar are further away and screened by the core electrons.

5.9.

5.9.1. The energy needed to remove the first electron from an atom in a gaseous phase.
5.9.2. Period 3
5.9.3.

5.9.3.1. Magnesium has a greater nuclear attraction to the valence electrons as there one more proton and one more electron compared to sodium.

5.9.3.2. Aluminium's outermost electron is found in the 2p orbital which is further away from the nucleus and does not experience as great attraction as compared to Magnesium. Aluminium's one valence electron is shielded by the electrons in the 2s orbital and by the core electrons and hence, it has a lower ionsation energy.

5.10.

5.10.1. Energy required to remove the first electron from a single stable atom in a gaseous phase of the element.

5.10.2. B - significant increase in energies between 3rd and 4th ionisation energies therefore the first 3 electrons are relatively easy to remove therefore 3 valence electrons therefore 3^+ ion.

5.10.3. A

5.10.4. C/D - Group 2

5.10.5. E/F - no significant increase for the first four which implies that electrons are not lost but gained therefore a non-metal (concept).

5.11. The Periodic Table of elements is now an indispensable tool in chemistry.

5.11.1. Group

5.11.2. Period

5.11.3.

5.11.3.1. 2

5.11.3.2. 8

5.11.4.

5.11.4.1. 7

5.11.4.2. 3

5.11.5.

5.11.5.1. Period 3 Group 14

5.11.5.2. Period 2 Group 15

5.11.6.

5.11.6.1. M_r= (14)+(5x1)+(16) = 35

5.11.6.2. M_r =(63,5)+(2x14)+(6x16) = 187,5

5.11.6.3. Mr =56+16 = 72

5.11.6.4. M_r =(39)+(55)+(4x16) = 158

5.11.7.

5.11.7.1. Hydrogen, Nitrogen, Fluorine, Chlorine, Bromine, Iodine, Oxygen

5.11.7.2. Bromine, Mercury, Francium

5.12.

5.12.1.

5.12.1.1. The energy necessary to remove an electron from an atom.

5.12.1.2. How does the ionisation energy change (INCREASE, DECREASE or REMAIN THE SAME)

5.12.1.2.1. Increase

5.12.1.2.2. Decrease

5.12.1.3. It only has 3 electrons

5.13.

5.13.1. Electronegativity refers to the ability of an atom to attract a bonding pair. Noble gases do not form bonds.

5.13.2. Fluorine

5.14.

5.14.1. The amount of energy released when a neutral atom accepts an electron.

5.14.2. Noble gases cannot accept any more electrons.

5.15.

	1							18
1	E	2	13	14	15	16	17	C
2	A		F		J	B	D	G
3	H	I						

CHEMICAL BONDING

EXAM LEVEL QUESTIONS

6.1.

6.1.1. Al_2S_3
6.1.2. $CuCl_2$
6.1.3. $FePO_4$

6.2.

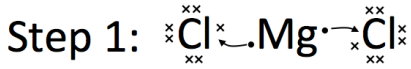
6.2.1. ammonium nitrate
6.2.2. lithium sulfate
6.2.3. sulphur trioxide

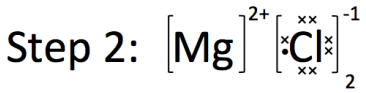
6.3.

6.3.1. C-H bond is polar covalent because C is more electronegative than H and draws the electron pair closer to itself, hence C is slightly negative and H is slightly positive.
6.3.2. CH_4 is tetrahedral- symmetrical in shape (an even distribution of electrons) and hence the molecule as a whole is non-polar.

6.4.

6.4.1. Mg – 2 and Cl - 1
6.4.2.

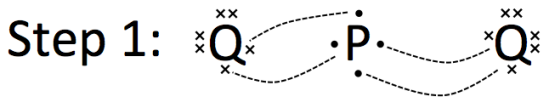




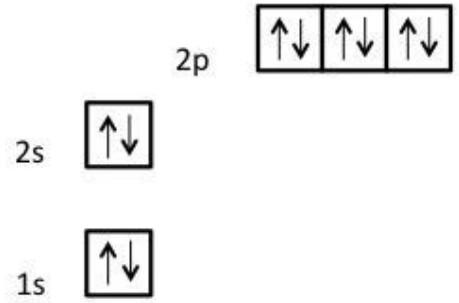
6.4.3. Electrostatic force of attraction
6.4.4. (Mg)1: 2(Cl)
6.4.5. Magnesium Chloride

6.5.

6.5.1.1. P - carbon or C; Q - oxygen or O
6.5.1.2. Covalent bond
6.5.1.3.



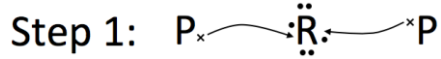
6.5.1.4. Ionic Bond
6.5.1.5. Potassium oxide
6.5.2. Correct energy levels, correct number of electrons, electrons spinning in opposite direction:

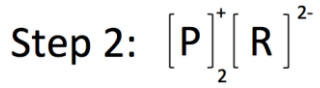


6.5.3. 3
6.5.4. 2

6.6.

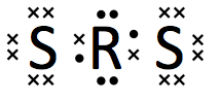
6.6.1. Ionic
6.6.2.





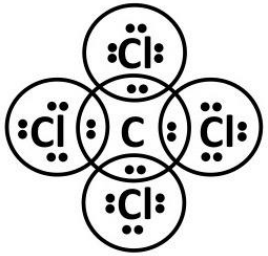
6.6.3. Covalent

6.6.4.



6.6.5. Covalent
6.6.6. P,R,S

6.7. Examine the following molecular structure.
6.7.1. A measure of the tendency of an atom to attract a bonding pair of electrons.
6.7.2.

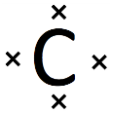


6.7.3. Disagree. There are four polar bonds between C and Cl. Cl is more electronegative than C and Cl pulls the bonding pair of electrons closer and hence Cl is slightly negative and C is slightly positive, making each bond polar. However, the shape is symmetrical and hence CCl_4 is non-polar molecule as a whole.

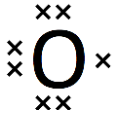
6.8.
6.8.1. Ionic
6.8.2. Any property e.g conducts electricity, conducts heat, malleable, ductile
6.8.3. Atom
6.8.4. Positive and negative ions
6.8.5. Covalent bonds
6.8.6. metallic bonds or Columbic force of attraction between atomic kernels and sea of delocalised electrons
6.8.7. e.g. NaCl – any ionic compound

6.9.
6.9.1. Allotropes
6.9.2. A- diamond B- graphite
6.9.3. Graphite has free/delocalized electrons while in diamond all electrons are fixed in covalent bonds
6.9.4. All four carbons take part in bonding, forming a giant network of carbons covalently bonded to each other, making diamond very strong.

6.10.
6.10.1. 4
6.10.2. 2
6.10.3.
6.10.3.1.



6.10.3.2.



6.10.3.3.

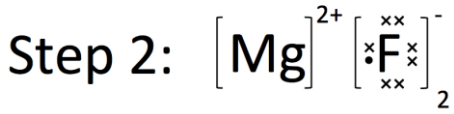
6.10.4. Covalent bonding
6.10.5. No. The bonds between the C and H atoms are polar and between the C and O atoms are polar because the bonding atoms have a difference in electronegativity, but the bonds between the C atoms are non-polar because they have the same electronegativity.
6.10.6. CH_3CH_2COOH or $C_3H_6O_2$

6.11.
6.11.1. Diamond
6.11.2. Iodine
6.11.3. Sodium Chloride
6.11.4. Sodium
6.11.5. Sodium Chloride
6.11.6. Sodium
6.11.7. Ice
6.11.8. Diamond

6.12.

6.12.1. The amount of energy required to remove one electron from a neutral atom in the gaseous phase.

6.12.2.



6.12.3.

6.12.3.1. Ionic
6.12.3.2. High
6.12.3.3. Poor
6.12.3.4. Good

6.13.

6.13.1. Metallic Bonding
6.13.2. Electrostatic forces/ Coulombic Forces
6.13.3. Giant covalent molecule/ macromolecule/ network covalent structure
6.13.4. C
6.13.5. A and D

PHYSICAL AND CHEMICAL CHANGE

EXAM LEVEL QUESTIONS

7.1.

	Volume	Shape	Spaces between particles	Forces between particles	Arrangement of particles	Movement of particles
Gas	Depends on container	Depends on container	Far apart	SMALL	FAR APART	VERY FAST
Liquid	FIXED	Depends on container	TOUCHING	MEDIUM	Touching each other but not in fixed positions	Slide past each other switching places.
Solid	Fixed	FIXED	TOUCHING	LARGE	Close together. Fixed positions in a set pattern.	Vibrate in fixed position

7.2. A chemical reaction takes place. Sodium and chlorine react to form a new substance Table salt which has different properties.

7.3.

7.3.1. Chemical
7.3.2. The 1,0g magnesium reacted with 0,8g oxygen in the air to form 1,8g MgO.

7.4.

7.4.1.

7.4.2. Molar mass ratio.
7.4.3. The ratio between the numbers of O and N atoms in the molecule.

7.4.4. $N_2 + O_2 \rightarrow 2NO$
$2N_2 + 5O_2 \rightarrow 2N_2O_5$

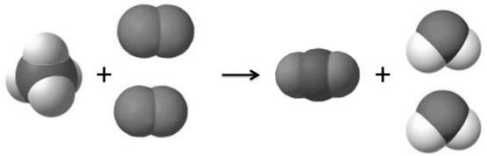
7.4.5. N_2O_5 has more energy stored because more bonds were formed when the reaction took place.

7.5.

7.5.1. $CH_4 + 2O_2 \rightarrow + 2H_20$

7.5.2. Chemical

7.5.3.



7.5.4. 2

7.5.5.

	Reactants before	**→**	**Products after**
Word equation	Methane (CH_4) reacts with oxygen		Water and carbon dioxide
Chemical equation	CH_4 + $2O_2$		CO_2 + $2H_20$
Atoms	C = 1 H = 4 O = 4		C = 1 H =4 O = 4
Mass of all atoms	(1 x 12) + (4 x 1) + (4 x16) = 80		(1 x 12) + (4 x 1) + (4 x16) = 80

7.6.

7.6.1. A reaction that releases heat into the environment.

7.6.2.

7.6.2.1. Exothermic

7.6.2.2. Exothermic

7.6.2.3. Endothermic

7.7.

7.7.1. $4Na + O_2 \rightarrow 2Na_2O$

7.7.2. $2NaNO_3 \rightarrow 2NaNO_2 + O_2$

7.7.3. $2HI \rightarrow H_2 + I_2$

7.7.4. $C + O_2 \rightarrow CO_2$

7.7.5. $Cu + 2H_2SO_4 \rightarrow CuSO_4 + 2SO_2 + 2H_2O$

7.8.

7.8.1. A and D

7.8.2. B and C

7.9.

7.9.1.

7.9.1.1. Metallic bonding

7.9.1.2. Ionic bonding

7.9.2. A chemical change. There are new bonds formed between lithium and oxygen.

7.9.3. $4Li(s) + O_2(g) \rightarrow 2Li_2O(s)$

7.9.4.

Reactants:	Products:
4(7) + (32)	2(30)
=60	=60

Mass of reactants= mass of products
Therefore mass is conserved

7.9.5. Covalent bonding

7.9.6. $2Li(s) + 2H_2O\ (l) \rightarrow 2LiOH(aq) + H_2(g)$

7.10.

7.10.1. $Mg + 2HCl \rightarrow MgCl_2 + H_2$

7.10.2. $2BiCl_3 + 3H_2S \rightarrow Bi_2S_3 + 6HCl$

7.10.3. $2KClO_3 \rightarrow 2KCl + 3O_2$

7.10.4. $2AgNO_3 + MgCl_2 \rightarrow 2AgCl + Mg(NO_3)_2$

7.10.5. $2Al + 3CuSO_4 \rightarrow Al_2(SO_4)_3 + 3Cu$

REACTIONS IN AQUEOUS SOLUTIONS

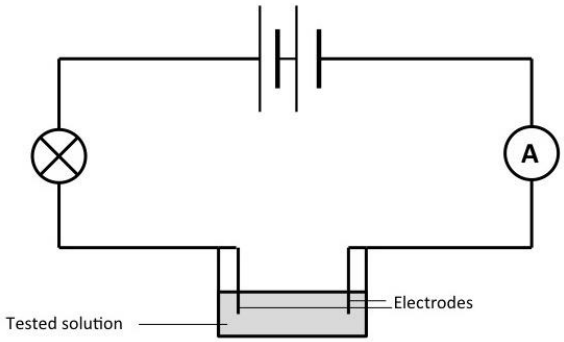
EXAM LEVEL QUESTIONS

8.1. Substance must contain charge carriers
Charge carriers must be free to move

8.2.

Substance	Prediction	Reason
Water - distilled	No	No ions
Water – tap	Yes	There are some ions to carry the charge, which are free to move
Copper wire	Yes	There are some electrons to carry the charge, which are free to move
NaCl in aqueous solution	Yes	There are some ions to carry the charge, which are free to move
Xylene –	No	No ions
Sulphur	No	No ions

8.3.



8.4. There are ions in the ionic solution. These ions are free to move. The negative ions will be attracted to the positive electrode on the left and the positive ions will be attracted to the negative electrode on the right. The circuit will be complete.

8.5.

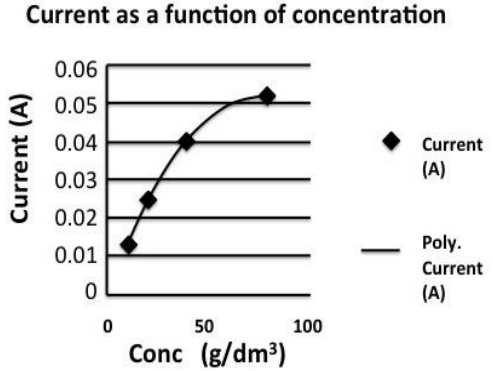
8.5.1. IV = concentrations of the solutions.
DV = current through each solution.

8.5.2. The distance between the electrodes and the voltage applied was kept constant.

8.5.3.

Data	Conc / [g dm^{-3}]	Current /[A]
1	10	0,013
2	20	0,025
3	40	0,040
4	80	0,051

8.5.4.



8.5.5. The graph shows that as the concentration increases, so does the current – however, the concentration and current is not directly proportional.

8.5.6. $MgCl_2(s) \rightarrow Mg^{2+}(aq) + 2Cl^-(aq)$

8.6.

8.6.1. $2\,Mg(s) + O_2(g) \rightarrow 2\,MgO(s)$

8.6.2. B: The iodide ions have been exchanged for the chloride ions.

8.6.3. A: Each Mg atoms have lost 2 electrons, one to each of the Cl atoms.
8.6.4. Acidify with Dilute HNO_3 Add a few drops of Ag NO_3.
White precipitate indicates Chloride ions are present. (AgCl has formed)

8.7.
8.7.1. $PbCl_2$, white
8.7.2. $CaCO_3$, white
8.7.3. AgBr, cream

8.8. No her conclusion is incorrect. Ammonium carbonate is soluble, but carbonate is insoluble with other ions. Tap water contains other ions that will form a low concertation precipitate leaving the solution murky.

8.9. There was a precipitation reaction that took place, the precipitation is most likely head iodide
$I^-_{(aq)}$ + $Pb^{+2}{}_{(aq)}$ → $PbI_{2(s)}$

8.10. Mixture A. Mixture B will form a precipitate which lowers the concentration of free ions in the solution.

QUANTITATIVE ASPECTS OF CHEMICAL CHANGE

EXAM LEVEL QUESTIONS

9.1.
9.1.1. Percent by mass of NITROGEN present in ammonium phosphate $[(NH_4)_3PO_4]$.
% by mass = 3 nitrogen atoms / $[(NH_4)_3PO_4]$ x 100 = 3 x 14 / (149) x 100 = 28,19 %
9.1.2. Molar mass of hexane (C_6H_{14}) = 72 + 14 = 86 g mol^{-1}
9.1.3. Moles of hexane are there in 4,3g: n = m / M = 0,05 mol
Molecules of hexane are there in 4,3g = 0,05 x 6,02 x 10^{23} = 3,01 x 10^{22}

9.2. 29,0% sodium, 40,5% sulphur, and 30,4 % oxygen by weight.

	Na	S	O
Mass	29	40,5	30,4
M	23	32	16
n	1,26	1,26	1,9
Ratio	1	1	1,5
Whole numbers	2	2	3

Formula is $Na_2S_2O_3$

9.3.
9.3.1. number of moles of Li_2CO_3 = m / M = 5 / (14+12+48) = 0,068 mol
9.3.2. concentration of solution = n / V = 0,068 / 0,1 = 0,68 $mol.dm^{-3}$

9.4.
9.4.1. 2 Na + Cl_2 → 2 NaCl
9.4.2. 2 mol Na form 2 mol NaCl. Mass = n x M = 2 x 58,5 = 117g
9.4.3. 1 mol Cl_2 required = 71g
9.4.4. 2,5 mol of sodium reacts with 1.25 mol Cl_2 volume of Cl_2 = 1,25 x 22,4 = 28dm^3

9.5. magnesium + hydrochloric acid → magnesium chloride + hydrogen gas
$Mg(s) + 2\ HCl\ (aq) \rightarrow Mg\ Cl_2\ (aq) + H_2\ (g)$
n.(hydrochloric acid) = 14,6 g / 36,5 = 0,4mol
n.(hydrogen gas) = 0,2 mol
volume of hydrogen gas = 0,2 x 22,4 = 4,48 dm^3.

9.6.
9.6.1. It indicates that the manganese ion will be a 4+ ion OR it indicates that the oxidation state of the manganese is 4+.
9.6.2. 4Al + $3MnO_2$ → $2Al_2O_3$ + 3Mn
9.6.3. The (total) mass of the reactants of a chemical reaction is equal to the (total) mass of the products of the reaction.
9.6.4. $M_r(\text{reactants}) = 4(27) + 3(55 + (16 \times 2))$
$= 369$
$M_r(\text{products}) = 2((27 \times 2) + (16 \times 3)) + (3 \times 55)$
$= 369$
M_r(reactants) = M_r(products)

Law of Conservation of Mass is valid

9.7.
9.7.1. An acid-base reaction is a reaction that takes place between acids and bases.
9.7.2. 17cm^3

9.7.3.

9.7.3.1. The concentration of a solution is the amount of solute per unit volume of solution.

9.7.3.2. 30cm^3 = 0,12g

% $CaCO_3$ in antacid tablet= $\frac{0,12}{0,5} \times 100 = 24\%$

9.7.3.3. $n(CaCO_3) = \frac{m}{M}$

$= \frac{0,12}{100}$

$= 1,2 \times 10^{-3}\ mol$

$CaCO_3 : HCl$

$1 : 2$

$1,2 \times 10^{-3} : 2,4 \times 10^{-3}$

$$c = \frac{n}{V}$$
$$0,15 = \frac{2,4 \times 10^{-3}}{V}$$
$$V = \frac{2,4 \times 10^{-3}}{0,15}$$
$$V = 0,016dm^3$$
$$\therefore = 16mL$$

9.8.

9.8.1. The number of particles or atoms as in 12,0g of carbon-12

9.8.2. $H_2 : NH_3$

$3 : 2$

$\therefore n(NH_3) = 2mol$

9.8.3. $Hydrogen\ is\ the\ limiting\ reactant$

$number\ of\ moles\ N_2\ used:$

$H_2 : N_2$

$3 : 1$

$30 : 10$

$\therefore amount\ of\ N_2 remaining = 5cm^3$

$number\ of\ moles\ of\ NH_3:$

$H_2 : NH_3$

$3 : 2$

$30 : 20$

$\therefore amount\ of\ NH_3 produced = 20cm^3$

$Volume\ remaining = 5 + 20 = 25cm^3$

9.8.4. $n(H_2) = \frac{m}{M}$

$= \frac{80}{2}$

$= 40mol$

$H_2 : N_2$

$3 : 1$

$2,86 : 0,96$

$\therefore n(N_2) = 0,95mol$

9.8.5. $n = \frac{V}{V_M}$

$0{,}95 = \frac{V}{22{,}4}$

$(0{,}95)(22{,}4) = V$

$V = 21{,}28dm^3$

9.9.

9.9.1. $Na_2S_2O_3(s) + 2HCl(aq) \rightarrow 2NaCl(aq) + S(s) + SO_2(g) + H_2O(l)$

9.9.2. $n(HCl) = cV$

$= (0{,}15)(0{,}4)$

$= 0{,}06mol$

9.9.3.

9.9.3.1. $HCl : SO_2$

$2 : 1$

$0{,}06 : 0{,}03$

$n = \frac{V}{V_M}$

$0{,}03 = \frac{V}{22{,}4}$

$V = (0{,}06)(22{,}4)$

$V = 0{,}672dm^3$

9.9.3.2. $HCl : S$

$2 : 1$

$0{,}06 : 0{,}03$

$n = \frac{m}{M}$

$0{,}03 = \frac{m}{32}$

$(0{,}03)(32) = m$

$m = 0{,}96g$

9.9.3.3. $HCl : NaCl$

$2 : 2$

$0{,}060{,}06$

$c = \frac{n}{V}$

$c = \frac{0{,}06}{0{,}4}$

$c = ,15mol \cdot dm^{-3}$

9.9.4. $n(S) = \frac{m}{M}$

$= \frac{50}{32}$

$= 1{,}56mol$

$S : Na_2S_2O_3$

$1 : 1$

$1{,}56 : 1{,}56$

$n = \frac{m}{M}$

$1{,}56 = \frac{m}{158}$

$m = (1{,}56)(158)$

$m = 246{,}48g$

9.10.

9.10.1. $C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4\square_2O\ (l)$

9.10.2.

9.10.2.1.

$$n(C_3H_8) = \frac{m}{M}$$
$$= \frac{9,48}{44}$$
$$= 0,22mol$$

$$no.of\ particles = nN_A$$
$$= (0,22)(6,02 \times 10^{23})$$
$$= 1,32 \times 10^{23}\ particles$$

9.10.2.2.

$$C_3H_8 : O_2$$
$$1 : 5$$
$$0,22 : 1,1$$

$$n = \frac{V}{V_M}$$
$$1,1 = \frac{V}{22,4}$$
$$V = 24,64dm^3$$

9.10.2.3.

$$C_3H_8 : CO_2 : H_2O$$
$$1 : 3 : 4$$
$$0,22 : 0,66 : 0,88$$

CO_2:

$$n = \frac{m}{M}$$
$$0,66 = \frac{m}{44}$$
$$m = (0,66)(44)$$
$$29,04g$$

H_2O:

$$n = \frac{m}{M}$$
$$0,88 = \frac{m}{18}$$
$$m = (0,88)(18)$$
$$m = 15,84g$$

$$Total\ mass = 29,04 + 15,84 = 44,88g$$

HYDROSPHERE

EXAM LEVEL QUESTIONS

10.1.

10.1.1. Hydrosphere

10.1.2. Atmosphere
Lithosphere
Biosphere

10.1.3. The process whereby water falls from the clouds to the ground in various forms such as rain, hail, snow or ice water.

10.1.4. Condensation

10.1.5. Transpiration

10.1.6. Rain
Hail
Snow
Sleet

10.1.7. Released. The temperature and kinetic energy of the water decreases.

10.1.8. Physical; There is no change in chemical composition of water, and no new substance is formed.

10.1.9. Consumable (safe drinking) water makes up a minor percentage of the Earth's naturally occurring water.

10.2.

10.2.1. Parts per million.

10.2.2. At point A, the pH levels of the water is already neutral, which is ideal for consumption. It also hasn't been polluted by the power plant, sewerage processing or agricultural and industrial run-off.

10.2.3. Water used for cooling the power plant is pumped back into the river.

10.2.4. Fish are unable to move down stream and migrate to spawning grounds.
Low-lying areas get flooded.
Nutrient-rich sediment can't wash down the river.
Wetlands downriver are disrupted and experience drought and loss of species.

10.2.5. The gases from the PowerStation (SO_2 and CO_2) are dissolved into atmospheric moisture forming acid rain that rains and/or washes into the river system.

10.2.6. pH-sensitive species will die, while some plant and algae species will thrive this could be caused by pesticides and lime from the farms and cement factory.

10.2.7. Increase in pH would cause fish species to die.
The dam that is upstream prevents fish from moving downriver.

10.2.8. Between the dam wall and the sewerage facility the proximity to the sewerage facility enables more effective waste management and less human waste in the river system The impact of pollution will be limited as most species will be located before the dam wall and very few thereafter.

10.2.9. Eutrophication will result in an increased algae growth (bloom). When this algae dies, it decomposes – the bacteria that is responsible for the decomposition depletes the oxygen in the water. Low levels of dissolved oxygen will result in the death or migration of fish and other water-dwelling creatures.

10.3.

10.3.1. The hydrosphere is the global system that includes all solid, liquid and gaseous water on, above and below the surface of the earth.

10.3.2.

10.3.2.1. Evaporation

10.3.2.2. Condensation

10.3.2.3. Surface run-off

10.3.2.4. Precipitation

10.3.3. Through percolation, water is filtered and stored in underwater lakes and rivers.

10.3.4. Dams are built on habitable or arable land
Dams can change the river ecosystems by preventing specie migration.

10.3.5. Lithosphere
Biosphere
Atmosphere