keep it simple science

KEEP IT SIMPLE SCIENCE

Chemistry Module 1

Properties & Structure of Matter

WORKSHEETS

VALENCY TABLE of common ions.

This data will be useful as you attempt some of these worksheets.

Name	Symbol	Electrons in outer shell	Charge on Ion
Simple Metal Ions			
Hydrogen	H	1	1+
Lithium	Li	1	1+
Sodium	Na	1	1+
Potassium	K	1	1+
● Silver	Ag	1	1+
Magnesium	Mg	2	2+
Calcium	Ca	2	2+
Barium	Ba	2	2+
● Zinc	Zn	2	2+
Aluminium	Al	3	3+
Metals with More Than One Ion			
● Copper	Cu	1 or 2	1+ or 2+
● Iron	Fe	2 or 3	2+ or 3+
● Tin	Sn	2 or 4	2+ or 4+
● Lead	Pb	2 or 4	2+ or 4+
Polyatomic Ion			
● Ammonium	NH_4^+		1+

Name	Symbol	Electrons in outer shell	Charge on Ion
Simple Non-Metal Ions (name changes to -IDE)			
Fluorine	F	7	1-
Chlorine	Cl	7	1-
Bromine	Br	7	1-
Iodine	I	7	1-
Oxygen	O	6	2-
Sulfur	S	6	2-
Nitrogen	N	5	3-
Phosphorus	P	5	3-
Carbon	C	4	4-
Polyatomic Ions			
● Hydroxide	OH^-		1-
● Nitrate	NO_3^-		1-
● Sulfate	SO_4^{2-}		2-
● Carbonate	CO_3^{2-}		2-

Species marked "●" need to be memorised.
All others can be easily read from the Periodic Table.
As you encounter new ions (especially polyatomic), add to this table

keep it simple science

Worksheet 1 Mixtures & Separations

Fill in the blanks

Student Name.....

Elements are a)..... substances composed of b)..... of atom. They c)..... be separated into any simpler substances by either d)..... nor ..... processes.

e)..... are f)..... substances which contain 2 or more types of atoms, which are g)..... bonded together in a h)..... ratio. They cannot be separated by any i)..... process, but can be chemically separated into the j)..... they contain.

Mixtures are k)..... substances which may contain various l)..... and ..... which are NOT all chemically m)..... to each other. The proportions of each part of the mixture may n)..... enormously.

The "Lithosphere" is the o)..... part of the Earth. It is mostly made of rocks, which are p)..... of minerals.

The q)..... is the liquid part of the Earth. It is a mixture of r)..... and various dissolved s)..... and ....., notably t)..... The Atmosphere is a mixture of u)....., the most abundant being v)..... and .....

Homogeneous mixtures appear to have a w)..... composition & are not obviously made of different x)..... y)..... mixtures are obviously composed of different parts or "phases".

Every mixture contains different parts, each with different z)..... This makes it fairly easy to aa)..... the "fractions" by simple ab)..... processes such as ac)....., ... and .....

ad)..... Analysis is the method of finding the composition of a mixture, by separating a mixture and ae)..... the fractions accurately as they are collected.

Worksheet 2 Practice Problems section 1

Answer in the spaces provided.

(on reverse, if insufficient room)

Student Name.....

1.
For each of the following mixtures, suggest a simple way to collect the specified fraction(s) in the laboratory.

a) Collect pure water from a copper sulfate solution.

b) Collect clear water from muddy water.

c) Collect copper oxide (insoluble) from a water suspension.

d) Collect solid nickel chloride from a water solution.

e) A can of lawn mower petrol has accidentally got some water in it... this could damage the engine. How to remove the water? (These liquids are immiscible)

2.
Fred has accidentally mixed flour (insoluble) and icing sugar (soluble) together.

a) Use a simple flow chart (answer on reverse) to describe a laboratory procedure to separate them again.

b) Which simpler procedure might have been possible if the sugar had been coarse-grained?

3. (Answer on reverse, showing working)
A dry mixture of soluble potassium sulfate and insoluble manganese dioxide was analysed gravimetrically as follows:
A weighed sample was thoroughly stirred into pure water, then filtered through a pre-weighed filter paper. The collected residue was oven dried and weighed.
Meanwhile, the filtrate was boiled in a pre-weighed evaporating basin until a dry solid formed, then weighed.

<u>Results</u>:

Mass of mixture sample	= 4.96g
Mass of filter paper	= 0.16g
Mass or paper + dried residue	= 3.04g
Mass of evap.basin	= 28.62g
Mass of basin + dry solid	= 30.70g

a) Name the substance collected in the filter paper.
b) Calculate the mass of this substance collected.
c) Calculate the % of this substance in the mixture.
d) Name the substance collected in the evap.basin.
e) Calculate the mass of this substance collected.
f) Calculate the % of this substance in the mixture.
g) What evidence is there that this analysis may be quite accurate?

h) Describe one technique, not mentioned in the outline above, which might have been done by the experimenter to help ensure accuracy.

keep it simple science

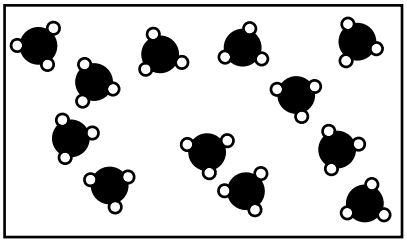
Worksheet 3 Practice Questions section 1

Answer in the spaces provided.
(on reverse, if insufficient room)

Student Name.....

Multiple Choice

1.
The diagram shows the particles within a substance.



Which of the following is the best description of this substance?

A. a pure mixture of 2 elements.
B. a pure compound of 2 elements.
C. an impure mixture of 2 elements.
D. an impure compound of 2 elements.

2.
The Earth's atmosphere is predominantly:
A. mixture of elements.
B. a mixture of compounds.
C. a compound of oxygen and nitrogen.
D. unbonded atoms.

The following information refers to Q3 & Q4.

A dry mixture of pebbles, sand and salt was separated as follows:
Step 1: Dry mix was shaken in a sieve
Step 2: The material that passed through the sieve was stirred into water.
Step 3: The water mixture was filtered.
Step 4: Part of the filtrate was evaporated
Step 5: The remainder of the filtrate was distilled.

3.
The material collected at Step 4 would have been:
A. water only.
B. sand only.
C. a mixture of sand & salt.
D. salt only.

4.
The "difference in properties" which allows a separation to occur at step 3 and at step 4, respectively, is:

A. particle size and boiling point.
B. solubility and melting point.
C. melting point and boiling point.
D. particle size and melting point.

Longer Response Questions

Mark values shown are suggestions only, and are to give you an idea of how detailed an answer is appropriate.

5. (4 marks)
You have been given a mixture of potassium chloride (which is highly soluble in water) and insoluble copper(II) oxide. Your task is to use simple laboratory procedures to prepare pure, dry samples of each chemical.

Construct a flow chart of the procedure you would use.

6. (8 marks)
A soil sample was subjected to gravimetric analysis as follows:
Step 1: An evaporating dish was weighed accurately. mass of basin = 42.85g
Step 2: The soil sample was placed in it and weighed. mass soil+basin = 54.27g
Step 3: Then placed in oven at 80^{o}C until mass was constant. mass after drying = 52.66g
Step 4: Then into oven at extremely high temperature. (this burns away all the organic (plant) matter, leaving only the minerals.) Cooled, re-weighed. final mass = 46.72g

a) Calculate the mass of:
i) the soil sample.

ii) the water in the sample.

iii) the organic matter in the sample.

iv) the minerals in the sample.

b) Showing working, calculate the percentage composition of the soil sample.

c) Which step in the analysis involved a chemical change?

d) Why was it important, in Step 3, for the dish to be left in the oven until the mass was constant?

keep it simple science

Worksheet 4 Atoms, Elements & Isotopes

Student Name.....

Guided Notes. (Make your own summary)

1. All atoms are composed of 3 types of particles:

....., ... & .....

2. The numbers of 2 of these are always equal. Which two?

..... = ...

3. Define "Atomic Number".

4. How can you calculate the "Mass Number" for any atom?

5. Mass No. is also known as...?

6. Why are the electrons NOT counted?

7. Why is it that Mass Numbers are always integer numbers, but the RAM (At.Weight) on the Periodic Table is nearly always NOT an integer.

8. How do the isotopes of an element compare to each other...

a) in their chemistry?

b) in atomic structure?

9. What is a "radioisotope"?

10. List 3 types of nuclear radiation, with detail of what each type actually is.

11. If an isotope undergoes alpha decay:
a) what is basically "wrong" with the atom?

b) What happens to the Mass No. of the atom?

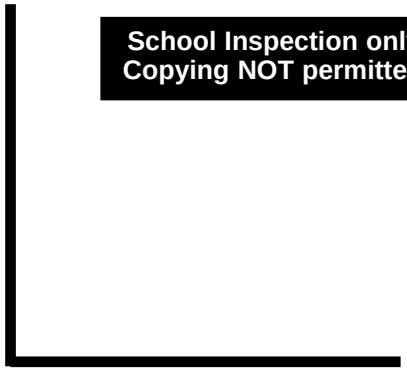
c) What happens to the Atomic No.?

12. If an isotope undergoes beta decay:
a) what is basically "wrong" with the atom?

b) What happens to the Mass No. of the atom?

c) What happens to the Atomic No.?

13. Sketch a graph to show the (approx) position of the "Line of Stability" (LoS) for the elements. Label the axes. Values are not required.



14. On the sketch graph add shadings & labels to indicate where isotopes would be found which are:

- **stable**
- **probable alpha decay isotopes**
- **probable beta decay isotopes**

15. How can radiations cause ionisation?

16. Which radiation type has the highest ionising ability?

Which one has least?

17. Which radiation type has the highest penetrating ability?

Which one has least?

18. Outline how artificial radioisotopes are produced.

keep it simple science

Worksheet 5 Isotopes & RAM

Practice Problems

Student Name.....

The following examples are ficticious elements & isotopes. The idea is to practise the method of calculating an element's RAM from isotopic data.

1. Element "M" occurs in 3 isotopic forms with nucleon numbers 26, 28 & 29. On Earth, any sample of "M" is 46% M-26, 38% M-28 & 16% M-29.
Calculate the RAM.

2. Element "J" occurs on Earth in 5 isotopic forms, with the following occurrences:
62% J-65, 5% J-66, 19% J-68, 11% J-69 & the balance is J-70.
Calculate the RAM.

3. Element "G" occurs in 4 isotopic forms with occurrence 15% G-153, 38% G-155, 3% G-156 & 44% G-158.
Calculate the RAM.

4. Element "Tz" occurs on Earth in 8 isotopic forms, with the following occurrences:
13% Tz-218, 5% Tz-220, 22% Tz-221, 11% Tz-224, 27% Tz-225, 3% Tz-227, 7% Tz-228 & the balance is Tz-230.
Calculate the RAM.

Worksheet 6 Radioactive Decay Equations

Practice Problems

Student Name.....

1. Plutonium-239 (Atomic No. = 94) decays by emitting alpha particles.
Write the equation to describe the change.

2. Radon-224 (At.No. 86) also undergoes alpha decay, emitting gamma rays as well.
Write the equation.

3. Strontium-90 (38) is an unstable beta-decayer.
Write the equation.

4. Write an equation for the beta decay of Be-10.

5. Potassium-40 is a naturally occurring radioisotope used to determine the age of ancient rocks. It decays by emitting beta plus gamma rays.
Write the equation.

6. Americium-241 (95) is an artificial isotope used in household smoke detectors. It decays by emitting alpha particles. (If these are blocked by smoke, an alarm sounds.) Write the equation for the decay.

7. Cs-137 is a dangerous isotope found in "nuclear fallout" after a surface nuclear bomb blast.
Write the equation for its beta + gamma decay.

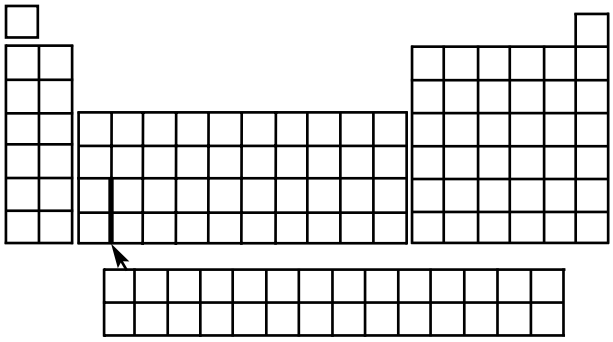
8. Write the equation for the alpha decay of Bi-209.

keep it simple science

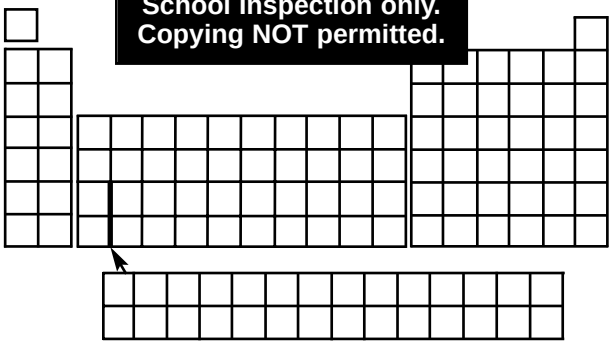
Worksheet 7 Periodic Table Basics

Student Name.....

1.
On the outline of the Periodic Table:
a) show the system for naming the horizontal rows.
b) show a method for numbering the vertical columns.
c) indicate the "block" names.
d) indicate the positions of the "Inert Gases", "Alkali Metals" & "Halogens".



2.
a) On this outline show the positions occupied by elements which are metals, non-metals & semi-metals.
b) Shade all the elements which are gases at standard conditions.
c) Circle any elements which are liquids at std.conditions.



Worksheet 8 Atoms, Electrons & Ions

Student Name.....

1. Atomic Number and Mass Number

a) Complete all the blank spaces in this table

No. Protons	No. Electrons	No. Neutrons	Atomic Number	Mass Number
19		20		
	27	32		
		5	4	
	11			23
			35	80

b) Use the Periodic Table to identify each element in the table above. (list from the top)

2. Electron Configuration

a) The first 20 elements of the Periodic Table are shown below by their symbol, and relative position in the table.
For each, write its electron configuration.

H							He
Li	Be	B	C	N	O	F	Ne
Na	K	Al	Si	P	S	Cl	Ar
K	Ca						

3. Formation of Ions

The electron configurations for various elements are given. State whether each atom would gain or lose electrons, and how many electrons.
State the charge on the ion formed.

Elect. Configuration	Gain/Lose?	How many?	Ion Charge?
i) 2.8.8.1			
ii) 2.8.6			
iii) 2.5			
iv) 2.8.8			
v) 2.2			
vi) 2.8.3			
vii) 2.6			
viii) 2.8.7			

keep it simple science

Worksheet 9 Orbitals

Student Name.....

1.
An element is described by the orbital notation:

$1s^2$, $2s^2$, $2p^6$, $3s^2$

a) How many electrons altogether?

b) Identify the element.

c) Electrons in its outer shell?

d) What will it do to form an ion?

e) Charge on the ion?

2.
Another element is described:

$1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $3d^{10}$, $4s^2$, $4p^5$

a) How many electrons altogether?

b) Identify the element.

c) Electrons in its outer shell?

d) What will it do to form an ion?

e) Charge on the ion?

3.
Yet another element is described:

$1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $3d^7$, $4s^2$

a) How many electrons altogether?

b) Identify the element.

c) Electrons in its outer shell?

d) What will it (probably) do to form an ion?

e) Charge on the ion?

4.
Write the expected orbital arrangement for:

a) Neon (10)

b) Scandium (21)

c) Silver (47)

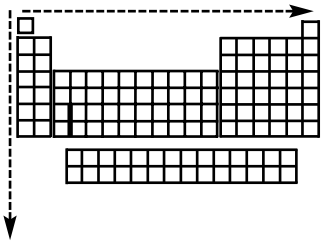
d) Chlorine (17)

e) Rubidium (37)

Worksheet 10 Periodic Patterns

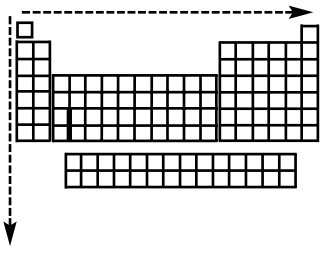
Student Name.....

1.
a) On this Per.Table outline, use the words "increasing" or "decreasing" to describe the trend in atomic radius in the directions shown by the arrows.



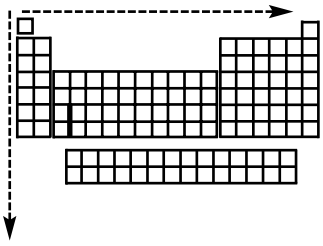
b) Explain the horizontal trend.

2.
a) On this Per.Table outline, use the words "increasing" or "decreasing" to describe the trend in ionisation energy in the directions shown by the arrows.



c) Write an equation to describe the 1st ionisation of an atom of copper (Cu).

3.
a) On this Per.Table outline, use the words "increasing" or "decreasing" to describe the trend in electronegativity in the directions shown by the arrows.



b) What IS "electronegativity"?

c) Which group of the Per.Table is NOT included in allocation of electronegativity values?

d) On the table, mark with an "x" the element with the highest electronegativity value.

e) Put a circle around the element with the lowest electronegativity value.

keep it simple science

Worksheet 11 Ionic Compounds

Student Name.....

1. Simple Ionic Compounds

Write the name, and predict the formula, for a compound formed from ions of:

a) potassium and chlorine

....

b) magnesium and sulfur

....

c) oxygen and lithium

....

d) bromine and zinc

....

e) calcium and fluorine

....

f) iodine and aluminium

....

g) beryllium and oxygen

....

h) silver and phosphorus

....

i) hydrogen and sulfur

....

j) fluorine and sodium

....

2. Multi-Valency Metal Ions

a) Give the name for each of these:

i) $CuCl$ .....

ii) $CuCl_2$ .....

iii) FeO .....

iv) Fe_2O_3 .....

v) $SnBr_2$ .....

vi) $SnBr_4$ .....

b) Write the name & formula for the compound of:

i) Fe^{2+} **ion with sulfur**

....

ii) Pb^{4+} **ion with chlorine**

....

iii) Cu^{+} **ion with oxygen**

....

iv) fluorine with the tin(IV) ion

....

v) nitrogen and the iron(III) ion

....

3. Polyatomic Ions

a) Name each compound and write symbols for the two ions present.

i) $MgSO_4$ ...., ...

ii) $ZnCO_3$ ...., ...

iii) $AgNO_3$ ...., ...

iv) KOH ...., ...

v) NH_4Cl ...., ...

vi) $Fe(OH)_3$ ...., ...

b) Write the formula for

i) calcium nitrate .....

ii) copper(II) hydroxide .....

iii) silver sulfate .....

iv) ammonium bromide .....

v) lithium carbonate .....

vi) aluminium nitrate .....

vii) lead(IV) sulfate .....

viii) iron(III) hydroxide .....

ix) potassium nitrate .....

x) ammonium carbonate .....

Worksheet 12 Covalent Compounds

Student Name.....

1. Write an appropriate name for:

i) CH_4 .....

ii) H_2O .....

iii) SO_3 .....

iv) N_2O_3 .....

v) PBr_5 .....

vi) OCl_2 .....

2. Write a formula for

i) sulfur difluoride .....

ii) phosporus tri-iodide .....

iii) nitrogen monoxide .....

iv) silicon tetrafluoride .....

v) diboron trioxide .....

vi) ammonia .....

keep it simple science

Worksheet 13

Student Name.....

Draw a Lewis Formula for

a) an atom of phosphorus

b) a phosphide ion (P^{3-})

c) an atom of calcium

d) a calcium ion (Ca^{2+})

e) an atom of neon

f) a sulfide ion (S^{-2})

g) the covalent compound PH_3 (hint: start with the individual atoms, then join them with covalent bonds)

h) the covalent compound OBr_2

i) the covalent compound ammonia, NH_3

j) carbon tetrachloride, CCl_4

Worksheet 14 Chemical Equations

Student Name.....

1. Equations for Ion Formation

Write an equation to describe the formation of:

a) a lithium ion from a lithium atom.

b) a bromide ion from a bromine atom.

c) bromide ions from a molecule of Br_2.

d) an aluminium ion from an aluminium atom.

e) a sulfide ion from a sulfur atom

f) Combine equations (a) & (c) to form an equation describing the formation of lithium bromide from its elements.
(hint: the equations must contain the same number of electrons, so that when added the electrons will cancel out. This will require one equation to be multiplied by 2 before adding)

g) Combine equations (a) & (e) to describe the formation of lithium sulfide. (similar hint)

h) Combine equations (d) & (c) to describe the formation of aluminium bromide.
(need to multiply one equation x2, the other x3, so they have same number of electrons, to cancel out)

i) Combine equations (d) & (e) to describe the formation of aluminium sulfide. **(you figure it out!)**

2. Balancing Equations

a) Balance the following equations.

$Ca + O_2 \rightarrow CaO$

$Ag + Cl_2 \rightarrow AgCl$

$Al + O_2 \rightarrow Al_2O_3$

$C + H_2 \rightarrow CH_4$

$S + O_2 \rightarrow SO_3$

3. Write and Balance

Write equations in words and in symbols (then balance) to describe the formation of:

i) potassium bromide, from its elements (bromine is Br_2)

ii) copper(II) oxide, from its elements (oxygen is O_2)

iii) nitrogen dioxide, from its elements (both diatomic)

iv) silicon tetrachloride, from its elements.

keep it simple science

Worksheet 15 Test Questions section 3

School Inspection only. Copying NOT permitted.

Student Name.....

Multiple Choice

1. Atoms of silver contain 47 protons, 47 electrons and 61 neutrons. The Atomic Number and the Mass Number, respectively, would be:
A. 47 & 94 B. 61 & 108
C. 47 & 108 D. 47 & 155

2. The electron configuration of a certain element is 2.8.6
You would expect that this element would:
A. form ions with charge 2+
B. form ions with charge 2-
C. be unlikely to form ions
D. form ions with charge 6+

3. Which of the following is a correct formula for an ionic compound?
A. $AlBr_3$ B. $CaCl_3$
C. MgO_2 D. KSO_4

4.
The correct name for the compound $CuCO_3$ is
A. copper carbon trioxide
B. copper carbonate
C. copper(I) carbonate
D. copper(II) carbonate

5. Which of the following chemical species (A, B, C or D) has exactly the same electron configuration as a chloride ion?
A. an atom of argon
B. a fluoride ion
C. a sodium ion
D. an atom of chlorine

6. A "double covalent bond" involves:
A. the transfer of 2 electrons from one atom to another.
B. the sharing of an electron between 2 atoms.
C. the sharing of 2 electrons.
D. the sharing of 4 electrons.

7. A molecular compound with formula N_2O_4 would be best named as:
A. dinitrogen 4-oxide
B. nitrogen(II) tetra-oxide
C. dinitrogen tetra-oxide
D. nitrogen tetroxide

8. Which of the following equations shows correctly the formation of ammonia (NH_3) from its elements?
A. $N + H_3 \rightarrow NH_3$
B. $N_2 + H_2 \rightarrow NH_3$
C. $N_2 + 3H_2 \rightarrow 2\ NH_3$
D. $N_2 + H_2 \rightarrow N_2H_2$

Longer Response Questions

Mark values shown are suggestions only, and are to give you an idea of how detailed an answer is appropriate. Answer on reverse if insufficient space.

9. (5 marks)
Find the element potassium on the Periodic Table, and state:
a) the number of electrons, protons and neutrons in a potassium atom.
(Round RAM to nearest whole number for assumed Mass No.)

b) the electron configuration.
c) what this atom would do to form an ion, and the electric charge on the ion.

10. (10 marks)
a) Give the correct name for each compound.
i) CaS
ii) $CaSO_4$
iii) $Cu(NO_3)_2$
iv) As_2O_3
v) $(NH_4)_2CO_3$

b) Write the formula for:
i) silver sulfate
ii) iron(III) iodide
iii) germanium dioxide
iv) aluminium hydroxide
v) lead(IV) sulfide

11. (5 marks)
Sketch a Lewis formula for:
a) an atom of neon
b) an atom of phosphorus
c) a chloride ion
d) an oxygen molecule (O_2)
e) a water molecule

12. (8 marks)
Write balanced symbol equations for
a) formation of a chloride ion from a chlorine atom.

b) formation of chloride ions from a molecule of Cl_2.

c) formation of a potassium ion from a potassium atom.

d) formation of the compound potassium chloride from its elements in their normal state.

13. (5 marks)
a) Sketch a Lewis Formula for a nitrogen atom.

b) Nitrogen and chlorine can form a compound NCl_3 by sharing electrons so that every atom achieves an outer shell of 8. Sketch the Lewis Formula for a molecule of NCl_3.

c) Give the name for this compound.

d) Sketch a structural formula for the molecule.

keep it simple science

Worksheet 16 Bonding, Structures & Properties

Fill in the blanks

Student Name.....

It is the a)..... of substances that allow us to identify and classify them. Physical properties include b)..... and ..... points, c)..... conductivity, and the hardness and flexibility of each substance.

d)..... properties include chemical reactivity and the types of e)..... a substance will undergo.

Each element or f)..... is a pure substance with a set of properties which are g)..... and .....

Mixtures are not pure, so their properties h)..... Generally, the properties of a compound are i)..... when compared to the properties of the j)..... it is made from.

It is often the k)..... within a substance that determines its general physical properties:

• <u>Ionic compounds</u> are a l)..... of ions. The "m)..... bonds" which hold the ions together are actually n)..... ..... between opposite electrical o)..... These bonds are very p)..... (strong/weak), so these substances generally have high q).....

• r)..... <u>Lattice substances</u> include some elements, such as s)....., and some compounds, such as t)..... The lattice is composed of atoms which are u)..... bonded together. These bonds are very v)..... (strong/weak) so these substances have very high w).....

• <u>Metals</u> are held together by "x)..... bonding". Each atom is really a y)..... (charge) ion because it fails to hold its outer z)....., which wander freely.

The electrical attraction between the ions and this "aa)..... of electrons" holds the metal together quite strongly and gives it a fairly ab)..... (high/low) melting point, but also allows flexibility. This is why metals have the properties of ac)..... and .....

• <u>Covalent ad)..... substances</u> include some elements, such as ae)..... and many compounds such as af)..... Each molecule is held together internally by ag)..... bonds which are very ah)..... (strong/weak) These are the "ai)..... - molecular" forces.

However, it is NOT these that must be broken in a change of state. There are also very aj)..... (strong/weak) forces between the molecules. These are the "ak)..... -molecular" forces which are broken by heat energy in a change of state. Since these are al)....., the melting points are generally very am).....

The property of electrical an)..... is very important in classifying matter. In general terms, a substance will conduct if it contains ao)..... which are able to ap)..... independently of each other.

Covalent lattice and covalent molecular substances aq).....(do/do not) conduct because they do not contain any ar).....

Metals are always as)..... conductors because of the mobile at)..... within.

Ionic compounds do not conduct in the au)..... state because the av)..... cannot aw)..... However, when they are ax)..... or when ay)..... they become conductors because their ions are az)..... .....

keep it simple science

Worksheet 17 Test Questions section 5

Answer in the spaces provided.
(on reverse, if insufficient room)

Student Name.....

Multiple Choice

School Inspection only. Copying NOT permitted.

1.
Most covalent molecular substances (e.g. water) have:

A. strong inter-molecular forces only.
B. weak intra-molcular forces only.
C. strong inter-molecular and weak intra-molecular forces.
D. strong intra-molecular and weak inter-molecular forces.

2.
The compound silicon disulfide has a very high melting point. Its chemical formula is SiS_2. It is very likely that:

A. this compound has an ionic lattice structure.
B. "SiS_2" is an empirical formula for a covalent lattice.
C. this is a covalent molecular compound.
D. the compound would conduct electricity when liquid.

3.
A substance is found to be a good conductor in both solid and liquid (molten) states. You would expect it to:

A. be brittle.
B. have a very low melting point.
C. be malleable
D. be soluble in water.

Longer Response Questions

Mark values shown are suggestions only, and are to give you an idea of how detailed an answer is appropriate.

4.
Compare & contrast "isotopes of an element' with "allotropes of an element" by answering the following:

a) Are the atomic structures the same or different? (If different, state how they are different)

<u>isotopes</u>:

<u>allotropes</u>:

b) Chemical properties the same or different?

<u>isotopes</u>:

<u>allotropes</u>:

c) Physical properties the same or different?

<u>isotopes</u>:

<u>allotropes</u>:

5. (10 marks)
The following are descriptions of 2 elements:

<u>Chlorine</u>: mp = -101^oC, poisonous green-yellow gas, highly reactive, valency -1.

<u>Silicon</u>: mp=1,410^oC, grey crystalline solid semi-conductor, valency -4, does not form ions but will share electrons covalently.

a) List 2 <u>chemical</u> properties of chlorine mentioned above.

b) Silicon and chlorine can combine to form a compound in which each atom achieves an outer electron shell of 8.

i) is it likely to be an ionic or covalent compound?

ii) Suggest a likely formula <u>and</u> name for this compound.

iii) Are properties of these elements above likely to be of any help in predicting the properties of the compound? Explain.

c) Sketch a Lewis Formula and structural formula for the compound.

d) Given the information that the compound is molecular rather than a lattice structure, predict (in general terms) its:

i) mp & bp. (high, low?)

ii) electrical conductivity.

iii) hardness & flexibility of the solid.

keep it simple science

Answer Section

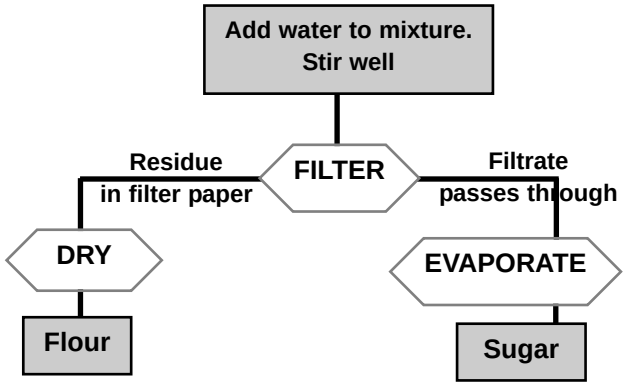
Worksheet 1

a) pure
b) one type
c) cannot
d) physical nor chemical
e) Compounds
f) pure
g) chemically
h) fixed
i) physical
j) elements
k) impure
l) elements & compounds
m) bonded
n) vary
o) solid (rocky)
p) mixtures
q) Hydrosphere
r) water
s) elements & compounds
t) salt
u) gases
v) nitrogen & oxygen
w) uniform
x) parts / fractions.
y) Heterogeneous
z) properties
aa) separate
ab) physical
ac) filtration, evaporation & distillation
ad) Gravimetric
ae) weighing

Worksheet 2

1.
a) distillation
b) filtration (filtrate)
c) filtration (residue)
d) evaporation
e) use a separating funnel

2.
a)



b) A sieve with appropriate mesh size.

3.
a) manganese dioxide

b) 3.04 - 0.16 = 2.88g

c) % composition = $\frac{2.88}{4.96}$ x 100 = 58.1%

d) potassium sulfate

e) 30.70 - 28.62 = 2.08g

f) % composition = $\frac{2.08}{4.96}$ x 100 = 41.9%

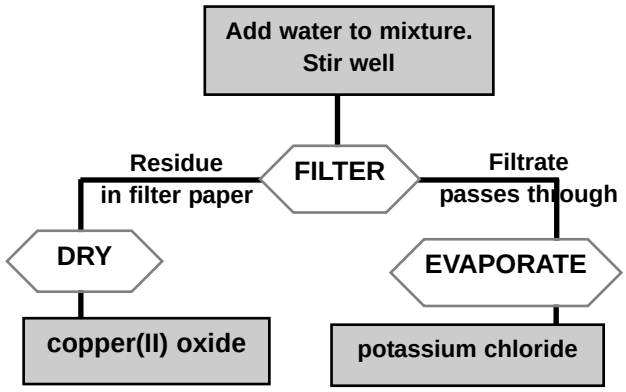
g) The 2 percentages add to exactly 100%.

h) Washing the residue with a little extra pure water. or Drying substances until their mass does not change, to ensure they are fully dry.

Worksheet 3

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

5.



6.
a) i) Soil sample = 54.27 - 42.85 = 11.42g
ii) Water = 54.27 - 52.66g = 1.61g
iii) Organic = 52.66 - 46.72 = 5.94g
iv) Minerals = 46.72 - 42.85 = 3.87g

b) %water = (1.61/11.42)x100 = 14.1%
% organic = (5.94/11.42)x100 = 52.0%
% minerals = (3.87/11.42)x100 = 33.9%

c) Step 4. Burning (combustion) is a chemical change.
d) To ensure that it was thoroughly dried before weighing.

Worksheet 4

1. protons, electrons & neutrons

2. Protons = Electrons

3. Atomic No. is the number of protons (=electrons) in any atom of that element.

4. Add protons + neutrons.

5. Nucleon Number
(nucleon is the general name for any particle in the nucleus. ie proton or neutron.)

6. The mass of electrons is so small (compared to a nucleon) that it is insignificant.

7. A Mass No. must be an integer because there must be a whole number of nucleons... no fractions of a particle.

RAM is the "weighted average" of the mix of different isotopes of that element, each with a different Mass No.

8.
a) same
b) different number of neutrons (only)

keep it simple science

Answer Section

Worksheet 4 (cont.)

9.
An isotope which is unstable and emits radiation as it decays into a more stable form.

10.
alpha = helium nucleus = 2 protons + 2 neutrons

beta = a high-speed electron

gamma = high frequency wave, similar to x-rays

11.
a) The nucleus is too large for the "strong nuclear force" (very short-range) to hold it all together.

b) decreases by 4

c) decreases by 2

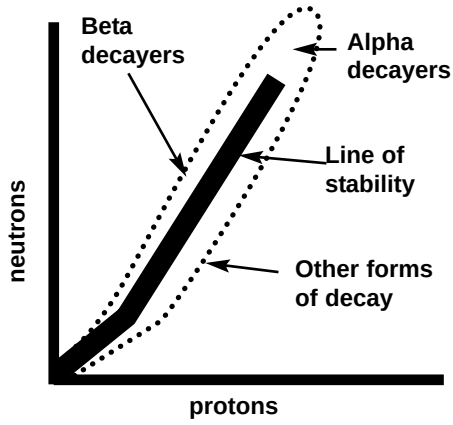
12.
a) The ratio between protons:neutrons is beyond the "balance" necessary for stability.

b) no change

c) goes UP by one.

13.

14.
on graph



15.
Radiation may strike an electron & give it so much energy that it is knocked out of orbit. This turns that atom into an electrically charged ion.

16.
a) highest = alpha
b) lowest = gamma

17.
highest = gamma
lowest = alpha

18.
Placing an appropriate element inside a nuclear reactor is one method. (note: there are other methods) Atoms will be struck by the huge flux of neutrons. Some neutrons may stick in the atomic nucleus. This creates a new isotope.

Worksheet 5

1.
RAM(M) = 26x0.46 + 28x0.38 + 29x0.16
= 27.24

2.
RAM(J) = 65x0.62 + 66x0.05 + 68x0.19 + 69x0.11 + 70x0.03
= 66.21

3.
RAM(G) = 153x0.15 + 155x0.38 + 156x0.03 +158x0.44
= 156.05

4.
RAM (Tz) = 218x0.13+220x0.05+221x0.22+224x0.11 +225x0.27+227x0.03+228x0.07+230x0.12
= 223.72

Worksheet 6

1.

$$^{239}_{94}Pu \rightarrow {}^{235}_{92}U + {}^{4}_{2}He$$

Plutonium-239 Uranium-235 Alpha

2.

$$^{224}_{86}Rn \rightarrow {}^{220}_{84}Po + {}^{4}_{2}He + \gamma$$

Polonium-220 Gamma

3.

$$^{90}_{38}Sr \rightarrow {}^{90}_{39}Y + {}^{0}_{-1}e^{-}$$

Yttrium-90 Beta

4.

$$^{10}_{4}Be \rightarrow {}^{10}_{5}B + {}^{0}_{-1}e^{-}$$

5.

$$^{40}_{19}K \rightarrow {}^{40}_{20}Ca + {}^{0}_{-1}e^{-} + \gamma$$

6.

$$^{241}_{95}Am \rightarrow {}^{237}_{93}Np + {}^{4}_{2}He$$

Neptunium-237

7.

$$^{137}_{55}Cs \rightarrow {}^{137}_{56}Ba + {}^{0}_{-1}e^{-} + \gamma$$

8.

$$^{209}_{83}Bi \rightarrow {}^{205}_{81}Tl + {}^{4}_{2}He$$

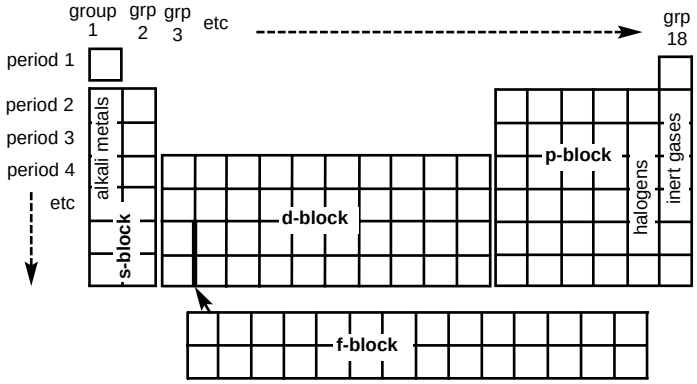
Thallium-205

keep it simple science

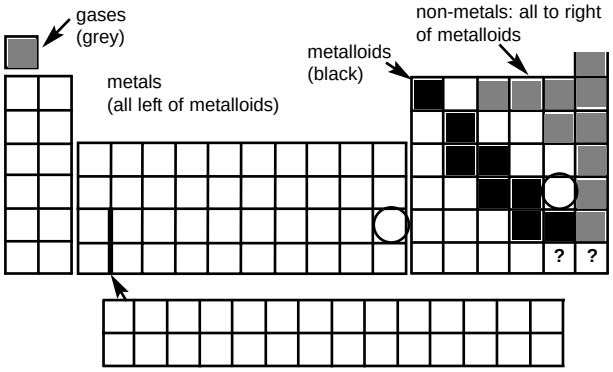
Answer Section

Worksheet 7

1.



2.



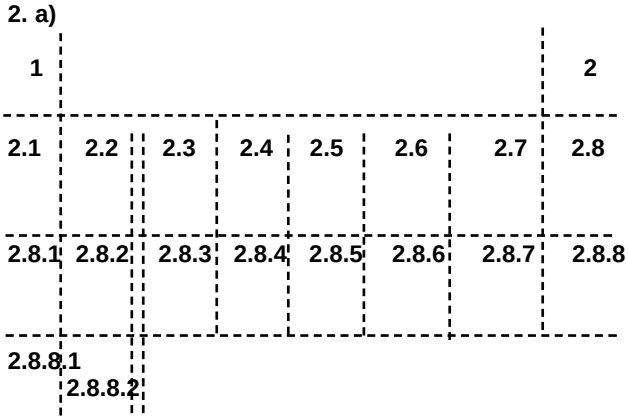
Worksheet 8

1. a)

protons	electrons	neutrons	At. No.	Mass No.
19	19	20	19	39
27	27	32	27	59
4	4	5	4	9
11	11	12	11	23
35	35	45	35	80

b) In order, potassium, cobalt, beryllium, sodium, bromine

2. a)



Worksheet 8 (cont.)

3.

Elect. Configuration	Gain/Lose?	How many?	Ion Charge?
i) 2.8.8.1	lose	1	1+
ii) 2.8.6	gain	2	2-
iii) 2.5	gain	3	3-
iv) 2.8.8	will not form ions		
v) 2.2	lose	2	2+
vi) 2.8.3	lose	3	3+
vii) 2.6	gain	2	2-
viii) 2.8.7	gain	1	1-

Worksheet 9

1.
a) 12 b) magnesium c) 2
d) lose outer 2 electrons e) 2+

2.
a) 35 b) bromine c) 7
d) gain 1 electron e) 1-

3.
a) 27 b) cobalt c) 2
d) lose outer 2 electrons e) 2+

4.
a) $1s^2$, $2s^2$, $2p^6$

b) $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $3d^1$, $4s^2$.

c) $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $3d^{10}$, $4s^2$, $4p^6$, $4d^9$, $5s^2$.

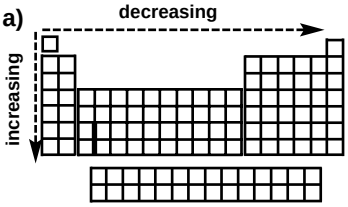
d) $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^5$.

e) $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $3d^{10}$, $4s^2$, $4p^6$, $5s^1$.

Worksheet 10

1.

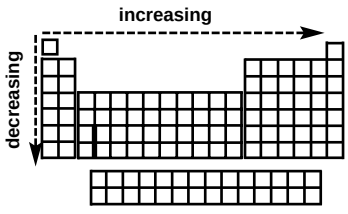
a)



b) The increasing amount of nuclear charge pulls the entire orbit closer in.

2.

a)



b) The increasing amount of nuclear charge requires more & more energy to remove an electron. (Plus, the electrons are closer to nucleus... held tighter.

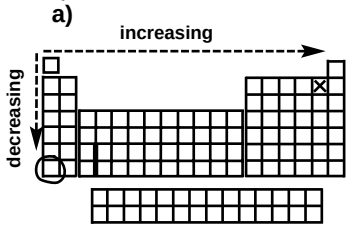
keep it simple science

Answer Section

Worksheet 10 (cont.)

3.

a)



b) Electronegativity is a numerical "score" given to elements, indicating each one's ability to attract electrons.

c) Inert gases

d) & e) on diagram.

Worksheet 11

1.

a) potassium chloride, KCl
b) magnesium sulfide, MgS
c) lithium oxide, Li_2O
d) zinc bromide, $ZnBr_2$
e) calcium fluoride, CaF_2
f) aluminium iodide, AlI_3
g) beryllium oxide, BeO
h) silver phosphide, Ag_3P
i) hydrogen sulfide, H_2S
j) sodium fluoride, NaF

2.

a) i) copper(I) chloride ii) copper(II) chloride
iii) iron(II) oxide iv) iron(III) oxide
v) tin(II) bromide vi) tin(IV) bromide

b)

i) iron(II) sulfide, FeS ii) lead(IV) chloride, $PbCl_4$
iii) copper(I) oxide, Cu_2O iv) tin(IV) fluoride, SnF_4
v) iron(III) nitride, FeN

3.

a) i) magnesium sulfate, Mg^{2+}, SO_4^{2-}
ii) zinc carbonate, Zn^{2+}, CO_3^{2-}
iii) silver nitrate, Ag^+, NO_3^-
iv) potassium hydroxide, K^+, OH^-
v) ammonium chloride, NH_4^+, Cl^-
vi) iron(III) hydroxide, Fe^{3+}, OH^-

b)

i) $Ca(NO_3)_2$	**ii) $Cu(OH)_2$**
iii) Ag_2SO_4	**iv) NH_4Br**
v) Li_2CO_3	**vi) $Al(NO_3)_3$**
vii) $Pb(SO_4)_2$	**viii) $Fe(OH)_3$**
ix) KNO_3	**x) $(NH_4)_2CO_3$**

Worksheet 12

1.

i) methane (memorise!) ii) water
iii) sulfur trioxide iv) dinitrogen trioxide
v) phosphorus pentabromide vi) oxygen dichloride

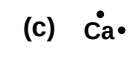
2.

i) SF_2 ii) PI_3 iii) NO
iv) SiF_4 v) B_2O_3 vi) NH_3 (learn!)

Worksheet 13

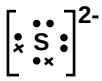
(a) 

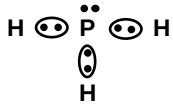
(b) 

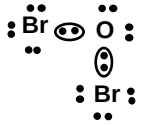
(c) 

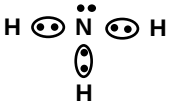
(d) 

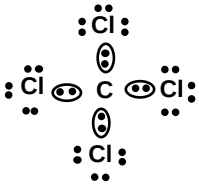
(e) 

(f) 

g) 

h) 

i) 

j) 

Worksheet 14

1.

a) $Li \longrightarrow Li^+ + e^-$

b) $Br + e^- \longrightarrow Br^-$

c) $Br_2 + 2e^- \longrightarrow 2Br^-$

d) $Al \longrightarrow Al^{+3} + 3e^-$

e) $S + 2e^- \longrightarrow S^{-2}$

f) (multiply eqn.(a)x2, then add (c)

$2Li + Br_2 + \cancel{2e^-} \longrightarrow 2Li^+ + \cancel{2e^-} + 2Br^-$

$2Li + Br_2 \longrightarrow 2\,LiBr$

g) multiply eqn(a) x2. Add to (e). Electrons cancel.

$2Li + S \longrightarrow Li_2S$

h) multiply (c)x3 and (d)x2, so both contain 6 electrons, then combine:

$2Al + 3Br_2 + \cancel{6e^-} \longrightarrow 2Al^{+3} + \cancel{6e^-} + 6Br^-$

$2Al + 3Br_2 \longrightarrow 2AlBr_3$

i) multiply (d)x2 and (e)x3 so both have 6 electrons.

$2Al + 3S \longrightarrow Al_2S_3$

2. a)

$2\,Ca + O_2 \longrightarrow 2\,CaO$

$2\,Ag + Cl_2 \longrightarrow 2\,AgCl$

$4Al + 3\,O_2 \longrightarrow 2Al_2O_3$

$C + 2H_2 \longrightarrow CH_4$

$2S + 3O_2 \longrightarrow 2SO_3$

b)

i) potassium + bromine $\longrightarrow$ potassium bromide
$2\,K + Br_2 \longrightarrow 2\,KBr$

ii) copper + oxygen $\longrightarrow$ copper(II) oxide
$2\,Cu + O_2 \longrightarrow 2\,CuO$

iii) nitrogen + oxygen $\longrightarrow$ nitrogen dioxide
$N_2 + 2\,O_2 \longrightarrow 2\,NO_2$

iv) silicon + chlorine $\longrightarrow$ silicon tetrachloride
$Si + 2\,Cl_2 \longrightarrow SiCl_4$

keep it simple science

Answer Section

Worksheet 15

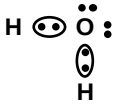
1. C 2. B 3. A 4. D 5. A 6. D
7. C 8. C

9.
a) 19 electrons, 19 protons, 20 neutrons
b) 2.8.8.1
c) lose 1 electron. Charge +1

10.
a) i) calcium sulfide ii) calcium sulfate
iii) copper(II) nitrate iv) diarsenic trioxide
v) ammonium carbonate

b) i) Ag_2SO_4 ii) FeI_3
iii) GeO_2 iv) $Al(OH)_3$
v) PbS_2

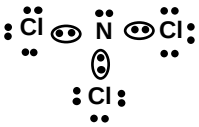
11. a)  b)  c) 

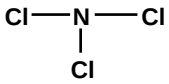
d)  e) 

12.
a) $Cl + e^- \longrightarrow Cl^-$
b) $Cl_2 + 2e^- \longrightarrow 2Cl^-$
c) $K \longrightarrow K^+ + e^-$
d) $2K + Cl_2 \longrightarrow 2KCl$

13.
a) 

(triple covalent bond)

b) 

c) nitrogen trichloride
d) 

Worksheet 16

a) properties b) melting & boiling
c) electrical d) Chemical
e) reactions f) compound
g) fixed & characteristic (or unique)
h) vary i) totally different
j) elements k) bonding
l) lattice m) ionic
n) electrical attractions o) charges
p) strong q) mp's & bp's
r) Covalent s) carbon
t) silicon dioxide (silica) u) covalently
v) strong w) mp's & bp's
x) metallic y) positive
z) electron(s) aa) sea
ab) high ac) malleability & ductility
ad) molecular ae) oxygen/hydrogen, etc.
af) water ag) covalent
ah) strong ai) intra-
aj) weak ak) inter-
al) weak am) low
an) conductivity ao) charged particles
ap) move aq) do not
ar) mobile charges as) good
at) sea of electrons au) solid
av) ions aw move
ax) melted ay) dissolved (in water)
az) free to move independently

Worksheet 17

1. D 2. B 3. C

4.
a) isotopes: different in no. of neutrons.
allotropes: same

b) isotopes: same
allotropes: form same compounds, but reactivity often different.

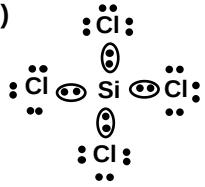
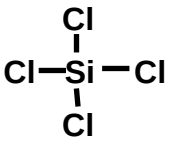
c) isotopes: same (except slight diff. in density)
allotropes: can be totally different in colour, density, mp & bp, etc.

5.
a) highly reactive, valency.
"Poisonous" might also be considered a chemical property since its effect depends on a chemical reaction.

b) i) covalent

ii) $SiCl_4$ Silicon tetrachloride

iii) Probably not. The properties of most compounds are totally different to the properties of the elements within.

c)  

d)
i) low
ii) poor
iii) possibly soft, but if hard, it will be brittle.