



Discussion / Activity 1

Suggested Answers

The following activity might be for class discussion, or there may be paper copies for you to complete. If studying independently, please use these questions to check your comprehension before moving on.

Mixtures

Student Name

1. Sort these substances into 3 lists: elements, compounds and mixtures.

salt water, sodium, water, chlorine, concrete, oxygen, air, salt.

Elements: sodium, chlorine, oxygen.

Compounds: water, salt.

Mixtures: salt water, concrete, air.

2. For each of these separation techniques, state the difference in properties which allows the process to separate the parts of a mixture.

a) Distillation. Different boiling points.

b) Filtration. Different particle sizes of liquid and undissolved solid.

c) Sieving. Different particle sizes of solid grains.

d) Evaporation. Different boiling points.

3. Outline the chain of techniques you would use in the laboratory to collect:

a) a sample of pure salt from dirty sea water.

Filter, then evaporate the filtrate liquid.

b) some pure water from a mixture of sea water and olive oil.

Separate oil and water (immiscible) using a separating funnel, then distil the water fraction.

c) some pure copper sulfate from a dry mixture of solid copper sulfate (soluble) and copper oxide (insoluble). The grain size of the mixture is all the same.

Stir into water, then filter. Collect the filtrate and evaporate it.



Discussion / Activity 2

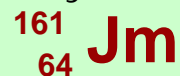
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Atomic Structure, Isotopes & Radioactivity Student Name

1. A certain fictitious element (symbol "Jm") has atoms with 64 protons, 64 electrons & 97 neutrons. What is its

- a) Atomic number? **64** b) Nucleon number? **161**
 c) Write a shorthand notation for this atom using only its symbol & these 2 numbers.



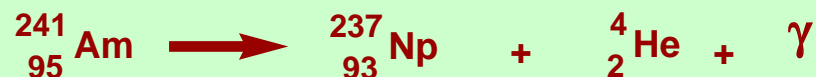
2. What are isotopes?

Different atoms of the same element. They have the same Atomic No., but different Mass No. due to a different number of neutrons.

3. Explain briefly why the "relative atomic mass" for an element is rarely a whole number, whereas the mass number for any atom always is.

Mass No. has to be an integer because it is a count of particles & there cannot be a fraction of a proton or neutron. RAM is the weighted average of the mix of isotopes of that element & always ends up a decimal fraction.

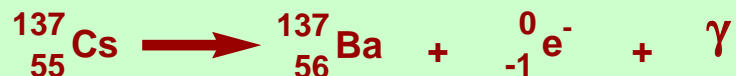
4. a) Write a balanced equation for the alpha decay of Am-241. (Periodic Table needed)
 (Gamma radiation is also emitted)



b) Write a balanced equation for the beta decay of Thallium-204. (beta only)



c) Write a balanced equation for the beta decay of Cs-137. (Beta + gamma)





Discussion / Activity 3

Suggested Answers

The following activity might be for class discussion, or there may be paper copies for you to complete. If studying independently, please use these questions to check your comprehension before moving on.

Basics of the Elements

Student Name

1. a) Explain why gold is found as an uncombined element in nature.

Gold has very low chemical reactivity, so it does not readily react with other elements to form compounds. So it remains uncombined.

b) Why then, is reactive oxygen also found as an uncombined element in air?

Oxygen is reactive, but is constantly made by plants in photosynthesis.

2. What is meant by "malleable" and "ductile"?

Malleable = able to be flattened into sheets by hammering or rolling.

Ductile = able to be stretched into wires.

3. List the general properties of metals. Write a comparison list for non-metals.

Metals are shiny, good conductors and generally malleable & ductile.

Non-metals are mostly dull in appearance, poor conductors and brittle.

4.

a) Name the only 2 elements which are liquid at 25°C and standard pressure.

Mercury and bromine.

b) List 5 elements which are gases, apart from the inert gases.

Hydrogen, nitrogen, oxygen, fluorine & chlorine.

c) Explain why these elements in (b) have a symbol (e.g. "H"), but also can be described by a formula such as "H₂". What's the difference?

A symbol like "H" is the symbol for this element, used in the Periodic Table to describe one atom of the element. However, all these elements actually exist as diatomic molecules, so "H₂" describes the element in its actual, normal molecular state.



Discussion / Activity 4

Suggested Answers

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Orbits & Orbitals

Student Name

1. Complete the following table. Refer to the Periodic Table. (example done for you)

Atomic No.	Name	Symbol	Block	Electron Configuration	Orbital Notation
10	Neon	Ne	p	2.8	$1s^2, 2s^2, 2p^6$
20	Calcium	Ca	s	2.8.8.2	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2$
30	Zinc	Zn	d	2.8.18.2	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}, 4s^2$
40	Zirconium	Zr	d	2.8.18.10.2	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}, 4s^2, 4p^6, 4d^2, 5s^2$
50	Tin	Sn	p	2.8.18.18.4	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}, 4s^2, 4p^6, 4d^{10}, 5s^2, 5p^2$
60	Neodymium	Nd	f	2.8.18.21.9.2	$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}, 4s^2, 4p^6, 4d^{10}, 4f^3, 5s^2, 5p^6, 5d^1, 6s^2$

Note: Quantum strangeness strikes again!

The given orbital arrangement for Nd is what you should expect in theory, but config. is actually 2.8.18.22.8.2.

2. a) Which column above relates to the "Bohr model"? Outline Bohr's 1913 proposal.

"Electron configuration" column: the number of electrons in each of Bohr's "allowed orbits", which he had proposed using Plank's "Quantum Theory". Allowed orbits overcame a theoretical problem with the previous atomic model.

b) What scientific mystery did he explain by his idea of the atom?

The "emission spectra" & spectral lines of each element.

c) Name the scientist, and the branch of Science, most associated with the right-hand column above.

Erwin Schrodinger. Quantum Mechanics.



Discussion / Activity 5

Suggested Answers

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Periodicity

Student Name

1. What is the trend in atomic radius:

a) across a period to the right? Explain this trend.

Generally, radius decreases because the increasing nuclear charge attracts the electrons with increasing strength & pulls the outer orbit in closer.

b) down a group? Explain this trend.

Radius increases because a whole new orbit has been added (compared to the element above).

This outer orbit is further away from the nucleus than the outer orbit of the element above it in the table

2. a) What is meant by "electronegativity"?

It is an assigned numerical "score" for the power of each element to attract electrons.

b) On the Periodic Table diagram, mark (X) the element with the highest value for electronegativity.

c) What is the trend in values:

i) to the left?

decreasing values

ii) down a group?

decreasing values

3. In general terms, where are the most chemically-active metals and most chemically-active non-metals found in the table? (Use group numbers to identify.)

Metals = group 1 (alkali metals)

Non-metals = group 17 (halogens)

4. a) Write a balanced equation for the 1st ionisation of an atom of potassium.

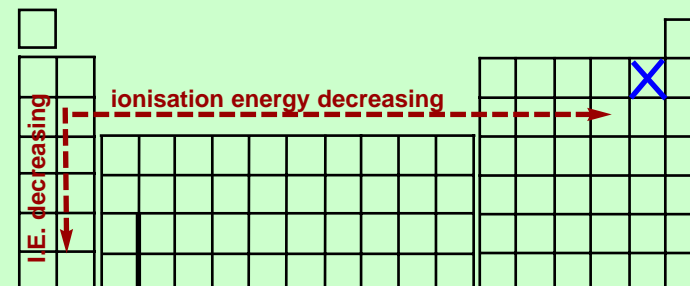


b) Would you expect the energy value to be relatively high or low? **low**

c) Add labelled arrows to the table diag. to show the trends:

i) to the right

ii) down a group





Discussion / Activity 6

Suggested Answers

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Atoms & Ions

Student Name

Here are the Periodic Table entries for 3 different elements. Use this information to answer the questions.

13	15	56
Al	P	Ba
Aluminium	Phosphorus	Barium
26.98	30.97	137.3

1. For each element, state how many electrons, protons and (probable) neutrons are in one atom.

Al: 13 protons, 13 electrons, 14 neutrons

P: 15 protons, 15 electrons, 16 neutrons

Ba: 56 protons, 56 electrons, 81 neutrons

2. State the electron configurations of aluminium and phosphorus.

Al: 2.8.3 P: 2.8.5

3. What might each of these atoms do to form an ion?

What electric charge will each ion have?

Al: lose 3 electrons. 3+ P: gain 3 electrons. 3-

4. Barium has electron configuration 2.8.18.18.8.2

a) What might a barium atom do to form an ion?

Lose 2 electrons

b) What charge will the ion have? 2+

c) Is barium likely to be a metal or a non-metal? Why?

Metal, because metals form positive ions.



Discussion / Activity 7

Suggested Answers

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Ionic Compounds

Student Name

1. Explain why the formula for sodium chloride is NaCl, but sodium sulfide is Na₂S.

Sodium loses 1 electron, while chlorine gains 1. They combine 1:1.

However, sulfur needs to gain 2 electrons, so 2 sodium atoms are required. They combine 2:1 ratio.

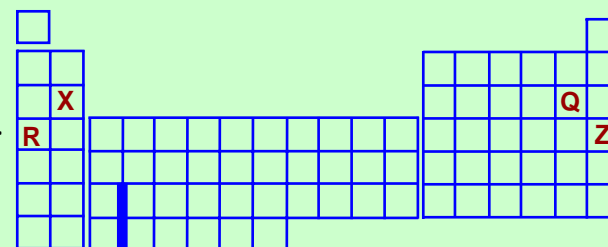
2. The positions of 4 elements Q,R,X,Z (not their correct symbols) in the Periodic Table are shown.

a) State the likely charge on the ion (if any) of each element.

R = 1+ X = 2+ Q = 1- Z would not form ions.

b) What would be the formula for a compound of:

i) Q & R? RQ ii) X & Q? XQ₂



3. There are 2 different forms of the compound copper chloride with formulas CuCl and CuCl₂.

a) Explain how² this is possible.

Copper atoms theoretically have outermost orbitals 3d⁹,4s² (valency +2), but will readily "shuffle" electrons to become 3d¹⁰, 4s¹ (valency +1). This means 2 different ions are possible, and 2 different compounds can form with chlorine.

b) Give the fully correct names for CuCl and CuCl₂.

copper (I) chloride copper (II) chloride

4.

a) What is meant by a "polyatomic ion"? It is a bonded group of atoms containing extra electrons (or missing electrons) so it has an overall electric charge and acts like a simple ion.

b) Explain what the formula Ca(NO₃)₂ really means, and name the compound.

This is an ionic compound of calcium ions (Ca²⁺) bonded to nitrate (polyatomic) ions (NO₃⁻). The ions are combined in a ratio 1:2. Name = calcium nitrate.



Discussion / Activity 8

Suggested Answers

The following activity might be for class discussion, or there may be paper copies for you to complete. If studying independently, please use these questions to check your comprehension before moving on

Chemical Bonding

Student Name

1.

a) Outline the basic difference between ionic and covalent bonding.

In ionic bonding, electrons are lost and gained to form ions which then bond together by electrical attraction. Covalent bonding involves sharing electrons.

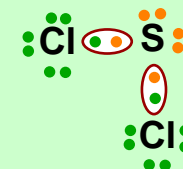
b) Chlorine bonds in a 1:2 ratio with magnesium to form ionic MgCl_2 .

Can you have a "molecule" of MgCl_2 ? Explain.

No. Ionic compounds form ionic lattices. There are no molecules.

c) Chlorine can also combine 1:2 with sulfur to form molecules of SCl_2 .

i) Sketch a Lewis Formula for this molecule.

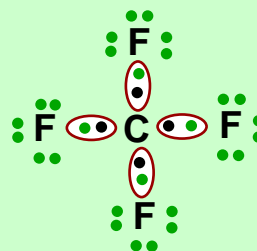


ii) How many electrons are involved in bonding in this molecule? Explain.

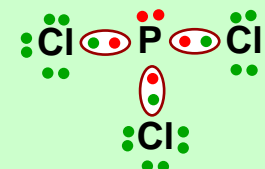
Four electrons. Each single covalent bond involves 2 electrons.

2. Suggest a name for these covalent compounds. Draw Lewis Formulas for the first 2.

a) CF_4 Carbon tetrafluoride.



b) PCl_3 Phosphorus trichloride.



c) N_2O_4 Dinitrogen tetroxide.

d) SiS_2 Silicon disulfide.

Worksheets 12-15 are also appropriate at this point



Discussion / Activity 9

Suggested Answers

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Bonding & Properties

Student Name

1. Explain why ionic compounds:

a) are usually hard, crystalline solids with high melting points.

The ions are tightly held in a regular array or lattice. It has a particular shape (crystal) and requires a lot of energy to melt it.

b) are poor electrical conductors as solids, but conduct well when melted.

As a solid the ions cannot move around to carry a current. When melted, the ions can move independently, so it can conduct.

2. Explain why covalent molecular substances are generally low-melting point non-conductors. There are no charged particles which can move to carry a current. The forces between molecules are weak, so it is easily melted.

3. Explain why metals:

a) are good electrical conductors.

There are many "free" electrons which can flow as a current.

b) are mostly hard, high-melting point solids.

There is a strong attraction between the metal ions and the "sea of electrons". This "metallic bond" holds the solid strongly together and requires a lot of energy to melt it.

c) are hard, but are malleable and ductile.

Although the metallic bond is strong, the structure is not rigid. The ions can move with the sea of electrons into new positions, so shape can change despite being strong.

4. Explain why covalent lattice substances are hard, crystalline, high-melting point non-conductors. Particles are strongly held together in a rigid lattice. There are no charged particles to carry current, and a lot of energy is needed to melt the lattice.