1. For some unknown reason, a few bottled water companies list the results of water analysis without including the ionic charges.

Using the charges of **polyatomic ions** and metal ions from the list shown, write the **empirical formulas** and **names** of any **four** compounds that can be created from these ions, if they were all present in sufficient quantities.

For example, if Li and OH had been listed,

We would first include the charges:

Li^+ (charge is positive one)
Polyatomic = OH^- (charge is negative one)

One of the four answers would have been:
- Empirical formula : LiOH
- Name: lithium hydroxide

Here are the charges for the polyatomic ions: HCO_3^-, NO_3^-, SO_4^{-2},

– Salerno – Italy

relle gazéifiée
spring water
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TERME DI

Analyse p.p.m.

As 0
HCO_3 228
Ca 44.7
Cl 10.3
Cu 0
F 0.11
Mg 20.6
NO_3 0
Pb 0
K 2.5
Na 4.9
SO_4 .... 8.5
Zn 0

Complete the following:

METAL IONS (those recognized by students from main groups studied)	POLYATOMICS HCO_3^- NO_3^- SO_4^{2-}	FORMULA for compounds	NAME
Ca^{2+}			
Mg^{2+}			
K^+			
Na^+			

2. Sodium benzoate is a preservative used in acidic foods such as jams and salad dressings.

    - Sodium benzoate's toxic dose is 500 mg/kg of body weight.

    - The greatest amount of sodium benzoate allowed in every 100 grams of jam is 0.10 g. This is the legal limit.

    One day, something went wrong at a jam factory, and two times the legal limit of sodium benzoate was added.

    In theory, how many 454 gram-jars of jam would a 50 kg child have to eat to experience the toxic dose?

3. Isotopes of oxygen have been crucial in understanding the history of climate change. Of the three stable isotopes of oxygen, the pair that provide insight into past temperatures are ^{18}O and ^{16}O.

    From the point of view of protons, neutrons, chemical properties, and physical properties, list two similarities and two differences between ^{18}O and ^{16}O.

4. Gallium, which is replacing the toxic element mercury in fever thermometers, has an atomic mass is 69.723 amu.

The following table shows the relative abundance for each of gallium's two isotopes.

Isotope	Relative Abundance
^{69}Ga	60.1 %
???	39.9 %

Calculate the mass number of the missing isotope.

5. In space vehicles, CO_2(carbon dioxide) has to be removed to prevent it from becoming toxic to astronauts. This is done by inserting cylinders of LiOH in the cabin of the vehicles, and then the following reaction occurs:
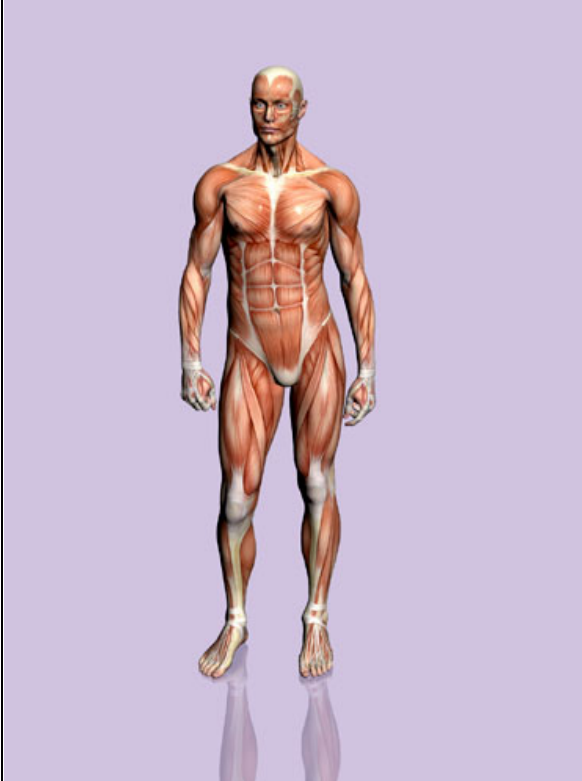
$$2 LiOH_{(s)} + CO_{2(g)} \rightarrow Li_2CO_{3(s)} + H_2O_{(s)}$$
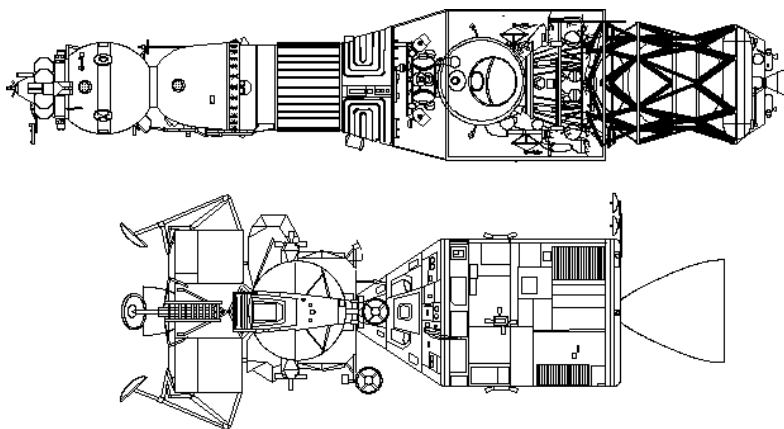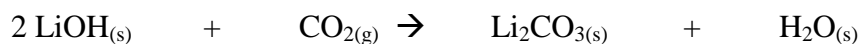
In a typical day, according to a study, a crew of four astronauts will exhale a total of 3600 grams of CO_2.

How many kg of LiOH are needed to absorb such an amount of CO_2?

6. The following table gives the mass of each element found in a 75 kg human body.

ELEMENT	Mass % in the human body	Mass (g)
O	65	48750
C	18	13500
H	10	7500
N	3	2250
Ca	1.5	1125
P	1.2	900
K	0.2	150
S	0.2	150
Cl	0.2	150
Na	0.1	75
Mg	0.05	37.5
Fe	0.05	37.5

Use these numbers to calculate the **total number of atoms** in a 75 kg human body.

7. The seed within a peach pit contains a small amount of cyanogenic glucosides, compounds that react with stomach acid to produce the poison hydrogen cyanide, HCN.

   Draw a Lewis dot structure for HCN and find the total number of covalent chemical bonds in one molecule of this poisonous compound.

8. To prevent the oxidation of lithium metal before it is
    placed in long-lasting batteries, it has to be stored in
    Vaseline jelly. If stored in oil, as is done with the rest of
    its group's members, lithium floats to the top and still
    reacts with oxygen.

    a) Use Lewis dot structures to reveal how oxygen (O)
       reacts with lithium (Li).
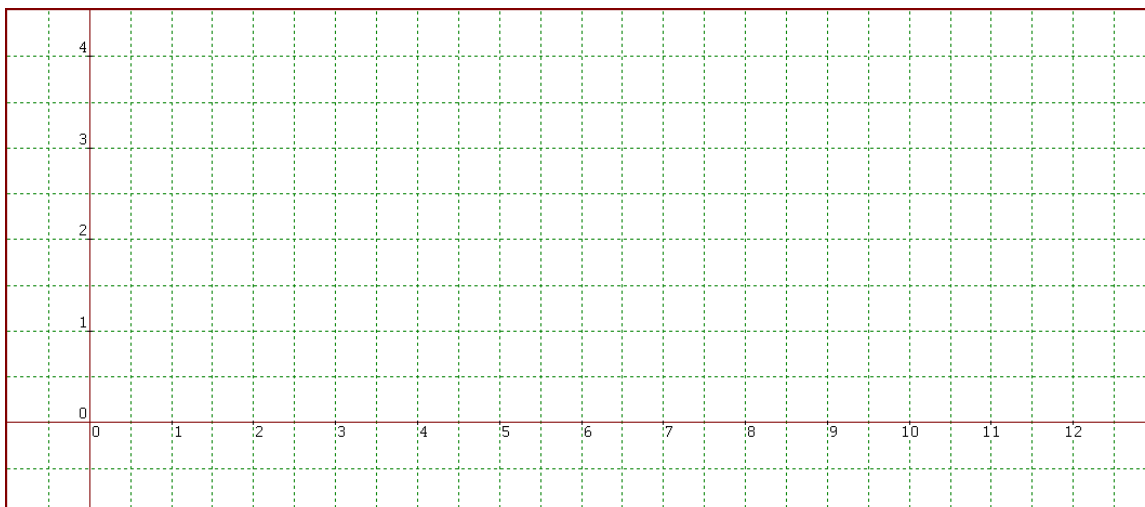   b) Then also draw a diagram to represent the product
       of this reaction.

9.   On the Cartesian plane provided, plot the electronegativity of the elements lithium
        through magnesium versus their atomic numbers.

        The electronegativities of the elements are listed in the table below in increasing
        order.

        To correctly match the electronegativities with their respective atomic numbers,
        you have to use your knowledge of the electronegativity trends within a period
        and within a group(family).

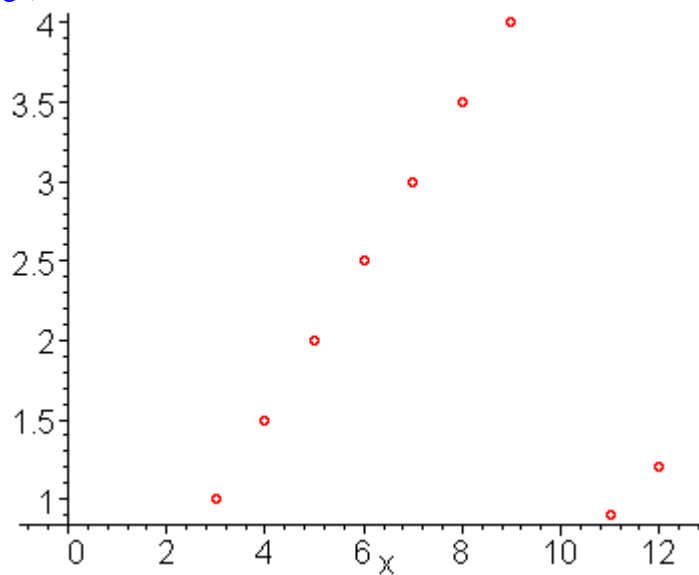   Correctly label both axes and label the graph with an appropriate title.

Electronegativity values for elements 3→12 (Paulings = unit)
0.9
1
1.2
1.5
2
2.5
3
3.5
4
cannot be measured

9.   SOLUTION

ELECTRONEGATIVITY VERSUS ATOMIC NUMBER

Electronegativity (Paulings)

Atomic Number

RATIONALIZATION FOR TEACHERS (if needed)

- **Neon(10) has no electronegativity because it does not bond.**
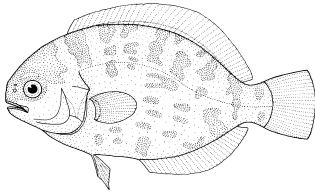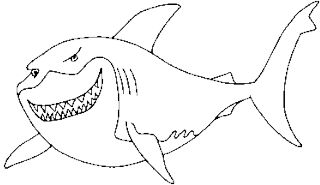- **From Li(3) to F(9) electronegativities increase across the period**

- $_{11}$Na 's value has to be lower than $_3$Li's because electronegativities decrease as you increase atomic number within a group.
- $_{12}$Mg 's value has to be lower than $_4$Be 's for the same reason (group trend).
- At the same time, Mg's value has to be higher than Na's because of the trend across the period

10. What three things have to managed more efficiently to reduce a society's ecological footprint?

11. When jeans are bleached with chlorine why is that considered an oxidation, even though oxygen is not involved in the reaction?

12. Which TWO of these reactions is exothermic?

   a) Sorbitol and especially xylitol cause a cold sensation in the mouth when they dissolve in saliva.
   b) Frying some potatoes until they turn golden-brown.
   c) Water condensing on glass.
   d) The neutralization of KOH with H_2SO_4.

13. If phosphate is only soluble with ammonium or alkali metals, identify the formula of the precipitate formed by mixing $K_3PO_{4(aq)}$ with $Ca(NO_3)_{2(aq)}$

10. Water, metal resources and energy

11. Chlorine plays the same electron-stealing role as oxygen.

12. c and d

13. $Ca_3(PO_4)_2$

14. The following table reveals concentrations of mercury found in water and in various organisms in the Gulf of Mexico in the year 2000.

Form a hypothesis about why algae have more mercury than the water itself, and why different fish have various concentrations of mercury.

		Eating habits	Concentration of mercury(ppm)
sea water			< 0.001
microscopic algae		Plant-like; makes its own food; serves as food for small fish	0.032
butterfish		The butterfish feeds on small fish, squid	0.058
white shark		Fish, marine mammals, who in turn eat fish	0.988

Source:http://www.cfsan.fda.gov/~frf/sea-mehg.html

14.   SOLUTION

The rate at which algae excrete mercury is lower than their intake rate. In other words, algae filter the mercury and *bioconcentrate* it because organic compounds within their cells bond to the toxic metal. When small fish feed on algae, the fish continue to accumulate the poison by a similar mechanism. Out of the three organisms, the shark is the highest on the food chain, so it *bioaccumulates* the most mercury.