

# NUMBERS AND CALCULATIONS

## 1. Discuss these questions in small groups.

- a) "Everything in science has its origin in mathematics."  
 "Mathematics is the most primary science." Do you agree? Why / why not?
- b) Describe the cartoon below.



- c) What could you calculate or measure in this classroom?

## 1. KINDS OF NUMBERS

Write one or more examples of each kind:

DECIMALS	NUMBERS BIGGER THAN ONE THOUSAND	ORDINALS	FRACTIONS	SQUARE ROOTS

Check in pairs how you read them.

## 2. ARITHMETIC

Complete the words in the table. If you are not sure, look at the examples below.

sign	=	+	-	×	÷
name of sign	<i>the equals sign</i>				
name of operation	-				

$4 + 4 = 8$	four <b>and (plus)</b> four is / <b>equals</b> eight
$9 - 2 = 7$	nine <b>minus</b> two is seven
$5 \times 5 = 25$	five <b>times</b> five is twenty-five or five <b>multiplied by</b> five is twenty-five
$8 \div 4 = 2$	eight <b>divided by</b> four is two

Here are some more arithmetical symbols. Notice how to say them.

$2^2$	two squared	$\sqrt{\quad}$	square root of ...
$-2^3$	minus (negative) two cubed	$\sqrt[3]{\quad}$	cube root of ...
$2^4$	two to the power of four	$\pi$	pi
$\log_{10}7$	log of seven to the base ten	$x=3(a+b)$	x equals three, bracket a plus b, bracket

Read aloud in pairs / small groups:

a)  $23-6=17$     b)  $32\div 8=4$     c)  $8\times 9=72$     d)  $\sqrt[3]{9}=3$     e)  $-5\frac{1}{4}$     f)  $e=mc^2$

Now solve these problems:

- $\sqrt{16} =$
- $4 + 7\frac{1}{5} = \dots$
- $\pi = \dots$
- $9 \times 5 =$
- $2^4 =$
- $9^2 =$
- Take the square root of 36. Add 14. Multiply by 5. Subtract 1.
- Take the average of 20, 24, 26 and 30. Multiply by 10.
- Take 50% of the students in your class. Multiply by 2. Divide by 4.
- Multiply 7 by 9. Add 9. Divide by 6. Subtract 3.

## LISTENING

### Mole calculation problem

<http://www.youtube.com/watch?v=M0NwbaQAoVc>

Watch the video – part 3.15-6.40 and answer the questions:

1. What is the first calculation problem?
2. How does the speaker write down the key facts – in a column / grid / or chart?
3. What did she do with the number 15.999 (molar mass of oxygen) ?
4. What kind of figures does she speak about when giving grams of  $H_2O$  ?
5. What is the second calculation problem?
6. Which synonym does she use for calculate or find out the number of  $H_2O$  moles?
7. What is  $6.02 \times 10^{23}$  ? Can you red this expression?

## QUANTITIES AND UNITS

Mole is the unit of the quantity called amount of substance. Other quantites are comprised in the table below. Complete the names of their units and abbreviations.

	QUANTITY	UNIT	ABBR.	NOTES
SI BASE UNITS	length mass time temperature		K	=39.36 inches/in =2.2 pounds/lb
SI DERIVED UNITS	area volume velocity density frequency acceleration force work/energy/heat amount of substance molar concentration			mol/m <sup>3</sup>
NON-SI UNITS USED IN CHEMISTRY	volume typical radius of an atom  about the mass of a proton or neutron	<ul style="list-style-type: none"> <li>• _____</li> <li>• _____</li> </ul>		=1000 cm <sup>3</sup> =10 <sup>-10</sup> m  =1.66054x10 <sup>-27</sup> kg  1/12 of the rest mass of an unbound neutral atom of carbon-12 in its nuclear and electronic ground state

**Some more measurements and their units:**

electric current	ampere (amp)
electric power	watt (W)
electric resistance	ohm ( $\Omega$ )
electric potential difference	volt (V)
temperature	degrees Centigrade ( $^{\circ}$ C)/ Fahrenheit (F)

**1. Write formulas for these relationships:**

1. Velocity is calculated by dividing distance by time.
2. The volume of a cube is calculated by multiplying the length times the width and the height.
3. The circumference of a circle equals  $\pi$  times the diameter.
4. Degrees Celsius equal five ninths degrees Fahrenheit minus thirty-two.

**2. Work with a neighbour. Complete the table and say a few examples of what the prefixes mean.**

*e.g. One kilometer equals ten to the power of three meters.*

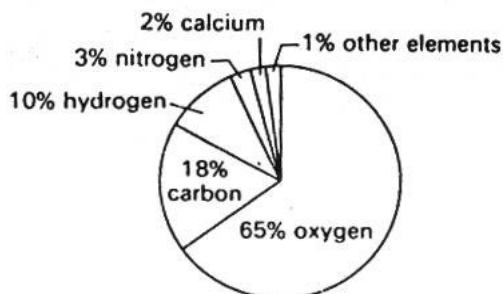
a) kilo-	one thousand: $1 \text{ km} = 1000 \text{ m}$	$10^3$
b) deci-	one tenth: $1 \text{ dm} = \frac{1}{10} \text{ m}$	$10$
c) centi-	one hundredth: $1 \text{ cm} = \frac{1}{100} \text{ m}$	$10$
d) milli-	one thousandth: $1 \text{ mm} = \frac{1}{1000} \text{ m}$	$10$
e) micro-	one millionth: $1 \text{ }\mu\text{m} = \frac{1}{1000000} \text{ m}$	$10$
f) nano-	one thousand millionth: $1 \text{ nm} = \frac{1}{1000000000} \text{ m}$	$10$
g) pico-	one picometer: $1 \text{ pm}$	$10$
h)	one : $1 \text{ fm}$	$10^{-15}$
i)atto-	one : $1 \text{ m}$	$10^{-18}$

**PERCENTAGES**

*65% (per cent) of our body weight is oxygen.*

*Our body contains 65% of oxygen.*

*Oxygen represents 65% of our body weight.*



**Describe the rest of the diagram below using the structures given.**

**FORMULAS:**

NaCl – sodium chloride    H<sub>2</sub>SO<sub>4</sub> – sulphuric acid    ZnSO<sub>4</sub> – zinc sulphate    C<sub>6</sub>H<sub>6</sub> - benzene  
 ZnO – zinc oxide    HCl – hydrochloric acid    Na<sub>2</sub>CO<sub>3</sub> – sodium carbonate    NH<sub>3</sub> - ammonia  
 CO<sub>2</sub> - carbon dioxide    NaOH – sodium hydroxide

**These formulas are used in writing EQUATIONS.**

*Example:*    HCl    +    NaOH    →    NaCl    +    H<sub>2</sub>O

*We spell as:*    H Cl    plus    Na OH    gives    Na Cl    plus    H<sub>2</sub>O

*We read as:* hydrochloric acid reacts with sodium hydroxide to form sodium chloride and water.  
 combines with

**Complete these equations.**

a)  $\text{CuO} + \text{H}_2 \rightarrow \dots\dots\dots$   
(copper oxide reacts with hydrogen to form copper and water)

b)  $\text{Na}_2\text{CO}_3 + 2 \text{HCl} \rightarrow \dots\dots\dots$   
(sodium carbonate reacts with hydrochloric acid to form sodium chloride, carbon dioxide and water)

c)  $\text{Zn} + 2\text{HCl} \rightarrow \dots\dots\dots$   
(zinc reacts with hydrochloric acid to form zinc chloride and hydrogen)

**Express these equations in words:**

1.  $2 \text{Na} + \text{Cl}_2 \rightarrow 2 \text{NaCl} \dots\dots\dots$

2.  $\text{ZnO} + \text{H}_2\text{SO}_4 \rightarrow 2 \text{ZnSO}_4 + \text{H}_2\text{O} \dots\dots\dots$

3.  $2 \text{Na} + 2 \text{H}_2\text{O} \rightarrow 2 \text{NaOH} + \text{H}_2 \dots\dots\dots$

**VIII. Watch the beginning of the video lecture about pH calculation given by Dr.Goldwhite.**

[http://www.youtube.com/watch?v=LZk1\\_yzF9js](http://www.youtube.com/watch?v=LZk1_yzF9js)

**Useful vocabulary:**

acid (n) - kyselina

base (n) – zásada

obtain (v) – získat

strongly acidic (adv+adj) – silně kyselé

basic (adj) - zásadité

species (n) - vzorek

concentration of a solution (n) – koncentrace roztoku

ion (n) - iont

questions: 1. Which two substances are in the initial instruction?

2. What is the unit of concentration?

3. What does  $\text{H}_2\text{SO}_4$  have?

4. What specific mathematical operation is used?

5. Complete the professor's comment: (two words) “\_\_\_\_\_ we would expect \_\_\_\_\_ it  
is a solution of a strong acid.”

**Watch again and check.**

**Do the following calculation, then watch the remaining part of the video and see whether you were right.**

## HOMEWORK

Say whether the following statements are true or false. Correct the false statements.

- a) Duration is measured in degrees Centigrade T/F
- b) The second is a unit of time T/F
- c) Speed is measured in kilograms per hour. T/F
- d) The watt is a unit of electrical charge. T/F
- e) Density is measured in grams per metre cubed. T/F
- f) The gram is a unit of mass. T/F
- g) Liquid measurements are made in litres, or cubic decimetres. T/F

## GRAMMAR: COUNTABLE/ UNCOUNTABLE NOUNS

I. Divide the words below into two categories: countable and uncountable nouns

percentage, metre, science, molecule, nitrogen, information, radius, second, temperature, heat, fraction, chemistry, base, acid, petroleum, research, change, salt, object, ion, water, light, substance, matter, energy, electron, equilibrium, neutron

II. Complete the sentences below with “many” or “much”

1. How \_\_\_\_\_ electrons does an atom of carbon possess?
2. How \_\_\_\_\_ elements are there in the periodic table?
3. How \_\_\_\_\_ liquid does a beaker contain?
4. How \_\_\_\_\_ chemical elements does the atmosphere contain?
5. How \_\_\_\_\_ nitrogen does the atmosphere contain?
6. Do you find \_\_\_\_\_ useful information about chemistry on the Internet?
7. Will we exploit \_\_\_\_\_ more nuclear energy in the future than we do today?

III. Complete the sentences with “little”, “a little”, “few”, “a few”

1. As very \_\_\_\_\_ research has been done in the field, we still have no antidote to the disease.
2. Doing just \_\_\_\_\_ research threw up some very useful information.
3. Only \_\_\_\_\_ scientists were invited to take part in the project. That is probably why it was not successful.
4. The project team consists of \_\_\_\_\_ well-known chemists.

Make several sentences and complete the units:

The	height	of	large small very small minute cylindrical	objects	is measured in	
	volume					
	area					
	width					
	surface area					
	length					
	radius					
	cross-sectional area					
	diameter					
	circumference					

For more units and their abbreviations visit <http://www.jbc.org/site/misc/itoa.TLxhtml>

Sources: Lesson based on Bates, Martin and Dudley-Evans, Tony: *Nucleus of General Science*. Longman 1990.

Cihová, Jarmila et al. *Angličtina pre študentov chémie*. Bratislava: Univerzita Komenského, 2003.