MEASUREMENT: QUANTITIES, NUMBERS AND UNITS

1. Numbers

a) Give an example of a *cardinal, ordinal, decimal, even* and *odd* number referring to you.

b) In pairs, decide how we say these values or symbols.

Values: a) $^3/_4$ b) $^5/_8$ c) 10^2 d) 10^3 e) 10^7 f) 10^{-9}

Symbols: a) % b) $\log_{10}7$ c) π d) $\sqrt{49}$ $e) \sqrt[3]{27}$

c) Write down a graphical image of the problem below.

Add 4 to two squared, multiply it by a cube root of twenty seven, then subtract two fifths. What is the answer?

2. Language for measurement

Work in pairs. Look at the word cloud. Which words do you know? Explain in English what they mean, or translate them.

3. Vocabulary - synonyms

Read the text below. For each phrase 1-7 find a word which matches the meaning of the phrase.

Example: something that changes its value – *variable*

1. numerical results of measurements
2. a characteristic attribute
3. a substance made up of two or more different kinds of elements
4. clear, certain, with a particular meaning
5. someone without professional knowledge of a subject
6. not mixed, focused on essential processes

In this section the language of measurement, which is central to chemistry, will be introduced. Chemists might measure a number of variables such as pressure, temperature, mass, and volume and use the experimental values to calculate some other property. The purity of a compound or the concentration of a compound in a commercial product are possible examples. The chemist needs to be able to record data and do calculations in a precise and unambiguous format. This requires a universally adopted language involving concepts, symbols and rules. While the average lay person knows little of these, knowledge of them is essential to the practising of chemistry. This section follows the recommendations of the International Union of Pure and Applied Chemistry (IUPAC), the international governing body for chemistry.

4. Answer the questions form the slide.

Then find the relevant parts of the text to the questions:

Quantity: A property that is measured [e.g. mass, length, time, volume, pressure].

Unit: A standard quantity against which a quantity is measured [e.g. gram, metre, second, litre, pascal; which are units of the above quantities].

Chemists measure various quantities. If the mass of a substance was found to be 6.0 grams, this can be expressed as an equation $m = 6.0$ g

It is important to realise that the magnitude of a quantity expressed as a number without units for the quantity is meaningless unless the quantity is in fact a ratio and is dimensionless (i.e. has no units since the units in the numerator and denominator cancel).

Many quantities are defined in terms of other quantities. Thus density, is defined as mass per unit volume. Thus if the mass and volume of a sample of a substance are known, the density is calculated by dividing the mass by the volume, density = mass/volume or $\rho = m/V$.

For many quantities there are different systems of units. It is essential that one can convert from one set of units to another. This is simply done by replacing the units in the equation by their values in terms of the desired unit [e.g. If the velocity of a particle is 200 miles per hour what is it in metres per second? 1 mile = 1609 m. 1 hour = 3600 s
v = 200 miles/hour = 200 miles (hour)-1 = 200 x (1609 m) x (3600 s)-1 = 89.4 m s-1].

5. Complete the gaps 1-10 with this vocabulary:

mass	amount of substance	force	area	volume	frequency	electric charge	length	pressure	electric current

International System of Units (SI units): The internationally adopted system which defines or expresses all quantities in terms of seven basic units, the six used by chemists being:

length	metre	m
mass	kilogram	kg
time	second	s
temperature	kelvin	K
1…	mole	mol
2. …	ampere	A

Other quantities commonly used in chemistry, and which have special names for the units derived from these basic units are:

3. …	hertz	Hz
energy	joule	J
4. …	newton	N
5. …	pascal	Pa
power	watt	W
6. …	coulomb	C
electric potential difference	volt	V

Further quantities used in chemistry but without special names for the derived units are:

7. …	m^2
volume	m^3
density	kg m^{-3}

absorbance - dimensionless (therefore no units).

Some multiple units have their own name, the three relevant for chemists being:

8. …	tonne t	1 t = 10^3 kg = 1 Mg
9. …	litre L	1 L = 10^{-3} m^3 = 1 dm^3 = 10^3 cm^3
10. …	ångström Å	1 Å = 10^{-8} cm = 10^{-10} m = 100 pm

6. Guess the quantities are described in A - C below.

A. a measure of the number of entities (atoms, molecules, ions, electrons, etc) present in a substance
B. force applied perpendicular to the surface of an object per unit area
C. ratio of the mass of one component to the total mass of the solution

7. Read the text about the rules for writing and correct the mistakes in a) – e):

a) 10 grams b) 15 kgs c) 273 Kelvins d) 20m/s e) 50 nano seconds

Units may be written out in full or the symbol used. The letter s is never added to the symbol to indicate a plural. A full stop is not written after symbols except at the end of a sentence. Those symbols named after a person have a capital first letter, but when the name of the unit is written out in full a lower case first letter is used [e.g. J, joule]. A space is left between the number and the symbol for the unit, but no space is left between the prefix indicating powers of ten and the symbol to which it applies. When symbols are combined as a quotient, [e.g. metres per second], either power to the minus one or the solidus may be used [e.g. m s-1 or m/s]. But the solidus may only be used once to avoid ambiguity [e.g. writing kg/m/s2 for pascal could be interpreted as kg m-1 s-2 or as kg m-1 s2].

The article is from https://www.canterbury.ac.nz/media/documents/science-documents/Measurement.pdf

8. You are going to hear eight short extracts in which scientists discuss their work. Listen and choose the correct answer (a - c).

1. What was the dosage of fluoride per kilogram of body weight?
   a) 0.166 b) 0.16 c) 0.616
2. What was the sensitivity of the assay?
   a) 0.02 b) 2.0 c) 0.2
3. What is the output impedance at the 5V end?
   a) 0.02 b) 0.20 c) 0.92
4. What amperage of flex is used?
   a) 0.6 b) 6 c) 6.8
5. What is the temperature below which the superconductor conducts electricity with no resistance?
   a) $^{9}/_{10}$ b) 19 c) 90
6. What is the enthalpy change when 2 moles of water are formed at a pressure of one atmosphere and a temperature of 298 kelvin?
   a) -517.6 b) -5716 c) -571.6
7. What is the lowest frequency at which young mice squeak when isolated from their mother?
   a) 450 b) 45 c) 405
8. What speed laser pulses were used? a) 15 b) 50 c) -50

9. Stoichiometry: Mass – volume problem https://www.youtube.com/watch?v=UXRSHplX-zo 0 – 3.30

Calculate the volume of oxygen gas required to react with 50g of aluminium. You know that:
One mole of an ideal gas at standard temperature and pressure occupies 22.4 litres.
Relative atomic masses: A_r (Al) = 27g/mol, A_r (O) = 16 g/mol, STP = standard temperature and pressure

Your calculation:

Summary of the tutorial:

1. What does the teacher start with?
2. What does she check?
3. The first thing to calculate is the number of …
4. How do you express this notation in words? (1.852 x 3)/4
5. What does she want to consider in the end?
6. Does she round the number in the middle of the calculation? When did you round your numbers?

10. Read the problems A, B. Explain in English how to solve them.

A Calculate the amount of substance in 1 kg of water.

B Calculate the volume of hydrogen which is produced in a reaction of 10.0g of metallic zinc in excess of hydrochloric acid. Ar (Zn) = 65.4