

LESSON 5

The weights of atoms and molecules.

The numbers on our cubes are the weights of atoms, not in kg, but in special tiny units (u). For example “12” on the C cube means the carbon atom weighs 12 u. (Not 12 kg!)

Q1. Look in the model box for the lightest atom, and write its weight. [*H, 1 u.*]

To save a word or two we say “the atomic weight of hydrogen is 1 u”.

There is an opportunity here for mental arithmetic aimed at familiarising atomic weights. Make a display of the cubes so that both symbols and weights can be seen, and ask questions such as.- “How many H atoms would balance the weight of an F atom? Which is the heaviest of all these atoms? Which is heavier, that atom or a grain of sand? Which weighs more, 2 F atoms or 3 O atoms? An O atom or 4 He atoms? (Now ask me one!)”

If you add the atomic weights of all the atoms in a particular molecule you get its molecular weight.

Q2. Make a model of the hydrogen molecule and work out the molecular weight. [*1 u + 1 u = 2 u.*]

Q3. Write the molecular weight of oxygen (if possible, without building the model). [*The molecule is O₂, so the molecular weight is 16 u + 16 u = 32 u.*]

Q4. Is it possible to build a model using all these pieces: 1 C cube, 2 F cubes, 3 H cubes and 5 rods? Would you expect to find a molecule CH₃F₂ in Google or a dictionary? [*It isn't possible to build a model using all the pieces, and there is no known molecule with the formula CH₃F₂.*]

Q5. With different combinations of the Q4 pieces it is possible to model H₂, F₂, HF, and two other molecules. Model those two other molecules and write their formulas. [*With different combinations of those pieces you can build models of CH₃F and CH₂F₂, and both of these molecules are in dictionaries.*]

It is not possible to type CH₃F or CH₂F₂ into a search engine, but try typing CH3F or CH2F2. You will be surprised!

Q6. Which of the two is the heavier molecule? [*CH₂F₂. Zillions of these molecules make a gas that is used in the freezing unit of many refrigerators.*]

Q7. Would you expect the following molecules to exist: CF₄, CHF₃? [*There are two gases made of these molecules. If you'd had enough cubes you could have made models of them without any empty holes.*]

Notes for Parents

Is the falling enrolment in advanced chemistry classes a result of missing out too much from the earlier years of teaching? The weights of atoms and molecules seem essential in building an honest impression of chemistry, and the present tendency to defer this topic in middle school could be a specific indicator that syllabuses are being “dumbed down”.

Scientists prefer atomic mass to atomic weight, because mass is independent of the gravitational field: but the mass/weight distinction is a nicety in comparison with the advantages of starting this topic at an early age. Your pupil is familiar with weight, and that matters most.

Your pupil will probably be capable of searching the Internet for molecules by the end of this lesson. (He/she might try an “impossible” formula such as CH_5 .)

Suppose your pupil’s answer to Q3 is “I don’t know what the oxygen molecule is”. Setbacks of that kind are to be expected, as any teacher will agree. Our brains are not up to hard disk standard in accepting and returning information, so when your pupil falls short, hide your disappointment and just continue with the policy of revising as much as you can without being boring. There is an ultimate reward!