

**Exercise 3: Atoms, the periodic table, conversions and significant figures**

1. Physicists use a furlong/fortnight as an example of obscure English units used to express a speed. To one significant figure, is one furlong/fortnight fast or slow compared to a snail's pace (1 cm/min)? Relevant conversions: one fortnight = 14 days; one furlong = one-eighth of a mile.

2. Given that the mass of the neutron is  $1.674954 \times 10^{-27}$  kg, the mass of a proton is  $1.6726430 \times 10^{-27}$  kg and the mass of an electron is  $9.1093897 \times 10^{-31}$  kg, what is the **mass** (in kg) of a single carbon-12 atom? **Pay attention to significant figures!**

3. Based on the definition of an amu, what is the **mass** (in amu) of a single carbon-12 atom?

4. 1 atomic mass unit has a mass of  $1.66054 \times 10^{-27}$  kg. Use this factor to convert your answer to question 3 into kg and **compare** it to the answer in question 2. Calculate the **difference** in mass (in kg).

5. This difference in mass is the amount of matter that is converted to energy which holds the nucleus together (**nuclear binding energy**). Convert this mass to energy (joules) using the famous equation in the box on page 1070. One Joule =  $1 \text{ kg m}^2/\text{s}^2$  and  $c = 3.00 \times 10^8 \text{ m/s}$ . Again, pay attention to sig figs.

6. Write the chemical **symbol** for an **isotope** which has 8 protons, 10 neutrons and 10 electrons. Hint: is this isotope also an **ion**?

7. Describe the **subatomic structure** of phosphorus-32, a commonly used “tracer” isotope, indicating the **number** and **placement** of subatomic particles, including the **electron configuration**.

8. The following table shows various properties of chlorine and iodine:

Element	Molecular formula	Boiling point (K)	Melting point (K)	Compound made with sodium
chlorine	Cl <sub>2</sub>	239	172	NaCl
bromine				
iodine	I <sub>2</sub>	457	386.5	NaI

Fill in the information for the missing line of bromine, given bromine’s relative position in the periodic table. **You do not have to look up these values in any reference.**

9. What **type of bond** (ionic or covalent) does iodine make with itself? What type of bond does iodine make with sodium?

10. At what temperature (in K) does I<sub>2</sub> **freeze**?