Problem solving 1
First quarter warm ups: Supplementary material

1.1 Counting Pubs

1.1.1 Standard form

If you are unfamiliar with using standard from (or scientific notation) read through 1.3 of the *Foundation Maths Support Pack*. The answers to the questions in the *Foundation Maths Support Pack* are can be found in the PDF on Blackboard under 'Foundation Maths Support Booklet'.

If after reading you are still lost, bring any questions to the next class and ask either me or the demonstrators to explain.

Questions:

1. Convert the following numbers to standard form:
   (a) 3000.2
   (b) 56.2
   (c) 0.004
   (d) 112.05
2. Write down the following numbers as decimal numbers
   (a) 1.002×10^{0}
   (b) 4.035×10^{4}
   (c) 567.001×10^{-4}
   (d) 23×10^{-1}
3. Without using a calculator, multiply the following numbers together, writing your answer in standard form:
   (a) 1×10^{0} and 3×10^{-5}
   (b) 4×10^{4} and 3×10^{-4}
   (c) 2×10^{-4} and 4×10^{8}
   (d) 5×10^{-1} and 5×10^{10}
4. Without using a calculator, divide the 1st number by the 2nd number, writing your answer in standard form:
   (a) 3×10^{0} and 3×10^{-5}
   (b) 12×10^{4} and 3×10^{-4}
   (c) 4×10^{-4} and 2×10^{8}
   (d) 5×10^{-1} and 5×10^{10}

Answers to questions:

1. Answers below:
   (a) 3.0002×10^3
   (b) 5.62×10^1
   (c) 4×10^{-3}
   (d) 1.1205×10^2
2. Answers below:
   (a) 1.002
   (b) 40350
   (c) 0.0567001
   (d) 2.3
3. Answers below:
   (a) 3×10^{-5}
   (b) 1.2×10^1
   (c) 8×10^4
   (d) 2.5×10^{10}
4. Answers below:
   (a) 1×10^5
   (b) 4×10^8
   (c) 2×10^{-12}
   (d) 1×10^{-11}

1.1.2 Converting units

In our experience, converting units is an aspect of numerical science that causes a lot of confusion. Here are some examples to try and explain before you attempt them yourself. First though, to familiarise yourself with 'prefixes' review Appendix A1 in the main document. You should also review 1.3, 2.1 and 2.2 of the *Foundation Maths Support Pack*.

Example 1.1 *Convert 154 cm to metres.*

OK, quite an easy one to start with. 'c' stands for 'centi' which means multiply by 1×10^{-2}. *Therefore 154 cm is equal to* 154×10^{-2} *m, which is* 1.54 *m. Although using standard form like this might seem alien at first, please stick with it. If you learn it well now, it will help you later on.*

Example 1.2 *Convert 100* cm^2 *to* m^2.

OK, a little trickier this one. Again 'c' stands for 'centi' (1×10^{-2}*), but the unit is squared. This means we need to square the* 1×10^{-2}, *i.e.* $\left(1 \times 10^{-2}\right)^2 = 1 \times 10^{-4}$, *adding the powers of 10). So therefore we have* 100×10^{-4} m^2, *which is* 1×10^{-2} m^2. *As a check you should note that when converting from* cm^2 *to* m^2 *there are less* m^2 *than* cm^2 *(a* m^2 *is larger than a* cm^2*).*

Example 1.3 *Convert 0.5* km^3 *to* cm^3.

Nasty! Here 'k' stands for 'kilo', which means multiply by 1×10^3. *However, the prefix is cubed. This means we have to cube the multiplier:* $\left(1 \times 10^3\right)^3 = 1 \times 10^9$. *So 0.5* km^3 *is equal to* 0.5×10^9 m^3. *But we wanted an answer in* cm^3. *As noted 'centi' means multiply by* 1×10^{-2}, *but because it is cubed this becomes* 1×10^{-6} *as we are now converting from* m^3 *to* cm^3 *we must divide, instead of multiply so we get* $0.5 \times 10^9 \div 1 \times 10^{-6} = 5.0 \times 10^{14}$ cm^3.

Questions:

1. Multiply the following numbers together and express the results in metres squared.
   (a) 3 km and 2 km.
   (b) 4 km and 3 m.
   (c) 2 Gm and 0.5 Mm. (note G$\equiv 1 \times 10^9$ and M$\equiv 1 \times 10^6$).
   (d) 2 mm and 1 cm. (note m$\equiv 1 \times 10^{-3}$ and c$\equiv 1 \times 10^{-2}$).
2. What is the product of the two numbers below expressed in metres cubed?
   (a) 3 km^2 and 5 km.
   (b) 1 Gm^2 and 3 nm. (note n$\equiv 1 \times 10^{-9}$).
   (c) 3 mm^2 and 9 cm.
3. What is the square root of the following numbers and expressed in metres?
   (a) 3 km^2.
   (b) 9 mm^2.
   (c) 100 μm^2. (note $\mu \equiv 1 \times 10^{-6}$).

Answers to questions:

1. Answers below
   (a) 6×10^6
   (b) 1.2×10^4
   (c) 1×10^{15}
   (d) 2×10^{-5}
2. Answers below
   (a) 1.5×10^{10}.
   (b) 3×10^9.
   (c) 2.7×10^{-7}
3. Answers below
   (a) 1.7321×10^3
   (b) 3×10^{-3}
   (c) 1×10^{-5}