

Indices and standard form

- 1 Given $a = 10^{-2}$, $b = 10^6$, $c = 10^3$, find without using a calculator,
- (1) ab (2) $\frac{b}{a}$ (3) a^2c (4) $\frac{c^3}{b}$ (5) $\sqrt{\frac{a}{b}}$
- (6) $\sqrt[3]{bc}$ (7) $(abc)^{-2}$ (8) $(bc^2)^{\frac{1}{4}}$ (9) $\frac{(3a)^2}{3a^2}$ (10) $\frac{(bc)^3}{bc^3}$
- 2 Redo no.1 with $a = 10^4$, $b = 10^{-6}$, $c = 10^{-3}$.
- 3 You are given the following approximations to certain physical constants: $N = 6 \times 10^{23}$, $c = 3 \times 10^8$, $m = 9 \times 10^{-31}$, $e = 1.6 \times 10^{-19}$ and $h = 10^{-34}$. Find in standard form, without calculator:
- (1) $\frac{N}{c}$ (2) $\frac{1}{h}$ (3) $\frac{c^2}{m}$ (4) mc^2 (5) \sqrt{e}
- (6) Ne (7) c^3 (8) mh^{-1} (9) $\frac{ec^2}{N}$ (10) $m + 100h$
- 4 The sun is about 150 million km from the earth, and light travels at 300 000 km/s.
- (a) Express these data in standard form.
 (b) How long does it take, in minutes and seconds, for light to reach earth from the sun?
 (c) How long would it take if light only travelled at 1 mph? (1 mile = 1.6 km.)
- 5 (a) A light-year is the distance light travels in a year. Express this in km and in miles, in standard form, to 3SF. (Take 1 year as 365 days, to allow for leap years.)
 (b) The nearest star, Proxima Centauri, is about $4\frac{1}{4}$ light years away. A space shuttle, travelling at its usual orbiting speed, would take 100 000 years to reach this star. Find the shuttle's speed in km/s and in mph.
- 6 The masses of a proton and an electron are 1.673×10^{-27} and 9.110×10^{-31} kg.
- (a) How many electrons have the same mass as one proton?
 (b) How many protons would have a total mass of 1kg?
- 7 A display in the Science Museum informs us that if the atoms in your hand were scaled up to the size of peas, then your hand would be big enough to hold the earth. Taking the earth as having diameter 12800 km, a pea's diameter as 4mm and a sphere that you can hold as having diameter 8cm, calculate an estimate of the diameter of an atom, giving your answer in mm in standard form to 2SF.
- 8 Solve
- (a) $x^{-3} = 27$ (b) $x^{\frac{1}{2}} = 0.1$ (c) $x^{\frac{2}{3}} = 16$ (d) $x^{\frac{1}{4}} = 1$
- 9 A sum of £1000 is invested in a savings account and 6% is added to the account at the end of each year; the interest is said to be *compounded annually* because the interest for the first year helps to earn more interest in the second year, and so on.
- (a) By what factor is the amount in the account multiplied each year?
 (b) What is the amount after n years? Evaluate this for $n = 10$.
 (c) What rate of interest would be needed to double the amount in 10 years?
 (d) What rate would give 50% growth in 5 years?