Large and Small

Data Sheet

World Earnings

The total amount earned in a year is about £33 000 000 000 000.
Use the conversion £1 = €1.46 to change this to euros.

Jupiter's Surface Area

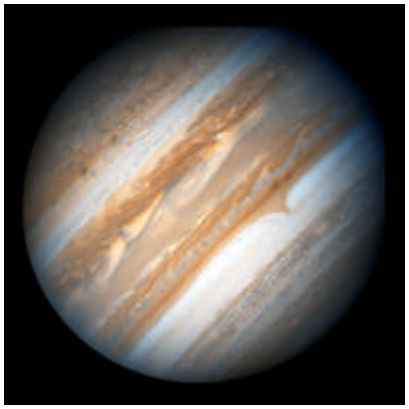


Image of Jupiter produced by STScI
for NASA from **http://hubblesite.org/**

The formula $S = 4\pi r^2$ gives the surface area of a sphere of radius r.

Jupiter's radius is 71 492 000 metres.
Use the formula to estimate the surface area of Jupiter.

Atomic Particles

Atoms are made up of protons, neutrons and electrons.

The mass of a proton is
0.000 000 000 000 000 000 000 000 001 673 kg.
This is 1836 times as heavy as an electron.

What is the mass of an electron?

How many protons are needed to make a mass of 1kg?

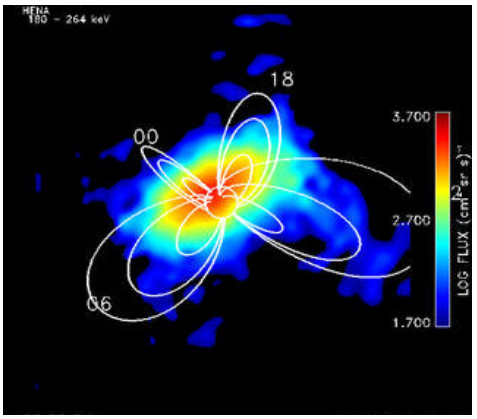


Image of an oxygen atom produced by the NASA/Goddard Space Flight Center Scientific Visualization Studio from http://www.nasa.gov

Photo-copiable

Large and Small

Worksheet

1 Write these in standard form:

a) three million b) £12.6 million c) eighty thousand
d) five billion e) £3.25 billion f) ten and a half billion
g) seven million, five hundred and twenty thousand
h) four hundred and fifty million and sixty-eight thousand

2 Write these as ordinary numbers.

a) 2.4×10^{6} b) 2.4×10^{-6} c) 3×10^{9} d) 3×10^{-9} e) 7.14×10^{5} f) 7.14×10^{-5}

3 Write these numbers in standard form.

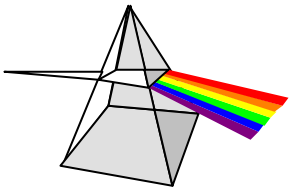
a) 36 000 000 b) 482 000 c) 900 000 000 d) 0.000 25 e) 0.000 007 f) 0.003 456

4 In 2005 there were 1.3×10^{9} main line telephones and 2.2×10^{9} mobile phones in the world.
What were the total number of phones?

5 The earth is 1.5×10^{11} metres from the sun. Light travels at about 3×10^{8} metres per second.
Use the formula: $\text{time} = \dfrac{\text{distance}}{\text{speed}}$ to estimate the time taken for sunlight to reach the earth.

6 The wavelength of red light is 7×10^{-7} metres
and that of violet light is 4×10^{-7} metres.

What is the difference between these wavelengths?



7 A bacterium measures 1×10^{-6} metres and a virus measures 2×10^{-7} metres.
How many times bigger is the bacterium than the virus?

8 A flea is 9.5×10^{-4} metres long and a dust mite is 2.3×10^{-3} metres long.
Which of these is longer and by how much?

9 The surface area of the world is approximately 5.1×10^{8} square kilometres.
The area of Europe is about 9.9×10^{6} square kilometres.
Approximately what % of the world's area is Europe?

10 Each locust in a swarm eats about 2×10^{-3} kilograms of food in a day and there are about 3×10^{4} locusts in the swarm. Roughly how much does the whole swarm eat in a day?

11 You may know that Saturn has rings. It also has moons.

The table gives some information about six of Saturn's moons.

Image from http://www.nasa.gov

Moon	Distance from Saturn (m)	Volume (m^3)	Mass (kg)
Dione	3.77×10^{8}	7.36×10^{17}	1.05×10^{21}
Enceladus	2.38×10^{8}	6.54×10^{16}	8.40×10^{19}
Iapetus	3.56×10^{9}	1.63×10^{18}	1.88×10^{21}
Rhea	5.27×10^{8}	1.88×10^{18}	2.49×10^{21}
Tethys	2.95×10^{8}	6.24×10^{17}	7.55×10^{20}
Titan	1.22×10^{9}	7.15×10^{19}	1.35×10^{23}

a) List the moons in the order of their distance from Saturn. Start with the nearest.
b) List the moons in the order of their volumes. Start with the largest moon.
c) List these moons in the order of their masses. Start with the heaviest.
d) Use the formula: $\text{density} = \dfrac{\text{mass}}{\text{volume}}$ to find the density of each moon.

12 The table gives the atomic masses of carbon, hydrogen, oxygen and nitrogen.

Element	Atomic Mass (kg)
Carbon	1.99×10^{-26}
Hydrogen	1.67×10^{-27}
Oxygen	2.66×10^{-26}
Nitrogen	2.33×10^{-26}

a) List the elements in the order of their masses. Start with the lightest.
b) Molecules of other substances are made from combinations of atoms.
Find the mass of each of the following molecules:
(i) carbon monoxide (CO) made from one atom of carbon plus one of oxygen
(ii) carbon dioxide (CO_2) made from one atom of carbon plus two of oxygen
(iii) water (H_2O) made from two atoms of hydrogen plus one of oxygen
c) (i) Which is heavier, a molecule of acetic acid ($C_2H_4O_2$) or nitric acid (HNO_3)?
(ii) What is the difference in their masses?

13 It has been said that "Unravel your DNA and it would stretch from here to the moon". (http://hypertextbook.com/facts/1998/StevenChen.shtml). Check whether this is true.

You can assume that there are about 10^{13} cells in the body and that each cell contains about 3 billion base pairs where each base pair is 3.4×10^{-10} metres long.

The distance between the earth and the moon is 3.8×10^{8} metres.

Teacher Notes

Unit Intermediate Level, Using algebra, functions and graphs

Skills used in this activity:

- converting between standard form and ordinary numbers
- calculating with standard form numbers

Notes on Activity

This activity can be used near the start of the course to introduce/revise standard form numbers. Some questions involving very large and very small numbers are given on the Data Sheet and the first slide of the Powerpoint presentation. You could start by asking students to find the answers. They are € 4.818×10^{13}, 6.4228×10^{16} m^2, 9.1122×10^{-31} kg and 5.977×10^{26} - extreme values that illustrate the need for standard form.

The rest of the slides in the Powerpoint presentation can then be used to demonstrate and discuss standard form conversions and calculations. Note that you may need to alter some of the notation to match that on your students' calculators. The Worksheet gives practice in the use of standard form in a variety of contexts. You may wish to adapt the questions to reflect your students' other studies or interests. For example, students studying Economics, Geography, Business Studies, Science (etc.) may prefer more examples relating to their studies.

Answers to Worksheet

1 a) 3×10^{6} b) £1.26×10^{7} c) 8×10^{4} d) 5×10^{9}
e) £3.25×10^{9} f) 1.05×10^{10} g) 7.52×10^{6} h) 4.50068×10^{8}

2 a) 2 400 000 b) 0.000 0024 c) 3 000 000 000 d) 0.000 000 003
e) 714 000 f) 0.000 0714

3 a) 3.6×10^{7} b) 4.82×10^{5} c) 9×10^{8} d) 2.5×10^{-4}
e) 7×10^{-6} f) 3.456×10^{-3}

4 3.5×10^{9}

5 500 seconds (or 8 minutes and 20 seconds)

6 3×10^{-7} metres

7 5 times bigger

8 Dust mite is 1.35×10^{-3} metres longer

9 2% (nearest %)

10 60 kg

11 a) Encaladus, Tethys, Dione, Rhea, Titan, Iapetus
b) Titan, Rhea, Iapetus, Dione, Enceladus, Tethys
c) Titan, Rhea, Iapetus, Dione, Tethys, Enceladus
d) Dione 1430 kg m^{-3}, Enceladus 1280 kg m^{-3}, Iapetus 1150 kg m^{-3}, Rhea 1320 kg m^{-3}, Tethys 1210 kg m^{-3}, Titan 1890 kg m^{-3} (to 3sf)

12 a) Hydrogen, Carbon, Nitrogen, Oxygen
b) (i) 4.65×10^{-26} kg (ii) 7.31×10^{-26} kg (iii) 2.99×10^{-26} kg
c) (i) Nitric acid (ii) 5.09×10^{-27} kg

13 Total length of DNA = 2.04×10^{13} metres
This is about 50 000 times the distance between the earth and the moon!

Websites

The website http://www.powersof10.com provides good examples that can help students to appreciate the size of numbers. You could also use a Search engine to find websites that give information about your students' studies or interests if these involve large or small numbers.