Maths Skills Activities

SI units

Every measurement must have a size (eg 2.7) and a unit (eg metres or °C). Sometimes, there are different units available for the same type of measurement. For example, ounces, pounds, kilograms and tonnes are all used as units for mass.

To reduce confusion, and to help with conversion between different units, there is a standard system of units called the SI units which are used for most scientific purposes.

These units have all been defined by experiment so that the size of, say, a metre in the UK is the same as a metre in China.

The seven SI base units are:

Physical quantity	Usual quantity symbol	Unit	Abbreviation
mass	m	kilogram	kg
length	l or x	metre	m
time	t	second	s
electric current	I	ampere	A
temperature	T	kelvin	K
amount of substance	N	mole	mol
luminous intensity	(not used at A-level)	candela	cd

All other units can be derived from the SI base units.

For example, area is measured in square metres (written as m^2) and speed is measured in metres per second (written as ms^{-1}).

It is not always appropriate to use a full unit. For example, measuring the width of a hair or the distance from Manchester to London in metres would cause the numbers to be difficult to work with.

Prefixes are used to multiply each of the units. You will be familiar with centi (meaning 1/100), kilo (1000) and milli (1/1000) from centimetres, kilometres and millimetres.

Maths Skills Activities

There is a wide range of prefixes. The majority of quantities in scientific contexts will be quoted using the prefixes that are multiples of 1000. For example, a distance of 33 000 m would be quoted as 33 km.

The most common prefixes you will encounter are:

Prefix	Symbol	Multiplication factor		
Tera	T	10^{12}	1 000 000 000 000	
Giga	G	10^{9}	1 000 000 000	
Mega	M	10^{6}	1 000 000	
kilo	k	10^{3}	1000	
deci	d	10^{-1}	0.1	1/10
centi	c	10^{-2}	0.01	1/100
milli	m	10^{-3}	0.001	1/1000
micro	μ	10^{-6}	0.000 001	1/1 000 000
nano	n	10^{-9}	0.000 000 001	1/1 000 000 000
pico	p	10^{-12}	0.000 000 000 001	1/1 000 000 000 000
femto	f	10^{-15}	0.000 000 000 000 001	1/1 000 000 000 000 000

Activity 1

Activity 1

Which SI unit and prefix would you use for the following quantities?

1. The time between heart beats
2. The length of a leaf
3. The distance that a migratory bird travelled each year
4. The width of a cheek cell
5. The mass of a rabbit
6. The mass of iron in the body
7. The volume of the trunk of a large tree

Activity 2

Sometimes, there are units that are used that are not combinations of SI units and prefixes.

These are often multiples of units that are helpful to use. For example, one litre is 0.001 m^3, or one day is 86 400 seconds.

Activity 2

Choose the most appropriate unit, and estimate the size of each of the following.

1. The mass of an elephant
2. The mass of an earthworm
3. The volume of water in a teardrop
4. The volume of water in a pond
5. The time taken for a sunflower to grow
6. The temperature difference between the blood in the heart and in the ear on a cold day
7. The width of a hair
8. The length that your fingernails grow each day
9. The total length of each of the hairs on your head

Activity 3

Put the following in order of size:

height of an elephant; length of DNA strand; width of a hair; height of a tree; width of a sodium ion; length of a nerve cell; length of a heart; width of a red blood cell; size of a virus; length of a finger; length of a mosquito; length of a human digestive system; width of a field; length of a water molecule.

Answers

Activity 1

1. Depending on the organism, or fitness level, s or ms
2. cm
3. km
4. µm
5. g or kg
6. g
7. m^3

Activity 2

1. 6000 kg
2. 4 g
3. 0.5 ml
4. 1.5 m^3
5. 120 days
6. 2 °C
7. 150 µm
8. 0.1 mm
9. The total length of each of the hairs on your head

Activity 3

1. Width of a field
2. Height of a tree
3. Length of a human digestive system
4. Height of an elephant
5. Length of DNA strand
6. Length of a nerve cell
7. Length of a heart
8. Length of a finger
9. Length of a mosquito
10. Width of a hair
11. Width of a red blood cell
12. Size of a virus
13. Length of a water molecule
14. Width of a sodium ion

Maths Questions:

Units

Convert the following numbers into metres:

1. 3 km
2. 20 cm
3. 2.3 mm
4. 550 nm
5. 5.1 μm
6. 13.7 Gm
7. 0.0025 km
8. 1.001 km

Simplify the following units:

9. $\text{cm} \times \text{cm}$
10. $\text{km}^2 \times \text{km}$
11. $\text{nm}^2 \times \text{nm}^{-1}$
12. $\frac{\text{kg m}}{\text{m}}$
13. $\frac{\text{cm}^3}{\text{cm}}$
14. $\frac{\text{kg cm}^3}{\text{cm}}$
15. $\frac{\text{cm}}{\text{cm}^2}$
16. $\frac{\text{g cm}^2}{\text{cm}^{-1}}$

17. Concrete has a density of 2400 kg m^{-3}. What volume of concrete would have a mass of 96 kg?

18. What would this volume be in a) dm^3 and b) cm^3

Maths Answers:

Units

Convert the following numbers into metres:

1. $3\ \text{km} = 3000\ \text{m}$
2. $20\ \text{cm} = 0.2\ \text{m}$
3. $2.3\ \text{mm} = 0.0023\ \text{m}$
4. $550\ \text{nm} = 0.000\ 000\ 55\ \text{m}$
5. $5.1\ \mu\text{m} = 0.000\ 0051\ \text{m}$
6. $13.7\ \text{Gm} = 13\ 700\ 000\ 000\ \text{m}$
7. $0.0025\ \text{km} = 2.5\ \text{m}$
8. $1.001\ \text{km} = 1001\ \text{m}$

Simplify the following units:

9. $\text{cm} \times \text{cm} = \text{cm}^2$
10. $\text{km}^2 \times \text{km} = \text{km}^3$
11. $\text{nm}^2 \times \text{nm}^{-1} = \text{nm}$
12. $\frac{\text{kg m}}{\text{m}} = \text{kg}$
13. $\frac{\text{cm}^3}{\text{cm}} = \text{cm}^2$
14. $\frac{\text{kg cm}^3}{\text{cm}} = \text{kg cm}^2$
15. $\frac{\text{cm}}{\text{cm}^2} = \text{cm}^{-1}$
16. $\frac{\text{g cm}^2}{\text{cm}^{-1}} = \text{g cm}^3$

17. Concrete has a density of 2400 kg m^{-3}. What volume of concrete would have a mass of 96 kg?

    $0.04\ \text{m}^3$

18. What would this volume be in a) dm^3 and b) cm^3

    a) $40\ \text{dm}^3$
    b) $40\ 000\ \text{cm}^3$

Maths Questions:

Standard Form

Convert the following numbers into standard form:

1. 32 000
2. 0.0006
3. 104 000
4. 18 200 000
5. 9 230 000
6. 0.000 040 5
7. 0.002 019
8. 30 200

Convert the following numbers from standard form into decimal notation:

9. 3.26×10^{4}
10. 8.4×10^{-3}
11. 7.29×10^{7}
12. 1.26×10^{2}
13. 8×10^{-6}
14. 1.3×10^{8}
15. 2.3×10^{-4}
16. 5.001×10^{6}

17. Using the formula Circumference $= 2 \times 3.14 \times$ radius, and given that the mean radius of the Earth is $6\,378\,000$ m, calculate the approximate circumference of the Earth leaving your answer in standard form to two significant figures.

18. There are $86\,400$ seconds in a day. Calculate the number of seconds in a year leaving your answer in standard form to two significant figures.

19. The current world population is approximately 7.4×10^{9} people. The United Kingdom population accounts for 0.88% of the total world population. Using this information, approximate the number of people living in the United Kingdom leaving your answer as a decimal number.

Maths Answers:

Standard Form

Convert the following numbers into standard form:

1. $32\,000 = 3.2 \times 10^4$
2. $0.0006 = 6 \times 10^{-4}$
3. $104\,000 = 1.04 \times 10^5$
4. $18\,200\,000 = 1.82 \times 10^7$
5. $9\,230\,000 = 9.23 \times 10^6$
6. $0.000\,040\,5 = 4.05 \times 10^{-5}$
7. $0.002\,019 = 2.019 \times 10^{-3}$
8. $30\,200 = 3.02 \times 10^4$

Convert the following numbers from standard form into decimal notation:

9. $3.26 \times 10^4 = 32\,600$
10. $8.4 \times 10^{-3} = 0.0084$
11. $7.29 \times 10^7 = 72\,900\,000$
12. $1.26 \times 10^2 = 126$
13. $8 \times 10^{-6} = 0.000\,008$
14. $1.3 \times 10^8 = 130\,000\,000$
15. $2.3 \times 10^{-4} = 0.000\,23$
16. $5.001 \times 10^6 = 5\,001\,000$

17. Using the formula Circumference $= 2 \times 3.14 \times$ radius, and given that the mean radius of the Earth is $6\,378\,000$ m, calculate the approximate circumference of the Earth leaving your answer in standard form to two significant figures.
$= 40 \times 10^6$ m $(= 40 \times 10^3$ km$)$

18. There are $86\,400$ seconds in a day. Calculate the number of seconds in a year leaving your answer in standard form to two significant figures.
$= 32 \times 10^6$ seconds

19. The current world population is approximately 7.4×10^9 people. The United Kingdom population accounts for 0.88% of the total world population. Using this information, approximate the number of people living in the United Kingdom leaving your answer as a decimal number.
$= 65\,120\,000$

Maths Questions:

Indices

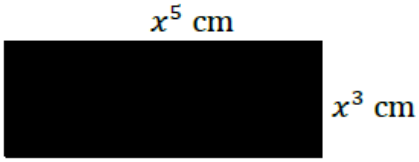
Simplify the following expressions:

1. $x^3 \times x^4$
2. $y^9 \div y^4$
3. $(z^7)^3$
4. $\frac{x^4 \times x^2}{x^5}$
5. $(ab)^2 \times a^3$
6. $b^{\frac{1}{3}}$
7. $c^{-3} \div c^4$
8. $\frac{(x^0 \times x^3)^2}{x^4}$

Solve the following equations for x

9. $2^{x+1} = 2^4$
10. $3^{x-2} + 1 = 28$
11. $2^{x+6} = 128$
12. $2(3^x)^2 = 162$
13. $7^{x+4} = 343$
14. $\frac{x^3 \times x^4}{x^5} = 64$

15. Find the area of the following rectangle. Write your answer in simplified form.



16. The moon is approximately 4×10^5 kilometres away. If an astronaut was to travel to the moon and back 3 times, how far would he have travelled in space?

17. If that same astronaut was to travel to the moon and back 10^3 times, how far would he have travelled in space?

Maths Answers:

Indices

Simplify the following expressions:

1. $x^3 \times x^4 = x^7$
2. $y^9 \div y^4 = y^5$
3. $(z^7)^3 = z^{21}$
4. $\frac{x^4 \times x^2}{x^5} = x$
5. $(ab)^2 \times a^3 = a^5 b^2$
6. $b^{\frac{1}{3}} = \sqrt[3]{b}$
7. $c^{-3} \div c^4 = c^{-7} = \frac{1}{c^7}$
8. $\frac{(x^0 \times x^3)^2}{x^4} = x^2$

Solve the following equations for x

9. $2^{x+1} = 2^4 \quad (x = 3)$
10. $3^{x-2} + 1 = 28 \quad (x = 5)$
11. $2^{x+6} = 128 \quad (x = 1)$
12. $2(3^x)^2 = 162 \quad (x = 2)$
13. $7^{x+4} = 343 \quad (x = -1)$
14. $\frac{x^3 \times x^4}{x^5} = 64 \quad (x = 8)$

15. Find the area of the following rectangle. Write your answer in simplified form.

x^5 cm

x^3 cm

$= x^8$ cm^2

16. The moon is approximately 4×10^5 kilometres away. If an astronaut was to travel to the moon and back 3 times, how far would he have travelled in space?
$= 2.4 \times 10^6$ kilometres

17. If that same astronaut was to travel to the moon and back 10^3 times, how far would he have travelled in space?
$= 8 \times 10^8$ kilometres

Maths Questions:

Ratios

Simplify the following ratios (Example $6:4 = 3:2$):

1. $120:50$
2. $64:24$
3. $13:52$
4. $100:10\,000$
5. $24:72$
6. $18:90$
7. $56:88$
8. $36:144$

Find x by scaling the ratio.

9. $1:2 = 4:x$
10. $8:3 = x:9$
11. $25:10 = x:2$
12. $x:160 = 2:8$
13. $49:x = 2:4$
14. $58.5:18 = x:4$

15. A toy is made from red bricks and yellow bricks.
    Number of red bricks: Number of yellow bricks = $5:2$.
    There are 210 more red bricks than yellow bricks.

    How many red bricks are in the toy?

16. There are 100 balls in a bag. The balls are red, blue, green or white. The ratio of blue to red is $5:1$. There are twice as many blue as green. $\frac{1}{4}$ of the balls are green.

    How many white balls are in the bag?

17. One day, 460 people visit a zoo. 280 are adults. The ratio of women to men is $4:3$. 180 are children. $\frac{3}{5}$ of them are boys. Jane says that altogether there were more females visiting the zoo.

    Show that she is correct.

Maths Answers:

Ratios

Simplify the following ratios (Example $6:4 = 3:2$):

1. $120:50 = 12:5$
2. $64:24 = 8:3$
3. $13:52 = 1:4$
4. $100:10\,000 = 1:100$
5. $24:72 = 1:3$
6. $18:90 = 1:5$
7. $56:88 = 7:11$
8. $36:144 = 1:4$

Find x by scaling the ratio.

9. $1:2 = 4:x\ (= 8)$
10. $8:3 = x:9\ (= 24)$
11. $25:10 = x:2\ (= 5)$
12. $x:160 = 2:8\ (= 40)$
13. $49:x = 2:4\ (= 98)$
14. $58.5:18 = x:4\ (= 13)$

15. A toy is made from red bricks and yellow bricks.
    Number of red bricks: Number of yellow bricks $= 5:2$.
    There are 210 more red bricks than yellow bricks.

    How many red bricks are in the toy? = 350 red bricks (140 yellow bricks)

16. There are 100 balls in a bag. The balls are red, blue, green or white. The ratio of blue to red is $5:1$. There are twice as many blue as green. $\frac{1}{4}$ of the balls are green.

    How many white balls are in the bag? = 15 white balls

17. One day, 460 people visit a zoo. 280 are adults. The ratio of women to men is $4:3$. 180 are children. $\frac{3}{5}$ of them are boys. Jane says that altogether there were more females visiting the zoo.

    Show that she is correct.

    280 adults in a $4:3$ ratio of women to men = 160 women and 120 men.
    180 children where $3/5$ are boys = 108 boys and 72 girls
    228 men and boys visited the zoo and 232 women and girls visited the zoo.