

## M1 Maths

# M1-3 Unit Conversion

- converting between units for mass and length, between L, mL and cm<sup>3</sup> and between units for time

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## Summary

To convert from one unit to another:

1. Decide whether the new units are bigger or smaller than the old units
2. If the new units are smaller you will need more of them, so multiply; if the new units are bigger, you will need less of them so divide
3. Decide how many of one unit in the other (the conversion factor) and multiply or divide by that number.

We convert between decimal fractions and mixed units (say 3.4 minutes as minutes and seconds) by considering the 0.4 min as  $0.4 \times 60 = 24$  s, to give 3 min 24 s.

To go the other way, we consider say 24 s as  $\frac{24}{60}$  i.e. 0.4 min. So 3 min 24 s = 3.4 min.

## Learn

We often have a measurement in one unit, e.g. hours, metres, kilograms, millilitres, and we want to convert it to another unit, e.g. minutes, centimetres, grams, litres. The method is basically the same for all types of units.

To convert from one unit to another:

1. Decide whether the new units are bigger or smaller than the old units
2. If the new units are smaller you will need more of them, so multiply; if the new units are bigger, you will need less of them so divide
3. Decide how many of one unit in the other (the conversion factor) and multiply or divide by that number.

**Example 1:** To convert 50 m to kilometres.

The new unit is bigger, so we need less of them, so divide. There are 1000 metres in a kilometre, so divide by 1000.  $50 \div 1000 = 0.05$

So 50 m = 0.05 km.

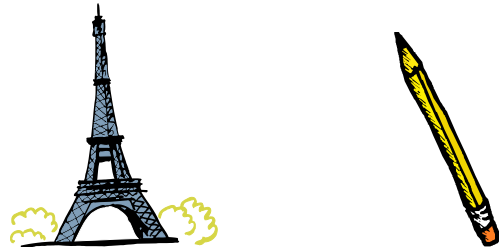
**Example 2:** To convert  $4\frac{1}{2}$  hours to seconds.

The new unit is smaller, so we need more of them, so multiply. There are 60 seconds in a minute and 60 minutes in an hour, so there are  $60 \times 60 = 3600$  seconds in an hour, so multiply by 3600.  $4\frac{1}{2} \times 3600 = 16\,200$ .

So  $4\frac{1}{2}$  hours = 16 200 seconds.

**Tip 1:** Feel free to do the multiplication or division on your calculator if you're not confident about doing it in your head.

**Tip 2:** Always picture the amount before doing the conversion. In Example 1 above, picture 50 m – maybe as half way along a football field. Then when you have finished the conversion, picture the answer in the new units. Obviously, half way along a football field is a small part of a kilometre, so 0.05 seems reasonable. Doing this will make you realise if you multiplied when you should have divided or vice versa, something which is quite easy to do. In the 50 m example, if you had multiplied instead of divided, you would have got an answer of 50 000 km. Quite obviously, half a football field isn't 50 000 km. So you know to go back and do it again.



**Tip 3:** When converting say centimetres to kilometres, you have two choices. If you can work out that there are 100 000 cm in a kilometre, then you can divide by that. Alternatively, you can convert to metres first by dividing by 100 and then convert to kilometres by dividing by 1000.

**Tip 4:** Remember that mL and  $\text{cm}^3$  are the same thing, so there is no need to convert between them.

## Practice

Q1 Copy and complete this table.

grams (g)	kilograms (kg)	tonnes (t)
10 000		
	2.5	
		0.1
600		
	4 000	
		0.000 023

Q2 Copy and complete this table.

kilometres (km)	metres (m)	centimetres (cm)	millimetres (mm)
3			
	0.2		
		650	
			80
0.000 04			
	12.582		
		4.7	
			340 000

Q3 Copy and complete this table.

litres (L)	millilitres (mL)	cubic centimetres (cm <sup>3</sup> )
4.2		
	200	
		15.5
0.07		
	4 500	
		0.5

To convert between time units, we do just the same. Though we need to know the various conversion factors.

You should know the following units and abbreviations:

second (s), minute (min), hour (h), day, week, month, year, decade, century

And you should know the following conversions:

$$60 \text{ s} = 1 \text{ min}$$

$$60 \text{ min} = 1 \text{ h}$$

$$24 \text{ h} = 1 \text{ day}$$

$$7 \text{ days} = 1 \text{ week}$$

$$52 \text{ weeks} = 1 \text{ year (approximately)}$$

$$12 \text{ months} = 1 \text{ year}$$

$$365 \text{ days} = 1 \text{ year (usually)}$$

$$10 \text{ years} = 1 \text{ decade}$$

$$100 \text{ years} = 1 \text{ century}$$

Example: To convert 500 min to hours.

The new unit is bigger, so we need less of them, so divide. There are 60 min in an hour, so divide by 60.  $500 \div 60 = 8.33\dots$

So  $500 \text{ min} = 8.333\dots \text{ h}$ .

As before, if you are converting say 2 weeks to minutes, you can work out how many minutes in a week ( $7 \times 24 \times 60 = 10\,080$ ) or you can convert to days, then to hours then to minutes.

## Practice

Q4 Complete the following, using decimal fractions where necessary.

300 min	=	..... s	=	..... h
0.4 days	=	..... h	=	..... min
9000 s	=	..... min	=	..... h
2.5 days	=	..... h	=	..... min
240 h	=	..... days	=	..... weeks
6 weeks	=	..... h		
30 s	=	..... h		

## Converting time between mixed units and decimal fractions

Time is about the only thing we measure that we don't usually use decimal fractions for. When we do a calculation involving time on a calculator, sometimes we get an answer like 3.4 minutes, but we would usually prefer the answer in minutes and seconds. So we need to be able to change answers like 3.4 minutes into minutes and seconds.



This is how we do this. 3 minutes just stays as 3 minutes. We have to change the 0.4 minutes to seconds. Seconds are smaller, so we multiply – by 60 – to get  $0.4 \times 60$  seconds, which is 24 seconds. So 3.4 minutes is 3 minutes and 24 seconds.

Sometimes we need to convert the other way too. For example, when we want to put 3 minutes and 24 seconds into a calculator. Again, the 3 minutes just stays as 3 minutes. The 24 seconds has to be converted to minutes. Minutes are smaller, so it is  $24 \div 60$  minutes, i.e. 0.4 minutes. Add this to the 3 minutes and we have 3.4 minutes.

## Practice

- Q5 Convert the following to hours and minutes or minutes and seconds.
- (a) 3.4 minutes                      (b) 2.1 hours                      (c) 1.05 minutes  
(d) 4.93 h                              (e) 4.75 min                      (f) 0.67 h
- Q6 Convert the following to decimal fractions of a minute or hour.
- (a) 3 hours 24 minutes    (b) 1 minute 12 seconds    (c) 3 min 17.4 s  
(d) 2 h 52 min                      (e) 15 h 2 min                      (f) 65 min 36 s

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## Solve

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- Q51 How many 1 cm by 1 cm squares would it take to cover a 1 m by 1 m square? Hence find how many square centimetres in a square metres and convert  $5 \text{ m}^2$  to square centimetres.
- Q52 How many square metres in a square kilometre?
- Q53 Find conversion factor between cubic metres to cubic kilometres. Hence express  $0.004 \text{ km}^3$  in cubic metres.
- Q54 Express 3 days, 4 hours and 25 minutes in days (as a decimal fraction).

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## Revise

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### Revision Set 1

- Q61 Copy and complete the following:
- (a) 300 cm            = ..... m            = ..... mm  
(b) 0.4 km            = ..... m            = ..... cm  
(c) 60 kg              = ..... g              = ..... t  
(d) 300 min           = ..... h              = ..... s  
(e) 2.5 L              = ..... mL            = .....  $\text{cm}^3$   
(f)  $200 \text{ cm}^3$         = ..... L              = ..... mL  
(g) 5 h                = ..... min           = ..... s  
(h) 2 weeks           = ..... min           = ..... h  
(i) 1400 min        = ..... h ..... min  
(j) 6 days 19 h     = ..... days        = ..... s

## Answers

- Q1     300 min     = 18 000 s     = 5 h  
        0.4 days     = 9.6 h             = 576 min  
        9000 s       = 15 min            = 0.25 h  
        2.5 days     = 60h               = 3600 min  
        240 h         = 10 days          = 1.43 weeks  
        6 weeks      = 1008 h  
        30 s            = 0.0083 h

- Q2     (a) 3 min 24 s         (b) 2 h 6 min             (c) 1 min 3 s  
        (d) 4 h 55.8 min     (e) 4 min 45 s            (f) 40.2 min  
        (a) 3.4 h             (b) 1.2 min                (c) 3.29 min  
        (d) 2.8667 h         (e) 15.033 h              (f) 65.6 min

Q4

grams (g)	kilograms (kg)	tonnes (t)
10 000	10	0.01
2 500	2.5	0.0025
100 000	100	0.1
600	0.6	0.000 6
4 000 000	4 000	4
23	0.023	0.000 023

Q5

kilometres (km)	metres (m)	centimetres (cm)	millimetres (mm)
3	3 000	300 000	3 000 000
0.000 2	0.2	20	200
0.006 5	6.5	650	6 500
0.000 08	0.08	8	80
0.000 04	0.04	4	40
0.012 582	12.582	1 258.2	12 582
0.000 047	0.047	4.7	47
0.34	340	34 000	340 000

Q6

litres (L)	millilitres (mL)	cubic centimetres (cm <sup>3</sup> )
4.2	4200	4200
0.2	200	200
0.015 5	15.5	15.5
0.07	70	70
4.5	4 500	4 500
0.000 5	0.5	0.5

- Q51    10 000, 10 000, 50 000  
 Q52    1 000 000  
 Q53    1 000 000 000, 4 000 000 m<sup>3</sup>  
 Q54    3.184 days

- Q61    (a) 300 cm     = 3 m             = 3000 mm  
        (b) 0.4 km     = 400 m          = 40 000 cm  
        (c) 60 kg       = 60 000 g       = 0.06 t  
        (d) 300 min   = 5 h              = 18 000 s  
        (e) 2.5 L       = 2500 mL       = 2500 cm<sup>3</sup>  
        (f) 200 cm<sup>3</sup>   = 0.2 L            = 200 mL  
        (g) 5 h         = 300 min       = 18 000 s  
        (h) 2 weeks   = 20 160 min   = 336 h

- (i)  $1400 \text{ min} = 23 \text{ h } 20 \text{ min}$   
(j)  $6 \text{ days } 19 \text{ h} = 6.7917 \text{ h} = 24\,450 \text{ s}$