22. [Units of Measurement / Time]

- Consider the unit of measurement and the value of each scale marking.

Q. What is the difference in temperature between the room and Glasgow?

Glasgow   room temperature
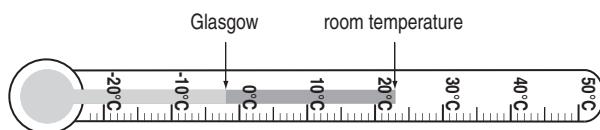
A. *Each marking represents 1°C.*
room temperature = 23°C
Glasgow = –2°C
Difference = 23°C – (–2°C)
*   = 23°C + 2°C*
*   = **25°C***

a) What is the difference in revolutions per minute (RPM) between the two vehicles?

RPM × 1000   RPM × 1000
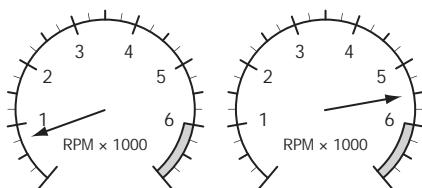
5.5 × 1000 – 0.75 × 1000

= 5500 – 750   = | 4750 RPM |

b) How many centimetres is the width difference between the two spiders?

| 0 cm   1 cm   scale view | 0 cm   1 cm   2 cm   scale view |

= | |
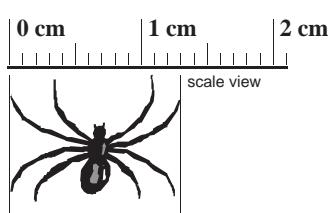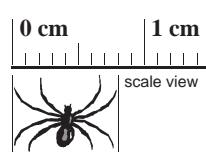
c) What is the difference in speed between the two vehicles?

60
40   km/h   80
20   100
0   93448   120

60
40   km/h   80
20   100
0   110123   120
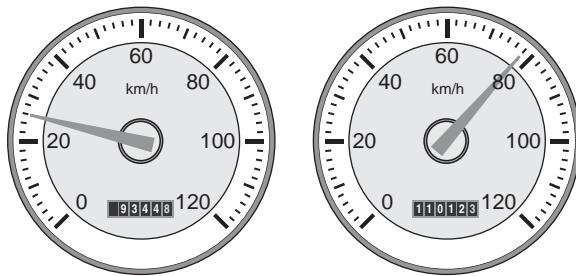
| km/h |

d) How many millimetres of mercury (mmHg) equal 980 millibars (mbar) of pressure?

1000   1010
990   750   760   1020
980   740   change   770   1030
rain
970   730   stormy   fair   780   1040
720   dry   790   1050
960
950   mmHg   1060
940 mbar 1070

| |
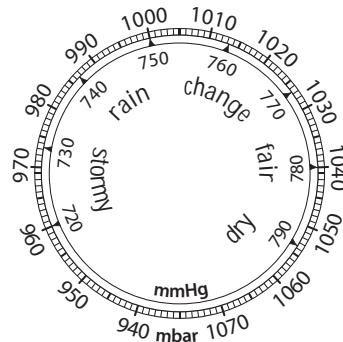
e) How much heavier is Mietta than Amelia?

Amelia   Mietta

10   30   50   60
kg   kg
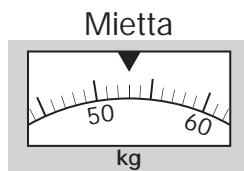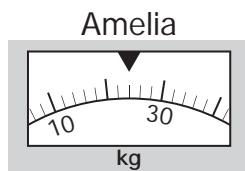
| kg |

f) How much more water is in the second cylinder?

30 mL
20 mL

60 mL
40 mL
20 mL

| mL |

Skill 22.2 Choosing appropriate units and measurements.
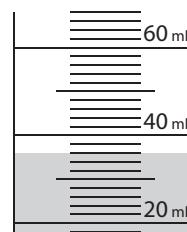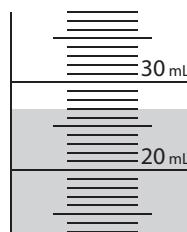
- Compare the length, area, mass or capacity to that of common objects (ruler, tennis court, bag of flour, carton of milk) or any standard units you know, chosen because they are sensible and accurate.

  Examples: Carpenters measure wood lengths in millimetres.
  Height of a person is measured in centimetres.
  Mountain heights are measured in metres.

Q. The diameter of a snowflake could most reasonably be described as:

A) 0.01 cm
B) 1 cm
C) 10 cm

A. *Convert difficult measurements to a unit you can visualise:*

A) 0.01 cm = 0.1 mm ⇒ *too small*
B) 1 cm ⇒ *reasonable*
C) 10 cm ⇒ *too large*
*The answer is **B**.*

---

a) The most appropriate unit for measuring the weight of a truck is:

A) tonnes
B) kilograms
C) grams per cubic centimetre
D) grams

A

b) The most appropriate unit for measuring the width of a book is:

A) square millimetres
B) metres
C) millimetres
D) square centimetres

c) The most appropriate unit for measuring the mass of a 20 cent coin is:

A) tonnes
B) kilograms
C) grams
D) milligrams

d) The most appropriate unit for measuring the area of a football ground is:

A) square centimetres
B) square kilometres
C) hectares
D) square metres

e) Choose the most reasonable weight of a BBQ gas cylinder.

A) 50 kg
B) 8.5 kg
C) 1 kg

f) Choose the most reasonable capacity of a green wheelie rubbish bin.

A) 240 L
B) 24 L
C) 2400 L

g) Choose the most reasonable weight of a standard red house brick.

A) 6 kg
B) 3 kg
C) 0.5 kg

h) Choose the most reasonable capacity of a hen's egg.

A) 45 mL
B) 20 mL
C) 5 mL

i) Choose the most reasonable volume of water used in a 3 minute shower.

A) 5 L
B) 500 L
C) 50 L

j) Choose the most reasonable surface area of skin on an adult human.

A) $1.7 \, m^2$
B) $0.17 \, m^2$
C) $17 \, m^2$

---

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- Consider the value of each metric prefix.   (see Glossary or Maths Facts, page 455)

Q. Which metric prefix is used to describe 1 000 000 standard units?

A. *Mega*

a) The symbol 'm' represents which metric prefix of 0.001 in value?

milli

b) The symbol 'c' represents which metric prefix of 0.01 in value?

c) The symbol 'k' represents which metric prefix of 1000 in value?

d) The symbol 'd' represents which metric prefix of one tenth in value?

e) Which metric prefix is used to describe one millionth of a unit?

f) Which metric prefix is used to describe 1 000 000 000 standard units?

g) Which metric prefix is used to describe one hundredth of a unit?

h) Which metric prefix is used to describe one thousandth of a unit?

i) Which number represents the metric prefix 'kilo'?

A) 0.01   B) $\dfrac{1}{10000}$

C) $\dfrac{1}{1000}$ D) 1000

j) Which number represents the metric prefix 'Mega'?

A) $\dfrac{1}{10000}$ B) 1 000 000

C) 100 000   D) $\dfrac{1}{1000000}$

k) Which number represents the metric prefix 'Giga'?

A) 0.000 000 000 1   B) $\dfrac{1}{1000000}$

C) 1 000 000 000   D) 1 000 000

l) Which number represents the metric prefix 'milli'?

A) $\dfrac{1}{10000}$ B) 0.01

C) 0.0001   D) $\dfrac{1}{1000}$

- Calculate the minimum accepted quantity by subtracting the tolerance from the normal quantity.
- Calculate the maximum accepted quantity by adding the tolerance to the normal quantity.

To calculate the tolerance interval of a measurement:
- Halve the sum (find the average) of the highest and lowest values.
- Halve the difference between the highest or lowest values.
- Add or subtract (±) this difference to the average.

Q. Regulations require potato chips bags to have a weight of 150 ± 2 g. What is the minimum acceptable weight?

A. *tolerance = 2 g*
minimum accepted weight = 150 – 2 = ***148 g***

---

a) Regulations require potato bags to have a weight of 3 ± 0.1 kg. What is the minimum acceptable weight?

2.9 kg

b) FIFA require soccer balls to have a circumference of 69 ± 1 cm. What is the maximum acceptable circumference?

cm

c) Regulations require cricket balls to have a diameter of 22.65 ± 0.25 cm. What is the maximum acceptable diameter?

cm

d) Regulations require certain cars' petrol tanks to have a capacity of 56 ± 0.5 L. What is the minimum acceptable capacity?

L

**e)** Regulations require CDs to have a diameter of 120 ± 0.5 mm. What is the minimum acceptable diameter?

mm

f) A healthy human's body temperature must measure 37 ± 0.8°C. What is the maximum acceptable temperature for a healthy body?

°C

g) Match the weights to the instruments based on the precision of their scales.

precision: the smallest unit on the scale

A) 0.2 g
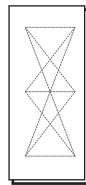
B) 0.05 g
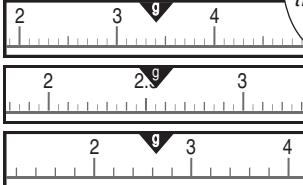
C) 0.1 g

h) Match the temperatures to the thermometers based on the precision of their scales.

A) 2°C
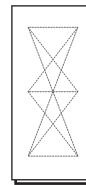
B) 1°C
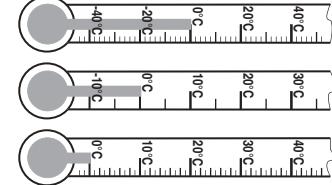
C) 5°C

i) 'Beer is fermented between 19°C and 23°C.' Choose the description for the temperature tolerance suggested by this statement.

A) 19 ± 4°C
B) 23 ± 4°C
C) 21 ± 2°C

$$\frac{19 + 23}{2} = 21 \quad and \quad \frac{23 - 19}{2} = 2$$

$21 \pm 2°C \Rightarrow$
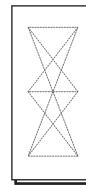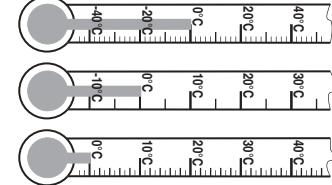
j) 'A softball must weigh between 177.2 g and 198.4 g.' Choose the description for the mass tolerance given this statement.

A) 198.4 ± 21.2 g
B) 187.8 ± 10.6 g
C) 177.2 ± 21.2 g

Hint: When calculating elapsed time from am to pm, or pm to am, first find the time to midnight or midday.

Q. How long is the flight from Singapore to London?

[Hint: Singapore time is 8 hours ahead of London time.]

Flights Out: Melbourne to London - Saturday 9 Feb 08				
From		To	Flight	Duration
14:00 Melbourne		15:20 Sydney	◣ QF438	27h 20m
17:50 Sydney		**06:20** London ^	◣ QF31	
17:10 Melbourne		21:30 Singapore	◣ QF9	22h 50m
22:45 Singapore		**05:00** London ^	■ QF3345	

^ = next day

A. *Singapore departure time = 22:45*

(London time = 22:45 less 8 h = 14:45)

Consider time difference

Flight time (Using London time) = 14:45 to 05:00

14:45 to 24:00 = 9 h 15 min

Compare times from one zone

First find time to midnight

9 h 15 min + 5 h

*= **14 h 15 min***

---

a) How many minutes from 8:30 pm until 2:10 am the next day?

First find time to midnight

8:30 pm to 12:00 = 3 h 30 min

3 h 30 min + 2 h 10 min = 5 h 40 min

300 min + 40 min   =   **340** min

b) How many minutes from 2:45 am until 3:20 pm the same day?

....

....

=   [   ] min

c) Express in minutes:

3 hours and 52 minutes =

[   ] min

d) Express in seconds:

5 minutes and 14 seconds =

[   ] s

e) At 0520 hours on a Friday in Wellington, what day and time is it at the Vatican given that the Vatican is 11 hours behind Wellington time?

....

=   [   ]

f) Greta departs Auckland on Monday at 1200 hours and arrives in Los Angeles (LA) on Monday at 1015 hours. If LA time is 19 hours behind Auckland, how long was the flight?

....

=   [h   min]

g) If it was 2:45 pm on the 9th of March 2010, how long would have to wait until the next high tide at Mooloolaba Beach?

Mooloolaba Beach (QLD) Tide data:			
Friday 9th March 2010		Saturday 10th March 2010	
05:00 am	0.62 m Low	05:45 am	0.73 m Low
09:46 am	1.37 m High	11:20 am	1.25 m High
04:55 pm	0.43 m Low	05:29 pm	0.5 m Low
11:33 pm	1.51 m High		

[h   min]

h) What is the latest tram you can take from Melbourne University to get to South Melbourne Beach by 6:30 am?

Monday to Friday East Coburg to South Melbourne Beach								
Route 1 via Brunswick > Carlton > City > Sth Melbourne								
Stop	AM	AM	AM	AM	AM	AM	AM	AM
135 East Coburg - Bell St						5:40	5:50	6:00
112 Elgin St & Lygon St	4:59	5:11	5:35	5:46	5:56	6:06	6:16	6:26
1 Melbourne University	5:01	5:13	5:25	5:37	5:48	5:58	6:08	6:18
13 Federation Square	5:12	5:24	5:36	5:48	5:59	6:09	6:16	6:29
14 Arts Centre	5:14	5:26	5:38	5:50	6:01	6:11	6:21	6:31
16 Southbank Blvd & St Kilda Rd	5:15	5:27	5:39	5:51	6:02	6:12	6:22	6:32
32 South Melbourne Beach	5:27	5:39	5:51	6:03	6:14	6:24	6:34	6:54

[   ]

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•   Find the conversion factor.   (see Maths Facts, page 455)

Q. The lake path around Canberra's Lake Burley Griffin measures 21.25 km. Express the length of the path in metres.

A. *1 km = 1000 m*   ⊂ Conversion factor
21.25 km × 1000
= **21 250 m**

⊂ mm to cm: ÷ 10

a) Convert 630 millimetres to centimetres.

630 mm ÷ 10 = ...   **63 cm**

b) Convert 645 centimetres to millimetres.

....

c) Express in millimetres:

1 m and 12 mm =

....

d) Express in metres:

3 m and 2100 cm =

....

e) Write in centimetres:

2 m and 760 mm =

....

f) A world pole vault record was set in 1994 by Sergei Bubka of 6.14 m.
Is this record <, = or > 6014 mm?

....

g) Mike Powell holds the world long jump record of 8.95 m. Is this record <, = or > 8950 cm?

....

h) Which distance is greater?
A) running 2 heats and the final in the 200 m
B) swimming 0.7 km

....

i) Which basketball organisation has their 3 point throw line further from the ring?
A) National Basketball Association - 7.24 m
B) International Basketball Federation - 625 cm

....

j) The blood vessels of a typical adult are approximately 160 000 000 m long. If it is 40 000 km around the equator, how many times would a person's blood vessels stretch around the earth?

....

k) Place in descending order:
301 cm, 3.1 m and 3001 mm   ⊂ convert all to mm

....

....

l) Place in ascending order:
5900 cm, 5.9 km and 590 m

....

....

- Find the conversion factor.   (see Maths Facts, page 455)

Q. The 'Mogul' emerald weighs 43.56 g. Express this weight in milligrams.

A. *1 g = 1000 mg*   ⟵ Conversion factor

43.56 g × 1000

= 43 560 mg

---

a) Convert 7500 milligrams to grams.   ⟵ mg to g: ÷ 1000

7500 mg ÷ 1000 = | 7.5 g |

b) Convert 0.001 kilograms to grams.

c) Express in kilograms:

1300 g =

d) Write in kilograms:

0.08 tonnes and 800 g =

e) Weight lifter Antonio Krastev in 1987 lifted 216 kg in the 'snatch'. Is this world record <, = or > 216 000 g?

f) The 4 cables of the Brooklyn Bridge can together sustain a load of about 44 000 tonnes. What load can 1 cable sustain in kg?

| kg |

g) The 'Hand of Faith' gold nugget weighs 27.2 kg. Express this weight in milligrams (mg).

h) If a heavier car is a safer car, which car is safer?
A) 1996 Holden HR weighing 1.178 tonnes
B) 2006 Holden Calais weighing 1642 kg

i) The Olympic flyweight boxing class is between 48 kg and 51 kg. Express this weight difference in grams.

j) A baseball weighs 142 g. If a baseball bat weighs 5 times as much as the ball, how much does the bat weigh in kilograms?

k) Place in ascending order:
2 kg, 2002 g and 0.02 tonne   ⟵ convert all to g

l) Place in descending order:
55 000 mg, 550 g and 5.5 kg

• Find the conversion factor.   (see Maths Facts, page 455)

Q. Convert 0.0006 megalitres to litres.

A. *1 ML = 1 000 000 L*   ⟵ Conversion factor
   0.0006 ML × 1 000 000
   = ***600 L***

a) Convert 50 millilitres to litres.   ⟨mL to L: ÷ 1000⟩

50 mL ÷ 1000 =   **0.05 L**

b) Convert 15 000 000 litres to megalitres (ML).

c) Express in millilitres:

   3 L and 75 mL =

d) Express in litres:

   3 L and 600 000 mL =

e) Express in litres:

   3 ML and 200 L =

f) Express in millilitres:

   1 L and 32 mL =

g) The average total lung capacity of a healthy teenager is 5800 mL. Express this in litres.

h) If a cup holds 250 mL, how many cups would you need to fill a 1.25 L bottle?

i) Moscow's biggest fountain in Manezhnaya Square holds 780 m^3 of water. Is this <, = or > 78 000 000 cm^3?

j) The human body carries approximately 4700 cubic centimetres of blood. Is this <, = or > 4.7 m^3?

k) An orange when squeezed provided 67.5 mL of juice and a grapefruit 0.25 L. Find the difference in millilitres.

l) Place in order from smallest to largest:
   0.0068 ML, 68 L and 680 000 mL
   ⟨convert all to L⟩

- Find the conversion factor.   (see Maths Facts, page 455)

Q. The area of the Bayeux Tapestry is 35 m^2.
Express this area in square centimetres.

A. *1 m^2 = 10 000 cm^2*   —(Conversion factor)

35 m^2 × 10 000

= **350 000 cm^2**

---

a) Convert 44 cm^2 to mm^2.   —(cm^2 to mm^2: × 100)

44 cm^2 × 100 = | **4400 mm^2** |

b) Express in square millimetres:

25 cm^2 and 500 mm^2 =

c) The surface area of the lungs of a human is
160 m^2. Is this area <, = or > 160 000 cm^2?

d) The area of a championship billiard table is
3.76 m^2. Express this area in
square millimetres.

e) Auckland, New Zealand, has an area of
approximately 650 km^2. Is this <, = or >
65 000 000 m^2?

f) Uluru National Park has an area of
approximately 132 500 hectares. Express this
area in km^2.

g) Graceland, Elvis Presley's estate, is
5.5 hectares. Is this <, = or > 55 000 m^2?

h) The area of Trafalgar Square is 0.121 km^2.
Express this area in square metres.

i) The Philippines has an area of 30 million
hectares. Indonesia is approximately
1 920 000 km^2. Which country is the biggest?

j) The soccer goal area between the posts, the
ground and the crossbar is approximately
178 000 cm^2. Express this area in m^2.

k) Place in order from largest to smallest:
2 cm^2, 0.02 m^2 and 2000 mm^2

l) Place in order from largest to smallest:
700 cm^2, 0.7 m^2 and 7 000 000 mm^2

Skill 22.10 Converting between units of measurement for capacity and cubic volume.

MM5.2 1 1 2 2 3 3 4 4
MM6.1 1 1 2 2 3 3 4 **4**

- Find the conversion factor. (see Maths Facts, page 455)

Q. The volume of a cement truck is 6.3 m³. After 3150 L of cement is unloaded, how many litres of cement are left?

A. *1 m³ = 1000 L*   (Conversion factor)

$6.3 \ m^3 \times 1000$

$= 6300 \ L$

$6300 - 3150$

$= \mathbf{3150 \ L}$

cm³ to L: ÷ 1000

a) Convert 500 000 cubic centimetres to litres.

$500\,000 \div 1000 =$ .... | 500 L

b) Change 2.3 litres to cubic centimetres.

c) Express in litres:

$24 \ m^3 =$

d) Write in millilitres:

$30\,000 \ cm^3 =$

e) Express in litres:

$2 \ L \ and \ 4000 \ cm^3 =$

f) Write in litres:

$3000 \ L \ and \ 500\,000 \ cm^3 =$

g) The capacity of a cement mixer is 350 L. How many cubic centimetres is this?

h) What volume of milk in cubic metres could be in a milk tanker with capacity of 26 million millilitres?

i) The dosage of medicine is 5 mL. How many cubic millimetres of volume would this equal?

j) A sprinkler uses 250 L of water every 15 minutes. How many cubic metres of water would be used after 1 hour?

k) Place in descending order:

$45 \ m^3$, 4500 L and 45 000 mL   *convert all to L*

l) Place in ascending order:

850 mL, 8.5 L and $85 \ cm^3$