

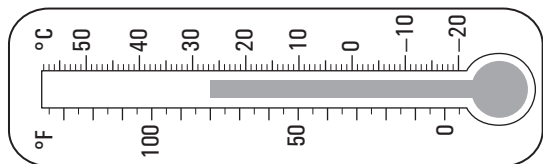
23. [Measuring]

Skill 23.1 Reading scales.

MMMaue 1 1 2 2 3 3 4 4
MMLime 1 1 2 2 3 3 4 4

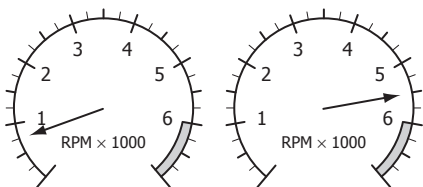
- Consider the unit of measurement and the value of each scale marking.

Q. Using the scale below, 80°F is equivalent to approximately how many degrees Celsius?
[Give your answer to the nearest degree.]



A. Each marking on the Fahrenheit scale represents 5°F .
Each marking on the Celsius scale represents 1°C .
 80°F is in between 26°C and 27°C , closer to 27°C
 $80^{\circ}\text{F} \approx 27^{\circ}\text{C}$

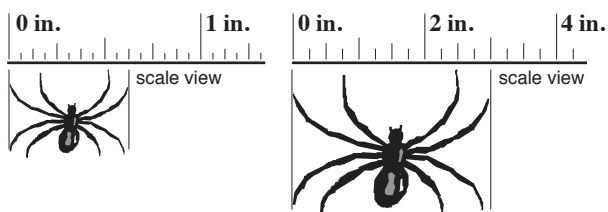
a) What is the difference in revolutions per minute (RPM) between the two vehicles?



$$5.5 \times 1000 - 0.75 \times 1000$$

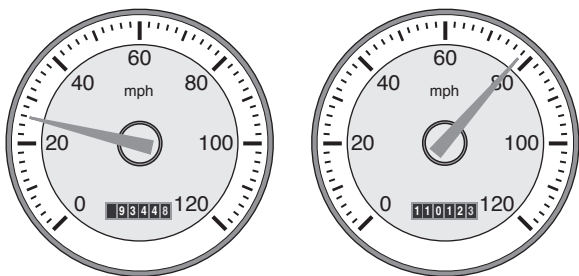
$$= 5500 - 750 = 4750 \text{ RPM}$$

b) What is the width difference in inches between the two spiders?



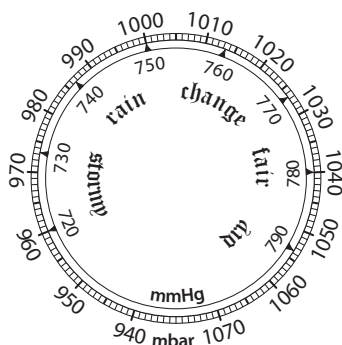
$$= \boxed{}$$

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



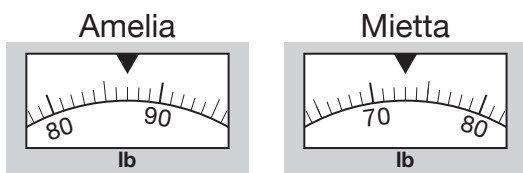
$$= \boxed{} \text{ mph}$$

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



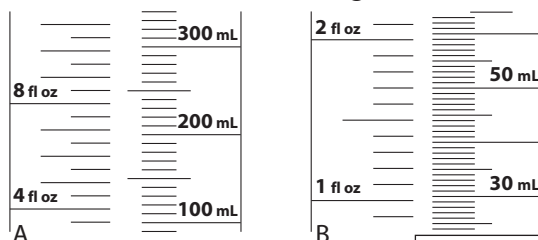
$$= \boxed{}$$

e) How much lighter is Mietta than Amelia?



$$= \boxed{} \text{ lb}$$

f) If cylinder A contains 8.5 fl oz and cylinder B contains 1.5 fl oz of water, how many mL of water would there be all together?



$$= \boxed{}$$

Skill 23.2 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 inches (or millimeters).

Height of a person is measured in feet and inches (or centimeters).

Mountain heights are measured in feet (or meters).

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 visualize

- A) $0.01\text{ cm} = 0.1\text{ mm}$ \Rightarrow too small
- B) 1 cm \Rightarrow reasonable
- C) 10 cm \Rightarrow too large

The answer is **B**.

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

- A) tons
- B) pounds
- C) ounces per cubic centimeter
- D) ounces

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

- A) square inches
- B) inches
- C) feet
- D) square feet

c) The most appropriate unit for measuring the mass of a nickel is:

- A) ounces
- B) pounds
- C) tons
- D) fluid ounce

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

- A) square feet
- B) square miles
- C) acres
- D) square yards

e) The weight of a BBQ gas cylinder could most reasonably be described as:

- A) 100 lb
- B) 20 lb
- C) 2 lb

f) The capacity of a trash can in a manual barrel collection area is most reasonably described as:

- A) 320 gal
- B) 32 gal
- C) 3.2 gal

g) The volume of water used in a 3 minute shower could most reasonably be described as:

- A) 5 qt
- B) 500 qt
- C) 50 qt

h) The surface area of skin on an adult human could be most reasonably described as:

- A) 1.7 m^2
- B) 0.17 m^2
- C) 17 m^2

Skill 23.3 Measuring with accuracy and tolerating error.

- 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:
- Find the average of the highest and lowest values.
 - Halve the difference between the highest or lowest values.
 - Add or subtract (\pm) this difference to the average.

Q. Find the minimum accepted mass when a bag of potato chips must weigh 5 ± 0.08 oz. **A.** *tolerance = 0.08 oz*
minimum accepted mass = $5 - 0.08 = 4.92$ oz

a) Find the minimum accepted mass when a bag of potatoes must weigh 7 ± 0.2 lb.

.....

b) Find the maximum accepted circumference when a soccer ball must measure 27.5 ± 0.5 in.

.....

c) Find the maximum accepted mass when a golf ball must weigh 1.6 ± 0.02 ounces (oz).

.....

d) Find the minimum accepted capacity when a car's gasoline tank must measure 15 ± 2 gal.

.....


e) Find the minimum accepted length when a CD's diameter must measure 120 ± 0.5 mm.


.....

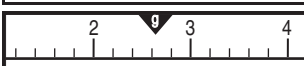
f) Find the maximum accepted temperature if a healthy human's body temperature must measure $98.2^\circ\text{F} \pm 1.3^\circ\text{F}$.

.....

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

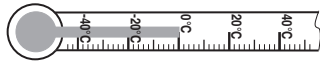
A) 0.2 g 

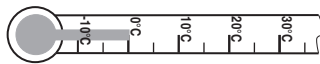
B) 0.05 g 


C) 0.1 g 

*precision:
the smallest unit
on the scale*

h) Match the temperatures to the instruments 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 best description for the temperature tolerance given by this statement.

- A) $19 \pm 4^\circ\text{C}$
- B) $23 \pm 4^\circ\text{C}$
- C) $21 \pm 2^\circ\text{C}$

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

$21 \pm 2^\circ\text{C} \Rightarrow$

j) A 12" softball must weigh between $6\frac{1}{4}$ oz and 7 oz. Choose the best description for the mass tolerance given by this statement.

- A) $6\frac{1}{2} \pm \frac{1}{2}$ oz
- B) $6\frac{5}{8} \pm \frac{3}{8}$ oz
- C) $6\frac{1}{8} \pm \frac{3}{8}$ oz

.....

Skill 23.4 Calculating elapsed time and reading timetables.

MMMaive 11 2 3 3 4 4
MMLime 11 2 3 3 4 4

Hint: When calculating elapsed time from A.M. to P.M., or P.M. to A.M., 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

First find time to midnight

Compare times from one zone

9 h 15 min + 5 h
= 14 h 15 min

a) How many minutes from 8:30 P.M. until 2:10 A.M.?

First find time to midnight

8:30 P.M. 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 A.M. until 3:20 P.M.?

=

c) Express in minutes:

3 hours and 52 minutes =

d) Express in seconds:

5 minutes and 14 seconds =

e) At 0520 hours on a Friday in Illinois, what day and time is it in Rome (Italy) given that Rome time is 7 hours ahead of Illinois time?

=

f) Greta departs Boston on Monday at 1000 hours and arrives in Los Angeles on Monday at 1015 hours. If Los Angeles time is 3 hours behind Boston, how long was the flight?

=

g) If it were 2:45 P.M. on the 9th of March 2007, how long would you have to wait until the next high tide at Mooloolaba Beach?

Mooloolaba Beach (QLD) Tide data:			
Friday 9th March 2007		Saturday 10th March 2007	
05:00 A.M.	0.62 m Low	05:45 A.M.	0.73 m Low
09:46 A.M.	1.37 m High	11:20 A.M.	1.25 m High
04:55 P.M.	0.43 m Low	05:29 P.M.	0.5 m Low
11:33 P.M.	1.51 m High		

min

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

Monday to Friday East Coburg to South Melbourne Beach								
Route 1 via Brunswick > Carlton > City > Sth Melbourne								
Stop	A.M.	A.M.	A.M.	A.M.	A.M.	A.M.	A.M.	A.M.
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

Skill 23.5 Converting units of measurement for length.

MMMaive 11 2 2 3 3 4 4
MMLime 11 2 2 3 3 4 4

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

Q. The *Central Loop* running track in Central Park, New York, measures 6500 meters. Express this length in kilometers.

A. $1 \text{ km} = 1000 \text{ m}$ — Conversion factor
 $\widehat{6500} \text{ m} \div 1000$
 $= 6.5 \text{ km}$

a) Convert 63 feet to yards.

ft to yd: $\div 3$

$63 \text{ ft} \div 3 =$

21 yd

b) Convert 15 feet to inches.

.....

c) Write in feet:

6 yd and 2 ft =

.....

d) Express in inches:

4 ft and 8 in. =

.....

e) Write in centimeters:

2 m and 760 mm =

..... cm

f) The world pole vault record set in 2004 was 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 organization has their 3 point throw arc further from the ring?

- A) College Basketball - 19.75 ft
 B) National Basketball Association - 285 in.

.....

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) Write in descending order:

60 ft, 600 in. and 18 yd

convert all to feet

.....

l) Write in ascending order:

20 yd, 480 in. and 50 ft

.....

Skill 23.6 Converting units of measurement for mass.

MMMaue 11 22 3 44
MMLime 11 22 3 44

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

Q. The *mogul* emerald weighs 43.5 g. Express this weight in milligrams.

A. $1 \text{ g} = 1000 \text{ mg}$ — Conversion factor
 $43.5 \times 1000 \text{ mg}$
 $= 43,500 \text{ mg}$

a) Convert 560 ounces to pounds.

oz to lb: $\div 16$

$560 \text{ oz} \div 16 =$

35 lb

b) Convert 0.05 kilograms to grams.

c) Write in ounces:

15 lb and 10 oz =

d) Write in pounds:

0.02 tons and 250 lb =

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

f) The 4 cables of the Brooklyn Bridge can together sustain a load of about 48,000 tons. What load can 1 cable sustain in pounds?

g) The *Hand of Faith* gold nugget weighs 61 lb 11 oz. Express this weight in ounces.

h) If a heavier car is a safer car, which car is safer?

- A) 2008 Honda Civic weighing 2733 lb
 B) 2008 Jaguar sedan weighing 1.95 ton

i) The Olympic flyweight boxing class is between 108 lb and 112 lb. Express this weight difference in ounces.

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) Write in ascending order:
 0.4 ton, 9000 oz and 500 lb

convert all to lb

l) Write in descending order:
 50 lb, 0.02 ton and 1280 oz

Skill 23.7 Converting units of measurement for capacity and volume.

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

Q. Convert 45 gallons to pints.

A. $1 \text{ gal} = 8 \text{ pt}$ — Conversion factor
 $45 \times 8 \text{ pt}$
 $= 360 \text{ pt}$

a) Convert 680 quarts to gallons.

qt to gal: $\div 4$

$680 \text{ qt} \div 4 =$

170 gal

b) Convert 1000 pints to gallons.

.....

c) Express in quarts:

$55 \text{ gal and } 3 \text{ qt} =$

.....

d) Write in pints:

$95 \text{ gal and } 6 \text{ pt} =$

.....

e) The average total lung capacity of a healthy teenager is 6 quarts. Express this in gallons.

.....

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

.....

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

.....

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

.....

i) It takes on average approximately 2640 gallons of water to produce 500 g of ground coffee. Write the water quantity in quarts.

.....

j) Place in order from smallest to largest: 24 gal, 75 pt and 120 qt

convert all to qt

.....

Skill 23.8 Converting units of measurement for area.

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

Q. The area of the Bayeux Tapestry embroidered cloth is 35 m^2 and shows the story of the 1066 Norman invasion of England. Express this area in square centimeters.

A. $1 \text{ m}^2 = 10,000 \text{ cm}^2$ — Conversion factor
 $35 \times 10,000 \text{ cm}^2$
 $= \widehat{350,000} \text{ cm}^2$

a) Convert 1440 ft^2 to yd^2 . ft^2 to yd^2 : $\div 9$
 $1440 \text{ ft}^2 \div 9 =$ **160 yd^2**

b) Express in square inches:
 6 ft^2 and $11 \text{ in.}^2 =$

c) The surface area of the lungs of an adult human is 160 m^2 . Is this area $<$, $=$ or $>$ $160,000 \text{ cm}^2$?

d) The area of a championship billiard table is 40.5 ft^2 . Express this area in square yards.

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

f) The Grand Canyon National Park has an area of approximately 5000 square kilometers. Write this area in m^2 .

g) The Philippines has an area of 300 billion square meters. Indonesia is approximately $1,920,000 \text{ km}^2$. Which country is the biggest?

h) The soccer goal area between the posts, the ground and the crossbar is approximately 200 ft^2 . Express this area in square inches.

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

j) Write in descending order:
 2160 in.^2 , 12 ft^2 and 2 yd^2 — convert all to in.^2

Skill 23.9 Converting units of measurement between volume and capacity.

MMMaive 11 22 33 44
MMLime 11 22 33 44

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

Q. The volume of a cement truck is 6.3 m^3 . After 3150 L of cement is unloaded, how many liters of cement are left?

$$\begin{aligned} \text{A. } 1 \text{ m}^3 &= 1000 \text{ L} \\ 6.3 \times 1000 \text{ L} & \\ &= \overbrace{6300}^{\text{Conversion factor}} \text{ L} \\ 6300 - 3150 & \\ &= \mathbf{3150 \text{ L}} \end{aligned}$$

cm^3 to L: $\div 1000$

a) Convert 500,000 cubic centimeters to liters.

$$500,000 \div 1000 =$$

500 L

b) Change 2.3 liters to cubic centimeters.

.....

c) Express in liters:

$$24 \text{ m}^3 =$$

.....

d) Write in milliliters:

$$30,000 \text{ cm}^3 =$$

.....

e) Express in liters:

$$2 \text{ L and } 4000 \text{ cm}^3 =$$

.....

f) Write in liters:

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

.....

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

.....

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

.....

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

.....

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

.....

k) Place in order from greatest to least:

$$45 \text{ m}^3, 450 \text{ L and } 45,000 \text{ mL}$$

convert all to L

.....
.....
.....

l) Write in ascending order:

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

.....
.....
.....