1 Earning Income

Relating Units of Time

1 year = 52 weeks
1 year = 12 months
1 hour = 60 minutes
1 week = 7 days

1. Which time relationship can you use to solve each problem?

a) All last year Tony worked part time and earned $15 000.
How much did he earn per month? ___________

b) All last year Eve worked full time and earned $62 400.
How much did she earn per week? ___________

c) Last week Richard worked 4 h and 30 min each day for 5 days. He earned $20/h (which means $20 per hour).
How much did he earn last week? ___________

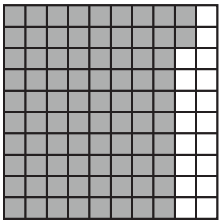
2. Solve each problem in Question 1.
Show your work and write a concluding statement.

a)

b)

c)

Working with Percents



Percent means "out of 100." 82 of the 100 squares in this grid are shaded, so 82% of the grid is shaded. 18 of the 100 squares are unshaded, so 18% of the grid is unshaded.

You can express a percent as a fraction or a decimal.

Shaded:

$$82\% = \frac{82}{100} \underset{\div 2}{\overset{\div 2}{=}} \frac{41}{50}$$

$$82\% = \frac{82}{100} \text{ or } 0.82$$

Unshaded:

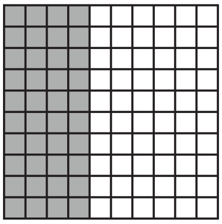
$$18\% = \frac{18}{100} \underset{\div 2}{\overset{\div 2}{=}} \frac{9}{50}$$

$$18\% = \frac{18}{100} \text{ or } 0.18$$

Hint
To create an equivalent fraction in simplest terms, divide each number by the same amount.

3. Write the percent of each grid that is shaded and unshaded. Then express each answer as a decimal.

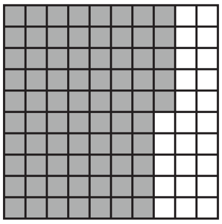
a)



shaded: ____________

unshaded: __________

b)



shaded: ____________

unshaded: __________

Hint

A whole grid is 100%. The percent that is unshaded can be calculated. 100% − 82% = 18%

4. The questions on a test are worth 100 marks.
A bonus question is worth 5 marks.
Is it possible to get more than 100% on the test?
Explain your thinking.

____

____

5. Express each percent as a decimal.

a) 27% = _______

b) 2% = _______

c) 10% = _______

d) 11.9% = _______

e) 0.5% = _______

f) 1.25% = _______

Hint

0.5% is 0.5 out of 100, so 0.5 of a square would be shaded on a hundreds grid. That's half a square.

6. Express each decimal as a fraction and a percent.

a) 0.73 = _______ _______

b) 0.9 = _______ _______

c) 0.02 = _______ _______

d) 0.025 = _______ _______

e) 0.375 = _______ _______

f) 0.001 = _______ _______

Hint

Express the decimal as a fraction with a denominator of 100. When necessary, write the numerator as a decimal.

7. Calculate the number of students in each part.

a) 1% of 200 students have red hair.

_______ × 200 = _______ students with red hair

b) 40% of 420 students are girls.

_______ × 420 = _______ girls

c) 12.5% of 56 students have blond hair.

_______ × 56 = _______ students with blond hair

Hint

In these calculations, "of" means multiply. Express the percent as a decimal and multiply.

2

Linear Measurement

Using Mental Math to Multiply or Divide by a Power of 10

When multiplying, the exponent on the power of 10 tells the number of places to move each digit to the left. For example,

$2.5 \times 10^0 = 2.5$

$2.5 \times 10^1 = 25$

$2.5 \times 10^2 = 250$

$2.5 \times 10^3 = 2500$

When dividing, the exponent on the power of 10 tells the number of places to move each digit to the right. For example,

$9.8 \div 10^0 = 9.8$

$9.8 \div 10^1 = 0.98$

$9.8 \div 10^2 = 0.098$

$9.8 \div 10^3 = 0.0098$

Powers of 10

$10^3 = 10 \times 10 \times 10$ or 1000
$10^2 = 10 \times 10$ or 100
$10^1 = 10$
$10^0 = 1$

1. Calculate.

a) $2.5 \times 10^2 =$ _______
b) $78.26 \times 10^2 =$ _______
c) $4.09 \times 10^3 =$ _______
d) $0.006 \times 10^3 =$ _______

2. Calculate.

a) $0.85 \div 10^1 =$ _______
b) $982.6 \div 10^2 =$ _______
c) $1760 \div 10^3 =$ _______
d) $4.33 \div 10^3 =$ _______

Using Metric Measurements for Length

The most common units for length are metre (m), kilometre (km), centimetre (cm), and millimetre (mm). The prefix on each unit name tells how it relates to the base unit, metre.

3. a) "Kilo" means thousand. This means 1 km = _______ m.
b) "Centi" means hundredth. This means 1 cm = _______ m.
c) "Milli" means thousandth. This means 1 mm = _______ m.

4. Complete each relationship.

a) 10 km = _______ m   0.1 km = _______ m
b) 10 cm = _______ m   100 cm = _______ m
c) 10 mm = _______ m   1000 mm = _______ m

5. Complete the tables. Use patterns to help you.

a)

km	m
1	
2	
3	

b)

cm	m
1	
2	
3	

c)

m	cm
1	
2	
3	

d)

m	mm
1	
2	
3	

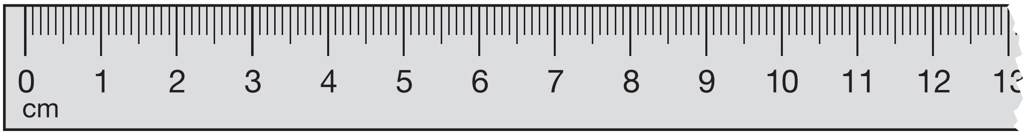
6. Complete each relationship. Use the ruler below to help you.

a) 1 cm = _______ mm

b) 2.5 cm = _______ mm

c) 20 mm = _______ cm

d) 13 mm = _______ cm



In the metric system, a measurement is written using a decimal for part of a unit. In the imperial system a measurement is usually written using a fraction for part of a unit.

7. Kyle measured a can: diameter (distance across end) = 67 mm circumference (distance around) = 21.0 cm.

a) Express both measurements in millimetres.

_______ mm _______ mm

b) Express both measurements in centimetres.

_______ cm _______ cm

Working with Fractions

8. Calculate.

a) $\frac{1}{3} \times 12 =$ _______

b) $\frac{3}{4} \times 36 =$ _______

c) $\frac{5}{8} \times 16 =$ _______

d) $\frac{2}{5} \times 100 =$ _______

Hint

To multiply fractions, multiply the numerators and then multiply the denominators. Remember, a whole number has a denominator of 1.

9. Complete each pair of equivalent fractions.

a) $\dfrac{4}{3} \overset{\times 5}{\underset{\times 5}{=}} \dfrac{\square}{15}$

b) $\dfrac{6}{\square} \overset{\times 2}{\underset{\times 2}{=}} \dfrac{3}{8}$

c) $\dfrac{36}{24} \overset{\div 12}{\underset{\div 12}{=}} \dfrac{\square}{2}$

d) $\dfrac{4}{6} \overset{\times 1.5}{\underset{\times 1.5}{=}} \dfrac{6}{\square}$

Hint

To create an equivalent fraction, multiply or divide the numerator and denominator by the same amount.

3

Measurement Problems

Solving Equations

A variable is a letter or symbol, such as a, x, T, or Z, that represents a number. To figure out the value of a variable, perform the same operation to both sides of the equation until the variable is alone on one side. Simplify the other side.

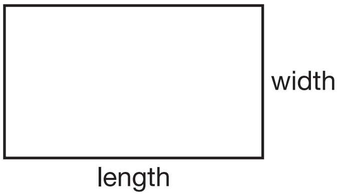
1. Solve for d in the equation $d = 2r$ when $r = 3.5$.

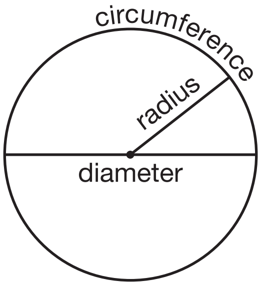
$d = 2r$
$d = 2 \times 3.5$
$d =$ _______

2. Solve for r in the equation $d = 2r$ when $d = 17$.

$d = 2r$
$17 = 2r$ (Divide both sides by 2.)
$17 \div 2 = 2r \div 2$
_______ $= r$

3. Calculate the perimeter, area, or circumference.





a) $P = 2(l + w)$. Solve for P if $l = 5$ cm and $w = 2$ cm.

$P =$ _______ cm

b) $A = l \times w$. Solve for A if $l = 7$ cm and $w = 4$ cm.

$A =$ _______ cm^2

c) $A = l \times w$. Solve for w if $A = 54\ \text{m}^2$ and $l = 9$ m.

$w =$ _______ m

d) $C = \pi \times d$. Solve for C if $d = 5$ mm. (Use $\pi = 3.14$.)

$C \doteq$ _______ mm

e) $C = \pi \times d$. Solve for d if $C = 31.4$ cm. (Use $\pi = 3.14$.)

$d \doteq$ _______ cm

Hint

In Question 4, P represents the **perimeter** of a rectangle, A represents the **area** of a rectangle, and C represents the **circumference** of a circle. π (pi) is not a variable. Its value is about 3.14.

4. Britney's ruler measures both inches and centimetres. It shows that 12 in. is about the same length as 30.5 cm.

a) How many inches are in 1 cm?

$$\frac{12\text{ in.}}{30.5\text{ cm}} \underset{\div 30.5}{\overset{\div 30.5}{=}} \frac{\boxed{}\text{ in.}}{1\text{ cm}}$$

1 cm $\doteq$ ______ in.

b) How many centimetres are in 1 in.?

$$\frac{12\text{ in.}}{30.5\text{ cm}} \underset{\div 12}{\overset{\div 12}{=}} \frac{1\text{ in.}}{\boxed{}\text{ cm}}$$

1 in. $\doteq$ ______ cm

Working with Fractions

- To add or subtract fractions with unlike denominators, create equivalent fractions with a common denominator and then add the numerators, or subtract one numerator from the other.

$$\frac{7}{10} + \frac{1}{4} = \frac{14}{20} + \frac{5}{20} = \frac{19}{20} \qquad \frac{2}{3} - \frac{1}{2} = \frac{4}{6} - \frac{3}{6} = \frac{1}{6}$$

5. a) $\frac{3}{4} + 3\frac{5}{8} =$ ______

b) $2\frac{1}{4} + \frac{2}{3} =$ ______

c) $1\frac{5}{16} - \frac{3}{4} =$ ______

d) $2\frac{3}{4} - \frac{2}{3} =$ ______

Hint

You may not need to rewrite mixed numbers as improper fractions to add or subtract. For example:

$$3\frac{1}{2} - 1\frac{1}{4} = 3\frac{2}{4} - 1\frac{1}{4}$$
$$= 2\frac{1}{4}$$

- To multiply fractions, multiply the numerators and then multiply the denominators. For example: $\frac{1}{4} \times \frac{2}{3} = \frac{2}{12}$ or $\frac{1}{6}$

6. a) $\frac{1}{4} \times \frac{2}{3} =$ ______

b) $\frac{7}{8} \times \frac{2}{3} =$ ______

c) $\frac{3}{4} \times 3\frac{1}{2} =$ ______

d) $2\frac{5}{8} \times 1\frac{2}{3} =$ ______

Hint

To multiply or divide mixed numbers, first rewrite them as improper fractions.

$$2\frac{1}{2} \times 1\frac{3}{4} = \frac{5}{2} \times \frac{7}{4}$$
$$= \frac{35}{8} \text{ or } 4\frac{3}{8}$$

- To divide fractions, multiply the first fraction by the **reciprocal** of the divisor. For example: $\frac{1}{4} \div \frac{1}{2} = \frac{1}{4} \times \frac{2}{1} = \frac{2}{4}$ or $\frac{1}{2}$

7. a) $\frac{3}{4} \div \frac{2}{3} =$ ______

b) $\frac{3}{4} \div \frac{1}{4} =$ ______

c) $1\frac{5}{8} \div \frac{1}{8} =$ ______

d) $2\frac{1}{2} \div 1\frac{1}{4} =$ ______

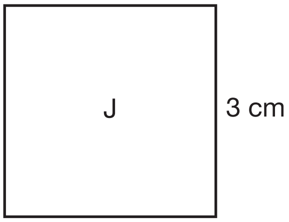
4 Area Measurement

Area of a Square

- When the length of a side is known, the area can be calculated using the formula Area of a square = side × side, or $(\text{side})^2$.

1. Determine the area of each square.

a)

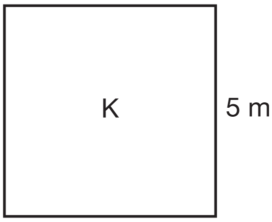


Area of square J

$= 3 \text{ cm} \times 3 \text{ cm}$

$=$ ______ cm^2

b)



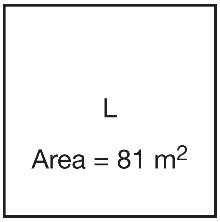
Area of square K

$=$ ______ m^2

- When the area of a square is known, the **square root** of the area is the length of each side.

2. Determine the side length of each square.

a)

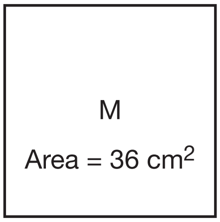


$81 \text{ m}^2 =$ ☐ m × ☐ m

side length $= \sqrt{81 \text{ m}^2}$

$=$ ______ m

b)



Area of Other 2-D Shapes

To calculate the area of a shape, substitute the linear measurements of the shape into the appropriate formula.

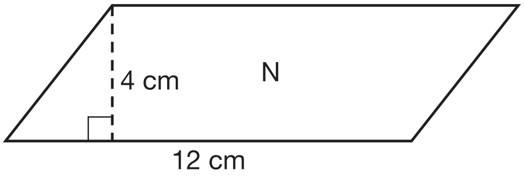
- Area of a parallelogram = base × height
- Area of a rectangle = base × height (or length × width)
- Area of a triangle $= \frac{1}{2}(\text{base} \times \text{height})$ or $\dfrac{\textit{base} \times \textit{height}}{2}$
- Area of a circle $= \pi \times r^2$

Hint

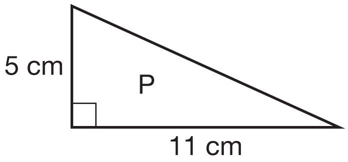
A **height** is perpendicular to a **base**. They form a 90° angle.

3. Determine the area.

a) Area of parallelogram N
$= 12 \text{ m} \times 4 \text{ m}$
$=$ _______ m^2



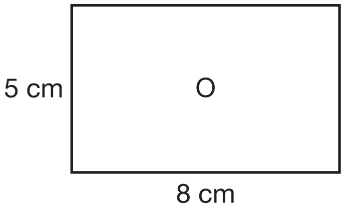
c) Area of triangle P
$= \frac{1}{2}(11 \text{ cm} \times 5 \text{ cm})$
$=$ _______ cm^2



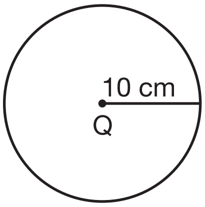
Hint

The formula for the area of a rectangle is the same as for a parallelogram because a rectangle is a type of parallelogram.

b) Area of rectangle O
$= 8 \text{ cm} \times 5 \text{ cm}$
$=$ _______ cm^2



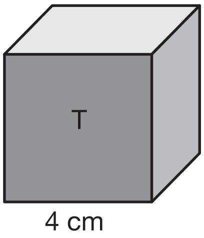
d) Area of circle Q
$= \pi(10 \text{ cm})^2$
$=$ _______ cm^2



Surface Area of 3-D Objects

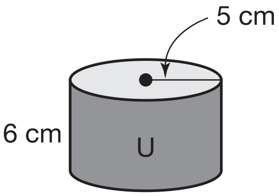
To calculate the surface area of a 3-D object, determine the area of each **face** and add. A cube has 6 identical square faces.

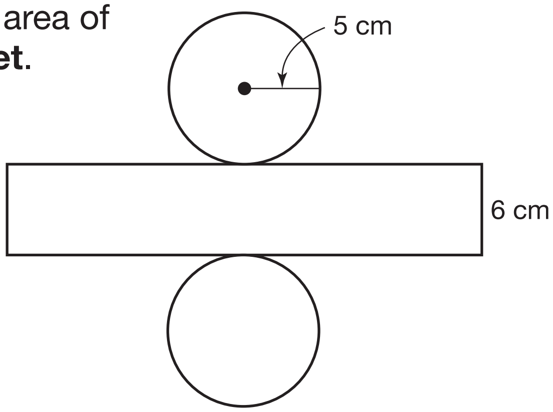
Surface area of a cube $= 6 \times$ area of one face



4. Surface area of cube T $= 6 \times 16 \text{ cm}^2 =$ _______ cm^2

5. Calculate the surface area of cylinder U. Use the **net**.





Hint

The curved surface is a rectangle, with a width of 6 cm and a length that equals the circumference of the circle.

Area of 2 circular ends:	Area of curved surface:

Total area $=$ _______ $\text{cm}^2 +$ _______ $\text{cm}^2 =$ _______ cm^2

5

Capacity, Volume, Mass, and Temperature

Using Metric Measurements for Capacity

Capacity is a measure of the amount a container can hold. Common units are litre (L) and millilitre (mL). The base unit is the litre.

A regular tube of toothpaste holds about 130 mL. The small amount of toothpaste you squeeze onto your toothbrush is about 1 mL.

1. Complete each relationship. (Remember, "milli" means thousandth.)

1 mL = _______ L

10 mL = _______ L

100 mL = _______ L

1000 mL = _______ L

Using Metric Measurements for Volume

Volume is a measure of the amount of space occupied by a 3-D object. The base unit is cubic metre (m^3). A cube that is 1 m × 1 m × 1 m has a volume of 1 m^3. Smaller volumes are measured in cubic centimetres (cm^3), and very small volumes in cubic millimetres (mm^3).

A refrigerator packing crate has a volume of about 1 m^3.
A regular marble has a volume of about 1 cm^3.

2. Complete each relationship. (Remember, "centi" means hundredth.)

$1\ cm^3$
$= 1\ cm \times 1\ cm \times 1\ cm$
$= 0.01\ m \times 0.01\ m \times 0.01\ m$
= _______ m^3

$1\ mm^3$
$= 1\ mm \times 1\ mm \times 1\ mm$
$= 0.1\ cm \times 0.1\ cm \times 0.1\ cm$
= _______ cm^3

Using Metric Measurements for Mass

Mass is a measure of the amount of matter in an object. Common units are gram (g), kilogram (kg), and milligram (mg). The base unit is the gram.

A raisin has a mass of about 1 g.
A bag of 1000 raisins has a mass of about 1 kg.

3. Complete each relationship. (Remember, "kilo" means thousand.)

1 kg = _______ g

10 kg = _______ g

0.1 kg = _______ g

1 mg = _______ g

10 mg = _______ g

100 mg = _______ g

4. Complete the tables. Identify patterns to help you.

a)

kg	g
1	
2	
3	
4	

b)

g	kg
1	
2	
3	
4	

c)

mg	g
1	
2	
3	
4	

d)

g	mg
1	
2	
3	
4	

Working with Fractions

5. Express each fraction as a decimal.

a) $\frac{1}{2}$ in. = _______ in.

c) $\frac{1}{8}$ in. = _______ in.

b) $\frac{3}{4}$ in. = _______ in.

d) $\frac{5}{8}$ in. = _______ in.

6. Solve for y in the equation $y = \frac{9}{5}x + 32$ when $x = 25$.

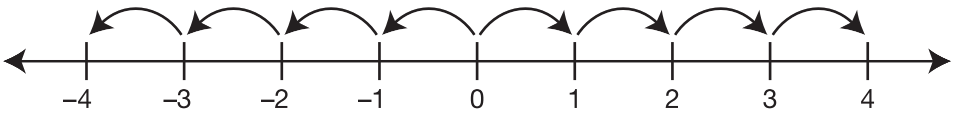
y = _______

Hint

Substitute the value of x into the equation.

Working with Integers

- The **opposite** of an integer is the number that is the same distance from 0 on the number line, but in the opposite direction. The opposite of +4 is –4.



Tech Tip

To enter a negative integer on a calculator, the key might be **(-)** or **+/-**

- To subtract integers, you can add the opposite. For example,

$$\begin{aligned} -10 - (-4) &= -10 + 4 \\ &= -6 \end{aligned}$$

7. Calculate.

a) $9 - (-2) =$ _______

c) $-6 - (-14) =$ _______

b) $-8 - (+13) =$ _______

d) $12 - (-3) =$ _______

8. Solve for y in the equation $y = \frac{5}{9}(x - 32)$ when $x = 41$.

y = _______

Hint

Substitute the value of x into the equation.

6 Working with Money

Working with Decimals

1. Round each amount to the nearest dollar.

a) $1.95 is about $_______

b) $6.02 is about $_______

c) $12.84 is about $_______

d) $39.99 is about $_______

2. Use mental math to estimate each amount to the nearest dollar.

a) $\frac{1}{4}$ of $39.99 is about $_______

b) $\frac{3}{4}$ of $39.99 is about $_______

c) $\frac{1}{3}$ of $11.99 is about $_______

d) $\frac{2}{3}$ of $11.99 is about $_______

e) $\frac{1}{2}$ of $27.99 is about $_______

f) $\frac{1}{5}$ of $99.99 is about $_______

Hint

To calculate $\frac{1}{4}$ of a number, you can divide by 4.

To calculate $\frac{3}{4}$ of a number, divide by 4 and multiply by 3.

3. Calculate.

a) $\frac{1}{4}$ of $28.99 = $_______

b) $\frac{3}{4}$ of $28.99 = $_______

c) $\frac{1}{3}$ of $15.50 = $_______

d) $\frac{2}{3}$ of $16.00 = $_______

e) $\frac{1}{2}$ of $28.99 = $ _______

f) $\frac{1}{5}$ of $28.99 = $_______

Hint

Round your answers to the nearest cent after doing the calculations.

Working with Percents

4. Express each fraction as a percent and as a decimal.

a) $\frac{17}{100}$ = _______ _______

b) $\frac{85}{100}$ = _______ _______

c) $\frac{3}{100}$ = _______ _______

d) $\frac{101}{100}$ = _______ _______

You can express fractions as percents when the denominator is not 100. Identify an equivalent fraction with a denominator of 100.

For example: $$\underset{\times 4}{\overset{\times 4}{\frac{4}{25} = \frac{16}{100}}} = 16\%$$

5. Express each fraction as a percent and as a decimal.

a) $\frac{17}{20} = \frac{\boxed{}}{100}$ Percent: ______ Decimal: ______

b) $\frac{15}{1000} = \frac{\boxed{}}{100}$ Percent: ______ Decimal: ______

c) $\frac{26}{25} = \frac{\boxed{}}{100}$ Percent: ______ Decimal: ______

6. Express each fraction as a percent. Round to the nearest tenth.

a) $\frac{1}{8} =$ ______

b) $\frac{1}{3} =$ ______

c) $\frac{4}{3} =$ ______

d) $\frac{7}{9} =$ ______

7. Calculate each amount.

Hint
In this question, "of" means multiply.

a) The sale price is 75% of $50.

b) The tip is about 15% of $96.40.

c) The discount is 12% of $6.

d) The new price is 125% of $54.

8. Use mental math to calculate.

a) 10% of $4 = $______

b) 10% of $25.50 = $______

c) 10% of $68 = $______

d) 5% of $68 = $______

9. Estimate.

a) 15% tip for a $29.95 meal is about $______

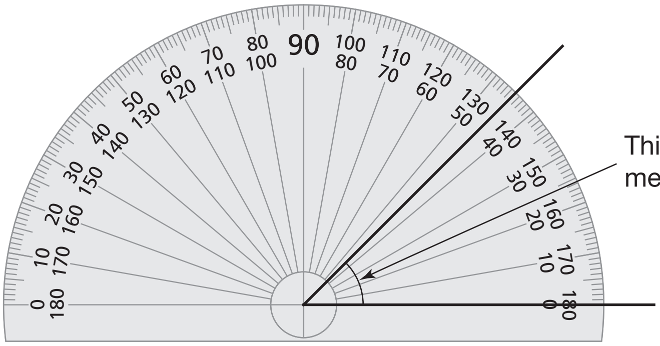
b) 15% tip for a $75 haircut is about $______

7 Lines and Angles

Angle Measures

Use a protractor to measure angles in degrees. Place the zero line of the protractor along one arm of the angle so that the centre is over the **vertex**. Read the measure of the angle from the protractor.

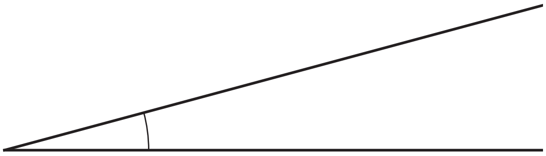
Hint
An arc can be used to identify the angle you want to measure.



This angle measures 45°.

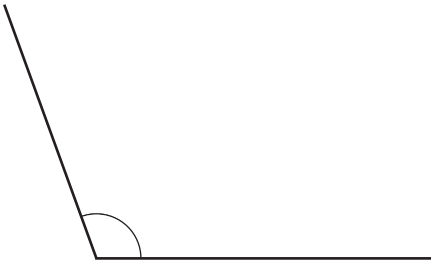
1. Use a protractor to measure each angle.

a)



________°

b)



________°

Hint
If necessary, extend the arms so that you can measure an angle accurately.

2. In each angle in Question 1, extend one arm through the vertex. What are the measures of the other angles around the vertex?

a) ________° ________°

b) ________° ________°

Hint
There are 360° around the centre in a circle.

3. How many **right angles** are in a **straight angle**?

Tell how you know.

____

____

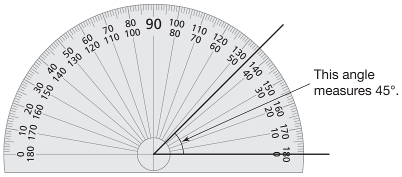
____

Angle measurement	Name of angle
90°	right
180°	straight
less than 90°	acute
between 90° and 180°	obtuse
between 180° and 360°	reflex

4. Use the protractor diagram from page 13.

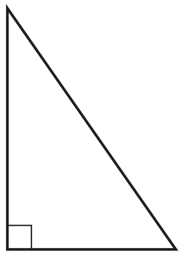
a) What is the measure of the **acute angle**? _______°

b) What is the measure of the **reflex angle**? _______°

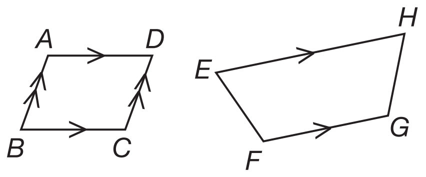


Perpendicular and Parallel Lines

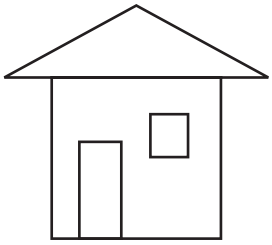
- Lines or line segments are **perpendicular** if they intersect to form a right angle. To show perpendicular lines in a diagram, mark the corner with a small square.



- Lines or line segments are **parallel** if they are always the same distance apart. This means they will never intersect. To show parallel lines in a diagram, mark the lines with matching arrowheads.



5. Most of the line segments in this picture are horizontal or vertical.



a) Which line segments are parallel? Circle the true statements.

- the horizontal line segments are parallel to each other
- the vertical line segments are parallel to each other
- the vertical line segments are parallel to the horizontal line segments

b) Mark the parallel line segments using matching arrowheads.

c) Mark the perpendicular line segments using square corners.

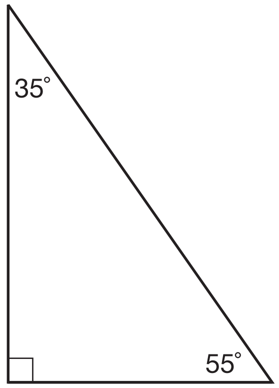
Note
It is not necessary to mark more than one square corner at a vertex.

8

Relationships in Right Triangles

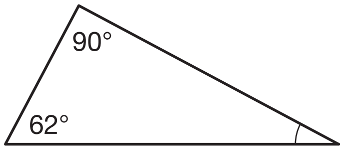
Right Triangles

A right triangle has one right angle. As in all triangles, the sum of its three angles is 180°.



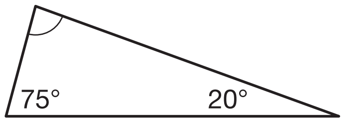
1. What is the measure of each angle marked with an arc?

a)



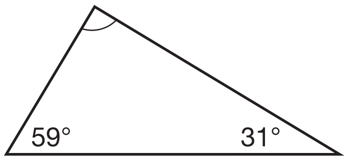
______°

b)



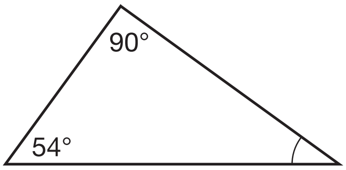
______°

c)



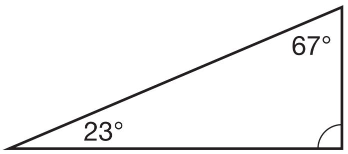
______°

d)



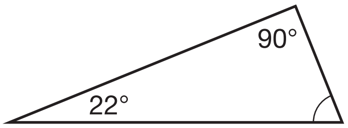
______°

e)



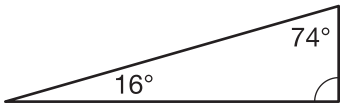
______°

f)



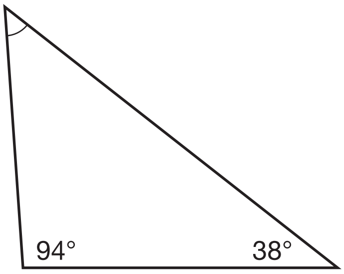
______°

g)



______°

h)



______°

2. Which of the triangles in Question 1 are right triangles? Tell how you know.

____

Squares and Square Roots

- To square a number, multiply the number by itself.
  For example: 92 = 9 × 9 or 81

  $(0.2)^2 = 0.2 \times 0.2$ or 0.04

3. What is the square of each number?

a) $8^2 =$ ________

b) $13^2 =$ ________

c) $2.5^2 =$ ________

d) $0.4^2 =$ ________

e) $10.05^2 =$ ________

f) $(100 + 20)^2 =$ ________

- To determine the square root of a number, figure out what number when multiplied by itself gives the original number.

  For example: $\sqrt{9} = 3$ because $3^2 = 9$
  $\sqrt{0.64} = 0.8$ because $(0.8)^2 = 0.64$

  Square roots may not be exact numbers.

  Estimate: $\sqrt{101} \doteq 10$ because $10^2 = 100$
  Use a calculator: $\sqrt{101} = 10.0498\ldots$

4. Calculate each square root.

a) $\sqrt{49} =$ _______

b) $\sqrt{0.16} =$ _______

c) $\sqrt{30} =$ _______

d) $\sqrt{0.1} =$ _______

e) $\sqrt{13^2} =$ _______

f) $\sqrt{(36 + 25)} =$ _______

Hint
Do operations inside the square root symbol first.

5. Solve for the variable.

a) If $c^2 = 25$, what is the value of c? $c =$ _______

b) If $x^2 = 50$, what is the value of x? $x =$ _______

6. Compare the left side with the right side. Write = or ≠.

a) $2^2 + 4^2 \; \square \; 6^2$

b) $7^2 \; \square \; 8^2 - 6^2$

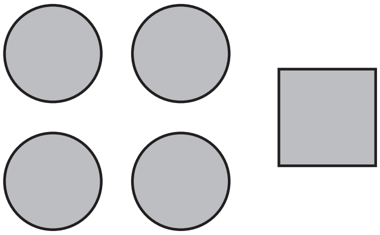
c) $50^2 \; \square \; 30^2 + 40^2$

d) $5^2 - 3^2 \; \square \; (5 - 3)^2$

Hint
An important relationship among the lengths of the sides in a right triangle is the **Pythagorean theorem.**
$a^2 + b^2 = c^2$

9 Similar Polygons

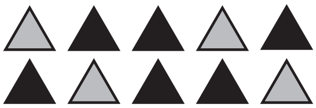
Ratios



A ratio is a comparison of numbers or quantities. You can express a ratio in different ways. For example, the ratio of circles to squares can be written as 4 : 1, or 4 to 1, or $\frac{4}{1}$.

A ratio of "part" to "total" works like a fraction. It can be expressed as a percent. For example, the ratio of circles to total shapes is 4 : 5, or 4 to 5, or $\frac{4}{5}$, which is $\frac{80}{100}$ or 80%.

1. Write each ratio that compares the numbers of triangles. Express the result in simplest terms.



a) grey triangles to black triangles ____:____

b) grey triangles to total triangles ____:____

c) What percent of all the triangles are grey? ________%

2. Circle the ratios that are equivalent to 4 : 32.

4 : 8   1 : 16   2 : 16   1 : 8

3. Circle the ratios that are equivalent to 25 : 5.

5 : 1   75 : 15   50 : 10   10 : 50

4. Circle the ratios that are equivalent to 60%.

60 : 100   10 : 50   30 : 50   3 : 5

5. Solve each equation.

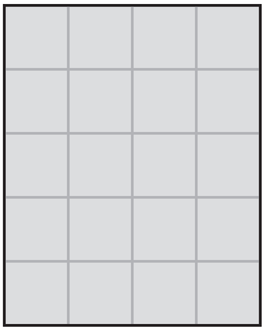
a) $\frac{1}{2} = \frac{\square}{8}$

b) $\frac{3}{4} = \frac{\square}{16}$

c) $\frac{14}{\square} = \frac{7}{8}$

d) $\frac{5}{6} = \frac{\square}{1.8}$

6. A photograph measures 4 in. by 6 in. Complete the ratio table below to show the measurements when the photo is enlarged.



Base (in.)	4	6	8	10	12	20
Height (in.)	6		12			

7. A 4 in.-by-5 in. photo can be reduced to a wallet-sized photo with a height of $3\frac{1}{8}$ in.

a) Express the height of the smaller photo as a decimal.

______ in.

b) Solve the equation to determine the length of the wallet-sized photo.

$$\frac{4 \text{ in.}}{5 \text{ in.}} = \frac{\boxed{}\text{ in.}}{3.125 \text{ in.}}$$

Measuring Lengths and Angles

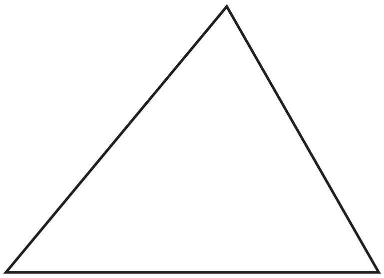
8. Use a protractor and a centimetre ruler to measure.

a) Measure and label the side lengths and angle measures of the triangle below.

b) Beside the triangle, draw a longer line that is parallel to one of the sides.

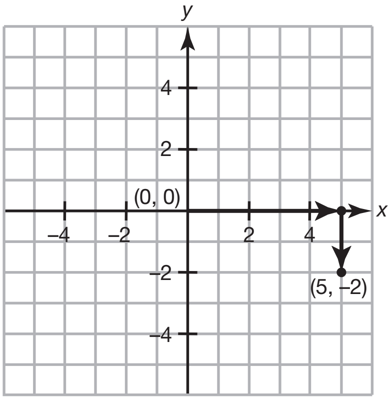
c) Repeat step b) for the other sides so that the three lines form a larger triangle.

d) Measure and label the side lengths and angle measures of the larger triangle.



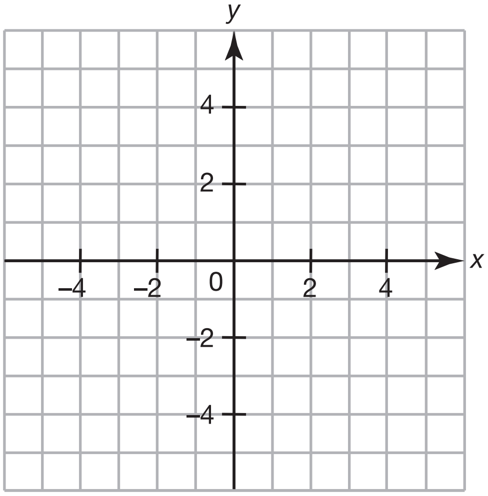
10 Transformations

Plotting Points on a Grid



The point where the *x*-axis and *y*-axis cross is the **origin** and has the coordinates (0, 0). To plot a point, start at the origin and move to the right (for a positive value) or left (for a negative value) along the *x*-axis. Then move up (for a positive value) or down (for a negative value) along the *y*-axis.
For example, to plot (5, −2), first count over 5 to the right along the *x*-axis, and then count down 2 along the *y*-axis. Label the point.

1. Plot *A*(−2, 3) and *B*(−3, −5) on the grid. Join the points to form line segment *AB*.



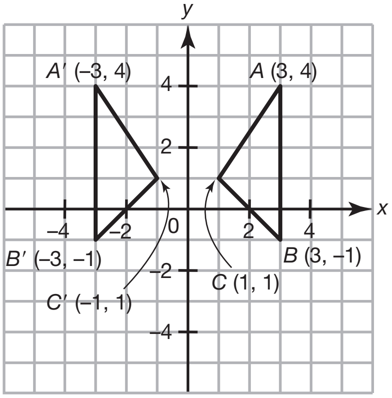
Translations

A **translation** is a transformation that slides a figure right, left, up, or down. The figure does not change its shape or size or orientation.

2. Use the grid in Question 1. Draw and label the image of *AB* after it has been translated right 5, up 2.

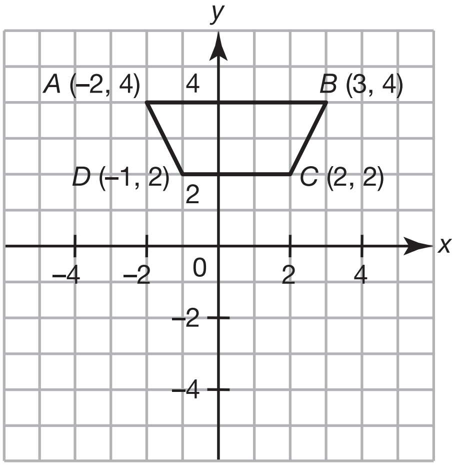
Reflections

A **reflection** is a transformation that flips a figure across a line. Each point on the image is the same distance from the line of reflection as the corresponding point on the original image. For example, triangle $A'B'C'$ is the image of triangle ABC after it is reflected across the y-axis.



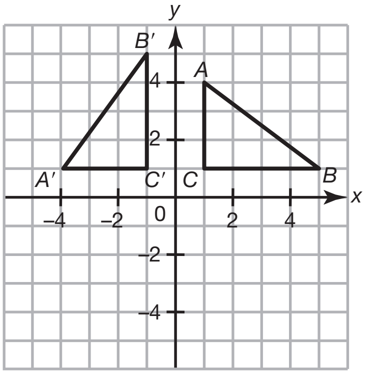
It is common to name an image of a figure using a prime symbol (′). For example, the image of A is A'.

3. Reflect figure $ABCD$ across the x-axis. Draw and label the image.



Rotations

A **rotation** is a transformation that turns a figure around a central point. The distance from the central point to any point on the figure remains the same. For example, triangle $A'B'C'$ is the image of triangle ABC after it has been rotated 90° counterclockwise around the origin, (0, 0).



4. Which figure below is the image of triangle XYZ after it has been rotated 90° clockwise?