Topics Covered
Measurement
Numbers, Radicals, and Exponents
Polynomials
Relations and Functions
Linear Functions
Systems of Equations
A workbook and animated series by Barry Mabillard
<table>
<thead>
<tr>
<th>Unit 1: Measurement</th>
<th>3 hours, 3 minutes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lesson 1: Metric and Imperial</td>
<td>72 minutes</td>
</tr>
<tr>
<td>Lesson 2: Surface Area and Volume</td>
<td>46 minutes</td>
</tr>
<tr>
<td>Lesson 3: Trigonometry I</td>
<td>37 minutes</td>
</tr>
<tr>
<td>Lesson 4: Trigonometry II</td>
<td>28 minutes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Unit 2: Numbers, Exponents, and Radicals</th>
<th>3 hours, 22 minutes</th>
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<tbody>
<tr>
<td>Lesson 1: Number Sets</td>
<td>19 minutes</td>
</tr>
<tr>
<td>Lesson 2: Primes, LCM, and GCF</td>
<td>47 minutes</td>
</tr>
<tr>
<td>Lesson 3: Squares, Cubes, and Roots</td>
<td>31 minutes</td>
</tr>
<tr>
<td>Lesson 4: Radicals</td>
<td>50 minutes</td>
</tr>
<tr>
<td>Lesson 5: Exponents I</td>
<td>23 minutes</td>
</tr>
<tr>
<td>Lesson 6: Exponents II</td>
<td>32 minutes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Unit 3: Polynomials</th>
<th>4 hours, 4 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lesson 1: Expanding Polynomials</td>
<td>63 minutes</td>
</tr>
<tr>
<td>Lesson 2: Greatest Common Factor</td>
<td>40 minutes</td>
</tr>
<tr>
<td>Lesson 3: Factoring Trinomials</td>
<td>85 minutes</td>
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<tr>
<td>Lesson 4: Special Polynomials</td>
<td>56 minutes</td>
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<table>
<thead>
<tr>
<th>Unit 4: Relations and Functions</th>
<th>1 hour, 40 minutes</th>
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<tbody>
<tr>
<td>Lesson 1: Graphing Relations</td>
<td>21 minutes</td>
</tr>
<tr>
<td>Lesson 2: Domain and Range</td>
<td>19 minutes</td>
</tr>
<tr>
<td>Lesson 3: Functions</td>
<td>27 minutes</td>
</tr>
<tr>
<td>Lesson 4: Intercepts</td>
<td>13 minutes</td>
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<tr>
<td>Lesson 5: Interpreting Graphs</td>
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<thead>
<tr>
<th>Unit 5: Linear Functions</th>
<th>2 hours, 37 minutes</th>
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<tbody>
<tr>
<td>Lesson 1: Slope of a Line</td>
<td>30 minutes</td>
</tr>
<tr>
<td>Lesson 2: Slope-Intercept Form</td>
<td>19 minutes</td>
</tr>
<tr>
<td>Lesson 3: Slope-Point Form</td>
<td>27 minutes</td>
</tr>
<tr>
<td>Lesson 4: General Form</td>
<td>45 minutes</td>
</tr>
<tr>
<td>Lesson 5: Parallel and Perpendicular Lines</td>
<td>36 minutes</td>
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<thead>
<tr>
<th>Unit 6: Systems of Equations</th>
<th>1 hour, 38 minutes</th>
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<tbody>
<tr>
<td>Lesson 1: Solving Systems Graphically</td>
<td>33 minutes</td>
</tr>
<tr>
<td>Lesson 2: Substitution</td>
<td>34 minutes</td>
</tr>
<tr>
<td>Lesson 3: Elimination</td>
<td>31 minutes</td>
</tr>
</tbody>
</table>

Total Course 17 hours, 9 minutes
Measurement

Conversion Table
This table contains a list of equivalent measurements.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Imperial Conversions</th>
<th>Metric Conversions</th>
</tr>
</thead>
<tbody>
<tr>
<td>inch (in. or ″)</td>
<td>1 in. = 2.54 cm</td>
<td></td>
</tr>
<tr>
<td>foot (ft. or ′)</td>
<td>1 ft. = 12 in.</td>
<td>1 ft. = 30.48 cm</td>
</tr>
<tr>
<td>yard (yd.)</td>
<td>1 yd. = 3 ft.</td>
<td>1 yd. = 91.44 cm</td>
</tr>
<tr>
<td></td>
<td>1 yd. = 36 in.</td>
<td>1 yd. = 0.9144 m</td>
</tr>
<tr>
<td>mile (mi.)</td>
<td>1 mi. = 1760 yd.</td>
<td>1 mi. = 1.609 km</td>
</tr>
<tr>
<td></td>
<td>1 mi. = 5280 ft.</td>
<td>1 mi. = 1609 m</td>
</tr>
<tr>
<td></td>
<td>1 mi. = 63 360 in.</td>
<td>1 mi. = 160 900 cm</td>
</tr>
</tbody>
</table>

Trigonometry

Pythagorean Theorem: $a^2 + b^2 = c^2$  \textit{(right triangles only)}

Trigonometric Ratios:

\[
\sin \theta = \frac{\text{opposite}}{\text{hypotenuse}} \quad \cos \theta = \frac{\text{adjacent}}{\text{hypotenuse}} \quad \tan \theta = \frac{\text{opposite}}{\text{adjacent}}
\]

Linear Functions

Slope of a Line:

\[
m = \frac{\text{rise}}{\text{run}}
\]

or

\[
m = \frac{y_2 - y_1}{x_2 - x_1}
\]

Slope-Intercept Form: $y = mx + b$

Slope-Point Form: $y - y_1 = m(x - x_1)$

General Form: $Ax + By + C = 0$

Parallel Lines: $m_{\parallel} = m_{\text{original}}$

Perpendicular Lines: $m_{\perp} = -\frac{1}{m_{\text{original}}}$
# Surface Area and Volume

## 2-D Shapes

<table>
<thead>
<tr>
<th>Shape</th>
<th>Perimeter</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square</td>
<td>$P = 4s$</td>
<td>$A = s^2$</td>
</tr>
<tr>
<td>Circle</td>
<td>$C = 2\pi r$ or $C = \pi d$</td>
<td>$A = \pi r^2$</td>
</tr>
<tr>
<td>Rectangle</td>
<td>$P = 2l + 2w$</td>
<td>$A = lw$</td>
</tr>
<tr>
<td>Triangle</td>
<td>$P = s_1 + s_2 + s_3$</td>
<td>$A = \frac{1}{2}bh$</td>
</tr>
</tbody>
</table>

## 3-D Objects

<table>
<thead>
<tr>
<th>Object</th>
<th>Surface Area</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cube</td>
<td>$SA = 6s^2$</td>
<td>$V = s^3$</td>
</tr>
<tr>
<td>Rectangular Prism</td>
<td>$SA = 2lw + 2wh + 2lh$</td>
<td>$V = lwh$</td>
</tr>
<tr>
<td>Sphere</td>
<td>$SA = 4\pi r^2$</td>
<td>$V = \frac{4}{3}\pi r^3$</td>
</tr>
<tr>
<td>Square Pyramid</td>
<td>$SA = A_{\text{base}} + 4A_{\text{side}}$</td>
<td>$V = \frac{1}{3}lwh$</td>
</tr>
<tr>
<td>Rectangular Pyramid</td>
<td>$SA = A_{\text{base}} + 2A_{\text{side}<em>1} + 2A</em>{\text{side}_2}$</td>
<td>$V = \frac{1}{3}lwh$</td>
</tr>
<tr>
<td>Right Cylinder</td>
<td>$SA = 2\pi r^2 + 2\pi rh$</td>
<td>$V = \pi r^2h$</td>
</tr>
<tr>
<td>Right Cone</td>
<td>$SA = \pi r^2 + \pi rs$</td>
<td>$V = \frac{1}{3}\pi r^2h$</td>
</tr>
</tbody>
</table>

## Exponents & Radicals

- $a^m \times a^n = a^{m+n}$
- $\frac{a^m}{a^n} = a^{m-n}$
- $(a^m)^n = a^{mn}$
- $(a^m b^n)^p = a^{mp} b^{np}$
- $\left(\frac{a^m}{b^n}\right)^p = a^{mp} b^{-np}$
- $a^0 = 1$
- $a^{-m} = \frac{1}{a^m}$
- $a^\frac{m}{n} = \sqrt[n]{a^m} \text{ OR } \left(\sqrt[n]{a}\right)^m$
Introduction to Measurement

a) Complete the following table:

<table>
<thead>
<tr>
<th>Unit</th>
<th>Length (in metres)</th>
<th>Referent</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>dm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>dam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>hm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>km</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b) Indicate which measuring tool is most appropriate for:

i) the width of your textbook _______________

ii) the perimeter of a park _______________

iii) the circumference of a vase _______________

iv) the diameter of a diamond ring with precision _______________

v) the distance from your house to a friend’s house _______________

vi) the thickness of a smartphone with precision _______________

vii) the width of a kitchen window _______________
c) Complete the following table:

<table>
<thead>
<tr>
<th>Unit</th>
<th>Imperial Conversions</th>
<th>Metric Conversions</th>
<th>Referent</th>
</tr>
</thead>
<tbody>
<tr>
<td>inch (in. or ”)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>foot (ft. or ‘)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>yard (yd.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mile (mi.)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

d) What are some of the drawbacks to using imperial units as a form of measurement?

e) Why is it important to understand both imperial units and metric units?
Example 1

Measure each of the following using an appropriate measuring tool.

a) The circumference of a circle.

b) The length of a curved line.

c) The actual distance between Grande Prairie and Medicine Hat.

Map Scale: 1:18,300,000
Example 2
Write each metric caliper measurement as a decimal.

(a) \[0\quad 1\quad 2\quad 3\quad 4\quad 5\quad 6\quad \text{cm}\]
(b) \[0\quad 1\quad 2\quad 3\quad 4\quad 5\quad 6\quad \text{cm}\]
(c) \[0\quad 1\quad 2\quad 3\quad 4\quad 5\quad 6\quad \text{cm}\]
(d) \[0\quad 1\quad 2\quad 3\quad 4\quad 5\quad 6\quad \text{cm}\]

Example 3
Metric Conversions

(a) Convert 7 m to kilometres.
(b) Convert 12 cm to metres.

(c) Convert 45.3 cm to kilometres.
(d) Convert 3 km to metres.

(e) Convert 8 m to centimetres.
(f) Convert 0.7 km to centimetres.
Example 4  Each of the following objects have been measured with inappropriate units. Convert them to more suitable units.

a) The thickness of a dime is 0.00122 m

b) The height of a basketball player is 2100 mm

c) The driving distance from Pincher Creek to Taber is 14 900 000 cm

Example 5  A trundle wheel can be used to measure the walking distance between two locations.

a) If the diameter of a trundle wheel is 45 cm, how far will a person have walked when the wheel makes one full rotation?

b) If a person walks for 0.7 km, how many times has the wheel rotated?
Example 6  Write the length of each line segment using imperial units.

a) 

b) 

c) 

d) 

e)
Example 7  Some of these conversions have an error. If there is an error, explain the nature of the error and complete the conversion correctly.

a) Convert 23 cm to metres.
   conversion: \( 23 \text{ cm} \times \frac{100 \text{ cm}}{1 \text{ m}} \)

   error:

   correct conversion:

b) Convert 5 m to millimetres.
   conversion: \( 5 \text{ m} \times \frac{1000 \text{ mm}}{5 \text{ m}} \)

   error:

   correct conversion:

c) Convert 7 yd. to miles.
   conversion: \( 7 \text{ yd.} \times \frac{1760 \text{ mi.}}{1 \text{ yd.}} \)

   error:

   correct conversion:

d) Convert 31 ft. to inches.
   conversion: \( 31 \text{ ft.} \times \frac{12 \text{ in.}}{1 \text{ ft.}} \)

   error:

   correct conversion:
Example 8: Imperial Conversions

- Convert 5 yards to feet.
- Convert 10 miles to yards.
- Convert 20 feet to inches.
- Convert 5'7” to inches.
- Convert 4 yards to inches.
- Convert 2 miles to feet.
Example 9  Imperial Conversions

a) Convert 78 feet to yards.

b) Convert 110 yards to miles.

c) Convert 48 inches to feet.

d) Convert 58” to feet.

e) Convert 90 feet to yards.

f) Convert 12000 feet to miles.
**Example 10**  Imperial to Metric Conversions

a) Convert 6 yards to metres.

b) Convert 3 miles to kilometres.

c) Convert 80 inches to metres.

d) Convert 3.8 feet to metres.

e) Convert 5’3” to metres.

f) Convert 0.4 miles to metres.
Example 11  Metric to Imperial Conversions

a) Convert 14 metres to yards.

b) Convert 7 kilometres to miles.

c) Convert 12 metres to inches.

d) Convert 2 kilometres to yards.

e) Convert 72 centimetres to feet.

f) Convert 400 metres to miles.
Example 12  Find the missing side of each right triangle using the Pythagorean Theorem

a)  
\[ \begin{align*}
\text{Side 1: } & \quad 15 \text{ m} \\
\text{Side 2: } & \quad 8 \text{ m} \\
\text{Hypotenuse: } & \quad 16 \text{ m}
\end{align*} \]

b)  
\[ \begin{align*}
\text{Side 1: } & \quad 60'' \\
\text{Side 2: } & \quad 61'' \\
\text{Hypotenuse: } & \quad \text{any length}
\end{align*} \]

c)  
\[ \begin{align*}
\text{Side 1: } & \quad 119 \text{ cm} \\
\text{Side 2: } & \quad 169 \text{ cm} \\
\text{Hypotenuse: } & \quad \text{any length}
\end{align*} \]

d)  
\[ \begin{align*}
\text{Side 1: } & \quad 12 \text{ yd.} \\
\text{Side 2: } & \quad 5 \text{ yd.} \\
\text{Hypotenuse: } & \quad \text{any length}
\end{align*} \]
Example 13

a) Five students measure their height using different units. Andrew is 176 cm, Brittney is 5’4”, Calvin is 1.8 yards, Don is 54 inches, and Elisha is 1.6 metres. Arrange the students from shortest to tallest.

b) A truck driver is entering a parkade that says the maximum height of a vehicle is 8’6”. If the height of the truck is 3 m, should the driver proceed into the parkade?
Example 14

a) A homeowner is laying sod in her lawn. The lawn is a rectangle with dimensions of 28' × 18'. If one piece of sod is a rectangle with dimensions of 60 cm × 40 cm, approximately how many pieces of sod should the homeowner order?

b) A homeowner wants to replace the linoleum in their kitchen. The floor plan for the kitchen is shown below. If linoleum costs $6.50/sq ft, what is the total cost of the linoleum? The counter and kitchen island do not require linoleum.
Introduction

Find the surface area and volume for each of the following 3-D objects.

a) sphere

![Sphere diagram with a radius of 8 cm]

<table>
<thead>
<tr>
<th>Surface Area Formula</th>
<th>Volume Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b) rectangular prism

![Rectangular prism diagram with dimensions 9 in. x 12 in. x 3 in.]

<table>
<thead>
<tr>
<th>Surface Area Formula</th>
<th>Volume Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
c) square pyramid

- Base: 5.75 cm x 7 cm
- Height: 8 cm

Surface Area Formula:

Volume Formula:

---

d) rectangular pyramid

- Base: 8 cm x 11.3 cm
- Height: 16 cm

Surface Area Formula:

Volume Formula:
e) right cylinder

Surface Area Formula

Volume Formula

f) right cone

Surface Area Formula

Volume Formula
Example 1

Find the unknown measurement in each of the following:

a) a sphere

\[ r = ? \]

i) Use the surface area formula to solve for the radius.

ii) Use the volume formula to solve for the radius.

\[ \text{SA} = 4536.46 \text{ cm}^2 \]
\[ V = 28731 \text{ cm}^3 \]

b) right cone

\[ h = ? \]

i) Use the surface area formula to solve for the slant height.

ii) Use the volume formula to solve for the height.

\[ s = ? \]
\[ \text{SA} = 320.44 \text{ m}^2 \]
\[ V = 347.57 \text{ m}^3 \]
Example 2  Sketch each shape and determine the indicated quantity.

a) A square pyramid has a base measuring 5 ft. by 5 ft. The height of the pyramid, from the centre of the base to the apex is 7 ft. Calculate the surface area of the pyramid.

b) A cylindrical water tank with an open top has a volume of 5702 m³ and a radius of 11 m. Calculate the height of the tank.
Example 3

Find the surface area and volume of this 3-D object.

(a) surface area

(b) volume
Example 4  Find the surface area and volume of this 3-D object.

a) surface area

b) volume
Example 5  Find the surface area and volume of this 3-D object.

a) surface area

b) volume
Example 6

Find the surface area and volume of this 3-D object.

a) surface area

b) volume
Example 7  Find the surface area and volume of this 3-D object.

a) surface area

b) volume
Introduction

Trigonometry I

a) Label the sides of each triangle, relative to the given angle.

i) 

ii) 

b) Calculate the ratio of the opposite side to the adjacent side for each similar triangle.

1 cm 2 cm 8 cm

2 cm 4 cm

4 cm

2 cm

1 cm

2 cm

4 cm

8 cm

c) Define the tangent ratio.
d) Calculate the ratio of the opposite side to the hypotenuse for each similar triangle.

\[
\frac{5\, \text{cm}}{2\, \text{cm}} \quad \frac{10\, \text{cm}}{4\, \text{cm}} \quad \frac{20\, \text{cm}}{8\, \text{cm}}
\]

e) Define the sine ratio.

f) Calculate the ratio of the adjacent side to the hypotenuse for each similar triangle.

\[
\frac{4\, \text{cm}}{3\, \text{cm}} \quad \frac{8\, \text{cm}}{6\, \text{cm}} \quad \frac{16\, \text{cm}}{12\, \text{cm}}
\]

g) Define the cosine ratio.

h) What is a useful memorization tool to remember the trigonometric ratios?
### Example 1
For each triangle, calculate each trigonometric ratio.

<table>
<thead>
<tr>
<th></th>
<th>sin θ</th>
<th>cos θ</th>
<th>tan θ</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Example 2  Calculate the angle $\theta$ in each triangle.

a)  
\[
\begin{align*}
\text{47 cm} & \\
\text{36 cm} & \\
\end{align*}
\]

b)  
\[
\begin{align*}
\text{26 cm} & \\
\text{87 cm} & \\
\end{align*}
\]

c)  
\[
\begin{align*}
\text{24 cm} & \\
\theta & \approx 73.74^\circ \\
\end{align*}
\]

d)  
\[
\begin{align*}
\text{50 cm} & \\
\text{68 cm} & \\
\end{align*}
\]
Example 3

Calculate the missing side of each triangle using two methods.

**Part a)**

\[
\begin{align*}
\text{24 cm} & \quad \theta \quad 73.74^\circ \\
7 \text{ cm} & \quad ?
\end{align*}
\]

**Part b)**

\[
\begin{align*}
\text{48 cm} & \quad \theta \quad 48.89^\circ \\
? & \quad 73 \text{ cm}
\end{align*}
\]
Example 4  Solve each triangle.

a)  

\[
\begin{align*}
\triangle & \quad m \quad \text{angle} \\
\quad & \quad 41^\circ \\
\quad & \quad \text{opposite} \\
\quad & \quad \text{adjacent} \\
\quad & \quad \text{hypotenuse} \\
\end{align*}
\]

\[
\begin{align*}
\text{Solve for } x, y, \text{ and } m.
\end{align*}
\]

b)  

\[
\begin{align*}
\triangle & \quad h \quad \text{angle} \\
\quad & \quad 8^\circ \\
\quad & \quad \text{opposite} \\
\quad & \quad \text{adjacent} \\
\quad & \quad \text{hypotenuse} \\
\quad & \quad \text{opposite} \\
\quad & \quad \text{adjacent} \\
\quad & \quad \text{hypotenuse} \\
\end{align*}
\]

\[
\begin{align*}
\text{Solve for } h, y, \text{ and } m.
\end{align*}
\]
c) \[ \triangle \text{hypotenuse} \quad \text{opposite} \quad \text{adjacent} \]

17.2 cm \[ h \]
16.4 cm

\[ 16.4 \text{ cm} \]

\[ 17.2 \text{ cm} \]

\[ 22.3 \text{ cm} \]

\[ 28.9 \text{ cm} \]

\[ x \]
Example 5  Solve each of the following problems.

a) The sketch on the right was drawn by a surveyor who is trying to determine the distance between two trees across a river. Using the information in the sketch, calculate the distance between the trees.

b) A 16 ft. ladder is leaning against the roof of a house. The angle between the ladder and the ground is 62°. How high above the ground is the base of the roof?
Introduction  Trigonometry II

a) A sailor on the deck of a ship observes an airplane in the sky. Label the diagram using the following terms:

- horizontal line
- line of sight
- angle of elevation
- angle of depression

b) The sailor uses a simple clinometer to measure the angle of elevation. A diagram of the clinometer is shown to the right. What is the angle of elevation?

c) If the sailor tilts her head 30° upwards to see the plane, and the plane is flying at an altitude of 3000 m, what is the horizontal distance from the boat to the plane?
Example 1  Solve for the unknown length.

a) 

\begin{align*}
\text{24°} & \quad \text{4.3 cm} \\
\text{15°} & \quad \text{4.3 cm} \\
\end{align*}

\[ x \]

b) 

\begin{align*}
\text{18°} & \quad \text{40°} \\
\text{7.7 cm} & \quad \text{7.7 cm} \\
\end{align*}

\[ x \]

c) 

\begin{align*}
\text{48°} & \quad \text{6.1 cm} \\
\text{16°} & \quad \text{6.1 cm} \\
\end{align*}

\[ x \]
Example 2  Solve for the unknown length.

a)

\[
\begin{align*}
\text{21°} & \quad 3.8 \text{ cm} \\
& \quad 8 \text{ cm} \\
& \quad x
\end{align*}
\]

b)

\[
\begin{align*}
\text{18°} & \quad 7.2 \text{ cm} \\
& \quad 31° \\
& \quad x
\end{align*}
\]

c)

\[
\begin{align*}
\text{34°} & \quad 27° \\
& \quad 14.3 \text{ cm} \\
& \quad x
\end{align*}
\]
Example 3  Solve for the unknown angle.

a)

\[
\begin{aligned}
\theta &\quad 9.4 \text{ cm} \\
\quad &\quad 6.1 \text{ cm} \\
8.0 \text{ cm} &
\end{aligned}
\]

b)

\[
\begin{aligned}
\theta &\quad 6.0 \text{ cm} \\
&\quad 7.0 \text{ cm} \\
48^\circ &
\end{aligned}
\]

c)

\[
\begin{aligned}
\theta &\quad 22^\circ \\
&\quad 8.0 \text{ cm} \\
&\quad 8.3 \text{ cm}
\end{aligned}
\]
Janis lives on the 4th floor of her apartment building. From her window, she has to tilt her head 52° upwards to see the top of the neighbouring building. She has to look down 35° to see the base of the neighbouring building. The distance between the buildings is 80 m.

a) Calculate the height of the neighbouring building.

b) What measuring tools could Janis use to obtain the angles and distance between the buildings?

c) Which quantities in this question were direct measurements? Which were indirect measurements?
Example 5

The sign for a restaurant is mounted on a pole. From a position 5 m from the base of the pole, Mike has to look up 42° to see the bottom of the sign, and 52° to see the top of the sign. How tall is the sign?
Example 6

Kevin and Rob are standing on opposite sides of Edmonton’s River Valley. In order to see a boat on the river, Kevin has to look down 32°, and Rob has to look down 38°. The width of the valley is 750 m, and the boat is exactly halfway between Kevin and Rob. How much higher is Rob than Kevin?
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Introduction

Define each of the following sets of numbers and fill in the graphic organizer on the right.

a) Natural Numbers

b) Whole Numbers

c) Integers

d) Rational Numbers

e) Irrational Numbers

f) Real Numbers
Example 1
Determine which sets each number belongs to.
In the graphic organizer, shade in the sets.

a) -4  b) 0  c) $1.273958\ldots$  d) 7

\begin{itemize}
  \item R
  \item Q
  \item W
  \item \overline{Q}
  \item I
  \item N
\end{itemize}

e) $7.\overline{4}$  f) 4.93  g) $\frac{2}{3}$  h) $\pi$

Example 2
For each statement, circle true or false.

a) All natural numbers are whole numbers.  T  F

b) All rational numbers are integers.  T  F

c) Some rational numbers are integers.  T  F

d) Some whole numbers are irrational numbers.  T  F

e) Rational numbers are real numbers, but irrational numbers are not.  T  F
Example 3  Sort the following numbers as rational, irrational, or neither. You may use a calculator.

\[
\begin{array}{cccccc}
\frac{1}{4} & \sqrt{8} & 0 & -\sqrt{2} & \frac{3}{0} & \sqrt[5]{-0.03125} & 27^{\frac{1}{3}} \\
-\sqrt{\frac{3}{5}} & \sqrt{49} & 5 & -\sqrt{2} & \frac{0}{3} & \sqrt{0.13} & (-2)^{\frac{1}{2}}
\end{array}
\]

<table>
<thead>
<tr>
<th>Rational</th>
<th>Irrational</th>
<th>Neither</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Example 4
Order the numbers from least to greatest on a number line. You may use a calculator.

a) \(-0.75, \frac{1}{4}, 1.357\ldots, \frac{1}{3}\)

b) \(-\sqrt{3}, \sqrt{5}, \sqrt{\frac{4}{5}}, \sqrt{\sqrt{6}}, 2\sqrt{2}, -2\sqrt{2}, \sqrt{8}\)

c) \(-2^2, (-2)^2, (-3)^\frac{1}{3}, 2^\frac{1}{2}, 4^{-1}, (-32)^\frac{1}{3}\)
**Introduction**

Prime Numbers, Least Common Multiple, and Greatest Common Factor.

a) What is a prime number?

b) What is a composite number?

c) Why are 0 and 1 not considered prime numbers?
d) What is prime factorization? Find the prime factorization of 12.

\[
12 = 2 \times 2 \times 3
\]

e) What is the LCM? Find the LCM for 9 and 12 using two different methods.

f) What is the GCF? Find the GCF for 16 and 24 using two different methods.
Example 1  Determine if each number is prime, composite, or neither.

a) 1  
b) 14  
c) 13  
d) 0

Example 2  Find the least common multiple for each set of numbers.

a) 6, 8  
b) 7, 14  
c) 48, 180  
d) 8, 9, 21
Example 3  Find the greatest common factor for each set of numbers.

a) 30, 42  
b) 13, 39

c) 52, 78  
d) 54, 81, 135
Example 4  Problem solving with LCM

a) A fence is being constructed with posts that are 12 cm wide. A second fence is being constructed with posts that are 15 cm wide. If each fence is to be the same length, what is the shortest fence that can be constructed?

b) Stephanie can run one lap around a track in 4 minutes. Lisa can run one lap in 6 minutes. If they start running at the same time, how long will it be until they complete a lap together?

c) There is a stack of rectangular tiles, with each tile having a length of 84 cm and a width of 63 cm. If some of these tiles are arranged into a square, what is the smallest side length the square can have?
Example 5 Problem solving with GCF

a) A fruit basket contains apples and oranges. Each basket will have the same quantity of apples, and the same quantity of oranges. If there are 10 apples and 15 oranges available, how many fruit baskets can be made? How many apples and oranges are in each basket?

b) There are 8 toonies and 20 loonies scattered on a table. If these coins are organized into groups such that each group has the same quantity of toonies and the same quantity of loonies, what is the maximum number of groups that can be made? How many loonies and toonies are in each group?

c) A box of sugar cubes has a length of 156 mm, a width of 104 mm, and a height of 39 mm. What is the edge length of one sugar cube? Assume the box is completely full and the manufacturer uses sugar cubes with the largest possible volume.
Introduction  Perfect Squares, Perfect Cubes, and Roots.

a) What is a perfect square? Draw the first three perfect squares.

b) What is a perfect cube? Draw the first three perfect cubes.
c) Complete the table showing all perfect squares and perfect cubes up to 10. The first three are completed for you.

<table>
<thead>
<tr>
<th>Number</th>
<th>Perfect Square</th>
<th>Perfect Cube</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$1^2 = 1$</td>
<td>$1^3 = 1$</td>
</tr>
<tr>
<td>2</td>
<td>$2^2 = 4$</td>
<td>$2^3 = 8$</td>
</tr>
<tr>
<td>3</td>
<td>$3^2 = 9$</td>
<td>$3^3 = 27$</td>
</tr>
</tbody>
</table>


d) What is a square root? Find the square root of 36.

i) Using a geometric square.

ii) Using the formula $A = s^2$


e) What is a cube root? Find the cube root of 125.

i) Using a geometric cube.

ii) Using the formula $V = s^3$
Lesson Notes

Example 1
Evaluate each power, without using a calculator.

a) $3^2$

b) $(-3)^2$

c) $-3^2$

d) $3^3$

e) $(-3)^3$

f) $-3^3$

Example 2
Evaluate each expression, without using a calculator.

a) $2(2)^3$

b) $-2(-4)^2$

c) $1 - 5^2$

d) $\frac{1}{4^3}$

e) $\frac{1}{2^2 + 2^3}$

f) $\frac{5(-2)^3}{-2^2}$
Example 3  Evaluate each root using a calculator.

a) \( \sqrt{8} \)  

b) \( \sqrt{-8} \)  

c) \( \frac{1}{2}\sqrt{8} \)  

d) \( \frac{1}{3}\sqrt{-8} \)

e) What happens when you evaluate \( \sqrt{-8} \) and \( \frac{1}{3}\sqrt{-8} \)?  
Is there a pattern as to when you can evaluate the root of a negative number?

Example 4  Evaluate each expression, without using a calculator.

a) \( 2\sqrt{49} + \sqrt{36} \)  

b) \( \frac{\sqrt{25} - \sqrt{8}}{3^2} \)  

c) \( \frac{1 - \sqrt{36}}{5(-2)^2} \)  

d) \( \frac{3\sqrt{27} - (-4)^2}{-3^2 - (-1)^2} \)
Example 5  The area of Edmonton is 684 km²

a) If the shape of Edmonton is approximated to be a square, how wide is the city?

b) If the shape of Edmonton is approximated to be a circle, how wide is the city?

Example 6  The formula for the volume of a sphere is \( V = \frac{4}{3} \pi r^3 \)

a) If a sphere has a radius of 9 cm, what is the volume?

b) If a sphere has a volume of approximately 5000 cm³, what is the radius?
Example 7

The amount of time, $T$, it takes for a pendulum to swing back and forth is called the period.

The period of a pendulum can be calculated with the formula: 

$$T = 2\pi \sqrt{\frac{l}{9.8}}$$

a) What is the period of the pendulum if the length, $l$, is 1.8 m?

b) What is the length of the pendulum if the period is 2.4 s?
Example 8  The total volume of gold mined throughout history is approximately 8340 m$^3$.

a) If all the gold was collected, melted down, and recast as a cube, what would be the edge length?

b) If the density of gold is 19300 kg/m$^3$, what is the mass of the cube?

The density formula is \[ \text{density} = \frac{\text{mass}}{\text{volume}} \]

c) In 2011, 1 kg of gold costs about $54 000. What is the value of all the gold ever extracted?
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Introduction Understanding Radicals

a) Label each of the following parts of a radical.

\[ \sqrt{8} \]

b) What is the index of \( \sqrt{5} \)?

c) What is the difference between an entire radical and a mixed radical?

d) Is it possible to write a radical without using the radical symbol \( \sqrt{ } \)?
**Example 1** Convert each entire radical to a mixed radical.

<table>
<thead>
<tr>
<th></th>
<th>Prime Factorization Method</th>
<th>Perfect Square Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) $\sqrt{20}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) $\sqrt{32}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) $\sqrt[3]{16}$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Example 2

Convert each entire radical to a mixed radical using the method of your choice.

a) $\sqrt{24}$

b) $\sqrt{72}$

c) $\sqrt{49}$

d) $\sqrt[3]{81}$

e) $\sqrt[4]{64}$

f) $\sqrt[5]{48}$
### Example 3
Convert each mixed radical to an entire radical.

<table>
<thead>
<tr>
<th></th>
<th>Reverse Factorization Method</th>
<th>Perfect Square Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) $3\sqrt{3}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) $6\sqrt{2}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) $2\sqrt[3]{5}$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$$3\sqrt{16} = 2\sqrt[3]{2}$$

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Example 4  Convert each mixed radical to an entire radical using the method of your choice.

a) \(4\sqrt{2}\)  \hspace{1cm} b) \(5\sqrt{3}\)

c) \(3\sqrt{3}\)  \hspace{1cm} d) \(2\sqrt{3}\)

Example 5  Estimate each radical and order them on a number line.

a) \(\sqrt{42}\)  \(\sqrt{20}\)  \(\sqrt{8}\)  \(\sqrt{14}\)

b) \(\sqrt[3]{92}\)  \(\sqrt[3]{169}\)  \(\sqrt[3]{54}\)  \(\sqrt[3]{35}\)
Example 6  Simplify each expression without using a calculator.

a) \( \frac{2\sqrt{12}}{4} \)

b) \( \frac{3\sqrt{27}}{36} \)

c) \( \frac{3\sqrt{32}}{4} \)

d) \( \frac{\sqrt{49}}{\sqrt{81}} \)

e) \( \frac{3\sqrt{72}}{\sqrt{64}} \)
Example 7  Write each power as a radical.

a) $3^2$  
b) $(-4)^3$  
c) $2^3$

d) $(-7)^{2/3}$  
e) $\left(\frac{2}{3}\right)^{3/2}$  
f) $16^{0.25}$

Example 8  Write each radical as a power.

a) $\sqrt{5}$  
b) $\sqrt[3]{9}$  
c) $\sqrt[2]{2^2}$

d) $(\sqrt[4]{3})^4$  
e) $\left(\sqrt[7]{5}\right)^2$  
f) $\sqrt[4]{\left(\frac{3}{4}\right)^2}$
**Introduction**  
Exponent Laws I

a) Product of Powers

\[2^3 \times 2^4 = \quad \left( \frac{3}{4} \right)^5 \left( \frac{3}{4} \right)^2 = \quad \text{General Rule:} \]

b) Quotient of Powers

\[(-6)^8 \div (-6)^5 = \quad \frac{7^9}{7^7} = \quad \text{General Rule:} \]

c) Power of a Power

\[(2^5)^3 = \quad \left( (-3)^2 \right)^4 = \quad \text{General Rule:} \]

d) Power of a Product

\[(a^2b^3)^3 = \quad (4a^3b^8)^4 = \quad \text{General Rule:} \]

e) Power of a Quotient

\[\left( \frac{a^3}{b^5} \right)^3 = \quad \left( \frac{2a^6}{3b^4} \right)^3 = \quad \text{General Rule:} \]

f) Exponent of Zero

\[2^0 = \quad \left( \frac{3mn^2}{7p^6q^4} \right)^0 = \quad \text{General Rule:} \]
Example 1  Simplify each of the following expressions.

a) \(2^3 \times 2^4\)  
b) \(\frac{3^9}{3^6}\)

c) \(\left(\frac{2a^2}{b}\right)^3\)  
d) \(3(3^5)\)

e) \(\frac{7^4}{7}\)  
f) \((3a^2)^3\)
Example 2 Simplify each of the following expressions.

a) \(5(3a^2b)\)

b) \((4a)(4b^2)\)

c) \((7a^2b^3)(-3ab^6)\)

d) \(\frac{36ab^2}{6b}\)

e) \(\frac{10a^8b}{15a^6c}\)

f) \(\frac{(3ab)(2ab)^2}{2(ab)^3}\)
Example 3  Simplify each of the following expressions.

a) \((3a^2b^3)^2\)  
b) \(\left(\frac{4a}{5b}\right)^2\)

c) \(\left(\frac{16a^2b^5}{20ab^3}\right)^3\)  
d) \(\left(-\frac{3a}{2b}\right)^0\)

e) \(\left(\frac{2a}{b}\right)^2(ab)^0\left(-\frac{1}{2}\right)^3\)  
f) \(\frac{1}{25a^4}(5a^5)^2\)
Example 4  For each of the following, find a value for $m$ that satisfies the equation.

a) $\left( a^2 \right)^m = a^{10}$

b) $a^{2m} \times a^8 = a^{14}$

c) $\frac{a^7}{a^{3m}} = a$

d) $\frac{a^m \times a^{2m}}{a} = a^{20}$
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Introduction

Exponent Laws II

a) Negative Exponents

\[ 3^{-3} = \]
\[ (-12)^{-4} = \]

General Rule:

\[ \frac{1}{7^{-2}} = \]
\[ \left(\frac{2}{3}\right)^{-5} = \]

b) Rational Exponents

\[ 6^{\frac{1}{2}} = \]
\[ (-5)^{\frac{1}{3}} = \]

General Rule:

\[ 3^{\frac{4}{5}} = \]
\[ \sqrt{7^{5}} = \]
Example 1

Simplify each of the following expressions. Any variables in your final answer should be written with positive exponents.

a) \((-4)^{-2}\)  

b) \(\left(\frac{3}{2}\right)^{-3}\)

c) \(\left(\frac{a^2b}{c^3}\right)^{-1}\)  

d) \((3a^3)^{-2}\)

e) \(\left(\frac{3^{-1}}{5}\right)^{-2}\)  

f) \(\frac{5(-4)^0}{2^{-1}}\)
Example 2

Simplify. Any variables in your final answer should be written with positive exponents.

a) \(2^3 (5)^{-2}\)  
b) \(\frac{2^{-3}}{a^4}\)

c) \(\frac{(2a)^3}{(2a)^{-2}}\)  
d) \(\left(a^5\right)^{\frac{3}{5}}\)

e) \(\left(\frac{a^{-4}}{(ab)^2}\right)^{\frac{3}{2}}\)  
f) \(\left(5a^3\right)^{\frac{3}{2}} \left(\frac{1}{a^2}\right)\)
Simplify each of the following expressions. Any variables in your final answer should be written with positive exponents.

a) \( \frac{10a^7b^9c^6}{5a^6b^{10}c^8} \)

b) \( \frac{-3a^{-7}b^{-11}}{12a^4b^{-3}} \)

c) \( \left( \frac{2}{5}a^{-3}b^{-1} \right)^{-3} \)

d) \( \left( \frac{4a^2b^3}{8ab^5} \right)^{-2} \)
Example 4

Simplify. Any variables in your final answer should be written with positive exponents. Fractional exponents should be converted to a radical.

a) \((a^5)\left(a^{\frac{1}{2}}\right)\)

b) \(\left(27a^{\frac{1}{2}}\right)^\frac{2}{3}\)

c) \(\left(\frac{9a^{-2}}{16b^{-4}}\right)^{\frac{3}{2}}\)

d) \(\left(2^{\frac{5}{4}}\right)\left(2^{\frac{4}{3}}\right)\)
Example 5

Simplify. Any variables in your final answer should be written with positive exponents. Fractional exponents should be converted to a radical.

a) \(-20a^{\frac{2}{3}}b^{\frac{1}{2}} / 4ab^{\frac{1}{2}}\)

b) \(2^{-3} + 2^{-4} / 2^{-5}\)

c) \(\left(\frac{1}{16}\right)^{\frac{5}{4}} \left(\frac{1}{16}\right)^{\frac{3}{4}} / \left(\frac{1}{16}\right)^{\frac{1}{4}} \left(\frac{1}{16}\right)^{\frac{3}{4}}\)

d) \(\left(\frac{a^3}{2b^{-\frac{1}{7}}}\right)^{\frac{1}{2}}\)

\[a^{-m} = \frac{1}{a^m}\]
\[a^n = \sqrt[n]{a^m} \text{ OR } \left(\sqrt[n]{a}\right)^m\]
Example 6

Write each of the following radical expressions with rational exponents and simplify.

a) \(-\sqrt[3]{a^3}\)  
b) \(\sqrt[3]{a}\)

c) \(\sqrt[3]{\sqrt[3]a}\)  
d) \(\sqrt[3]{64a^6b^{12}}\)
Example 7

A culture of bacteria contains 5000 bacterium cells. This particular type of bacteria doubles every 8 hours. If the amount of bacteria is represented by the letter $A$, and the elapsed time (in hours) is represented by the letter $t$, the formula used to find the amount of bacteria as time passes is:

$$A = 5000(2)^{\frac{t}{8}}$$

a) How many bacteria will be in the culture in 8 hours?

b) How many bacteria will be in the culture in 16 hours?

c) How many bacteria were in the sample 8 hours ago?
Example 8

Over time, a sample of a radioactive isotope will lose its mass. The length of time for the sample to lose half of its mass is called the *half-life* of the isotope. Carbon-14 is a radioactive isotope commonly used to date archaeological finds. It has a half-life of 5730 years.

If the initial mass of a Carbon-14 sample is 88 g, the formula used to find the mass remaining as time passes is given by:

\[
A = 88 \left( \frac{1}{2} \right)^{\frac{t}{5730}}
\]

In this formula, \( A \) is the mass, and \( t \) is time \((in years)\) since the mass of the sample was measured.

a) What will be the mass of the Carbon-14 sample in 2000 years?

b) What will be the mass of the Carbon-14 sample in 5730 years?

c) If the mass of the sample is measured 10000 years in the future, what percentage of the original mass remains?
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Introduction

Find the product using algebra tiles:

a) $3(4x^2)$

b) $2x(x - 1)$

c) $(x - 2)(3x + 1)$
Polynomials
LESSON ONE - Expanding Polynomials
Lesson Notes

Example 1  \textit{Monomial \times Monomial.} Determine the product.

\begin{align*}
\text{a)} \; & 3(2x^2) & \text{d)} \; & (4x)^2 \\
\text{b)} \; & (5x)(7x) & \text{e)} \; & 2(3x)(5x) \\
\text{c)} \; & (6a)(3ab)
\end{align*}

Example 2  \textit{Monomial \times Binomial.} Determine the product.

\begin{align*}
\text{a)} \; & -2x(3x - 1) & \text{c)} \; & x^2(x^2 - 4) \\
\text{b)} \; & -8a(a - ab) & \text{d)} \; & (3x)^2(2x - 1)
\end{align*}
Example 3  \textit{Binomial \times Binomial}. Determine the product.

a) \((x + 1)(x + 2)\)  

b) \((2x - 3)(x + 4)\)  

c) \((3x - 2)^2\)  

d) \(2(2x + 1)(4x - 5)\)

Example 4  \textit{Binomial \times Binomial continued}. Determine the product.

a) \((5x - 8)(5x + 8)\)  

b) \((3x - 2)(1 - 2x)\)  

c) \((2x + y)(x - 3y)\)  

d) \(3x(-5 - 2x)^2\)
Example 5  
*Multiplying with Trinomials.* Determine the product.

a) $(4x - 3y)(2 + 3x - y)\quad\quad$ c) $(3x - 1)^2(2x + 1)$

b) $(2x - 3)^3\quad\quad\quad\quad$ d) $(-2x^2 - x + 1)(-3x^2 + 3x - 2)$
Example 6  Multi-term Expansions

a) $2x - 1 - (3x - 2)$  
c) $3(x - 1)^2 - 2(2x - 3)^2$

b) $(x + 1)(4x - 3) + 4(x - 2)^2$  
d) $2x(x - y) - (3x - 2y)(5x + y)$
Example 7  Determine an expression for the shaded area.

a) 

$$4x$$

$$3x - 1$$

$$2x + 4$$

$$3x$$

b) 

3 circles
Example 8

A piece of cardboard is made into an open box by cutting out squares from each corner.

The length of the piece of cardboard is 50 cm and the width is 25 cm. Each square has a side length of \( x \) cm.

a) Write expressions for the length and width of the box.

b) Write an expression for the area of the base.

c) Write an expression for the volume of the box.

d) What is the volume of the box if each removed corner square had a side length of 3 cm?
Example 9

A picture frame has a white mat surrounding the picture.

The frame has a width of 27 cm and a length of 36 cm. The mat is 2 cm wider at the top and bottom than it is on the sides.

a) Write expressions for the width and length of the picture.

b) Write an expression for the area of the picture.

c) Write an expression for the area of the mat.
Introduction

Factor each expression using algebra tiles.

a) \(3x - 6\)

b) \(x^2 + 4x\)

c) \(2x^2 - 8x\)
Polynomials
LESSON TWO - Greatest Common Factor
Lesson Notes

Example 1
Find the greatest common factor of each pair.

a) 36 and 48
b) 15 and 45
c) 16x^2 and 24x
d) 3a^2b^3 and 6a^4b^3
e) \pi r^2 and \pi rs

Example 2
Factor each binomial.

a) 3x - 12
b) -4x^2 + 24x
c) 15x^4 + 60x^2
d) -12x^3 - 27x
Example 3

Factor each polynomial.

a) \(a^2b - a^2c + a^2d\) 

b) \(6x^2y^2 + 18xy\)

c) \(-13ab^2c^3 + 39bc^2 - 26ab^4\)

d) \(-xy^3 - x^2y^2\)

Example 4

Factor each polynomial.

a) \(3x(x - 1) + 4(x - 1)\)

b) \(4x(2x + 3) - (2x + 3)\)

c) \(5ax - 15a - 3x + 9\)

d) \(4x^4 + 4x^2 - 3x^2 - 3\)
Example 5

The height of a football is given by the equation
\( h = -5t^2 + 15t \), where \( h \) is the height above the ground in metres, and \( t \) is the elapsed time in seconds.

a) Write the factored form of this equation.

b) Calculate the height of the football after 2 s.
Example 6

A pencil can be thought of as a cylinder topped by a cone.

a) Write a factored expression for the total visible surface area.

b) Calculate the visible surface area if the radius of the pencil is 0.5 cm, the cylinder height is 9 cm and the slant height of the cone is 2 cm.

From Formula Sheet:

\[ SA_{\text{Cylinder}} = 2\pi r^2 + 2\pi rh \]

\[ SA_{\text{Cone}} = \pi r^2 + \pi rs \]

Hint: The top of the cylinder (and the bottom of the cone) are internal to the pencil and do not contribute to the surface area.
Example 7

Laurel is making food baskets for a food drive. Each basket will contain boxes of spaghetti, cans of beans, and bags of rice.

Each basket must contain exactly the same quantity of items. *(example: all baskets have 2 spaghetti boxes, 3 cans of beans, and 2 bags of rice).*

If there are 45 boxes of spaghetti, 27 cans of beans, and 36 bags of rice, what is the maximum number of baskets that can be prepared? What quantity of each item goes in a basket?
Polynomials
LESSON THREE - Factoring Trinomials
Lesson Notes

**4x^2 - 3x - 1**
A×C = -4  B = -3  works?
-4 and 1  -3  √

---

**Introduction**

a) Multiply 23 and 46 using an area model.

b) Expand (x + 1)(3x - 2) using an area model.

c) Expand (x + 1)(3x - 2) using algebra tiles.

d) What generalizations can be made by comparing the area model from part b with the tile grid in part c?

e) Factor 3x^2 + x - 2 using algebra tiles.
Polynomials
LESSON THREE - Factoring Trinomials
Lesson Notes

Example 1
If possible, factor each trinomial using algebra tiles.

a) \(2x^2 + 7x + 6\)

b) \(2x^2 + 3x - 9\)

c) \(x^2 - 8x + 4\)
LESSON THREE - Factoring Trinomials

If possible, factor each trinomial using decomposition.

Note: In this example, we are factoring the trinomials from Example 1 algebraically.

Example 2

a) \(2x^2 + 7x + 6\)

\[A \times C = \square \quad B = \square \quad \text{works?}\]

b) \(2x^2 + 3x - 9\)

\[A \times C = \square \quad B = \square \quad \text{works?}\]

c) \(x^2 - 8x + 4\)

\[A \times C = \square \quad B = \square \quad \text{works?}\]
Example 3

Factor each trinomial using the indicated method.

a) \(x^2 - 8x + 12\)

\[A \times C = \square \quad B = \square \quad \text{works?} \]

\[\text{i) shortcut} \quad \text{ii) decomposition} \]

b) \(x^2 - x - 20\)

\[A \times C = \square \quad B = \square \quad \text{works?} \]

\[\text{i) shortcut} \quad \text{ii) decomposition} \]
Example 4

Factor each trinomial using the indicated method.

a) \(6a - 4a^2 - 2a^3\)

\[4x^2 - 3x - 1\]

<table>
<thead>
<tr>
<th>(A \times C = )</th>
<th>(B = )</th>
<th>works?</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4</td>
<td>-3</td>
<td>✓</td>
</tr>
</tbody>
</table>

\[Ax = \square\quad B = \square\quad \text{works?}\]

i) shortcut

ii) decomposition

b) \(x^2y^2 - 5xy + 6\)

\[Ax = \square\quad B = \square\quad \text{works?}\]

i) shortcut

ii) decomposition
Example 5  Factor each trinomial using decomposition.

a) $10a^2 - 17a + 3$

b) $24x^2 - 72x + 54$
Example 6 Factor each trinomial using decomposition.

a) $12 + 21x - 6x^2$

b) $8a^2 - 10ab - 12b^2$
Example 7

Find up to three integers that can be used to replace \( k \) so each trinomial can be factored.

a) \( 3x^2 + kx - 10 \)

b) \( x^2 + 4x + k \)

c) \( 3x^2 - 8x + k \)
**Example 8** Factor each expression to find the dimensions.

a) rectangle

\[ A = 2x^2 + 3x - 9 \]

b) rectangular prism

\[ V = 4x^3 - 40x^2 + 36x \]
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Introduction

Factor each expression using algebra tiles first, then use the shortcut.

a) $4x^2 - 9$

b) $x^2 - 6x + 9$
Example 1

Factor each expression using algebra tiles.

a) \(9x^2 - 16\)

b) \(16 - 9x^2\)

c) \(16x^2 + 24x + 9\)

d) \(1 - 16x + 64x^2\)
Example 2
Factor each expression using decomposition.
Note: In this example, we are factoring the trinomials from Example 1 algebraically.

a) \(9x^2 - 16\)

\[
\begin{array}{c|c|c|c|c|c|c|c}
A \times C & 9 & -16 & B \times \text{works?} \\
\end{array}
\]

b) \(16 - 9x^2\)

\[
\begin{array}{c|c|c|c|c|c|c|c}
A \times C & 16 & -9x^2 & B \times \text{works?} \\
\end{array}
\]

c) \(16x^2 + 24x + 9\)

\[
\begin{array}{c|c|c|c|c|c|c|c}
A \times C & 16 & 24x & +9 \times \text{works?} \\
\end{array}
\]

d) \(1 - 16x + 64x^2\)

\[
\begin{array}{c|c|c|c|c|c|c|c}
A \times C & 1 & -16x & +64x^2 \times \text{works?} \\
\end{array}
\]
Example 3  Factor each expression using a shortcut.
Note: In this example, we are factoring the trinomials from Examples 1 & 2 with a shortcut.

a) $9x^2 - 16$

c) $16x^2 + 24x + 9$

b) $16 - 9x^2$

d) $1 - 16x + 64x^2$

Example 4  If possible, factor each of the following

a) $x^2 + 9$

b) $x^2 - 8x + 4$
Example 5

If possible, factor each of the following:

a) $9x - 4x^3$

b) $4x^2 + 16$

c) $2x^4 - 32$

d) $16x^2 + 8xy + y^2$

e) $9x^4 - 24x^2 + 16$
Example 6  Find a value for $k$ that will make each expression a perfect square trinomial.

a) $9x^2 + kx + 49$

b) $25x^2 + 10x + k$

c) $kx^2y^2 - 48xy + 9$
Caitlin rides her bike to school every day. The table of values below shows her distance from home as time passes.

a) Write a sentence that describes this relation.

b) Represent this relation with ordered pairs.

c) Represent this relation with an arrow diagram.

d) Write an equation for this scenario.

e) Graph the relation.

Example 1

For each relation, complete the table of values and draw the graph.

a) \( y = -2x + 3 \)

\[
\begin{array}{c|c}
 x & y \\
-2 & \ \\
-1 & \ \\
0 & \ \\
1 & \ \\
2 & \ \\
\end{array}
\]

b) \( y = x \)

\[
\begin{array}{c|c}
 x & y \\
-2 & \\
-1 & \\
0 & \\
1 & \\
2 & \\
\end{array}
\]
Relations and Functions
LESSON ONE - Graphing Relations

Lesson Notes

**Example 2** For each relation, complete the table of values and draw the graph. State if the relation is linear or non-linear.

a) \( y = x^2 \)

\[
\begin{array}{c|c}
 x & y \\
\hline
-2 & \quad \\
-1 & \quad \\
0 & \quad \\
1 & \quad \\
2 & \quad \\
\end{array}
\]

\[
\begin{array}{c|c}
 x & y \\
-2 & 4 \\
-1 & 1 \\
0 & 0 \\
1 & 1 \\
2 & 4 \\
\end{array}
\]

b) \( y = \frac{1}{2}x + 1 \)

\[
\begin{array}{c|c}
 x & y \\
-4 & \\
-2 & \\
0 & \\
2 & \\
4 & \\
\end{array}
\]

**Example 3** For each scenario, state the dependent variable, the independent variable, and the rate. Write the equation.

a) A fruit vendor generates a revenue of \( R \) dollars by selling \( n \) boxes of plums at $3 each.

i) the dependent variable is ___________.
ii) the independent variable is ___________.
iii) the rate is ___________.
iv) the equation is ________________.

b) A runner with a speed of 9 m/s can run \( d \) metres in \( t \) seconds.

i) the dependent variable is ___________.
ii) the independent variable is ___________.
iii) the rate is ___________.
iv) the equation is ________________.

c) A diver experiences a pressure of \( P \) kilopascals at a depth of \( d \) metres. Underwater pressure increases at 10 kilopascals/metre.

i) the dependent variable is ___________.
ii) the independent variable is ___________.
iii) the rate is ___________.
iv) the equation is ________________.
Relations and Functions

LESSON ONE - Graphing Relations

Lesson Notes

Example 4
Tickets to a concert cost $12 each. The revenue from ticket sales is \( R \), and the number of tickets sold is \( n \).

a) Write an equation for this scenario.

b) Generate a table of values.

c) Draw the graph.

d) Is the relation continuous or discrete?

Example 5
A cylindrical tank is being filled with water at a rate of 3 L/min. The volume of water in the tank is \( V \), and the elapsed time is \( t \).

a) Write an equation for this scenario.

b) Generate a table of values.

c) Draw the graph.

d) Is the relation continuous or discrete?

Example 6
A relation is represented by \( 4x + 2y = 8 \).

a) Isolate \( y \) so this relation can be graphed.

b) Generate a table of values.

c) Draw the graph.

d) Is the relation continuous or discrete?
Example 7

Nick, a salesman, earns a base salary of $600/week plus an 8% commission on sales. The amount of money Nick earns in a week is $E$, and the total value of his sales is $s$.

a) Write an equation that relates the variables.

b) Complete the table of values.

<table>
<thead>
<tr>
<th>$s$</th>
<th>$E$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td></td>
</tr>
<tr>
<td>3000</td>
<td></td>
</tr>
<tr>
<td>4000</td>
<td></td>
</tr>
</tbody>
</table>

g) If Nick makes $6200 in sales one week, what will his earnings be?

h) How much will Nick have to sell if he makes $1560 in one week?

c) Draw the graph.

d) Is this relation linear or non-linear?

e) Is this relation discrete or continuous?

f) What are the dependent and independent variables?
Introduction

a) Write the domain and range of this graph in sentence form.

b) Write the domain and range of this graph as number lines.

c) Write the domain and range of this graph in set notation.

d) Write the domain and range of this graph as a discrete list.
e) Write the domain and range of this graph using interval notation.

![Graph with arrows and a grid]

**Example 1**

Write the domain of each number line.

**a)**

![Number line with points at -10, -9, -8, ..., 9, 10]

**Domain:**

**b)**

![Number line with points at -10, -9, -8, ..., 9, 10]

**Domain:**

**c)**

![Number line with points at -10, -9, -8, ..., 9, 10]

**Domain:**

**d)**

![Number line with points at -10, -9, -8, ..., 9, 10]

**Domain:**

**e)**

![Number line with points at -10, -9, -8, ..., 9, 10]

**Domain:**

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Lesson Notes

**Example 2**
domain and range of discrete graphs.

a) Domain: 

b) Domain: 

**Example 3**
domain and range of continuous graphs.

a) Domain: 

b) Domain: 

**Example 4**
domain and range of graphs with endpoints

a) Domain: 

b) Domain: 

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Example 5  domain and range of parabolas and enclosed shapes

a)  

b)  

Example 6

A Ferris wheel has a radius of 12 m and makes one complete revolution every two minutes. Riders board the wheel at a height of one metre above the ground. A ride lasts for three revolutions of the wheel. The graph of the motion is shown below. State the domain and range, in as many ways as possible.
Introduction

For each of the following functions, complete the table of values and draw the graph.

a) \( f(x) = x + 4 \)

<table>
<thead>
<tr>
<th>( x )</th>
<th>( f(x) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2</td>
<td></td>
</tr>
<tr>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

b) \( f(x) = 3x - 4 \)

<table>
<thead>
<tr>
<th>( x )</th>
<th>( f(x) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2</td>
<td></td>
</tr>
<tr>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

c) \( f(x) = x^2 - 3 \)

<table>
<thead>
<tr>
<th>( x )</th>
<th>( f(x) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2</td>
<td></td>
</tr>
<tr>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>
Example 1
For each function, calculate \( f(3) \).

a) \( f(x) = -3x - 7 \)

b) \( f(x) = \frac{5}{3}x + 2 \)

c) \( f(x) = -\frac{1}{3}x - 3 \)

d) \( f(x) = x^2 - 2 \)

e) \( f(x) = (x - 1)^2 \)

f) \( f(x) = 2x^3 - 5x^2 + x - 7 \)

Example 2
Use the graph of each function to determine the value of \( f(3) \).
Example 3

Determine which of the following graphs represents a function.

a) b) c) d)

Function: Yes No Function: Yes No Function: Yes No Function: Yes No

Example 4

a) Given \( f(x) = 5x + 2 \), the point \((k, 12)\) exists on the graph. Find \(k\).

b) Given \( f(x) = -\frac{3}{4}x + 5 \), the point \((k, -13)\) exists on the graph. Find \(k\).

c) Does the point \((-11, 81)\) exist on the graph of \(f(x) = -7x + 3\)?
A speed walker walks with a speed of 6 km/hour.

a) Use a table of values to determine the distance walked in the first five hours.

<table>
<thead>
<tr>
<th>$t$</th>
<th>$d$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

d) State the dependent and independent variables.

$dependent$: $independent$:

e) Write the domain and range.

<table>
<thead>
<tr>
<th>Domain:</th>
<th>Range:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

f) How far does the speed walker travel in 1.4 hours?

g) How long does it take for the speed walker to walk 15.6 km?
Example 6

The cost of a sandwich is $4.40 with two toppings, and $5.00 with five toppings.

a) Use a table of values to determine the cost of the sandwich for the first five toppings.

<table>
<thead>
<tr>
<th>n</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

d) State the dependent and independent variables.

*dependent:*

*independent:*

e) Write the domain and range.

f) What is the price of a sandwich with seven toppings?

<table>
<thead>
<tr>
<th>Domain:</th>
<th>Range:</th>
</tr>
</thead>
</table>

g) How many toppings are on a $5.80 sandwich?

![Graph of the cost function]

Cost Function

![Graph of the cost function]

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Introduction
Find the intercepts and draw the graph.

a) \( y = 4x - 8 \)

b) \( f(x) = \frac{2}{3}x + 2 \)

c) \( d(t) = -2t + 18 \)

Example 1
a) The function \( f(x) = 2x + k \) has a y-intercept of -5. Find the value of \( k \).

b) The function \( f(x) = 3x + k \) has an x-intercept of -2. Find the value of \( k \).
Example 2

A cylindrical tank with 45 L of water is being drained at a rate of 5 L/min.

a) Graph the volume of the tank.

\[ V(t) \]

\[ \begin{array}{c|c|c|c|c|c|c|c|c|c|c|c|c} \hline t & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 \\ \hline V(t) & 45 & 40 & 35 & 30 & 25 & 20 & 15 & 10 & 5 \\ \hline \end{array} \]

b) Write a function to represent this scenario.

c) What does each intercept represent?

d) State the domain and range.
Example 3

A mountain climber is at the peak of a mountain with an altitude of 1400 m. It takes 8 hours for the climber to return to ground level. The climber can descend the mountain at an average speed of 175 m/hour.

a) Graph the height of the mountain climber.

b) Write a function to represent this scenario.

c) What does each intercept represent?

d) State the domain and range.
This page is left blank intentionally for correct page alignment.
Introduction

In a 100 m fish race, there are three competitors.

*Teleporting Fish* - has the ability to instantly warp from location to location.
*Instant-Speed Fish* - can reach any desired speed instantly without accelerating.
*Real-World Fish* - must speed up and slow down, just like objects in reality.

a) Teleporting Fish spends the first 20 s of the race resting at the start line. He then warps to the midpoint of the track and rests for another 20 seconds. Finally, he warps to the end and waits 20 seconds while the other fish arrive. Graph this motion.

b) Instant-Speed Fish begins the race at 2.5 m/s, and sustains that speed for 20 seconds until she reaches the midpoint. After resting for 20 seconds, she resumes her speed of 2.5 m/s and heads to the finish line.

c) Real-World Fish accelerates to a speed of 2.5 m/s in 6 seconds, holds that speed for 8 seconds, and then decelerates to zero in 6 seconds - this brings him to the midpoint. After resting for 20 seconds, Real-World fish repeats the motion - accelerate for 6 seconds, hold the speed for 8 seconds, and decelerate for 6 seconds. This brings him to the finish line.
Example 1

Alex walked halfway to school, but realized he forgot his calculator. He turned around, ran back home, and searched his room for five minutes trying to find the calculator. He then ran two-thirds of the way back to school, but got tired and had to walk the remaining third. Draw a graph representing Alex's journey. Assume instant speed changes.

Drawing the graph exactly requires calculations using time = $\frac{\text{distance}}{\text{speed}}$.

Find ordered pairs that will let you draw the graph. Use the space below for your work.

i) walking to school  
ii) running back home  
iii) looking for calculator  
iv) running to school  
v) walking to school
Example 2

Each of the following graphs represents a potential path Naomi can take from home to school. Determine if each graph represents a possible or impossible motion.

a) $d(t)$
   
   ![Graph 1](image1)
   
   Possible: Yes   No

b) $d(t)$
   
   ![Graph 2](image2)
   
   Possible: Yes   No

c) $d(t)$
   
   ![Graph 3](image3)
   
   Possible: Yes   No

Example 3

Represent each of the following motions in graphical form.

a) A ball is thrown straight up and falls back down.

b) A rubber ball is dropped and bounces three times.

c) The swimming pool below is filled with water.

![Graph 4](image4)

![Graph 5](image5)

![Graph 6](image6)
Example 4

The following table shows the Canada Post 2010 price list for mailing letters within Canada.

<table>
<thead>
<tr>
<th>Letter Mass</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to (and including) 30 g</td>
<td>$0.57</td>
</tr>
<tr>
<td>up to (and including) 50 g</td>
<td>$1.00</td>
</tr>
<tr>
<td>up to (and including) 100 g</td>
<td>$1.22</td>
</tr>
<tr>
<td>up to (and including) 200 g</td>
<td>$2.00</td>
</tr>
<tr>
<td>up to (and including) 300 g</td>
<td>$2.75</td>
</tr>
<tr>
<td>up to (and including) 400 g</td>
<td>$3.00</td>
</tr>
<tr>
<td>up to (and including) 500 g</td>
<td>$3.25</td>
</tr>
</tbody>
</table>

a) Graph this data

b) State the domain and range
Introduction

Find the slope of each line.

a) using slope = $\frac{\text{rise}}{\text{run}}$ 
using slope = $\frac{y_2 - y_1}{x_2 - x_1}$

b) using slope = $\frac{\text{rise}}{\text{run}}$ 
using slope = $\frac{y_2 - y_1}{x_2 - x_1}$
c) using slope = \( \frac{\text{rise}}{\text{run}} \)  

using slope = \( \frac{y_2 - y_1}{x_2 - x_1} \)

d) using slope = \( \frac{\text{rise}}{\text{run}} \)  

using slope = \( \frac{y_2 - y_1}{x_2 - x_1} \)
Example 1

For each pair of points, graph the line and calculate the slope.

a) A line passes through (-3, 7) and (9, -1).

b) A line passes through (0, -3) and (0, 3)
c) A line passes through (-10, -10) and (10, -10).

d) A line passes through (-3, -5) and (6, 7).
Example 2 Draw each of the following lines, given the slope and a point on the line.

a) Slope = \( \frac{1}{3} \), Point = (-4, -5)

b) Slope = -2, Point = (-3, 7)

c) Slope = undefined, Point = (6, -2)

d) Slope = 0, Point = (-8, 9)
Example 3

a) A line has points located at (-3, 5) and (4, a). What is the value of a if the slope is -2?
Solve this question both graphically and algebraically.

Graphical Solution

Algebraic Solution

\[ m = \frac{y_2 - y_1}{x_2 - x_1} \]

b) A line has points located at (a, 3) and (2, 9). What is the value of a if the slope is \( \frac{3}{5} \)?
Solve this question both graphically and algebraically.

Graphical Solution

Algebraic Solution

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Example 4

The equation relating distance and time is \( d = st \), where \( s \) is the speed. In a physics experiment, a motorized toy car drives across the floor and its position is measured every five seconds.

a) Graph the data

<table>
<thead>
<tr>
<th>elapsed time (seconds)</th>
<th>position (metres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>0.9</td>
</tr>
<tr>
<td>10</td>
<td>1.8</td>
</tr>
<tr>
<td>15</td>
<td>2.7</td>
</tr>
<tr>
<td>20</td>
<td>3.6</td>
</tr>
<tr>
<td>25</td>
<td>4.5</td>
</tr>
<tr>
<td>30</td>
<td>5.4</td>
</tr>
<tr>
<td>35</td>
<td>6.3</td>
</tr>
<tr>
<td>40</td>
<td>7.2</td>
</tr>
<tr>
<td>45</td>
<td>8.1</td>
</tr>
<tr>
<td>50</td>
<td>9.0</td>
</tr>
</tbody>
</table>

b) Determine the speed of the car.

c) State the dependent and independent variables, then write an equation that relates the variables.
d) How far would the car go if it drove for 8 minutes?

e) How many hours would it take for the car to travel 1 km?
**Introduction**

a) Draw the graph of \( y = -3x + 7 \)

b) Determine the slope-intercept equation of the line shown.

c) Find the equation of the horizontal line shown.

d) Find the equation of the vertical line shown.
Lesson Notes

**Example 1**
Given the following slope-intercept equations, graph the line.

a) $y = 3x - 2$

b) $y = -\frac{4}{3}x + 1$
Example 2  Write the equation of each graph.

a)

b)

c)
Example 3  The speed of sound at 0 °C is 331 m/s. At 15 °C, the speed increases to 340 m/s.

a) Draw a graph representing this data.

b) Write an equation for the speed of sound as a function of temperature.

c) What is the speed of sound at 35 °C?

d) At what temperature is the speed of sound 364 m/s?
Example 4  

John is a salesman earning $800 per week plus a 9% commission.

a) Write an equation for John’s earnings as a function of sales. Graph the function.

\[ y = mx + b \]

b) If John sells $2500 worth of product in a week, what does he earn?

c) How much did John sell if he earned $1016 in a week?
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Introduction

The equation of a line in slope-point form is \( y - 3 = -\frac{1}{2}(x + 5) \)

Equation → Graph

a) Draw the graph of \( y - 3 = -\frac{1}{2}(x + 5) \)

Graph → Equation

b) Determine the slope-point equation of the line shown.

c) How can you tell if slope-intercept form or slope-point form should be used to find the equation of a line?
Example 1  Graph each of the following lines

a) $y + 4 = -\frac{1}{2}(x - 1)$

b) $y = \frac{4}{3}(x + 5)$
Example 2  Find the slope-point equation for each of the following lines.

a)

b)
Example 3  
Draw each line and determine its equation.

a) A line passes through the points (-3, -1) and (2, -6).

b) A line passes through the points (-4, 7) and (5, -3).

c) A line passes through the points (-9, -7) and (-9, -4).
Example 4

The following table shows population data for two small cities.

<table>
<thead>
<tr>
<th>Year</th>
<th>Population of City A</th>
<th>Population of City B</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>34000</td>
<td>29170</td>
</tr>
<tr>
<td>2020</td>
<td>38960</td>
<td>27410</td>
</tr>
</tbody>
</table>

a) Represent this data on a graph where \( t \) represents the number of years since 2010 and \( P \) is the population.
b) Determine the slope of each line. What does the slope tell you about the growth of each city?

c) For each city, write an equation for population as a function of time.

d) Predict the population of each city in 2029.
Example 5

A cylindrical tank contains an unknown amount of water. If water is added to the tank at a rate of 5 L/min for 12 minutes, the volume of the water will be 89 L.

a) Write an equation for the volume of the tank as a function of time. Draw the graph.

b) What is the volume of water in the tank after 17 minutes?

c) The maximum volume of the tank is 134 L. How long can the tank be filled before it overflows?
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Introduction
The equation of a line is $3x + y + 3 = 0$.

a) Write $3x + y + 3 = 0$ in slope-intercept form and draw the graph.

b) Find the intercepts of $3x + y + 3 = 0$ and draw the graph.

c) Determine the general form equation of the line shown.
Example 1

Write each equation in slope-intercept form and graph the line.

a) $2x - y + 3 = 0$

b) $\frac{3}{4}x - \frac{3}{2}y - 6 = 0$
Example 2  Graph each equation using x & y intercepts.

a) $7x - 8y - 56 = 0$

b) $\frac{1}{5}x - \frac{1}{2}y - 1 = 0$
Example 3  Determine the general form equation of each line shown below.

a)

b)
Example 4
Two positive real numbers, $a$ and $b$, have a sum of 5.

a) Use a table to generate data for $a$ and $b$.

<table>
<thead>
<tr>
<th>$a$</th>
<th>$b$</th>
<th>sum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b) Write an equation that relates the variables. State the dependent and independent variables.

\[ \begin{align*} \text{Equation} \\
\text{i) } b \text{ V.S. } a \\
\text{ii) } a \text{ V.S. } b \end{align*} \]

Graph the relation in two ways:

i) $b$ V.S. $a$

ii) $a$ V.S. $b$
Example 5

A small appliance store is having a sale on fans and lamps. A fan costs $10, and a lamp costs $20. At the end of the day, the revenue from these items is $120.

a) Find the intercepts of this relation.

<table>
<thead>
<tr>
<th>fans ($10)</th>
<th>lamps ($20)</th>
<th>revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b) Write an equation that relates the variables. State the dependent and independent variables.

c) Graph the relation in two ways:

i) lamps V.S. fans

ii) fans V.S. lamps

Equation

Equation
Example 6
A stack of bills contains only $5 and $20 denominations. The total value is $140.

a) Find the intercepts of this relation.

<table>
<thead>
<tr>
<th>fives ($5)</th>
<th>twenties ($20)</th>
<th>total amount</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b) Write an equation that relates the variables. State the dependent and independent variables.

c) Graph the relation in two ways:

i) twenties V.S. fives
Equation

ii) fives V.S. twenties
Equation
d) Using the equation, determine if it’s possible to have twelve $5 bills and four $20 bills.

e) Using the equation, determine if it’s possible to have eighteen $5 bills and six $20 bills.

f) Use the equation to find the number of $5 bills if there are five $20 bills.
Example 7

A truck is transporting beets and potatoes. The density of beets is 720 kg/m³, and the density of potatoes is 760 kg/m³. The total mass of the beets and potatoes is 12000 kg.

The density formula is \( d = \frac{m}{V} \), where \( d \) is the density, \( m \) is the mass, and \( V \) is the volume.

a) If the volume of the beets is \( b \), and the volume of the potatoes is \( p \), write an equation that relates the variables.

b) Find the intercepts of this relation.

<table>
<thead>
<tr>
<th>volume of beets</th>
<th>volume of potatoes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
c) Graph the relation in two ways:

i) volume of potatoes V.S. volume of beets

ii) volume of beets V.S. volume of potatoes.

---

d) If the volume of the potatoes is 7.3 m³, what is the volume of the beets?
Example 8

There are 400 Calories in one bowl of dry cereal.

a) Write an equation that relates the amount of Calories to the number of bowls. State the dependent and independent variables.

b) Why is this relation a function? Write the relation using function notation.

c) Graph the relation. Why can it only be graphed as $C$ vs $b$?
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Introduction

Graph each pair of lines and calculate the slope of each line. State if the pair of lines is parallel, perpendicular, or neither.

a) Points on Line 1: (-9, -9) & (-4, -1)
   Points on Line 2: (1, 1) & (6, 9)

b) Points on Line 1: (-5, 6) & (1, -1)
   Points on Line 2: (-4, 0) & (3, 6)

c) Points on Line 1: (-5, -5) & (4, 10)
   Points on Line 2: (4, -5) & (8, 0)
## Example 1

For each pair of slopes, find the value of $a$.

i) if the slopes are parallel to each other  
ii) if the slopes are perpendicular to each other

<table>
<thead>
<tr>
<th>Pair</th>
<th>Parallel</th>
<th>Perpendicular</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) $\frac{5}{4}, \frac{a}{8}$</td>
<td>parallel</td>
<td>perpendicular</td>
</tr>
<tr>
<td>b) $\frac{-2}{a}, 3$</td>
<td>parallel</td>
<td>perpendicular</td>
</tr>
<tr>
<td>c) undefined, $a$</td>
<td>parallel</td>
<td>perpendicular</td>
</tr>
</tbody>
</table>
Example 2

a) A line with points at (-9, 5) and (-4, 8) is parallel to a line with points at (-4, -5) and (a, 1). Determine the value of a using a graphical approach first, then use an algebraic approach.

b) A line with points at (-7, 3) and (1, -3) is perpendicular to a line with points at (-1, -3) and (a, 5). Determine the value of a using a graphical approach first, then use an algebraic approach.
Example 3

a) Given the equation $6x - 2y + 10 = 0$, find the slope-intercept equation of a parallel line passing through $(-2, -7)$. Graph the original line and the parallel line on the same coordinate grid.
b) Given the equation $x + 6y - 18 = 0$, find the slope-intercept equation of a perpendicular line passing through $(4, -1)$. Graph the original line and the perpendicular line on the same coordinate grid.
Example 4

a) Given the equation $x - 2 = 0$, find the equation of a parallel line passing through the point (-8, -5). Graph the original line and the parallel line on the same coordinate grid.

b) Given the equation $y + 4 = 0$, find the equation of a perpendicular line passing through the point (-8, 9). Graph the original line and the perpendicular line on the same coordinate grid.
Example 5

Two perpendicular lines intersect on the x-axis. The equation of one of the lines is \(x - 2y - 2 = 0\). Find the equation of the other line. Graph the original line and the perpendicular line on the same coordinate grid.
Example 6

Given the equation $2x - y + 5 = 0$, find the slope-intercept equation of a perpendicular line with the same x-intercept as $3x - 4y - 24 = 0$. Graph the original line and the perpendicular line on the same coordinate grid.
Example 7

The line $4x - 5y + 27 = 0$ comes into contact with a circle at the point $(-3, 3)$. The centre of the circle is at the point $(a, -2)$. Find the value of $a$. 

$4x - 5y + 27 = 0$

$(-3, 3)$

$(a, -2)$
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Introduction

An online music store offers two payment methods.

1) The customer pays a monthly subscription fee of $8 and songs can be downloaded for $0.70 each.
2) The customer pays-as-they-go, at the full rate of $0.90/song.

How many songs would have to be downloaded for the subscription plan to be a better deal?
Example 1  Solve graphically.

a) $y = -\frac{3}{4}x + 1$ and $y = \frac{7}{4}x - 9$

b) $4x - 7y + 35 = 0$ and $5x + 7y + 28 = 0$
Example 2  
Determine if each system of equations has one solution, infinite solutions, or no solution.

a) \[ y = \frac{1}{2} x + 1 \] and \[ y = \frac{1}{6} x + 3 \]

b) \[ y = -2x + 3 \] and \[ 6x + 3y = 9 \]

c) \[ y = -\frac{1}{3} x + 6 \] and \[ 2x + 6y = 24 \]
Example 3

Determine the number of solutions for each system by inspecting the coefficients.

a) \( x + 2y = 8 \) and \( x + 2y = 8 \)

b) \( 3x + 9y = -9 \) and \( x + 3y = -3 \)

c) \( x + 2y = 4 \) and \( x + 2y = 10 \)

d) \( 4x + 12y = 12 \) and \( x + 3y = 9 \)
Example 4

Four students, Anne, Bethany, Clyde, and Daniel, are raising money in a school fundraiser. Their current total and donation rate are shown in the following table:

<table>
<thead>
<tr>
<th></th>
<th>Current Total</th>
<th>Donation Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anne</td>
<td>$240</td>
<td>$20/week</td>
</tr>
<tr>
<td>Bethany</td>
<td>$120</td>
<td>$30/week</td>
</tr>
<tr>
<td>Clyde</td>
<td>$60</td>
<td>$30/week</td>
</tr>
<tr>
<td>Daniel</td>
<td>$0</td>
<td>$60/week</td>
</tr>
</tbody>
</table>

a) write equations for each student and graph each line on the same grid.

b) How many weeks will it take for Daniel to catch up to Bethany?

c) Will Daniel ever raise more money than Anne?
Example 5

The highway distance from Edmonton to Edson is 200 km. Heidi leaves Edmonton at noon (on her bike) and averages 25 km/h. Cameron leaves Edson (by car) at exactly the same time, and drives at 100 km/h.

Equation one:  \[ y = x + 1 \]
Equation two:  \[ y = -x + 4 \]

a) how long will it take for Heidi and Cameron to pass on the highway?

b) how far away from Edmonton are Heidi and Cameron when they pass?

Complete the algebraic solution here
Example 6

A rectangular lot is separated by a fence. The large region has an area 20 m² greater than the small region. The total area of the lot is 145 m². Determine the area of each region.

Equation one:  

Equation two:  

Complete the algebraic solution here
Example 7

Peter and Nancy are writing a math workbook. Peter has already written 28 questions and can write 4 questions/hour. Nancy has already written 20 questions and can write 5 questions/hour.

\[
\begin{align*}
\text{Equation one:} & & \text{Equation two:} \\
& & \\
\end{align*}
\]

\[y = x + 1\]
\[y = -x + 4\]

a) when will both writers have written the same number of questions?

b) how many questions will have been written in total?

Complete the algebraic solution here
Example 8

In an apartment building, one elevator rises from the 14th floor to the 24th floor in 20 seconds. During that same time, another elevator descends from the 32nd floor to the 12th floor.

a) Graph the motion of each elevator and provide equations.

b) How many seconds will it take for the elevators to pass each other?

c) On what floor will the elevators pass?

Complete the algebraic solution here
This page is left blank intentionally for correct page alignment.
Introduction

A 60 m cable is cut into two pieces. One piece is twice as long as the other piece. Determine the length of each piece of cable.

| long piece | short piece |

Equation one: \[ x = 2y - 2 \]
Equation two: \[ 3x - y = 4 \]

a) Solve the system graphically.

b) Solve the system using substitution
Example 1  Solve the system $x + 3y = 9$ and $4x - y = 10$

a) graphically

b) using substitution

Example 2  Solve each of the following systems using substitution.

a) $x - 2y = -2$ and $3x - y = 4$
**Systems of Equations**

**LESSON TWO - Substitution Method**

**Lesson Notes**

\[
\begin{align*}
&x = 2y - 2 \\
&3x - y = 4
\end{align*}
\]

B) \( x + 6y = -29 \) and \( x + \frac{1}{4}y = -6 \)

C) \( x + 3y = 3 \) and \( 3x + 9y = 9 \)

D) \( 2x - y = -13 \) and \( 2x - y = -1 \)

**Independent Systems**

Systems that yield a definite result, such as \( x = -5 \) and \( y = -4 \), are called **independent systems**.

The equations of an independent system yield intersecting lines and have one solution.

**Indeterminate Systems**

Systems that yield an equality, such as \( 0 = 0 \) or \( 2 = 2 \), are called **indeterminate systems**.

The equations of an indeterminate system yield identical lines and have infinite solutions.

**Inconsistent Systems**

Systems that yield a false result, such as \( 0 = 12 \), are called **inconsistent systems**.

The equations of an inconsistent system yield parallel lines and have no solution.
Example 3

Katrina has $2.50 worth of nickels and dimes. She has 36 coins in total. How many nickels and dimes does she have?

<table>
<thead>
<tr>
<th></th>
<th>nickels</th>
<th>dimes</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>number of coins</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>monetary value</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Equation one:  
Equation two:
Example 4

Kory drives from Edmonton to Lloydminster and back. Going to Lloydminster, he drives with an average speed of 96 km/h. For the return trip, he averages a speed of 100 km/h. The total time driving is 5.1 hours. Using this information, calculate the distance from Edmonton to Lloydminster.

<table>
<thead>
<tr>
<th></th>
<th>distance</th>
<th>speed</th>
<th>time</th>
</tr>
</thead>
<tbody>
<tr>
<td>going</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>returning</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Equation one:  

Equation two:
Example 5

Nathan scored 76% on the multiple choice portion of his physics test and 62% on the written portion. For the entire test, Nathan scored 50 points out of a possible 75. How many marks was each portion of the test worth?

<table>
<thead>
<tr>
<th></th>
<th>multiple choice</th>
<th>written</th>
<th>whole test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Possible Points</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nathan’s Points</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Equation one:  

Equation two:
Example 6

James invests a total of $5000 in two different investments. The first investment earns 2.9% interest, and the second investment earns 4.5% interest. The total interest earned is $196.20. How much did James invest in each investment?

<table>
<thead>
<tr>
<th>money invested</th>
<th>lower yield inv.</th>
<th>higher yield inv.</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>interest earned</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Equation one:  
Equation two:
Example 7

One bin of dried fruit mix contains 28% apricots. A different bin of dried fruit mix contains 18% apricots. A new mix is made using one scoop from each bin. This mix has a mass of 600 g, and contains 25% apricots. What was the mass of dried fruit in each scoop?

<table>
<thead>
<tr>
<th>bin 1</th>
<th>bin 2</th>
<th>new mix</th>
</tr>
</thead>
<tbody>
<tr>
<td>mass of dried fruit in scoop</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mass of apricots</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Equation one:

Equation two:
Example 8

The system of equations \( x + 2y = 0 \) and \( x + 5y = b \) has the solution \((-2, a)\).
Determine the values of \( a \) and \( b \).
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Introduction
Rahim goes to a grocery store and spends $22.00 to purchase 3 cartons of strawberries and 2 cartons of raspberries. Paul goes to the same grocery store and spends $41.00 to purchase 4 cartons of strawberries and 5 cartons of raspberries.

What is the price of one carton of strawberries and one carton of raspberries?

<table>
<thead>
<tr>
<th></th>
<th>money spent on strawberries</th>
<th>money spent on raspberries</th>
<th>total spent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rahim</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paul</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Example 1  Solve the system $2x - y = 8$ and $5x - 3y = 21$

a) graphically

b) using elimination

\[
\begin{align*}
2x - y &= -6 \\
-(2x + 4y) &= -16 \\
\hline
-5y &= 10
\end{align*}
\]
Systems of Equations
LESSON THREE - Elimination Method
Lesson Notes

Example 2 Solve each of the following systems using elimination.

a) \[ x - \frac{1}{2} y = -3 \] and \[ \frac{1}{2} x + y = -4 \]

Independent Systems
Systems that yield a definite result, such as \( x = -5 \) and \( y = -4 \), are called independent systems.

The equations of an independent system yield intersecting lines and have one solution.

Memorize this!

b) \( 6x + 4y = 14 \) and \( x + \frac{2}{3} y = \frac{7}{3} \)

Indeterminate Systems
Systems that yield an equality, such as \( 0 = 0 \) or \( 2 = 2 \), are called indeterminate systems.

The equations of an indeterminate system yield identical lines and have infinite solutions.

Memorize this!

c) \[ x - \frac{1}{2} y = 4 \] and \( 2x - y = 5 \)

Inconsistent Systems
Systems that yield a false result, such as \( 0 = 12 \), are called inconsistent systems.

The equations of an inconsistent system yield parallel lines and have no solution.

Memorize this!
Example 3

A coin collection has 33 quarters and nickels. The number of nickels is 5 greater than three times the number of quarters. How many coins of each type are there?

Equation one: 

Equation two:

a) solve using substitution

b) solve using elimination
Example 4

A parking lot contains motorcycles (2 wheels) and cars (4 wheels). There are 35 vehicles and 114 wheels. How many motorcycles and cars are there?

<table>
<thead>
<tr>
<th>motorcycles</th>
<th>cars</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Equation one:

Equation two:
Example 5

It takes 3 hours for a canoe to travel 45 km downstream. The return trip, going upstream, takes 5 hours. What is the speed of the boat and the speed of the current?

<table>
<thead>
<tr>
<th>distance</th>
<th>speed</th>
<th>time</th>
</tr>
</thead>
<tbody>
<tr>
<td>going (downstream)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>returning (upstream)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Equation one:

Equation two:
Example 6

Tickets to a museum cost $7 for a child and $12 for an adult. On a particular day, 233 people attended the museum and there was a total revenue of $2216. How many tickets of each type were sold?

<table>
<thead>
<tr>
<th>child</th>
<th>adult</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Equation one: 

\[2x - y = -6\]

\[-(2x + 4y = -16)\]

\[-5y = 10\]

Equation two:
Example 7

Corrine's mom is 25 years older than Corrine. In two years, Corrine's mom will be twice Corrine's age. How old are Corrine and Corrine's mom?
Example 8

Ryan and Greg split the driving on a 1335 km trip from Calgary to Winnipeg. Ryan drove to Regina with an average speed of 90 km/h. Greg drove the rest of the way to Winnipeg with an average speed of 100 km/h. The total trip took 14.2 hours.

What is the distance between Calgary and Regina? Regina and Winnipeg?

<table>
<thead>
<tr>
<th></th>
<th>distance</th>
<th>speed</th>
<th>time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ryan (Calgary to Regina)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greg (Regina to Winnipeg)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Equation one:  
Equation two:
This page is left blank intentionally for correct page alignment.
Measurement Lesson One: Metric and Imperial

Introduction

<table>
<thead>
<tr>
<th>Unit</th>
<th>Length</th>
<th>Referent</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm</td>
<td>1/1000 m</td>
<td>thickness of a dime</td>
</tr>
<tr>
<td>cm</td>
<td>1/100 m</td>
<td>width of a paperclip</td>
</tr>
<tr>
<td>dm</td>
<td>1/10 m</td>
<td>length of a crayon</td>
</tr>
<tr>
<td>m</td>
<td>1 m</td>
<td>floor to doorknob</td>
</tr>
<tr>
<td>dam</td>
<td>10 m</td>
<td>width of a house</td>
</tr>
<tr>
<td>hm</td>
<td>100 m</td>
<td>football field</td>
</tr>
<tr>
<td>km</td>
<td>1000 m</td>
<td>walking 15 minutes</td>
</tr>
</tbody>
</table>

b) i. 30 cm ruler, ii. Trundle Wheel, iii. Tape Measure iv. Vernier Calipers, v. Trundle Wheel, vi. Vernier Calipers, vii. Tape Measure

c) | Unit | Imp. to Imp. | Imp. to Metric | Referent |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>inch</td>
<td>1 in. = 2.54 cm</td>
<td></td>
<td>middle thumb joint to tip of thumb.</td>
</tr>
<tr>
<td>foot</td>
<td>1 ft. = 12&quot;</td>
<td>1 ft. = 30.48 cm</td>
<td>about the same as a 30 cm ruler.</td>
</tr>
<tr>
<td>yard</td>
<td>1 yd. = 3 ft.</td>
<td>1 yd. = 0.9144 m</td>
<td>a little bit shorter than a 1 m ruler.</td>
</tr>
<tr>
<td>mile</td>
<td>1 mi. = 1760 yd.</td>
<td>1 mi. = 1.609 km</td>
<td>distance walked in 20 minutes.</td>
</tr>
</tbody>
</table>

Example 1: a) 12.57 cm b) 19 cm c) 787 km
Example 2: a) 3.56 cm b) 0.70 cm c) 4.98 cm d) 1.52 cm
Example 3: a) 0.007 km b) 0.12 m c) 0.000453 km d) 3000 m e) 800 cm f) 70 000 cm
Example 4: a) 2 1/2 in. b) 3/4 in. c) 2 3/8 in. d) 3 15/16 in. e) 1 9/16 in.
Example 5: a) 141.37 cm, b) 495.15 rotations
Example 6: a) 2 1/2" b) 3/4 in. c) 2 3/8" d) 3 15/16 in. e) 1 9/16 in.
Example 7: a) 0.23 m b) 5000 mm c) 0.00398 mi. d) 372 in.
Example 8: a) 15 ft. b) 17 600 yd. c) 240 in. d) 67 in. e) 10 560 ft.
Example 9: a) 26 yd. b) 0.0625 mi. c) 4 ft. d) 4.83' e) 30 yd. f) 2.27 mi.
Example 10: a) 5.49 m b) 4.83 km c) 149 km d) 495.15 rotations
Example 11: a) 15.31 yd. b) 4.35 mi. c) 472.44 in. d) 2188 yd. e) 2.36 ft. f) 0.25 mi.
Example 12: a) 17 m, b) 11" c) 120 cm d) 13 yd.
Example 13: a) Don 1.37 m, Elisha 1.6 m, Brittney 1.63 m, Calvin 1.65 m, Andrew 1.76 m b) No. The maximum height is 2.59 m.
Example 14: a) 195 pieces of sod are required to cover the lawn b) The cost of the linoleum is $2329.21.

Measurement Lesson Two: Surface Area and Volume

Introduction:

Example 1: a) i. r = 19 cm, ii. r = 19 cm b) i. s = 11 m, ii. h = 9 m
Example 2: a) SA = 99 ft² b) h = 15 m
Example 3: SA = 479 cm², V = 905 cm³
Example 4: SA = 1949 cm², V = 2933 cm³
Example 5: SA = 6542 mm², V = 20 858 mm³
Example 6: SA = 2065 cm², V = 6000 cm³
Example 7: SA = 3047 m², V = 9019 m³

Measurement Lesson Three: Trigonometry I

Introduction:

Example 1: a) sin θ = 0.8 cos θ = 0.6 tan θ = 1.3 b) sin θ = 0.7241 cos θ = 0.6897 tan θ = 1.05 c) sin θ = 0.9692 cos θ = 0.2462 tan θ = 3.9375 d) sin θ = 0.9231 cos θ = 0.3846 tan θ = 2.4
Example 2: a) θ = 40° b) θ = 73° c) θ = 16.26° d) θ = 47° e) SOH CAH TOA
Example 3: a) x = 53 cm, y = 46 cm, m = 49° b) y = 3 cm, h = 24 cm, m = 82° c) h = 24 cm, m = 44°, n = 46° d) x = 18 cm, m = 39.5°, n = 50.5° e) Each ratio is 0.75 f) Each ratio is 0.75
Example 4: a) 83 m b) 30° c) 5196 m

Measurement Lesson Four: Trigonometry II

Introduction:

Example 1: a) 17.9 cm b) 14.5 cm c) 2.5 cm d) 1.9 m
Example 2: a) 3.5 cm b) 6.6 cm c) 18.5 cm d) 59 cm
Example 3: a) 45° b) 1.2° c) 22.7°
Example 4: a) 158.4 m b) clinometer for angles, trundle wheel for distance c) direct measurements are obtained using an instrument, while indirect measurements are found with math. The angles of elevation and depression, and the distance between the buildings are direct measurements. The height of the building is an indirect measurement.
Numbers, Radicals, and Exponents Lesson One: Number Sets

Introduction: a) The set of natural numbers (N) can be thought of as the counting numbers.

b) The whole numbers (W) include all of the natural numbers plus one additional number - zero.

c) The set of integers (I) includes negative numbers, zero, and positive numbers.

d) The set of rational numbers (Q) includes all integers, plus terminating and repeating decimals.

e) Irrational numbers (Q) are non-terminating and non-repeating decimals.

f) Real numbers (R) includes all natural numbers, whole numbers, integers, rationals, and irrationals.

Example 1: a) I, Q, R  b) W, I, Q, R  c) Q, R  d) N W I Q R  e) Q R  f) Q R

Example 2: a) true b) false c) true d) false e) false

Example 3: Rational: $\frac{1}{4}$ $\sqrt{2} \overline{0.3125}$ 27 $\sqrt[3]{8} \overline{0.13}$ Irrational: $-\sqrt{2} -\sqrt{6} -\sqrt{7} \overline{4} \overline{5}$ 2$\sqrt{2}$ $\sqrt{8}$ Neither: $\frac{3}{0} \sqrt{-2} (-2)^{1/2}$

Numbers, Radicals, and Exponents Lesson Two: Primes, LCM, and GCF

Introduction: a) A prime number is a natural number that has exactly two distinct natural number factors: 1 and itself.

b) A composite number is a natural number that has a positive factor other than one or itself.

c) 0 is not a prime number because it has infinite factors. 1 is not a prime number because it has only one factor - itself.

d) Prime Factorization is the process of breaking a composite number into its primes. 12 = 2 x 2 x 3

e) The LCM is the smallest number that is a multiple of two given numbers. LCM of 9 & 12 is 36.

f) The GCF is the largest natural number that will divide two given numbers without a remainder. GCF of 16 & 24 is 8.

Example 1: a) neither b) composite c) prime d) neither • Example 2: a) 24 b) 14 c) 720 d) 504 • Example 3: a) 6 b) 13 c) 26 d) 27

Example 4: a) 60 cm b) 12 minutes c) 252 cm

Example 5: a) 5 baskets, with 3 oranges and 2 apples in each. b) 4 groups, with 5 loonies and 2 toonies in each. c) cube edge = 13 mm

Numbers, Radicals, and Exponents Lesson Three: Squares, Cubes, and Roots

Introduction:

a) A perfect square is a number that can be expressed as the product of two equal factors. First three perfect squares: 1, 4, 9

b) A perfect cube is a number that can be expressed as the product of three equal factors. First three perfect cubes: 1, 8, 27

c) A cube root is one of three equal factors of a number. The cube root of 125 is 5.

d) A square root is one of two equal factors of a number. The square root of 36 is 6.

e) An entire radical does not have a coefficient, but a mixed radical does.

d) Yes. Radicals can be represented with fractional exponents.

Example 1: a) 9  b) 9  c) -9  d) 27  e) -27  f) -27 • Example 2: a) 16 b) -32 c) -24 d) 1/64 e) 1/12 f) 10

Example 3: a) 2.8284... b) error c) 2 d) -2 e) error, -1.5157... • Example 4: a) 20 b) 1/3 c) -1/4 d) 7/10

The odd root of a negative number can be calculated, but the even root of a negative number is not calculable.

Example 5: a) 26.2 km b) 29.5 km

Example 6: a) 3054 cm b) 10.61 cm

Example 7: a) 2.7 s b) 1.4 m • Example 8: a) 20.28 m b) 160 962 000 kg c) 8.7 trillion dollars

Numbers, Radicals, and Exponents Lesson Four: Radicals

Introduction:

a) The radical symbol has two parts: the index and the radicand. For example, in $\sqrt[3]{8}$, the index is 3 and the radicand is 8.

b) the index is 2

c) an entire radical does not have a coefficient, but a mixed radical does.

d) Yes. Radicals can be represented with fractional exponents.

Example 1: a) $2\sqrt{5}$ b) $4\sqrt{2}$ c) $2\sqrt[3]{3}$

Example 2: a) $2\sqrt{6}$ b) $6\sqrt{2}$ c) 7 d) $3\sqrt{3}$ e) 4 f) $2\sqrt[3]{3}$

Example 3: a) $\sqrt{27}$ b) $\sqrt{75}$ c) $\sqrt{81}$ d) $\sqrt[4]{48}$

Example 4: a) $\sqrt[3]{8}$ b) $\sqrt[3]{14} \overline{0.70} \overline{42}$ b) $\sqrt[3]{35} \overline{44} \overline{92} \overline{169}$

Example 6: a) $\sqrt[3]{3}$ b) $\sqrt[3]{1/4}$ c) $\sqrt[3]{7/9}$ d) $\sqrt[3]{3/5}$ e) $\sqrt[3]{4}$

Example 7: a) $\sqrt[3]{3}$ b) $\sqrt[3]{4}$ c) $\sqrt[3]{27}$ or $(\sqrt[3]{2})^4$

d) $\sqrt[4]{(-7)^2}$ or $(\sqrt[4]{(-7)})^2$ e) $\overline{3} \overline{0} \overline{3}$ f) $\sqrt[4]{6}$

Example 8: a) $5^{1/2}$ b) $9^{1/2}$ c) $2^{1/2}$ d) $(-3)^{1/2}$ e) $\left(\frac{5}{7}\right)^{1/3}$ f) $\frac{3}{4}$

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Numbers, Radicals, and Exponents Lesson Five: Exponents I

Introduction:

a) \(2^7\), \(\left(\frac{3}{4}\right)^2\), \(a^m \times a^n = a^{m+n}\)

b) \((-6)^3\), \(7^2\), \(a^m \div a^n = a^{m-n}\)

c) \(2^{15}\), \((-3)^9\), \((a^n)^9 = a^{9n}\)

d) \(a^4b^3\), \(256a^3b^3\), \((a^n b^m)^p = a^{np} b^{mp}\)

e) \(\frac{a^8}{b^5}\), \(\frac{8a^{16}}{27b^{12}}\), \((\frac{a^p}{b^q})^p = a^{mp} b^{-mq}\)

f) 1, \(\frac{1}{a^0} = 1\)

Example 1:

a) \(b\)   b) \(c\)   c) \(d\)   d) \(e\)   e) \(f\)

Example 2:

a) \(\frac{8}{25}\)  b) \(\frac{1}{8a^4}\)  c) \(32a^2\)  d) \(\frac{1}{a^2}\)  e) \(\frac{a^2b^2}{5^2}a^2\)

Example 3:

a) \(\frac{2a}{bc^2}\)  b) \(\frac{1}{a^2b}\)  c) \(\frac{125a^3b^2}{8}\)  d) \(\frac{4b^4}{a^2}\)

Example 4:

a) \((\sqrt[3]{a})^9\)  b) \(9\sqrt[3]{a}\)  c) \(\frac{64a^9}{27b^9}\)  d) \(\frac{1}{(\sqrt[3]{2})^3}\)

Example 5:

a) \(-\frac{5}{3}\)  b) \(\frac{1}{6}\)  c) \(\frac{1}{6}\)  d) \(3\)

Example 6:

a) \(-\frac{3}{2}\)  b) \(\frac{1}{a^2}\)  c) \(\frac{1}{a^2}\)  d) \(2ab^2\)

Example 7:

a) 10 000 bacteria  b) 20 000 bacteria  c) 2500 bacteria  d) \(69\) g  e) \(44\) g  f) \(30\)%

Numbers, Radicals, and Exponents Lesson Six: Exponents II

Introduction:

a) \(\frac{1}{3^2}\), \(\frac{1}{(-12)^4}\), \(7^2\), \((\frac{2}{3})^5\), \(a^{-m} = \frac{1}{a^m}\)

b) \(\sqrt[3]{6}\), \(\frac{1}{2}\), \(\frac{3}{2}\) or \((\frac{3}{2})^4\), \(\frac{5}{3}\), \(a^m = \sqrt[a]{a^m}\) or \((\sqrt[a]{a})^m\)

Example 1:

a) \(\frac{1}{16}\)  b) \(\frac{8}{27}\)  c) \(\frac{c^3}{a^2b}\)  d) \(\frac{1}{9a^6}\)  e) \(225\)  f) \(10\)

Example 2:

a) \(\frac{8}{25}\)  b) \(\frac{1}{8a^4}\)  c) \(32a^8\)  d) \(\frac{1}{a^2}\)  e) \(\frac{a^2b^2}{5^2}a^2\)

Example 3:

a) \(\frac{2a}{bc^2}\)  b) \(\frac{1}{a^2b}\)  c) \(\frac{125a^3b^2}{8}\)  d) \(\frac{4b^4}{a^2}\)

Example 4:

a) \((\sqrt[3]{a})^9\)  b) \(9\sqrt[3]{a}\)  c) \(\frac{64a^9}{27b^9}\)  d) \(\frac{1}{(\sqrt[3]{2})^3}\)

Example 5:

a) \(-\frac{5}{3}\)  b) \(\frac{1}{6}\)  c) \(\frac{1}{6}\)  d) \(3\)

Example 6:

a) \(-\frac{3}{2}\)  b) \(\frac{1}{a^2}\)  c) \(\frac{1}{a^2}\)  d) \(2ab^2\)

Example 7:

a) 10 000 bacteria  b) 20 000 bacteria  c) 2500 bacteria

Polynomials Lesson One: Expanding Polynomials

Introduction:

a) \(12x^2\)  b) \(2x^2 - 2x\)  c) \(3x^2 - 5x - 2\)

Example 1:

a) \(6x^2\)  b) \(35x^2\)  c) \(18a^2b\)  d) \(16x^2\)  e) \(30x^2\)

Example 2:

a) \(-6x^2 + 2x\)  b) \(-8a^2 + 8a^2b\)  c) \(x^4 - 4x^2\)  d) \(18x^3 - 9x^2\)

Example 3:

a) \(x^2 + 3x + 2\)  b) \(2x^2 + 5x - 12\)

Example 4:

a) \(25x^2 - 64\)  b) \(-6x^2 + 7x - 2\)

Example 5:

a) \(12x^2 - 13xy + 3y^2 + 8x - 6y\)  b) \(8x^3 - 36x^2 + 54x - 27\)

Example 6:

a) \(-x + 1\)  b) \(8x^2 - 15x + 13\)  c) \(-5x^2 + 18x - 15\)  d) \(-13x^2 + 5xy + 2y^2\)

Example 7:

a) \(6x^2 - 10x + 4\)  b) \(12x^2 - 3\pi x^2\)

Example 8:

a) \(l = 50 - 2x, w = 25 - 2x\)  b) \(A = 4x^2 - 150x + 1250\)  c) \(V = 4x^3 - 150x^2 + 1250x\)

Example 9:

a) \(l = 32 - 2x, w = 27 - 2x\)  b) \(A = 4x^2 - 118x + 864\)  c) \(A = 4x^2 + 118x + 108\)

Polynomials Lesson Two: Greatest Common Factor

Introduction:

a) \(3(x - 2)\)  b) \(x(x + 4)\)  c) \(2x(x - 4)\)

Example 1:

a) \(12\)  b) \(15\)  c) \(8x\)  d) \(3a^2b^3\)  e) \(\pi r\)

Example 2:

a) \(3(x - 4)\)  b) \(-4x(x - 6)\)  c) \(15x^2(x^2 + 4)\)  d) \(-3x(4x^2 + 9)\)

Example 3:

a) \(a^2(b - c + d)\)  b) \(6xy(xy + 3)\)  c) \(-13b(ac^2 - 3c^2 + 2ab^3)\)  d) \(-xy^2(7 + x)\)

Example 4:

a) \((x - 1)(3x + 4)\)  b) \((2x + 3)(4x - 1)\)

Example 5:

a) \(h = -5(t - 3)\)  b) \(h = 10\ m\)

Example 6:

a) \(SA = \pi r(r + 2h + s)\)  b) \(32.2\ cm^2\)

Example 7:

a) Nine baskets can be made.

Each basket will have 5 boxes of spaghetti, 3 cans of beans, and 4 bags of rice.
Polynomials Lesson Three: Factoring Trinomials

Introduction:

a) 1058  
b) $3x^2 + x - 2$  
c) $3x^2 + x - 2$  
d) Each quadrant is either positive or negative. As such, it may contain only one tile color.

d) 40 6  
e) $(x + 1)(3x - 2)$

Example 1:

a) $(2x + 3)(x + 2)$  
b) $(2x - 3)(x + 3)$  
c) We can't place all of the tiles, so this expression is not factorable.

d) 40 6  
e) $(x + 1)(3x - 2)$

Example 2: a) $(x + 2)(2x + 3)$ b) $(x + 3)(2x - 3)$

Example 4: a) not factorable b) not factorable

Example 5: a) $(2a - 3)(5a - 1)$ b) $6(2x - 3)^2$

Example 6: a) $-3(x - 4)(2x + 1)$ b) $2(a - 2b)(4a + 3b)$

Example 7 (answers may vary): a) -29, 29, -13 b) 3, 4, -5 c) -11, 5, 4

Example 8: a) $(x + 3)(2x - 3)$ b) $4x(x - 9)(x - 1)$

Polynomials Lesson Four: Special Polynomials

Introduction:

a) $(2x + 3)(2x - 3)$  
b) $(x - 3)^2$  
c) $(4 - 3x)(4 + 3x)$  
d) $(4x + 3)^2$  
e) $(1 - 8x)^2$

Example 2: a) $(3x - 4)(3x + 4)$ b) $(4 - 3x)(4 + 3x)$ c) $(4x + 3)^2$ d) $(1 - 8x)^2$

Example 3: a) $(3x - 4)(3x + 4)$ b) $(4 - 3x)(4 + 3x)$ c) $(4x + 3)^2$ d) $(1 - 8x)^2$

Example 4: a) not factorable b) not factorable

Example 5: a) $-2a(a + 3)(a - 1)$ b) $(xy - 3)(xy - 2)$

Example 6: a) $-3(x - 4)(2x + 1)$ b) $2(a - 2b)(4a + 3b)$

Example 7: a) $-29, 29, -13$ b) $3, 4, -5$ c) $-11, 5, 4$

Example 8: a) $(x + 3)(2x - 3)$ b) $4x(x - 9)(x - 1)$

Relations and Functions Lesson One: Graphing Relations

Introduction:

a) Caitlin bikes 250 metres for every minute she travels.  
b) $\{(0, 0), (1, 250), (2, 500), (3, 750), (4, 1000), (5, 1250)\}$

c)  

d) $d = 250t$

e) $d = 250t$

Example 1: x y

Example 2: x y

Example 3: a) dependent variable: $R$, independent variable: $n$, rate: $3$/box, equation: $R = 3n$

b) dependent variable: $d$, independent variable: $t$, rate: $9$ m/s, equation: $d = 9t$

c) dependent variable: $P$, independent variable: $d$, rate: $10$ kPa/m, equation: $P = 10d$

Example 7: a) $E = 0.08s + 600$ b)  

c)  

d) linear e) continuous

f) earnings is dependent, sales is independent.

g) $1 096$

h) $12 000$

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Relations and Functions Lesson Two: Domain and Range

Introduction:

a) Domain: All real numbers between -4 and 0, but not including -4.
   Range: All real numbers between 1 and 8, but not including 1.

Example 1: a) [-5, -1, 4, 9]  b) {n | n ≥ -3, n ∈ R}  c) {n | n < -1, n ∈ R}  d) {n | 1 < n < 6, n ∈ R}  e) {n | -7 < n ≤ 3, n ∈ R}

Example 2: a) {-5, -4, -3, -2, -1, 0, 1}, {-9, -6, -3, 0, 3, 6, 9}  b) {-10, -8, -6, -4, -2, 0, 2, 4, 6, 8, 10}

Example 4: a) x > -4, y < -2  b) -6 < x ≤ 5, -4 < y ≤ 0

Example 5: a) x ∈ R, y ≥ -3  b) -2 ≤ x ≤ 6, -2 ≤ y ≤ 6

Example 6: Sentence: The domain is between 0 and 6, and the range is between 1 and 25.

Number Lines: Domain: 
Range: 
Intervals: [0, 6], [1, 25]

Relations and Functions Lesson Three: Functions

Example 1: a) {-5, -4, -3, -2, -1, 0, 1}, {-9, -6, -3, 0, 3, 6, 9}  b) {-10, -8, -6, -4, -2, 0, 2, 4, 6, 8, 10}

Example 2: a) x ∈ R, y ∈ R  b) x = 6, y ∈ R

Example 3: a) x > -4, y < -2  b) -6 < x ≤ 5, -4 < y ≤ 0

Example 5: a) x ∈ R, y ≥ -3  b) -2 ≤ x ≤ 6, -2 ≤ y ≤ 6

Example 6: Sentence: The domain is between 0 and 6, and the range is between 1 and 25.

Number Lines: Domain: 
Range: 
Intervals: [0, 6], [1, 25]

Relations and Functions Lesson Four: Intercepts

Example 1:
Example 2:
Example 3:
Example 4:

Relations and Functions Lesson Five: Interpreting Graphs

Example 1:
Example 2:
Example 3:
Example 4:
Linear Functions Lesson One: Slope of a Line

Introduction:
a) $\frac{2}{3}$  
b) $-3$  
c) 0  
d) undefined  
Example 1:
a) -$\frac{2}{3}$  
b) undefined  
c) 0  
d) $\frac{4}{3}$  
Example 2:
a) $\frac{1}{3}$  
b) -2  
c) undefined  
d) 0  
Example 3:
a) $a = -9$  
b) $a = -8$  
c) $(4, -9)$  
d) $(8, 3)$  
Example 4:
a) $t$  
b) 10  
c) 20  
d) 30  
e) 40  
f) 50  
g) 1  
h) 2  
i) 3  
j) 4  
k) 5  
l) 6  
m) 7  
n) 8  
o) 9  
p) 10  
Example 1:
a) $d = 0.18t$  
b) speed = 0.18 m/s  
c) distance is the dependent variable, and time is the independent variable.  
Equation: $d = 0.18t$  
d) 86.4 m  
e) 1.5 hours

Linear Functions Lesson Two: Slope-Intercept Form

Introduction:
a)  
b) $y = -3x + 7$  
c) $y = 3$  
d) $x = -6$  
Example 1:
a)  
b)  
Example 3:
a)  
b)  
c)  
d)  
e)  
f)  
g)  
h)  
i)  
j)  
k)  
l)  
m)  
Example 4:
a) $E(s) = 0.09s + 800$  
b) $s(T) = 0.6t + 331$  
c) $352$ m/s  
d) $55$ °C  
e) $\$1025$  
f) $\$2400$  

Linear Functions Lesson Three: Slope-Point Form

Introduction:
a)  
b) $y - 3 = -\frac{1}{2}(x - 5)$  
c) Use slope-intercept when the y-intercept is easily read from a graph. Use slope-point otherwise.  
Example 1:
a)  
b)  
c)  
d)  
e)  
f)  
g)  
h)  
i)  
j)  
k)  
Example 2:
City A: 620 people/year  
City B: -220 people/year  
c) City A: $P_A(t) = 620t + 32760$  
City B: $P_B(t) = -220t + 29610$  
d) City A: 44540 people  
City B: 25430 people  
Example 5:
a)  
b)  
c)  
d)  
e)  
f)  
g)  
h)  
i)  
j)  
k)  
Example 4:
Example 3:
Example 5:

Linear Functions Lesson Four: General Form

Introduction:
a) $y = -3x - 3$  
b) x-intercept: (-1, 0)  
y-intercept: (0, -3)  
c) 3x + y + 3 = 0  
Example 1:
a) $y = 2x + 3$  
b) $y = -\frac{1}{2}x - 4$  
c)  
d)  
e)  
f)  
g)  
h)  
i)  
j)  
k)  
Example 2:
a) x-intercept: (8, 0)  
y-intercept: (0, -7)  
b) x-intercept: (5, 0)  
y-intercept: (0, -2)  
c)  
d)  
e)  
f)  
g)  
h)  
i)  
j)  
k)  
Example 3:
a) $x - 2y - 11 = 0$  
b) $8x + 3y + 24 = 0$
Example 4:

<table>
<thead>
<tr>
<th>a</th>
<th>b</th>
<th>sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>5</td>
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<tr>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>

b) $b = -a + 5$ OR $a = -b + 5$

There is no independent or dependent variable.

c) $c = -b + 5$ OR $b = -c + 5$

Example 5:

a) $C = 400$
b. The dependent variable is Calories, and the independent variable is the number of bowls.

c) $C(b) = 400b$. This relation is a function because we have a dependent and independent variable, and the graph passes the vertical line test.

c) The relation must be graphed as $C$ vs $b$ since Calories is the dependent variable (must go on y-axis), and the number of bowls is the independent variable (must go on x-axis).

d) yes  e) no  f) 8 fives

Example 8:

a) $C = 400b$. The dependent variable is Calories, and the independent variable is the number of bowls.

b) $C(b) = 400b$. This relation is a function because we have a dependent and independent variable, and the graph passes the vertical line test.

c) The relation must be graphed as $C$ vs $b$ since Calories is the dependent variable (must go on y-axis), and the number of bowls is the independent variable (must go on x-axis).

Linear Functions Lesson Five: Parallel and Perpendicular Lines

Introduction:

a) $m_1 = \frac{8}{5}$
b) $m_2 = \frac{7}{6}$
c) $m_3 = \frac{5}{3}$

Example 1:

a) i) $a = 10$, ii) $a = -32/5$

b) i) $a = -2/3$, ii) $a = 6$

c) i) undefined, ii) 0

Example 2:

a) original line: $y = 3x + 5$

parallel line: $y = 3x - 1$

b) original line: $y = -4$

perpendicular line: $x = -2x + 4$

Example 3:

a) original line: $y = 3x + 5$

parallel line: $y = 3x - 1$

b) original line: $y = -1/6x + 3$

parallel line: $y = 6x + 25$

Example 4:

a) original line: $x = 2$

parallel line: $x = -8$

b) original line: $y = -4$

perpendicular line: $x = -8$

Example 5:

original line: $y = 1/2x - 1$

parallel line: $x = 2x + 4$

Example 6:

original line: $y = 2x + 5$

parallel line: $x = -1/2x + 4$

Example 7:

a) $a = 1$
Answer Key

Systems of Equations Lesson One: Solving Systems Graphically

Introduction:

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The solution to the system is (40, 36)
The pay-as-you-go option is a better deal for less than 40 downloads.
The subscription option is a better deal for more than 40 downloads.

Example 1:
- a) equation 1: \( y = -\frac{3}{4}x + 1 \)
- b) equation 1: \( y = \frac{4}{7}x + 5 \)
- solution: \((4, -2)\)
- solution: \((-7, 1)\)

Example 2:
- a) one solution
- b) infinite solutions
- c) no solution
- d) no solution

Example 3:
- a) infinite solutions
- b) infinite solutions
- c) no solution
- d) no solution

Example 4:
- a) \( A(n) = 20n + 240 \), \( B(n) = 30n + 120 \), \( C(n) = 30n + 60 \), \( D(n) = 60n \)
- b) 4 weeks
- c) yes, in 6 weeks

Example 5:
- a) 1.6 hours
- b) 40 km from Edmonton

Example 6:
- small area = 62.5 m²
- large area = 82.5 m²

Example 7:
- a) 8 hours
- b) 120 questions in total from both teachers.

Example 8:
- a) \((2, 2)\)
- b) \((-5, -4)\)
- c) infinite
- d) no solution

14 dimes, 22 nickels
250 km

Systems of Equations Lesson Two: Substitution

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Example 1:
- b) solution: \((3, 2)\)

Example 2:
- a) \((2, 2)\)
- b) \((-5, -4)\)
- c) infinite
- d) no solution

Example 3:
- 14 dimes, 22 nickels

Example 4:
- 250 km

Example 5:
- Multiple Choice: 25 points, Written: 50 points
- $1800 (lower yield), $3200 (higher yield)
- scoop 1: 420 g, scoop 2: 180 g

Example 6:
- a) \((-4, -2)\)
- b) infinite solutions
- c) no solution

Example 3:
- 26 nickels, 7 quarters
- 13 motorcycles, 22 cars
- canoe: 12 km/h, current: 3 km/h
- 117 adult tickets, 116 child tickets
- Corrine: 23, Corrine’s mom: 48
- Calgary to Regina: 765 km, Regina to Winnipeg: 570 km

Systems of Equations Lesson Three: Elimination

Introduction:

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Example 1:
- a) \((-4, -2)\)
- b) \((3, -2)\)

Example 2:
- a) \((-4, -2)\)
- b) infinite solutions
- c) no solution

Example 3:
- 26 nickels, 7 quarters

Example 4:
- 13 motorcycles, 22 cars

Example 5:
- canoe: 12 km/h, current: 3 km/h

Example 6:
- 117 adult tickets, 116 child tickets

Example 7:
- Corrine: 23, Corrine’s mom: 48

Example 8:
- Calgary to Regina: 765 km, Regina to Winnipeg: 570 km