## 8.2 Modelling and Solving Linear Systems

- Solve problems that involve systems of linear equations in two variables graphically

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### 8.2 Modelling and Solving Linear Systems

**Example 1 Model a Linear System Algebraically and Graphically**

People can rent ski and snowboard equipment from two places at Winterland Resort.

- Option A charges a one-time $30 fee and then $8 per hour.
- Option B charges $14 per hour.

a) Create a system of linear equations to model the rental charges.

b) Solve the linear system graphically. What does the solution represent?

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**Solution**

**a)** Both rental options involve a constant rate per hour, so they represent linear relations.
Identify the unknown values and assign variables.
Let $C$ represent the cost, in dollars.
Let $t$ represent the length of time, in hours, of the rental.

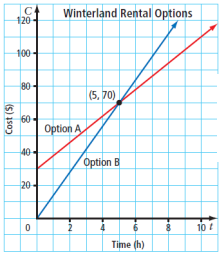
*Option A*: The cost is \$30 plus \$8 per hour.

$C = 30 + 8t$

*Option B*: The initial value is \$0 and the rate per hour is \$14.
The cost is \$14 per hour.
$C = 14t$
The equations $C = 30 + 8t$ and $C = 14t$ form a linear system.

**b)** To solve the linear system $C = 30 + 8t$ and $C = 14t$, graph the equations together and identify the point of intersection.

Graph the two equations.




From the graph, the point of intersection is (5, 70). This is the solution to the linear system. It represents the length of rental when both options have the same charge.

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## Your Turn

During a stage performance by a theatre company, the main act was on stage for 3 min less than twice the time of the opening act. Together, the two acts performed for 132 min.

a) Write a system of linear equations to represent the length of time each act performed.

b) Using technology find the solution to this linear system. What does the solution represent?

**Example 2**

Two fish tanks are being filled at constant rates.

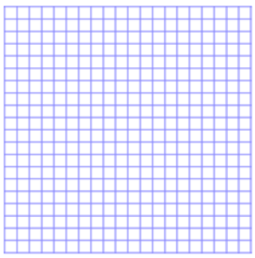
- Tank A contains 15 L of water and is filled at a rate of 5 L/min.
- Tank B is empty and is filled at a rate of 10 L/min.

Let $V$ represent the volume of water in the tanks, in litres, and $t$ represent the time, in minutes.

a) Determine the equation that models the volume of water in Tank A.

b) Determine the equation that models the volume of water in Tank B.

c) Graph the system of linear equations that models the filling of the two tanks and determine the solution to the system.



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**Example 2**

Two fish tanks are being filled at constant rates.

- Tank A contains 15 L of water and is filled at a rate of 5 L/min.
- Tank B is empty and is filled at a rate of 10 L/min.

Let $V$ represent the volume of water in the tanks, in litres, and $t$ represent the time, in minutes.

a) Determine the equation that models the volume of water in Tank A.

b) Determine the equation that models the volume of water in Tank B.

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Chapter 8

## Solving Linear Systems

Tank A contains 15 L of water and is filled at a rate of 5 L/min.
Tank B is empty and is filled at a rate of 10 L/min.

Graph the system of linear equations that models the filling of the two tanks and determine the solution to the system.


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Answer

$V = 15 + 5t$ $V = 10t$

The solution to this linear system is ( , ) .



Jun 4-11:59 AM

### Your Turn

Two pools start draining at the same time. The larger pool contains 54 675 L of water and drains at a rate of 25 L/min. The smaller pool contains 35 400 L of water and drains at a rate of 10 L/min.

a) Model the draining of the pools algebraically using a system of linear equations.

b) Represent the linear system graphically. Describe how the information shown in the graph relates to the pools.

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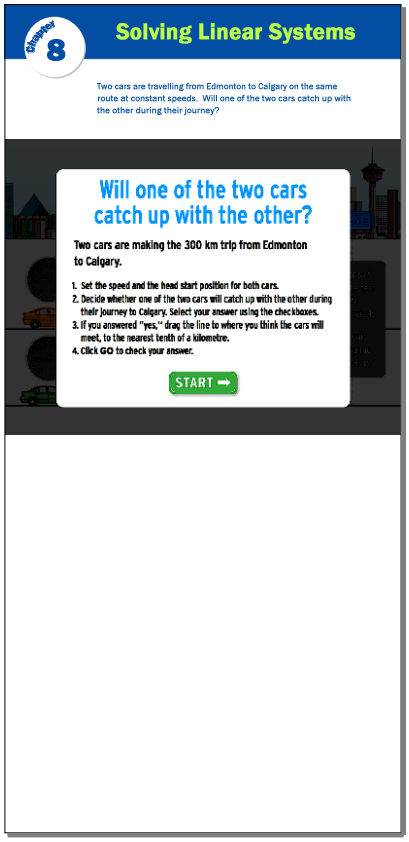


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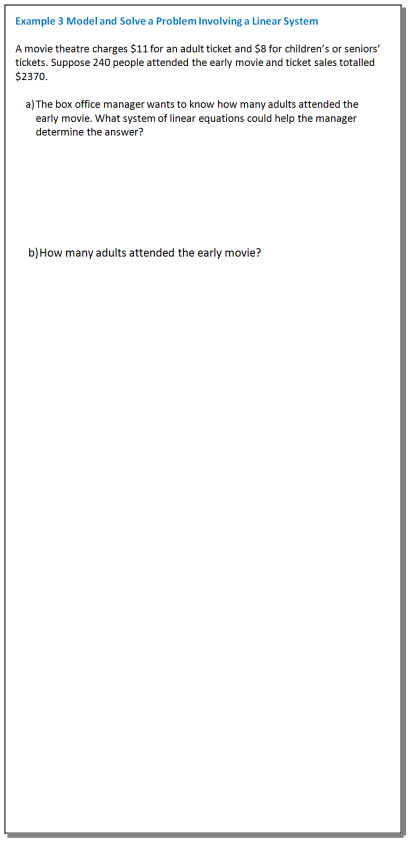

Example 3 Model and Solve a Problem Involving a Linear System

A movie theatre charges $11 for an adult ticket and $8 for children's or seniors' tickets. Suppose 240 people attended the early movie and ticket sales totalled $2370.

a) The box office manager wants to know how many adults attended the early movie. What system of linear equations could help the manager determine the answer?

b) How many adults attended the early movie?

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**Solution**

**a)** Define the variables.

Let $a$ represent the number of adult tickets sold.

Let $c$ represent the number of children's or seniors' tickets sold.

Write an equation to model the number of people at the early movie.

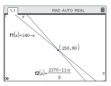
$a + c = 240$

Write an equation to model the ticket sales.

$11a + 8c = 2370$

The manager could use the linear system $a + c = 240$ and $11a + 8c = 2370$ to help determine the number of adults at the movie.

**b)** Graph both equations and identify the point of intersection.




The coordinates of the point of intersection are (150, 90). This is the only point that satisfies both equations. So, (150, 90) is the solution to the system of linear equations. There were 150 adults and 90 children and seniors at the early movie.

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**Homework**: Page 440 #1, 3, 5, 7, 8, 10, 14, 16, 24

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