

Equations and Graphs

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Summary	Students will further compare two linear functions in the context of evaluating two plans for shoveling snow. One plan has two parts: a basic charge plus a charge based on the number of square meters cleared. The other plan has no basic charge; it only charges according to the number of square meters cleared. However the per-meter charge is higher than in the other plan. Students are asked to determine the circumstances in which the bill from each plan would be the same. They then examine the graph of the two functions and discuss how equations and inequalities relate to the graph.
Goals	1. To relate graphs and algebraic notation.
Materials	Overheads, Handouts
Keywords	Compare/Contrast Functions Contextualized Situations Coordinate Pairs Full Class Discussion Function Representations Inequality Functions Interpretation of Graphs Interpretation of Stories Linear Functions Production of Algebraic Expressions Production of Equations Production of Graphs Production of Tables Small Group Work

	Solving Equations
Hints	Focus especially on the algebraic notation, $k(s)=20s$ and $j(s)=500+10s$. Focus on the use of algebraic notation for each of the functions and for the point where the two lines cross, i.e., where $20s=500+10s$.

Activity Plan:

1. Discussing the Problem (30 minutes).

Show the Overhead in Page 1 with the problem:

Karen and Joe shovel their neighbor's snow in the winter.

Karen charges 20 cents per square meter.

Joe charges \$5.00 to come to your house plus 10 cents per square meter.

You measured your driveway to figure out whom to hire and found out that Karen and Joe would both charge you the same amount of money to clear the same number of square meters of your driveway.

Discuss the advantages and disadvantages of each plan with the children.

Ask them whether they think that at some point the two persons could pay the same amount of money for the same amount of square meters.

One of the big questions in this lesson is: how do we express algebraically the fact that they pay the same amount in order to obtain the amount of square meters? It may be strange for students that we set up an equation equating money in order to obtain area. It is important to insist that the point that we are looking for has the same numeric value for money and for area in both functions.

In that case, ask them to find out for which number of square meters Karen and Joe will be paid the same amount. Distribute handout 1 (Page 1) and guide the students to:

- (a) Express the cost of each plan as a general rule or function, where s refers to the number of square meters they shovel, $k(s)$ refers to the charges (the amount of money) that Karen gets for s square meters and $j(s)$ refers to Joe's charges. Introduce and discuss the notation, $k(s)=sx20$ or $k(s)=20s$ and $j(s)=500+(sx10)$ or $j(s)=500+10s$. Review the functional notation. Recall that k refers to Karen's charges, s refers to the amount of money and $k(s)$ indicates that the variable k , amount of money, depends on the variable

s , amount of square meters. A similar reasoning applies to Joe's case.

- (b) Ask the children to write an equation that sets the amount in one plan equal to the amount in the other; namely, $20s = 500 + 10s$.
- (c) Solve the equation $20s = 500 + 10s$ using an equation template.
- (d) Discuss what may happen when s assumes values different from the solution. When is one plan better than the other?

2. Representing the Two Options on graph (Page 2) [group work] (30 minutes)

Show the overhead in Page 2 and ask the students to analyze the given graph and develop an argument to recommend plans to their neighbors.

3. Discussion of Handout: Comparing the Two Functions [whole class] (30 minutes)

Ask a few volunteers to present and discuss their answers. If there is time, use algebraic notation to represent the inequalities in different parts of the graph.

4. Homework: An equation and a graph

Children will work on a similar problem, will compare two linear functions (solving an equation), create tables for the two given functions, and represent the two functions graphically.

Overhead and Handout: Problem and Equation (Page 1)

Name: _____ Date: _____

Karen and Joe shovel their neighbor's driveway in the winter.

Karen charges 20 cents per square meter of snow she removes.

Joe charges \$5.00 (that is, 500 cents) to come to your house plus 10 cents per square meter.

You measured your driveway to figure out whom to hire. Surprisingly, you discover that Karen and Joe charge you exactly the same amount to clear your driveway.

Write expressions for Karen and Joe's charges. The functions are:

$k(s) =$ _____ (s stands for the number of

$j(s) =$ _____ square meters shoveled)

Now write an equation to show that Karen and Joe charge the same amount of money to clear your driveway:

Solve the equation to find out the number of square meters for which they charge exactly the same amount.

<div style="border: 1px solid black; padding: 5px; display: inline-block;">Karen's plan</div>	=	<div style="border: 1px solid black; padding: 5px; display: inline-block;">Joe's plan</div>
↓		↓
○		○
↓		↓
=	=	=
↓		↓
○		○
↓		↓
=	=	=
↓		↓
○		○
↓		↓
=	=	=

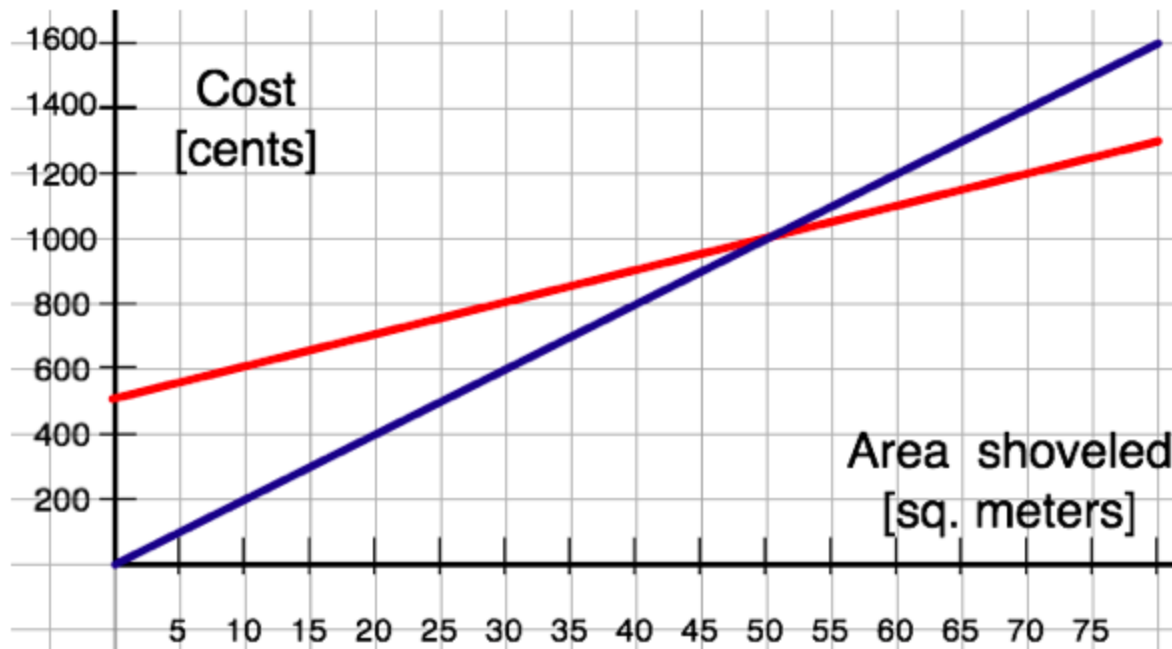
Your neighbors want to know which plan is better. What advice would you give to them? Explain why.

Overhead and Handout: Problem and Graph (Page 2)

Name: _____ Date: _____

Karen's plan: $k(s) = 20s$

Joe's plan: $j(s) = 500 + 10s$



Label the plotted functions corresponding to Karen's and Joe's plan.

Your neighbors want to know which plan is better. What advice would you give to them? Explain why.

Homework: Part I

(Page 3)

Name: _____ Date: _____

Painter A charges 10 cents per square meter of wall she paints.

Painter B charges 60 cents to come to your house plus 5 cents for each square meter painted.

You measured your walls to figure out whom to hire. Surprisingly, you discovered that Painters A and B would charge you the same amount to paint your walls.

Write expressions for Painter A and Painter B's charges. The functions are:

$a(s) =$ _____ (s stands for the number of

$b(s) =$ _____ square meters painted)

Now write an equation to show that Painter A and Painter B charge the same amount of money to paint your walls:

Solve the equation to find out the number of square meters for which they charge exactly the same amount.

Painter A's plan

Painter B's plan

_____ = _____

_____ = _____

_____ = _____

_____ = _____

For how many square meters did the painters charge the same amount?

Name: _____ Date: _____

Show how much each painter charges for different numbers of square meters.

Painter A:**10 cents per square meter
square meter****Painter B:****60 cents plus 5 cents per
square meter**

s [square meters]	s x 10 [cents]		s [square meters]	60 + (s x 5) [cents]
0			0	
1			1	
2			2	
3			3	
4			4	
5			5	
10			10	
20			20	

Your neighbors want to know which plan is better. What advice would you give to them? Explain why.

Homework: Part III

(Page 5)

Name: _____ Date: _____

Now plot each function below.

