

Math 2 Honors - Santowski

## S1.3 – Linear Equations in 2 Variables

### Fast Five – Warm up & Challenge

- Given a rectangle whose vertices are defined by the co-ordinates A(-1,4), B(2,-2), C(6,3), and D(x,y). Determine the co-ordinates of point D
- Determine the co-ordinates of the intersection point of the diagonals.
- Determine which point(s) are equidistant from K(-2,2) and M(3,6)

### Lesson Objectives

- Write a linear equation in two variables given sufficient information
- Introduce the term **linear function**
- Express a linear equation in a variety of forms including slope-intercept form, standard form, and point-slope form
- Write an equation for a line that contains a given point and is parallel or perpendicular to a given line

### (A) Slope Calculation

- To calculate the slope between any 2 points,  $(x_1, y_1)$  and  $(x_2, y_2)$ , we can use the "formula"

$$\text{slope} = m = \frac{y_2 - y_1}{x_2 - x_1}$$

- This formula "works" as long as .....???

## (B) Linear Equations

- We can determine the equations of linear equations if:
  - (a) we know 2 points that the line passes through
    - Ex. A(-3,5) & B(-6,-4)
  - (b) if we know the slope of the line and a point through which the line passes
    - Ex. If slope =  $-1/2$  and P(-3,6)

## (B) Linear Equations - Modeling

- If shares in Microsoft were \$25.50/share on June 11 and are \$22.74/share on August 17, determine:
  - (a) the slope of the linear equation that can be used to model the share price of Microsoft shares.
  - (b) Interpret the MEANING of the slope.
  - (c) If I set the "y-intercept" to be New Years, Jan 1, 2009, determine the equation of the line which models the share price of Microsoft

## (C) Slope Interpretation – Rate of Change

- An ABSOLUTELY vital thing to understand about slope is that the slope of the segment between any 2 points represents the AVERAGE RATE OF CHANGE between those 2 points
- Ex. Determine the average rate of change between A(1,1) and B(4,9)

## (D) Forms of Linear Equations

- Linear equations can be written in many forms:
  - (A) Slope-intercept form → ex. In the linear equation  $y = 4x - 5$ , the slope of the line is 4 while the y-intercept is at (0,-5)
  - So the general form looks like  $y = mx + b$  where m is the slope and b is the y-intercept

### (D1) Slope-Intercept form of Linear Equations

- On a grid, sketch the lines defined by the following linear equations:
  - (a)  $y = 2x + 3$
  - (b)  $y = -1/2x + 2$
  - (c)  $y = 1 - x$
  - (d)  $y = 3$
  - (e)  $x = 2$

### (D1) Slope-Intercept form of Linear Equations

- insert graph

### (D) Forms of Linear Equations

- Linear equations can be written in many forms:
- (B) Point - Slope → ex. If we know that a line of slope 3 passes through the point (1,2), we can quickly write the linear equation as follows:  $y - 2 = 3(x - 1)$  and leave it in that form.
- HOW ????

### (D2) Point-Slope Form of Linear Equations

- If a line passes through  $P(x_1, y_1)$  and has a slope of  $m$ , then
 
$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$3 = \frac{y - 2}{x - 1}$$

$$y - 2 = 3(x - 1)$$
- Write in point-slope form, the equations of the lines:
  - (a) slope of 8 passing through (-3,6)
  - (b) passing through (2,-3) and (-1,9)
- So in general for a line of slope  $m$  passing through the point  $(h, k)$ , the eqn becomes:
  - $y - k = m(x - h)$

## (E) Special Lines & Slopes

- There are 2 special lines that deserve attention:
- Horizontal lines have a slope of 0 and have an equation  $y = k$ , where  $k$  represents any arbitrary  $y$  value that is constant for every ordered pair on that line
- Vertical lines have an undefined slope and have an equation in the form of  $x = h$ , where  $h$  represents any arbitrary value that is constant for every ordered pair on that line

## (E) Special Lines & Slopes

- There are 2 special cases of lines that deserve attention:
- Parallel lines are lines that have the same slope
- Perpendicular lines have slopes that are negative multiplicative inverses (i.e. Negative reciprocals of each other)

## (E) Special Lines

- Insert graph

## (F) Forms of Linear Equations

- Given the following equations, rearrange the equation and graph it on the TI-84
- What special observation do you notice?

$$\frac{x}{2} + \frac{y}{3} = 1$$

$$\frac{x}{4} - \frac{y}{1} = 1$$

$$\frac{y}{2} - \frac{x}{3} = 1$$

## (F1) – Intercept Form of Linear Equations

- So an equation written in the form of

$$\frac{x}{a} + \frac{y}{b} = 1$$

or

$$bx + ay = ab$$

- tell us the x- and y-intercepts of the line (and even the slope can be easily calculated as ...?)

## (G) Extension

- Graph the parabola  $y = x^2$  and highlight the points  $A(1,1)$  and  $B(2,4)$
- (a) A **secant** line passes through 2 points on the curve and will go through the points A and B → Determine the slope of this secant line
- (b) Now move point B to  $(1.5, 2.25)$  and find slope
- (c) Move B to  $(1.1, 1.21)$  and find slope
- (d) Move B to  $(1.01, 1.0201)$  and find slope
- (e) Let B be located at  $(x+h, (x+h)^2)$ . Find the slope of AB
- (f) Explain the statement  $\lim_{h \rightarrow 0} \frac{(x+h)^2 - x^2}{(x+h) - x}$

## Homework

- p. 26 # 17-21, 27-37 odds, 47-51 odds, 60-61