480/81
Notes
Day 17

7.11 NOTES – VARIATION FUNCTIONS

OBJECTIVES:

1) Write general equations for direct and inverse variation functions.

VOCABULARY:

DIRECT VARIATION:

y varies directly with x if there is some nonzero constant k such that:

$y = kx$ (k is called the constant of variation)

"More education gets more income."

INVERSE VARIATION:

y varies inversely with x if there is some nonzero constant k such that

$xy = k$ or $y = \frac{k}{x}$

"The larger a car's engine, the lower a car's gas mileage."

Write general equations from the given information.

1. y varies directly with x. $y = kx$
2. y varies inversely with the square of x. $y = \frac{k}{x^2}$
3. y varies directly with the cube root of x. $y = k\sqrt[3]{x}$
4. y varies inversely with seventh power of x. $y = \frac{k}{x^7}$

Do you notice the difference between directly and inversely?

MULTIPLY–MULITPLY PROPERTY OF VARIATION FUNCTIONS:

For variation functions, multiplying x by a constant multiplies y by a constant.

Example: $y = 2x^3$

x	y
2	16
4	128
8	1024

$y = 3x^4$

x	y
1	3
2	48
4	768

$y = \frac{2}{x^2}$

x	y
1	2
3	$\frac{2}{9}$
9	$\frac{2}{81}$

Examples:

1. Given the points: (8, 300) (24, 100) and (72, $33\frac{1}{3}$)
   a. Name the type of function. inverse variation
   b. What is the general equation of this function? $y = \frac{k}{x}$
   c. Find the particular equation of the function. (8, 300) $y = \frac{2400}{x}$
   d. If x = 36, what is y? $y = \frac{2400}{36} = \frac{200}{3}$
   e. If y = 235, what is x? $235 = \frac{2400}{x}$ $x = \frac{2400}{235} = \frac{480}{47}$

2. Given the points: (6, 3.2) (12, 12.8) and (24, 51.2)

   a. Name the type of function and write the general equation of this function.

   Direct Variation: $y = kx^2$

   b. Find the particular equation of the function.

   (6, 3.2) $3.2 = k \cdot 6^2$ $k = \frac{4}{45}$ $\boxed{y = \frac{4}{45}x^2}$

   c. If x = 16.6, what is y?

   $y = 24.49$

   e. If y = 73.4, what is x?

   $x \approx 28.736$

3. The distance an object falls from rest varies directly with the square of the time it falls (ignoring air resistance). If a ball falls 144 feet in three seconds, how far will the ball fall in seven seconds?

   (3, 144) $y = kx^2$ $144 = k \cdot 3^2$ $k = 16$ $y = 16x^2$ $x = 7$,

   $y = 16 \cdot 7^2 = \boxed{784 \text{ ft}}$

4. Bomb Blast Problem—The radiation dose you receive from a nuclear bomb blast is inversely proportional to the square of your distance from "ground zero" where the bomb goes off.

   a. Write the particular equation expressing dose in terms of distance if, at 3 km, the dose is 400 units. Don't forget to define your variables!

   x = distance

   y = amount of radiation

   $y = \frac{k}{x^2}$ (3, 400) $400 = \frac{k}{3^2}$ $k = 3600$ $\boxed{y = \frac{3600}{x^2}}$

   b. What dose would you get at

      i. 6 km?

      $y = \frac{3600}{6^2} = \boxed{100 \text{ units}}$

      ii. 13km?

      $y = \frac{3600}{169} = \boxed{21.3 \text{ units}}$

   c. If the lethal dose is 1000 units, how far must you be from ground zero in order to survive?

   $1000 = \frac{3600}{x^2}$ $x^2 = \frac{3600}{1000}$ $x = \pm\sqrt{3.6}$ $x \approx 1.9$ km {at least 1.9 km away!