6.4 Variation and Modeling

PRACTICE

Directions: Write the equation of variation for each situation, use k as the constant of variation.

1) F is inversely proportional to x

$F = \frac{k}{x}$

2) R is jointly proportional to S and T.

$R = kST$

3) R varies directly as m and inversely as the square of d.

$R = \frac{km}{d^2}$

4) Kinetic energy, *E*, is directly proportional to the square of the velocity, *v* and the mass m.

$E = k \cdot v^2 m$

Directions: Write the equation of variation for each situation and solve.

5) U varies directly as the square root of v. If u=3 when v= 4, find u when v = 10.

$U = k \cdot \sqrt{v}$

$3 = k \cdot \sqrt{4}$

$3 = 2k$

$\frac{3}{2} = k$

$U = \frac{3}{2} \cdot \sqrt{10}$

$\boxed{U = \frac{3\sqrt{10}}{2}}$

6) Y varies directly as the cube of x. If y = 48 when x = 4, find y when x = 8.

$y = k \cdot x^3$

$48 = k \cdot 4^3$

$48 = k \cdot 64$

$\frac{48}{64} = k$

$\frac{3}{4} = k$

$y = \frac{3}{4} \cdot (8)^3$

$\boxed{y = 384}$

7) Q varies jointly as m and the square of n, and inversely as P. If Q = 2 when m = 3, n = 6, and P = 12, find Q when m = 4, n = 18, and P = 2.

$Q = \frac{k \cdot m \cdot n^2}{P}$

$2 = \frac{k \cdot 3 \cdot 6^2}{12}$

$2 = 9k$

$\frac{2}{9} = k$

$Q = \frac{(\frac{2}{9})(4)(18)^2}{2}$

$\boxed{Q = 144}$

8) W varies jointly as x, y and z. If w = 36 when x = 2, y = 8, and z = 12, find w when x = 1, y = 2, and z = 4.

$W = k \cdot x \cdot y \cdot z$

$36 = k \cdot 2 \cdot 8 \cdot 12$

$36 = 192k$

$\frac{3}{16} = k$

$w = \frac{3}{16}(1)(2)(4)$

$\boxed{w = \frac{3}{2}}$

Directions: Translate each statement into an equation using k as the constant of variation.

9) The length of time, t, that it takes fruit to ripen is inversely proportional to the sum, T, of the average daily temperatures during the growing season.

$t = \frac{k}{T}$

10) The maximum safe load, L, for a horizontal beam varies jointly as its width, w, and the square of its height, h, and inversely as its length, x.

$L = \frac{k \cdot w \cdot h^2}{x}$

11) The number, N, of long-distance phone calls between two cities varies jointly as the populations P_1 and P_2 of the two cities, and inversely as the distance, d, between the two cities.

$$N = \frac{k \cdot P_1 \cdot P_2}{d}$$

12) The erosive force, P, of a swiftly flowing stream is directly proportional to the sixth power of the velocity, v, of the water.

$$P = k \cdot v^6$$

Directions: Write the equation of variation for each situation and solve.

13) The weight, w, of an object on or above the surface of the Earth varies inversely as the distance, d, between the object and the center of the Earth. If a girl weighs 100 pounds on the surface of the Earth, how much would she weigh 400 miles above Earth's surface? Assume the radius of the Earth is 4,000 miles.

$$w = \frac{k}{d}$$

$$100 = \frac{k}{4000}$$

$$400{,}000 = k$$

$$w = \frac{400{,}000}{4{,}400}$$

$$\boxed{w = 90.9 \text{ pounds}}$$

14) Ohm's Law states that the current, I, in a wire varies directly as the electromotive forces, E, and inversely as the resistance, R. If I = 22 amperes when E = 110 volts and R = 5 ohms, find I if E = 220 volts and R = 11 ohms.

$$I = \frac{k \cdot E}{R}$$

$$22 = \frac{k \cdot 110}{5}$$

$$1 = k$$

$$I = \frac{E}{R}$$

$$I = \frac{220}{11}$$

$$\boxed{I = 20 \text{ amperes}}$$

15) If the amount of time, t, it takes Sully to complete one unit of Pre-Calc varies jointly as the number of sections, s, and the number of mastery checks per section, m, and inversely as the square root of the number of problems per section, p, and t= 12 when s = 3, m= 2, and p = 64, find t when s = 5, m= 2, and p = 25.

$$t = \frac{k \cdot s \cdot m}{\sqrt{p}}$$

$$12 = \frac{k \cdot 3 \cdot 2}{\sqrt{64}}$$

$$16 = k$$

$$t = \frac{16 \cdot 5 \cdot 2}{\sqrt{25}}$$

$$\boxed{t = 32 \text{ hrs}}$$

16) The electrical resistance of a wire varies directly as its length and inversely as the square of its diameter. A wire with a length of 200 inches and a diameter of one-quarter of an inch has a resistance of 20 ohms. Find the electrical resistance in a 500 inch wire with the same diameter.

$$R = \frac{k \cdot l}{d^2}$$

$$20 = \frac{k \cdot 200}{.25^2}$$

$$.00625 = k$$

$$R = \frac{.00625 \cdot 500}{.25^2}$$

$$\boxed{R = 50 \text{ ohms}}$$