**Activity 4.2.5 Variation Application Problems – Direct, Indirect, and Joint**

1. The volume of a cone varies jointly as the height and the square of the radius of the base. The constant of variation is $\frac{π}{3}$ . The equation is V = $\frac{1}{3}$ π r2 h. Find the volume of a cone if the radius is 5 cm and height is 6 cm.

1. The temperature, T (in degrees Kelvin), of an enclosed gas varies jointly with the product of the volume, V (in cubic centimeters), and the pressure, P (in kilograms per square centimeter). The temperature of a gas is 266oK when the volume is 7000 cubic centimeters and the pressure is 0.76 kilogram per square centimeter. What is the temperature when the volume is 8000 cubic centimeters and the pressure is 0.87 kilogram per square centimeter?
2. Supposed ***x*** varies jointly with ***y*** and the square of ***z***.  When ***x*** = ­–81 and

***y*** = 3, then ***z*** = 3**.  Find *y* when *x* = 15 and *z* = 5.**

1. When a boat is going at a high speed, most of the boat’s motor goes into generating the wake (the track of waves left in the water). The power *p* used to generate the wake is directly proportional to the seventh power of the boat’s speed *s*.
2. If a boat’s speed is 10 knots (nautical miles per hour) and uses 0.2 horsepower, write the equation for this situation.
3. If a boat’s speed is 30 knots, how much power will it need to generate a wake?
4. The maximum weight *M* (in pounds) that a board could hold varies directly as its width *w* (in inches) and the square of its thickness *t* (in inches) and inversely from the distance *d* (in feet) of its supports. Find the maximum weight that a board can support if it the supports are 18 feet apart, the board is 11 in wide and 2 in. thick and the constant of variation is

70 $\frac{ft-lb}{in^{3}}$.

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1. The electrical resistance *r* of a wire varies directly as its length *l* and inversely as the square of its diameter *d*. A wire with a length of 300 inches and a diameter of one-half of an inch has a resistance of 20 ohms. If a 600 inch wire has the same diameter find its electrical resistance.
2. The kinetic energy of an object (measured in Joules) varies jointly with the mass of the object and the square of its velocity. If the kinetic energy of an object with mass 12 kg moving at 8 meters per second is 384 Joules, what is the mass of an object moving 12 meters per second that generates 576 Joules?
3. It is known that gravitational force, F varies directly as the masses of two objects and inversely as the square of the distance between them. Which of the following equations correctly represents the phenomenon of gravitational force (F) if *m*1 and *m*2 are the masses of the bodies between which the force of gravity exists and *d* is the distance between them.
4. F = $\frac{kd^{2}}{m\_{1}m\_{2}}$
5. F = $km\_{1}m\_{2}d^{2}$
6. F = $\frac{km\_{1}m\_{2}}{\sqrt{d}}$
7. F = $\frac{km\_{1}m\_{2}}{d^{2}}$
8. Animals usually defend their territory vigorously against intruders, especially of the same species, by attacking intruders that come in to the region. According to the statistical studies reported in J.M. Emlen's Ecology: An Evolutionary Approach, the defended region's area *a* varies directly with the 1.31 power of the animal's body mass *m*in km.
9. Suppose that a normal 20 kilogram beaver will defend a region of area 200 square meters. Write an equation for this function.
10. Skeletons show that thousands of years ago North American beavers were up to 3.5 meters long and had a mass of 200 kg. How many square meters should a beaver have defended?
11. The maximum weight *M* (in pounds) that a board could hold varies directly as its width *w* (in inches) and the square of its thickness *t* (in inches) and inversely from the distance *d* (in feet) of its supports.
12. Write the general equation of this function.
13. A beam 2 inches by 12 inches by 10 feet long is turned on “edge” so that the width is two inches, its thickness is 12 inches and it can support a load of 1,584 pounds. Write an equation for this particular function.
14. If it is laid flat, what load can it support?
15. By what factor is the maximum weight changed if the thickness is doubled.