1. Three ounces of broiled ground beef contains 245 calories (The World Almanac Book of Facts, 1999 p. 718). Is the number of calories directly or inversely proportional to the number of ounces? Explain your reasoning and write a formula for the proportion. How many calories are there in 4 ounces of broiled hamburger?

2. A volcano erupts in a powerful explosion. The sound from the explosion is heard in all directions for many hundreds of kilometers. The speed of sound is about 340 meters per second.
    a. Create a table of values showing the distance, d, that the sound of the explosion has traveled at times t = 5 sec, 10 sec, 1 min, 5 min. Write a formula for d as a function of t.
    b. How long after the explosion will a person living 200 km away hear the explosion?
    c. Add to your table from part a. the land areas, A, over which the explosion can be heard as a function of the given times. Write a formula for A as a function of t.
    d. The average population density around the volcano is 31 people per square kilometer. Write a formula for P as a function of t, where P is the number of people who have heard the explosion.
    e. Graph the function P = f(t). How long will it take until 1 million people have heard the explosion or is this impossible? Explain.

3. The thrust, T, delivered by a ship's propeller is proportional to the square of the propeller rotation speed, R, times the fourth power of the propeller diameter, D (Gillner, Thomas C., *Modern Ship Design*, (US Naval Institute Press, 1972)).
    a. Write a formula for T in terms of R and D.
    b. What happens to the thrust if the propeller speed is doubles?
    c. What happens to the thrust if the propeller diameter is doubles?
    d. If the propeller diameter is increased 50%, by how much can the propeller speed be reduced to deliver the same thrust?

4. When an aircraft flies horizontally, its *stall velocity* (the minimum speed required to keep the aircraft aloft) is directly proportional to the square root of the quotient of its weight by its wing area. If a breakthrough in material science allows the construction of an aircraft with the same weight but twice the wing area, would the stall velocity be increased or decreased? By what percentage? Explain in words.

Answers

1. $c = 81.67x$; 326.68

2. **(a)** $d = 1.7, 3.4, 20.4, 102$
   $d = 0.34t$
   (b) 9.8 mins
   (c) $A = 9.1, 36.3, 1307, 32685$
   $A = 0.363t^2$
   (d) $P = 11.25t^2$
   (e) 298 sec, or approx 5 min

3. **(a)** $T = kR^2D^4$
   (b) Increases by factor of 4
   (c) Increases by factor of 16
   (d) Reduce to 44.4%

4. Decrease by 29.289%