APPLICATIONS of FUNCTIONS (Key on website)

6. ***Cost of Owning a Car Problem*** The number of dollars per month it costs you to own a car is a function of the number of kilometers per month you drive it. Based on information in an issue of *Time* magazine, the cost varies linearly with the distance, and is \$366 per month for 300 km per month, and \$510 per month for 1500 km per month.
   a. Write the particular equation expressing cost in terms of distance.
   b. Sketch the graph of this function.
   c. Predict your monthly cost if you drive 500, 1000, and 2000 km/month.
   d. About how far could you drive in a month without exceeding a monthly cost of \$600?
   e. What does the slope represent?
   f. List all the reasons you can think of to explain why the dollars per month intercept is greater than zero.

8. ***Thermal Expansion Problem*** Bridges on expressways often have expansion joints, which are small gaps in the roadway between one bridge section and the next. The gaps are put there so that the bridge will have room to expand when the weather gets hot. (See sketch.) Suppose that a bridge has a gap of 1.3 cm when the temperature is 22°C, and that the gap narrows to 0.9 cm when the temperature warms to 30°C. Assume that the gap width varies linearly with the temperature.
   a. Write the particular equation for gap width as a function of temperature.
   b. How wide would the gap be at 35°C? At −10°C?

10. ***Gas Tank Problem*** Suppose that you get your car's gas tank filled up, then drive off down the highway. As you drive, the number of minutes, t, since you had the tank filled, and the number of liters, g, remaining in the tank are related by a linear function.
    a. Which variable should be independent, and which should be dependent?
    b. After 40 minutes you have 52 liters left. An hour after the fill-up you have 40 liters left. Write the particular equation for this function.
    c. Use the equation to predict the time when you will run out of gas.
    d. Find the g-intercept, and tell what it represents in the real world.
    e. Sketch the graph of this linear function.
    f. Tell what the slope represents in the real world, and tell the significance of the fact that the slope is negative.

16. ***Charles's Gas Law*** In 1787 the French scientist Jacques Charles observed that when he plotted the graph of volume of a fixed amount of air versus the temperature of the air, the points lay along a straight line. Therefore, he concluded that volume of a gas varies linearly with temperature. Suppose that at 27°C a certain amount of air occupies a volume of 500 cm^3. When it is warmed to 90°C it occupies 605 cm^3.

a. Write the particular equation expressing volume in terms of temperature.
b. Predict the volume at 60°C.
c. The process of predicting a value *between* two given data points is called "interpolation." What is the origin of this word?
d. Predict the volume at 300°C.
e. The process of predicting a value *beyond* any given data points is called "extrapolation." What is the origin of this word?
f. Extrapolate your mathematical model back to the point where the volume is zero. That is, find the temperature-intercept.
g. Find out what special name is given to the temperature in part (f). Absolute Zero
h. Sketch the graph of volume versus temperature. Check work.

18. ***Speeding Bullet Problem*** The speed a bullet is traveling depends on the number of feet the bullet has traveled since it left the gun. Assume that $s = -4d + 3600$, where s is the number of feet per second and d is the number of feet.

a. How do you know that s varies *linearly* with d?
b. How fast is the bullet going when it has traveled 300 feet?
c. How far has the bullet gone when it has slowed to 500 feet per second?
d. What does the slope represent in the real world?
e. What does the d-intercept equal? What does it tell you about the bullet?
f. Write a suitable domain for the linear function.

20. ***Direct Variation, Pancake Problem*** If the constant b in $y = mx + b$ equals zero, then y is said to vary *directly* with x. The amount of pancake batter you must mix up varies directly with the number of people who come to breakfast. Suppose that it takes 7 cups of batter to serve 10 people.

a. Write the particular equation expressing number of cups in terms of number of people.
b. How many cups must you prepare for 50 people?
c. About how many people can you serve with 12 cups of batter?
d. Sketch the graph of this function. Through what special point does the graph of a direct variation function go?