MATH 101
Lia Vas

Line and Applications of Linear Functions

Equation of a line. Find the equation of a line that is:

1. parallel to $2x + 5y = 11$ and passing the point (3,-5);
2. perpendicular to $2x + 5y = 11$ and passing the point (3,-5);
3. perpendicular to $2x - 7y = 11$ and has -7 as x-intercept;
4. parallel to x-axis and goes through the point (-3,5);
5. perpendicular to x-axis and goes through the point (-3, 5).

Applications of Linear Functions

1. The length of a steel beam is a linear function of the temperature. When temperature is 40F a certain steel beam is 50 feet long and at 95F the same beam is 50.12 feet long. What is the length of the beam at 70F? At what temperature is the beam 49.9 feet long?
2. The life span of an insect can be modified by the temperature of the environment. Assume that the relationship between temperature of the environment (in degrees Celsius) and life span of the fruit flies (in days) is linear. If a population of fruit flies has the life span of 80 days at the temperature of 10 degrees and the life span of 50 days at the temperature of 20 degrees, write the linear relationship between the temperature and the life span. What is the life span at the temperature of 25 degrees? At what temperature is the life span 92 days?
3. Lehigh 2% reduced fat milk can be used 10 days after opening if it is stored at 40 degrees Fahrenheit and 26 days after opening if it is stored at 32 degrees Fahrenheit. Assume that the number of days that fresh milk stays unspoiled depends linearly on the temperature at which milk is kept. Write down the above linear relationship. How long will the milk stay unspoiled at 34 degrees? If the milk is supposed to last 30 days, at what temperature should it be stored?
4. Water freezes at 32 degrees Fahrenheit or 0 degrees Celsius and boils at 212 degrees Fahrenheit or 100 degrees Celsius. Derive an equation converting degrees Celsius to degrees Fahrenheit. Use the equation, convert 30 degrees Celsius to degrees Fahrenheit.
5. In 1990, 35 million years of healthy life was lost globally due to tobacco. This quantity grew linearly at a rate of 28 million years each decade. In contrast 100 million years of healthy life were lost due to diarrhea, with the rate going down linearly 22 million years each decade. Write the years of healthy life in millions lost to tobacco and diarrhea as the two linear functions of the years since 1990. Find the year the amount of healthy life lost to tobacco is expected to first exceed that lost to diarrhea.

6. A simple thermometer costs \$10 and the cost of preparing it for the next patient is \$2. A more sophisticated thermometer costs \$120 but it costs only \$.75 to prepare it for the next patient. How many patients would be required for the cost of two thermometers to be equal? Which thermometer is more efficient if the number of patients is large?

7. Acme Products sells a machine for doing a certain type of blood test for \$40,000 which costs \$20 for each use. Amalgamated Medical Supplies sells a similar machine for \$32,000 but it costs \$30 for each use. How many times must the machines be used for the cost to be equal? Which machine is more efficient if it is used many times?

8. A tomato plant grows linearly by 2 inches every month starting from the height of 5 inches.
   a) Write down an equation representing the relationship between the height of the plant and the number of month that passed since the plant was 5 inches tall.
   b) After 3 months (how tall is the plant then?), the neighboring rose bush starts obstructing the sunlight the tomato plant is getting. This results in the change of the rate of growth of the tomato plant - the growth drops from 2 to 1.5 inches every month. Write down a linear function that describes the height of the tomato plant as a function of the number of months passed.
   c) How many months need to pass before the plant is 20 inches tall?

9. The concentration of a medication in patients body increases linearly during the first two hours. Initially, it is 3 μg/ cm^3, and after two hours it is 3.25 μg/ cm^3. After two hours, the concentration starts decreasing so that 5 hour after, it is 2.80 μg/ cm^3. Describe the concentration as a linear function of number of hours passed before 2 hours and a linear function of number of hours passed after 2 hours. When will the concentration drop below 2 μg/ cm^3?

Solutions.

Line. 1. $y = -2/5x - 19/5$ 2. $y = 5/2x - 25/2$ 3. $y = -7/2x - 49/2$ 4. $y = 5$ 5. $x = -3$.

Applications of Linear Functions. 1. 50.065 feet. -5.826 F. 2. $y = -3x + 110$. 35 days. 6 degrees. 3. $y = -2x + 90$. 22 days. 30 degrees. 4. $F = \frac{9}{5}C + 32$. 86 degrees Fahrenheit.

5. Tobacco: $y = 35 + 2.8x$, diarrhea: $y = 100 - 2.2x$. Intersection $x = 13$, so starting with 2003, there will be more years of healthy life lost to tobacco than to diarrhea.

6. $y_1 = 10 + 2x$, $y_2 = 120 + .75x$. Intersection $x = 88$, so when used 88 times, they cost the same. If used more than 88 times, it is cheaper to buy more sophisticated thermometer.

7. $y_1 = 40,000 + 20x$, $y_2 = 32,000 + 30x$. Intersection $x = 800$, so when used 800 times, they cost the same. If used more than 800 times, it is cheaper to buy a machine from Acme Products.

8. $y_1 = 5 + 2x$; for $x \leq 3$ and $y_2 = 6.5 + 1.5x$ for $x > 3$. The plant is over 20 in after 9 months.

9. $y_1 = 3 + .125x$ for ≤ 2 and $y_2 = 3.55 - .15x$ for $x > 2$ The concentration will drop below 2 μg/ cm^3 10.333 hours (or 10 hours and 20 minutes) after the medication is given.