1: Functions --- Answers

1. Symbolic (e.g. \( y = 2x + 7 \)), graphical (e.g. gas prices over time), numerical (e.g. table of data, such as test scores), and verbal (e.g. an explanation of how the circumference of a circle increases as the diameter increases).

2. 
   a) No. The definition of a function is that for every valid input there is one and only one output.
   b) Yes, that does not violate the definition of a function. For example in the function \( y = x^2 \), the inputs \(-2\) and \(2\) both have the same output \(4\).

3. If a vertical line passes through a graph at more than one point, that means there are two distinct \(y\)-values (outputs) for one \(x\)-value (input). Thus the graph violates the definition of a function.

4. If a horizontal line passes through a graph at more than one point, this means that two distinct \(x\)-values (inputs) have the same \(y\)-value (output). This does not violate the definition of a function.

5. 
   a) This is a function since nobody has (or at least should have) more than one social security number.
   b) This is not a function since some people have more than one major.
   c) This is a function since each input has exactly one output.
   d) This is a function since for every possible input there will be only one output.
   e) This is not a function since the graph fails the vertical line test.

6. 
   a) Domain: positive real numbers with a length unit.  
      Range: positive real numbers with cubic units.
   b) Domain: non-negative real numbers with units of volume.  
      Range: non-negative real numbers with units of money.
   c) Domain: years between say 1895 and 2004.  
      Range: positive real numbers with units of money say between $4000 and $50,000.
   d) Domain: days of the month of December, between 1 and 31.  
      Range: real numbers with temperature units say between \(-30\) and 100 degrees F.

7. A symbolic representation.

8. 265,916,993 people

9. 2,026,688 people. This seems quite a bit low considering the graph on page 2.

10. The output row.

11. Division by zero and a negative number under a square root sign.

12. 
   a. Domain: all real numbers. Range: all real numbers.
   b. Domain: all positive real numbers. Range: all positive real numbers.
13.  
   a. Domain: all real numbers. Range: All real numbers greater than or equal to \(-2\).
   b. Domain: all real numbers except \(x = 10\). Range: all real numbers except \(f(x) = 0\).
   c. Domain: \(0 \leq x \leq 6\). Range: \(0 \leq y \leq 16\).
   d. Domain: \(\{0, 2, 4, 6\}\). Range: \(\{-1, 1, 2\}\)
   e. Domain is hours, \(0 \leq h \leq 168\). Range is pay in dollars, \(0 \leq p \leq 1218\).
   f. Domain: \(M \geq 0\). Range: \(F \geq 0\). (unless you assign a negative value for a distance "behind" a starting point)

14. When 2 is put into the function \(f\), the output is 1.

15.  
   a. 4 
   b. 16 
   c. \(3a^2 + 4\) 
   d. \(3(x + 1)^2 + 4\)

16.  
   a. \(-8\) 
   b. 0 
   c. 8

17. Answers will vary. Another example is the rule to determine the total cost gasoline pumped into your car depends of what grade of fuel is purchased.

18.  
   a. Answers will vary. The company may be enticing customers to pay a higher monthly charge for the possibility of more hours at a better rate.
   b. $20 
   c. 45 hours