

# Chapter 1

## Functions and Graphs

### Exercise Solution

#### Exercise 1.1.53

##### Instruction

A vehicle has a 20-gal tank and gets 15 mpg. The number of miles  $N$  that can be driven depends on the amount of gas  $x$  in the tank.

- (a) Write a formula that models the situation.
- (b) Determine the number of miles the vehicle can travel on (i) a full tank of gas and (ii)  $3/4$  of a tank of gas.
- (c) Determine the (i) domain and (ii) range of the function.
- (d) Determine how many times the driver had to stop for gas if she has driven a total 578 miles.

##### Solution

- (a) A gallon makes the vehicle go 15 miles. This information leads to that the number of miles  $N$  that can be driven on  $x$  gallons of gas is  $N(x) = 15x$ . This is formula is a function because it maps each input to exactly on output.
- (b)
  - (i) A full tank holds 20 gallons. This is our known  $x$ , that we can use in the formula from above. The number of miles that can be traveled is  $N(20) = 15 \cdot x = 15 \cdot 20 = 300$  miles.
  - (ii)  $3/4$  of the tank is 15 gallons. Again, this is our known  $x$ , that we can use in the formula from above. The number of miles that can be traveled is  $N(15) = 15 \cdot x = 15 \cdot 15 = 225$  miles.
- (c)
  - (i) The domain of the function is all the different amount of gas that is possible to put in the tank, from empty to full,  $0 \leq x \leq 20$ .

- (ii) The function between the amount of gas and miles traveled is a linear relation. The more gas we have the further we can travel. With an empty tank we can travel  $N(0) = 15 \cdot x = 15 \cdot 0 = 0$  miles. With a full tank we can travel  $N(20) = 15 \cdot x = 15 \cdot 20 = 300$  miles. When we have something in between the extreme values in the tank we will be able to travel in between 0 and 300 miles. The range of the function is hence  $[0, 300]$ .
- (d) We start by calculating the number of gallons of gas required for the trip. We solve  $N = 15x$  for  $x$  by dividing both sides by 15,  $x = N/15$ . We now have a relation describing number of gallons per distance. Plug in the known distance to calculate number of gallons required,  $x = 578/15 \approx 39$  gallons. If assuming that the trip was started with a full tank, holding 20 gallons, we conclude that the driver was  $39 - 20 = 19$  gallons short. 19 being less than one full tank means that driver had to stop at least one time during the trip to fill up the tank.

**Answer**

- (a)  $N(x) = 15x$ .
- (b) 300 miles can be traveled on a full tank of gas. 225 miles can be traveled on  $3/4$  of a full tank of gas.
- (c) Domain:  $0 \leq x \leq 20$ , range:  $[0, 300]$ .
- (d) The driver had to stop for gas refill at least once.