SOLUTIONS

1. **Bathtub Problem:** You pull out the plug from the bathtub. After 40 seconds, there are 13 gallons of water left in the tub. One minute after you pull the plug, there are 10 gallons left. Assume that the number of gallons varies linearly with the time since the plug was pulled.

a. Write the particular equation expressing the number of gallons (g) left in the tub in terms of the number of seconds (s) since you pulled the plug.

s - time (seconds)

g - amount of water left in tub (gallons)

(40, 13)

(60, 10)

1 min = 60 sec

$m = \frac{\Delta y}{\Delta x} = \frac{13-10}{40-60} = \frac{3}{-20} = \frac{-3}{20}$

$y - y_1 = m(x - x_1)$

$y - 10 = \frac{-3}{20}(x - 60)$

$y - 10 = \frac{-3}{20}x + 9$

$y = \frac{-3}{20}x + 19$

b. How many gallons would be left after 20 seconds? 50 seconds?

$g(20) = \frac{-3}{20}(20) + 19$

$= -3 + 19$

$= 16$ gallons

$g(50) = \frac{-3}{20}(50) + 19$

$= \frac{-150}{20} + 19$

$= -7.5 + 19$

$= 11.5$ gallons

c. At what time will there be 7 gallons left in the tub?

$7 = \frac{-3}{20}(x) + 19$

$-12 = \frac{-3}{20}x$

$-240 = -3x$

$x = 80$ seconds

d. Find the y-intercept (gallon-intercept). What does this number represent in the real world?

(0, #)

$g(0) = \frac{-3}{20}(0) + 19$

$g(0) = 19$ (0, 19)

At the start of problem, there are 19 gallons of H_2O in tub.

e. Find the x-intercept (time- intercept). What does this number represent in the real world?

(#, 0)

$0 = \frac{-3}{20}(x) + 19$

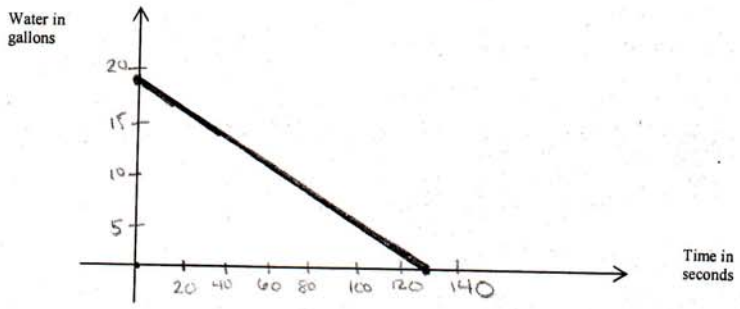
$-19 = \frac{-3}{20}(x)$

$380 = -3x$

$x = \frac{-380}{3} \approx 126.7$ sec

It takes approx 127 seconds for the tub to empty

f. Plot the graph of this linear function. Use a suitable domain.



g. What is the slope? What does this number represent?

$m = \frac{\Delta y}{\Delta x} = \frac{\text{gallons}}{\text{seconds}}$ gallons per seconds

The water in the tub decreased 3 gallons per 20 seconds

2. Driving Home Problem: As you drive home from the football game, the number of kilometers you are away from home depends on the number of minutes you have been driving. Assume that the distance varies linearly with time. Suppose you are 11 km from home when you have been driving for 10 minutes, and 8 km from home when you have been driving for 15 minutes.

a. Write the particular equation expressing the number of kilometers you are from home (d) in terms of the number of minutes since you left the game (t).

t = time (minutes)
d = distance from home (km)

(10, 11)
(15, 8)

$m = \frac{\Delta d}{\Delta t} = \frac{8-11}{15-10} = \frac{-3}{5}$

$y - 11 = \frac{-3}{5}(x - 10)$
$y - 11 = -3/5x + 6$

$d = \frac{-3}{5}t + 17$

b. Predict your distance from home after driving for 20 min., 25 min., and 30 min.

$d(20) = \frac{-3}{5}(20) + 17$
$= -12 + 17$
$= 5$ km

$d(25) = \frac{-3}{5}(25) + 17$
$= -15 + 17$
$= 2$ km

$d(30) = \frac{-3}{5}(30) + 17$
$= -1$ km
I must be home!

c. When were you are 7 km from home, how many minutes have you been traveling?

$7 = \frac{-3}{5}t + 17$
$-10 = \frac{-3}{5}t$
$-50 = -3t$
$t = -50/-3 = 16\frac{2}{3}$ minutes

16m 40sec

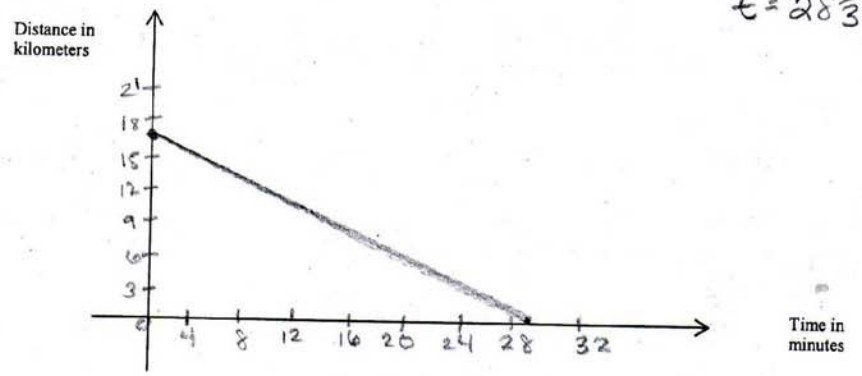
d. Find the distance-intercept. What does this number represent in the real world?

(0, #)
$d = \frac{-3}{5}(0) + 17$
$d = 17$
game is 17 km from your house

e. Find the time-intercept. What does this number represent in the real world?

(#, 0)
$0 = \frac{-3}{5}t + 17$
$17 = \frac{-3}{5}t$
$85 = -3t$
$t = 28\frac{1}{3}$m = 28m 20sec to get home

f. Plot the graph of this linear function. Use a suitable domain.



g. What is the slope? What does this number represent? What is the significance that the slope is negative?

$m = \frac{\Delta d}{\Delta t} = \frac{km}{mins}$ kilometers per minutes

you are 3 km closer to home every 5 minutes