SOLUTIONS

2.1 A first look at linear equations – Practice exercises

1. A truck hauling bags of grass seed pulls into a weigh station along the highway. Trucks are weighed to determine the amount of highway tax. This particular truck weighs 3,900 pounds when it's empty. Each bag of seed it carries weighs 4.2 pounds. For example, a truck is carrying 1,000 bags of grass seed weighs

$$3{,}900 \text{ pounds} + \frac{4.2 \text{ pounds}}{\text{bag}} * 1{,}000 \text{ bags} = 3{,}900 + 4.2 \times 1{,}000 = 8{,}100 \text{ pounds}$$

In official trucking lingo, we say the **curb weight** of 3,900 pounds plus the **load weight** of 4,200 pounds results in a **gross weight** of 8,100 pounds. So, now you know. *Story also appears in 3.1#1 and 3.2 #1*

(a) Calculate the gross weight of the truck if it contains 2,000 bags of grass seed.

$3900 + 4.2 \times 2000 =$ 12,300 pounds

As always, don't forget the letter name, description, units, and dependence when naming variables

(b) Name the variables, including units, and write an equation showing how the gross weight of the truck is a function of the number of bag seed it contains.

T = gross weight of truck (pounds) ~ dep
B = amount of grass seed (bags) ~ indep
$T = 3900 + 4.2B$

(c) Identify the slope and intercept, along with their units, and explain what each means in terms of the story.

slope = 4.2 pounds/bag It's the weight of each bag of grass seed.
intercept = 3,900 pounds It's the curb weight of the truck.

(d) The bags of grass seed are piled on wood **pallets** (sturdy platforms) to make them more stable for moving. How much does the truck weigh if it is carrying 12 pallets of grass seed bags, where each pallet weighs 15 pounds and holds 96 bags of seed?

$12 \text{ pallets} * 15 \frac{\text{pounds}}{\text{pallet}} = 180$

$$\begin{array}{r} 3900 \\ +\ 180 \\ \hline 4080 \end{array}$$

$12 \text{ pallets} * 96 \frac{\text{bags}}{\text{pallet}} * 4.2 \frac{\text{pounds}}{\text{bag}} = 12 \times 96 \times 4.2$
$= 4838.4$
$+4080$
8918.4 pounds

-OR- $12 \times 96 = 1152$ bags
$T = 3900 + 180 + 1152 * 4.2 =$
$= 8918.4$ ✓

2. The water in the local reservoir was 47 feet deep but there's been so little rain that the depth has fallen 18 inches a week over the past few months. Officials are worried if dry conditions continue the reservoir will not have enough water to supply the town.

Story also appears in 3.2 Exercises and 4.1 #3

(a) Name the variables and write an equation relating them. First convert 18 inches to feet. $18 \text{ inches} \times \frac{1 \text{ foot}}{12 \text{ inches}} = 18 \div 12 = 1.5 \text{ feet}$

D = depth of reservoir (feet) ~ dep
W = time (weeks) ~ indep
$D = 47 - 1.5W$

(b) Identify the slope and intercept, along with their units, and explain what each means in terms of the story.

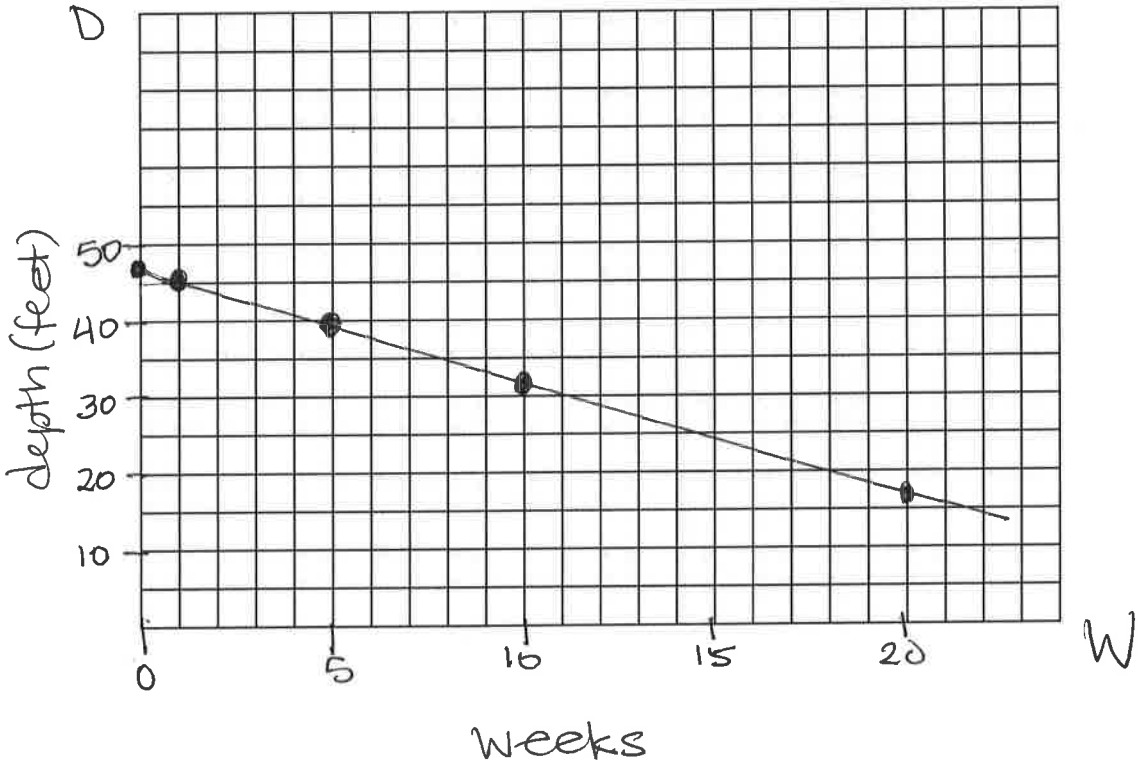
slope = −1.5 feet/week; it's how fast water level is falling
intercept = 47 feet; it's the starting depth of water in the reservoir.

(c) Make a table of values showing the projected depth of the reservoir after 1 week, 5 weeks, 10 weeks, and 20 weeks if the current trend continues.

W	1	5	10	20
D	45.5	39.5	32	17

$47 - 1.5 \times 5 =$ $47 - 1.5 \times 10 =$ $47 - 1.5 \times 20 =$

(d) Draw a graph illustrating the function.



3. I was short on cash so I got a **line of credit** (short term loan) on my bank account, of which I spent \$2,189.57. That means my account balance is −\$2,189.57. I will pay back the interest plus an extra \$250 each month. When the loan is paid off, I plan to continue to deposit \$250 per month to start saving.

Story also appears in 3.2 Exercises

not sure on (a)? try (b) first.

(a) Write an equation showing my account balance, \$$B$, in M months. Ignore the interest.

$B = -2{,}189.57 + 250M$

also okay to write: $B = 250M - 2189.57$

(b) Identify the slope and intercept, along with their units, and explain what each means in terms of the story.

intercept = \$2,189.57 It's the initial balance (debt).

slope = +\$250/month It's what I deposit (+interest) each month

(c) Make a table of values showing my account balance now, after 4 months, and at the end of a year.

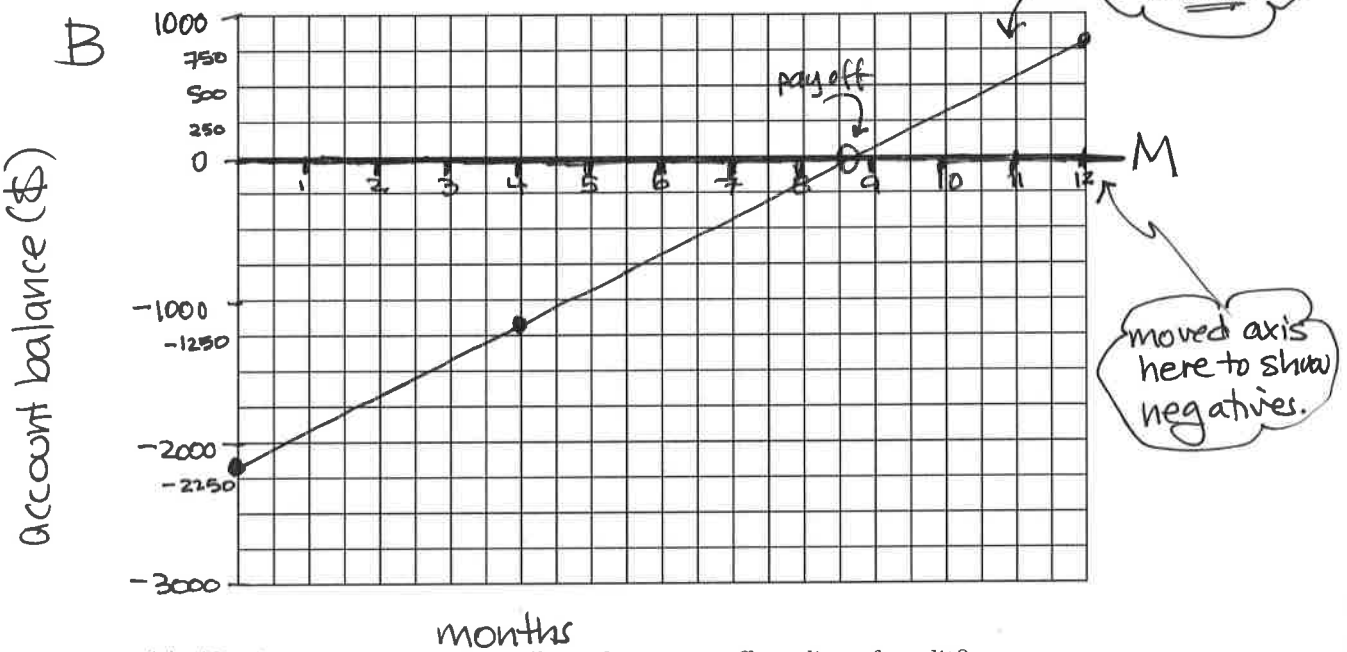
1 yr × 12 mo/yr = 12 mo ☺

M	0	4	12
B	−2,189.57	−1,189.57	810.43

−2189.57 − 12 × 250 =

(d) Draw a graph showing my account balance over this coming year.

should be a LINE



moved axis here to show negatives.

(e) About how many months will it take to pay off my line of credit?

graph → just over 8½ ↳ $B = \$0$

≈9 months to pay off line of credit

check:

M	8	9
B	−189.57	60.43 ☺

4. A mug of coffee costs \$3.45 at Juan's favorite cafe, unless he buys their discount card for \$10 in which case each mug costs \$2.90. *Story also appears in 1.2 #4 and 4.2 #2*

   (a) Name the variables, including units.

T = total cost (\$) ~ dep

M = amount of coffee (mugs) ~ indep

   (b) Write an equation describing how the total cost depends on how many mugs of coffee Juan buys without the discount card.

← intercept = \$0

slope = \$3.45/mug

$$T = 3.45M$$

   (c) Write an equation describing how the total cost depends on how many mugs of coffee Juan buys if he buys the discount card.

intercept = cost of discount card = \$10

slope = price per mug w/ d.card = \$2.90/mug

$$T = 10 + 2.90M$$

   (d) How would the equation change if the cafe offers a new annual membership card that cost \$59.99 but entitles Juan to buy coffee for only \$1 per mug all year?

← intercept = \$59.99 ↑ slope = \$1/mug

T = 59.99 + 1M

$$T = 59.99 + M$$