Thinking With Mathematical Models Answers

Investigation 1 Additional Practice

1. a. 16; 19

b. $t = 3n + 1$

c. $n = 33$; the 33rd figure will use 100 toothpicks.

d. To get to stage n from stage $n - 1$, you need to add three toothpicks to make a new box, starting with the first box, which uses four toothpicks. OR: At stage n, you need n toothpicks for the bottom of the figure, n toothpicks for the top of the figure, and $n + 1$ toothpicks for the vertical lines.

e. Graph is a straight line through points (1, 4) and (2, 7) or a collection of discrete points at (1, 4), (2, 7), (3, 10), (4, 13). The x-axis is labeled something like "Figure Number" and the y-axis is labeled something like "Number of Toothpicks". Whole graph is labeled "Toothpicks Needed to Make the Figures"

f. The pattern is linear. For each new stage, we add three toothpicks.

2. a. 11; 13

b. $t = 2n + 1$

c. $n = 30$; the 30th figure will use 61 toothpicks.

d. To get to stage n from stage $n - 1$, you need to add two toothpicks to make a new triangle, starting with the first triangle, which uses three toothpicks. OR: At stage n, you need n toothpicks for the top and bottom of the figure and $n + 1$ toothpicks for the sides.

e. Graph is a straight line through the points (1, 3) and (2, 5) or a collection of discrete points through (1, 3) (2, 5), (3, 7), (4, 9), (5, 11), etc. The x-axis is labeled something like "Figure Number" and the y-axis is labeled something like "Number of Toothpicks". Whole graph is labeled something like, "Toothpicks Needed to Make the Figures".

f. The pattern is linear. For each new stage, add two new toothpicks.

3. a. 9; 11

b. $t = 2n - 1$

c. $n = 13$; the 13th figure will use 25 tiles.

d. To get to stage n from stage $n - 1$, you need to add 2 tiles, starting with the first figure, which uses one tile. OR: At stage n, you need n tiles along the bottom and $n - 1$ tiles vertically. (Or vice versa).

e. The graph is a straight line through the points (1, 1), (2, 3), (3, 5), (4, 7) or a discrete collection of points. The x-axis is labeled "figure number", the y-axis is labeled "number of tiles" and the whole graph is labeled "Tiles Needed to Make the Figures"

f. This is a linear pattern. At every stage, add two new tiles.

4. a. 30; 42

b. $t = n^2 + n$

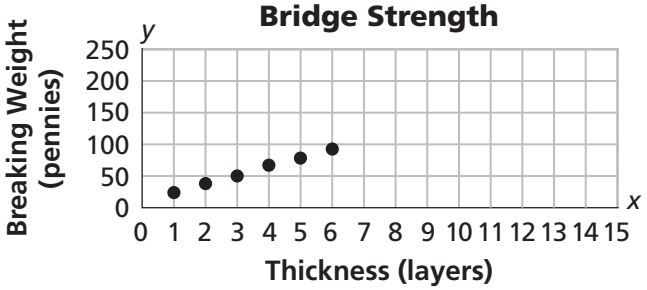
c. $n = 20$; the 20th figure will use 420 tiles.

d. At stage n, you need a square of size n^2 and n additional tiles.

e. Graph: same labels as last graph, but points are (1, 2), (2, 6), (3, 12), (4, 20).

f. The graph is not linear. A growing numbers of tiles is added at each stage. The rate of change is not constant.

5. a. The more layers there are, the higher the breaking weight.



b. Possible prediction: 200 pennies.

6. a.

Day	15	16	17	18	19
Total Number of Squash	1	3	5	7	9

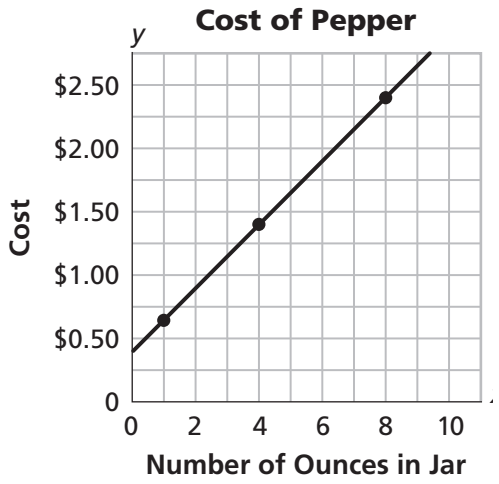
b. 15; 23

c. Each day after the 15th, 2 more squash are produced.

d. $y = 2(x - 15) + 1$ or $y = 2x - 29$, so long as $x \geq 15$
The coefficient of x is the number of squash produced each day, after day 15.

7. a.

Number of Ounces in Jar	1	4	8
Cost	\$0.65	\$1.40	\$2.40



b. \$0.90, \$1.15, \$1.90

c. Each added ounce of pepper costs \$0.25. The jar costs \$0.40.

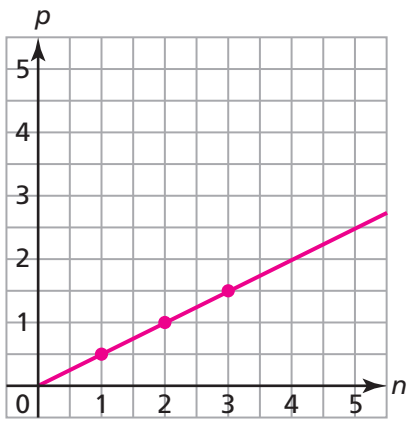
d. $y = 0.25x + 0.40$
The coefficient of x is the cost of each ounce of pepper.
The constant term is the cost of the jar.

8. 2

9.

Time (h)	1	3	4	6
Miles traveled	35	105	140	210

10. a.



b. $0.5n = p$

Skill: Patterns and Predictions

1. Missing time value: 3; missing distance value: 56

2. Missing time value: 2; missing distance value: 3

3. $m = 8; n = 30$ **4.** $p = 2; q = 37$

5. a.

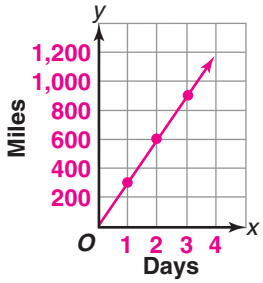
b.

Figure number	1	2	3	4	5
Number of Squares	5	8	11	14	17

$3n + 2$

6.

n	0	1	2	3
d	0	300	600	900



7.

n	0	1	2	3
p	0	7	14	21