MAT.08.PT.4.MYPET.A.415

Sample Item ID:	MAT.08.PT.4.MYPET.A.415
Title:	Cost of a Pet
Grade:	08
Primary Claim:	**Claim 4: Modeling and Data Analysis** Students can analyze complex, real-world scenarios and can construct and use mathematical models to interpret and solve problems.
Secondary Claim(s):	Claim 1: Concepts and Procedures Students can explain and apply mathematical concepts and carry out mathematical procedures with precision and fluency. Claim 2: Problem Solving Students can solve a range of well-posed problems in pure and applied mathematics, making productive use of knowledge and problem-solving strategies.
Primary Content Domain:	Statistics and Probability
Secondary Content Domain(s):	Functions
Assessment Target(s):	4 A: Apply mathematics to solve problems arising in everyday life, society, and the workplace. 1 C: Understand the connections between proportional relationships, lines, and linear equations. 1 F: Use functions to model relationships between quantities. 1 D (Gr 7): Solve real-life and mathematical problems using numerical and algebraic expressions and equations. 1 A (Gr 6): Understand ratio concepts and use ratio reasoning to solve problems. 1 D (Gr 5): Perform operations with multi-digit whole numbers and with decimals to hundredths. 2 B: Select and use appropriate tools strategically. 2 C: Interpret results in the context of a situation. 4 B: Construct, autonomously, chains of reasoning to justify mathematical models used, interpretations made, and solutions proposed for a complex problem. 4 D: Interpret results in the context of a situation. 4 E: Analyze the adequacy of and make improvements to an existing model or develop a mathematical model of a real phenomenon.

	4 F: Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flowcharts, or formulas). 4 G: Identify, analyze and synthesize relevant external resources to pose or solve problems.
Standard(s):	8.EE.6, 8.F.4, 7.EE.3, 6.RP.2, 5.NBT.7
Mathematical Practice(s):	1, 2, 4, 5, 6
DOK:	4
Item Type:	PT
Score Points:	11
Difficulty:	M
How this task addresses the "sufficient evidence" for this claim:	The student must use information derived from research to estimate the costs to adopt and maintain a pet. This work will be supported by the use of calculations, graphical representation of data, and generalizations using algebra.
Target-Specific Attributes (e.g., accessibility issues):	Accommodations may be necessary for students who have visual challenges. Technology is needed to enable students to create a circle graph, bar graph, or line graph.
Stimulus/Source:	www.petsmart.com
Notes:	Multi-part task
Task Overview:	Prework: In groups or as a whole class, students brainstorm what items are needed to maintain a pet over time. Day 1: With partners, students decide which type of pet they want to adopt. Students use a set of provided "Web sites" to look up the costs of necessary items for the chosen pet. Day 2: Students individually estimate the cost of adopting and maintaining their chosen pet for 1 year. Students explain why their estimate is reasonable. As part of the explanation, the student must make and refer to a line graph showing the monthly increase in money spent over the year.
Teacher Preparation / Resource Requirements:	Teacher preparation: The day before the administration of the task, there is prework that is designed to encourage students to begin thinking about the upcoming task. The prework involves a class brainstorming session and discussion. The remainder of the task involves a group assignment for one day followed by scored portions of the task on the second day. During Session 1, students work with partners to develop a list of items that are needed to own a pet and the costs of those items. During Session 2, students work individually to estimate the cost of raising a pet for the first and second year and the relationship between time and cost. Students provide justifications for their answers.
Teacher Responsibilities During Administration:	Monitor individual student work; provide resources as necessary.
Time Requirements:	One pretask session that requires no more than 15 minutes of class discussion. Group work follows (45 minutes), directed by

	the teacher and prior to the beginning of the scored portion of the task. The scored portion of the task starts with *Part A*. The total time involved should be 15 minutes (pretask) + 45 minutes (group work) + 60 minutes (scored portion).

Prework: Class discussion, facilitated by teacher, no more than 15 minutes.

Students brainstorm ideas for items that are needed to maintain a pet over time. At the end of a class discussion, the teacher should elicit from students a list of items, possibly including food, toys, a cage/carrier/bed, a leash or collar, veterinary visits, litter box. The teacher should note that not all of these items are needed for all types of animals.

Teacher Preparation:
[Note: Students will be grouped in partners or small groups. If possible, a student who owns or has owned a pet should be placed in each group.]

Teacher says:
Today you are going to do some research about the cost of owning a pet. You will create a list of items that you will need for your pet and the cost of each item. You will need this list and associated costs in order to complete the upcoming performance task.

First, choose the type of pet that you [by partner or group] would like to research. The choices are a dog, a cat, a hamster, or a parakeet.

These links will direct you to Web pages that might be useful to you: [Note that all of the Web sites below are fictitious, and would need to be developed. A PowerPoint file shows some examples of what the Web sites would look like as part of the fictitious cached file available with this task.]

PlusmaxPetSupplies.com [sells pet supplies only; gives info about how much and how often to feed pets]

AndreasPetShop.com [sells pets, and some (but not all) supplies]

PetFacts.info [gives info on what items you need to have a pet]

MeAndMyPets.com [a personal blog about someone who has many pets; this site will not contain any useful information for students]

<u>AnimalRescueGroup.org</u> [students can use this site to choose to adopt a pet instead of buy one]

<u>DowntownVeterinaryCare.com</u> [a veterinarian's site that will give estimates on how often a pet should go to the veterinarian and what a typical visit might cost]

<u>HappyDayPettingZoo.com</u> [another site without any useful info; this site will have the hours and prices for visiting a local petting zoo]

Create a list of items you will need for your pet and the prices of the items.

Cost of Owning and Caring for a Pet

Part A

Enter the list of pet items and costs you created yesterday, including the initial cost to buy or adopt your pet.

Based on your research, estimate the cost of adopting and maintaining a pet <dog, cat, hamster, parakeet> for one year.

You may click on the links to the Web pages you looked at yesterday to help you revise or adjust your list in order to determine the cost for an entire year.

Part B

What do you estimate the cost of adopting and maintaining a pet <dog, cat, hamster, parakeet> for one year is?

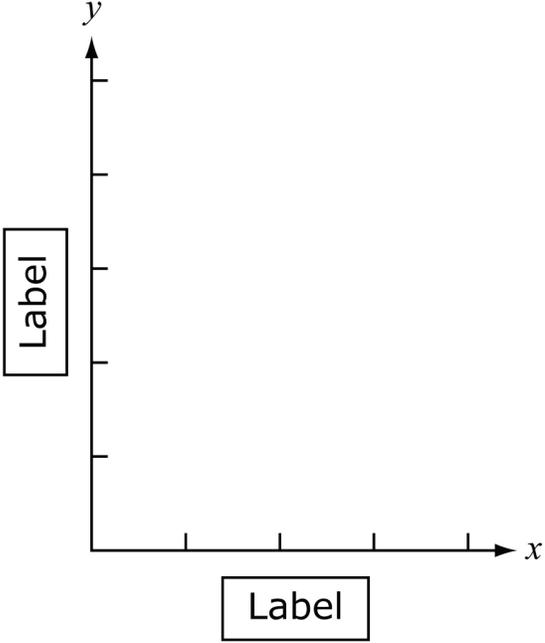$ [   ]

Provide a thorough explanation below that proves you have thought of <u>all</u> the costs associated with owning your choice of pet. Be sure to account for all one-time costs, as well as recurring costs and the frequency of those costs. Adjust your total above if needed.

Next, support your answer by using the line graph tool to create a line graph that shows the months of the year and the total amount of money you have spent on your pet through the end of each month. Your graph should show how the amount of money you have spent increases over time.

x-minimum	0
x-maximum	12
x-scale	2
y-maximum	0
y-maximum	50
y-scale	10

Data Points:

Click to add a data point

y

Label

Label

x

Part C

Estimate the cost of maintaining your pet <dog, cat, hamster, parakeet> for *one additional year* after the first.

$ [   ]

Again, provide a thorough explanation below that proves you have thought of <u>all</u> the costs associated with owning your choice of pet for one *additional* year.

Part D

Write a linear equation that best fits the total cost of adopting and maintaining your pet for a given number of *months*. Assume that your pet will not need to go to the veterinarian throughout this time.

> Equation:

Explain how you created your model equation. Be sure to describe what the variables represent and how you determined the slope and intercept for your equation.

Sample Top-Score Response:
[Note: This response is based on a student choosing a hamster.]

Group work:
My group researched the cost of owning a hamster. (Group work not scored.)

Part A
Items needed:
- Carefresh Basic Pet Bedding (14-liter bag) $5.99

- All Living Things Water Bottles for Small Animals $3.99

- All Living Things Hamster Starter Kit $22.94

- Great Choice Hamster & Gerbil Food (5 pounds) $6.99

- Super Pet Small Animal Run-About Ball $7.99

- Super Pet CritterTrail Puzzle Playgrounds $8.99

- Winter White Hamster $15.99

Part B
The cost of adopting and maintaining a pet hamster for one year is $231.62.

x-minimum 1
x-maximum 12
x-scale 1
y-minimum 50
y-maximum 250
y-scale 25
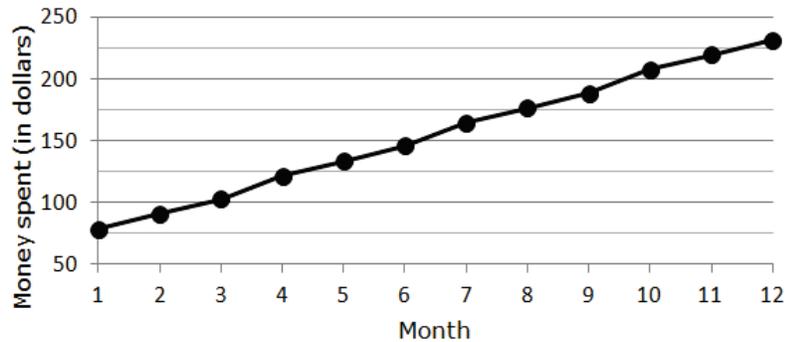
Data Points:

(1, 78.87)   (7, 164.73)
(2, 90.85)   (8, 176.71)
(3, 102.83) (9, 188.69)
(4, 121.80) (10, 207.66)
(5, 133.78) (11, 219.64)
(6, 145.76) (12, 231.62)

Click to add another data point

Explanation:
I know that my estimation is accurate because it includes the costs of all items that I would need to adopt and maintain a pet hamster for one year (assuming that my hamster does not need to go to the veterinarian). I looked on a pet supply Web site and on a pet shop Web site in order to find the costs of the items needed.

I first found all of the one-time costs:

- All Living Things Water Bottles for Small Animals $3.99

- All Living Things Hamster Starter Kit $22.94

- Super Pet Small Animal Run-About Ball $7.99

- Super Pet CritterTrail Puzzle Playgrounds $8.99

- Winter White Hamster $15.99

Then I found the annual costs for bedding and food; I calculated the number of bags of each that I would need to buy for one year, based on the pet supply Web site's information.
- Carefresh Basic Pet Bedding (14-liter bag) $5.99

  o The directions listed on the Web site are: Replace bedding 4 times each month. Each time use 7 liters (1/2 a bag) of bedding in the bottom of your hamster or gerbil's cage.

  o So, we would need to use 4 X 1/2 = 2 bags a month. This would cost 2 x $5.99 = $11.98 a month.

  o Over one year, this would cost $11.98 per month x 12 months = $143.76.

- Great Choice Hamster & Gerbil Food (5 pounds) $6.99

  o According to the Web site, 1 bag feeds a hamster for approximately 90 days. This is about 3 months.

  o So every 3 months, or 4 times a year, we would need a new bag of food. This would cost 4 x $6.99 = $27.96 a year.

To find the total cost of owning a pet hamster for one year, I added the one-time costs to the annual costs for bedding and food:
$$3.99 + 22.94 + 7.99 + 8.99 + 15.99 + 143.76 + 27.96 = 231.62$$
That is how I estimated that the cost of adopting and maintaining a pet hamster for one year would be approximately $231.62.

Part C
The cost for maintaining a pet hamster for one additional year is approximately $171.72. Explanation:
I made my estimation for the cost for one additional year by adding only the annual food and bedding costs, $27.96 and $143.76, respectively, because all of the other expenses for the first year were one-time costs:
$$143.76 + 27.96 = 171.72$$
That is how I estimated that the cost of maintaining a pet hamster for one additional year would be approximately $171.72.

Part D
My model equation is $y = 13.89(x - 1) + 78.87$, where y represents the total amount of money spent on the hamster after each month, and x represents the number of months since adopting the hamster.
First, I noted that my graph looks almost like a straight line, so I decided to use a linear equation to model the cost. Since the total cost was $78.87 after the first month and $231.62 after the twelfth month, I decided to create a line that went through the points $(1, 78.87)$ and $(12, 231.62)$. Next I found the slope of the line m:

$$m = \frac{231.62 - 78.87}{12 - 1} \approx 13.89$$

Using this slope and the point $(1,\ 78.87),$ I found that the equation of the line should be $y = 13.89(x - 1) + 78.87.$

Scoring Notes:

Note that in the sample response for *Part D*, the slope and *y*-intercept were calculated based on the graph. At this grade level, it would be considered acceptable for a student to make simply an approximation of the slope and *y*-intercept by looking at the graph.

Scoring Rubric:

Each part of the task is evaluated individually. The total number of points is determined by adding the points assigned for each part. A total of 12 points is possible.

Part A
2 points: Thorough understanding of how to identify, analyze, and synthesize relevant external resources to solve problems. The student identifies all of the items necessary for the pet and gives each cost based on the information provided.

1 point: Partial understanding of how to identify, analyze, and synthesize relevant external resources to solve problems. The student identifies all but 1 or 2 of the items necessary for the pet and gives each cost based on the information provided. **OR** The student identifies all of the items necessary for the pet but 1 or 2 of the associated costs are not based on the information provided.

0 points: Limited or no understanding of how to identify, analyze, and synthesize relevant external resources to solve problems. The student has more than 2 of the pet items/costs incorrect or incomplete.

Part B
3 points: Thorough understanding of how to identify important quantities in a practical situation and map their relationships using a line graph. The student provides explanations of correct work on how the estimation was obtained. The data shown in the line graph is consistent with the explanation provided, the graph is labeled correctly, and appropriate scales are used for the axes.

2 points: Partial understanding of how to identify important quantities in a practical situation and map their relationships using a line graph. The student provides explanations of correct work on how the estimation was obtained. The data shown in the line graph is consistent with the explanation provided, but the graph is labeled incorrectly and/or inappropriate scales are used for the axes. **OR** The student makes a minor error in calculation that leads to an incorrect graph, but provides explanations of work that show conceptual understanding. The data shown in the line graph is consistent with the explanation provided, the graph is labeled correctly, and appropriate scales are used for the axes.

1 point: Limited understanding of how to identify important quantities in a practical situation and map their relationships using a line graph. The student makes a minor error in

calculation that leads to an incorrect graph, but provides explanations of work that show conceptual understanding. The data shown in the line graph is consistent with the explanation provided, but the graph is labeled incorrectly and/or inappropriate scales are used for the axes.

0 points: No understanding of how to identify important quantities in a practical situation and map their relationships using a line graph. The student provides explanations that do not show understanding of how the estimation was obtained. The line graph provided is incorrect or irrelevant.

Part C
3 points: Thorough understanding of how to interpret the results of *Part B* in terms of the context and how to extend those results to an additional year. The student estimates the cost for one additional year by extending only the recurring costs from the first year. One-time costs from the first year are not included. The student provides explanations of correct work on how the estimation was obtained.

2 points: Partial understanding of how to interpret the results of *Part B* in terms of the context and how to extend those results to an additional year. The student makes a minor error in calculating the estimation. The student extends only the recurring costs from the first year. One-time costs from the first year are not included. The student provides explanations of correct work on how the estimation was obtained.

1 point: Limited understanding of how to interpret the results of *Part B* in terms of the context and how to extend those results to an additional year. The student estimates the cost for one additional year by extending the recurring costs from the first year, but 1 or 2 one-time costs from the first year are included. The student provides explanations of correct work on how the estimation was obtained.

0 points: No understanding of how to interpret the results of *Part B* in terms of the context and how to extend those results to an additional year.

Part D
3 points: Thorough understanding of how to develop a mathematical model for the cost of a pet. The student writes a model consistent with the graph provided in *Part B*. The student states the meaning of the symbols used in the model. The student provides explanations of correct work on how the model was obtained.

2 points: Partial understanding of how to develop a mathematical model for the cost of a pet. The student writes a model consistent with the graph provided in *Part B*, but the student does not state the meaning of the symbols used in the model. The student provides explanations of correct work on how the model was obtained. **OR** Thorough understanding of how to develop a mathematical model for the cost of a pet. The student writes a model consistent with the graph provided in *Part B*, but the model gives the cost per year (instead of per month). The student states the meaning of the symbols used in the model. The student provides explanations of correct work on how the model was obtained.

1 point: Limited understanding of how to develop a mathematical model for the cost of a pet. The student writes a model consistent with the graph provided in *Part B*, but the model gives the cost per year (instead of per month) and the student does not state the meaning of the symbols used in the model. The student provides explanations of correct work on how

the model was obtained.

0 points: Inconsistent or no understanding of how to develop a mathematical model for the cost of a pet. The student does not write a model consistent with the graph provided in *Part B* or does not accurately provide explanations of how the model was obtained.