

MAT.06.PT.4.BDBRC.A.280 Claim 4

Sample Item ID:	MAT.06.PT.4.BDBRC.A.280
Title:	Bead Bracelet (BDBRC)
Grade:	06
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 interpret and carry out mathematical procedures with precision and fluency.
Primary Content Domain	Ratios and Proportional Relationships
Secondary Content Domain(s):	Equations and Expressions, The Number System, Numbers and Operations in Base Ten
Assessment Target(s):	4 A: Apply mathematics to solve problems arising in everyday life, society, and the workplace. 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. 1A: Understand ratio concepts and use ratio reasoning to solve problems. 1F: Reason about and solve one-variable equations and inequalities. 1 G: Represent and analyze quantitative relationships between dependent and independent variables. 1 C: Compute fluently with multi-digit numbers and find common factors and multiples. 1 C (Gr 5): Understand the place-value system.
Standard(s):	6.RP.1, 6.RP.2, 6.RP.3, 6.EE.7, 6.EE.9, 6.NS.3, 5.NBT.4
Mathematical Practice(s):	1, 3, 4, 5
DOK:	3
Item Type:	PT
Score Points:	16
Difficulty:	H
How This Task Addresses The "Sufficient Evidence" For This Claim:	The student carries out mathematical procedures with precision when determining the design of a bracelet. Once the design is determined, the student uses ratio and proportion to determine the number and type of beads needed for a necklace, as well as uses properties of inequalities in some instances. Finally, the student creates a cost analysis by determining the cost of the bracelet and necklace, along with the profit for the items when given a certain percentage.

Target-Specific Attributes (e.g., accessibility issues):	Accommodations may be necessary for students with fine motor-skill challenges and language-processing challenges.
Stimulus/Source:	http://www.orientaltrading.com
Notes:	Calculator tool should be available during this task.
Task Overview:	Students must calculate various ratios and proportions when constructing a beaded bracelet and necklace. Additionally, students must perform calculations to determine the cost of the items and the possible amount of profit, given certain criteria.
Teacher Preparation/Resource Requirements:	None
Teacher Responsibilities During Administration:	Monitor individual student work; provide resources as necessary.
Time Requirements:	Two sessions totaling no more than 120 minutes. <i>Part A</i> and <i>Part B</i> should be completed in Session 1. <i>Part C</i> and <i>Part D</i> should be completed in Session 2.

Prework: None

Bead Bracelets

Your school is hosting an Arts and Crafts Fair to raise funds. Your class has been asked to help by designing and making jewelry for the fund-raiser. In this task, you will be asked to design a bracelet, calculate ratios, make predictions, and calculate costs.

Designing a Bracelet

Part A

Your principal has purchased the materials to make the jewelry. The materials include:

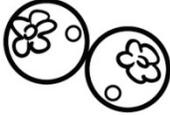
- Three types of glass beads
- Three types of spacer beads (the beads used to separate sections of glass beads)
- Beading wire (the wire that holds the beads when making

a bracelet or a necklace)

- Clasps (the fasteners that hold the ends of a bracelet or necklace together)

The cost of each type of bead is shown below.

Glass Beads

	Type A – \$4.25 for a bag of 48 beads
	Type B – \$6.00 for a bag of 25 beads
	Type C – \$8.00 for a bag of 25 beads

Spacer Beads

	Type D – \$4.00 for a bag of 25 beads
	Type E – \$8.00 for a bag of 24 beads
	Type F – \$7.00 for a bag of 300 beads

Design a bracelet using at least **two** types of glass beads and **one** type of spacer bead.

- Use between 8 and 12 glass beads.
- Use at least 6 spacer beads.
- Use no more than 25 total beads in your bracelet.

Write the type letter (A, B, C, D, E, or F) to represent each bead in your design. Use the 25 blanks below to lay out the design for your bracelet. Only write one letter in each blank you use.

Write 5 ratios that can be used to mathematically describe the bracelet you designed. Make sure your ratios show each of the following:

- The relationship between one type of glass bead used and another type of glass bead used
- The relationship between one type of glass bead used and all the beads used
- The relationship between one type of glass bead used and a type of spacer bead used
- The relationship between all the glass beads used and all the spacer beads used
- The relationship between one type of spacer bead used and all the beads used

You have been given one bag of each type of bead that you have selected. Based on your design, how many complete bracelets can you make before you run out of one type of bead? Explain your answer using diagrams, mathematical expressions, and/or words.

Part B**Calculating the Costs**

The cost of one clasp and enough beading wire to make a bracelet is \$0.25. Using the information from *Part A*, determine the cost to create one of the bracelets you designed. Explain your answer using diagrams, mathematical expressions, and/or words.

In *Part A*, you determined the number of complete bracelets you could make before running out of one type of bead. Determine the cost to create this number of bracelets. Explain your answer using diagrams, mathematical expressions, and/or words.

Part C

Matching Necklaces

Your principal would like you to make some necklaces to match the bracelets you designed.

- The cost of one clasp and enough beading wire to make a 24-inch necklace is \$0.30.
- Your bracelet is 8 inches long.

Determine the cost to create a 24-inch necklace that contains the same ratios of beads as your bracelet contains. Explain your answer using diagrams, mathematical expressions, and/or words.

Approximately how many of each type of bead will be needed to create a 24-inch necklace? Explain your answer using diagrams, pictures, mathematical expressions, and/or words.

Part D

Predicting Profits

[The teacher should discuss the definition of profit in this context. "A profit is the amount of money that is earned when a product is sold. Profit is determined by subtracting the cost of making the products from the price charged to customers."]

For the Arts and Crafts Fair, your principal sets the price of each bracelet and necklace such that the school makes a profit that is 60% of the cost to make each piece of jewelry.

Determine the price at which your bracelet and necklace will be sold at the Arts and Crafts Fair. Explain your answer using diagrams, pictures, mathematical expressions, and/or words.

Your principal would also like to offer discounted prices for customers who buy sets of 3 bracelets. When customers buy sets of 3 bracelets, the school will make a profit that is 40% of the cost to make each bracelet. Determine the price at which a set of 3 bracelets will be sold at the Arts and Crafts Fair. Explain

your answer using diagrams, pictures, mathematical expressions, and/or words.

The list below shows the pieces of jewelry that were sold at the Arts and Crafts Fair.

- 5 sets of 3 bracelets
- 4 necklaces
- 20 individual bracelets

Determine the **total** profit the school made from selling these pieces of jewelry. Explain your answer using diagrams, mathematical expressions, and/or words.

*Sample Top-Score Response:***Part A**

F, D, A, D, A, D, F, B, F, D, A, D, A, D, F, B, F, D, A, D, A, D, F
(highlighted for visual)

Ratios will vary based upon the layout of beads chosen by the student.

1 Type B glass bead to 3 Type A glass beads (1:3)

3 Type A glass beads to 1 Type B glass bead (3:1)

6 Type A glass beads out of 23 beads in total (6:23)

2 Type B glass beads out of 23 beads in total (2:23)

2 Type A glass beads to 3 Type D spacer beads (2:3)

1 Type A glass bead to 1 Type F spacer bead (1:1)

2 Type B glass beads to 9 Type D spacer beads (2:9)

2 Type B glass beads to 6 Type F spacer beads (1:3)

8 glass beads to 15 spacer beads (8:15)

9 Type D spacer beads out of 23 beads in total (9:23)

6 Type F spacer beads out of 23 beads in total (6:23)

I can make 2 bracelets. There are only 25 Type D spacer beads in a package, and my bracelet used 9 per bracelet. $25 \div 9 = 2 \text{ R}7$, so I can only make 2 complete bracelets before I run out of Type D spacer beads.

Part B

$4.25 \div 48 = 0.089$ so \$0.09 per Type A glass bead

$6.00 \div 25 = 0.24$ so \$0.24 per Type B glass bead

$4.00 \div 25 = 0.16$ so \$0.16 per Type D spacer bead

$7.00 \div 300 = 0.023$ so \$0.02 per Type F spacer bead

$6(\$0.09) + 2(\$0.24) + 9(\$0.16) + 6(\$0.02) + \$0.25 = \2.83

$2(\$2.83) = \5.66

Part C

$\$2.83 - \$0.25 = \$2.58$; $\$2.58 \times 3 + \$0.30 = \$8.04$

The 8-inch bracelet was designed with 6 Type A glass beads. Based on this design, a 24-inch necklace would have 18 of these beads.

There are 2 Type B glass beads in the 8-inch bracelet. The 24-inch necklace would have 6 of these beads.

There are 9 Type D spacer beads in the 8-inch bracelet. The 24-inch necklace would have 27 of these beads.

There are 6 Type F spacer beads in the 8-inch bracelet. The 24-inch necklace would have 18 of these beads.

OR

$$23 \div 8 = 2.875 \text{ beads per inch}$$

$$2.875 \times 24 = 69 \text{ beads on a 24-inch necklace}$$

$$23 \div 6 = 3.83$$

$$69 \div 3.83 = 18.02$$

There will be approximately 18 Type A glass beads and 18 Type F spacer beads on the necklace.

$$23 \div 2 = 11.5$$

$$69 \div 11.5 = 6$$

There will be approximately 6 Type B glass beads on the necklace.

$$23 \div 9 = 2.56$$

$$69 \div 2.56 = 26.95$$

There will be approximately 27 Type D spacer beads on the necklace.

OR

$$\frac{6}{23} = \frac{n}{69}$$

$$6(69) = 23n$$

$$414 = 23n$$

$$414 \div 23 = n$$

$$18 = n$$

There will be approximately 18 Type A glass beads and 18 Type F spacer beads on the necklace.

$$\frac{2}{23} = \frac{n}{69}$$

$$2(69) = 23n$$

$$138 = 23n$$

$$138 \div 23 = n$$

$$6 = n$$

There will be approximately 6 Type B glass beads on the necklace.

$$\frac{9}{23} = \frac{n}{69}$$

$$9(69) = 23n$$

$$621 = 23n$$

$$621 \div 23 = n$$

$$27 = n$$

There will be approximately 27 Type D spacer beads on the necklace.

Part D

$$\$2.83 \times 1.6 = \$4.53$$

$$\$8.04 \times 1.6 = \$12.86$$

$$(\$2.83 \times 3) \times 1.4 = \$11.89$$

Profit from sets of bracelets:

$$\$11.89 \times 5 = \$59.45; \$2.83 \times 15 = \$42.45; \$59.45 - \$42.45 = \$17.00$$

Profit from necklaces:

$$\$12.86 \times 4 = \$51.44; \$8.04 \times 4 = \$32.16; \$51.44 - \$32.16 = \$19.28$$

Profit from individual bracelets:

$$\$4.53 \times 20 = \$90.60; \$2.83 \times 20 = \$56.60; \$90.60 - \$56.60 = \$34.00$$

Total profit:

$$\$17.00 + \$19.28 + \$34.00 = \$70.28$$

Scoring Notes:

Each section is evaluated independently. The total number of points is determined by adding the points assigned for each task.

Scoring Rubric:

Part A

6 points: Thorough understanding of ratio and proportional relationships. Thorough understanding of the given directions. The student correctly used one type of spacer bead and at least two types of glass beads. The student correctly used no more than 25 total beads and correctly used 8 to 12 glass beads and at least 6 spacer beads. The student correctly wrote a set of 5 ratios according to bulleted directions. The student correctly used mathematics to find the number of bracelets that can be made using *all* the different types of beads the student chose for the bracelet.

5 points: Thorough understanding of ratio and proportional relationships. Partial understanding of the given directions. The student correctly used one type of spacer bead and at least two types of glass beads. The student used a number of glass beads or spacer beads that were outside of directions. The student correctly wrote a set of 5 ratios according to bulleted directions. The student correctly used mathematics to find the number of bracelets that can be made using *all* the different types of beads the student chose for the bracelet. **OR** The student did everything else required, but only correctly wrote 4 of the 5

required ratios. **OR** The student did everything else required, but did not correctly determine the number of bracelets that could be made.

4 points: Partial understanding of ratio and proportional relationships. Partial understanding of the given directions. The student did everything else required, but only correctly wrote 3 of the 5 required ratios. **OR** The student did everything else required, but only correctly wrote 4 of the 5 required ratios and did not correctly determine the number of bracelets that could be made. **OR** The student did everything else required, but used a number of glass beads or spacer beads that were outside of directions and only correctly wrote 4 of the 5 required ratios. **OR** The student did everything else required, but used a number of glass beads or spacer beads that were outside of directions and did not correctly determine the number of bracelets that could be made.

3 points: Partial understanding of ratio and proportional relationships. Partial understanding of the given directions. The student did everything else required, but only correctly wrote 2 of the 5 required ratios. **OR** The student did everything else required, but only correctly wrote 3 of the 5 required ratios and did not correctly determine the number of bracelets that could be made. **OR** The student did everything else required, but used a number of glass beads or spacer beads that were outside of directions and only correctly wrote 3 of the 5 required ratios. **OR** The student used a number of glass beads or spacer beads that were outside of directions, made an error with 1 ratio, and did not correctly determine the number of bracelets that could be made.

2 points: Partial understanding of ratio and proportional relationships. Partial understanding of the given directions. The student did everything else required, but only correctly wrote 1 of the 5 required ratios. **OR** The student did everything else required, but only correctly wrote 2 of the 5 required ratios and did not correctly determine the number of bracelets that could be made. **OR** The student did everything else required, but used a number of glass beads or spacer beads that were outside of directions and only correctly wrote 2 of the 5 required ratios. **OR** The student used a number of glass beads or spacer beads that were outside of directions, made an error with 2 ratios, and did not correctly determine the number of bracelets that could be made.

1 point: Limited understanding of ratio and proportional relationships. Limited understanding of the given directions. The student used a number of glass beads or spacer beads that were outside of directions, made an error with 3 or more ratios, and did not correctly determine the number of bracelets that could be made. **OR** The student used a number of glass beads or spacer beads that were outside of directions, made an error with 4 or 5 ratios, but correctly determined the number of bracelets that could be made.

0 points: No understanding of ratio and proportional relationships. No understanding of the given directions. The student made errors in every section of *Part A*.

Part B

3 points: Thorough understanding of numbers and operations. Thorough understanding of solving real-world problems involving the cost of making bracelets. The student correctly determines the minimum cost of the bracelet by first dividing the total cost of each package of beads by the number of beads in the package. Then the student correctly multiplies each individual cost by the number of each type of bead in the bracelet. The student correctly determines the cost of the total number of bracelets created from one bag of each style of

bead by multiplying the number of bracelets that can be made and the cost of each individual bracelet.

2 points: Partial understanding of numbers and operations. Partial understanding of solving real-world problems involving the cost of making bracelets. The student correctly determines the minimum cost of the bracelet by first dividing the total cost of each package of beads by the number of beads in the package. Then the student correctly multiplies each individual cost by the number of each type of bead in the bracelet. The student incorrectly determines the cost of the total number of bracelets created from one bag of each style of bead when multiplying the number of bracelets that can be made and the cost of each individual bracelet.

1 point: Limited understanding of numbers and operations. Limited understanding of solving real-world problems involving the cost of making bracelets. The student correctly determines the minimum cost of the bracelet by first dividing the total cost of each package of beads by the number of beads in the package. Then the student incorrectly multiplies each individual cost by the number of each type of bead in the bracelet. The student incorrectly determines the cost of the total number of bracelets created from one bag of each style of bead when multiplying the number of bracelets that can be made and the cost of each individual bracelet.

0 points: No understanding of numbers and operations. No understanding of solving real-world problems involving the cost of making bracelets. The student incorrectly determines the minimum cost of the bracelet when dividing the total cost of each package of beads by the number of beads in the package. Then the student incorrectly multiplies each individual cost by the number of each type of bead in the bracelet. The student incorrectly determines the cost of the total number of bracelets created from one bag of each style of bead when multiplying the number of bracelets that can be made and the cost of each individual bracelet.

Part C

4 points: Through understanding of ratio and proportions. Thorough understanding of mathematical expressions. The student correctly determines the cost for each inch of the necklace by subtracting \$0.25, multiplying the cost of the bracelet by 3, and adding \$0.30. The student correctly determines the number of each type of bead that would be needed for the necklace.

3 Points: Partial understanding of ratio and proportions. Partial understanding of mathematical expressions. The student correctly determines the cost for each inch of the necklace by subtracting \$0.25, multiplying the cost of the bracelet by 3, and adding \$0.30. The student makes an error when determining the number of 1 type of bead that would be needed for the necklace. **OR** The student makes an error when determining the cost of the necklace, but correctly determines the number of each type of bead that would be needed for the necklace.

2 points: Partial understanding of ratio and proportions. Partial understanding of mathematical expressions. The student correctly determines the cost for each inch of the necklace by subtracting \$0.25, multiplying the cost of the bracelet by 3, and adding \$0.30. The student makes an error when determining the number of 2 types of bead that would be needed for the necklace. **OR** The student makes an error when determining the cost of the necklace and makes an error when determining the number of 1 type of bead that would be

needed for the necklace.

1 point: Limited understanding of ratio and proportions. Limited understanding of mathematical expressions. The student correctly determines the cost for each inch of the necklace by subtracting \$0.25, multiplying the cost of the bracelet by 3, and adding \$0.30. The student does make errors in determining the number of 3 or more of the bead types needed to make the necklace. **OR** The student makes an error when determining the cost of the necklace and makes an error when determining the number of 2 types of bead that would be needed for the necklace.

0 points: No understanding of ratio and proportions. No understanding of mathematical expressions and inequalities. The student does not correctly complete any section of *Part C*.

Part D

3 points: Thorough understanding of numbers and operations and the number system. The student correctly determines the profit of 60% by multiplying the cost of the bracelet by 1.6 and the cost of the necklace by 1.6. The student correctly determines the 40% profit from selling a set of 3 bracelets by multiplying the cost of the bracelet by 3 and then multiplying that total by 1.4. The student correctly determines a total profit of \$70.28.

2 points: Partial understanding of numbers and operations and the number system. The student makes an error in 1 of the 3 sections of *Part D*.

1 point: Limited understanding of numbers and operations and the number system. The student makes an error in 2 of the 3 sections of *Part D*.

0 points: Little or no understanding of numbers and operations and the number system. The student makes errors in all 3 sections of *Part D*.