Learning and Evaluation Situation

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SSC1: Solve a Situational Problem

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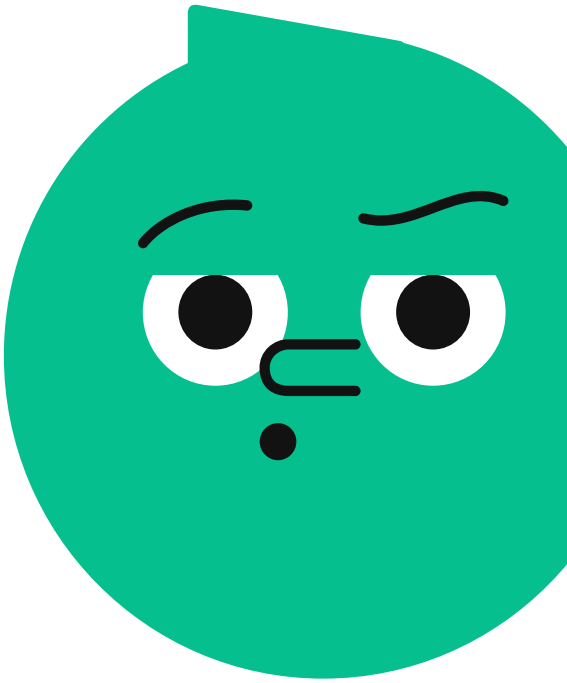


Mathematics

Secondary IV – SN

The Forges of Farador

Student Booklet

Instructions

Farador's Blacksmiths

Tom wants to open a new business, *Farador's Blacksmiths*, that will make and sell equipment for live action role players (LARPers). His plan is to sell shields, swords, daggers, wizard's staves, bows, and arrows. He also plans to offer a discount to customers who purchase sets.

Your mission

Calculate the selling price of each piece of equipment, then **determine a discounted price for each set** that meets all of Tom's requirements.

Discounted sets

Name of set	**Gardakan** the Paladin	**Mordak** the Archmage	**Boba Fett** the Thief
Equipment	• 1 shield • 1 sword of 75 cm	• 1 wizard's staff • 1 dagger	• 1 bow • 15 arrows

- The percentage discount for the **Gardakan** set must be a whole number between the percentage discounts applied to the other 2 sets.
- The price of the staff in the **Mordak** set must be the same as the price of the bow when sold separately.
- The total price of the **Boba Fett** set must be the same as the price of 1 bow and 8 arrows when sold separately.
- If a customer buys all 3 sets, they must save at least $120 on the price they would have paid if they had bought all the items separately.

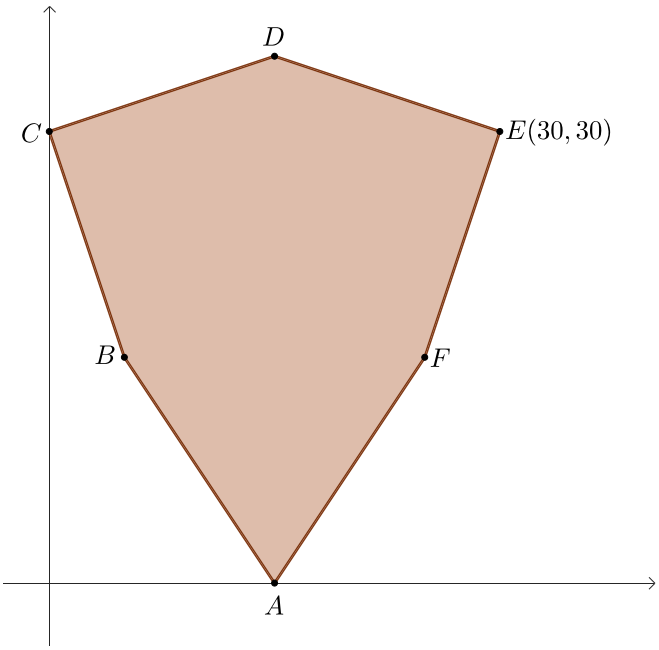
Individual equipment prices

Shield

The shield sold by *Farador's Blacksmiths* is made of top-quality wood. Tom's woodworker has agreed to supply the wood, and will also engrave a dragon on the shield and sand and varnish the wood.

To make a profit, Tom prices his shields according to this formula: The customer pays \$50 for a surface area of 2.5 dm^2 or less, plus \$25 for each additional 2.5 dm^2, based on a greatest integer function.

Here's the shield mock-up that Tom drew for the woodworker.



- Point A is on the x-axis.
- Point C is on the y-axis.
- The shield is symmetrical along the $\overline{AD}$-axis.
- The total height of the shield is 35 cm.
- Segments $\overline{BC}$ and $\overline{CD}$ are perpendicular.
- The equation of the line through points A and B is:

$$y = -\frac{3}{2}x + 22.5$$

Sword, Dagger, Wizard's Staff

Tom wants to make the sword, dagger, and wizard's staff from cylindrical Styrofoam, because it's a light and strong material. The selling price will be based on the item's length, in centimetres. The p function, which determines the price of the items made of Styrofoam, has the following characteristics.

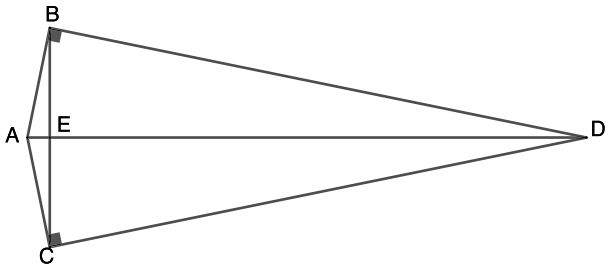
- $p(x)$ is a quadratic function.
- The domain of $p(x)$ is $[10, 110]$ cm.
- Tom sells the smallest piece of Styrofoam for \$38.
- The most expensive piece of Styrofoam is 1 metre long and sells for \$200.

Tom's dagger is made from the smallest possible piece of Styrofoam, and the staff from the largest possible piece.

Arrows

The arrows consist of a 70 cm plastic shaft and a rubber tip. The price for 1 arrow is \$3 for the plastic plus \$0.1/cm² for the rubber.

Here's the design of the rubber arrowhead.

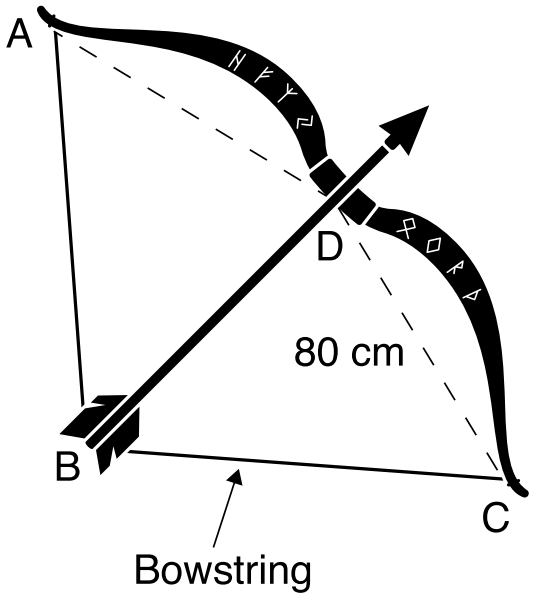


- Triangles ABD and ACD are right triangles symmetrical to one another.
- Segment $\overline{AB}$ is 3 cm long.
- Segment $\overline{DE}$ is 14.4 cm long.

Bow

The price of a bow sold by *Farador's Blacksmiths* depends on the length of wood used and the number of runes engraved on it. Each engraved rune costs \$10, plus \$0.50/cm of wood.

Tom decided to sell the 8-rune model below.



The archer must release the bowstring when the tip of the arrowhead reaches point D (i.e., when segment BD in the figure above corresponds to the length of the arrow shaft). At this point, the angle formed between the arrow and the string is 66°. For a bow to work properly, the total length of wood used must be 20% longer than the the length of the bowstring.