

Pennsylvania Grade 11 Open Response Solutions

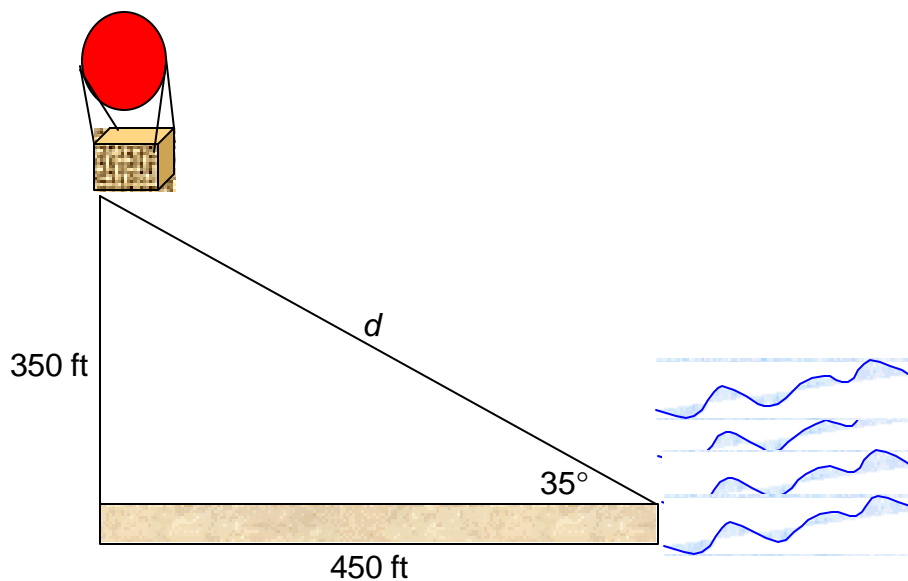
1.

A hot air balloon is 350 feet above the ground and 450 feet from the beach. It is descending at a 35° angle relative to the ground. With this angle of descent, will the hot air balloon land on the ground or in the water?

If the balloon lands on the ground, determine the distance it is from the water line. If the balloon lands in the water, find the measure, to the nearest degree, of the angle the balloon's path should have made with the ground.

Solution:

Draw a diagram to help you understand the question.



Calculate where the balloon will land.

Let d = the distance to the water.

$$\begin{aligned}\tan 35 &= \frac{350}{d} \\ d &= \frac{350}{\tan 35} \\ d &\approx 500\end{aligned}$$

Since 500 feet is greater than 450 feet, the balloon will land in the water.

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To avoid landing in the water, the balloon could descend at a steeper angle. To find the measure of the smallest angle at which it could descend, solve the equation

$$\tan x = \frac{350}{450}$$

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$$\tan x \approx 0.7778$$

$$x \approx 37.87^\circ$$

At a descent of approximately 38° or greater the balloon will land on the ground.

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2.

New agents at H-1 Realty are allowed to choose between two different salary options. Option 1 offers a base salary of \$3000 per month and a 4% sales commission. Option 2 offers no base salary and an 8% sales commission.

1. For each plan, write an equation that represents an agent's total monthly pay.
2. Graph both equations on the same coordinate plane.
3. Determine which plan a new agent should choose if the agent plans to sell \$120,000 in property per month.

Solution:

1. Write an equation.

Let x = the monthly sales of a new agent at H-1 Realty

Let T = total pay

Option 1

total pay = base pay + commission

commission = (percent)(monthly sales)

total pay = base pay + (percent)(monthly sales)

total pay = 3000 + (0.04)(monthly sales)

$T = 3000 + 0.04x$

Option 2

total pay = commission

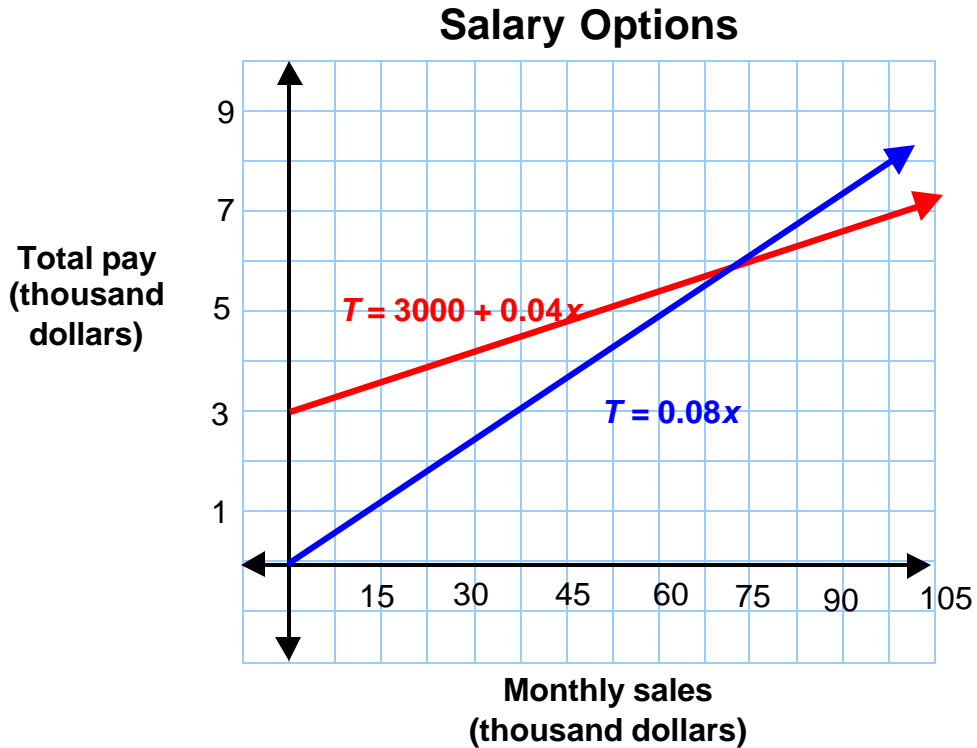
commission = (percent)(monthly sales)

total pay = (percent)(monthly sales)

total pay = (0.08)(monthly sales)

$T = 0.08x$

2. Graph each equation.



3. Determine which plan a new employee should choose.

Looking at the graph of the two equations, you can see that if a new agent sells more than \$75,000 per month, Option 2 will result in more money. If a new agent plans to sell \$120,000 in property per month, Option 2 should be chosen.

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3.

The formula for the power output P of a battery is $P = VI - Rl^2$, where V is the electromotive force in volts, R is the resistance, and l is the current. Find the current (measured in amperes) that corresponds to a maximum value of P in a battery for which $V = 16$ volts and $R = 0.25$ ohms. Assume that a 40-ampere fuse bounds the current in the interval $0 \leq l \leq 40$.

Could replacing the 40-ampere fuse with a 60-ampere fuse increase the power output? Explain.

Solution:

1. Write an equation for the power output of a battery when $V = 16$ volts and $R = 0.25$.

$$P = 16l - 0.25l^2$$

2. Find the derivative of the equation.

$$\frac{dP}{dl} = 16 - 0.5l$$

3. Since the slope of the line at the maximum point is zero, set the derivative equal to zero, and solve for l .

$$0 = 16 - 0.5l$$

$$-16 = -0.5l$$

$$\frac{-16}{-0.5} = \frac{-0.5}{-0.5}l$$

$$32 = l$$

The maximum current is 32 amperes.

The power cannot be increased by replacing the 40-ampere fuse with a 60-ampere fuse because the power P is decreasing for $l \geq 32$.