

Name: KEY Quiz Score: /25**Quiz 3: Version A**

Show your reasoning. Use standard notation correctly. Simplify your answers.
You may NOT share calculators or use a cell phone or any Internet device as a calculator.

1. An orange grower finds that if she plants 30 trees per acre, each tree will yield 70 bushels of oranges. She also estimates that for each additional tree that she plants per acre, the yield of each tree will decrease by 5 bushels. We wish to find how many trees she should plant per acre to maximize her harvest (total yield per acre).

Let x be the number of *additional* trees she plants per acre.

- (a) (4 pts) Find an expression in terms of x for the number of trees per acre.

$$30 + x \quad \text{trees/acre}$$

- (b) (4 pts) Find an expression in terms of x for the yield per tree.

$$70 - 5x \quad \text{bushels/tree}$$

- (c) (4 pts) Write a function $Y(x)$ representing the total yield per acre. Simplify.

$$Y(x) = (30+x)(70-5x) = 2100 - 80x - 5x^2 \quad \text{bushels/acre}$$

- (d) (6 pts) Use calculus to find the value of the variable which gives the absolute maximum value of your yield function.

$$Y'(x) = -80 - 10x$$

$$\boxed{Y'(x) = 0}$$

$$-80 - 10x = 0$$

$$-10x = 80$$

$$x = -8$$

- (e) (4 pts) **Verify** that this is indeed the **absolute maximum** on the appropriate interval. *Explain!*

$$Y''(x) = -10$$

$$Y''(-8) = -10 < 0$$

So Y has a relative max at $x = -8$. Since there is only one critical number, this is one critical number, this is concave down. also the absolute max.

- (f) (3 pts) Answer the question in a complete sentence.

$$30 + (-8) = 22 \text{ trees/acre}$$

To maximize her yield, she should plant 22 trees per acre.

Name: KEY Quiz Score: _____ /25**Quiz 3: Version B**

Show your reasoning. Use standard notation correctly. Simplify your answers.
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1. An orange grower finds that if she plants 40 trees per acre, each tree will yield 100 bushels of oranges. She also estimates that for each additional tree that she plants per acre, the yield of each tree will decrease by 5 bushels. We wish to find how many trees she should plant per acre to maximize her harvest (total yield per acre).

Let x be the number of *additional* trees she plants per acre.

- (a) (4 pts) Find an expression in terms of x for the number of trees per acre.

$$40 + x \text{ trees/acre}$$

- (b) (4 pts) Find an expression in terms of x for the yield per tree.

$$100 - 5x \text{ bushels/tree}$$

- (c) (4 pts) Write a function $Y(x)$ representing the total yield per acre. Simplify.

$$Y(x) = (40 + x)(100 - 5x) = 4000 - 100x - 5x^2 \text{ bushels/acre}$$

- (d) (6 pts) Use calculus to find the value of the variable which gives the absolute maximum value of your yield function.

$$Y'(x) = -100 - 10x$$

$$Y'(x) = 0$$

$$-100 - 10x = 0$$

$$-10x = 100$$

$$x = -10$$

- (e) (4 pts) **Verify** that this is indeed the **absolute maximum** on the appropriate interval. *Explain!*

$$Y''(x) = -10 < 0$$

$$Y''(-10) = -10 < 0$$

Concave down.

So Y has a relative max at $x = -10$. Since there is only one critical number, this is also the absolute max.

- (f) (3 pts) Answer the question in a complete sentence.

$$40 + (-10) = 30 \text{ trees/acre}$$

To maximize her yield, she should plant 30 trees per acre.

Quiz 3: Version C

Show your reasoning. Use standard notation correctly. Simplify your answers.

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1. An orange grower finds that if she plants 20 trees per acre, each tree will yield 50 bushels of oranges. She also estimates that for each additional tree that she plants per acre, the yield of each tree will decrease by 5 bushels. We wish to find how many trees she should plant per acre to maximize her harvest (total yield per acre).

Let x be the number of *additional* trees she plants per acre.

- (a) (4 pts) Find an expression in terms of x for the number of trees per acre.

$$20 + x \text{ trees/acre}$$

- (b) (4 pts) Find an expression in terms of x for the yield per tree.

$$50 - 5x \text{ bushels/tree}$$

- (c) (4 pts) Write a function $Y(x)$ representing the total yield per acre. Simplify.

$$Y(x) = (20 + x)(50 - 5x) = 1000 - 50x - 5x^2 \text{ bushels/acre}$$

- (d) (6 pts) Use calculus to find the value of the variable which gives the absolute maximum value of your yield function.

$$Y'(x) = -50 - 10x$$

$$\boxed{Y'(x) = 0}$$

$$-50 - 10x = 0$$

$$-10x = 50$$

$$x = -5$$

- (e) (4 pts) **Verify** that this is indeed the **absolute maximum** on the appropriate interval. *Explain!*

$$Y''(x) = -10$$

$$Y''(-5) = -10 < 0$$

so concave down. the absolute max.

So Y has a relative max at $x = -5$. Since there is only one critical number, this is also

- (f) (3 pts) Answer the question in a complete sentence.

$$20 + (-5) = 15$$

To maximize her yield, she should plant 15 trees per acre.

Name: KEY Quiz Score: /25**Quiz 3: Version D**

Show your reasoning. Use standard notation correctly. Simplify your answers.
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1. An orange grower finds that if she plants 40 trees per acre, each tree will yield 60 bushels of oranges. She also estimates that for each additional tree that she plants per acre, the yield of each tree will decrease by 5 bushels. We wish to find how many trees she should plant per acre to maximize her harvest (total yield per acre).

Let x be the number of *additional* trees she plants per acre.

- (a) (4 pts) Find an expression in terms of x for the number of trees per acre.

$$40 + x \quad \text{trees/acre}$$

- (b) (4 pts) Find an expression in terms of x for the yield per tree.

$$60 - 5x \quad \text{bushels/tree}$$

- (c) (4 pts) Write a function $Y(x)$ representing the total yield per acre. Simplify.

$$Y(x) = (40+x)(60-5x) = 2400 - 140x - 5x^2 \quad \text{bushels/acre}$$

- (d) (6 pts) Use calculus to find the value of the variable which gives the absolute maximum value of your yield function.

$$Y'(x) = -140 - 10x$$

$$\boxed{Y'(x) = 0}$$

$$-140 - 10x = 0$$

$$-10x = 140$$

$$x = -14$$

- (e) (4 pts) **Verify** that this is indeed the **absolute maximum** on the appropriate interval. *Explain!*

$$Y''(x) = -10$$

So Y has a relative max at $x = -14$.

$$Y''(-14) = -10 < 0$$

Since there is only one critical number, this is also the absolute max.

So concave down

- (f) (3 pts) Answer the question in a complete sentence.

$$40 + (-14) = 26$$

To maximize her yield, she should plant 26 trees per acre.