Lesson 9.3/9.4 Trigonometry

Tuesday, April 11, 2023 10:58 PM

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Trigono...

Lesson 9.3/9.4 Trigonometry

Pages 143-147 and Pages 155-158

Content Objective

Students will solve problems using the trigonometric ratios and inverse trigonometric ratios for acute angles.

Florida's B.E.S.T. Standards for Mathematics

MA.912.T.1.1

Define trigonometric ratios for acute angles in right triangles.

MA.912.T.1.2
Solve mathematical and real-world problems involving right triangles using trigonometric ratios and the Pythagorean Theorem.

Learn
Trigonometry

The word **trigonometry** comes from the Greek terms *trigon*, meaning triangle, and *metron*, meaning measure. So the study of trigonometry involves triangle measurement. A **trigonometric ratio** is a ratio of the lengths of two sides of a right triangle.

The names of the three most common trigonometric ratios are given on the next few slides.

McGraw Hill | Trigonometry
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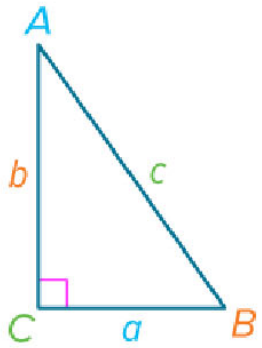
Learn
Trigonometry

Key Concept: Trigonometric Ratios

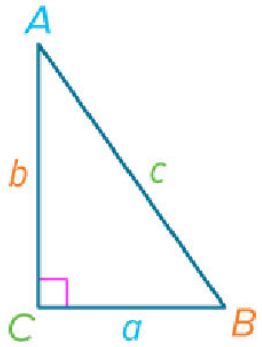
Sine: If $\triangle ABC$ is a right triangle, then the sine of each acute angle in $\triangle ABC$ is the ratio of the length of the leg opposite that angle (opp) to the length of the hypotenuse (hyp).



$$\sin A = \frac{\text{opp}}{\text{hyp}} \text{ or } \frac{a}{c}; \quad \sin B = \frac{\text{opp}}{\text{hyp}} \text{ or } \frac{b}{c}$$

Learn
Trigonometry

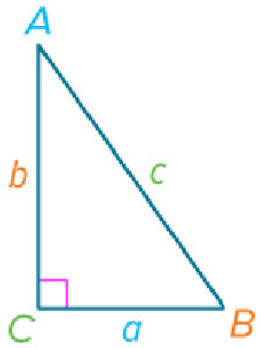
Cosine: If $\triangle ABC$ is a right triangle, then the cosine of each acute angle in $\triangle ABC$ is the ratio of the length of the leg adjacent to that angle (adj) to the length of the hypotenuse (hyp).



$$\cos A = \frac{\text{adj}}{\text{hyp}} \text{ or } \frac{b}{c}; \cos B = \frac{\text{adj}}{\text{hyp}} \text{ or } \frac{a}{c}$$

Learn
Trigonometry

Tangent: If $\triangle ABC$ is a right triangle, then the tangent of each acute angle in $\triangle ABC$ is the ratio of the length of the leg opposite that angle (opp) to the length of the leg adjacent to that angle (adj).

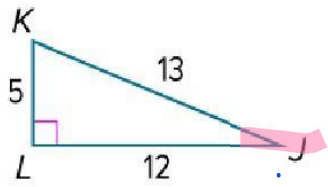


$$\tan A = \frac{\text{opp}}{\text{adj}} \text{ or } \frac{a}{b}; \tan B = \frac{\text{opp}}{\text{adj}} \text{ or } \frac{b}{a}$$

Example 1
Find Trigonometric Ratios

Find sin *J*, cos *J*, tan *J*, sin *K*, cos *K*, and tan *K*. Express each ratio as a fraction and as a decimal to the nearest hundredth.

SOH CAH TOA



$\sin J = \frac{5}{13} = 0.38$

$\cos J = \frac{12}{13} = 0.92$

$\tan J = \frac{5}{12} = 0.42$ (13)

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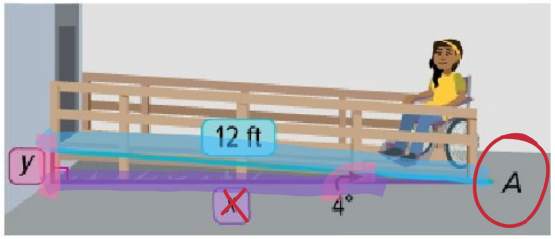
Example 3
Estimate Measures by Using Trigonometry

SOH CAH TOA

ACCESSIBILITY Mathias builds a ramp so his sister can access the back door of their house. The 12-foot ramp to the house slopes upward from the ground at a 4° angle. What is the horizontal distance between the foot of the ramp and the house? What is the height of the ramp?



$\frac{Adj}{Hyp}$ $\frac{opp}{hyp}$

$12(\cos 4 = \frac{x}{12})12$ $12(\sin 4 = \frac{y}{12})12$

$11.97 = x$ $y = 0.84$

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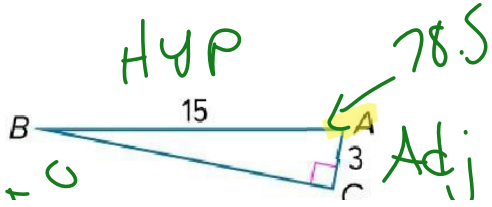
SOH CAH TOA

Example 4
Find Angle Measures by Using Inverse Trigonometric Ratios

Use a calculator to find $m\angle A$ to the nearest tenth.



Hyp 78.5° Adj

$\cos^{-1} A = \frac{3}{\quad} \approx 78.5$

$\frac{}{15} = 18.5$

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Example 4

Find Angle Measures by Using Inverse Trigonometric Ratios

SOH CAH TOA

Check

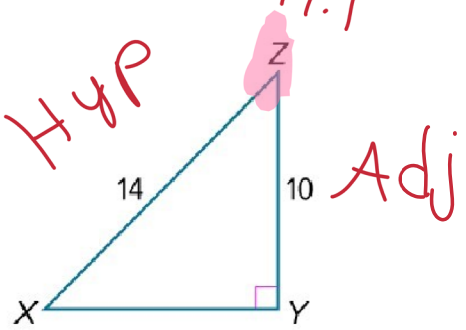
Use a calculator to find $m\angle Z$ to the nearest tenth.

$\cos Z^{-1} = \frac{10}{17} = 44.4$

44.4°

Hyp

Adj



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Example 5

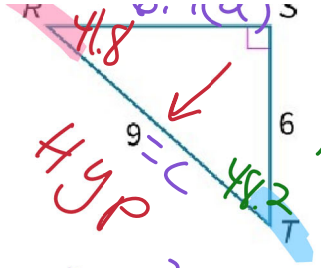
Solve a Right Triangle

$6(\tan 48.2)$

SOH CAH TOA

pp

Solve the right triangle. Round side and angle measures to the nearest tenth.



b Adj

Hyp = c

$\sin^{-1} R = \frac{6}{9} = 41.8$

$\cos^{-1} T = \frac{6}{9} = 48.2$

$\tan 48.2 = \frac{x}{6}$ (6)

$\sin 48.2 = \frac{x}{9}$ (9)

$9(\sin 48.2) = 6.7$

$a^2+b^2=c^2$

$a^2+6^2=9^2$

$a^2+36=81$

$-36\ -36$

$a^2 = 45$

$a\sqrt{45} = 6.7$

$\sqrt{45}$

$\sqrt{9}\sqrt{5}$

$3\sqrt{5}$

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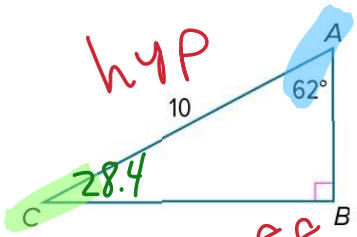
Example 5
Solve a Right Triangle

Check SOH CAH TOA

Solve the right triangle by finding $m\angle C$, AB, and BC. Round side and angle measures to the nearest tenth.



hyp

$x = 4.7$ Adj

$\cos^{-1} C = \frac{8.8}{10}$

$x = 8.8$

$10(\sin 62 = \frac{x}{10})10$

$10(\sin 62) = x$

$14(\cos 62 = \frac{x}{10})10$

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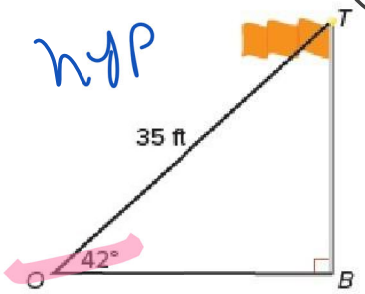
Solve. Round answers to the nearest tenth.

SOH CAH TOA

1. Find the height of the flagpole, *TB*.



hyp

X

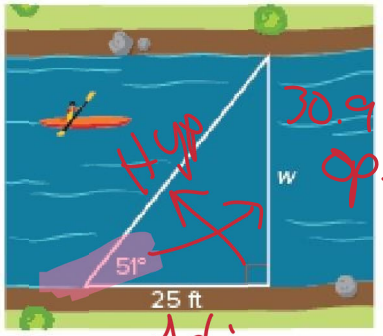
opp

$\sin 42 = \frac{x}{35}$

$35(\sin 42) = x$

23.4

2. Find the width of the river, *w*.



Hyp

30.9

opp

Adj

next

$\tan 51 = \frac{w}{25}$

$25(\tan 51) = w$

$30.9 = w$

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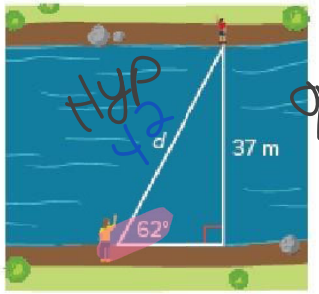
Solve. Round answers to the nearest tenth.

SOH CAH TOA

3. What is the distance between the two people on opposite sides of the river?



Hyp

x

opp

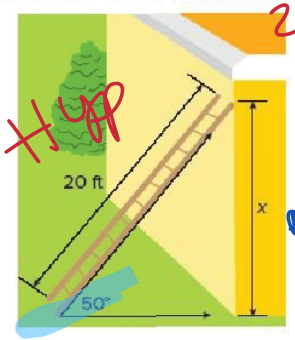
$\sin 62 = \frac{37}{x}$

$x(\sin 62) = 37$

$x = 42$

0.88

4. A 20-foot ladder leaning against a wall makes a 50° angle between the ground and the ladder. How far up the wall does the ladder go?



Hyp

opp

$\sin 50 = \frac{x}{20}$

$20(\sin 50) = x$

15.3

Example 1
Angle of Elevation

SOH CAH TOA

DRONES Rakeem is flying his drone at the park. He spots the drone at an angle of elevation that he estimates to be 30°. The remote control tells Rakeem that his drone is 102 feet above the ground. If Rakeem is 6 feet tall, how far is he from the drone to the nearest foot?

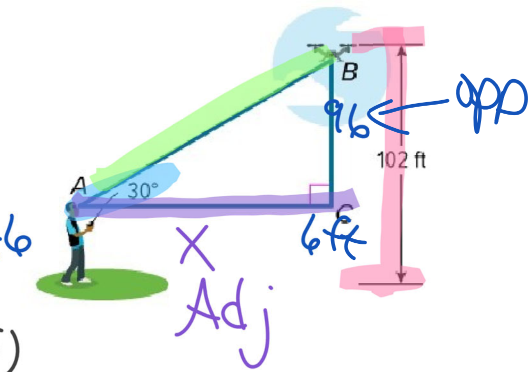
$102 - 6$

$x(\tan 30 = \frac{96}{x})x$

$\frac{x(\tan 30)}{(\tan 30)} = \frac{96}{(\tan 30)}$

0.577

$x \approx 166$



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Example 1 Angle of Elevation

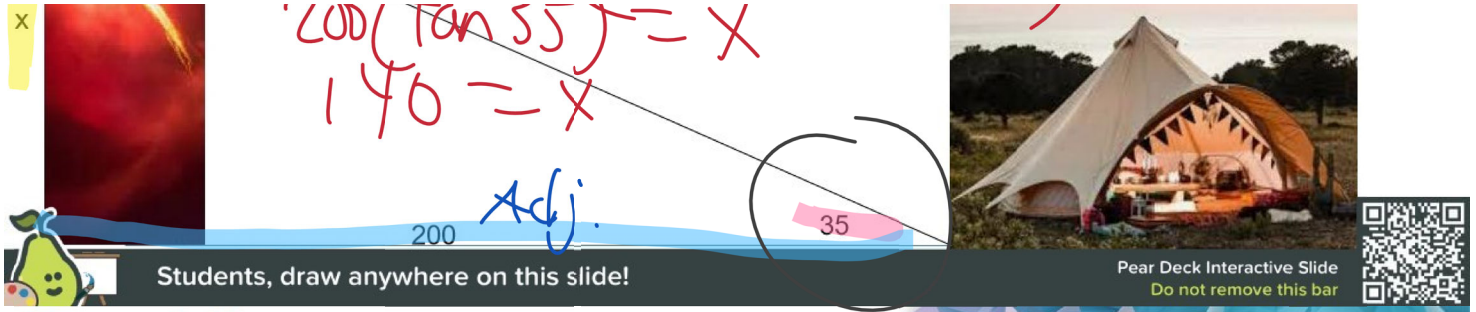
Check

SEARCH AND RESCUE A flare is shot vertically into the air approximately 200 meters from base camp. The angle of elevation from base camp to the maximum height of the flare is 35°. The group at base camp needs to know the altitude of the flare. What is the maximum height of the flare to the nearest meter?

SOH CAH TOA

$200(\tan 35 = \frac{x}{200})200$

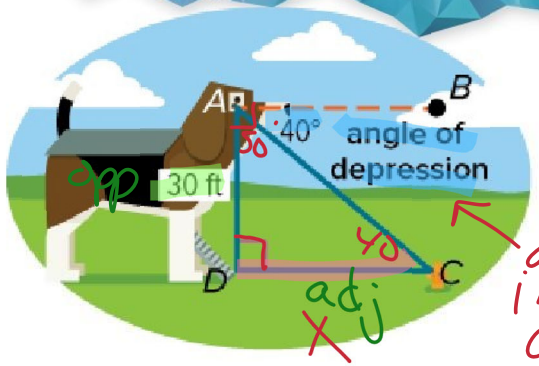
opp

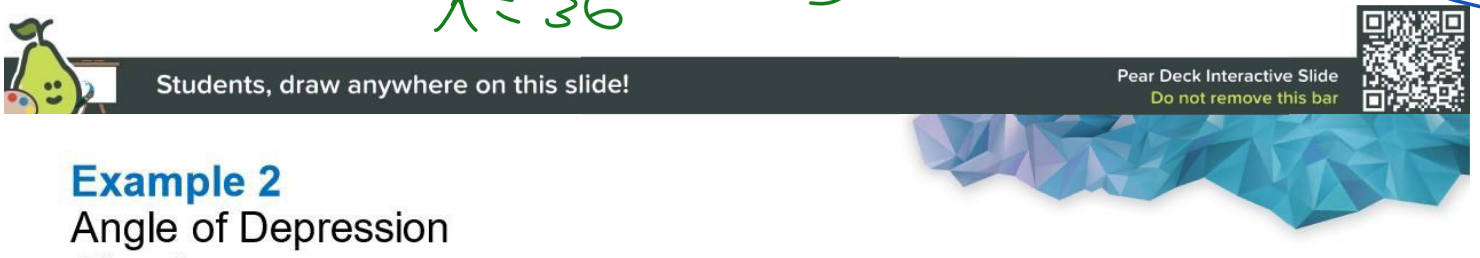


Example 2

Angle of Depression

SIGHTSEEING Cottonwood, Idaho's Dog Bark Park Inn is a popular tourist attraction featuring a hotel in the shape of a 30-foot wood-carved beagle. Pedro looks out the window 30 feet from the ground and spots a fire hydrant on the ground at an estimated angle of depression of 40°. What is the horizontal distance from Pedro to the hydrant to the nearest foot?





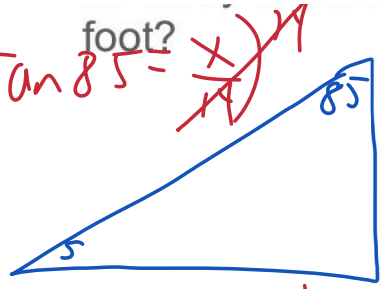
Example 2

Angle of Depression

Check

LIFEGUARDING Braylen stands on an 8-foot platform and sights a swimmer at an angle of depression of 5°. If Braylen is 6 feet tall, how far away is the swimmer from the base of the platform to the nearest

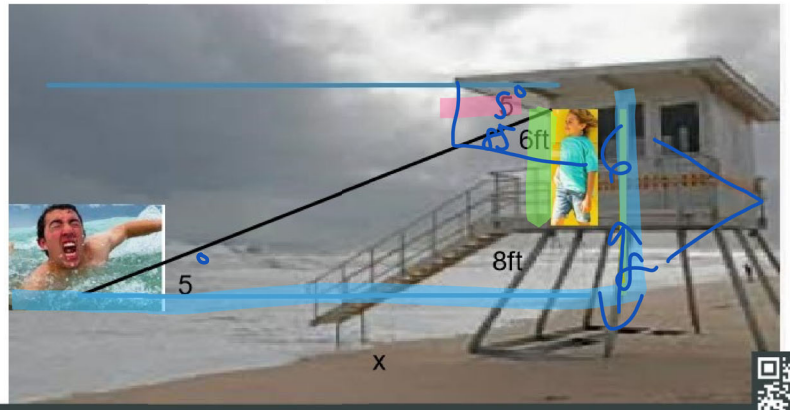
foot?



14 Adj

X = 160 ft

Opp



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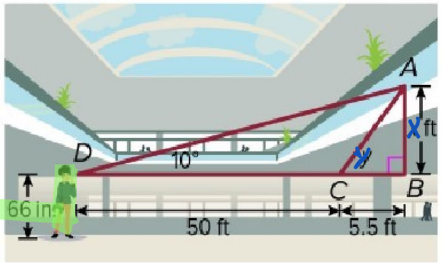
SOH CAH TOA

14 Tan5 = 14/x

Example 3

Use Two Angles of Elevation or Depression

MALL Wei is estimating the height of the second floor in the mall. She sights the second floor at a 10° angle of elevation. She then steps forward 50 feet, until she is 5.5 feet from the wall and sights the second floor again. If Wei's line of sight is 66 inches above the ground, at what angle of elevation does she sight the second floor? Also determine the degrees of angle y.



5.5 ft

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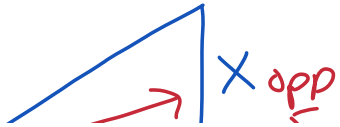
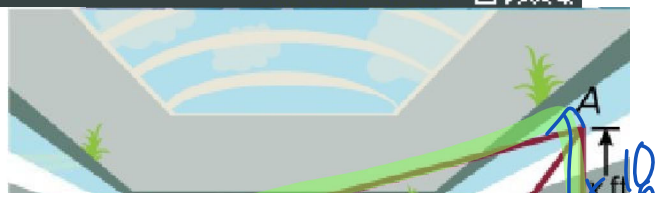
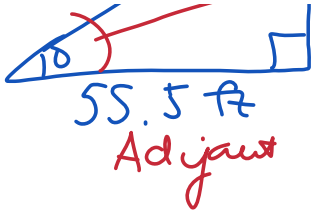
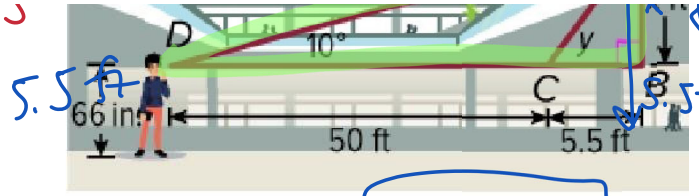




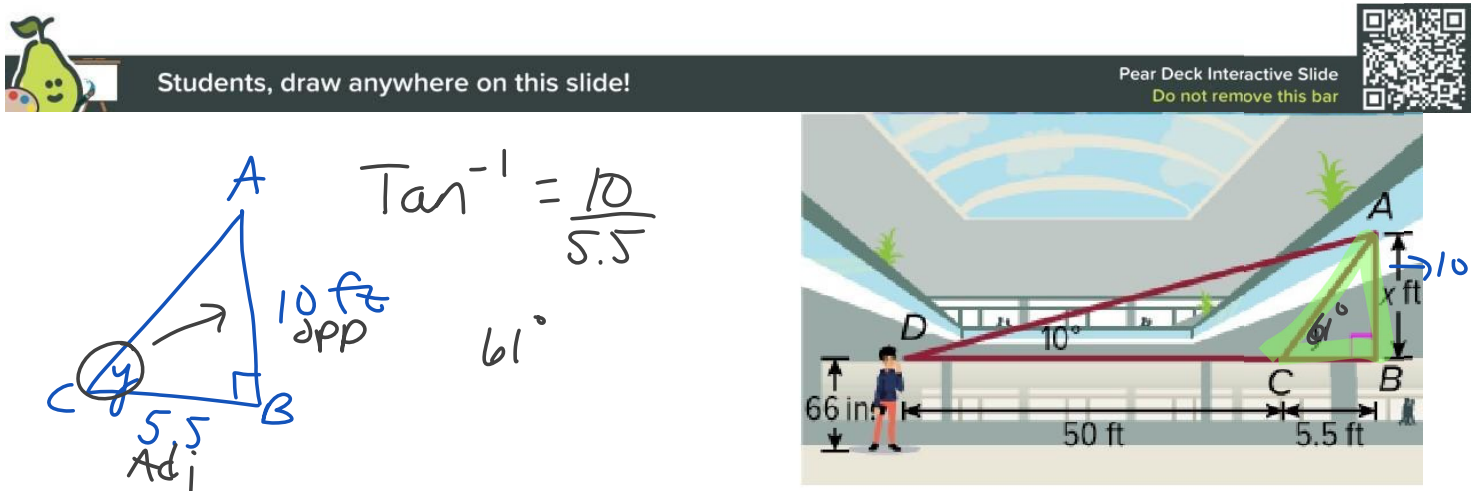


$55.5(\tan 10 = \frac{x}{55.5})$

$55.5(\tan 10) = x$



$10 + 5.5 = \boxed{15.5 \text{ ft}}$



$\tan^{-1} = \frac{10}{5.5}$

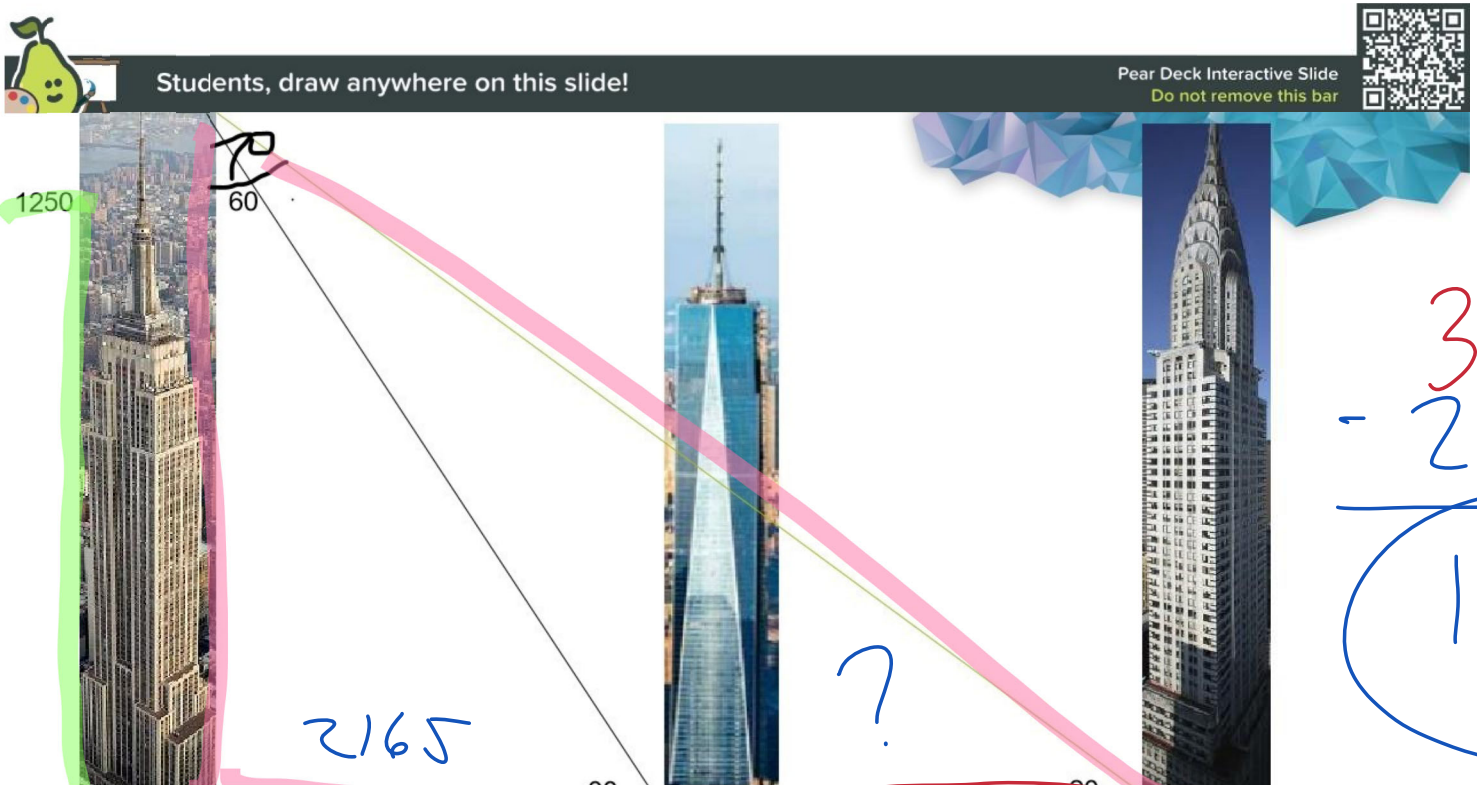
$61°$

Example 3

Use Two Angles of Elevation or Depression

Check

SIGHTSEEING Looking north, two skyscrapers are sighted from the viewing deck of the Empire State Building, which is at a height of 1250 feet. The base of one skyscraper is sighted at a $20°$ angle of depression and the base of a second skyscraper is sighted at a $30°$ angle of depression. How far apart are the two skyscrapers to the nearest foot?



3434
- 2165
1269

Empire State Bld

World Trade Center

Chrysler Building

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1250

70

20

$\tan 70 = \frac{x}{1250}$

$1250(\tan 70) = x$

3,434 ft

x

Att Int ∠'s = Adj

70

1250

Empire State Bld.

Chrysler Building

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1250

60

30

$\tan 60 = \frac{x}{1250}$

1250

1250

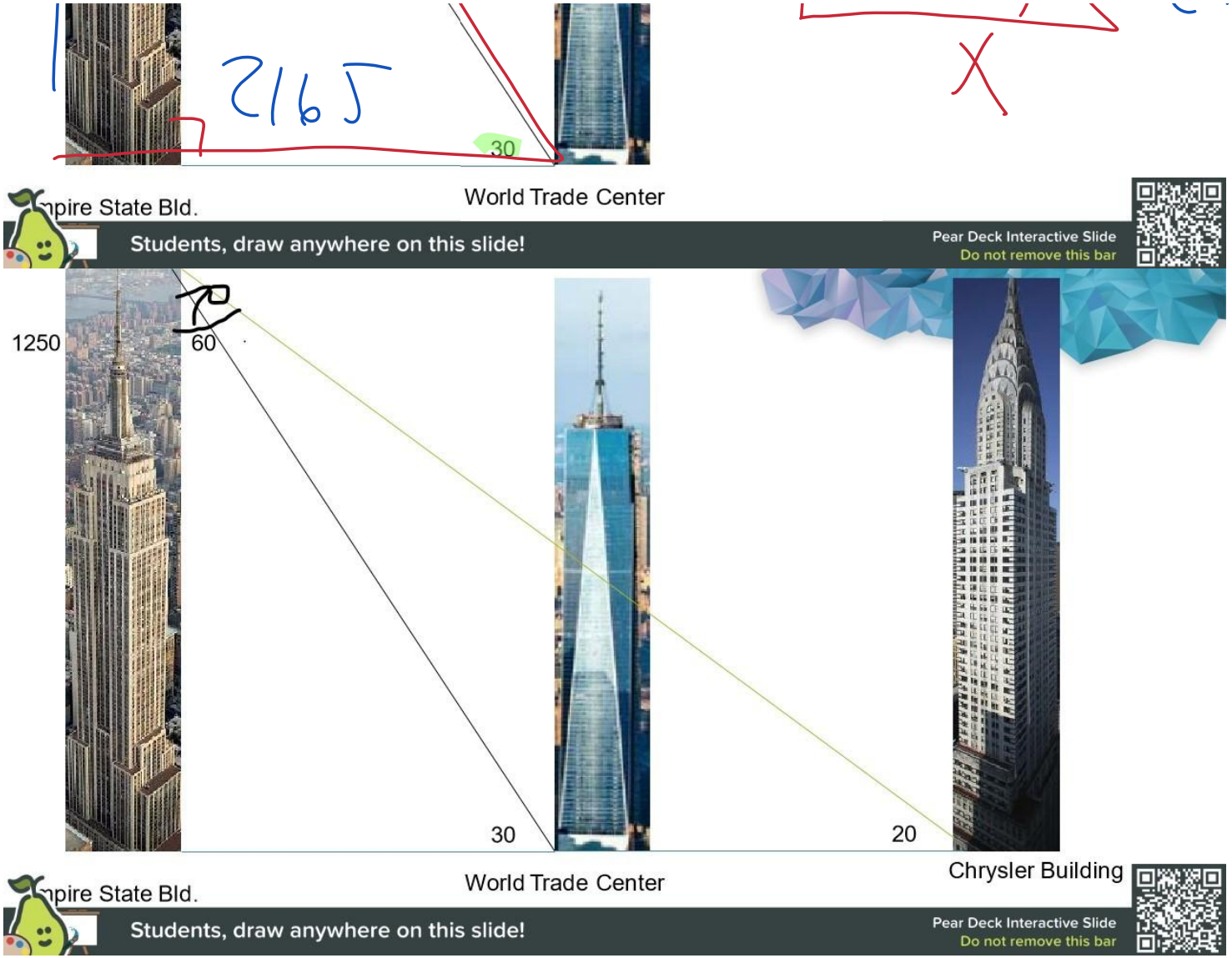
60

30

$x(\tan 30 = \frac{1250}{x}$

$x(\tan 30) = 12$

$(\tan 30)$ tan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30
X
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World Trade Center
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