Lesson 3.10 Perpendiculars & Distance

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Lesson 3.10
Perpendic...

Lesson 3.7 Perpendiculars and Distance

Content Objective
Students use perpendicular lines to find distance.

Key Concept : Distance Between a Point and a Line
The distance between a line and a point not on the line is the length of the segment perpendicular to the line from the point.

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

MA.912.GR.1.1
Prove relationships and theorems about lines and angles. Solve mathematical and real-world problems involving postulates, relationships and theorems of lines and angles.

MA.912.GR.3.3
Use coordinate geometry to solve mathematical and real-world geometric problems involving lines, circles, triangles and quadrilaterals.

triangles and quadrilaterals.

Learn
Distance Between a Point and a Line

Given $\overleftrightarrow{AB}$ and point C not on the line, there are an infinite number of lines that pass through the point and intersect the line. The shortest distance between the point and the line is the length of the segment that is perpendicular to the line through the point. So, the distance between C and $\overleftrightarrow{AB}$ is CD.
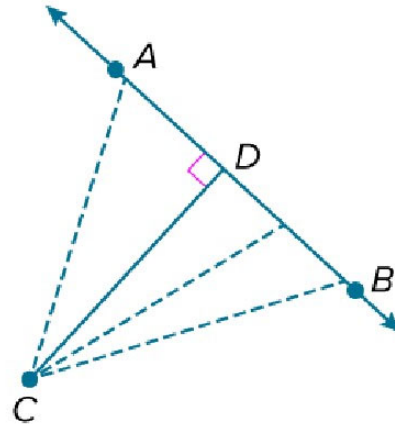
Students, drag the icon!

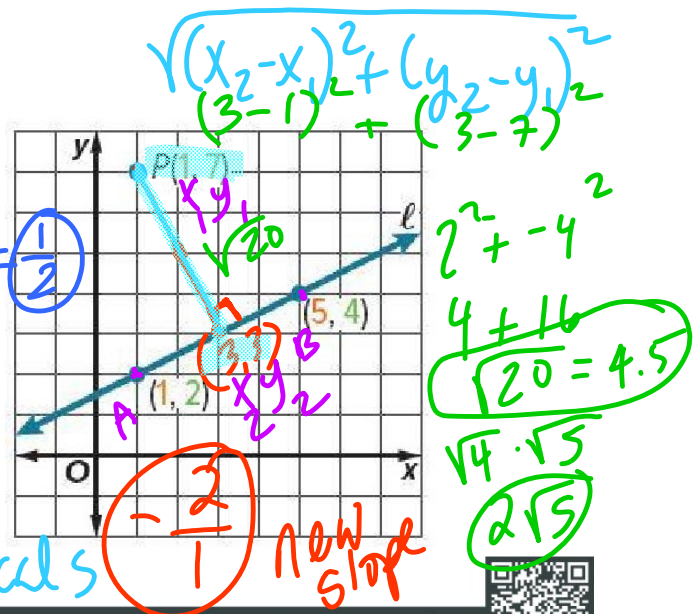Pear Deck Interactive Slide
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Example 1
Distance from a Point to a Line on the Coordinate Plane

Line ℓ contains points (1, 2) and (5, 4). Find the distance between line ℓ and the point $P(1, 7)$.

Handwritten annotations:

$x_1 \, y_1$ (over (1, 2))
$x_2 \, y_2$ (over (5, 4))

1st Step Slope of AB $\frac{2}{4} = \frac{1}{2}$

$\frac{y_2 - y_1}{x_2 - x_1}$

Slopes of parallel lines Same

perpendicular negative reciprocals $\left(-\frac{2}{1}\right)$ new slope

$\sqrt{(x_2-x_1)^2 + (y_2-y_1)^2}$

$(3-1)^2 + (3-7)^2$

$2^2 + -4^2$

$4 + 16$

$\sqrt{20} = 4.5$

$\sqrt{4} \cdot \sqrt{5}$

$2\sqrt{5}$

$\sqrt{20}$

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Example 1
Distance from a Point to a Line on the

Example 1
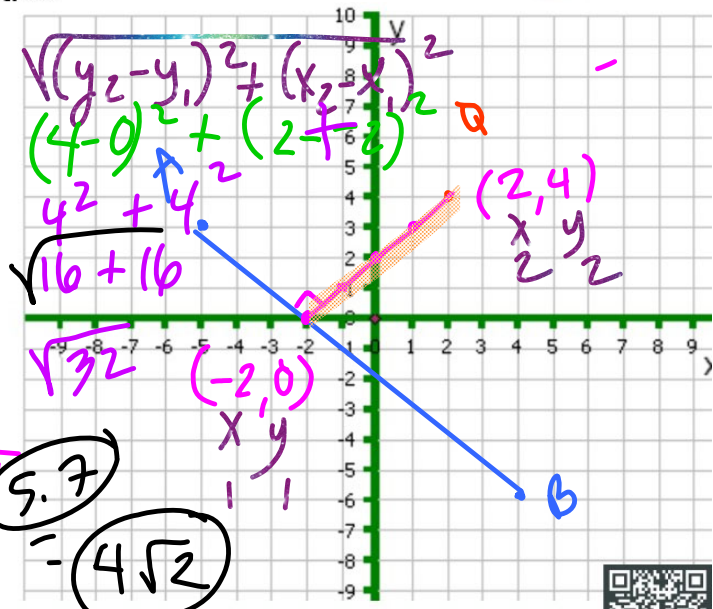### Distance from a Point to a Line on the Coordinate Plane

Check

Line n contains points $(-5, 3)$ and $(4, -6)$. Find the distance between line n and point $Q(2, 4)$. Round to the nearest tenth, if necessary.

$\dfrac{y_2 - y_1}{x_2 - x_1}$ A   B $\dfrac{Rise}{Run}$

Slope of $\overline{AB}$ $-\dfrac{1}{1}$

new slope neg. reciprocal $\dfrac{1}{1}$

$\sqrt{(y_2 - y_1)^2 + (x_2 - x_1)^2}$

$(4-0)^2 + (2 - -2)^2$ Q

$4^2 + 4^2$

$\sqrt{16 + 16}$

$\sqrt{32}$

$(2, 4)$ $x_2 \, y_2$

$(-2, 0)$ $x_1 \, y_1$

$\sqrt{32} = \boxed{5.7}$

$\sqrt{16} \cdot \sqrt{2} = \boxed{4\sqrt{2}}$
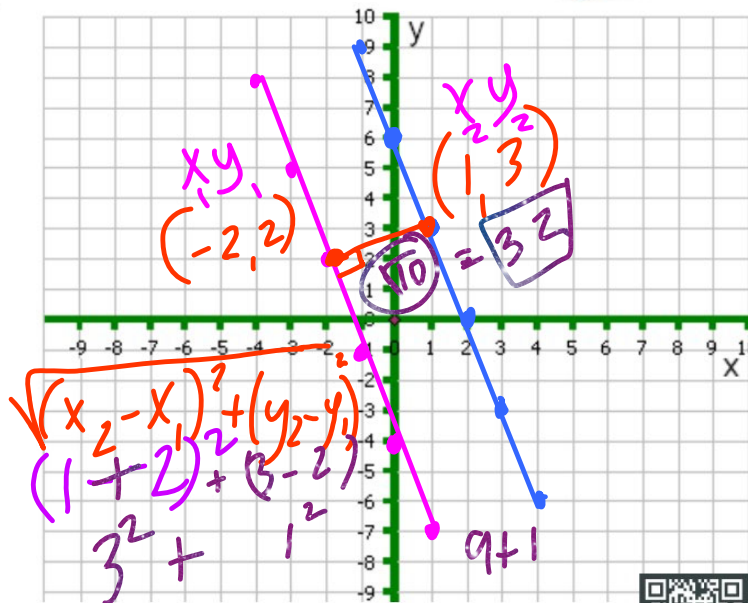
Example 3
Distance Between Parallel Lines

Find the distance between the parallel lines r and t with equations $y = -3x - 4$ and $y = -3x + 6$.

$y = mx + b$

$y = mx + b$
↓ slope → y-int

same slope → parallel lines

$-\dfrac{3}{1}$ new slope perp $= \dfrac{1}{3}$

$(-2, 2)$ $x_1 \, y_1$

$(1, 3)$ $x_2 \, y_2$

$\boxed{10} = 3 \cdot 2$

$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$(1 + 2)^2 + (3 - 2)^2$

$3^2 + 1^2$

$9 + 1$

Example 3
Distance Between Parallel Lines

Check

Find the distance between parallel lines a and b with equations $x + 3y = 6$ and $x + 3y = -24$, respectively. Round to the nearest hundredth, if necessary.

$y = mx + b$

$x + 3y = 6$
$-1x \qquad -1x$

$3y = -1x + b$

equations $x + 3y = 6$ and $x + 3y = -24$, respectively.
Round to the nearest hundredth, if necessary.

$-1x + 3y = -24$
$\underline{-1x \qquad\qquad -1x}$

$\dfrac{3y}{3} = \dfrac{-1x}{3} - \dfrac{24}{3}$

$y = -\dfrac{1}{3}x - 8$

※Same Slope parallel lines

$\dfrac{3y}{3} = \dfrac{-1x}{3} + \dfrac{6}{3}$

$y = -\dfrac{1}{3}x + 2$

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$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$(3-0)^2 + (1 + 8)^2$

$3^2 + 9^2$

$9 + 81$

$\sqrt{90} = 9.5$

$\sqrt{9}\ \sqrt{10}$

$3\sqrt{10}$

(x_2, y_2)
$(3, 1)$

$(6, 0)$

$\sqrt{90}$

$(3, -9)$

$(0, -8)$

original slope $-\dfrac{1}{3}$

new slope negative Reciprocal $\dfrac{3}{1}$

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