Finding Distance with the Pythagorean Theorem

Applications and design

Name _____ **Date** _____ **Score** _____ / 6

QUICK REVIEW

Between (x_1, y_1) and (x_2, y_2), horizontal and vertical changes are $\Delta x = x_2 - x_1$ and $\Delta y = y_2 - y_1$. These form perpendicular legs, so $d = \sqrt{(\Delta x)^2 + (\Delta y)^2}$. Subtract negative coordinates carefully. A horizontal or vertical segment needs only one absolute difference. Multiply the final grid distance by the map scale, and round only the final length.

Worked example

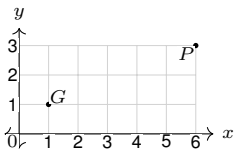
Find the distance from $E(-2, 1)$ to $F(3, 4)$. Give an exact value; round nonintegers to the nearest tenth.

1. The coordinate changes are $\Delta x = 3 - (-2) = 5$ and $\Delta y = 4 - (1) = 3$. They form perpendicular legs on the grid.
2. At 1 units per grid step, $d^2 = 1^2[(5)^2 + (3)^2] = 34$ square units. This scales both perpendicular lengths before squaring.
3. Take the positive root: $d = \sqrt{34} \approx 5.8$ units. Negative coordinate changes do not make the distance negative; round only this final length.
Answer: $\sqrt{34} \approx 5.8$ units

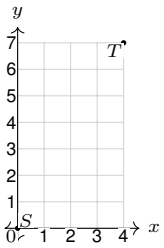
Practice Problems

Show your thinking.

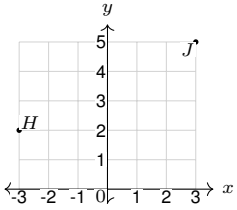
1. Gate $G(1, 1)$ and pond $P(6, 3)$ are on a map with 10 m per step. Find direct separation. Give an exact value; round nonintegers to the nearest tenth.



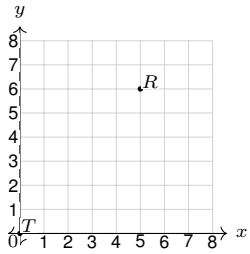
2. Sprinklers are at $S(0, 0), T(4, 7)$ meters. Find their straight-line spacing. Give an exact value; round nonintegers to the nearest tenth.



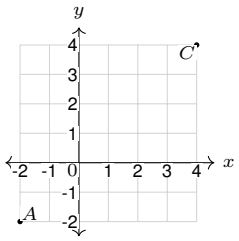
3. A cable joins hooks $H(-3, 2), J(3, 5)$ cm. Find its minimum straight length. Give an exact value; round nonintegers to the nearest tenth.



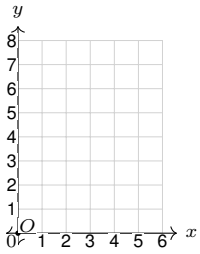
4. Transmitter $T(0, 0)$ has radius 8 km. Receiver $R(5, 6)$ uses kilometer coordinates. Is it covered? Compare squares.



5. A square garden has diagonal endpoints $A(-2, -2), C(4, 4)$ meters. Find its diagonal and area exactly.



6. In meter coordinates, design and plot $P(6, y)$ exactly 10 m from $O(0, 0)$, with $y > 0$.



Answer Key

1. $10\sqrt{29} \approx 53.9$ m
2. $\sqrt{65} \approx 8.1$ m
3. $\sqrt{45} \approx 6.7$ cm
4. Yes; $\sqrt{61}\text{km} < 8\text{km}$.
5. $6\sqrt{2}\text{m}$; 36m^2.
6. $P = (6, 8)$; $OP = 10\text{m}$.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. The coordinate changes are $\Delta x = 6 - (1) = 5$ and $\Delta y = 3 - (1) = 2$. They form perpendicular legs on the grid.

2. At 10 m per grid step, $d^2 = 10^2[(5)^2 + (2)^2] = 2900$ m^2. This scales both perpendicular lengths before squaring.

3. Take the positive root: $d = 10\sqrt{29} \approx 53.9$ m. Negative coordinate changes do not make the distance negative; round only this final length.

Problem 2

1. The coordinate changes are $\Delta x = 4 - (0) = 4$ and $\Delta y = 7 - (0) = 7$. They form perpendicular legs on the grid.

2. At 1 m per grid step, $d^2 = 1^2[(4)^2 + (7)^2] = 65$ m^2. This scales both perpendicular lengths before squaring.

3. Take the positive root: $d = \sqrt{65} \approx 8.1$ m. Negative coordinate changes do not make the distance negative; round only this final length.

Problem 3

1. The coordinate changes are $\Delta x = 3 - (-3) = 6$ and $\Delta y = 5 - (2) = 3$. They form perpendicular legs on the grid.

2. At 1 cm per grid step, $d^2 = 1^2[(6)^2 + (3)^2] = 45$ cm^2. This scales both perpendicular lengths before squaring.

3. Take the positive root: $d = \sqrt{45} \approx 6.7$ cm. Negative coordinate changes do not make the distance negative; round only this final length.

Problem 4

1. The receiver distance satisfies $TR^2 = 5^2 + 6^2 = 61\text{km}^2$.

2. The squared coverage radius is $8^2 = 64\text{km}^2$. Thus $TR = \sqrt{61}\text{km} < 8\text{km}$.

3. The receiver is covered because $61\text{km}^2 < 64\text{km}^2$. Exact squares avoid a rounded boundary decision.

Problem 5

1. The changes are $6, 6$, so $d^2 = 6^2 + 6^2 = 72\text{m}^2$ and $d = 6\sqrt{2}\text{m}$.

2. For a square, $d^2 = 2s^2$, so $s^2 = 72/2 = 36\text{m}^2$.

3. The area is 36m^2. Its side is 6m, shorter than diagonal $6\sqrt{2}\text{m}$; using d^2 as area would double the result.

Problem 6

1. The distance condition is $6^2 + y^2 = 10^2$, so $36 + y^2 = 100\text{m}^2$.

2. Thus $y^2 = 64\text{m}^2$, and $y = 8$ because the height must be positive.

3. Plot $P = (6, 8)$. The check $\sqrt{36 + 64} = 10\text{m}$ verifies distance; $8 > 0$ verifies the design constraint.

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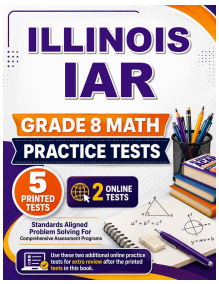

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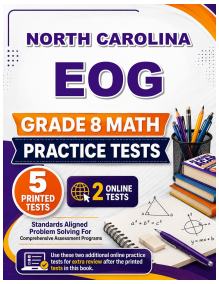

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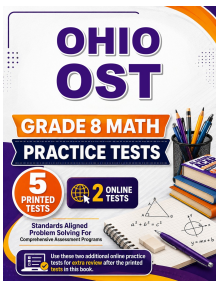

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