Right-Triangles — Answers & Explanation Guide

Based on your assignment: test.pdf

This is a right-triangles unit test with six multi-part problems: plotting and classifying a triangle on a coordinate grid, a square playground diagonal, a ladder-against-a-house problem, an equilateral triangle split into two 30-60-90 triangles, a baseball-diamond diagonal, and a 30-60-90/60-90-30 dolphin-spotting diagram with distances labeled on the given figure. All numbers used below (the 55-meter walkway, the 12-foot ladder and 5-foot base, the 8-inch equilateral triangle, the 90-foot base path, and the 30°/60°/100-foot dolphin diagram) come directly from the worksheet text and the images provided.

Question 1 — 10 pts

Part I: Plot and connect A(1,-3), B(3,-1), C(5,-3); find the distance between A and C; mark the right angle at B; find and label the measures of angles A and C. Part II: Identify the type of triangle. Part III: Find the unknown side lengths AB and BC.

REFERENCE — Triangle Angle Sum Theorem

The three interior angles of any triangle add up to 180°.

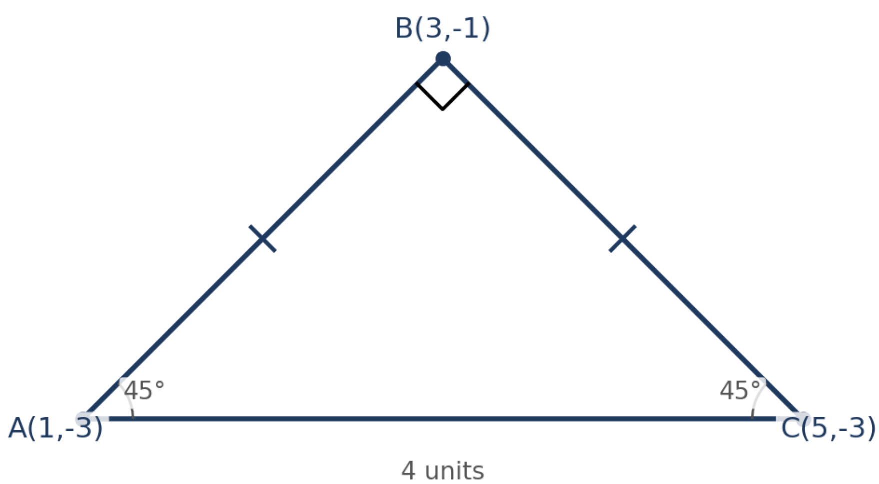
REFERENCE — Distance Formula

The distance between points (x1,y1) and (x2,y2) is √[(x2-x1)² + (y2-y1)²], derived from the Pythagorean Theorem.

REFERENCE — 45-45-90 Triangle Theorem

In a right isosceles triangle, the hypotenuse equals a leg length times √2.

Right isosceles triangle: A(1,-3), B(3,-1), C(5,-3)



A coordinate grid with points A(1,-3), B(3,-1), C(5,-3) plotted and connected into a triangle; a right-angle mark at B; '45°' labels at A and C; and '4 units' labeled along segment AC.

ANSWER

Part I(a) — Plotting: On your grid, plot A at (1, -3), B at (3, -1), and C at (5, -3), then draw segments AB, BC, and CA to connect them into a triangle. Since this is a 'draw/label' part of a hand-graded test, your grader needs to actually SEE three labeled points and three drawn segments — not just the answer written in words.

Part I(b) — Distance AC: Notice A and C both have y-coordinate -3, so segment AC is horizontal. For a horizontal segment you can just subtract the x-coordinates.

AC = 5 - 1 = 4 units

On your graph, mark this by writing '4 units' along the segment from A to C.

Part I(c) — Right angle at B: Since you're told angle B is the right angle, draw the small square 'right angle' symbol inside the triangle at vertex B, in the corner formed by segments BA and BC.

Part I(d) — Angles A and C: Every triangle's interior angles sum to 180° (Triangle Angle Sum Theorem). You're told angle B = 90° and angle A = angle C.

180° = angle A + angle B + angle C

180° = angle A + 90° + angle A (since angle A = angle C)

90° = 2 × angle A

angle A = 45°, and therefore angle C = 45° too

Label both A and C as 45° on your graph.

Part II — Type of triangle: With one 90° angle and two equal 45° angles (and, as Part III confirms, two equal legs), this is a right isosceles triangle.

Part III — Finding AB and BC: Use the Distance Formula, which comes straight from the Pythagorean Theorem applied to the horizontal and vertical distance between two points: distance = $\sqrt{(x2-x1)^2 + (y2-y1)^2}$.

AB: from A(1,-3) to B(3,-1)

AB = $\sqrt{(3-1)^2 + (-1-(-3))^2}$

AB = $\sqrt{2^2 + 2^2} = \sqrt{4+4} = \sqrt{8} = 2\sqrt{2} \approx 2.8$ units

BC: from B(3,-1) to C(5,-3)

BC = $\sqrt{(5-3)^2 + (-3-(-1))^2}$

BC = $\sqrt{2^2 + (-2)^2} = \sqrt{4+4} = \sqrt{8} = 2\sqrt{2} \approx 2.8$ units

Check this against Part I: since angle B = 90°, AC should be the hypotenuse of a 45-45-90 triangle, so AC = leg × √2 = 2√2 × √2 = 4 — and that matches the AC = 4 found in Part I(b) exactly, so everything is consistent.

IN SHORT

You plot the three points, see that AC is a flat horizontal line of length 4, and since angle B is 90° with A and C equal, each of those angles is 45°. That makes it a right isosceles triangle, and using the Distance Formula both legs AB and BC come out to 2√2 (about 2.8 units) — which checks out perfectly with a 45-45-90 triangle's hypotenuse being leg×√2.

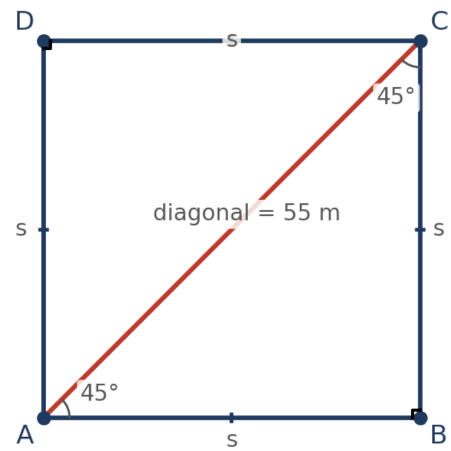
Question 2 8 pts

The South Memorial School playground is square, with a diagonal walkway 55 meters long. Part I: Sketch the playground and find the length of one side, rounded to the nearest tenth. Part II: Use that answer to find the perimeter, rounded to the nearest tenth.

REFERENCE — 45-45-90 Triangle Theorem

In a right isosceles triangle (like the two halves of a square split by its diagonal), the hypotenuse equals a leg times √2.

Square with diagonal splitting it into two 45-45-90 right triangles



A square labeled with all four sides equal to 's', a diagonal line drawn corner to corner labeled '55 m', splitting the square into two right triangles.

ANSWER

Part I — Finding the side length: A square's diagonal cuts it into two 45-45-90 right triangles, so the diagonal is always leg × √2 (the 45-45-90 Triangle Theorem, which is really just the Pythagorean Theorem applied to a right isosceles triangle: $s^2 + s^2 = d^2$, so $d = s\sqrt{2}$).

Given: diagonal d = 55 meters

$d = s\sqrt{2}$

$55 = s\sqrt{2}$

$s = 55 \div \sqrt{2}$

$s = 55 \div 1.41421356...$

$s \approx 38.9$ meters (rounding to the nearest tenth)

Part II — Finding the perimeter: A square has 4 equal sides, so perimeter = 4 × side.

Perimeter = 4×38.9

Perimeter ≈ 155.6 meters (rounding at the end)

IN SHORT

The diagonal of a square splits it into two 45-45-90 triangles, so side = diagonal ÷ √2. With a 55-meter diagonal, each side is about 38.9 meters, and multiplying by 4 gives a perimeter of about 155.6 meters.

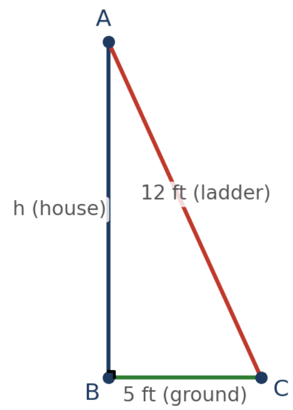
Question 3 — 6 pts

Ken leans a 12-foot ladder against his house, with the base 5 feet from the house. Part I: Sketch and label a figure of the scenario. Part II: Set up and solve an equation to find how far up the house the ladder reaches, rounded to the nearest tenth.

REFERENCE — Pythagorean Theorem

$a^2 + b^2 = c^2$ for a right triangle with legs a, b and hypotenuse c.

Ladder against a house: right triangle with base 5 ft, ladder 12 ft, height h



A right triangle: vertical line for the house, horizontal line for the ground meeting it at a right angle, and the ladder as the hypotenuse connecting the top of the wall to a point 5 ft out on the ground; label the base 5 ft, the ladder 12 ft, and the unknown height h.

ANSWER

Part I — The sketch: Draw a right triangle where the house is the vertical leg, the ground is the horizontal leg, and the ladder is the hypotenuse leaning against the house. Label the ground distance (base of ladder to house) as 5 feet, the ladder itself as 12 feet (the hypotenuse, since it's the side opposite the right angle formed where the wall meets the ground), and mark the unknown height up the wall as 'h'. Since this is a hand-graded sketch question, make sure your triangle actually shows the right angle where the house meets the ground, and all three sides are labeled with their values (5 ft, 12 ft, h).

Part II — Solving for h: The ladder, house, and ground form a right triangle, so the Pythagorean Theorem applies: $a^2 + b^2 = c^2$, where c is the hypotenuse.

Given: base = 5 ft, ladder (hypotenuse) = 12 ft, height = h

$5^2 + h^2 = 12^2$

$25 + h^2 = 144$

$h^2 = 144 - 25$

$h^2 = 119$

$h = \sqrt{119}$

$h \approx 10.9$ feet (rounding to the nearest tenth)

IN SHORT

The ladder, wall, and ground make a right triangle, so the Pythagorean Theorem ($5^2 + h^2 = 12^2$) gives $h = \sqrt{119}$, which is about 10.9 feet up the house.

Question 4 12 pts

An equilateral triangle has sides 8 inches long. Part I: Draw and label the triangle, its angle measures, an altitude splitting it into two congruent triangles, their angle measures, and the base of each smaller triangle. Part II: Find the height in simplest radical form. Part III: Find the area in simplest radical form.

REFERENCE — Triangle Angle Sum Theorem

The three interior angles of any triangle add up to 180°.

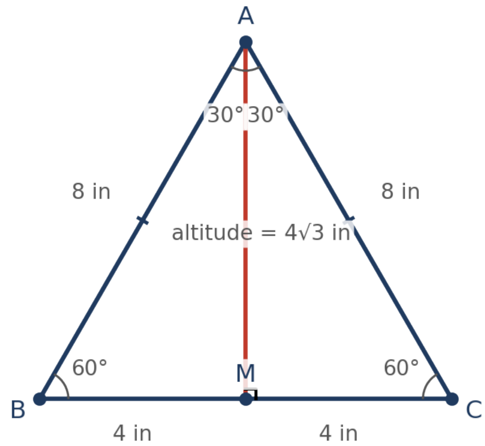
REFERENCE — 30-60-90 Triangle Theorem

In a 30-60-90 right triangle, the hypotenuse is twice the shorter leg, and the longer leg equals the shorter leg times √3.

REFERENCE — Triangle Area Formula

Area = ½ × base × height.

Equilateral triangle (8 in) split by altitude into two 30-60-90 triangles



An equilateral triangle with all sides labeled 8 in and all angles labeled 60°, with a dashed altitude drawn from the top vertex to the midpoint of the base, a right-angle mark at the base, the two base segments each labeled 4 in, and the two resulting right triangles labeled with 30°, 60°, 90° angles.

ANSWER

Part I(a) — Draw the triangle: Sketch a triangle with all three sides labeled 8 inches (since it's equilateral, all sides are equal).

Part I(b) — Angle measures: In any equilateral triangle all three angles are equal, and since they must sum to 180° (Triangle Angle Sum Theorem), each angle measures 180° ÷ 3 = 60°. Label all three vertices 60° on your drawing.

Part I(c) — Draw the altitude: Draw a straight line from the top vertex straight down to the midpoint of the base, meeting the base at a right angle. This altitude is also a line of symmetry — draw it as an actual perpendicular segment with a small right-angle box where it meets the base, since a grader needs to see the perpendicular mark, not just hear it described.

Part I(d) — Angle measures of the two new triangles: The altitude splits the original 60° top angle into two 30° angles (since it bisects the equilateral triangle exactly down the middle), it creates a 90° angle where it meets the base, and it leaves the original 60° angle at each bottom vertex untouched. So each of the two smaller triangles has angles of 30°, 60°, and 90° — label all three angles on both small triangles.

Part I(e) — Base of each small triangle: The altitude hits the exact midpoint of the original 8-inch base (because the two small triangles are congruent by the Hypotenuse-Leg or ASA reasoning — they share the altitude, have equal 8-inch hypotenuses, and equal 60° base angles). So each small triangle's base is half of 8, which is 4 inches. Label 4 inches on each side of the altitude's foot.

Part II — Height of the equilateral triangle: Each small triangle is a 30-60-90 triangle where the shorter leg is 4 inches (the half-base, opposite the 30° angle) and the height is the longer leg (opposite the 60° angle).

The 30-60-90 Triangle Theorem says the longer leg equals the shorter leg times $\sqrt{3}$.

Given: shorter leg = 4 inches

height = $4 \times \sqrt{3}$

height = $4\sqrt{3}$ inches (this is already in simplest radical form)

Part III — Area of the equilateral triangle: Use the Triangle Area Formula, Area = ½ × base × height, with the ORIGINAL base (8 inches, not the half-base) and the height you just found.

Area = ½ × base × height

Area = $\frac{1}{2} \times 8 \times 4\sqrt{3}$

Area = $\frac{1}{2} \times 32\sqrt{3}$

Area = $16\sqrt{3}$ square inches

IN SHORT

Splitting the equilateral triangle down the middle gives two 30-60-90 triangles with a short leg of 4 inches, so the height (the long leg) is $4\sqrt{3}$ inches. Using the full base of 8 inches and that height, the area works out to $16\sqrt{3}$ square inches.

Question 5 5 pts

On the square baseball diamond shown, the distance from first base to second base is 90 feet. How far does the catcher have to throw the ball from home plate to reach second base? Round to the nearest tenth.

REFERENCE — 45-45-90 Triangle Theorem

In a right isosceles triangle, the hypotenuse equals a leg length times √2.

ANSWER

Looking at the diagram, home plate, first base, second base, and third base form a square, and the right-angle mark at home plate shows that the throw from home to second base is the diagonal of that square, cutting it into two 45-45-90 right triangles.

Given: each side of the diamond (like first-to-second base) = 90 feet

By the 45-45-90 Triangle Theorem, the diagonal equals a leg times $\sqrt{2}$:

diagonal = $90 \times \sqrt{2}$

diagonal = $90 \times 1.41421356...$

diagonal ≈ 127.3 feet (rounding to the nearest tenth)

IN SHORT

Home plate to second base is the diagonal of the square diamond, and since each side is 90 feet, the diagonal is 90 × √2, which comes out to about 127.3 feet.

Question 6 — 8 pts

Rex (B), Paulo (D), and Ben (A) are on shore watching a dolphin (C) that surfaces about 100 feet directly in front of Paulo. The diagram shows a right angle at D (Paulo, on segment BA), a 30° angle at B (Rex), a 60° angle at A (Ben), and CD as the altitude from the dolphin down to line BA. Part I: Using triangle BCD, find the distance between Rex and the dolphin, and between Rex and Paulo (distance between Paulo and the dolphin is exactly 100 feet). Part II: Using triangle ACD, find the distance between Ben and Paulo, and between Ben and the dolphin.

REFERENCE — Triangle Angle Sum Theorem

The three interior angles of any triangle add up to 180°.

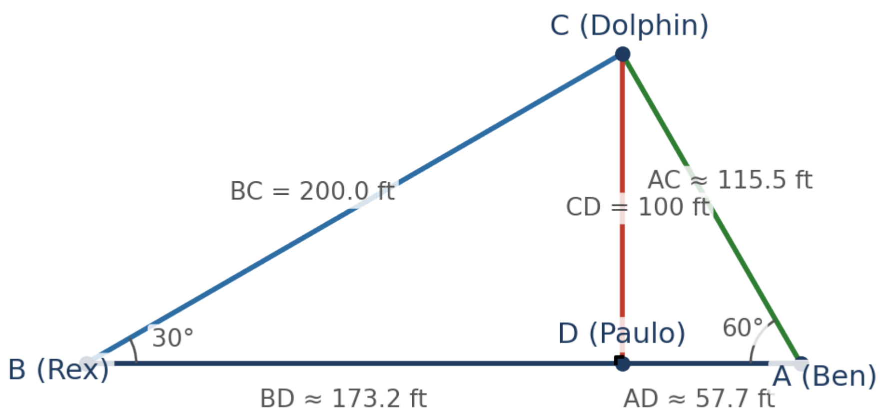
REFERENCE — 30-60-90 Triangle Theorem

In a 30-60-90 right triangle, the hypotenuse is twice the shorter leg (opposite the 30° angle), and the longer leg (opposite the 60° angle) equals the shorter leg times √3.

REFERENCE — Right Triangle Altitude (Geometric Mean) Relationship

When the altitude is drawn from the right angle of a right triangle to its hypotenuse, that altitude length squared equals the product of the two segments it creates on the hypotenuse.

Dolphin sighting: triangle ABC with altitude CD to shoreline



This diagram is already given: triangle with B (Rex) and A (Ben) on the shoreline, D (Paulo) between them on that same line with a right-angle mark, C (Dolphin) above D connected by segment CD; 30° labeled at B, 60° labeled at A; label CD = 100 ft, BD ≈ 173.2 ft, BC = 200.0 ft, AD ≈ 57.7 ft, and AC ≈ 115.5 ft on the figure.

ANSWER

First, let's set up what the diagram tells us. Paulo stands at D, directly in front of the dolphin at C, so segment CD is vertical and CD = 100 feet (given). D also has a right-angle mark, meaning CD is perpendicular to line BA — so CD is the altitude of the big triangle from the dolphin down to the shoreline.

Part I — Triangle BCD (Rex's triangle): This triangle has a right angle at D, and 30° at B (Rex), so the third angle, at C, must be 60° (since 90° + 30° + 60° = 180°, satisfying the Triangle Angle Sum Theorem).

The hint tells us: in a 30-60-90 triangle, the shorter leg is opposite the 30° angle, the longer leg is opposite the 60° angle, and the hypotenuse (opposite the 90° angle) is twice the shorter leg.

In triangle BCD, side CD is opposite the 30° angle at B, so CD = 100 ft is the SHORTER leg.

Hypotenuse BC (distance Rex-to-dolphin) is opposite the right angle:

BC = 2 × shorter leg = 2 × 100 = 200.0 feet

Longer leg BD (distance Rex-to-Paulo) is opposite the 60° angle at C:

BD = shorter leg × $\sqrt{3}$ = 100 × $\sqrt{3}$

BD = 100 × 1.7320508...

BD ≈ 173.2 feet (rounding to one decimal place)

So: Distance between Rex and the dolphin = 200.0 feet, and distance between Rex and Paulo ≈ 173.2 feet.

Part II — Triangle ACD (Ben's triangle): This triangle has a right angle at D and 60° at A (Ben), so the third angle, at C, must be 30° (since 90° + 60° + 30° = 180°).

Here, side CD is opposite the 60° angle at A, so CD = 100 ft is now the LONGER leg (a different role than in Part I, because the 60°/30° angles are swapped between the two smaller triangles).

Longer leg = shorter leg × $\sqrt{3}$, so:

shorter leg AD = CD ÷ $\sqrt{3}$ = 100 ÷ $\sqrt{3}$

AD = 100 ÷ 1.7320508...

AD ≈ 57.7 feet (rounding to one decimal place) — this is the distance between Ben and Paulo

Hypotenuse AC (distance Ben-to-dolphin) = 2 × shorter leg:

AC = 2 × 57.7350... = 115.4701...

AC ≈ 115.5 feet (rounding to one decimal place)

Check for consistency: A nice built-in check here is the geometric mean (altitude-on-hypotenuse) relationship for the big right triangle ABC (which has its own right angle at C, since 30° + 60° + 90° = 180° across the whole triangle ABC). That relationship says CD^2 should equal BD × AD.

$CD^2 = 100^2 = 10{,}000$

BD × AD = 173.205... × 57.735... = 10,000.0 (matches exactly, confirming the answers are consistent)

IN SHORT

Both triangle BCD and triangle ACD are 30-60-90 triangles sharing the same short vertical side (Paulo-to-dolphin = 100 ft), but that 100-foot side plays a different role in each (it's the short leg for Rex's triangle, but the long leg for Ben's triangle) because the 30° and 60° angles are on opposite sides. That gives Rex-to-dolphin = 200.0 ft, Rex-to-Paulo ≈ 173.2 ft, Ben-to-Paulo ≈ 57.7 ft, and Ben-to-dolphin ≈ 115.5 ft, and these all check out together using the altitude relationship in the big triangle.

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