

ANSWER MAZE

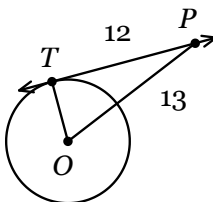
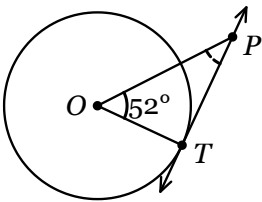


TANGENT LINES AND THE RADIUS

Tangent Lines and the Radius

The right angle at the point of tangency · one page · 10–15 minutes · nothing to prepare

FREE

 3 Find the diameter. Line TP is tangent at T. O is the center. $5 \rightarrow$ go to box 4 $10 \rightarrow$ go to box 7 <i>Hint: Which length does the question ask for?</i>	 7 Find angle OPT. Line TP is tangent at T. O is the center. $38^\circ \rightarrow$ go to box 1 $128^\circ \rightarrow$ go to box 6 <i>Hint: What angle stands at the point of tangency?</i>
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1. **Hand out page 3**, one per student. Scrap paper helps. A calculator is not needed.
2. **Say this once:** *“Start at box 3. When a box says a line is tangent, draw the right angle at the point of tangency first. Every number answer is a whole number. Box 5 asks: tangent or not? Write every box number in the row at the bottom as you go.”*
3. **Check a sheet quickly.** A student with no mistakes writes **3 7 1 5 8 2**: six boxes, then out.

Student sheet page 3, one per student, and scrap paper for working.
Answers page 4.

Every box shows a circle drawn to scale, with its center O, a point T on the circle and a line through T and a point P. No box marks the right angle at T. The radius drawn to the point of tangency is perpendicular to the tangent line, so the student must put the right angle there. This sheet calls a tangent a line that touches the circle at exactly one point. Some textbooks use other definitions, so tell the class which ones this sheet uses.

Every wrong answer comes from one of two mistakes. In the first, the student gives the diameter when the box asks for the radius, or the radius when it asks for the diameter. These wrong answers send the student to box 4. In the second, the student loses track of the right angle at T. Either the angles of the triangle are taken to add to 180° without the 90° at T, or, in box 5, a right angle is found but put at the wrong corner. The numbers 12, 16, 20 fit the Pythagorean theorem, but the longest side is TP, so the right angle is at O and line TP is not tangent. These wrong answers send the student to box 6. Boxes 4 and 6 ask the same kind of question again, and both of their answers lead back to the route.

The row at the bottom is the check. A clean run is six numbers. Each wrong answer adds at least one more. Guessing does not get a student out: every simple guessing rule, such as always taking the larger number, goes wrong within the first two boxes.



This is the free lesson this activity came from. The worksheet, the full answers and the lesson plan are on it, at three levels of difficulty.
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Answer Maze — tangent lines and the radius

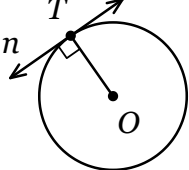
Start at box 3

Name _____

Period _____

Date _____

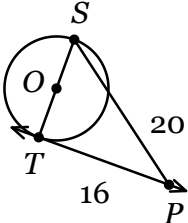
Start at box 3. **Every number answer is a whole number.** Pick one answer and go to the box it names. Write each box number in the row at the bottom as you go.



Tangent → right angle: a tangent line is perpendicular to the radius drawn to the point of tangency.

Right angle → tangent: a line through a point of the circle that is perpendicular to the radius there is a tangent line.

A diameter is twice as long as a radius.



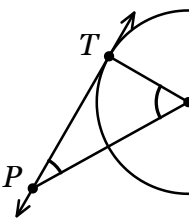
1 Find the radius.

Line TP is tangent at T . ST is a diameter, and O is the center.

12 → go to box 4

6 → go to box 5

Hint: Which part of the diameter is a radius?



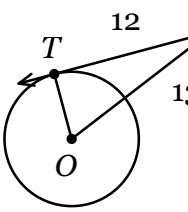
2 Find angle TOP.

Line TP is tangent at T . O is the center. Angle $OPT = (x + 6)^\circ$ and angle $TOP = (2x + 9)^\circ$.

119° → go to box 6

59° → you are out

Hint: The triangle has three angles. Where is the third?



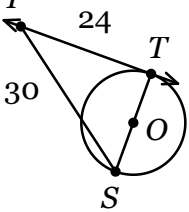
3 Find the diameter.

Line TP is tangent at T . O is the center.

5 → go to box 4

10 → go to box 7

Hint: Which length does the question ask for?



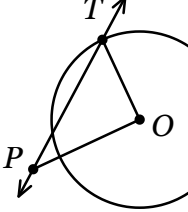
4 Find the radius.

Line TP is tangent at T . ST is a diameter, and O is the center.

18 → go to box 3

9 → go to box 7

Hint: Which segment runs from the center to the circle?



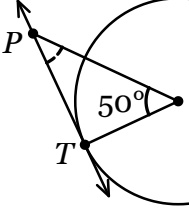
5 Is line TP tangent at T?

T is on the circle. $OT = 12$, $OP = 16$ and $TP = 20$.

Not tangent → go to box 8

Tangent → go to box 6

Hint: Which angle is across from the longest side?



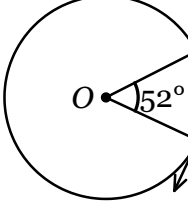
6 Find angle OPT.

Line TP is tangent at T . O is the center.

40° → go to box 1

130° → go to box 7

Hint: Which two segments meet at the point of tangency?



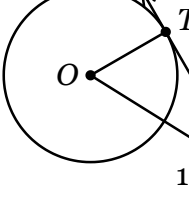
7 Find angle OPT.

Line TP is tangent at T . O is the center.

38° → go to box 1

128° → go to box 6

Hint: What angle stands at the point of tangency?



8 Find the diameter.

Line TP is tangent at T . O is the center.

16 → go to box 2

8 → go to box 4

Hint: Which segment in the drawing is a radius?

Write every box number here, in order.

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The route, in order. Boxes 4 and 6 are not on it. A student reaches them only by a wrong answer. They are the last two rows of the table.

3 → 7 → 1 → 5 → 8 → 2 → out

	The box's question	Right answer, and why	Wrong answer, and why a student picks it
1	Box 3 Line TP is tangent at T . $OP = 13$ and $TP = 12$. Find the diameter.	10. The radius OT is perpendicular to the tangent at T , so triangle OTP has its right angle at T . $OT^2 = 13^2 - 12^2 = 169 - 144 = 25$, so the radius is 5. The diameter is twice the radius: 10.	"5" goes to box 4. 5 is the radius OT . The question asks for the diameter, which is twice as long.
2	Box 7 Line TP is tangent at T . Angle $TOP = 52^\circ$. Find angle OPT .	38°. The radius OT is perpendicular to the tangent, so the angle at T is 90° . The angles of triangle OTP add to 180° , so angle $OPT = 180^\circ - 90^\circ - 52^\circ = 38^\circ$.	"128°" goes to box 6. 128° leaves out the right angle at T : $180^\circ - 52^\circ = 128^\circ$. An angle of 128° cannot sit in a triangle beside a right angle.
3	Box 1 ST is a diameter and line TP is tangent at T . $SP = 20$ and $TP = 16$. Find the radius.	6. The tangent is perpendicular to the diameter at T , so triangle STP has its right angle at T . $ST^2 = 20^2 - 16^2 = 400 - 256 = 144$, so $ST = 12$. The radius is half of the diameter: 6.	"12" goes to box 4. 12 is the whole diameter ST . The question asks for the radius, which is half of it.
4	Box 5 T is on the circle, $OT = 12$, $OP = 16$ and $TP = 20$. Is line TP tangent to the circle at T ?	not tangent. $12^2 + 16^2 = 144 + 256 = 400 = 20^2$, so the triangle has a right angle. But $TP = 20$ is the longest side, so the right angle is at O , not at T . The line is not perpendicular to the radius, so it is not tangent.	"tangent" goes to box 6. $12^2 + 16^2 = 144 + 256 = 400 = 20^2$, so the triangle has a right angle. A student who stops there says "tangent." But the right angle is across from the longest side, TP , so it is at O , not at T .
5	Box 8 Line TP is tangent at T . $OP = 17$ and $TP = 15$. Find the diameter.	16. The radius OT is perpendicular to the tangent at T , so triangle OTP has its right angle at T . $OT^2 = 17^2 - 15^2 = 289 - 225 = 64$, so the radius is 8. The diameter is twice the radius: 16.	"8" goes to box 4. 8 is the radius OT . The question asks for the diameter, which is twice as long.
6	Box 2 Line TP is tangent at T . Angle $OPT = (x + 6)^\circ$ and angle $TOP = (2x + 9)^\circ$. Find angle TOP .	59°. The angle at T is 90° , so the other two add to 90° : $3x + 15 = 90$, so $x = 25$. Angle $TOP = 2 \times 25 + 9 = 59^\circ$.	"119°" goes to box 6. Setting the two angles' sum to 180° leaves out the right angle at T : $3x + 15 = 180$ gives $x = 55$ and $2 \times 55 + 9 = 119^\circ$, which is more than 90° .
	Box 4 ST is a diameter and line TP is tangent at T . $SP = 30$ and $TP = 24$. Find the radius.	9. The tangent is perpendicular to the diameter at T , so triangle STP has its right angle at T . $ST^2 = 30^2 - 24^2 = 900 - 576 = 324$, so $ST = 18$. The radius is half of the diameter: 9.	"18" goes to box 3. 18 is the whole diameter ST . The question asks for the radius, which is half of it.
	Box 6 Line TP is tangent at T . Angle $TOP = 50^\circ$. Find angle OPT .	40°. The radius OT is perpendicular to the tangent, so the angle at T is 90° . The angles of triangle OTP add to 180° , so angle $OPT = 180^\circ - 90^\circ - 50^\circ = 40^\circ$.	"130°" goes to box 7. 130° leaves out the right angle at T : $180^\circ - 50^\circ = 130^\circ$. An angle of 130° cannot sit in a triangle beside a right angle.

How to check any box. Draw the radius to the point of tangency and mark the right angle there. In the right triangle, the side from the center to the outside point is the longest. A radius runs from the center to the circle, and the diameter is twice as long.

A student can find the last four boxes of the route by following the arrows backward from "you are out." So ask a student with a clean row to explain one box.