



Angle relationships

GRADE 7 MATH

Answer keys for the exit ticket, practice worksheet, and homework, plus notes for the lesson slides. Each answer shows the steps and the most likely wrong answer (“If wrong”), so you can tell what a mistake means, not just that it is one. Questions go from **fluency** to **application** to **reasoning**.

Exit Ticket — answer key

Use: End of the angle relationships lesson. 5–8 min, independent. Item 4 requires converting x back into two angles and checking against the original relationship — the step most often skipped.

Timing: 5–8 min · independent. An answer of ‘ $x = 16$ ’ with no angles is the commonest incomplete response; mark for both angles and the check.

1. Complement of 35° ? **FLUENCY**

Answer: 55°

1. Complementary angles sum to 90° .
2. $90 - 35 = 55^\circ$.
3. Check: $35 + 55 = 90$.

If wrong: Answered 145° by using 180. Complementary is the smaller pair — think of the C in Corner, a right angle.

2. Supplement of 35° , and why larger? **REASONING**

Answer: 145°

1. Supplementary angles sum to 180° , so $180 - 35 = 145^\circ$.
2. It is larger than the complement because it is measured against a bigger total: 180° rather than 90° .
3. The same angle has two different partners depending on which relationship you mean.
4. A supplement is always exactly 90° more than the complement of the same angle, since the totals differ by 90.

If wrong: Answered 55° by using 90. The two words are easy to swap, and the totals are what distinguish them.

3. Two lines cross, one angle 62° APPLICATION

Answer: **Vertical angle 62° ; adjacent angle 118°**

1. Vertical angles are opposite each other at the crossing point and are always EQUAL, so the vertical angle is 62° .
2. An adjacent angle sits next to it on a straight line, so the two are supplementary: $180 - 62 = 118^\circ$.
3. Check: $62 + 118 = 180$, a straight line.

If wrong: Made the vertical angle 118° . Vertical angles are equal; it is the ADJACENT angles that are supplementary.

4. Complementary angles $(2x + 10)^\circ$ and $(3x)^\circ$ REASONING

Answer: **$x = 16$; the angles are 42° and 48°**

1. Complementary means the two angles sum to 90° .
2. Equation: $(2x + 10) + 3x = 90$.
3. Collect like terms: $5x + 10 = 90$.
4. Subtract 10: $5x = 80$. Divide by 5: $x = 16$.
5. Now convert back to angles: $2(16) + 10 = 42^\circ$, and $3(16) = 48^\circ$.
6. Check: $42 + 48 = 90$. Correct.
7. Note $x = 16$ is not an angle — it is a step. Both angles must be stated, and the check must use the original relationship.

If wrong: Stopped at $x = 16$. The question asks for the angles, and 16 is neither of them. A close second: setting $2x + 10 = 90$ and ignoring the other angle entirely.

Quick answers for fast checking:

#	Level	Answer
1	fluency	55°
2	reasoning	145°
3	application	62° and 118°
4	reasoning	42° and 48°

Practice Worksheet — answer key

Use: During the lesson after the deck. Item 9 is the core of the standard: the relationship comes from the geometry, not the picture. Items 3 and 4 are the self-partnering angles, which students find genuinely surprising.

Timing: 15–25 min · pairs or independent · circulate on 8 and 9. Require the relationship NAMED in words before any equation is written.

1. Complement of 20° ? **FLUENCY**

Answer: 70°

1. $90 - 20 = 70^\circ$.

If wrong: Answered 160° .

2. Supplement of 20° ? **FLUENCY**

Answer: 160°

1. $180 - 20 = 160^\circ$.

If wrong: Answered 70° .

3. Complement of 45° ? **REASONING**

Answer: 45° — it is its own complement

1. $90 - 45 = 45^\circ$.

2. So 45° is the only angle equal to its own complement, because it is exactly half of 90° .

3. Two 45° angles fit together to make a right angle.

If wrong: Assumed an error because the answer repeats the question. Half of 90 is genuinely its own partner.

4. Supplement of 90° ? **REASONING**

Answer: 90° — a right angle is its own supplement

1. $180 - 90 = 90^\circ$.

2. So a right angle is its own supplement, being half of 180° .

3. This means two right angles form a straight line, which is worth seeing: a straight angle is exactly two right angles.

4. Note 90° has no complement, since $90 - 90 = 0$ and a 0° angle is not an angle.

If wrong: Answered 0° by using 90 instead of 180.

5. $3x = 90$, find x APPLICATION

Answer: $x = 30^\circ$

1. Divide both sides by 3: $x = 30^\circ$.
2. Check: three angles of 30° make 90° .

If wrong: Answered 60 by subtracting rather than dividing.

6. $x, x, x + 30$ on a straight line APPLICATION

Answer: $x = 50^\circ$

1. Angles on a straight line sum to 180° .
2. Equation: $x + x + (x + 30) = 180$.
3. Collect: $3x + 30 = 180$. Subtract 30: $3x = 150$. Divide by 3: $x = 50^\circ$.

If wrong: Wrote $3x + 30 = 90$, using the complementary total for a straight line.

7. Check by finding all three APPLICATION

Answer: $50^\circ, 50^\circ, 80^\circ$ — summing to 180°

1. The angles are $x = 50$, $x = 50$, and $x + 30 = 80$.
2. $50 + 50 + 80 = 180$. Correct.
3. Substituting back into the ORIGINAL relationship is what confirms the answer, not just re-checking the algebra.

If wrong: Checked $3x + 30 = 180$ without converting back to the three actual angles. The question asks for the angles.

8. Complementary angles x and $2x$ REASONING

Answer: 30° and 60°

1. Complementary means they sum to 90° .
2. Equation: $x + 2x = 90$, so $3x = 90$ and $x = 30^\circ$.
3. The angles are 30° and $2(30) = 60^\circ$.
4. Check: $30 + 60 = 90$. Correct.
5. Note the question asks for BOTH angles, so stopping at $x = 30$ is only half an answer.

If wrong: Answered $x = 30$ and stopped. The variable is a step toward the angles, not the answer itself.

9. Two angles that look equal REASONING

Answer: **Looking equal is not evidence; the relationship must come from the geometry**

1. A diagram is a sketch, and sketches are not drawn to scale unless stated.
2. Two angles can look equal and be 88° and 92° , which no eye can reliably separate.
3. And even if they ARE equal, that does not make them 90° each — two equal angles on a straight line are 90° , but two equal angles at a point are 180° each, and two equal angles in a right angle are 45° each.
4. So the student made two unjustified leaps: from ‘looks equal’ to ‘is equal’, and from ‘equal’ to ‘ 90° each’.
5. Being right by accident is still wrong reasoning, and it will fail on the next diagram.

If wrong: Accepted the reasoning because the answer was right. The method has to work on problems where the picture is misleading, which is most of them.

Quick answers for fast checking:

#	Level	Answer
1	fluency	70°
2	fluency	160°
3	reasoning	45°, its own complement
4	reasoning	90°, its own supplement
5	application	30°
6	application	50°
7	application	50, 50, 80
8	reasoning	30° and 60°
9	reasoning	appearance is not evidence

Homework — answer key

Use: Parallels the practice sheet. Item 8 returns to the ‘don’t read it off the picture’ theme, this time with a diagram convention that actively misleads.

Timing: ~15 min at home · independent · review item 8 as the next-day warm-up; draw two lines crossing at a shallow angle to make the point visually.

1. Complement of 18° ? FLUENCY

Answer: 72°

1. $90 - 18 = 72^\circ$.

If wrong: Answered 162° .

2. Supplement of 18° ? FLUENCY

Answer: 162°

1. $180 - 18 = 162^\circ$.

If wrong: Answered 72° .

3. $4x = 180$ APPLICATION

Answer: $x = 45^\circ$

1. Divide by 4: $x = 45^\circ$.
2. Check: four angles of 45° make 180° .

If wrong: Answered 176 by subtracting.

4. $(5x - 15)^\circ$ is a right angle APPLICATION

Answer: $x = 21$

1. A right angle is 90° , so $5x - 15 = 90$.
2. Add 15: $5x = 105$. Divide by 5: $x = 21$.

If wrong: Used 180 instead of 90, giving $x = 39$.

5. Check $x = 21$ FLUENCY

Answer: $5(21) - 15 = 90^\circ$

1. $5 \times 21 = 105$, and $105 - 15 = 90$. Correct.

If wrong: Checked the rearranged equation rather than the original.

6. x , $3x$ and 40° on a straight line APPLICATION

Answer: $x = 35^\circ$

1. Straight line: $x + 3x + 40 = 180$.
2. Collect: $4x + 40 = 180$. Subtract 40: $4x = 140$. Divide by 4: $x = 35^\circ$.

If wrong: Wrote $4x + 40 = 90$.

7. All three angles REASONING

Answer: 35° , 105° and 40° , summing to 180°

1. $x = 35^\circ$. Then $3x = 105^\circ$. The third is given as 40° .
2. Sum: $35 + 105 + 40 = 180$. Correct.
3. Converting back matters: the question is about angles, and $x = 35$ alone names only one of the three.

If wrong: Reported $x = 35$ as the answer. Two of the three angles are still unstated.

8. Must four angles at a crossing be 90° ? REASONING

Answer: **No** — a counterexample is 62° , 118° , 62° , 118°

1. Two lines crossing at any angle produce four angles, and they need not be right angles.
2. Counterexample: if one angle is 62° , the four are 62° , 118° , 62° , 118° .
3. What IS always true: opposite (vertical) angles are equal, adjacent angles are supplementary, and all four sum to 360° .
4. Check the counterexample: $62 + 118 + 62 + 118 = 360$. Correct.
5. All four are 90° only in the special case where the lines are perpendicular — one possibility among infinitely many, not the rule.

If wrong: Agreed with the student because crossing lines are usually drawn perpendicular. Diagrams are drawn that way for neatness, which is exactly why the picture cannot be trusted.

Quick answers for fast checking:

#	Level	Answer
1	fluency	72°
2	fluency	162°
3	application	45°
4	application	$x = 21$
5	fluency	checks out

6	application	35°
7	reasoning	35, 105, 40
8	reasoning	62, 118, 62, 118

Lesson slides — teaching notes & timing

Mini-lesson deck: ~12–15 min, then the practice sheet. Draw the crossing lines at a deliberately shallow angle — a perpendicular sketch teaches the wrong instinct.

Slide	~Time	Note
1/8	0:00	Frame it: the standard asks for equations, so naming the relationship comes before any arithmetic.
2/8	1:00	Hook — poll whether all four are 90°. Do NOT resolve. Draw the lines at about 60° so the picture argues against it.
3/8	2:30	The three relationships. Complementary/Corner is a workable mnemonic if your class wants one.
4/8	4:30	WE1 — resolve. Emphasise that vertical angles are EQUAL and adjacent ones are supplementary; swapping those is the common error.
5/8	7:00	WE2 — writing the equation. Insist the relationship is named in words first, every time.
6/8	9:00	CFU — all-student response. 30° and 60°. Watch for students stopping at $x = 30$.
7/8	11:00	Converting back. This costs marks constantly and takes ten seconds to fix as a habit.
8/8	13:00	Launch the in-class practice sheet.