Angle Relationships: Supplementary, Complementary, and Vertical Angles

Apply the skill to decisions and designs

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QUICK REVIEW

Complementary angles sum to $90°$; supplementary angles sum to $180°$; vertical (opposite) angles are equal. Determine whether the angles add to a right angle, add to a straight angle, or lie opposite each other. Diagrams are not to scale.

Worked example

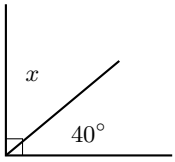
Find the supplement of $28°$.

1. Supplementary means $x + 28 = 180$.
2. $x = 180 - 28 = 152°$.
3. Check $152 + 28 = 180°$.
Answer: $152°$.

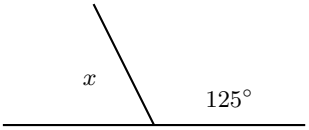
Practice Problems

Show your thinking.

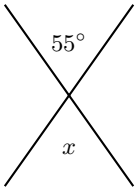
1. A hinge design needs complementary angles. One is $40°$. Find the matching angle and decide whether an angle of $55°$ would work.



2. A hinge design needs supplementary angles. One is $125°$. Find the matching angle and decide whether an angle of $60°$ would work.



3. A hinge design needs vertical angles. One is $55°$. Find the matching angle and decide whether an angle of $60°$ would work.



4. Design two complementary hinge turns, with the larger $20°$ more than the smaller. Find both turns.

5. A folding design needs a turn supplementary to $76°$, labeled $(3x + 5)°$. Find its turn and design parameter x.

6. At an intersection a design angle $(2x + 10)°$ is opposite $46°$. Find x and the adjacent opening.

7. A hinge needs complementary turns in ratio $2 : 3$, neither above $55°$. Find both turns and decide if the design works.

8. A folding panel uses supplementary turns $(3x + 10)°$ and $(5x + 10)°$. Find x and check whether the larger turn is below $115°$.

Answer Key

1. $x = 50^\circ$. The proposed angle does not work.
2. $x = 55^\circ$. The proposed angle does not work.
3. $x = 55^\circ$. The proposed angle does not work.
4. 35° and 55°.
5. $x = 33$; angle 104°.
6. $x = 18$; adjacent angle 134°.
7. 36° and 54°. Both fit the 55° limit.
8. $x = 20$; angles $70^\circ, 110^\circ$. The larger turn fits.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. Complementary angles sum to 90°: $x + 40 = 90$.
2. $x = 90 - 40 = 50^\circ$.
3. Check $50 + 40 = 90^\circ$.
4. The proposed 55° differs from 50° by 5°, so it fails.

Problem 2

1. Supplementary angles sum to 180°: $x + 125 = 180$.
2. $x = 180 - 125 = 55^\circ$.
3. Check $55 + 125 = 180^\circ$.
4. The proposed 60° differs from 55° by 5°, so it fails.

Problem 3

1. Opposite angles at the intersection are vertical, so $x = 55^\circ$.
2. Each adjacent angle is $180 - 55 = 125^\circ$.
3. Check around the point: $2(55) + 2(125) = 360^\circ$.
4. The proposed 60° differs from 55° by 5°, so it fails.

Problem 4

1. $x + (x + 20) = 90$.
2. $2x = 90 - 20 = 70$, so $x = 35^\circ$.
3. Other angle $35 + 20 = 55^\circ$; check $35 + 55 = 90^\circ$.

Problem 5

1. $3x + 5 + 76 = 180$.
2. $3x = 180 - 5 - 76 = 99$, so $x = 33$.
3. Angle $3(33) + 5 = 104^\circ$; check $104 + 76 = 180^\circ$.

Problem 6

1. Vertical angles are equal: $2x + 10 = 46$.
2. $x = (46 - 10)/2 = 18$.
3. Adjacent angle $180 - 46 = 134^\circ$; all four total $2(46) + 2(134) = 360^\circ$.

Problem 7

1. Write angles $2x, 3x$; complementary gives $2x + 3x = 90$.
2. $5x = 90$ gives $x = 18$, so angles $2(18) = 36$ and $3(18) = 54$ degrees.
3. Check $36 + 54 = 90^\circ$ and divide both terms of $36 : 54$ by 18 to recover $2 : 3$.
4. The larger turn is 54°, at most 55°, so both turns fit.

Problem 8

1. Supplementary angles sum to 180°: $3x + 10 + 5x + 10 = 180$.
2. $8x = 160$, so $x = 20$.
3. Substitute: $3(20) + 10 = 70$ and $5(20) + 10 = 110$ degrees. Check $70 + 110 = 180^\circ$.
4. The larger turn is 110°, which satisfies $110 < 115$.

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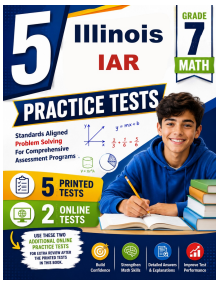

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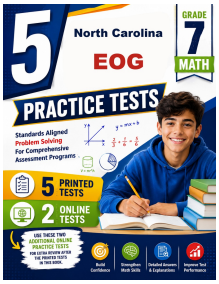

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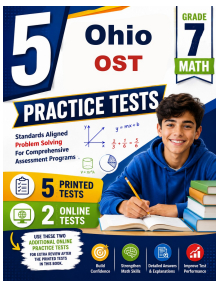

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