

Reasoning and Proof: math practice, Grade 10 – download the PDF

22 problems graded by difficulty (★ easy, ★★ medium, ★★★ hard). Try first, without looking at the solutions!

1 Continue the pattern



Look at the sequence **5, 11, 17, 23, ...**

- Describe the pattern and give the next two terms.
- Make a conjecture for the 10th term.
- Is this inductive or deductive reasoning?

2 Hypothesis and conclusion



Consider: “If a whole number is divisible by 10, then it ends in 0.”

- Identify the hypothesis and the conclusion.
- Write the converse.
- Decide whether each statement is true or false.

3 Inductive or deductive?



Classify each argument.

- a. The last five buses were late, so tomorrow's bus will be late.
- b. Every prime greater than 2 is odd, and 31 is a prime greater than 2, so 31 is odd.
- c. You measure the angles of eight triangles, find each sum is 180° , and decide all triangles work this way.
- d. $\angle A$ and $\angle B$ are supplementary and $m\angle A = 70^\circ$, so $m\angle B = 110^\circ$.

4 Name the property



Name the property that justifies each statement.

- a. If $AB = CD$, then $CD = AB$.
- b. If $x = y$ and $y = 7$, then $x = 7$.
- c. $\angle P \cong \angle P$.
- d. If $3x = 18$, then $x = 6$.
- e. If $a = 5$ and $a + b = 12$, then $5 + b = 12$.

5 Four related statements



Start with: "If a figure is a square, then it is a rectangle." Write the converse, inverse and contrapositive, and give the truth value of each, with a counterexample for any false one.

6 Biconditional or not?



Which statements can be rewritten as a true biconditional? Explain.

- a. If $x = 4$, then $x^2 = 16$.
- b. If an integer is even, then it is divisible by 2.
- c. If a polygon is a triangle, then it has exactly three sides.

7 Justify each step



Solve $5x - 9 = 26$ and give a reason for every step.

8 Find a counterexample



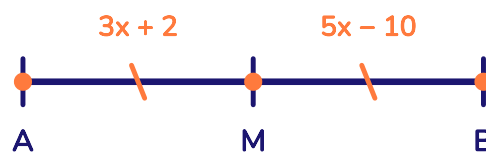
Give a counterexample to each false statement.

- a. Every prime number is odd.
- b. If a number is a multiple of 3, then it is odd.

9 Trail midpoint



On a trail map, a rest stop M is the midpoint of trail $\overline{AB}$ (lengths in meters), as in the figure. Find x and the full length AB . Give reasons.



10 Angle addition



Ray BD lies inside $\angle ABC$. $m\angle ABD = (2x + 10)^\circ$, $m\angle DBC = (3x - 5)^\circ$, and $m\angle ABC = 125^\circ$. Find x and both smaller angles.

11 Linear pair

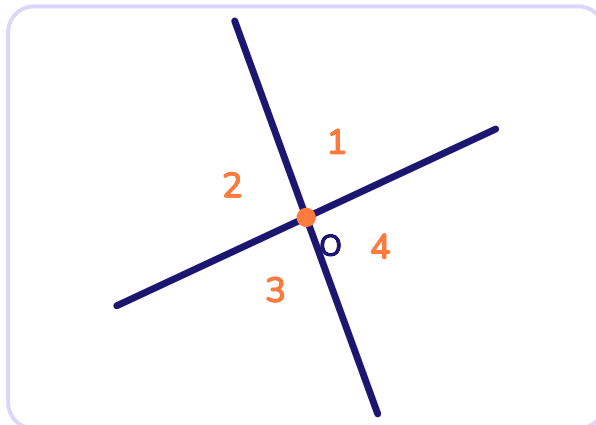


$\angle 1$ and $\angle 2$ are a linear pair with $m\angle 1 = (4x + 12)^\circ$ and $m\angle 2 = (2x + 6)^\circ$. Find both measures.

12 Reading vertical angles



Two lines intersect as shown, and $m\angle 1 = 85^\circ$. Find $m\angle 2$, $m\angle 3$, $m\angle 4$ and name the reason for each.



13 Complete the proof

Given: $3(x - 2) = 2x + 5$. Prove: $x = 11$. Supply the missing reason in each row.

Statements	Reasons
1. $3(x - 2) = 2x + 5$	1. Given
2. $3x - 6 = 2x + 5$	2. ?
3. $x - 6 = 5$	3. ?
4. $x = 11$	4. ?

14 True or false?

Decide whether each claim is true or false, and justify.

- The contrapositive of a true conditional is always true.
- The converse of a true conditional is always true.
- A conditional and its inverse always have the same truth value.

15 Chain of congruent angles

$\angle A \cong \angle B$, $\angle B \cong \angle C$, and $\angle C \cong \angle D$. If $m\angle A = 47^\circ$, find $m\angle D$ and name the properties used.

16 Rewrite as if-then



Rewrite in if-then form and test the converse.

- a. Every integer divisible by 6 is divisible by 3.
- b. A triangle with three congruent angles is equiangular.

17 Congruent supplements



Given: $\angle 1$ and $\angle 2$ are supplementary, and $\angle 3$ and $\angle 2$ are supplementary. Prove: $\angle 1 \cong \angle 3$.
Write a paragraph proof.

18 A prime pattern that fails



A student computes $n^2 - n + 11$ for $n = 1, 2, 3, \dots, 10$ and gets 11, 13, 17, 23, 31, 41, 53, 67, 83, 101, all prime. The student conjectures that it is prime for every positive integer n . Find a counterexample.

19 Midpoint converse



The definition of midpoint says: “ M is the midpoint of $\overline{AB}$ if and only if M is on $\overline{AB}$ and $AM = MB$.”

- a. Split it into two conditionals.
- b. A student claims “If $AM = MB$, then M is the midpoint of $\overline{AB}$.” Use $A(0, 0)$, $B(4, 0)$, $M(2, 3)$ to refute it.

20 Chain of conditionals



A building’s system works like this. (1) If the alarm rings, then the door is locked. (2) If the door is locked, then the lights go off. You notice the lights are on. What can you conclude about the alarm? Explain with the contrapositive.

21 Full two-column proof

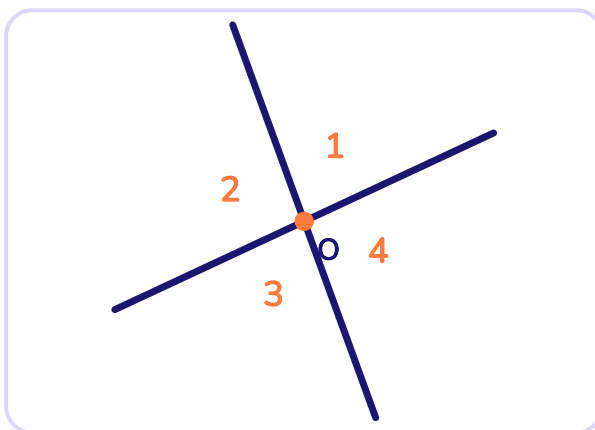


Point B is between A and C , $AC = 24$ ft, $AB = 3x - 1$, $BC = x + 9$. Write a two-column proof that $x = 4$, then find AB and BC .

22 Algebra with vertical angles



Two lines intersect, forming vertical angles $\angle 1$ and $\angle 3$ with $m\angle 1 = (5x - 7)^\circ$ and $m\angle 3 = (3x + 19)^\circ$. Find x , $m\angle 1$ and $m\angle 2$, where $\angle 2$ forms a linear pair with $\angle 1$.



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