Homework explanations

LESSON 1.1 / Geometry language and logical foundations

Use after a complete first attempt. Check the reasoning as well as the final statement.

QUESTION 1

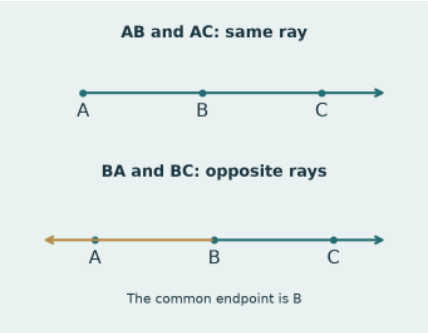
Sketch a line through P and Q, a segment with endpoints R and S, and a ray with endpoint T passing through U. Label the objects in notation.

Use $\overleftrightarrow{PQ}, \overline{RS}, \overrightarrow{TU}$. The line has arrows at both ends, the segment has two marked endpoints, and the ray begins at T with an arrow continuing through U.

QUESTION 2

P, Q, R and S lie in the order P-Q-R-S. Compare $\overrightarrow{PQ}$ with $\overrightarrow{PS}$, and $\overrightarrow{QP}$ with $\overrightarrow{QR}$. Explain your verdicts.

The first pair names the same ray, with endpoint P. The second pair is opposite rays, sharing Q and extending in opposite directions. Different endpoints alone would not meet the opposite-ray definition.



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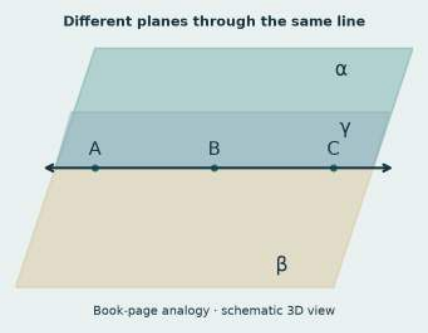
QUESTION 3

Explain why three collinear points lie in a plane but do not determine a unique plane. Illustrate your explanation.

Any plane containing their common line contains all three points. Several planes can share that line, so existence does not imply uniqueness. A correctly labelled book-page diagram illustrates the distinction.



QUESTION 4

Classify and justify: (a) a midpoint is a point on a segment dividing it into two congruent parts; (b) exactly one line passes through two distinct points, taken as an accepted starting fact; (c) a result established by a valid argument from the foundations.

(a) Definition: fixes meaning and conditions. (b) Postulate/axiom: an accepted starting fact. (c) Theorem: a proved result. Examples alone would instead support a conjecture.

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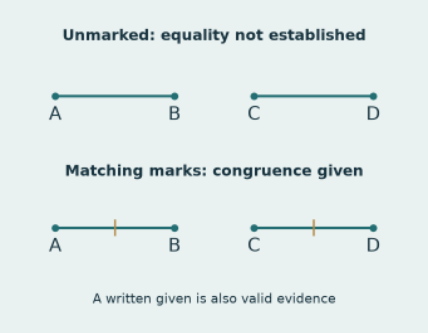
QUESTION 5

Draw one diagram where $AB = CD$ is given by matching tick marks, and one where the segments merely look equal. State what is justified in each.

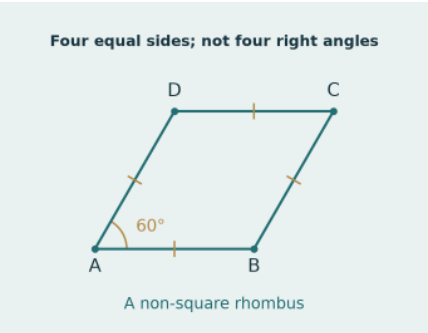
In the marked diagram, congruence is given and the lengths are equal. In the unmarked diagram, equality is not established by appearance alone; it is not automatically false either.



QUESTION 6

Give a counterexample to each claim: (a) every triangle is isosceles; (b) every quadrilateral with four equal sides is a square. Explain how each example meets the assumption but fails the conclusion.

(a) A 3-4-5 triangle has three unequal sides. (b) A rhombus with four equal sides and a stated 60-degree angle is not a square. Both examples satisfy the relevant hypothesis and fail its proposed conclusion.



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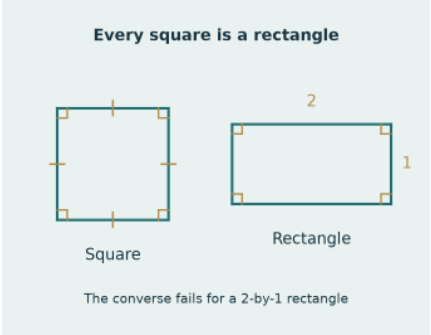
QUESTION 7

Using the inclusive definition of rectangle, explain why “every square is a rectangle” is true. Write its converse and decide whether that converse is true.

Every square satisfies the four-right-angle definition of rectangle. The converse says every rectangle is a square; this is false, as shown by a 5 cm by 2 cm rectangle. A true implication cannot simply be reversed.



QUESTION 8

M is given as the midpoint of $\overline{AB}$. If $AM = 2x + 3$ and $MB = 4x - 5$, find x, each half-length and AB. Give a reason for each step.

$2x + 3 = 4x - 5 \Rightarrow x = 4$. The two half-lengths are 11, and AB=22. Equal halves follow from the given midpoint; adding the halves uses segment addition. Both lengths are positive, so the result is consistent.