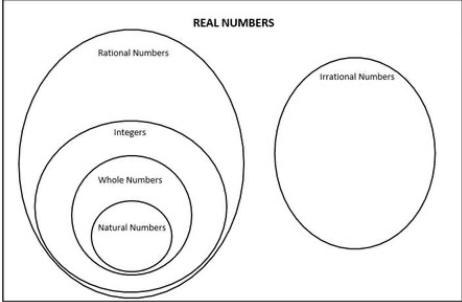


Check Your Understanding 2.2b

Spans all rubric rows introduced through 2.2b. Students begin in class.

Basic	Intermediate	Advanced
<i>Conditional Statements — Write All Four Forms</i> 1. Write the converse, inverse, and contrapositive of: "If a figure is a square, then it has four right angles." 2. For each of your four statements, write T (true) or F (false) and give a counterexample for any that are false.	<i>Conditional Statements — Truth Values and Equivalence</i> 3. For the statement in problem 1: a. Which form is logically equivalent to the original? Why? b. Is this statement biconditional? Explain. c. Draw a Venn diagram for the original conditional. Use it to explain why the converse is not guaranteed.	<i>Conditional Statements — Venn Diagram and Biconditional</i> 4. Draw a Venn diagram relating squares, rectangles, and rhombuses. 5. Use your diagram to write a true conditional statement, then write its contrapositive. 6. Is the statement in problem 5 biconditional? How does the Venn diagram show you the answer?
<i>Biconditional — Identify and Write</i> 7. What makes a conditional statement biconditional? Explain in your own words. 8. Give one example of a biconditional statement.	<i>Inverse Error — Recognize and Explain</i> 9. A student says: "My teacher told me that if I study, I will pass. I didn't study, so I won't pass." a. What error is the student making? b. Is the conclusion guaranteed? Explain. c. What is the formal name for this error?	<i>Biconditional — Write and Verify</i> 10. Rewrite as a biconditional if possible, or explain why not: "A number is divisible by 6 if it is divisible by both 2 and 3." 11. Given the Venn diagram of the number system, write a true conditional statement using the word 'not,' then write its contrapositive. 

Basic	Intermediate	Advanced
<i>Spiral — Inductive / Deductive</i> 12. Classify each as inductive or deductive reasoning: a. Every time I press this button the light turns on. Therefore, pressing the button causes the light to turn on. b. All mammals breathe air. Dolphins are mammals. Therefore, dolphins breathe air.	<i>Spiral — Unit 1</i> 13. Given endpoint (3, 4) and midpoint $(-1, 2.5)$, find the missing endpoint. 14. Find the distance between $(-2, 1)$ and $(4, 9)$.	<i>Extension — Pattern Check</i> 15. Consider the statement: <i>"If it is your Geometry teacher this year, then it is Mr. Shea."</i> a. Write all four forms of this statement. b. What is the truth value of each form? c. Is this statement biconditional? Explain. What does the Venn diagram look like? d. How does this compare to the divisibility example from the thinking task?

CYU 2.2b — Answer Key

1. Converse: If a figure has four right angles, then it is a square. | Inverse: If a figure is not a square, then it does not have four right angles. | Contrapositive: If a figure does not have four right angles, then it is not a square.

2. Original: T. Converse: F (counterexample: rectangle). Inverse: F (counterexample: rectangle). Contrapositive: T.

3a. The contrapositive is logically equivalent. The p-circle (squares) sits inside the q-circle (figures with four right angles); outside q means outside p.

3b. Not biconditional — the converse is false. Having four right angles is not sufficient to be a square (a rectangle is a counterexample).

3c. Venn diagram: circle of squares sits inside circle of 'four right angles.' The converse would require all figures with four right angles to be squares — the diagram shows space in the outer circle not covered by the inner one.

4–6. Answers vary. Key check: squares $\subset$ rectangles $\subset$ quadrilaterals; squares $\subset$ rhombuses. A valid conditional: 'If a figure is a square, then it is a rectangle.' Contrapositive: 'If a figure is not a rectangle, then it is not a square.' Not biconditional — a rectangle need not be a square.

7. When both the conditional and its converse are true — the relationship works in both directions.

8. Answers vary. Example: A number is even if and only if it is divisible by 2.

9a. The inverse error — assuming the inverse ($\sim p \rightarrow \sim q$) follows from the conditional.

9b. Not guaranteed. The original says studying leads to passing; it says nothing about what happens without studying.

9c. Denying the antecedent.

10. Biconditional: A number is divisible by 6 if and only if it is divisible by both 2 and 3. Both directions hold.

11. Example: If a number is rational, then it is not irrational. Contrapositive: If a number is irrational, then it is not rational. Both true.

12a. Inductive. **12b.** Deductive.

13. Missing endpoint: $(-5, 1)$. **14.** Distance = 10.

15. All four forms of the Mr. Shea statement are true (it is biconditional — there is only one Geometry teacher this year, and it is Mr. Shea). This is different from the divisibility example, where the converse and inverse were false. The pattern breaks because the relationship is one-to-one — the two sets (your Geometry teacher, Mr. Shea) are identical. Venn diagram: both circles completely overlap. This is what a biconditional always looks like.