



Attempt questions first; check the separate key afterward. Show all working. Draw accurate figures where required.

A. Very short answers - 1 mark each

1. What is a mathematical proposition?
2. Is "Close the door" a proposition?
3. State the converse: if an integer is divisible by 4, it is even.
4. Is that converse true? Give a counterexample.
5. State the converse of the Pythagorean theorem.
6. Test it with lengths 7, 24, 25.
7. Is every square a rectangle?
8. Is the converse true?

B. Short answers / practice - 2 marks each

9. State hypothesis and conclusion: if $x=3$, then $x^2=9$.
10. Is its converse true over real numbers?
11. Negate: all prime numbers are odd.
12. Give a counterexample to the original claim.
13. Explain why one counterexample disproves a universal claim.
14. Does one confirming example prove such a claim?
15. State the converse: equal chords subtend equal angles at a circle's centre.
16. Is this converse true in the same circle?
17. Is " n^2+n is even for every integer n " true? Prove it.
18. Is n^2+n always divisible by 4?
19. If a triangle is equilateral, it is equiangular. State its converse.
20. Are both true in Euclidean geometry?

C. Application / reasoning - 3 marks each

21. A learner claims all rectangles are squares because one drawn rectangle is square. Identify the error.

22. Supply a numerical counterexample.
 23. Write a true implication whose converse is false.
 24. Write a true implication whose converse is also true.
 25. Prove that the sum of two even integers is even.
 26. Does an even sum imply both summands are even?
 27. State and test the converse: if an integer ends in 0, it is divisible by 5.
 28. Negate: every rectangle has four equal sides.
 29. Prove that the square of an odd integer is odd.
 30. If $xy=0$, must both x and y be zero? Justify.
 31. State an if-and-only-if condition for a real number's square to be zero.
- ### D. Extended practice - 5 marks per pair
32. Distinguish a definition, an axiom and a theorem.
 33. Explain why a diagram alone is insufficient as proof.
 34. If a quadrilateral's diagonals bisect each other, it is a parallelogram. Prove using triangle congruence.
 35. State and justify the converse.

ANSWER KEY - Numerical / closed questions

- 2) No. 3) If an integer is even, it is divisible by 4. 4) No; 6. 6) Right triangle. 7) Yes. 8) No. 9) Hypothesis $x=3$; conclusion $x^2=9$. 10) No; $x=-3$. 11) At least one prime number is not odd. 12) 2. 14) No. 15) Equal central angles subtend equal chords. 16) Yes. 17) Yes. 18) No; $n=1$. 19) If equiangular, then equilateral. 20) Yes. 22) A 2×3 rectangle. 23) Example: divisible by 6 implies divisible by 3. 24) Example: integer even iff divisible by 2. 26) No; $1+3=4$. 27) Converse false; 15 is a counterexample. 28) At least one rectangle does not have four equal sides. 30) No; at least one is zero. 31) $x^2=0$ iff $x=0$.