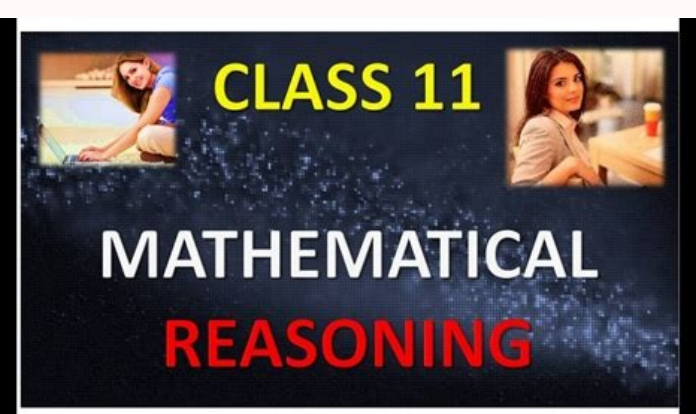




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**Continue**



4. Given statements in (a) and (b). Identify the statements given below as contrapositive or converse of each other.
- (a) If you live in Delhi, then you have winter clothes.
    - (i) If you do not have winter clothes, then you do not live in Delhi.
    - (ii) If you have winter clothes, then you live in Delhi.
  - (b) If a quadrilateral is a parallelogram, then its diagonals bisect each other.
    - (i) If the diagonals of a quadrilateral do not bisect each other, then the quadrilateral is not a parallelogram.
    - (ii) If the diagonals of a quadrilateral bisect each other, then it is a parallelogram.

**14.6 Validating Statements**

In this Section, we will discuss when a statement is true. To answer this question, one must answer all the following questions.

What does the statement mean? What would it mean to say that this statement is true and when this statement is not true?

The answer to these questions depend upon which of the special words and phrases “and”, “or”, and which of the implications “if and only”, “if-then”, and which of the quantifiers “for every”, “there exists”, appear in the given statement.

Here, we shall discuss some techniques to find when a statement is valid.

We shall list some general rules for checking whether a statement is true or not.

**Rule 1** If  $p$  and  $q$  are mathematical statements, then in order to show that the statement “ $p$  and  $q$ ” is true, the following steps are followed.

**Step-1** Show that the statement  $p$  is true.

**Step-2** Show that the statement  $q$  is true.

**Rule 2** Statements with “Or”

If  $p$  and  $q$  are mathematical statements, then in order to show that the statement “ $p$  or  $q$ ” is true, one must consider the following.

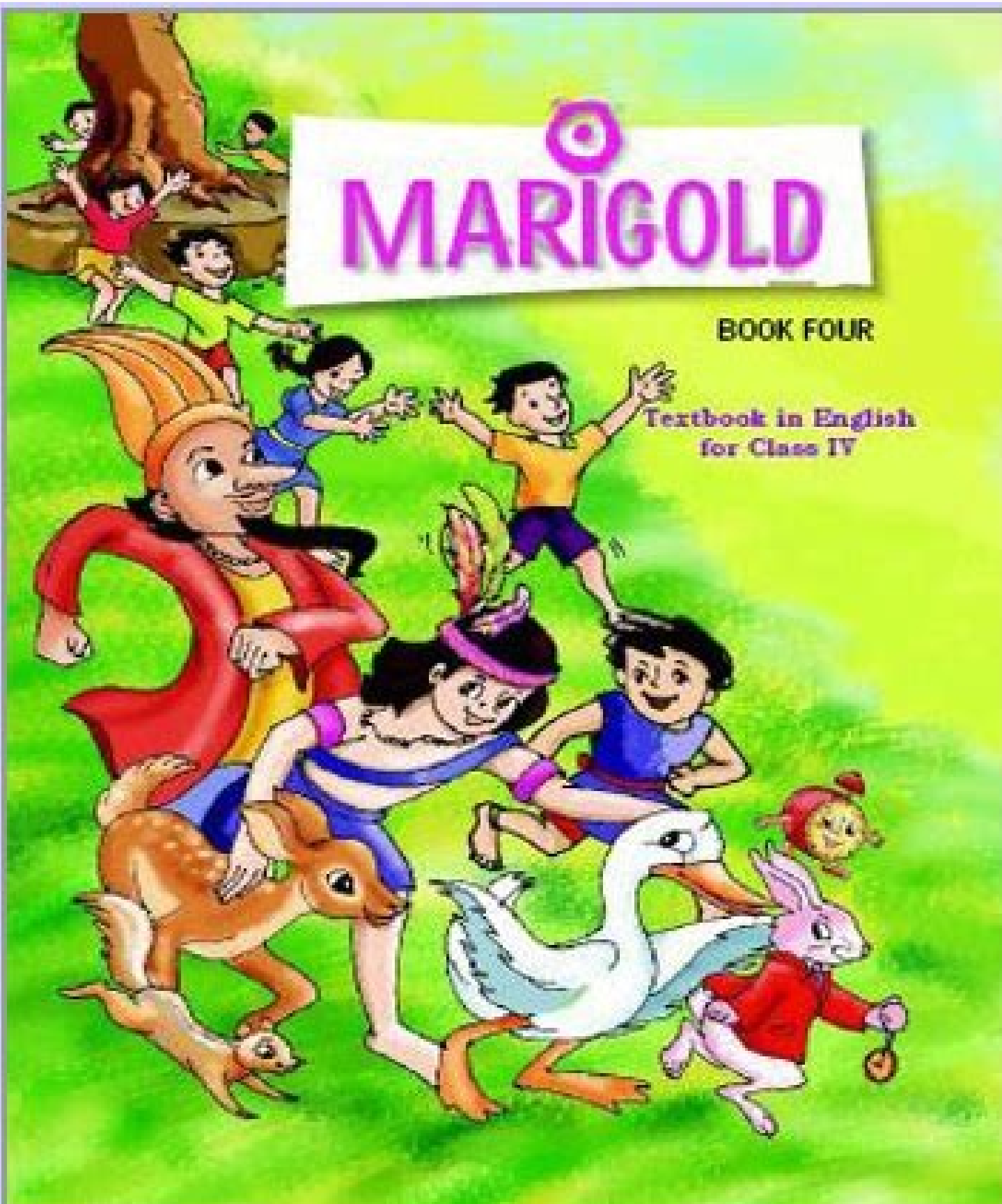
**Case 1** By assuming that  $p$  is false, show that  $q$  must be true.

**Case 2** By assuming that  $q$  is false, show that  $p$  must be true.

**Rule 3** Statements with “If-then”

**Exercise 14.6**

Question 1:  
 Show that the statement  
 $p$ : “If  $x$  is a real number such that  $x^2 = 4$ , then  $x = 2$ ” is true by  
 (i) direct method  
 (ii) method of contradiction  
 (iii) method of contrapositive  
**Answer**  
 $p$ : “If  $x$  is a real number such that  $x^2 = 4$ , then  $x = 2$ ”  
 Let  $x$  be a real number such that  $x^2 = 4$ , then  $x = 2$   
 $x^2 = 4$   
 $x = \pm 2$   
 (i) To show that statement  $p$  is true, we assume that  $x$  is true and then show that  $p$  is true.  
 Therefore, let statement  $p$  be true.  
 $x = 2$   
 $x^2 = 4$   
 $x = \pm 2$   
 However, since  $x = 2$ , it is 0.  
 Thus, statement  $p$  is true.  
 (ii) To show statement  $p$  is true by contradiction, we assume that  $p$  is not true.  
 Let  $x$  be a real number such that  $x^2 = 4$ , but  $x \neq 2$ .  
 Therefore,  $x^2 = 4$   
 $x = \pm 2$   
 $x = 2$  or  $x = -2$   
 However,  $x = -2$ , which is a contradiction since we have assumed that  $x \neq 2$ .  
 Thus, the given statement  $p$  is true.  
 (iii) To prove statement  $p$  is true by contrapositive method, we assume that  $x$  is false and prove that  $p$  must be true.  
 Here,  $x$  is false implies that  $x$  is required to consider the negation of statement  $p$ . This shows the following statement.



$p$ :  $\sqrt{2}$  is a rational number.

$q$ :  $\sqrt{2}$  is an irrational number.

The first statement is false and second is true. Here the connecting word is 'or'.  
 (vi) The component statements are

$p$ : 24 is a multiple of 2.

$q$ : 24 is a multiple of 4.

$r$ : 24 is a multiple of 8.

All the three statements are true. Here the connecting words are 'and'. Thus, we observe that compound statements are actually made-up of two or more statements connected by the words like 'and', 'or', etc. These words have special meaning in mathematics. We shall discuss this matter in the following section.

**EXERCISE 14.2**

- Write the negation of the following statements:
  - Chennai is the capital of Tamil Nadu.
  - $\sqrt{2}$  is not a complex number.
  - All triangles are not equilateral triangle.
  - The number 2 is greater than 7.
  - Every natural number is an integer.
- Are the following pairs of statements negations of each other?
  - The number  $x$  is not a rational number. The number  $x$  is not an irrational number.
  - The number  $x$  is a rational number. The number  $x$  is an irrational number.
- Find the component statements of the following compound statements and check whether they are true or false.
  - Number 3 is prime or it is odd.
  - All integers are positive or negative.
  - 100 is divisible by 3, 11 and 5.

**14.4 Special Words/Phrases**  
 Some of the connecting words which are found in compound statements like "And",

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