1.1 Prime and Composite Numbers

A **prime number** is an integer greater than 1 that has no other positive integer factors other than 1 and itself.

Examples: 2, 3, 5, and 7 are prime numbers since their only factors are 1 and themselves (For example, the only factors of 3 are 1 and 3). However, 6 is not prime since it has two different sets of integer factors: 1 and 6 or 2 and 3.

A **factor** of a number is a divisor of that number (it divides evenly into it)

Examples:

(i) List all factors of 10
- 1, 2, 5, and 10 are all factors of 10 since they all divide evenly into 10.
- Of these factors, only 2 and 5 are prime factors.

(ii) Show the following numbers as products of prime factors
- $12 = 2 \times 2 \times 3$
- $50 = 2 \times 5 \times 5$

A **multiple** of a number is the product of that number times another whole number greater than 0.

Example: Multiples of 5 are $(5 \times 1) = 5$; $(5 \times 2) = 10$; $(5 \times 3) = 15$; $(5 \times 4) = 20$; etc.

A **composite number** is not a prime number and can be factored in more than one way. All numbers that are not prime are composite (with the exception of 1).

Example: 15 is a composite number since it can be factored as 15×1 or 5×3.

Examples with Solutions

1. Which of the following numbers are not prime?

   1, 3, 4, 5, 7, 9, 11, 15

1 is not prime since it is not greater than 1.

4, 9, and 15 are not prime. They are composite, since they have more than one pair of factors.

For example, 9 can be factored as 9×1 or 3×3.

2. List all factors of 20.

Factor 20 as follows $2 \times 2 \times 5$

The set of all factors consists of all numbers that divide evenly into 20.

The numbers are 1 plus all combinations of 2, 2, and 5 shown in step 1.

Answer: 1, 2, 4, 5, 10, 20

3. List all multiples of 7 less than 40.

Multiples of 7 consist of numbers that are the product of 7 times 1, 2, 3, 4, ..., etc.

We want multiples of 7 less than 40.

7×1, 7×2, 7×3, 7×4, 7×5. (7×6 is 42, which is larger than 40.)

Answer: 7, 14, 21, 28, 35

4. Show 90 as a product of prime factors.

Factor 90 until all factors are broken down into prime factors.

$90 = 9 \times 10 = 3 \times 3 \times 2 \times 5$

Exercises 1.1

1. Identify whether or not each number is prime. Then give a reason for it.

Number	Yes/No	Reason
a. 22		
b. 31		
c. 77		
d. 57		
e. 43		
f. 51		

2. List all factors of each number. Then list the prime factors only.

Number	All Factors	Prime Factors Only
a. 30		
b. 100		
c. 75		
d. 90		
e. 135		
f. 38		

3. List all multiples of the following numbers that meet each condition.

Number	Multiples of the Number
a. all multiples of 11 that are greater than 40 and less than 100	
b. all multiples of 5 between 11 and 41	
c. all multiples of 9 less than 100	
d. all multiples of 20 less than 200	
e. all multiples of 13 less than 100 that are odd numbers.	

4. Write each number as a product of prime factors.

Number	Product of Primes
a. 30	
b. 12	
c. 26	
d. 36	
e. 250	

Number	Product of Primes
f. 1000	
g. 90	
h. 216	
i. 196	
j. 242	

Extra for Experts

5. List all factors which are common to both 9 and 30.

6. List all factors which are common to 10, 14, and 70.

7. List all numbers less than 100 that are multiples of both 15 and 10.

8. List all numbers less than 50 that are multiples of both 3 and 5.

9. I am a multiple of both 9 and 15. I am less than 200 and more than 150. Who am I?