CREST Olympiads

MATHEMATICS WORKBOOK

7

For the preparation of National & International Olympiads

- Chapter-wise practice exercises
- Previous year paper

CREST Mathematics Olympiad (CMO)

Mathematics Olympiad

Exams Preparation Book

CMO | IMO | UMO | iOM | UIMO | HMO

Grade 7

CREST Olympiads

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CREST Mathematics Olympiad Workbook for Grade 7

Fourth Edition

Disclaimer: The information in the Workbook is to give you the path to success but it does not guarantee 100% success as the strategy is completely dependent on its execution. And it is based on previous year papers of CMO exam.

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Preface

We are pleased to launch a thoroughly revised edition of this workbook. We welcome feedback from students, teachers, educators and parents. For improvements in the next edition, please send your suggestions at info@crestolympiads.com. Our team will make an effort to work on those suggestions. The status of the improvements can be checked at https://www.crestolympiads.com/corrections-class7-120

CREST Olympiads is one of the largest Olympiad Exams with students from more than 60 countries. The objective of these exams is to build a competitive spirit while evaluating students on conceptual understanding of the concepts.

We strive to provide a superior learning experience, and this workbook is designed to complement the school studies and prepare the students for various competitive exams including the CREST Olympiads. This workbook provides a crisp summary of the topics followed by the practice questions. These questions encourage the students to think analytically, to be creative and to come up with solutions of their own. There is a previous year's paper given at the end of this workbook for the students to attempt after completing the syllabus. This paper should be attempted in 1 hour to get an assessment of the student's preparation for the final exam.

Publishers

Chapter 1

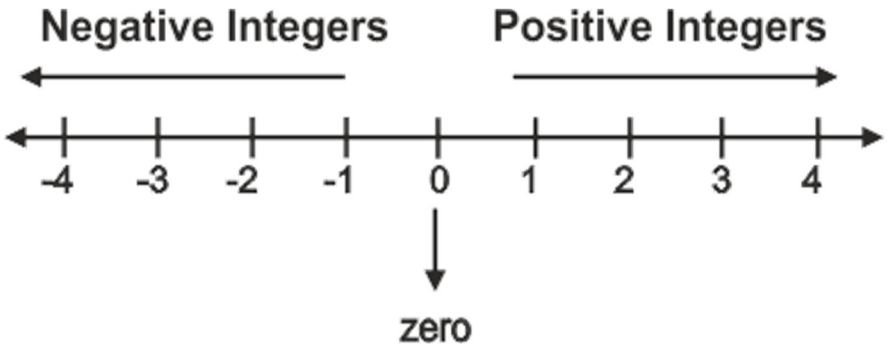
Integers

Integers

Integers are a combination of counting numbers (positive numbers), zero and negatives of the counting numbers.

21, 4, 0, -2048 are few examples of integers.

Integers can be represented on the number line as shown below:



Zero is neither positive nor negative.

Properties of Integers

- **Closure Property:** Closure property holds true for addition, subtraction, and multiplication on the set of integers.
  For any two integers a and b, a + b, a - b, a x b are also integers.
  Example 1: 3 - 4 = 3 + (-4) = -1
  Example 2: (-5) + 4 = 1
  Example 3: 6 x 3 = 18; (-5) x 2 = -10

- **Commutative Property:** Commutative property holds true for addition and multiplication in the set of integers.
  For any two integers, a and b:
  a + b = b + a
  a x b = b x a
  Example 1: 4 + (-6) = (-6) + 4
  -2 = -2
  Example 2: 10 x (-2) = (-2) x 10
  -20 = -20

- **Associative Property:** Associative property holds true for addition and multiplication in the set of integers.
  For any three integers a, b, and c:

a + (b + c) = (a + b) + c
a x (b x c) = (a x b) x c
Example 1: 1 + (2 + (-3)) = (1 + 2) + (-3)
0 = 0
Example 2: 1 x (2 x (-3)) = (1 x 2) x (-3)
-6 = -6

- **Distributive Property:** Multiplication can be distributed over addition and subtraction for the set of integers.
  For any three integers a, b, and c:
  a x (b + c) = a x b + a x c
  a x (b - c) = a x b - a x c
  Example 1: -3(2 + 1) = (-3 x 2) + (-3 x 1)
  -9 = -9

- **Identity Element:** 0 is called as the additive identity and 1 is called as the multiplicative identity.
  For any integer a:
  a + 0 = 0 + a = a
  a x 1 = 1 x a = a
  Example: 5 + 0 = 0 + 5 = 5; 0 x 1 = 1 x 0 = 0

- **Multiplication by Zero:** For any integer a, a x 0 = 0 x a = 0.

Divisibility Rules

- **Divisibility by 2:** This rule states that any number with the last digit 0, 2, 4, 6, or 8 will be divisible by 2.

- **Divisibility by 3:** If the sum of the digits of a number is divisible by 3, then the number is divisible by 3.

- **Divisibility by 6:** If a number is divisible by 2 and 3, then the given number is also divisible by 6.

- **Divisibility by 4:** If the number formed by the last two digits is divisible by 4, then the given number is divisible by 4.

- **Divisibility by 8:** If the number formed by last three digits is divisible by 8, then the given number is divisible by 8.

- **Divisibility by 5:** If the units digit of a number is either 0 or 5, the given number is divisible by 5.

- **Divisibility by 7:** Take the units digit of a number, double it, subtract it from the truncated original number and continue doing this until we get a one digit remains. If this is 0 or 7, then the original number is divisible by 7.

- **Divisibility of 9:** If the sum of the digits of a number is divisible by 9, then the given number is divisible by 9.

- **Divisibility by 10:** A number is divisible by 10 if the units digit of the number is 0.

- **Divisibility by 11:** Consider the sum of digits at even places and odd places. Find the difference of sum of digits at even and odd places. If the answer is 0 or 11 then the result is divisible by 11.

Example 1: The product of the predecessor and successor of an odd natural number is always divisible by:

a. 8
b. 6
c. 4
d. 2

Solution 1: a

The predecessor of an odd number is an even number.
The successor of an odd number is also an even number.
These two even numbers are two consecutives even numbers, and the product of two consecutive even numbers is always divisible by 8.

Example 2: What least value should be given to * so that the number 6342*1 is divisible by 3?

a. 3
b. 2
c. 1
d. 0

Solution 2: b

Sum of the given digits = 6 + 3 + 4 + 2 + 1 = 16
We know that multiple of 3 greater than 16 is 18.
∴ 18 - 16 = 2
Therefore, the smallest required digit is 2.

Example 3: If a negative sign precedes a bracket, what happens to the terms inside it?

a. Their signs have changed.
b. The terms are reciprocated.
c. The signs remain the same.
d. The terms are doubled.

Solution 3: a

If a negative sign precedes a bracket, the signs of the terms inside the bracket are changed.
For example: - (-4) = +4

Special Divisibility Rules

- If a number is divisible by another number, then it is divisible by each of the factors of the second number.
- If a number is divisible by two co-prime numbers, then it is divisible by their product also.

- If two given numbers are divisible by a number, then their sum is also divisible by that number.
- If two given numbers are divisible by a number; then their difference is also divisible by that number.

Let us take some examples to understand the topic better:

Example 1: Which of the following statements is true?

a. A number is divisible by 4 if it is divisible by 2.
b. A number is divisible by 9 if it is divisible by 3.
c. A number is divisible by 11 if the number formed by its last two digits is divisible by 11.
d. A number is divisible by 8 if the number formed by its last three digits is divisible by 8.

Solution 1: d

The correct statement is:
A number is divisible by 8 if the number formed by its last three digits is divisible by 8.
For example, 13256 is divisible by 8 because 256 is completely divisible by 8.

Example 2: The sum of two integers is 116. If one of them is -79, find the other integers.

a. 37
b. 116
c. 195
d. -195

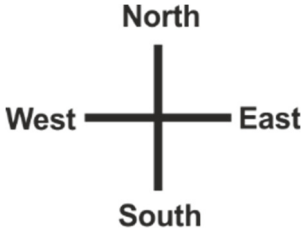
Solution 2: c

Sum of two integers = 116
One of them = -79
Other integer = Sum of two integers - One of them
= 116 - (-79)
= 195

Example 3: A man walked 3 km towards North then 8 km towards South. What is his final position with respect to his initial position?

a. 5 km towards West
b. 5 km towards East
c. 5 km towards South
d. 5 km towards North

Solution 4: c



The north direction can be taken as positive and south as negative.
Then walking 3 km towards north can be taken as +3 km.
Walking 8 km towards south can be taken as -8 km.

The final position = +3 - 8 = -5 km.
Here, the '-' sign shows that he is in south direction with respect to his initial position.
The man's final position is 5 km to the south with respect to his initial position.

Practice Questions

1. The product of two whole numbers is 7. What is the sum of the squares of their reciprocals?

   a. 59/49
   b. 50/49
   c. 49/50
   d. 51/50

2. The sum of two integers is 112. If one of the integers is -23, find the other integer.

   a. 135
   b. 89
   c. -89
   d. 125

3. A man walked 119 km towards North then 126 km towards South. What is his final position with respect to his initial position?

   a. 7 km towards the north
   b. 245 km towards the north
   c. 7 km towards the south
   d. 245 km towards the south

4. What should be the value given to * so that the number 1343*47 is divisible by 3?

   a. 0
   b. 2
   c. 1
   d. 3

5. The difference between the squares of two consecutive odd integers is always divisible by:

   a. 6
   b. 5
   c. 4
   d. 3

6. Calculate (-77) × (-12) + (-3).

   a. 921
   b. 927
   c. 2763
   d. 2772

7. P is the smallest prime number between 113 and 189. Find P.

   a. 123
   b. 127
   c. 131
   d. 129

8. 43 + k is a prime number. What is the least value of k?

   a. 0
   b. 7
   c. 2
   d. 4

9. Solve the expression given below:
89 - 34 - 23 × 2 =?

a. 7
b. 10
c. 8
d. 9

10. P is a three-digit even number less than 400, and more than 210 that is divisible by 7. Find P.

a. 348
b. 378
c. 312
d. 334

11. If n = 6m + 45, and 'm' is a positive integer, which of the following divides n?

a. 8
b. 2
c. 3
d. 4

12. The temperature of a room is lowered by 7°F every 2 hours. If the initial temperature of the room is 17°F what will be the temperature of the room after 14 hours?

a. -47°F
b. -49°F
c. -32°F
d. 37°F

13. What is the product of the multiplicative inverse of 5 and multiplicative inverse of -5?

a. -25
b. 1/25
c. 25
d. -1/25

14. If a six-digit number 78r7s0 is divisible by 55, then find the values of r and s respectively.

a. 7 and 4
b. 6 and 2
c. 4 and 9
d. 3 and 7

15. The quotient of two numbers is (-112). If one of the numbers is (896), find the other number.

a.-8
b.-5
c. 8
d. 5

16. If “h” is an even integer, then which of the following options must be an odd integer?

a. “h+5”
b. “h/2”
c. “h-4”
d. “hx6”

17. The product of two whole numbers is 11. What is the sum of their reciprocals?

a. 10/11
b. -10/11
c. -12/11
d. 12/11

18. How many prime numbers between 50 and 100 have the sum of their digits as 8?

a. 10
b. 6
c. 4
d. 2

19. The number “H” is divisible by 132. Which of the following options do not divide “H” completely?

a. 11
b. 8
c. 4
d. 6

20. Solve the expression given below:
16 × (-18) × (-6) - (-6) = ?

a. 1437
b. 1734
c. 1347
d. 1537