

# APPROXIMATION

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## 2.6 Approximation

A number of times we need to find the approximate values instead of exact values of calculations. In such cases, we can arrive at the answers quickly by modifying the calculation process slightly. However, we need to be very careful about the desired accuracy level.

### 2.6.1 Addition and Subtraction

#### (i) Rounding off

We round off both the numbers to the nearest tens, hundreds, thousands etc.

**Example:**  $36,869 + 7,583 = ?$

$36,869 + 7,583$	$= 44,452$	<u>Rounded to</u> exact value
$36,869 + 7,583 \cong 36,870 + 7,580$	$= 44,450$	(tens)
$36,869 + 7,583 \cong 36,900 + 7,600$	$= 44,500$	(hundreds)
$36,869 + 7,583 \cong 37,000 + 8,000$	$= 45,000$	(thousands)

The more the number of zeros generated at the end of a number by rounding off, the calculation becomes simpler but less accurate. So we need to go by the answer choices available.

#### (ii) Adjusting the numbers

- a. While adding, we can increase one number and decrease the other one by roughly equal amounts i.e. compensate in opposite directions.

**Example:**  $889 + 1015 \cong 900 + 1000 = 1900$

- b. While subtracting, we adjust both the numbers in the same direction by roughly equal amounts.

**Example:**  $36,869 - 7,583 \cong 36,900 - 7,600 = 29,300$

### 2.6.2 Multiplication

- Splitting the Numbers

Calculation can be simplified by splitting the numbers and use of brackets and splitting the numbers.

- a. Splitting one Number

**Example:**  $1705 \times 800 = ?$

**Solution:**  $= (1700 + 5) \times 800 = 1700 \times 800 + 5 \times 800$   
 Answer =  $13,60,000 + 4,000 = 13,64,000$

- b. Splitting both numbers

**Example:**  $742 \times 848 = ?$

**Solution:**

$$(740 + 2) (850 - 2)$$

$$= 740 \times 850 - 740 \times 2 + 2 \times 850 - 2 \times 2$$

(Ignore)

$$= 6,29,000 - 1480 + 1700 = 6,29,220$$

Here we ignored the last term since it's value is small compared to other terms and will not affect the accuracy of the result significantly.

A convenient format to write the above calculation is:

$$\begin{array}{r}
 740 \times 850 \quad \Rightarrow \\
 \quad \quad \quad +2 \quad \quad -2 \\
 \quad \quad \quad = 6,29,000 \\
 \quad \quad \quad = (+2) 850 + (-2) \times 740 = + 220 \\
 \text{Answer} = 6,29,000 + 220 = 6,29,220
 \end{array}$$

- Use of algebraic identities

**Example:**  $705 \times 705 = 705^2 = (700 + 5)^2$   
 use  $(a + b)^2 = a^2 + 2ab + b^2 = 700^2 + 2(700)(5) + 5^2$   
 (Ignore)

$$\text{Answer} = 4,90,000 + 7000 + 25 = 4,97,025$$

**Example:**  $695 \times 695 = 695^2 = (700 - 5)^2$   
 use  $(a - b)^2 = a^2 - 2ab + b^2 = 700^2 - 2(700)(5) + 5^2$   
 (Ignore)

$$\text{Answer} = 4,90,000 - 7000 + 25 = 4,83,025$$

### 2.6.3 Division

Here we increase (or decrease) both the dividend and the divisor in approximately proportionate amounts.

**Example:**  $\frac{568}{8.8} = ?$

Here the divisor is a decimal but we can't simply round it to 9, since even a small change can affect the accuracy significantly, which is clear from the following exact calculations.

$$\frac{568}{8.8} = 64.5454\dots$$

$$\frac{568}{9} = 63.1111\dots$$

In such situation, we increase the dividend by a proportionate amount = Increase in divisor  
 $\times$  Approximate quotient.

$$= 0.2 \times 63 = 12.6 \cong 13$$

$$\text{Hence, } \frac{568}{8.8} \cong \frac{568+13}{9} = \frac{581}{9} = 64.55$$

This answer is much closer to the exact answer.

**Example:**  $\frac{568}{9.2} \cong \frac{568-13}{9} = \frac{555}{9} = 61.671$  (Exact answer is 61.74)