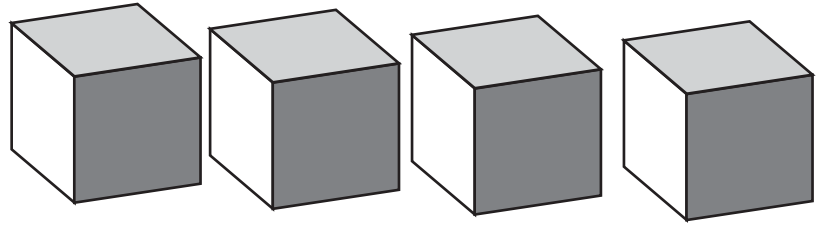# Algebraic identity

Objective
To verify the identity $(a - b)^3 = a^3 - 3a^2b + 3ab^2 - b^3$, for simple cases using a set of unit cubes.

Pre–requisite knowledge

1. Express the volume of an object as the number of unit cubes in it.

2. Knowledge of the identity $a^3 - a^2b - a^2b - a^2b + ab^2 + ab^2 + ab^2 - b^3$
   $= (a - b)^3$.

Material Required
64 unit cubes made of wood (dimension is 1 unit × 1 unit × 1 unit).

Procedure
For representing a^3

1. Take a = 4 and b = 1. Make a cube of dimensions 4 × 4 × 4 using 64 unit cubes as shown in Fig 25 (a).

2. Remove a cuboid of dimensions a^2b i.e. 4 × 4 × 1 [Fig 25 (b)] three times from Fig 25 (a) as shown in Fig 25 (c).

3. Add a cuboid of dimensions ab^2 i.e. 4 × 1 × 1 [Fig 25 (d)] three times to Fig 25 (c) as shown in Fig 25 (e).

4. Remove a cube b^3 of dimensions 1 × 1 × 1 [Fig 25 (f)] from Fig 25 (e) as shown in Fig 25 (g).

5. The total number of remaining cubes will be 27 = 3^3 i.e. a^3 as shown in Fig 25 (g).

Observations

1. Number of unit cubes in $a^3 = 4^3 = 64$

2. Number of unit cubes in cuboid $a^2b = 4 × 4 × 1 = 16$ is removed

   Number of cubes left = 64 – 16 = 48

3. Number of unit cubes in cuboid $ab^2 = 4×1×1$ is added

   Number of cubes left = 48 + 4 = 52

4. Number of unit cubes in cuboid $a^2b = 4×4×1=16$ is removed

   Number of cubes left = 52 – 16 = 36

5. Number of unit cubes in cuboid $ab^2 = 4 × 1 × 1 = 4$ is added

   Number of cubes left = 36 + 4 = 40

6. Number of unit cubes in cuboid $a^2b = 4× 4 × 1 = 16$ is removed

   Number of cubes left = 40 – 16 = 24

7. Number of unit cubes in cuboid $ab^2 = 4 \times 1 \times 1$ is added

   Number of cubes left $= 24 + 4 = 28$

8. Number of unit cube $b^3 = 1 \times 1 \times 1$ is removed

   Number of cubes left $= 28 - 1 = 27$

   9. $27 = 3^3$

10. It is verified that

   $a^3 - a^2b + ab^2 - a^2b + ab^2 - a^2b + ab^2 - b^3 = (a-b)^3$

   $a^3 - 3a^2b + 3ab^2 - b^3 = (a-b)^3$

Learning Outcomes

1. The students obtain the skill of making cuboids using unit cubes.
2. The students obtain the skill of adding and subtracting the volume of cuboids.
3. Showing the volume of a cube as the sum of cuboids helps them to get a geometric feeling of volume.

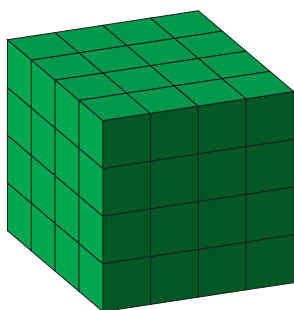## Remark

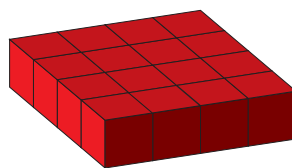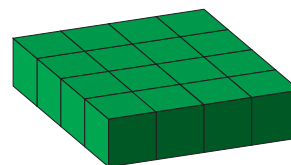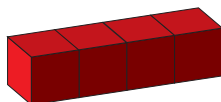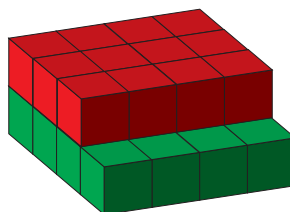Teachers can take any value of a and b and verify the result.

Fig 25 (a)

Fig 25 (b)

Fig 25 (c)

Fig 25 (d)

Fig 25 (e)

Fig 25 (f)

Fig 25 (g)