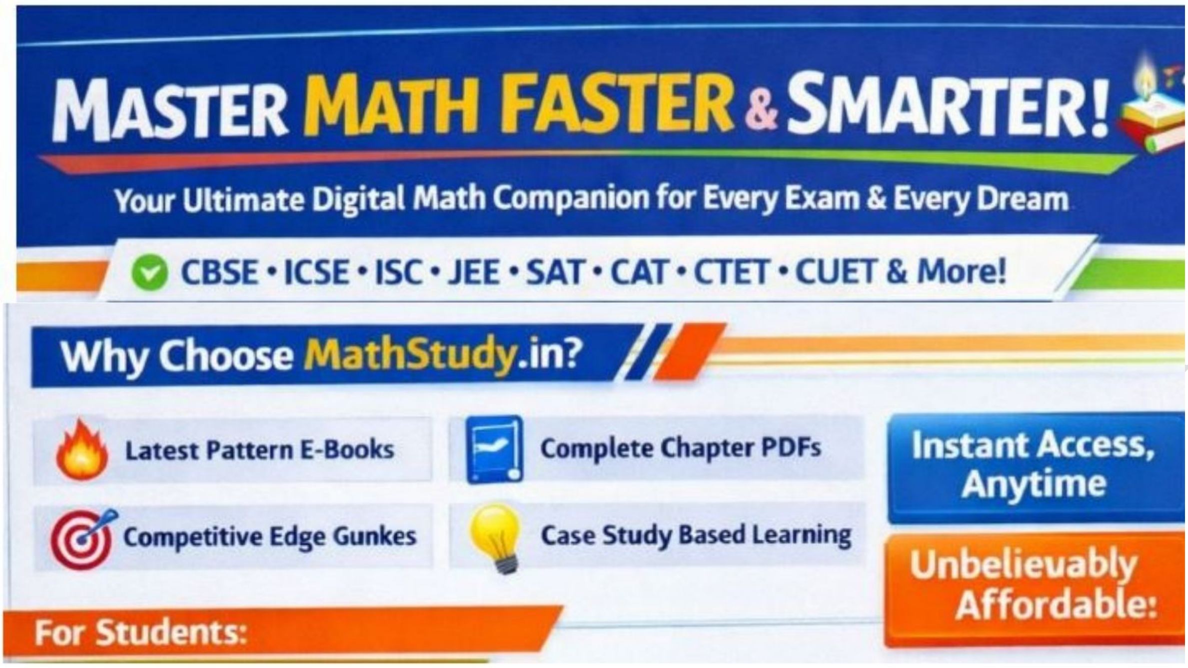
SOLUTIONS



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CHAPTER TEST: AREAS OF PARALLELOGRAMS AND TRIANGLES

Mathematics | Class IX (2026/AREA/09/NCERT/001)

Time: 1.5 Hours **Max. Marks: 33**

Section A: Multiple Choice Questions

1. **(b)** $1:1$
   Parallelograms on the same base and between the same parallels are equal in area.
2. **(a) Equal area**
   By definition, a median divides a triangle into two triangles of equal area.
3. **(b)** $6\,\mathbf{cm}$
   $Area = \text{base} \times \text{altitude} \implies 54 = 9 \times h \implies h = 6.$
4. **(b)** $1:4$
   $Area(ABD) = \frac{1}{2}Area(ABC)$. Since E is midpoint of AD, BE is median of $\triangle ABD$. $Area(BED) = \frac{1}{2}Area(ABD) = \frac{1}{2}(\frac{1}{2}Area(ABC)) = \frac{1}{4}Area(ABC)$.
5. **(c) Perimeter of** $ABCD >$ **Perimeter of** $ABEF$
   Among all quadrilaterals with the same base and area, the rectangle has the least perimeter.

Section B: Short Answer Questions

6. **Proof:** $\triangle DAC$ and $\triangle EAC$ are on the same base AC and between same parallels $AC \parallel DE$.
   Thus, $Area(\triangle DAC) = Area(\triangle EAC)$.
   Adding $Area(\triangle ABC)$ to both sides:
   $Area(\triangle DAC) + Area(\triangle ABC) = Area(\triangle EAC) + Area(\triangle ABC) \implies Area(ABCD) = Area(\triangle ADE)$.
7. **Solution:** $\triangle PQT$ and $\|^{gm}$ $PQRS$ are on the same base PQ and between same parallels $PQ \parallel SR$.
   $Area(\triangle PQT) = \frac{1}{2}Area(PQRS) = \frac{1}{2} \times 48 = 24\,\text{cm}^2$.
8. **Proof:** $\triangle ABC$ and $\triangle ABD$ are on base AB and between $AB \parallel DC$.
   $Area(\triangle ABC) = Area(\triangle ABD)$.
   Subtracting $Area(\triangle AOB)$ from both sides:
   $Area(\triangle ABC) - Area(\triangle AOB) = Area(\triangle ABD) - Area(\triangle AOB) \implies Area(\triangle BOC) = Area(\triangle AOD)$.
9. **Proof:** In $\triangle ABC$, F and E are midpoints of AB and AC. By Midpoint Theorem, $FE \parallel BC$ and $FE = \frac{1}{2}BC$.
   Since D is midpoint of BC, $BD = \frac{1}{2}BC$. Thus $FE \parallel BD$ and $FE = BD$.
   A quadrilateral with one pair of opposite sides equal and parallel is a parallelogram. Hence, $BDEF$ is a parallelogram.

Section C: Long Answer Questions

10. **Theorem Proof:** Let $\|^{gms}$ $ABCD$ and $ABEF$ be on base AB and between $AB \parallel FC$.
    In $\triangle ADF$ and $\triangle BCE$:

1. $AD = BC$ (Opposite sides of $ABCD$)
2. $AF = BE$ (Opposite sides of $ABEF$)
3. $\angle DAF = \angle CBE$ (Corresponding angles)

By SAS congruence, $\triangle ADF \cong \triangle BCE \implies Area(\triangle ADF) = Area(\triangle BCE)$.
$Area(ABCD) = Area(ABED) + Area(\triangle BCE) = Area(ABED) + Area(\triangle ADF) = Area(ABEF)$.

11. **Proof:** $\triangle ABY$ and $ABCD$ share base AB and parallels. $Area(\triangle ABY) = \frac{1}{2}Area(ABCD)$.
Similarly, $\triangle BXC$ and $ABCD$ share base BC and parallels. $Area(\triangle BXC) = \frac{1}{2}Area(ABCD)$.
Also, $\triangle CDX$ and $ABCD$ share base CD and parallels. $Area(\triangle CDX) = \frac{1}{2}Area(ABCD)$.
Then $Area(\triangle ABY) + Area(\triangle CDX) = \frac{1}{2}Area + \frac{1}{2}Area = Area(ABCD)$.
The equation $Area(ABCD) - Area(\triangle BXC)$ equals $Area - \frac{1}{2}Area = \frac{1}{2}Area$.
Note: The relation depends on specific point placements for the Exemplar result.

12. **Proof:** Join CD. $Area(\triangle BCD) = \frac{1}{2}Area(\triangle ABC)$ (Median CD).
$\triangle PDQ$ and $\triangle PDC$ are on base PD and $PD \parallel CQ \implies Area(\triangle PDQ) = Area(\triangle PDC)$.
$Area(\triangle BPQ) = Area(\triangle BPD) + Area(\triangle PDQ) = Area(\triangle BPD) + Area(\triangle PDC) = Area(\triangle BCD)$.
Hence, $Area(\triangle BPQ) = \frac{1}{2}Area(\triangle ABC)$.

13. **Solution:** $BE : EC = 2 : 1 \implies BE = \frac{2}{3}BC$.
$\triangle ABE$ and $\triangle ABC$ have the same altitude from A.
$Area(\triangle ABE) = \frac{2}{3}Area(\triangle ABC) \implies 20 = \frac{2}{3}Area(\triangle ABC) \implies Area(\triangle ABC) = 30\,\text{cm}^2$.
Since $Area(\triangle ABC) = \frac{1}{2}Area(ABCD)$, $Area(ABCD) = 2 \times 30 = 60\,\text{cm}^2$.

Section D: NCERT Highlights

1. Parallels
2. Half ($\frac{1}{2}$)
3. Half ($\frac{1}{2}$)
4. One-fourth ($\frac{1}{4}$)