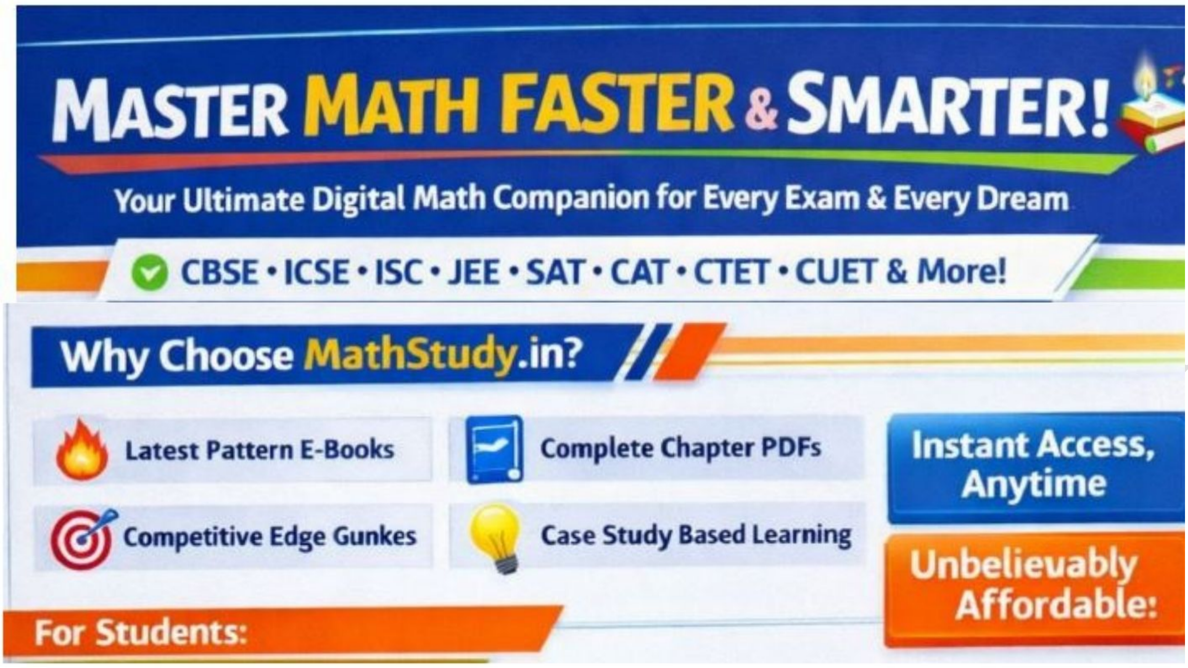
SOLUTIONS

www.udgamwelfarefoundation.com

For Best Mathematics E-Books, Visit:
www.mathstudy.in



Special Features

- **Board-Specific** – CBSE, ICSE, ISC, State Boards
- **Exam-Focused** – JEE, SAT, CAT, CTET, CUET, NTSE
- **Grade-Wise** – Class 6 to 12
- **Bilingual Options** – English & Hindi Medium Support
- **Printable & Shareable** – Use offline, anytime

How to Order:

Visit : https://www.mathstudy.in
Browse by Exam, Class, or Topic
Add to Cart & Checkout

Contact & Support:

✉️ Email: admin@mathstudy.in
💬 WhatsApp Support Available : +91-+91 92118 65759

💡 Why Wait? Empower your learning journey, save time, and achieve your dreams!

🌐 Explore & Start Learning Today:
https://www.mathstudy.in – Premium eBooks for success
https://www.udgamwelfarefoundation.com – Free PDFs, practice tests, & guida

MathStudy.in — Empowering Learners, Enabling Educators, Encouraging Excellence.
Digital Learning | Affordable Excellence | Trusted by Thousands

SOLUTIONS: AREAS OF PARALLELOGRAMS AND TRIANGLES (HOTS)

Mathematics | Class IX | (2026/AREA-HOTS/09/001)

Section A: Multiple Choice Questions

1. **Answer: (b)** $1:2$
   A triangle is half the area of a parallelogram if they share the same base and parallels.
2. **Answer: (b) Equal area**
   A median of a triangle bisects its area.
3. **Answer: (c)** $30\,\mathbf{cm}^2$
   $Area(\triangle ABC) = 2 \times Area(\triangle ABD) = 2 \times 15 = 30.$
4. **Answer: (b) Equal in area**
   This is a fundamental theorem of Euclidean geometry.
5. **Answer: (b)** $24\,\mathbf{cm}^2$
   Both are parallelograms on the same base and parallels.
6. **Answer: (b)** $40\,\mathbf{cm}^2$
   $Area(ABCD) = 2 \times Area(\triangle ABE) = 2 \times 20 = 40.$
7. **Answer: (a) Parallel to the base line**
   Equal areas and bases imply equal altitudes; hence the vertices must lie on a line parallel to the base.
8. **Answer: (c)** $\frac{1}{4} Area(ABC)$
   Joining the mid-points of a triangle divides it into 4 triangles of equal area.

Section B: Short Answer Questions

1. $Area(\triangle PQS) = \frac{1}{2} Area(PQRS) = 20\,\text{cm}^2$.
   $\triangle PSA$ and $\triangle PQS$ share the same altitude from P to the diagonal QS. However, $Area(\triangle PQS) = Area(\triangle PSQ)$. By diagonal property, $Area(\triangle PSQ) = Area(\triangle RSQ)$. Actually, for point A on diagonal QS, $Area(\triangle PSA) = Area(\triangle RQA)$. Since $Area(\triangle PSQ) = 20$, and A is on QS, $Area(\triangle PSA)$ depends on the position of A. *Note: If A is the midpoint of QS, area is $10\,cm^2$.*
2. Let $ABCD$ be a parallelogram. Diagonal AC forms $\triangle ABC$ and $\triangle ADC$.
   They have $AB = CD$, $BC = DA$ and AC common. By SSS, $\triangle ABC \cong \triangle ADC$.
   Congruent triangles have equal areas.
3. $Area(\triangle ABD) = \frac{1}{2} Area(\triangle ABC)$ (Median AD).
   In $\triangle ABD$, BE is the median (as E is mid-point of AD).
   $Area(\triangle BED) = \frac{1}{2} Area(\triangle ABD) = \frac{1}{2}(\frac{1}{2} Area(\triangle ABC)) = \frac{1}{4} Area(\triangle ABC)$.
4. A triangle is divided into 6 triangles of equal area by its three medians.
   $Area(\triangle AGB) = 2 \times (\frac{1}{6} Area) = \frac{1}{3} Area(\triangle ABC)$.
   Since each of the three triangles equals $\frac{1}{3}$ total area, they are all equal.

Section C: Short Answer Questions

1. $\triangle DBC$ and $\triangle EBC$ are on the same base BC and have equal areas.
   By the converse of the area theorem, they must lie between the same parallels.
   Therefore, $DE \parallel BC$.

2. $Area(\triangle APB) = \frac{1}{2}Area(ABCD)$ is incorrect (that's for base AB).
   $Area(\triangle APB) = \frac{1}{2}Area(ABCD)$ if P is on CD.
   Sum of areas: $Area(\triangle APB) + Area(\triangle AQD) = \frac{1}{2}Area(ABCD) + \frac{1}{2}Area(ABCD)$ is false.
   Correct relation: Each triangle is half the parallelogram if its base is a side and vertex is on the opposite side.

3. $\triangle ADX$ and $\triangle ACX$ are on same base AX and between $AX \parallel DC$. No.
   Correct approach: $Area(\triangle ACX) = Area(\triangle ACY)$ (Same base AC, $AC \parallel XY$).
   $Area(\triangle ADX) = Area(\triangle ACX)$? No.
   Using $AB \parallel DC$: $Area(\triangle ADC) = Area(\triangle BDC)$.

Section D: Long Answer / HOTS Questions

1. **(i)** $PQRS$ and $ABRS$ have same base SR and parallels $SR \parallel PB$.
   $\implies Area(PQRS) = Area(ABRS)$.
   (ii) In $\triangle AXS$ and $\parallel^{gm}$ $ABRS$, same base AS and parallels $AS \parallel BR$.
   $\implies Area(\triangle AXS) = \frac{1}{2}Area(ABRS)$.
   Since $Area(ABRS) = Area(PQRS)$, $Area(\triangle AXS) = \frac{1}{2}Area(PQRS)$.

2. **(i)** In $\triangle DOC$ and $\triangle AOB$: Let h_1, h_2 be altitudes from D, B to AC.
   Since $OB = OD$, altitudes $h_1 = h_2$. With $AB = CD$, we prove $\triangle DOC \cong \triangle AOB$ (SAS).
   $\implies Area(\triangle DOC) = Area(\triangle AOB)$.
   (ii) Add $Area(\triangle BOC)$ to both sides:
   $Area(\triangle DOC) + Area(\triangle BOC) = Area(\triangle AOB) + Area(\triangle BOC) \implies Area(\triangle DCB) = Area(\triangle ACB)$.
   (iii) Since $\triangle DCB$ and $\triangle ACB$ have same base BC and equal area, $AD \parallel BC$. Combined with $AB = CD$, it is a parallelogram.

3. Join CD. AD is median $\implies Area(\triangle BCD) = \frac{1}{2}Area(\triangle ABC)$.
   $\triangle PDQ$ and $\triangle PDC$ are on base PD with $PD \parallel CQ$.
   $\implies Area(\triangle PDQ) = Area(\triangle PDC)$.
   $Area(\triangle BPQ) = Area(\triangle BPD) + Area(\triangle PDQ) = Area(\triangle BPD) + Area(\triangle PDC) = Area(\triangle BCD)$.
   Thus, $Area(\triangle BPQ) = \frac{1}{2}Area(\triangle ABC)$.