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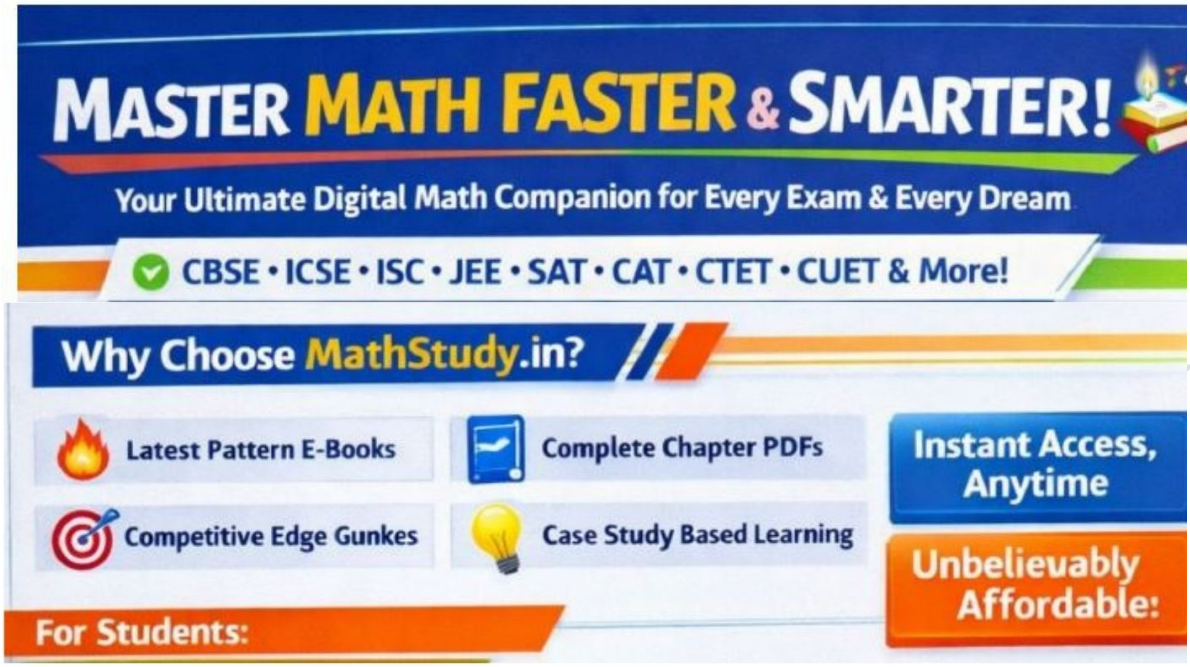

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SOLUTIONS: HERON'S FORMULA

Mathematics | Class IX (2026/HERON/09/003)

Section A: Multiple Choice Questions

1. **(c) 9**: Original Area $A = \frac{\sqrt{3}}{4}a^2$. New side is $3a$. New Area $= \frac{\sqrt{3}}{4}(3a)^2 = 9\left(\frac{\sqrt{3}}{4}a^2\right)$.
2. **(a) 7 cm**: Perimeter $= 2s = 24$. Let equal sides be x. $x + x + 10 = 24 \implies 2x = 14 \implies x = 7$.
3. **(a) $20\sqrt{2}$ cm^2**: $s = (s-a)+(s-b)+(s-c) = 5+10+1 = 16$. Area $= \sqrt{16 \times 5 \times 10 \times 1} = \sqrt{800} = 20\sqrt{2}$.
4. **(a) 54 cm^2**: $3x + 4x + 5x = 36 \implies x = 3$. Sides are $9, 12, 15$. Area $= \frac{1}{2} \times 9 \times 12 = 54$.
5. **(b) Half of the sum of three sides**: $s = (a+b+c)/2$.
6. **(a) $\sqrt{32}$ cm**: $\frac{1}{2}x^2 = 8 \implies x^2 = 16$. Hypotenuse $= \sqrt{x^2 + x^2} = \sqrt{32}$.
7. **(a)** A/s: Standard relation where Area $A = rs$.
8. **(c) 16**: Total area is the sum of all identical triangular tiles.

Section B: Very Short Answer Questions

1. Third side $= 42 - (18 + 10) = 14$ cm. $s = 21$.
   Area $= \sqrt{21(21-18)(21-10)(21-14)} = \sqrt{21 \times 3 \times 11 \times 7} = 21\sqrt{11}$ cm^2.
2. Height $= \sqrt{17^2 - 15^2} = 8$ cm. $s = (15 + 17 + 8)/2 = 20$.
   Area $= \sqrt{20(5)(3)(12)} = 60$ cm^2.
3. $3x + 5x + 7x = 300 \implies x = 20$. Sides: $60, 100, 140$.
   $s = 150$ m. Longest side $c = 140$. $s - c = 150 - 140 = 10$ m.
4. Side $a = 60/3 = 20$ cm. Area $= \frac{\sqrt{3}}{4}(20)^2 = 100\sqrt{3}$ cm^2.

Section C: Short Answer Questions

1. For $\triangle\,(26, 28, 30)$: $s = 42$. Area $= \sqrt{42(16)(14)(12)} = 336$ cm^2.
   Area of parallelogram = base $\times\, h \implies 336 = 28 \times h \implies h = 12$ cm.
2. Area $\triangle ABC = \frac{1}{2} \times 4 \times 3 = 6$ cm^2. (By Pythagoras, $AC = 5$ cm).
   For $\triangle ACD$, sides are $5, 5, 5$ (using $BD = 5$, $BC = 3$ to find $CD = 5$ is given).
   Area $\triangle ACD = \frac{\sqrt{3}}{4}(5)^2 \approx 10.82$. Total Area ≈ 16.82 cm^2.
3. Area $= \frac{\sqrt{3}}{4}a^2$. If $P = 180$, $a = 60$. Area $= \frac{\sqrt{3}}{4}(60)^2 = 900\sqrt{3}$ cm^2.

Section D: Long Answer Questions

1. In $\triangle BCD$, $BD = \sqrt{12^2 + 5^2} = 13$ m. Area $= \frac{1}{2} \times 12 \times 5 = 30$ m^2.
   In $\triangle ABD$ $(13, 9, 8)$: $s = 15$. Area $= \sqrt{15(2)(6)(7)} = 6\sqrt{35} \approx 35.5$ m^2.
   Total Area ≈ 65.5 m^2.

2. **I:** $s = 5.5$, Area ≈ 2.49. **II:** $6.5 \times 1 = 6.5$. **III:** Area ≈ 1.3.
   IV & V: $2 \times (\frac{1}{2} \times 6 \times 1.5) = 9$. Total Area ≈ 19.3 cm^2.

Section E: Case Study

Answers: 1.(c) Semi-perimeter, 2.(b) Heron's formula, 3.(c) Only side lengths known, 4.(a) Total area, 5.(c) Optimizes material and cost.