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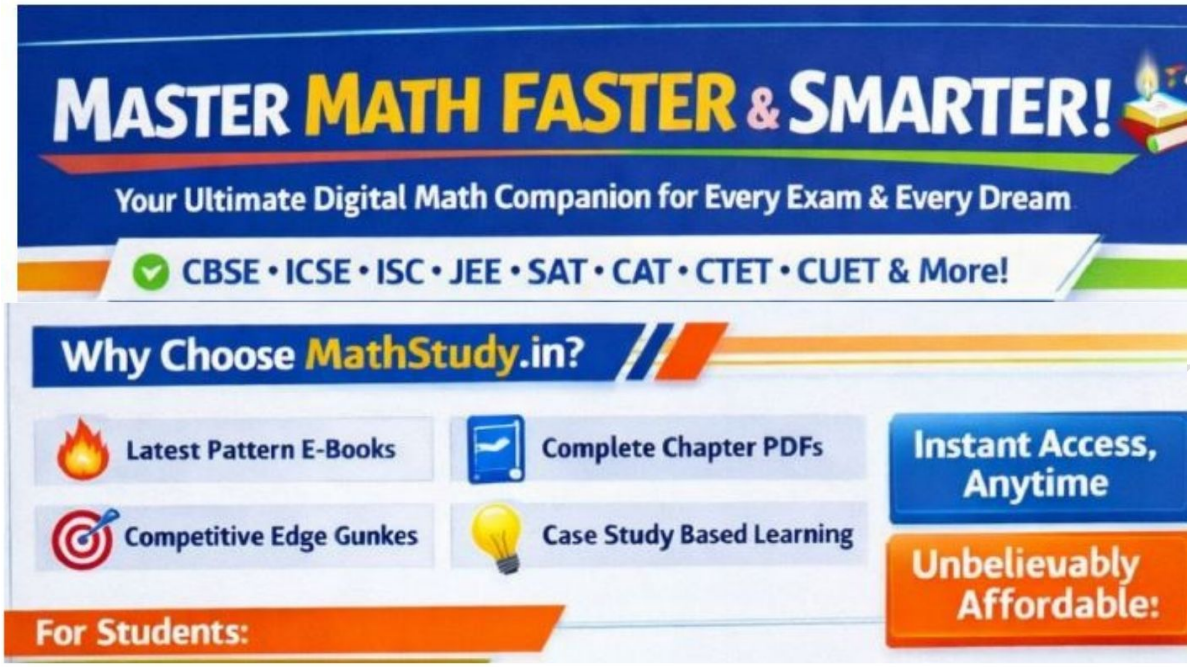

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SOLUTIONS: HERON'S FORMULA

Mathematics | Class IX (2026/HERON/09/001)

Section A: Multiple Choice Questions

1. **Value of $k = 9$**: Area is proportional to the square of the side ($A = \frac{\sqrt{3}}{4}a^2$). If side $a \to 3a$, then Area $\to (3)^2 = 9$ times.

2. **Semi-perimeter $s = 30$ cm**: $s = \frac{15+20+25}{2} = \frac{60}{2} = 30$ cm.

3. **Hypotenuse $= \sqrt{32} \approx 5.66$ cm**: $\frac{1}{2}x^2 = 8 \implies x^2 = 16 \implies x = 4$. Hypotenuse $= \sqrt{4^2 + 4^2} = \sqrt{32}$ cm.

4. **Area $= 54$ cm^2**: $3x + 4x + 5x = 36 \implies x = 3$. Sides are $9, 12, 15$. Area $= \frac{1}{2} \times 9 \times 12 = 54$ cm^2.

5. **Perimeter $= 24$ cm**: $\frac{\sqrt{3}}{4}a^2 = 16\sqrt{3} \implies a = 8$. Perimeter $= 3 \times 8 = 24$ cm.

6. **Height $= \frac{\sqrt{3}}{2}a$**: Derived from Pythagoras theorem in an equilateral triangle.

7. **Area $= \sqrt{s(s-a)(s-b)(s-c)}$**: Here $s = (s-a)+(s-b)+(s-c) \implies s = 5+10+1 = 16$. Area $= \sqrt{16 \times 5 \times 10 \times 1} = \sqrt{800} = 20\sqrt{2}$ cm^2.

8. **Semi-perimeter $s = 36$**: $s = \frac{9+28+35}{2} = \frac{72}{2} = 36$ cm.

Section B: Very Short Answer Questions

1. Third side $c = 32 - (8 + 11) = 13$ cm. $s = 16$.
   Area $= \sqrt{16(16-8)(16-11)(16-13)} = \sqrt{16 \cdot 8 \cdot 5 \cdot 3} = 8\sqrt{30}$ cm^2.

2. Equal sides $= (32 - 12)/2 = 10$ cm. $s = 16$.
   Area $= \sqrt{16(16-10)(16-10)(16-12)} = \sqrt{16 \cdot 6 \cdot 6 \cdot 4} = 4 \times 6 \times 2 = 48$ cm^2.

3. $s = \frac{6+8+10}{2} = 12$. Area $= \sqrt{12(6)(4)(2)} = \sqrt{576} = 24$ cm^2.
   Verification: $6^2 + 8^2 = 36 + 64 = 100 = 10^2$. It satisfies Pythagoras theorem, so it is a right triangle.

4. $s = \frac{120+80+50}{2} = 125$ m.
   Area $= \sqrt{125(5)(45)(75)} = \sqrt{25 \cdot 5 \cdot 5 \cdot 5 \cdot 9 \cdot 25 \cdot 3} = 375\sqrt{15}$ m^2.

Section C: Short Answer Questions

1. For side 'a': Area $= \frac{\sqrt{3}}{4}a^2$.
   If $P = 180$, then $a = 60$. Area $= \frac{\sqrt{3}}{4}(60)^2 = 900\sqrt{3}$ cm^2.

2. In $\triangle ABC$: $3^2 + 4^2 = 5^2$, so Area$_1 = \frac{1}{2} \times 3 \times 4 = 6$ cm^2.
   In $\triangle ADC$: $s = \frac{5+5+4}{2} = 7$. Area$_2 = \sqrt{7(2)(2)(3)} = 2\sqrt{21} \approx 9.16$ cm^2.
   Total Area ≈ 15.16 cm^2.

3. In $\triangle BCD$: $BD = \sqrt{12^2 + 5^2} = 13$ m. $\text{Area}_1 = \frac{1}{2} \times 12 \times 5 = 30$ m^2.
   In $\triangle ABD$: $s = \frac{9+8+13}{2} = 15$. $\text{Area}_2 = \sqrt{15(6)(7)(2)} = 6\sqrt{35} \approx 35.5$ m^2.
   Total Area ≈ 65.5 m^2.

Section D: Long Answer Questions

1. **Wings:** $2 \times (\frac{1}{2} \times 6 \times 1.5) = 9$ cm^2.
   Body (Rectangle): Area $= 4 \times 1 = 4$ cm^2.
   Nose (Equilateral $\triangle$): Side $= 1$ cm (matches body width). Area $= \frac{\sqrt{3}}{4}(1)^2 \approx 0.43$ cm^2.
   Tail: Usually treated as a trapezium. If total area is required, sum all parts.

2. In $\triangle DCE$ (where $DE \parallel CB$): Sides are $13, 14, 15$. $s = 21$.
   Area($\triangle$) $= \sqrt{21(8)(7)(6)} = 84$ m^2.
   Height $h = \frac{2 \times 84}{15} = 11.2$ m.
   Area(Trapezium) $= \frac{1}{2}(25 + 10) \times 11.2 = 196$ m^2.

Section E: Case Study

Answers: 1.(b) 13m, 2.(b) 30 sq.m, 3.(c) 16m, 4.(a) 44 sq.m, 5.(a) 74.12 sq.m.