# Heron's Formula

## Case Study Based Questions

### Case Study 1

World sandwich day is celebrated every year on 3 November. The sandwich got it's name from John Montagu in the 18th century. On the occasion of sandwich day, a food manufacturing company decided to make a record by making the biggest triangular sandwich.

Suppose sides of sandwich are 7 cm, 8 cm and 9 cm.

On the basis of the above information, solve the following questions:

**Q1. Heron's formula is used for finding the:**

a. area of circle

b. area of triangle

c. area of cuboid

d. area of cone

**Q2. The perimeter of a triangle is:**

a. 28 cm

b. 24 cm

c. 26 cm

d. 30 cm

**Q3. The area of sand wich is:**

a. $13 \text{ cm}^2$

b. $12\sqrt{5} \text{ cm}^2$

c. $3\sqrt{5} \text{ cm}^2$

d. $7\sqrt{9} \text{ cm}^2$

**Q4. The length of altitude to the smallest side of a triangle is:**

a. $\frac{24\sqrt{5}}{7}$ cm

b. $\frac{25\sqrt{5}}{7}$ cm

c. $\frac{23}{7}$ cm

d. $\frac{13}{7}$ cm

**Q5. The length of altitude to the largest side of a triangle is:**

a. $4\sqrt{5}$ cm

b. $\frac{8\sqrt{5}}{3}$ cm

c. $\frac{4}{3}\sqrt{5}$ cm

d. $4\sqrt{7}$ cm

## Solutions

**1.** (b) Heron's formula is used for finding the area of triangle.

So, option (b) is correct.

**2.** (b) The perimeter of a triangle is 7 + 8 + 9 i.e., 24 cm.

So, option (b) is correct.

**3.** (b) Since, sandwich is in the shape of triangle.

Let a = 7 cm, b = 8 cm and c = 9 cm.

Then, semi-perimeter of a triangle is:

$$s = \frac{a+b+c}{2} = \frac{7+8+9}{2}$$

$$= \frac{24}{2} = 12 \text{ cm}$$

By using Heron's formula,

Area of triangle, $\Delta = \sqrt{s(s-a)(s-b)(s-c)}$

$$= \sqrt{12(12-7)(12-8)(12-9)}$$

$$= \sqrt{12 \times 5 \times 4 \times 3}$$

$$= 12\sqrt{5} \text{ cm}^2$$

So, option (b) is correct.

**4.** (a) In given sides of a triangle, the smallest side is

7 cm, which we consider the base of the triangle.

Let h be the length of altitude of a triangle.

$$\therefore \text{ Area of triangle} = \frac{1}{2} \times 7 \times h$$

$$\Rightarrow \quad 12\sqrt{5} = \frac{7}{2} \times h$$

$$\Rightarrow \quad h = \frac{24\sqrt{5}}{7} \text{cm}$$

So, option (a) is correct.

**5.** (b) In given sides of triangle, the largest side is 9 cm, which we consider the base of the triangle.

Let $h_1$ be the length of altitude of a triangle.

Then area of triangle,

$$A = \frac{1}{2} \times \text{base} \times \text{altitude}$$

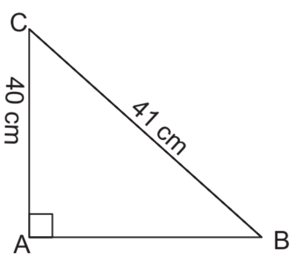
$$\Rightarrow \quad 12\sqrt{5} = \frac{1}{2} \times 9 \times h_1$$

$$\Rightarrow \quad h_1 = \frac{12\sqrt{5} \times 2}{9} = \frac{8\sqrt{5}}{3} \text{ cm}$$

So, option (b) is correct.

## Case Study 2

Mr. Silvestar is a property dealer. He bought a triangle shaped field such that the biggest measures 41 cm. The measurement of sides of the field is as shown in the figure.




On the basis of the above information, solve the following questions:

**Q1. The length of AB in the triangle ABC is:**

a. 10 cm      b. 9 cm

c. 12 cm      d. 15 cm

**Q2. Area of triangle ABC is:**

a. 190 $cm^2$ b. 185 $cm^2$

c. 180 $cm^2$ d. 200 $cm^2$

**Q3. The perimeter of a triangle is:**

a. 85 cm b. 93 cm c. 90 cm d. 95 cm

**Q4. If the cost of painting a field is ₹ 1.20 per $cm^2$, then the total cost of painting the field is:**

a. ₹ 220 b. ₹ 216 c. ₹ 230 d. ₹ 250

**Q5. Identify the correct statement:**

a. The length of longest altitude is the perpendicular distance from the opposite vertex to the largest side of a triangle.

b. Heron's formula is helpful when it is not possible to find the height of the triangle easily.

c. The length of smallest altitude is the perpendicular distance from the opposite vertex to the smallest side of a triangle.

d. Area of an equilateral triangle is $\frac{\sqrt{3}}{2}(\text{side})^2$.

## Solutions

**1.** (b) In right angled $\Delta ABC$, use Pythagoras theorem,

$$AB = \sqrt{(BC)^2 - (AC)^2}$$

$$= \sqrt{(41)^2 - (40)^2} = \sqrt{1681 - 1600}$$

$$= \sqrt{81} = 9 \text{ cm}$$

So, option (b) is correct.

**2.** (c) Area of $\Delta ABC = \frac{1}{2} \times AB \times AC$

$$= \frac{1}{2} \times 9 \times 40$$

$$= 180 \text{ cm}^2$$

So, option (c) is correct.

**3.** (c) The perimeter of a triangle is AB + BC + CA

= 9 + 41 + 40 = 90 cm

So, option (c) is correct.

**4.** (b) Since, cost of 1 $cm^2$ field is ₹ 1.20

∴ Cost of 180 $cm^2$ field = ₹ 180 × 1.20

= 216

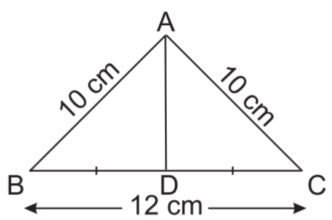
So, option (b) is correct.

**5.** (b) The correct statement is 'Heron's formula is helpful when it is not possible to find the height of triangle easily.

So, option (b) is correct.

## Case Study 3

International kite festival in Gujarat also known as Uttarayan is one of the biggest festival celebrated in Gujarat. It is celebrated on the auspicious day of makar sankranti every year. It is a sign for the farmers about the beginning of summer season. On the day of Uttarayan, Suresh a 16 year old boy wants to fly kite. He ordered a triangle shape kite whose sides are 10 cm, 10cm and 12 cm.




On the basis of the above information, solve the following questions:

**Q1. The perimeter of a Δ ABC is:**

a. 22 cm b. 16 cm

c. 32 cm d. 24 cm

**Q2. Find the area of triangle ABC.**

a. 40 $cm^2$ b. 48 $cm^2$

c. 49 $cm^2$ d. 50 $cm^2$

**Q3. The length of AD is:**

a. 7 cm b. 8 cm

c. 5 cm d. Can not be determined

**Q4. The area of AABD is:**

a. 18 $cm^2$ b. 20 $cm^2$

c. 24 $cm^2$ d. 23 $cm^2$

**Q5. If cost of paper is ₹ 1.50 per $cm^2$, then the cost of making a kite is:**

a. ₹ 75 b. ₹ 72

c. ₹ 80 d. ₹ 90

## Solutions

**1.** (c) The perimeter of a Δ ABC is AB + BC + AC

= 10 + 12 + 10 = 32 cm

So, option (c) is correct.

**2.** (b) Here, a = 10 cm and b = 12 cm

∴ Area of an isosceles triangle

$$= \frac{b}{4}\sqrt{4a^2 - b^2}$$

$$= \frac{12}{4}\sqrt{4(10)^2 - (12)^2}$$

$$= 3\sqrt{400 - 144}$$

$$= 3\sqrt{256} = 3 \times 16$$

$$= 48 \text{ cm}^2$$

So, option (b) is correct.

**3.** (b) In an isosceles triangle, median AD is equal to the altitude of a triangle.

$$\therefore \text{Area of } \Delta \text{ ABC } = \frac{1}{2} \times \text{BC} \times \text{AD}$$

$$48 = \frac{1}{2} \times 12 \times AD$$

$$\Rightarrow \quad AD = 8 \text{ cm}$$

So, option (b) is correct.

**4.** (c)

$$\therefore \text{ Area of } \Delta ABD = \frac{1}{2} \times \text{area of } \Delta ABC$$

$$= \frac{1}{2} \times 48 = 24\text{cm}^2$$

So, option (c) is correct.

**5.** (b).

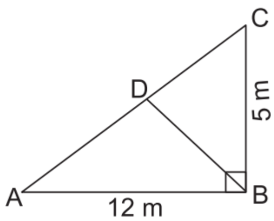
$\therefore$ The cost of making a kite = 1.50 × 48

= 72

So, option (b) is correct.

## Case Study 4

Mayank bought a triangle shape field and wants to grow potato and wheat on his field. He divided his field by joining opposite sides. On the largest park he grew wheat and on the rest part he grew potato. The dimensions of a park are shown in the park.




On the basis of the above information, solve the following questions:

**Q1. Find the length of AC in a Δ ABC.**

**Q2. Find the area of Δ ABC.**

**Q3. If the cost of ploughing park is ₹ 5 per $cm^2$, then find the total cost of ploughing the park.**

### Solutions

**1.** In right angled Δ ABC, use Pythagoras theorem,

$$AC = \sqrt{(AB)^2 + (BC)^2} = \sqrt{(12)^2 + (5)^2}$$

$$= \sqrt{144 + 25} = \sqrt{169} = 13 \text{ m}$$

Hence, length of AC is 13 m.

**2.** Area of Δ ABC

$$= \frac{1}{2} \times AB \times BC$$

$$= \frac{1}{2} \times 12 \times 5 = 30 \text{ m}^2$$

**3.** Since, the total area of the park = 30 $m^2$

∴ The cost of ploughing the park in 1 $m^2$ = 5

∴ The cost of ploughing the park in 30 $m^2$

= 5 x 30

= 150