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Abstract—This manual provides a unified approach for teaching primary and middle school mathematics by employing geometry for learning arithmetic. This is likely to speed up math learning besides helping the student apply mathematics in daily life. For best results, teachers and parents will have to create many examples similar to those available in the text. Also, students should be asked to draw all the figures themselves.

Problem 1. The following figure is a rectangle with sides $AB = 3\text{cm}$ and $BC = 4\text{cm}$. Draw the rectangle using a scale and protractor. Note that all angles in the rectangle are 90°

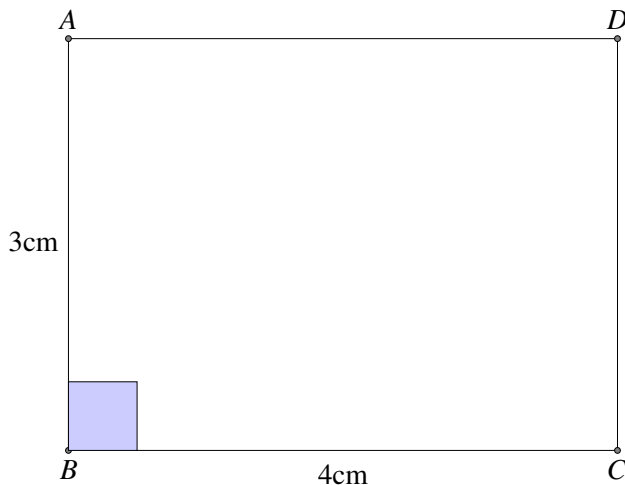


Fig. 1: Area of the rectangle = $AB \times BC$.

Problem 2. The area of the rectangle $ABCD \triangleq AB \times BC$. Draw rectangles of different sizes and find their area.

Problem 3. Cut the rectangle in Fig. 1 across the line AC to get the triangle ABC as shown in Fig. 3.

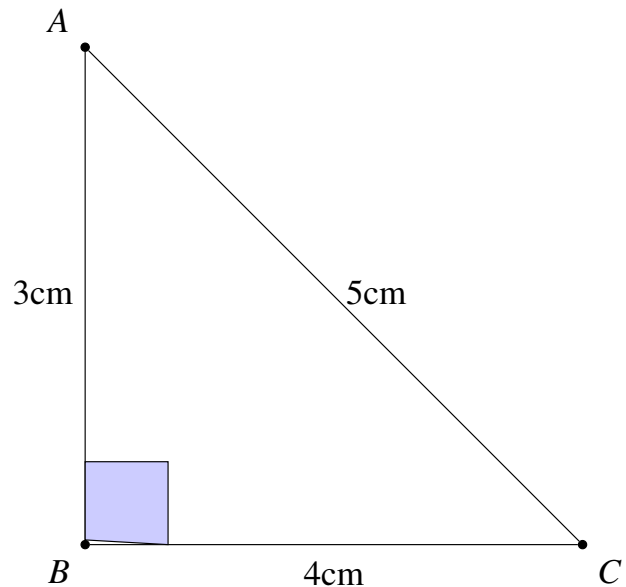


Fig. 3: Area of $\triangle ABC = AB \times BC$.

Problem 4. Verify that the area of $\triangle ABC \triangleq \frac{1}{2}AB \times BC$. Draw various such triangles and find their area.

Problem 5. The figure in Fig.5 is a square where all the sides are equal. Draw it using a scale and protractor. Note that all angles in the square are 90°

Problem 6. In $\triangle ABC$ in Fig. 3, verify that the area of the square on the side $AC =$ area of the square on the side $AB +$ area of the square on the side BC , or

$$AC^2 = AB^2 + BC^2 \quad (0.1)$$

Problem 7. In the Figure 7, $BCDF$ is a rectangle with $CD = 3\text{cm}$ and $DF = 4\text{cm}$. Choose points A and E on the line DF such that $AE = BC$. Join AB and CE . The figure $ABCE$ is known as a parallelogram, denoted as $\parallel\text{gm}$.

Problem 8. Verify that the area of $\parallel\text{gm } ABCE =$

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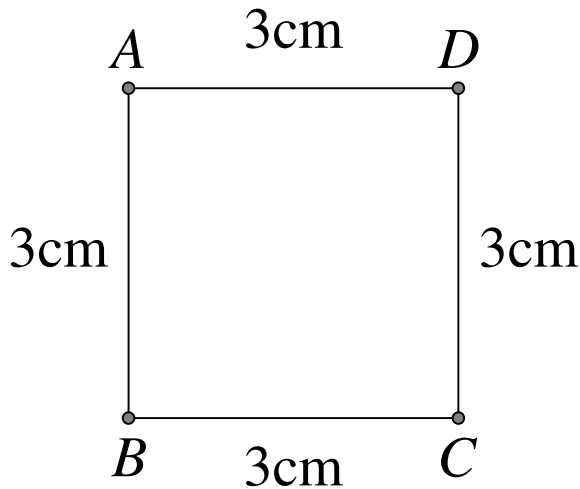


Fig. 5: Area of the square = $AB \times AB = AB^2$.

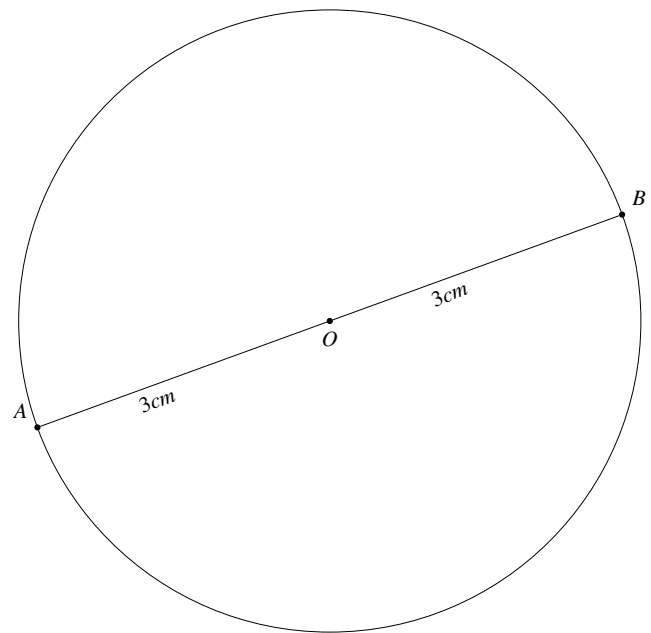


Fig. 10: Circle

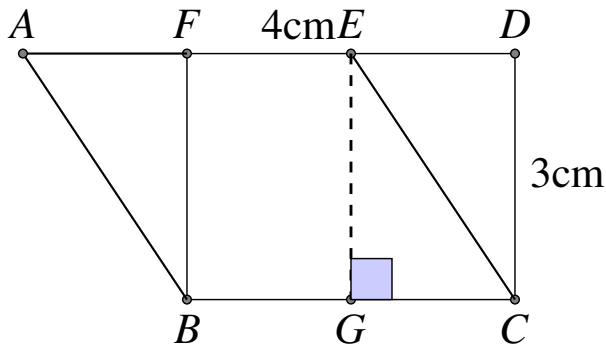


Fig. 7: Area of the square = $AB \times AB = AB^2$.

area of rectangle $BCDF$.

Problem 9. Obtain a formula for finding the area of a parallelogram.

Problem 10. Draw the following Figure 10 using a compass. This is known as a circle with centre O and radius r . $AB = 2r$ is known as the diameter of the circle.

Problem 11. Draw the circle in Fig. 11 with AC as the diameter. Take any point B on the circle. Verify that $\angle ABC = 90^\circ$.

Problem 12. Draw a line such that it touches the circle in Fig. 12 at the point P . Verify that the radius $OP \perp$ the tangent.

Problem 13. In $\triangle ABC$ in Fig. 13, $BE \perp AC$ and

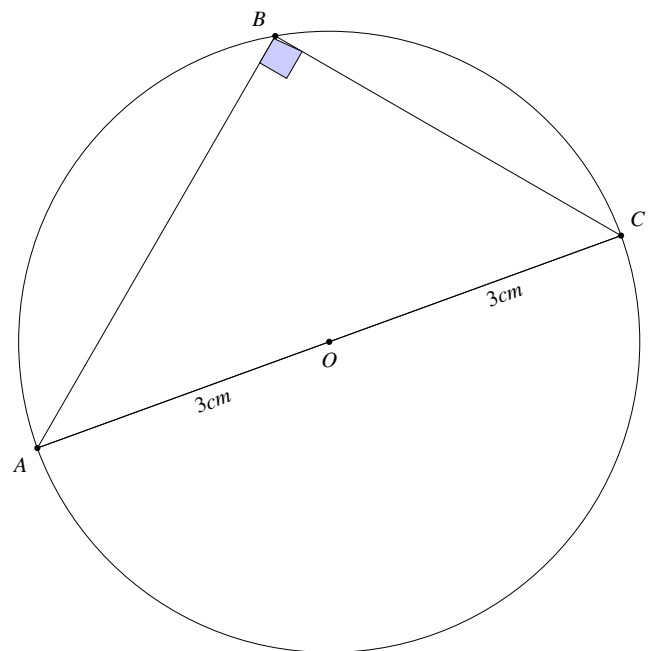


Fig. 11: Angle in a semi circle = 90° .

$CF \perp AB$ are defined as the altitudes. Show that

$$\text{area of } \triangle ABC = \frac{1}{2} BE \times AC = \frac{1}{2} AB \times CF \quad (0.2)$$

Problem 14. BE and CF in Fig. 13 meet at O . Extend AO to meet BC at D . Verify that AD is also an altitude of the $\triangle ABC$.

Problem 15. Draw the line BE such that it divides the side AC into two equal parts in $\triangle ABC$ as shown

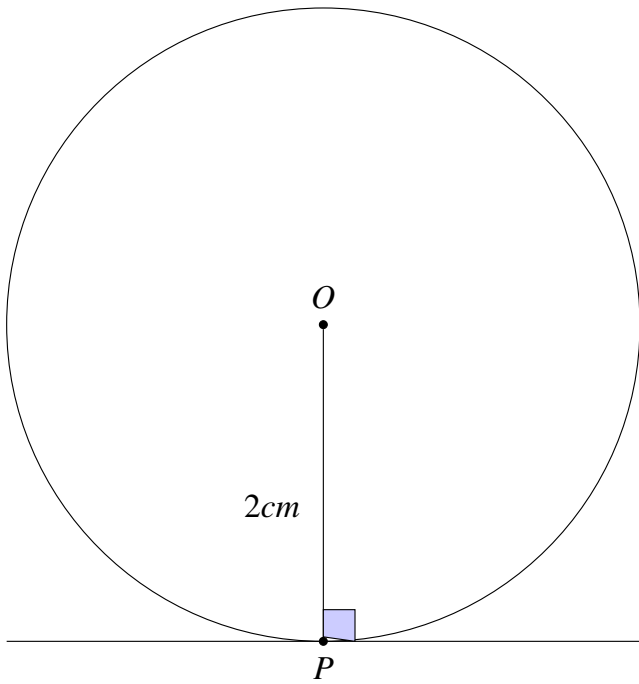


Fig. 12: Tangent to the circle.

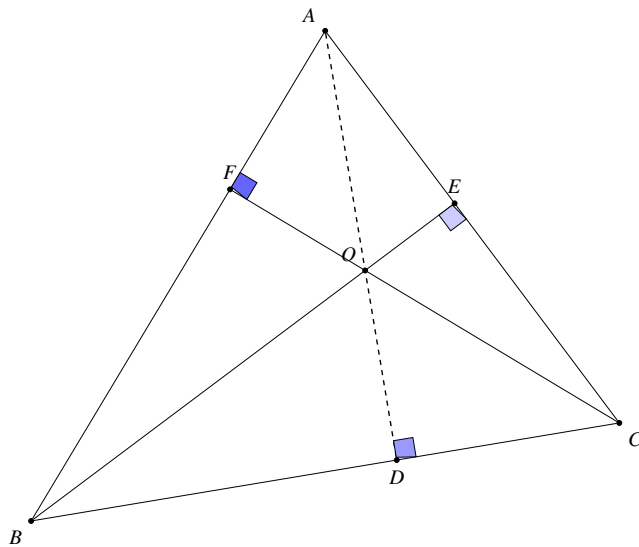


Fig. 13: Altitudes of a triangle meet in a point.

in Fig. 15. BE is known as the median. CF is another median. BE and CF meet at O. Verify that

$$\frac{OE}{OB} = \frac{OF}{OC} = \frac{1}{2} \quad (0.3)$$

Problem 16. Extend the line AO in Fig. 15 to meet BC at D. Verify that AD is also a median.

Problem 17. In $\triangle ABC$ in Fig. 17, mark the mid points of BC, AC and AB respectively as D, E and F. Verify that

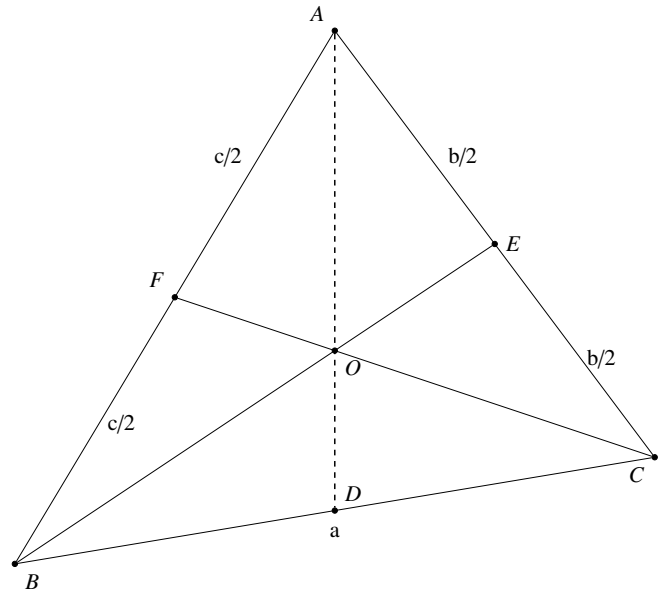


Fig. 15: Medians of a triangle meet in a point.

- 1) $\frac{EF}{BC} = \frac{DE}{AB} = \frac{DF}{AC} = \frac{1}{2}$
- 2) $\frac{\text{Area of } \triangle DEF}{\text{Area of } \triangle ABC} = \frac{1}{4}$
- 3) $\angle EDC = \angle DEF$
- 4) $EF \parallel BC = DE \parallel AB = DF \parallel AC$
- 5) $\triangle DEF \sim \triangle ABC$.

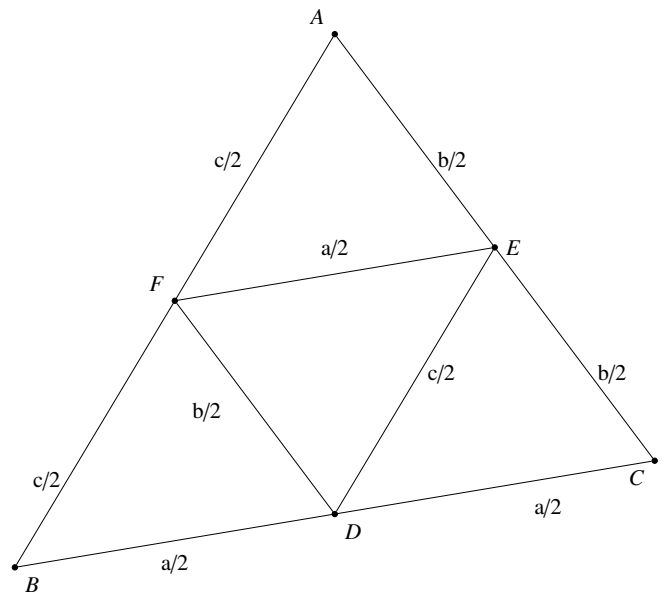


Fig. 17: Similar Triangles

Problem 18. Draw any circle with diameter AB as shown in Fig. 10 and verify that

$$\frac{\text{circumference}}{\text{diameter}} = \pi \approx \frac{22}{7} \quad (0.4)$$

Repeat this exercise for circles of different radii.

Problem 19. The area of a circle is given by πr^2 . Calculate the areas of various circles of different radii.

Problem 20. Draw the chords AB and CD meeting at P as shown in Fig. 20. Join AC and BD and verify that $\Delta PAC \sim \Delta PDB$.

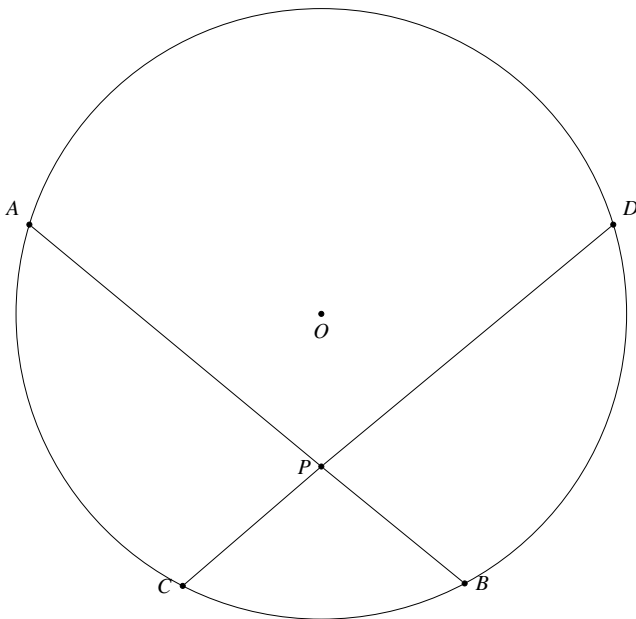


Fig. 20: $\Delta PAC \sim \Delta PDB$

Problem 21. Now join the lines OB and OC in Fig. 20 and verify that

$$\angle BOC = 2\angle BDC = 2\angle BAC \quad (0.5)$$

Problem 22. Draw the tangent through the point B and ΔABC as in Fig. 22. Verify that the marked angles are equal.

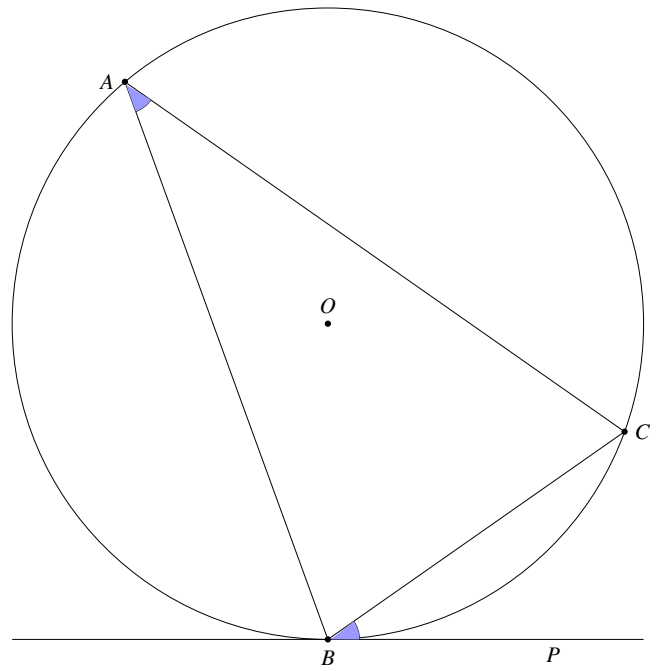


Fig. 22: Angles in the figure are equal.

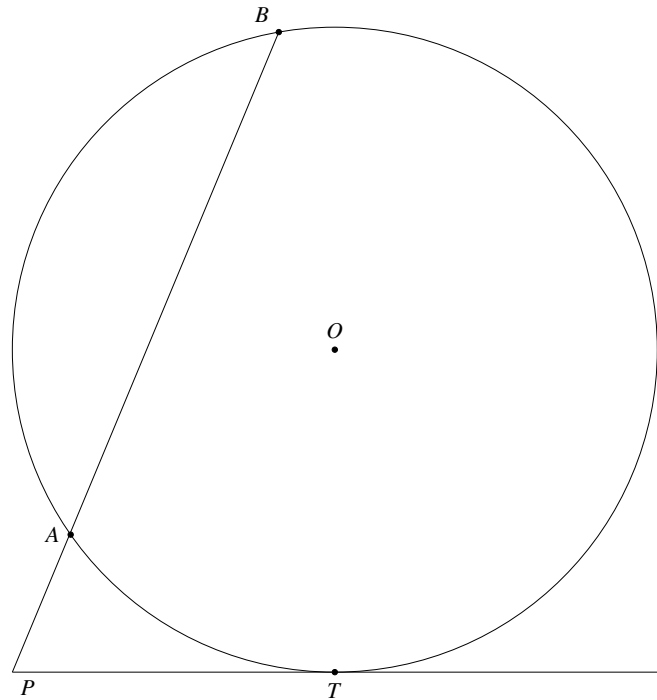


Fig. 23: $PA \times PB = PT^2$.

Problem 23. Draw the tangent PT to the circle as shown in Fig. 23 and a line PAB intersecting the circle at points A and B. Verify that

$$PA \times PB = PT^2 \quad (0.6)$$

Problem 24. In Fig. 24 draw tangents PA and PB to the circle. Verify that $PA = PB$.

Problem 25. In Fig. 25 draw the angle bisectors BD and CF such that

$$\angle ABD = \angle CBD \quad (0.7)$$

$$\angle ACF = \angle BCF \quad (0.8)$$

Verify that the line AO is also an angle bisector.

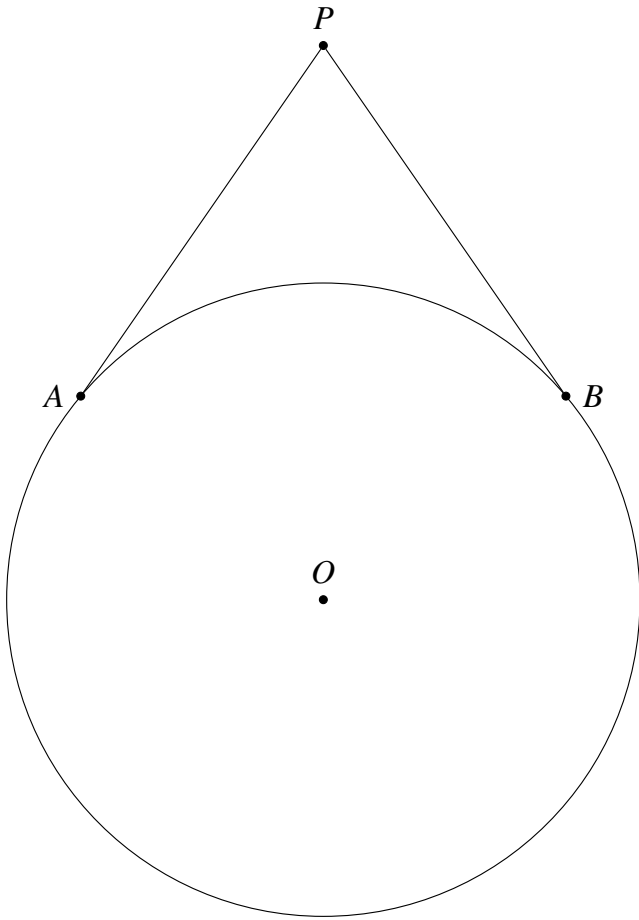


Fig. 24: $PA = PB$.

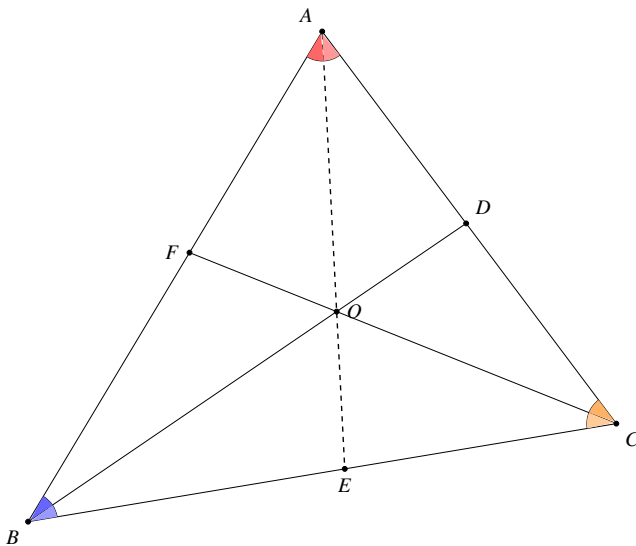


Fig. 25: Angles bisectors meet at a point.

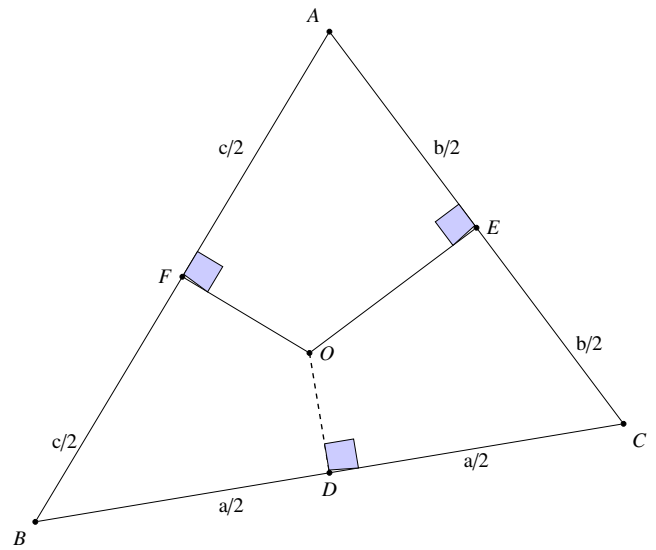


Fig. 26: Perpendicular bisectors meet at a point.

Problem 26. In Fig. 26 draw the perpendicular bisectors BD and CE meeting at the point O . Draw OD perpendicular to BC . Verify that $BD = DC$.