Solutions

Section A — Multiple Choice Questions

Q1. Correct Option: (B) $\angle OTP = 90^\circ$

Reason: The tangent at any point on a circle is perpendicular to the radius at that point. Hence $OT \perp PT \Rightarrow \angle OTP = 90^\circ$.

Q2. Correct Option: (D) 90°

Reason: Since PA is a tangent, $OA \perp PA$, so $\angle OAP = 90^\circ$ always, regardless of $\angle APB$.

Q3. Correct Option: (C) Drawing the perpendicular bisectors of all three sides.

Reason: The circumcentre is equidistant from all three vertices. A point equidistant from two points lies on their perpendicular bisector. The intersection of the three perpendicular bisectors gives the circumcentre.

Q4. Correct Option: (C) Drawing the angle bisectors from each of the three vertices.

Reason: The incentre is equidistant from all three sides. A point equidistant from two lines lies on their angle bisector. The intersection of the three angle bisectors gives the incentre.

Q5. Correct Option: (C) 12 **cm**

Reason: Tangent $\perp$ radius at point of contact. In right $\triangle OTP$:

$$PT = \sqrt{OP^2 - OT^2} = \sqrt{13^2 - 5^2} = \sqrt{169 - 25} = \sqrt{144} = \mathbf{12} \text{ cm}$$

Q6. Correct Option: (C) 5 **cm**

Reason: For a regular hexagon inscribed in a circle, the side length equals the radius of the circle. Hence radius = 5 cm.

Q7. Correct Option: (A) Both A and R are true, and R is the correct explanation of A.

Reason:

A is TRUE. The standard construction of tangents from external point P begins by finding midpoint M of OP and drawing a circle with diameter OP (radius MP).

R is TRUE. By the angle-in-a-semicircle theorem, any point on the circle with diameter OP subtends 90° at OP. Where this auxiliary circle meets the given circle, the angle between the radius and OP is 90°, confirming the point of tangency. R correctly and completely explains why the construction in A works.

Q8. Correct Option: (B) 1

Reason: When P lies **on** the circle, exactly **one** tangent can be drawn at that point (the tangent at the point of contact).

Q9. Correct Option: (C) Outside the triangle, since the triangle is obtuse-angled.

Reason: For an acute triangle, the circumcentre lies inside. For a right triangle, it lies on the hypotenuse. For an **obtuse** triangle, the circumcentre lies **outside** the triangle, on the opposite side of the longest side from the obtuse vertex.

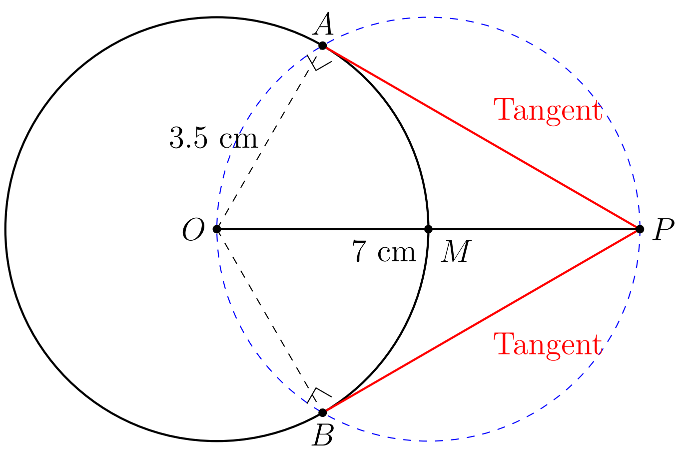
Q10. Correct Option: (A) Side $= r$; longest diagonal $= 2r$

Reason: In a regular hexagon inscribed in a circle of radius r, the side length equals r (each side subtends $60°$ at the centre, forming equilateral triangles). The longest diagonal passes through the centre and equals $2r$ (the diameter).

Section B — Short Answer Questions (4 × 3 = 12 Marks)

Q11. Part (i) Construction Steps:

1. Draw a point O and use a compass to draw a circle of radius 3.5 cm.
2. Draw a line segment from O extending outwards and mark a point P such that $OP = 7$ cm.
3. Construct the perpendicular bisector of the line segment OP to find its midpoint M.
4. Place the compass at M, set the radius to MO (or MP), and draw a circle.
5. Mark the two points where this new circle intersects the original circle as A and B.
6. Draw straight lines PA and PB. These are the required tangents.



Part (ii) Measurement: When measured with a ruler, the length of each tangent PA and PB will be approximately 6.1 cm.

Part (iii) Verification:

In $\triangle OAP$, $\angle OAP = 90°$ (radius is perpendicular to tangent).

By Pythagoras' theorem:

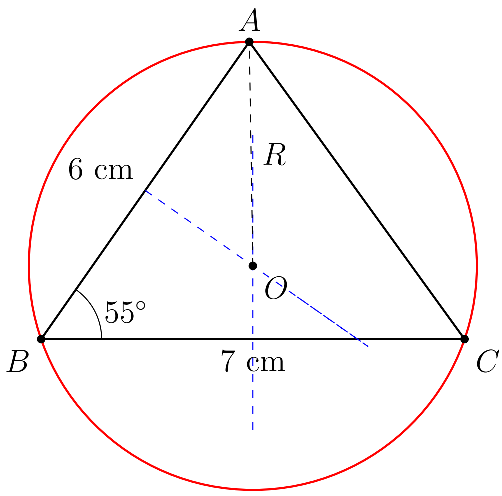
$$PA^2 + OA^2 = OP^2$$

$$PA^2 + (3.5)^2 = 7^2$$
$$PA^2 + 12.25 = 49$$

$$PA = \sqrt{36.75} \approx 6.06 \text{ cm}$$

Final Answer: The measured length is approximately 6.1 cm, which matches the theoretical length of 6.06 cm.

Q12.



Part (i) Construction Steps:

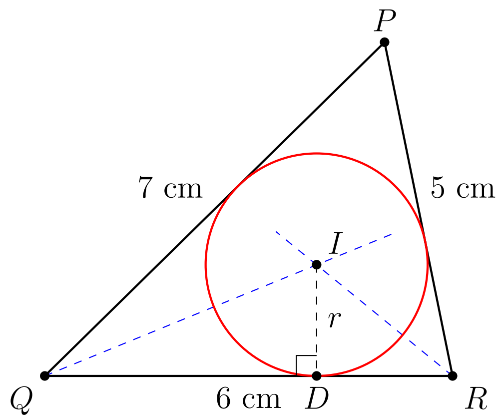
1. Draw a base line $BC = 7$ cm.
2. At point B, use a protractor to construct an angle of $55°$.
3. Along the arm of this angle, use a compass to mark a point A such that $AB = 6$ cm. Join A to C to complete $\triangle ABC$.
4. Construct the perpendicular bisectors of any two sides (e.g., AB and BC).
5. Mark the intersection of these bisectors as the circumcentre O.
6. With O as the centre and OA as the radius, draw the circumcircle passing through A, B, and C.

Part (ii) Measurement: Using a ruler, the circumradius OA will measure approximately 3.7 cm. Theoretical value:

$$R = \frac{AC}{2 \sin B} \approx \frac{6.068}{2 \times 0.819} \approx 3.70 \text{ cm}$$

Part (iii) Construction Step:Final Answer: The circumcentre is located by drawing the perpendicular bisectors of the sides of the triangle.

Q13.



Part (i) Construction Steps:

1. Draw a base line $QR = 6$ cm.
2. With Q as the centre and a radius of 7 cm, draw an arc.
3. With R as the centre and a radius of 5 cm, draw another arc intersecting the first arc at point P. Join PQ and PR.
4. Construct the angle bisectors of $\angle PQR$ and $\angle PRQ$.
5. Mark the intersection of these angle bisectors as the incentre I.
6. Construct a perpendicular line from I to the side QR and mark the foot of the perpendicular as D.
7. With I as the centre and ID as the radius, draw the incircle touching all three sides.

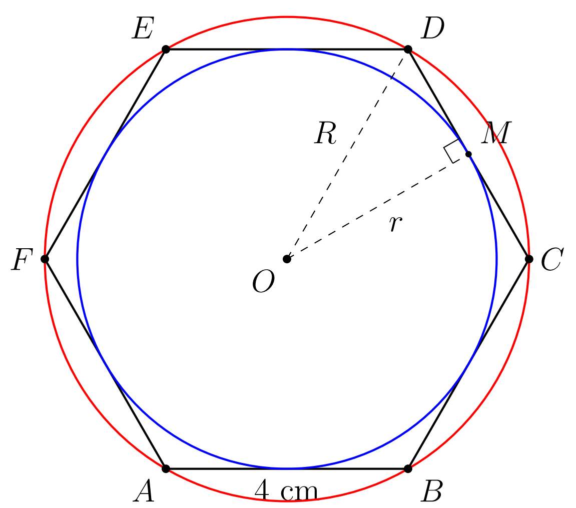
Part (ii) Measurement:
Using a ruler, the inradius ID will measure approximately 1.6 cm.
Theoretical value:

$$A = \sqrt{9(9-5)(9-6)(9-7)} = \sqrt{216} \approx 14.7$$

$$r = \frac{A}{s} = \frac{14.7}{9} \approx 1.63 \text{ cm}$$

Part (iii) Construction Step: The incentre is located by drawing the angle bisectors of the interior angles of the triangle.

Q14.



Construction of Regular Hexagon:

1. Draw a circle of radius 4 cm with centre O.
2. Mark a point A on the circumference.
3. Without changing the compass width (4 cm), place the compass point on A and cut an arc on the circle to mark B. Repeat from B to find C, and so on, until all 6 vertices are marked.
4. Join $ABCDEF$ to form the regular hexagon.

Part (i) Circumscribed Circle:

The circumcircle is the circle already drawn in Step 1. Since it connects all vertices to the centre O, its radius is exactly the side length of the hexagon.

$$\text{Circumradius} = 4 \text{ cm}$$

Part (ii) Inscribed Circle:

1. Construct the perpendicular bisector of any side, say AB, which will pass through O.
2. The intersection of this perpendicular with AB is the midpoint M. OM is the radius of the inscribed circle.
3. Draw a circle with centre O and radius OM.

Using a ruler, OM will measure approximately 3.5 cm.
Theoretical value: altitude of an equilateral triangle

$$= 4 \times \frac{\sqrt{3}}{2} = 2\sqrt{3} \approx 3.46 \text{ cm}$$

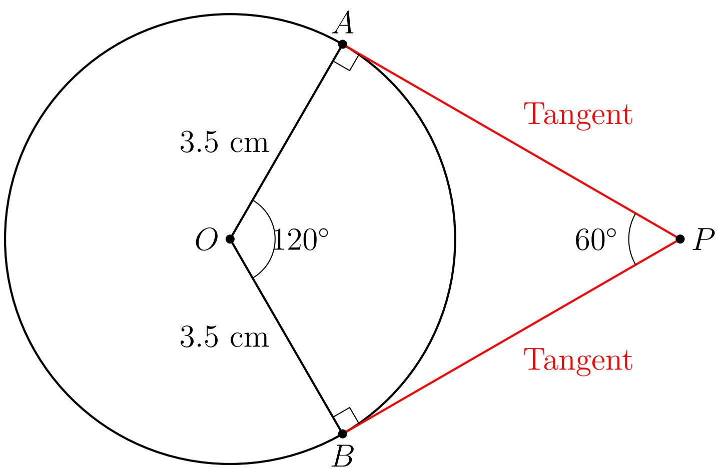
$$\text{Inradius} \approx 3.5 \text{ cm} \quad \left(\text{or } 2\sqrt{3} \text{ cm}\right)$$

Part (iii) Ratio:

$$\text{Ratio} = \frac{\text{Circumradius}}{\text{Inradius}} = \frac{4}{2\sqrt{3}} = \frac{2}{\sqrt{3}}$$

The ratio is $2 : \sqrt{3}$.

Q15.



Part (i): Construction of Tangents from P to the Circle

Step 1: Draw a circle with centre O and radius 3.5 cm.

Step 2: Mark an external point P such that $OP = 7$ cm.

Step 3: Find the midpoint M of OP by constructing the perpendicular bisector of OP.

Step 4: With M as centre and MP (i.e., 3.5 cm) as radius, draw a semicircle.

Step 5: Mark the points A and B where this semicircle intersects the original circle.

Step 6: Join PA and PB. These are the required tangents.

Part (ii): Measuring the Tangents
On measuring from the construction:

$$PA = PB \approx 6.06 \text{ cm}$$

Yes, $PA = PB$.
Reason: Tangents drawn from an external point to a circle are equal in length. (Theorem: Equal Tangents from an External Point)

Part (iii): Calculation using Pythagoras' Theorem
In right-angled triangle OAP:

- $\angle OAP = 90^\circ$ (tangent is perpendicular to radius at point of contact)
- $OA = 3.5$ cm (radius)
- $OP = 7$ cm

By Pythagoras' theorem:

$$PA^2 = OP^2 - OA^2$$

$$PA^2 = 7^2 - 3.5^2$$

$$PA^2 = 49 - 12.25$$

$$PA^2 = 36.75$$

$$PA = \sqrt{36.75}$$

$$PA \approx 6.06 \text{ cm}$$

$$\boxed{PA = PB \approx 6.06 \text{ cm}}$$

This matches the measured value. ✓

Part (iv): Angle $\angle APB$ and Type of Triangle OAP
From construction, on measuring:

$$\angle APB \approx 60^\circ$$

This makes sense because $OP = 7$ cm $= 2 \times OA = 2 \times 3.5$ cm, so:

$$\sin(\angle OPA) = \frac{OA}{OP} = \frac{3.5}{7} = \frac{1}{2} \quad \Rightarrow \quad \angle OPA = 30^\circ$$

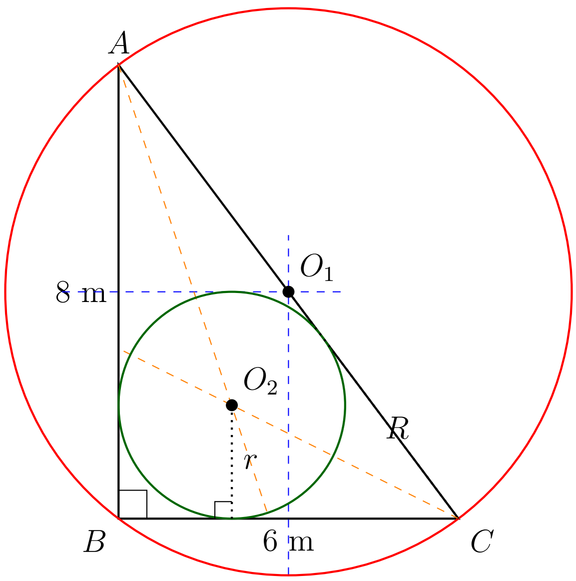
$$\therefore \quad \angle APB = 2 \times \angle OPA = 2 \times 30^\circ = 60^\circ$$

Type of triangle OAP:
In $\triangle OAP$:

- $\angle OAP = 90^\circ$
- $\angle OPA = 30^\circ$
- $\angle AOP = 60^\circ$

$\triangle OAP$ is a **right-angled scalene triangle** (with angles 30°–60°–90°).

Q16.



Solution:
Given Scale: 1 cm = 2 m.

- Drawing length of $AB = \frac{8}{2} = 4$ cm.
- Drawing length of $BC = \frac{6}{2} = 3$ cm.

(i) Construction of Triangle and Circumcircle:

1. Draw a base line segment $BC = 3$ cm.
2. At point B, use a compass to construct a 90° angle.
3. Along this perpendicular line, cut an arc of 4 cm from B and mark it as A.
4. Join A to C to complete the right-angled $\triangle ABC$. (Note: AC will measure exactly 5 cm on paper).

5. Construct the perpendicular bisectors of sides AB and BC.
6. Mark their point of intersection as O_1.
7. With O_1 as the center and radius O_1A (2.5 cm on paper), draw a circle passing through A, B, and C.

(ii) Circumcentre Location and Calculation:

In any right-angled triangle, the circumcentre always lies exactly at the midpoint of the hypotenuse.

Actual length of hypotenuse:

$$AC = \sqrt{AB^2 + BC^2} = \sqrt{8^2 + 6^2} = \sqrt{64 + 36} = \sqrt{100} = 10 \text{ m}$$

$$\text{Circumradius} = \frac{\text{Hypotenuse}}{2} = \frac{10}{2} = 5 \text{ m}$$

(iii) Construction of Incircle:

1. Construct the angle bisectors of $\angle BAC$ and $\angle BCA$ using a compass.
2. Mark the point where the angle bisectors intersect as the incentre O_2.
3. Drop a perpendicular from O_2 to the side BC to find the exact inradius on the drawing.
4. With O_2 as the center and the perpendicular distance as the radius, draw the incircle which will perfectly touch all three sides of $\triangle ABC$.

(iv) Calculation and Comparison of Inradius:

Using the given formula for a right triangle with actual side lengths $a = 6$ m, $b = 8$ m, and $c = 10$ m:

$$r = \frac{a + b - c}{2} = \frac{6 + 8 - 10}{2} = \frac{4}{2} = 2 \text{ m}$$

Calculated Inradius = 2 m

Comparison: On the scale drawing, the inradius should measure exactly 1 cm (since 1 cm = 2 m). Upon measuring the constructed incircle from part (iii) with a ruler, the radius will indeed be exactly 1 cm. Thus, the calculated value and the measured value on the scale drawing perfectly match.