1. Draw a circle of radius 6 cm. From a point 10 cm away from its centre, construct a pair of tangents to the circle and measure their lengths.

Steps of Construction:
Step I: With O as a centre and radius equal to 6 cm, a circle is drawn.
Step II: A point P at a distance of 10 cm from the centre O is taken. OP is joined.
Step III: Perpendicular bisector of OP is drawn and it intersects OP at M.
Step IV: With M as a centre and OM as a radius, a circle is drawn intersecting the previous circle at Q and R.
Step V: PQ and PR are joined.
Thus, PQ and PR are the tangents to the circle.
On measuring the length, tangents are equal to 8 cm.
PQ = PR = 8 cm.
Justification:
OQ is joined.
\[ \angle PQO = 90^\circ \] (Angle in the semi-circle)
\[ \therefore OQ \perp PQ \]
Therefore, OQ is the radius of the circle then PQ has to be a tangent of the circle.
Similarly, PR is a tangent of the circle.
Let ABC be a right triangle in which AB = 6 cm, BC = 8 cm and $\angle B = 90^\circ$.

BD is the perpendicular from B on AC. A circle through B, C, D is drawn.

Construct the tangents from A to this circle.

**Steps of Construction:**

1. Draw $\triangle ABC$.
2. Perpendicular to AC is drawn to point B which intersected it at D.
3. With O as a center and OC as a radius, a circle is drawn. The circle through B, C, D is drawn.
4. OA is joined and a circle is drawn with diameter OA which intersected the previous circle at B and E.
5. AE is joined.

Thus, AB and AE are the required tangents to the circle from A.

**Justification:**

$\angle OEA = 90^\circ$ (Angle in the semi-circle)

$\therefore OE \perp AE$

Therefore, OE is the radius of the circle then AE has to be a tangent of the circle.

Similarly, AB is another tangent to the circle.
3. Draw a right triangle in which the sides (other than hypotenuse) are of lengths 4 cm and 3 cm. Then construct another triangle whose sides are \( \frac{5}{3} \) times the corresponding sides of the given triangle.

Steps of Construction:
Step I: BC = 3 cm is drawn.
Step II: At B, A ray making an angle of 90° with BC is drawn.
Step III: With B as centre and radius equal to 4 cm, an arc is made on the previous ray intersecting it at point A.

Step IV: AC is joined to form \( \triangle ABC \).

Step V: A ray BX is drawn making an acute angle with BC opposite to vertex A.
Step VI: 5 points \( B_1, B_2, B_3, B_4 \text{ and } B_5 \) are marked at equal distances on BX.
Step VII: \( B_3C \) is joined \( B_5C' \) is made parallel to \( B_3C \).
Step VIII: \( A'C' \) is drawn parallel to AC.
Thus, \( \triangle A'BC' \) is the required triangle.
4. Construct an isosceles triangle whose base is 8 cm and altitude 4 cm and then another triangle whose sides are 1.5 times the corresponding sides of the isosceles triangle.

Steps of Construction:
Step I: BC = 8 cm is drawn.
Step II: Perpendicular bisector of BC is drawn and it intersects BC at O.

Step III: At a distance of 4 cm, a point A is marked on the perpendicular bisector of BC.

Step IV: AB and AC are joined to form ΔABC.

Step V: A ray BX is drawn making an acute angle with BC opposite to vertex A.
Step VI: 3 points B₁, B₂ and B₃ are marked on BX.
Step VII: B₂ is joined with C to form B₂C.
Step VIII: B₃C' is drawn parallel to B₂C and C'A' is drawn parallel to CA.
Thus, A'BC' is the required triangle formed.

Justification:
ΔAB'C' ~ ΔABC by AA similarity condition.

\[
\frac{AB}{AB'} = \frac{BC}{B'C'} = \frac{AC}{AC'}
\]

Also,
\[
\frac{AB}{AB'} = \frac{AA_2}{AA_3} = \frac{2}{3}
\]

\[\Rightarrow AB' = \frac{3}{2}AB, \quad B'C' = \frac{3}{2}
\]

BC and AC' = \frac{3}{2}AC
5. Construct a triangle of sides 4 cm, 5 cm and 6 cm and then a triangle similar to it whose sides are \( \frac{2}{3} \) of the corresponding sides of the first triangle.

Steps of Construction:
Step I: AB = 6 cm is drawn.
Step II: With A as a centre and radius equal to 4 cm, an arc is drawn.
Step III: Again, with B as a centre and radius equal to 5 cm an arc is drawn on the same side of AB intersecting the previous arc at C.
Step IV: AC and BC are joined to form \( \triangle ABC \).
Step V: A ray AX is drawn making an acute angle with AB below it.
Step VI: 5 equal points (sum of the ratio = 2 + 3 = 5) is marked on AX as \( A_1, A_2, \ldots, A_5 \).
Step VII: \( A_5B \) is joined. \( A_2B' \) is drawn parallel to \( A_5B \) and \( B'C' \) is drawn parallel to BC.
\( \triangle A'B'C' \) is the required triangle.

Justification:
\[ \angle A(\text{Common}) \]
\[ \angle C = \angle C' \text{ and } \angle B = \angle B' \text{ (corresponding angles)} \]
Thus \( \triangle A'B'C' \sim \triangle ABC \) by AAA similarity condition.

From the figure,
\[ \frac{AB'}{AB} = \frac{AA_2}{AA_5} = \frac{2}{3} \]
\[ AB' = \frac{2}{3} AB \]
\[ AC' = \frac{2}{3} AC \]
6. Draw a line segment of length 7.6 cm and divide it in the ratio 5 : 8. Measure the two parts.

1) Draw a line segment AB = 7.6 cm.

2) Draw a ray AX making an acute angle \( \angle BAX \) along with AB.

3) On AX make 5 + 8 i.e. 13 equal parts and mark them as \( A_1, A_2, A_3, A_4, \ldots A_{13} \)

4) Join B to \( A_{13} \). From \( A_5 \) draw \( A_5C \parallel A_{13}B \).

C is the required point of division and \( AC : CB = 5 : 8 \).

On measuring, we get

\( AC = 3.1 \text{ cm,} \)

\( CB = 4.5 \text{ cm} \)

Justification

\( \frac{A_5C}{A_{13}B} = \frac{AC}{CB} \)

[Using basic proportionality theorem]

But \( \frac{A_5C}{A_{13}A_{13}} = \frac{5}{8} \)

This shows that C divides AB in the ratio 5 : 8.
7. Draw an isosceles triangle ABC in which AB = AC = 6 cm and BC = 5 cm

Construct a triangle PQR similar to ΔABC in which PQ = 8 cm, Also justify the construction.

Thinking process
(i) Here, for making two similar triangles with one vertex is base We assume that in ΔABC and ΔPQR, vertex B = vertex Q.

(ii) In ΔABC and ΔPQR, vertex B = vertex Q. 
So, we get the required scale factor.

Now, construct a ΔABC and then a ΔPBR, similar to ΔABC whose sides are \( \frac{PQ}{AB} \) of the corresponding sides of the ΔABC.

Let ΔPQR and ΔABC are similar triangle, then its scale factor between the corresponding sides is \( \frac{PQ}{AB} = \frac{8}{6} = \frac{4}{3} \)

Steps of construction
1. Draw a line segment BC = 5 cm
2. Construct OQ the perpendicular bisector of line segment BC meeting BC at P′
3. Taking B and C as centers draw two arcs of equal radius 6 cm intersecting each other at A
4. Join BA and CA. So. ΔABC′ is the required isosceles triangle.

5. From B, draw a ray BX making an acute \( \angle CBX \)

6. Locate four points \( B_1, B_2, B_3, B_4 \) on BX Such that \( BB_1 = B_1B_2 = B_2B_3 = B_3B_4 \)
Practice Challenge - Subjective

7. Join $B_3C$ and from $B_4$ draw a line $B_4R \parallel B_3C$ intersecting the extended line segment $BC$ at $R$.

8. From point $R$ draw $RP \parallel CA$ meeting $BA$ produced at $P$

Then, $\triangle PBR$ is the required triangle.

Justification

$\because B_4R \parallel B_3C$

$\therefore \frac{BC}{CR} = \frac{3}{1}$

Now

$\frac{BR}{BC} = \frac{BC + CR}{BC}$

$= 1 + \frac{CR}{BC} = 1 + \frac{1}{3} = \frac{4}{3}$

Also $RP \parallel CA$

$\therefore \triangle ABC \cong \triangle PBR$

And

$\frac{PB}{AB} = \frac{RP}{CA} = \frac{BR}{BC} = \frac{4}{3}$

Hence the new triangle is similar to the given triangle whose sides are $\frac{4}{3}$ times of the corresponding sides of the isosceles $\triangle AC$. 

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8. Draw a circle of radius 4 cm. Construct a pair of tangents to it, the angle between which is $60^\circ$. Also justify the construction. Measure the distance between the centre of the circle and the point of intersection of tangents.

In order to draw the pair of tangents, we follow the following steps:

**Steps of construction**
1. Take a point $O$ on the plane of the paper and draw a circle of radius $OA = 4$ cm.
2. Produce $OA$ to $B$ such that $OA = AB = 4$ cm.
3. Taking $A$ as the center, draw a circle of radius $OA = AB = 4$ cm. Suppose it cuts the circle drawn in step 1 at $P$ and $Q$.
4. Join $BP$ and $BQ$ to get desired tangents.

**Justification in $\Delta OAP$, we have**

$OA = OP = 4$ cm (∵ Radius)

Also, $AP = 4$ cm (∵ Radius of circle with centre)

$\Delta OAP$ is equilateral

$\Rightarrow \angle PAO = 60^\circ$

$\Rightarrow \angle BAP = 120^\circ$

In $\Delta BAP$, we have

$BA = AP$ and $\angle BAP = 120^\circ$

$\therefore \angle ABP = \angle APB = 30^\circ$

$\Rightarrow \angle PBQ = 60^\circ$
Practice Challenge - Subjective

Steps of construction
1. Take a point O on the plane of the paper and draw a circle with centre O and radius OA = 4cm
2. AT O construct radii OA and OB such that to $\angle AOB$ equal $120^\circ$ i.e supplement of the angle between the tangents.
3. Draw perpendicular to OA and OB at A and B respectively Suppose these Perpendicular intersects at P. Then PA and PB are required tangents.

Justification

In quadrilateral OAPB we have

$\angle OAP = \angle OBP = 90^\circ$

And $\angle ABO = 120^\circ$

$\therefore \angle OAP + \angle OBP + \angle AOB + \angle APB = 360^\circ$

$\angle APB = 360^\circ - (90^\circ + 90^\circ + 120^\circ)$

$= 360^\circ - 300^\circ = 60^\circ$