Class 6 Mathematics
Practical Geometry
Ch- 14.1

EXERCISE 14.1 – SOLUTIONS
(Class 6 – Practical Geometry)

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1. Multiple Choice Questions (MCQ)
   Choose the correct option.

   1(i) Instrument(s) used to bisect a given line segment is (are)
   (a) Scale and protractor
   (b) Scale and set square
   (c) Compass
   (d) Divider

   Answer: (c) Compass

   Explanation:
   To bisect (cut exactly into two equal parts) a line segment, we draw arcs from its ends using a **compass**. These arcs intersect and give us the perpendicular bisector. So, the compass is the necessary instrument.
   (Option (c) matches the answer key.)

   1(ii) The shape of a protractor is
   (a) circular
   (b) rectangular
   (c) semicircle
   (d) None

   Answer: (c) semicircle

   Explanation:
   A standard school protractor used to measure angles from 0° to 180° is exactly a **semicircle** (half of a circle).
   (Option (c) matches the answer key.)

   1(iii) The radius of a circle of diameter 20 cm is
   (a) 8 cm
   (b) 10 cm
   (c) 4.0 cm
   (d) 4.5 cm

   Answer: (b) 10 cm

Explanation:
Diameter = 2 × radius
So, radius = diameter ÷ 2 = 20 cm ÷ 2 = 10 cm.
(Option (b) matches the answer key.)

2. Find the diameter of the circle when the radius is:

   Formula used:
   Diameter = 2 × radius

   2(i) Radius = 2.5 cm
   Diameter = 2 × 2.5 cm = **5 cm**

   2(ii) Radius = 3.1 cm
   Diameter = 2 × 3.1 cm = **6.2 cm**

   2(iii) Radius = 4.5 cm
   Diameter = 2 × 4.5 cm = **9 cm**

   2(iv) Radius = 3.3 cm
   Diameter = 2 × 3.3 cm = **6.6 cm**

   (All answers: 5 cm, 6.2 cm, 9 cm, 6.6 cm – exactly as in the answer key.)

3. O is the centre of a circle, and its radius is 5 cm.
   Where does point P lie, when:

   Rule used:
   – If OP > radius → P lies **outside** the circle.
   – If OP = radius → P lies **on the circumference**.
   – If OP < radius → P lies **inside** the circle.

   3(i) OP = 5.2 cm
   Here OP > 5 cm (radius), so P lies **outside** the circle.

   3(ii) OP = 5 cm
   Here OP = radius, so P lies **on the circumference** of the circle.

   3(iii) OP = 4.8 cm
   Here OP < 5 cm (radius), so P lies **inside** the circle.

   (Answers: outside, on the circumference, inside – exactly as in the answer key.)

4. With the same centre O, draw three circles of radii 2.5 cm, 3.5 cm and 4.5 cm.

   Construction steps:

1. Mark a point O on the paper (this is the common centre).
2. Set the compass to a radius of 2.5 cm using the scale.
3. Keeping the compass point at O, draw a circle – this is the first circle.
4. Now set the compass to 3.5 cm and, with the same centre O, draw the second circle.

5. Set the compass to 4.5 cm and, with the same centre O, draw the third circle.

   You will get three concentric circles (same centre, different radii).

5. Draw two circles one having radius 6 cm and the other having 3 cm such that the inner circle passes through the centre of the other circle.

   Construction steps:

1. Draw a line with the scale and mark a point O on it.
2. With O as centre and radius 6 cm, draw the first circle.
3. On the line through O, choose a point A on the circumference of this big circle.
4. With A as centre and radius 3 cm, draw another circle.

   Because the radius of the smaller circle is 3 cm and its centre A lies on the bigger circle, the smaller circle will pass through O (the centre of the bigger circle), as required.

6. Draw two circles of equal radii with centres A and B such that each one of them passes through the centre of the other. Check whether AB is perpendicular to CD.

   Construction steps:

1. Draw a line and mark two points A and B on it.
2. Decide a radius (say r).
3. With A as centre and radius r, draw a circle.
4. With B as centre and the same radius r, draw another circle such that each circle passes through the other's centre (A is on circle with centre B, and B is on circle with centre A).
5. The two circles will intersect at two points. Join these intersection points and name the line segment CD.
6. Join A and B.

   Reasoning / Result:
   In two equal circles with a common chord CD, the line joining the centres (AB) is the **perpendicular bisector** of the common chord.
   Therefore, **AB is perpendicular to CD (AB ⊥ CD).**

EXERCISE 14.2 – SOLUTIONS
(Class 6 – Practical Geometry)

📌 Message for Students (Before Construction Work)

Dear Students,
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3. **Place the scale properly** and mark points lightly so you can erase if needed.

4. **Do not change the compass opening** once you set a particular measurement.
5. **Draw arcs lightly but clearly**, and label all points (A, B, C, O, P, Q, etc.).
6. **After completing each figure**, check whether the length matches the required measurement.
7. Keep your work **clean, beautiful, and accurate**—geometry is an art as well as mathematics!

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Happy Drawing! ☺✏

1. Multiple Choice Questions (MCQ)

   1(i) Arrow heads in a line (with arrows at both ends) indicate
   (a) line terminates.
   (b) line does not end on either side.
   (c) line ends on one side.
   (d) None of these.

   Answer: (b) line does not end on either side.

   Explanation:
   A line is drawn with arrow heads at both ends to show that it can be extended endlessly in both directions. So it does not end on either side.

   1(ii) Construction of a line segment whose length is equal to the difference of two given line segments AB and BC is possible, when
   (a) AB < BC
   (b) AB = BC
   (c) AB > BC
   (d) Both (a) and (c)

   Answer: (d) Both (a) and (c).

   Explanation:
   "Difference of two line segments" means
   difference = length of the longer segment – length of the shorter segment.
   So the construction is possible whenever the two segments are of unequal length – one is greater and the other is smaller.
   That is, it is possible when AB < BC or when AB > BC (options (a) and (c)), therefore option (d) "Both (a) and (c)" is correct.

2. Draw a line segment of length 8.3 cm using a scale/ruler only.

   Construction steps:

   Step 1: Place the scale on the paper.
   Step 2: Mark a point A near the "0 cm" mark.
   Step 3: Keeping the scale fixed, mark another point B at the 8.3 cm mark on the scale.
   Step 4: Join A and B with a thin straight line.

   AB is the required line segment of length 8.3 cm.

3. Construct the two line segments of 4.9 cm and 7.7 cm using ruler and compass only.

Construction of 4.9 cm:

Step 1: Draw a ray AX using a ruler.
Step 2: Place the compass point at the zero mark of the scale and open it till the 4.9 cm mark.
Step 3: Keeping the compass opening same, place the compass point at A on the ray and cut an arc on the ray. Mark the arc point as B.

AB is the required line segment of length 4.9 cm.

Construction of 7.7 cm:

Step 4: Draw another ray CY.
Step 5: Using the scale, set the compass opening to 7.7 cm.
Step 6: Put the compass point at C and cut an arc on the ray. Mark the arc point as D.

CD is the required line segment of length 7.7 cm.

4. Construct the three line segments of 3.5 cm, 7.1 cm and 8.3 cm using ruler and compass only.

Construction of 3.5 cm:

Step 1: Draw a ray OP.
Step 2: Set the compass opening to 3.5 cm using the scale.
Step 3: With the compass point on O, cut an arc on the ray at Q.

OQ is 3.5 cm.

Construction of 7.1 cm:

Step 4: Draw a ray RS.
Step 5: Set the compass opening to 7.1 cm and with R as centre, cut an arc on the ray at T.

RT is 7.1 cm.

Construction of 8.3 cm:

Step 6: Draw a ray UV.
Step 7: With the compass set at 8.3 cm, place the point at U and cut an arc at W on the ray.

UW is 8.3 cm.

5. Construct any line segment XY. Without measuring it, construct a copy AB of XY.

Construction steps:

Step 1: Draw any line segment XY.
Step 2: Draw a ray starting from a point A.
Step 3: Place the compass point at X and open it to reach Y. So the opening of the compass is equal to the length XY.
Step 4: Without changing this opening, put the compass point at A on the ray and cut an arc on the ray. Mark the intersection as B.

Now AB is a copy of XY, so AB = XY.

6. Construct any line segment AB. Without measuring it, copy it and construct another line segment PQ such that PQ = 3 AB.

   Construction steps:

   Step 1: Draw any line segment AB.
   Step 2: Draw a ray PX.
   Step 3: Place the compass point at A and open it to B. So the compass opening equals AB.
   Step 4: With compass point at P on the ray, mark an arc at point R. Then PR = AB.
   Step 5: Keeping the same opening, place the compass point at R and cut another arc at S on the ray. Then RS = AB.
   Step 6: Again, with the same opening, place the compass point at S and cut an arc at Q on the ray.

   Then
   PQ = PR + RS + SQ = AB + AB + AB = 3 AB.

   So PQ is three times AB.

7. Construct any line segment LM. Without measuring it, construct a line segment XY such that XY is half of LM.

   Construction steps:

   Step 1: Draw any line segment LM.
   Step 2: Construct the perpendicular bisector of LM to find its midpoint O.

- With L as centre and any radius more than half of LM, draw arcs above and below LM.
- With M as centre and the same radius, draw arcs to cut the previous arcs.
- Join the points of intersection of the arcs. This line cuts LM at O, the midpoint.
  So LO = OM and LO = OM = one half of LM.

   Step 3: Draw a ray XY.
   Step 4: Place the compass point at L and open it to O (this opening equals half of LM).
   Step 5: Without changing the opening, place the compass point at X on the ray and cut an arc at Y.

   Then XY = LO = half of LM.

8. If PQ = 6.8 cm and ST = 3.4 cm, construct the following:

   (a) PQ + ST
   (b) PQ − ST
   (c) PQ − 1/2 ST

   First compute the required lengths:

   PQ + ST = 6.8 cm + 3.4 cm = 10.2 cm
   PQ − ST = 6.8 cm − 3.4 cm = 3.4 cm
   1/2 ST = 3.4 cm ÷ 2 = 1.7 cm
   PQ − 1/2 ST = 6.8 cm − 1.7 cm = 5.1 cm

Now constructions:

8(a) To construct PQ + ST = 10.2 cm

Step 1: Draw a ray AX.
Step 2: Set compass opening equal to PQ (6.8 cm) using the scale.
Step 3: With A as centre, cut an arc at B on the ray. Then AB = PQ = 6.8 cm.
Step 4: Now open the compass equal to ST (3.4 cm) using the scale.
Step 5: With B as centre, cut an arc at C on the same ray.

Then AC = AB + BC = 6.8 cm + 3.4 cm = 10.2 cm.
AC is the required line segment PQ + ST.

8(b) To construct PQ − ST = 3.4 cm

Step 1: Draw a line segment AD equal to PQ = 6.8 cm (as in part (a)).
Step 2: With the compass opening equal to ST = 3.4 cm, place the compass point at D and cut an arc backwards on AD to meet it at E.

Then DE = ST = 3.4 cm and AE = AD − DE = 6.8 cm − 3.4 cm = 3.4 cm.
So AE is the required line segment PQ − ST.

8(c) To construct PQ − 1/2 ST = 5.1 cm

Step 1: Draw a line segment ST of length 3.4 cm.
Step 2: Construct its midpoint N (by perpendicular bisector method as in Question 7).
Then SN = NT = 1/2 ST = 1.7 cm.

Step 3: Draw a ray AY.
Step 4: Set the compass opening equal to PQ = 6.8 cm using the scale.
Step 5: With A as centre, cut an arc at B on the ray. So AB = PQ = 6.8 cm.
Step 6: Now set the compass opening equal to SN (half of ST).
Step 7: With B as centre, cut an arc at C on AB (towards A).

Then BC = 1/2 ST = 1.7 cm and
AC = AB − BC = 6.8 cm − 1.7 cm = 5.1 cm.

So AC is the required line segment PQ − 1/2 ST.

EXERCISE 14.3 – SOLUTIONS
(Class 6 – Practical Geometry)

📌 Message for Students (Before Construction Work)

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5. **Draw arcs lightly but clearly**, and label all points (A, B, C, O, P, Q, etc.).
6. **After completing each figure**, check whether the length matches the required measurement.
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Do your best and enjoy the construction activity.
Happy Drawing! ☺✏

1. Multiple Choice Questions (MCQ) – Choose the correct option.

1(i) The number of perpendicular bisector a line segment can have is
(a) 0 (b) 1 (c) 2 (d) 3

Answer: (b) 1

Explanation:
A perpendicular bisector is a line which is perpendicular to a line segment and passes through its midpoint.
For a given line segment there is only one such line.
So the number of perpendicular bisectors is 1.

1(ii) A perpendicular to a line through a point not on it can be drawn with the help of
(a) Scale/Ruler
(b) Scale/Ruler and set square
(c) Scale/Ruler and compass
(d) Both (b) and (c)

Answer: (d) Both (b) and (c)

Explanation:
To draw a perpendicular from a point outside a line,
– we can use a ruler and a set square, or
– we can use a ruler and a compass.
Thus both methods (b) and (c) are possible, so option (d) is correct.

2. How many lines can be drawn which are perpendicular to a given line and pass through a given point

(i) lying on the line?
(ii) lying outside the line?

Answer:
(i) Only one line.
(ii) Only one line.

Explanation:
Through any given point, there is exactly one line which is perpendicular to a given line.
This is true whether the point lies on the line or outside the line.

3. With the help of set-square or protractor, determine which of the following are perpendicular to each other:

   (i) first figure
   (ii) second figure
   (iii) third figure

   Answer:
   Only the lines in figure (ii) are perpendicular.

   Explanation:
   When we check the angle between the pair of lines in each figure with a set-square or a protractor,
   – in figure (ii) the angle is 90 degrees,
   – in figures (i) and (iii) the angles are not 90 degrees.
   So only figure (ii) shows perpendicular lines.

4. Draw a line segment AB. Mark any point C on it. Through C, draw a perpendicular to AB:
   (i) using set-square,
   (ii) using compasses.

   (i) Using set-square:

   Step 1: Draw a line segment AB with a ruler.
   Step 2: Mark any point C on AB.
   Step 3: Place the ruler along AB.
   Step 4: Place the set-square so that one of its straight edges rests exactly along the ruler.
   Step 5: Slide the set-square along the ruler until another edge of the set-square passes through C.
   Step 6: Keeping the set-square fixed, draw a line along this edge through C.

   The line through C drawn in Step 6 is perpendicular to AB.

   (ii) Using compasses:

   Step 1: Draw line segment AB and mark a point C on it.
   Step 2: With C as centre and a convenient radius, draw an arc that cuts AB at two points D and E on opposite sides of C. So CD = CE.
   Step 3: With D as centre and a radius greater than half of DE, draw an arc above AB.
   Step 4: With E as centre and the same radius, draw another arc to cut the first arc at point F.
   Step 5: Join C and F.

   The line CF is perpendicular to AB at C.

5. Draw a line segment CD = 8 cm. Mark any point P outside CD. Draw a perpendicular from P to line segment CD and measure the perpendicular distance from P.

   Construction:

   Step 1: Draw CD = 8 cm with a ruler.
   Step 2: Take a point P anywhere outside the line segment CD.
   Step 3: With P as centre and a radius large enough to cut CD in two places, draw an arc cutting CD at points A and B.

Step 4: With A as centre and a radius more than half of AB, draw an arc below CD.
Step 5: With B as centre and the same radius, draw another arc to cut the previous arc at Q.
Step 6: Join P and Q.

Line PQ is perpendicular to CD.
Step 7: Measure the length of PQ with a ruler.
This length PQ is the perpendicular distance from point P to the line segment CD.

6. Draw a line segment PQ = 8.5 cm and mark a point A on it such that PA = 6.5 cm. Draw a perpendicular to PQ at A.

Construction:

Step 1: Draw PQ = 8.5 cm with a ruler.
Step 2: From point P, mark 6.5 cm on PQ and name the point as A. So PA = 6.5 cm.
Step 3: With A as centre and a convenient radius, draw an arc cutting PQ at two points B and C on either side of A.
Step 4: With B as centre and a radius greater than half of BC, draw an arc above PQ.
Step 5: With C as centre and the same radius, draw another arc to cut the previous arc at R.
Step 6: Join A and R.

AR is perpendicular to PQ at A.

7. Draw a line segment AB = 8.5 cm. Taking a point C on AB such that BC = 5 cm, draw a perpendicular to AB at C.

Construction:

Step 1: Draw AB = 8.5 cm with a ruler.
Step 2: From point B measure 5 cm along AB towards A and mark this point as C. So BC = 5 cm.
Step 3: With C as centre and a convenient radius, draw an arc cutting AB at two points D and E.
Step 4: With D as centre and a radius greater than half of DE, draw an arc above AB.
Step 5: With E as centre and the same radius, draw another arc to cut the first arc at F.
Step 6: Join C and F.

CF is perpendicular to AB at C.

8. Draw a line segment XY of length 8.5 cm. Mark any point P outside it. Now, draw a perpendicular PQ on XY.

Construction:

Step 1: Draw XY = 8.5 cm with a ruler.
Step 2: Take any point P outside the line segment XY.
Step 3: With P as centre and a radius large enough to cut XY in two places, draw an arc cutting XY at A and B.
Step 4: With A as centre and a radius greater than half of AB, draw an arc below XY.
Step 5: With B as centre and the same radius, draw another arc to cut the previous arc at Q.
Step 6: Join P and Q.

PQ is the required perpendicular from point P to line segment XY.

9. Draw a line segment XY = 4.9 cm. Mark any point P outside XY. Draw a perpendicular from P to the line segment XY and measure the perpendicular distance from P.

Construction:

Step 1: Draw XY = 4.9 cm with a ruler.
Step 2: Take a point P outside XY.
Step 3: With P as centre and a radius large enough to cut XY, draw an arc cutting XY at A and B.
Step 4: With A as centre and a radius greater than half of AB, draw an arc below XY.
Step 5: With B as centre and the same radius, draw another arc to cut that arc at Q.
Step 6: Join P and Q.

PQ is perpendicular to XY.
Step 7: Measure PQ with a ruler.

The length PQ is the perpendicular distance from point P to the line segment XY.

EXERCISE 14.4 – SOLUTIONS
(Class 6 – Practical Geometry)

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5. **Draw arcs lightly but clearly**, and label all points (A, B, C, O, P, Q, etc.).
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Happy Drawing! ☺✏

1. Multiple Choice Questions (MCQ)

1(i) A line of length 8 cm is bisected by a perpendicular bisector.
The length of each part of the line segment is
(a) 4 cm (b) 4 m (c) 0.4 cm (d) 0.04 cm

Answer: (a) 4 cm

Explanation:
To bisect means to cut into two equal parts.
So each part = 8 cm ÷ 2 = 4 cm.

1(ii) Which of the following shows the correct drawing when a line segment of 9.2 cm is bisected by a perpendicular line?

Figure (a): 4 cm and 5 cm
Figure (b): 6 cm and 3 cm
Figure (c): 4.6 cm and 4.6 cm
Figure (d): 4.7 cm and 4.5 cm

Answer: (c)

Explanation:
If 9.2 cm is divided into two equal parts,
each part = 9.2 ÷ 2 = 4.6 cm.
So the correct figure is the one showing 4.6 cm and 4.6 cm on the two sides of the perpendicular line, that is figure (c).

2. Draw a line segment of 7.6 cm and draw its perpendicular bisector.

Construction:

1. Draw a line segment AB of length 7.6 cm with a ruler.
2. With A as centre and radius more than half of AB, draw an arc above AB and another arc below AB.
3. With B as centre and the same radius, draw arcs to cut the previous two arcs at points P (above) and Q (below).
4. Join P and Q.

Line PQ is the **perpendicular bisector** of AB.
It cuts AB exactly at its midpoint and makes a right angle (90°) with AB.

3. Divide a line segment of length 8.5 cm into four equal parts using compass.

(Each part will be 8.5 ÷ 4 = 2.125 cm, but we shall get it by construction.)

Construction:

1. Draw a line segment AB of length 8.5 cm with a ruler.
2. Construct the perpendicular bisector of AB as in Question 2. Let it cut AB at point M. Then AM = MB, so AB is divided into two equal parts.
3. Now construct the perpendicular bisector of segment AM. Let it cut AM at point C.
4. Construct the perpendicular bisector of segment MB. Let it cut MB at point D.

Now AB is divided into four equal parts:
A–C, C–M, M–D and D–B.
Each of these parts is one–fourth of AB.

4. Draw a circle of radius 5 cm. Draw two chords on it. Construct the perpendicular bisector of these chords. Where do they meet?

Construction and result:

1. Draw a circle with centre O and radius 5 cm using a compass.
2. Draw any chord AB of this circle.
3. Draw another chord CD of the same circle (not parallel to AB).
4. Construct the perpendicular bisector of AB by taking A and B as centres and drawing arcs to meet at points P and Q, then joining P and Q.
5. Construct the perpendicular bisector of CD in the same way and get line RS.

Observation:
The two perpendicular bisectors PQ and RS meet at one common point.
This common point is the **centre O of the circle**.

Answer: The perpendicular bisectors of the two chords meet at the centre of the circle.

5. Draw a triangle. Construct three perpendicular bisectors on each of its side. Check whether all three bisectors meet at one point.

Construction and result:

1. Draw any triangle ABC.
2. Construct the perpendicular bisector of side BC. Let it cut BC at D and extend it as a line.
3. Construct the perpendicular bisector of side CA in the same way. Let it cut CA at E. Let these two perpendicular bisectors meet at point O.
4. Now construct the perpendicular bisector of side AB.

Observation:
The perpendicular bisector of AB also passes through the same point O.

Answer: All three perpendicular bisectors meet at one common point O.
This point is called the **circumcentre** of the triangle.

6. Divide a line segment of length 8.8 cm into four equal parts using compass.

(Each part will be 8.8 ÷ 4 = 2.2 cm, but we shall do it by construction.)

Construction:

1. Draw a line segment AB = 8.8 cm with a ruler.
2. Construct the perpendicular bisector of AB and let it cut AB at M. Now AM = MB (AB is divided into two equal parts).
3. Construct the perpendicular bisector of AM and let it cut AM at C.
4. Construct the perpendicular bisector of MB and let it cut MB at D.

Now AB is divided into four equal parts:
A–C, C–M, M–D and D–B.
Each of these parts is one–fourth of 8.8 cm.

7. In the figure, given below AD = CD = CE = BE. Which perpendicular bisector among three can be the axis of symmetry of AB?

(Three perpendicular lines are drawn on AB through points D, C and E. They are named RS, MN and PQ respectively.)

Answer:
The perpendicular bisector through point C (line MN) can be the axis of symmetry of AB.

Explanation:

Let A and B be the ends of the line segment AB.
We are given that:

AD = CD = CE = BE

This means:
– The distance from A to D, from C to D, from C to E and from E to B are all equal.
If we put AB on a number line, these equal distances show that point C lies exactly halfway between A and B.
So C is the **midpoint** of AB.

The axis of symmetry of AB must
– pass through the midpoint of AB, and
– be perpendicular to AB.

Among the three perpendicular bisectors in the figure, only the one through C (line MN) passes through the midpoint of AB.
Therefore, **MN is the required axis of symmetry of AB**.

EXERCISE 14.5 – SOLUTIONS
(Class 6 – Practical Geometry)

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1. MULTIPLE CHOICE QUESTIONS (MCQ)

(i) What kind of an angle is it, if it is equal to its complement?
(a) acute (b) right (c) obtuse (d) None

Answer: (a) acute

Explanation:
If an angle is equal to its **complement**, then
let the angle be x°.
Its complement is (90° − x°).
Given: x° = 90° − x°
⇒ 2x° = 90°
⇒ x° = 45°.
A 45° angle is less than 90°, so it is an **acute** angle.

(ii) With the help of compass, we can draw the angle of
(a) 40° (b) 80° (c) 75° (d) 95°

Answer: (c) 75°

Explanation:
Using ruler and compass we can easily construct
– 60° (by drawing an equilateral triangle),
– 30° (half of 60°),
– 90° (a right angle),
– 150° (straight angle – 30°), etc.
Then we can get 75° = 150° ÷ 2.
So 75° is a standard constructible angle by compass.
Among the given options, only **75°** is commonly constructed using compass.

2. Use protractor to draw angles of:

(i) 60° (ii) 30° (iii) 15° (iv) 7½°
(v) 90° (vi) 45° (vii) 22½° (viii) 75°
(ix) 150° (x) 120° (xi) 135°

General steps for each angle (say θ°):

1. Draw a ray **OX** with a ruler. Point O will be the vertex of the angle.
2. Place the centre hole of the protractor exactly on O.
3. Place the baseline of the protractor along ray OX.
4. On the required scale (inner or outer), find the mark **θ°** and put a small dot there.
5. Remove the protractor and join O with the dot.

The angle formed ∠XOY is θ°.

For each of the given angles, repeat the same steps, only changing θ to
60°, 30°, 15°, 7½°, 90°, 45°, 22½°, 75°, 150°, 120° and 135° respectively.

3. Use compass and scale/ruler to draw the angles mentioned in Q. 2.

Below, all angles are constructed at point O on ray OA.

(i) **To construct 60°**

1. Draw ray OA.
2. With O as centre and any convenient radius, draw an arc cutting OA at B.
3. With B as centre and the same radius, cut the arc at C.
4. Join O and C.

∠AOC = 60° (angles of an equilateral triangle).

(ii) **To construct 30°**

1. First construct 60° at O (as above) so that ray OC makes 60° with OA.
2. With O as centre, draw an arc cutting OA at B and OC at C.
3. With B and C as centres and equal radius (more than half BC), draw two arcs to intersect at D.
4. Join O and D.

OD is the bisector of ∠AOC,
so ∠AOD = 30°.

(iii) **To construct 15°**

1. Construct 30° at O (∠AOD = 30°).
2. With O as centre, draw an arc cutting OA at B and OD at C.
3. With B and C as centres and equal radius, draw two arcs intersecting at E.
4. Join O and E.

OE bisects the 30° angle,
so ∠AOE = 15°.

(iv) **To construct 7½°**

1. Construct 15° at O (∠AOE = 15°).
2. With O as centre, draw an arc cutting OA at B and OE at C.
3. With B and C as centres and equal radius, draw arcs intersecting at F.
4. Join O and F.

OF bisects the 15° angle,
so ∠AOF = 7½°.

(v) **To construct 90°**

1. Draw a line l (or ray OA).

2. Take O as a point on l.
3. With O as centre and convenient radius, draw an arc cutting l at B and C.
4. With B and C as centres and same radius (more than half BC), draw arcs above the line to meet at D.
5. Join O and D.

∠BOD (or ∠AOD) = 90°.

(vi) **To construct 45°**

1. Construct 90° at O (∠AOD = 90°).
2. With O as centre, draw an arc cutting OA at B and OD at C.
3. With B and C as centres and equal radius, draw arcs intersecting at E.
4. Join O and E.

OE bisects the 90° angle,
so ∠AOE = 45°.

(vii) **To construct 22½°**

1. Construct 45° at O (∠AOE = 45°).
2. With O as centre, draw an arc cutting OA at B and OE at C.
3. With B and C as centres and equal radius, draw arcs intersecting at F.
4. Join O and F.

OF bisects the 45° angle,
so ∠AOF = 22½°.

(viii) **To construct 75°**

We shall first make 150° and then bisect it.

1. Construct 30° at O (∠AOC = 30°).
2. Extend ray AO in a straight line in the opposite direction to point A′ (so ∠CA′O = 180° − 30° = 150°). Thus ∠A′OC = 150°.
3. With O as centre, draw an arc cutting OA′ at B and OC at C.
4. With B and C as centres and equal radius, draw arcs intersecting at D.
5. Join O and D.

OD bisects the 150° angle,
so each of ∠A′OD and ∠DOC is 75°.

Any one of these (for example ∠A′OD) is 75°.

(ix) **To construct 150°**

1. Construct 30° at O on ray OA (∠AOC = 30°).
2. Extend OA in a straight line beyond O to A′ (straight line gives 180°). Then the angle between OA′ and OC on the other side is ∠A′OC = 180° − 30° = 150°.

So ∠A′OC is 150°.

(x) **To construct 120°**

1. Construct 60° at O (∠AOC = 60°).
2. Keeping O as vertex and OC as one arm, construct another 60° angle on OC inside the same half-plane. (That is, repeat the 60° construction once more starting from OC.)
3. Let the new ray be OD.

Then the total angle ∠AOD = 60° + 60° = 120°.

(You may also get 120° as the exterior angle: 180° − 60°.)

(xi) **To construct 135°**

1. Construct 90° at O (∠AOC = 90°).
2. Bisect the 90° angle to get 45° (as in 45° construction) with ray OE.
   So ∠AOE = 45°.
3. Now the angle between OE and the extension of OA on the other side will be
   135° = 90° + 45°.
   Alternatively, extend OA to A′ in a straight line; then
   ∠A′OE = 135°.

   Thus ∠A′OE is 135°.

4. Construct the copy of following angles (using compass).

   (There are two angles shown in the book: one at A and one at S.
   The method is the same for any angle.)

   General method to copy an angle ∠XYZ at a new point O:

1. Given an angle ∠XYZ (with vertex Y).
2. Draw a ray OP where you want the new angle.
3. With Y as centre and any convenient radius, draw an arc cutting YX at A and YZ at B.
4. Using the same radius, with O as centre, draw an arc cutting OP at C.
5. Measure the distance AB with the compass (keep the opening AB).
6. With O as centre and the same opening, place the compass point at C on the new arc and cut it at D.
7. Join O and D.

   Then ∠POD is a copy of ∠XYZ.

   Use this method to copy both angles shown in Question 4.

5. Draw an ∠BAC such that ∠BAC = 2 ∠QPR, where ∠QPR is drawn in the figure.

   Let the given angle be ∠QPR. We have to construct an angle at A whose measure is double of ∠QPR.

   Construction:

1. Draw a ray AB. Point A will be the vertex of the required angle.
2. Copy the angle ∠QPR at vertex A to get ∠DAB = ∠QPR (using the copying method from Question 4).
   So ray AD is such that ∠DAB = ∠QPR.

3. Now again copy ∠QPR, but this time with AD as the starting arm:
   – With P as centre draw an arc of ∠QPR and copy it at A with AD as first arm, getting a new ray AC such that ∠CAD = ∠QPR.

   Now,
   ∠BAC = ∠DAB + ∠CAD
   = ∠QPR + ∠QPR
   = 2 ∠QPR.

   So ∠BAC is the required angle whose measure is twice that of ∠QPR.

MISCELLANEOUS EXERCISE – SOLUTIONS
(Class 6 – Practical Geometry)

📌 Message for Students (Before Construction Work)

Dear Students,
Today you will be practising **Practical Geometry**, where you will draw different line segments and constructions using only a **scale, pencil, and compass**.

Please follow each step slowly and carefully:

1. **Read the question twice** so that you know exactly what length or construction is required.
2. **Use a sharp pencil** for neat and accurate drawings.
3. **Place the scale properly** and mark points lightly so you can erase if needed.
4. **Do not change the compass opening** once you set a particular measurement.
5. **Draw arcs lightly but clearly**, and label all points (A, B, C, O, P, Q, etc.).
6. **After completing each figure**, check whether the length matches the required measurement.
7. Keep your work **clean, beautiful, and accurate**—geometry is an art as well as mathematics!

Do your best and enjoy the construction activity.
Happy Drawing! ☺✏

1. Draw three circles of radii 3 cm, 4.5 cm and 5.5 cm with same centre.

Construction:

1. Mark a point **O** on the paper. This will be the common centre.
2. Set the compass to a radius of **3 cm** using the ruler.
   Keeping the compass point at O, draw a circle.
3. Now open the compass to **4.5 cm** and, with the same centre O, draw the second circle.
4. Open the compass to **5.5 cm** and, again with centre O, draw the third circle.

You get three **concentric circles** (same centre, different radii).

2. Construct a line segment AB of length 8 cm. From this, cut a line segment AC of length 3.6 cm. Measure the remaining line segment.

Construction and calculation:

1. Draw a line segment **AB = 8 cm** using a ruler.
2. Place the zero mark of the scale at **A** and mark a point **C** on AB such that **AC = 3.6 cm**.
3. The remaining part of the segment is **CB**.
4. Measure CB with the ruler.

Calculation:
8.0 cm − 3.6 cm

- From 8.0 subtract 3.6 → 4.4

So **CB = 4.4 cm**.

3. Draw a line segment AB of length 6 cm. Draw three perpendiculars, one at mid-point and other two at each of the end-points.

Construction:

1. Draw **AB = 6 cm**.
2. **Find the mid-point M of AB**:
   - With A as centre and radius more than half of AB, draw arcs above and below AB.
   - With B as centre and same radius, draw arcs to cut the previous arcs at P and Q.
   - Join P and Q. PQ cuts AB at **M**, the mid-point.
3. **Perpendicular at mid-point M:**
   The line **PQ** already drawn is perpendicular to AB at M. (This is the perpendicular bisector of AB.)
4. **Perpendicular at end-point A:**
   - With A as centre and any convenient radius, draw an arc cutting AB at R and extending above it.
   - With R as centre and same radius, draw an arc above AB.
   - Join A with this new point S.
   The line **AS** is perpendicular to AB at A.
   (You may also use a set-square to erect a perpendicular at A.)
5. **Perpendicular at end-point B:**
   Repeat the same steps at B to get line **BT** perpendicular to AB at B.

Thus three perpendiculars are drawn: at A, at M and at B.

4. Draw a line segment AB = 5 cm. Take a point P not lying on the line. Construct a perpendicular on line AB from P.

Construction:

1. Draw **AB = 5 cm**.
2. Take any point **P** above or below AB (not on AB).
3. With P as centre and a radius large enough to cut AB, draw an arc cutting AB at points **C** and **D**.
4. With C as centre and radius more than half of CD, draw an arc on the side of P.
5. With D as centre and same radius, draw another arc to cut the previous arc at **Q**.
6. Join **P** and **Q**.

Line **PQ** is perpendicular to AB. So PQ is the required perpendicular from P to AB.

5. Draw a circle of radius 4 cm. Draw any chord AB. Construct a perpendicular bisector of AB. Also, examine whether it passes through the centre of the circle.

Construction and observation:

1. With a compass and ruler, draw a circle of **radius 4 cm** and centre **O**.
2. Draw any chord **AB** of the circle (a straight line joining two points on the circle).
3. To construct the perpendicular bisector of AB:

- With A as centre and radius more than half of AB, draw arcs above and below the chord.
- With B as centre and same radius, draw arcs to cut the previous arcs at points **P** (above) and **Q** (below).
- Join P and Q. This line PQ is the **perpendicular bisector** of AB.

Examine:
Observe that line PQ passes through point **O**, the centre of the circle.

Conclusion:
The perpendicular bisector of a chord of a circle **always passes through the centre** of the circle.

6. Draw an angle measuring 132°. Construct its bisector.

Construction:

1. Draw a ray **BA**. Point B will be the vertex.
2. Using a **protractor**, place its centre on B and its baseline along BA.
3. Mark a point **C** at **132°**.
4. Join B and C. Now ∠ABC = 132°.

To construct its bisector:

5. With B as centre, draw an arc that cuts BA at **E** and BC at **F**.
6. With E and F as centres and equal radius, draw two arcs in the interior of the angle to intersect at **D**.
7. Join B and D.

Ray **BD** is the **bisector** of ∠ABC.

Measure of each part:
132° ÷ 2 = 66°.
So ∠ABD = 66° and ∠DBC = 66°.

7. Draw an angle measuring 120°. Divide it into four equal parts.

Construction:

1. Draw a ray **BA**.
2. With protractor, construct **∠ABC = 120°** by marking 120° and joining B to C.

Now we divide 120° into four equal angles:

(a) First bisection)
3. With B as centre, draw an arc cutting BA at E and BC at F.
4. With E and F as centres and equal radius, draw arcs intersecting at **G**.
5. Join B and G.
Ray BG bisects 120° into two angles of **60°** each: ∠ABG = 60°, ∠GBC = 60°.

(b) Second bisection)
6. To bisect ∠ABG (60°):

- With B as centre, draw an arc cutting BA at H and BG at J.
- With H and J as centres and equal radius, draw arcs meeting at **K**.
- Join B and K.
  Now ∠ABK = 30°.

7. To bisect ∠GBC (60°):
   - With B as centre, draw an arc cutting BG at L and BC at M.
   - With L and M as centres and equal radius, draw arcs meeting at **N**.
   - Join B and N.
   Now ∠GBN = 30° and ∠NBC = 30°.

Thus the original angle of 120° is divided into **four equal angles of 30° each**:
∠ABK, ∠KBG, ∠GBN and ∠NBC.

8. Draw ∠ABC = 135°. Find its axis of symmetry.

Construction:

1. Draw ray **BA**.
2. Using a protractor, construct ∠ABC = **135°** by marking 135° and joining B to C.

To find its axis of symmetry (angle bisector):

3. With B as centre, draw an arc cutting BA at **D** and BC at **E**.
4. With D and E as centres and equal radius, draw arcs intersecting at **F** in the interior of the angle.
5. Join B and F.

Ray **BF** is the **bisector** of ∠ABC.

Explanation:
The axis of symmetry of an angle is a line through its vertex that divides the angle into two equal parts. Here BF divides 135° into two angles of 67.5° each, so **BF is the axis of symmetry of ∠ABC**.

CHAPTER TEST – 14 : SOLUTIONS (Practical Geometry – Class 6)

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1. The bisectors divide an equilateral triangle in

(a) 1 region
(b) 2 regions
(c) 3 regions
(d) 6 regions

Answer: (d) 6 regions

Explanation:
An equilateral triangle has **three equal angles of 60°**.
If we draw the **angle bisector of each angle**, each 60° is divided into two 30° angles.
All three bisectors meet at one point inside the triangle and the triangle is cut into **6 small triangles**.
So the triangle is divided into **6 regions**.

2. What kind of an angle is it, if it is equal to its supplement?

(a) acute
(b) obtuse
(c) right
(d) None

Answer: (c) right

Explanation:
Let the angle be **x°**.
Its supplement is **(180° − x°)**.
Given that they are equal:
$x° = 180° - x°$
$\Rightarrow 2x° = 180°$
$\Rightarrow x° = 90°$.
A 90° angle is a **right angle**.

3. What kind of an angle is it, if it is smaller than its supplement?

(a) acute
(b) right
(c) obtuse
(d) None

Answer: (a) acute

Explanation:
If two angles are **supplementary**, their sum is 180°.
Among two numbers whose sum is 180, the **smaller one is less than 90°**.
An angle less than 90° is called an **acute angle**.

4. What kind of an angle is it, if it is greater than its supplement?

(a) acute
(b) right
(c) obtuse
(d) None

Answer: (c) obtuse

Explanation:
Again, supplementary angles add up to 180°.

If an angle is **greater than its supplement**, then it is **greater than 90°**.
Any angle greater than 90° and less than 180° is an **obtuse angle**.

5. With the help of a compass, we can draw the angle of

(a) 40°
(b) 55°
(c) 65°
(d) 90°

Answer: (d) 90°

Explanation:
Using a **ruler and compass** we can easily draw **perpendicular lines**, and the angle between perpendicular lines is **90°** (a right angle).
The angles 40°, 55° and 65° are **not standard compass constructions** at this level, but 90° is.

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6. Write *true* or *false* in the following:

6(i) Angle, which can be drawn by using ruler and compass, should be multiple of 15°.

Answer: True

Explanation:
In this class we usually construct angles like 30°, 45°, 60°, 75°, 90°, 120°, etc.
All of these are **multiples of 15°**, so the statement is taken as true in this context.

6(ii) To draw an angle of 90° using a ruler and compass, we bisect the angle between 60° and 120°.

Answer: True

Explanation:
If we construct angles of **60°** and **120°** with the same vertex, the angle between their arms is
120° − 60° = 60°.
If we **bisect** this 60° angle, we get
60° ÷ 2 = 30°.
But the required right angle at the vertex is the angle in the middle between the rays at 60° and 120°.
That central angle is **90°**, so this method indeed gives a right angle.

(Your book accepts this method as giving a 90° angle, so it is marked true.)

6(iii) An angle has an interior as well as an exterior region.

Answer: True

Explanation:
Two rays forming an angle divide the plane into **two parts**:

- the space **inside** the angle (interior) and
- the space **outside** the angle (exterior).

So the statement is true.

6(iv) Protractor is used to mark off equal lengths, but does not measure them, also used to draw arcs and circles.

Answer: False

Explanation:
The instrument used to mark off equal lengths and draw arcs and circles is the **compass**, not the protractor.
A **protractor** is used to **measure and draw angles**.
So the statement is false.

6(v) Perpendicular lines are the lines that intersect at an angle 60°.

Answer: False

Explanation:
Perpendicular lines meet at a **right angle**, that is **90°**, not 60°.
Therefore the statement is false.

6(vi) The perpendicular bisector of a line segment is the line that is perpendicular to the line segment.

Answer: True

Explanation:
A **perpendicular bisector** is a line which

- is **perpendicular** to the segment, and
- passes through the **mid-point** of the segment.

The book treats this description as correct, so the statement is marked true.

6(vii) 30°, 60°, 120°, 90°, 45° etc. are some special angles which can be constructed without use of protractor.

Answer: True

Explanation:
All these angles can be constructed using **only a ruler and compass** (for example, by constructing equilateral triangles, right angles and bisecting angles).
So the statement is true.

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7. Fill in the blanks:

7(i) If three or more lines intersect at a point, we say that lines are ________.

Answer: concurrent

Explanation:
Lines which all pass through the **same point** are called **concurrent lines**.

7(ii) A line which is perpendicular to a given line segment and divides it into two equal halves is called a ________ of the line.

Answer: perpendicular bisector

Explanation:
"Perpendicular" means it meets the segment at **90°**, and "bisector" means it **cuts it into two equal parts**.
So such a line is the **perpendicular bisector**.

7(iii) The measure of an angle depends upon ________.

Answer: opening of arms

Explanation:
An angle is formed by two arms (rays).
How **wide the arms are opened** determines the measure of the angle.

7(iv) ________ line can be drawn passing through two given points.

Answer: one

Explanation:
Through any **two distinct points**, exactly **one straight line** can be drawn.

7(v) Instrument used to draw any angle is ________.

Answer: protractor

Explanation:
A **protractor** is specially designed to **measure and draw angles** accurately.

7(vi) A line l is the perpendicular bisector of AB¯\overline{AB}AB, if l makes an angle of ________ with AB¯\overline{AB}AB at the mid-point of AB¯\overline{AB}AB.

Answer: 90°

Explanation:
A perpendicular bisector must be **perpendicular** to AB at its mid-point.
Perpendicular means it makes an angle of **90°**.