NCERT SOLUTIONS
CLASS-IX MATHS
CHAPTER-11 CONSTRUCTIONS

Question-1 Construct an angle of 90° at the initial point of a given ray and justify the construction.

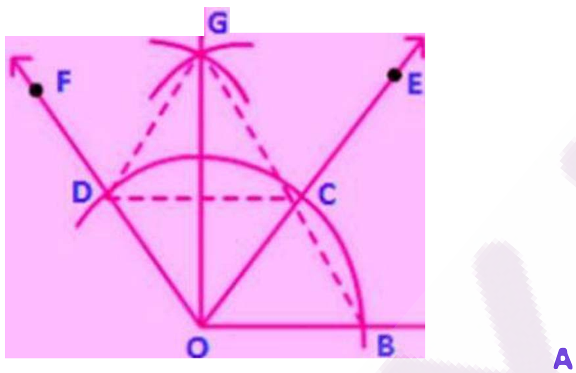
Solution:

Given a ray OA.

Required: To construct an angle of 90° at 0 and justify the construction.

Steps of Construction:

1. Taking 0 as centre and some radius, draw an arc of a circle, which intersects OA, say at a point B.
2. Taking B as centre and with the same radius as before, draw an arc intersecting the previously drawn arc, say at a point C.



3. Taking C as centre and with the same radius as before, draw an arc intersecting the arc drawn in step 1, say at D.
4. Draw the ray OE passing through C. Then ∠EOA = 60°.

Draw the ray OF passing through D. Then ∠FOE =60°.

5. Next, taking C and D as centres and with the radius more than CD, draw arcs to intersect each other, say at G.
6. Draw the ray 0G. This ray OG is the bisector of the angle ∠FOE, i.e., ∠ FOG = ∠EOG = ; ∠FOE = (60°) = 30°.

Thus, ∠GOA = ∠GOE + ∠EOA = 30° +60° = 90°.

Justification:

(i) Join BC.

Then, OC = OB = BC (By construction)

ΔCOB is an equilateral triangle.

∠COB =60°.

∠ EOA = 60°.

(ii) Join CD.

Then, OD = OC = CD (By construction) ΔDOC is an equilateral triangle.

∠DOC = 60°.

∠ FOE = 60°.

(iii) Join CG and DG.

In ΔODG and ΔOCG,

OD = OC I Radii of the same arc

DG = CG I Arcs of equal radii

OG = OG I Common ∴ ΔODG≅ Δ OCG ISSS Rule

∴ ∠DOG =∠COG ICPCT

∴ ∠FOG = ∠EOG =$\frac{1}{2}$ ∠FOE = $\frac{1}{2}$ (60°) = 30°

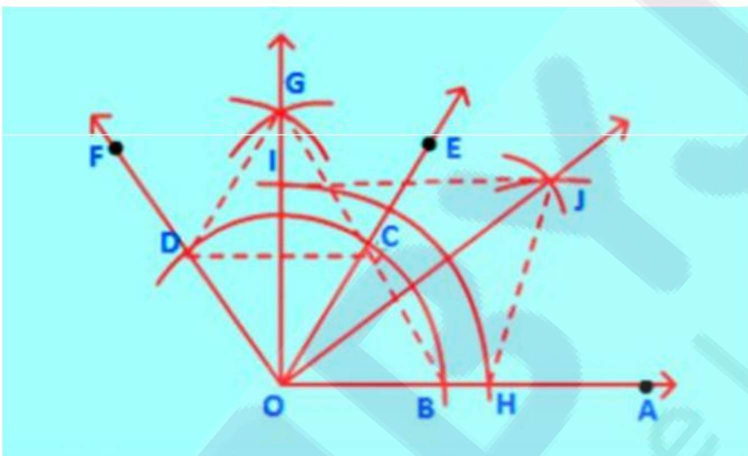
Thus, ∠GOA = ∠GOE + ∠EOA = 30° + 60° = 90°.

Question-2

Construct an angle of 45° at the initial point of a given ray and justify the construction.

Solution: Given: A ray OA. Required: To construct an angle of 45° at 0 and justify the construction. Steps of Construction:

1. Taking 0 as centre and some radius, draw an arc of a circle, which intersects OA, say at a point B.
2. Taking B as centre and with the same radius as before, draw an arc intersecting the previously drawn arc, say at a point C.
3. Taking C as centre and with the same radius as before, draw an arc intersecting the arc drawn in step 1, say at D.



4. Draw the ray OE passing through C. Then ∠EOA = 60° .
5. Draw the ray OF passing through D. Then ∠ FOE = 60° .
6. Next, taking C and D as centres and with radius more than 1CD, draw arcs to intersect each other, say at G.
7. Draw the ray OG. This ray OG is the bisector of the angle FOE, i.e., ∠FOG = ∠EOG = $\frac{1}{2}$ ∠FOE = $\frac{1}{2}$ (60°) = 30° .

Thus, ∠GOA = ∠GOE + ∠ EOA = 30° + 60° = 90°.

8. Now, taking 0 as centre and any radius, draw an arc to intersect the rays OA and OG, say at H and I respectively.
9. Next, taking H and I as centres and with the radius more than $\frac{1}{2}$HI, draw arcs to intersect each other, say at J.
10. Draw the ray OJ. This ray OJ is the required bisector of the angle GOA. Thus, ∠GOJ = ∠AOJ = $\frac{1}{2}$ ∠GOA = $\frac{1}{2}$ (90°) = 45°.

Justification:

(i)Join BC.

Then, OC = OB = BC triangle. (By construction)

∴ ∠COB is an equilateral triangle.

∴ ∠COB = 60°.

∴ ∠EOA = 60°.

(ii)Join CD.

Then, OD = OC = CD (By construction)

D DOC is an equilateral triangle.

∴ $\angle$DOC = 60°.

∴ $\angle$ FOE = 60°.

(iii)Join CG and DG.

In ΔODG and ΔOCG,

OD = OC | Radii of the same arc

DG = CG | Arcs of equal radii

OG = OG | Common

∴ Δ ODG = ΔOCG | SSS

Rule ∴ $\angle$ DOG = $\angle$COG | CPCT

∴ $\angle$FOG = $\angle$ EOG = $\frac{1}{2}$ $\angle$FOE = $\frac{1}{2}$ (60°) = 30°

Thus, $\angle$GOA = $\angle$GOE + $\angle$EOA = 30° + 60° = 90°.

Join HJ and IJ.

In ΔOIJ and ΔOHJ,

01 = OH | Radii of the same arc

IJ = HJ | Arcs of equal radii

OJ = OJ | Common ∴ ΔOIJ = Δ OHJ

Rule ∴ $\angle$I0J = $\angle$ HOJ (90°) = 45° | CPCT

∴ $\angle$AOJ =] $\angle$GOJ = $\frac{1}{2}$ $\angle$GOA = $\frac{1}{2}$

Question-3

Construct the angles of the following measurement:

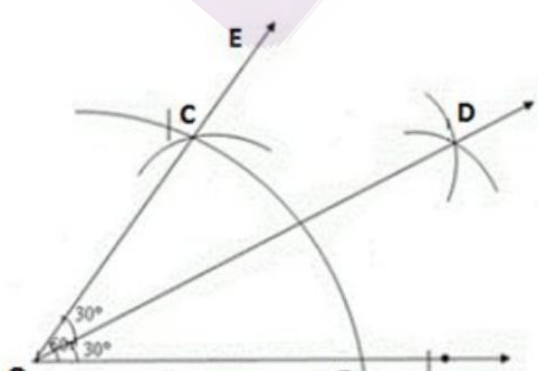
30°
$22\frac{1}{2}$
15°

Solution:

30°

Given: A ray OA

Required:To construct an angle of 30° at O.



Steps of Construction:

1. Taking 0 as centre and some radius , draw an arc of a circle, which intersects OA, say at a point B.
2. Taking B as centre and with the same radius as before, draw an arc intersecting the previously drawn arc, say at a point C.
3. Draw the ray OE passing through C. Then $\angle$EOA = 60°.
4. Taking B and C as centres and with the radius more than $\frac{1}{2}$BC, draw arcs to intersect each other, say at D.
5. Draw the ray OD. This ray OD is the bisector of the angle EOA, i.e., $\angle$EOD = $\angle$AOD = $\frac{1}{2}$ $\angle$EOA = $\frac{1}{2}$(60°) = 30°.

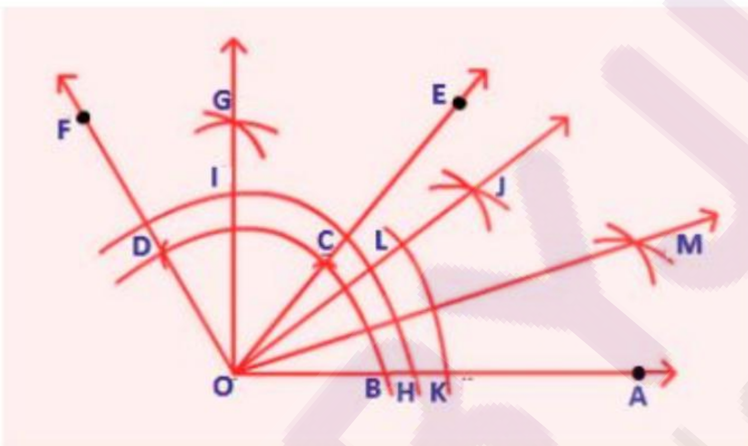
(ii) $22\frac{1}{2}^\circ$

Given: A ray OA.

Required: To construct an angle of $22\frac{1}{2}^\circ$ at 0.

Steps of Construction:

1. Taking 0 as centre and some radius, draw an arc of a circle, which intersects OA, say at a point B.
2. Taking B as centre and with the same radius as before, draw an arc intersecting the previously drawn arc, say at a point C .



3. Taking C as centre and with the same radius as before, draw an arc intersecting the arc drawn in step 1, say at D.
4. Draw the ray OE passing through C. Then $\angle$EOA = 60°.
5. Draw the ray OF passing through D. Then $\angle$ FOE = 60°.
6. Next, taking C and D as centres and with radius more than $\frac{1}{2}$CD, draw arcs to intersect each other, say at G.
7. Draw the ray OG. This ray OG is the bisector of the angle FOE, i.e., $\angle$FOG = $\angle$EOG = $\frac{1}{2}$ $\angle$FOE = $\frac{1}{2}$ (60°) = 30°.

Thus, $\angle$ZGOA = $\angle$GOE + $\angle$EOA = 30° + 60° = 90°.

8. Now, taking 0 as centre and any radius, draw an arc to intersect the rays OA and OG, say at H and I respectively.
9. Next, taking H and I as centres and with the radius more than $\frac{1}{2}$HI, draw arcs to intersect each other, say at J.
10. Draw the ray OJ. This ray OJ is the bisector of the angle GOA. i.e., $\angle$GOJ = $\angle$AOJ = $\frac{1}{2}$ $\angle$GOA = $\frac{1}{2}$(90°) = 45°.
11. Now, taking 0 as centre and any radius, draw an arc to intersect the rays OA and OJ, say at K and L respectively.
12. Next, taking K and Las centres and with the radius more than $\frac{1}{2}$KL, draw arcs to intersect each other, say at M.
13. Draw the ray OM. This ray OM is the bisector of the angle AOJ, i.e., $\angle$JOM = $\angle$AOM = $\frac{1}{2}$ $\angle$AOJ = $\frac{1}{2}$(45°) = $22\frac{1}{2}^\circ$

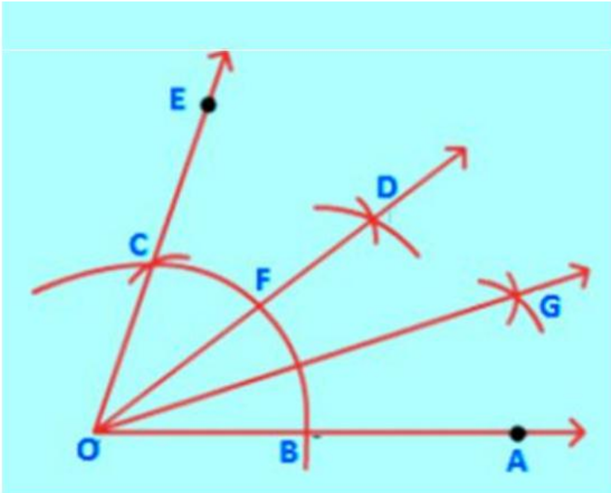
(iii) 15°

Given: A ray OA.

Required: To construct an angle of 15° at 0.

Steps of construction:

1. Taking 0 as centre and some radius, draw an arc of a circle, which intersects OA, say at a point B.
2. Taking B as centre and with the same radius as before, draw an arc intersecting the previously drawn arc, say at a point C.



3. Draw the ray OE passing through C. Then ∠EOA $= 60^{\circ}$.
4. Now, taking B and C as centres and with the radius more than $\frac{1}{2}$BC, draw arcs to intersect each other, say at D.
5. Draw the ray OD intersecting the arc drawn in step 1 at F. This ray OD is the bisector of the angle EOA,

i.e., ∠EOD = ∠AOD = $\frac{1}{2}$ ∠EOA = $\frac{1}{2}$ (60°) = 30°.

6. Now, taking B and F as centres and with the radius more than $\frac{1}{2}$BF, draw arcs to intersect each other, say at G.
7. Draw the ray OG. This ray OG is the bisector of the angle AOD, i.e., ∠DOG = ∠AOG = $\frac{1}{2}$ ∠AOD = $\frac{1}{2}$ (30°) = 15°.

Question-4

Construct the following angles and verify by measuring them by a protractor:

75°
105°
135°

Solution:

75°

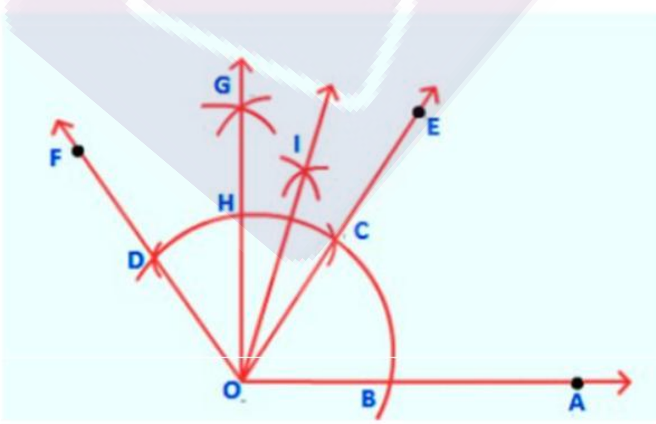
Given: A ray OA .

Required: To construct an angle of 75°

at 0.

Steps of Construction:

1. Taking 0 as centre and some radius, draw an arc of a circle, which intersects OA, say at a point B.



2. Taking B as centre and with the same radius as before, draw an arc intersecting the previously drawn arc, say at a point C.
3. Taking C as centre and with the same radius as before, draw an arc intersecting the arc drawn in step 1, say at D.
4. Join the ray OE passing through C. Then ∠EOA $= 60^{\circ}$.
5. Draw the ray OF passing through D. Then ∠FOE – 75°.

6. Next, taking C and D as centres and with the radius more than $\frac{1}{2}$CD, draw arcs to intersect each other, say at G.
7. Draw the ray OG intersecting the arc of step 1 at H. This ray OG is the bisector of the angle FOE, i.e., $\angle$FOG = $\angle$EOG = $\frac{1}{2}$ $\angle$FOE = $\frac{1}{2}$ (60°) = 30°.
8. Next, taking C and H as centres and with the radius more than $\frac{1}{2}$CH, draw arcs to intersect each other, say at I.
9. Draw the ray 01. This ray 01 is the bisector of the angle GOE, i.e., $\angle$GOI= $\angle$E0I = $\frac{1}{2}$ $\angle$GOE = $\frac{1}{2}$ (30°) = 15°.

Thus, $\angle$IOA = $\angle$I0E + $\angle$EOA = 15° + 60° = 75°.

On measuring the $\angle$I0A by protractor, we find that $\angle$I0A = 75°.

Thus the construction is verified.

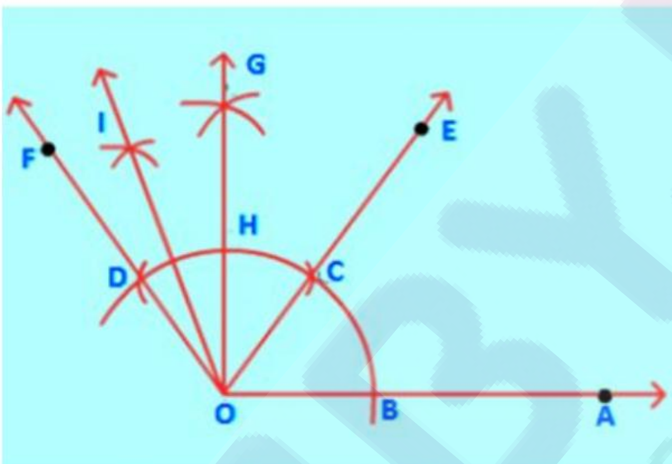
(ii) 105°

Given: A ray OA. Required: To construct an angle of 105°

at 0.

Steps of Construction:

1. Taking 0 as centre and some radius , draw an arc of a circle, which intersects OA, say at a point B.



2. Taking B as centre and with the same radius as before, draw an arc intersecting the previously drawn arc, say at a point C .
3. Taking C as centre and with the same radius as before, draw an arc intersecting the arc drawn in step 1, say at D.
4. Draw the ray OE passing through C. Then$\angle$EOA=60°.
5. Draw the ray OF passing through D.

Then $\angle$FOE =60°.

6. Next, taking C and D as centres and with the radius more than $\frac{1}{2}$CD, draw arcs to intersect each other, say at G.
7. Draw the ray OG intersecting the arc drawn in step 1 at H. This ray OG is the bisector of the angle FOE, i.e., $\angle$FOG = $\angle$EOG = ; $\frac{1}{2}$ $\angle$FOE = $\frac{1}{2}$ (60°) = 30°

Thus, $\angle$GOA = $\angle$GOE + $\angle$EOA = 30° + 60° = 90°.

8. Next, taking H and D as centres and with the radius more than $\frac{1}{2}$HD, draw arcs to intersect each other, say at I.
9. Draw the ray 0I. This ray 0I is the bisector of the angle $\angle$FOG, i.e., $\angle$FOI =$\angle$GOI = $\frac{1}{2}$ $\angle$FOG = $\frac{1}{2}$ (30°) = 15°.

Thus, $\angle$I0A = $\angle$I0G + $\angle$GOA = 15° + 90° = 105°.

On measuring the $\angle$I0A by protractor, we find that $\angle$FOA = 105°.

Thus the construction is verified.

(iii) 135°

Given: A ray OA

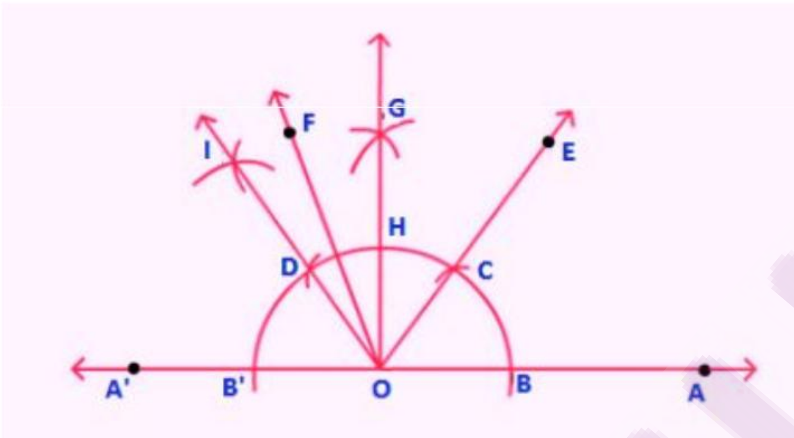
Given: A ray OA .

Required: To construct an angle of 135°

at 0.

Steps of Construction:

1. Produce AO to A' to form ray OA'.



2. Taking 0 as centre and some radius, draw an arc of a circle, which intersects OA at a point B and OA at a point B'.
3. Taking B as centre and with the same radius as before, draw an arc intersecting the previously drawn arc at a point C.
4. Taking C as centre and with the same radius as before, draw an arc intersecting the arc drawn in step 1, say at D.
5. Draw the ray OE passing through C.

Then $\angle$EOA = 60°.

6. Draw the ray OF passing through D.

Then $\angle$FOE =60°.

7. Next, taking C and D as centres and with the radius more than $\frac{1}{2}$ CD, draw arcs to intersect each other, say at G.
8. Draw the ray OG intersecting the arc drawn in step 1 at H. This ray OG is the bisector of the angle FOE, i.e., $\angle$FOG = $\angle$EOG = $\frac{1}{2}$ $\angle$ FOE = $\frac{1}{2}$ $(60^\circ) = 30^\circ$.

Thus, $\angle$GOA = $\angle$GOE + $\angle$EOA = 30° + 60° = 90°.

$\therefore$ $\angle$B'OH = 90°.

9. Next, taking B' and H as centres and with the radius more than . $\frac{1}{2}$ B'H, draw arcs to intersect each other, say at I.
10. Draw the ray 01. This ray 01 is the bisector of the angle B'OG, i.e., $\angle$B'0I = $\angle$G0I=$\frac{1}{2}$ $\angle$B'OG = $\frac{1}{2}$ (90°) = 45°.

Thus, $\angle$IOA = $\angle$I0G + $\angle$GOA = 45° + 90° = 135°.

On measuring the $\angle$I0A by protractor, we find that $\angle$IOA = 135°.

Thus the construction is verified.

Question-5

Construct an equilateral triangle, given its side and justify the Construction.

Solution:

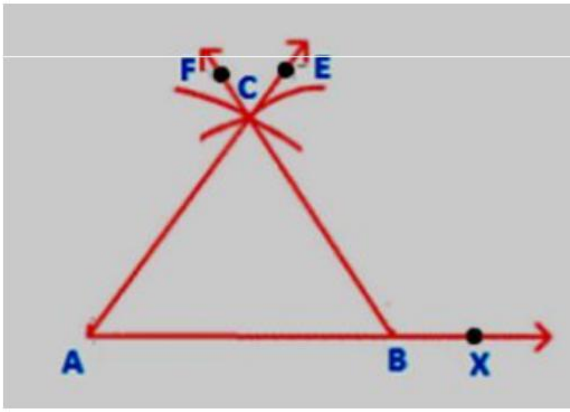
Given: Side (say 6 cm) of an equilateral triangle .

Required: To construct the equilateral triangle and justify the construction.

Steps of Construction:

1. Take a ray AX with initial point A.
2. Taking A as centre and radius (= 6 cm), draw an arc of a circle, which intersects AX, say at a point B.

2. Taking A as centre and radius (= 6 cm), draw an arc of a circle, which intersects AX, say at a point B.



3. Taking B as centre and with the same radius as before, draw an arc intersecting the previously drawn arc, say at a point C.
4. Join AC and BC.

Justification:

AB = BC | By construction

AB = AC | By construction

∴ AB = BC = CA

∴ Δ ABC is an equilateral triangle.

∴ The construction is justified.

In countries like USA and Canada, temperature is measured in Fahrenheit, Whereas in countries like India. It is measured in Celsius. Here is a linear equation that converts Fahrenheit to Celsius

$F = \left(\frac{9}{5}\right) C + 32$

Is there a temperature which is numerically the same in both Fahrenheit and Celsius? If yes, find it?

Solution:-

Let the temperature be x numerically .Then,

$F = \left(\frac{9}{5}\right) C + 32$

$\Rightarrow\ x = \left(\frac{9}{5}\right) x + 32$

$\Rightarrow \left(\frac{9}{5}\right) x - x = -32$

$\Rightarrow\ x = -\frac{32X5}{4}$

$\Rightarrow\ \left(\frac{4}{5}\right) x = -32$

$\Rightarrow\ x = \frac{-32X5}{4}$

$\Rightarrow$ x=-40

∴ Numerical value of required temperature=-40