Chapter 11 : Lines and Angles

ANSWER KEYS

EXERCISE 11.1

1. Since, the measures of two complementary angles add up to 90°, and the measures of two supplementary angles add up to 180°. Therefore,

(*i*) Complementary angle of 26° = (90° – 26°)
= 64°

Supplementary angle of 26° = (180° – 26°)
= 154°

(*ii*) Complementary angle of 62° = (90° – 62°)
= 28°

Supplementary angle of 62° = (180° – 62°)
= 118°

(*iii*) Complementary angle of 9° = (90° – 9°)
= 81°

Supplementary angle of 9° = (180° – 9°)
= 171°

(*iv*) Complementary angle of 51° = (90° – 51°)
= 39°

Supplementary angle of 51° = (180° – 51°)
= 129°

(*v*) Complementary angle of 37° = (90° – 37°)
= 53°

Supplementary angle of 37° = (180° – 37°)
= 143°

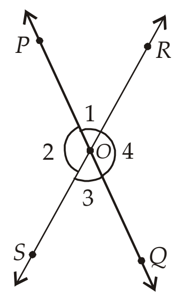
2. (*i*) The complement of 72° = (90° – 72°)
= 18°

(*ii*) The complement of 19° = (90° – 19°)
= 71°

(*iii*) The complement of 88° = (90° – 88°)
= 2°

(*iv*) The complement of 25° = (90° – 25°)
= 65°

3. Since, *PQ* is a straight line and *OR* stands on it. Therefore, ∠1 and ∠4 form a linear pair of angles.



$\therefore \quad \angle 1 + \angle 4 = 180°$

$\therefore \quad 53° + \angle 4 = 180° \qquad (\because \angle 1 = 53°)$

$\Rightarrow \quad \angle 4 = 180° - 53° = 127°.$

Since, ∠1 and ∠3 are vertically opposite angles.

$\therefore \quad \angle 1 = \angle 3$

$\Rightarrow \quad 53° = \angle 3$

$\Rightarrow \quad \angle 3 = 53°$

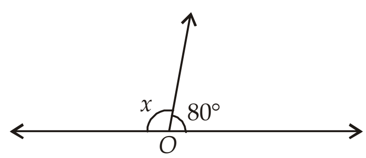
Also, ∠2 and ∠4 are vertically opposite angles.

$\angle 2 = \angle 4$

$\Rightarrow \quad \angle 2 = 127°$

Hence, ∠2 = 127°, ∠3 = 53°, ∠4 = 127°.

4. (*i*)

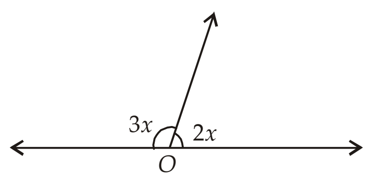


$\because \quad x + 80° = 180° \qquad$ (Linear pair of angles)

$\Rightarrow \quad x = 180° - 80°$

$\Rightarrow \quad \boxed{x = 100°}$

(*ii*)



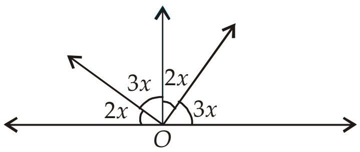
$\because \quad 3x + 2x = 180° \qquad$ (Linear pair of angles)

$\Rightarrow \quad 5x = 180°$

$$\Rightarrow \qquad x = \frac{180^\circ}{5} = 36^\circ$$

$$\Rightarrow \qquad \boxed{x = 36^\circ}$$

(*iii*)



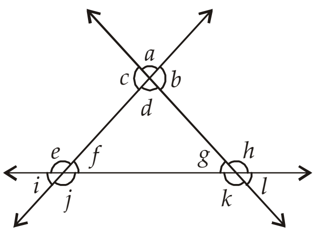
$2x + 3x + 2x + 3x = 180^\circ$ (Linear pair of angles)

$$\Rightarrow \qquad 10x = 180^\circ$$

$$\Rightarrow \qquad x = \frac{180^\circ}{10} = 18^\circ$$

$$\Rightarrow \qquad \boxed{x = 18^\circ}$$

5.



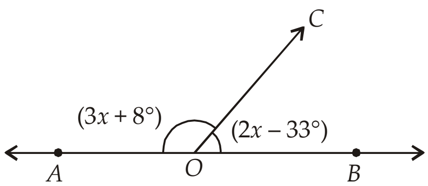
Linear pair of angles:

(a, c), (c, d), (d, b), (a, b), (e, f), (i, e), (i, j), (j, f), (g, h), (g, k), (k, l), (l, h)

Pair of vertically opposite angles:

(a, d), (c, b), (e, j), (i, f), (g, l), (h, k)

6.



If AOB is a straight line, then

$\angle AOC + \angle BOC = 180^\circ$

$$\Rightarrow \quad (3x + 8^\circ) + (2x - 33^\circ) = 18^\circ$$

$$\Rightarrow \quad 5x - 25^\circ = 180^\circ$$

$$\Rightarrow \quad 5x = 180^\circ + 25^\circ$$

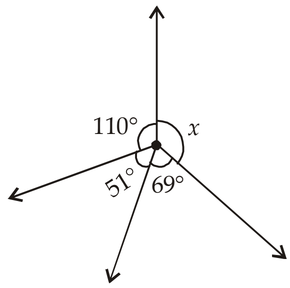
$$\Rightarrow \quad 5x = 205^\circ$$

$$\Rightarrow \quad x = \frac{205^\circ}{5}$$

$$\Rightarrow \quad x = 41^\circ$$

Hence, $x = 41^\circ$ will make AOB a straight line.

7.



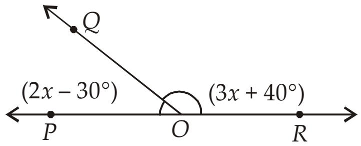
$\because \quad 110^\circ + 51^\circ + 69^\circ + x = 360^\circ$ (Complete angle)

$$\Rightarrow \quad x = 360^\circ - 230^\circ$$

$$\Rightarrow \quad x = 130^\circ$$

Hence, the value of x is 130°.

8. $\because$ Ray OQ stands on a straight line POR.



Therefore,

$\angle POQ + \angle ROQ = 180^\circ$ (Linear pair of angles)

$$\Rightarrow \quad (2x - 30^\circ) + (3x + 40^\circ) = 180^\circ$$

$$\Rightarrow \quad 5x + 10^\circ = 180^\circ$$

$$\Rightarrow \quad 5x = 180^\circ - 10^\circ$$

$$\Rightarrow \quad 5x = 170^\circ$$

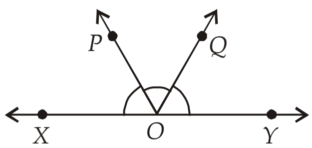
$$\Rightarrow \quad x = \frac{170^\circ}{5}$$

$$\Rightarrow \quad x = 34^\circ$$

Hence, $\angle POQ = (2 \times 34^\circ - 30^\circ) = 38^\circ$

$\angle ROQ = (3 \times 34^\circ + 40^\circ) = 142^\circ$

9. $\because$ XOY is a straight line and ray OP and ray OQ stand on it.



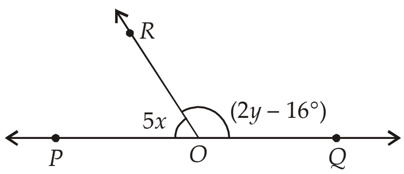
Then, pair of adjacent angles:

($\angle XOP$, $\angle POQ$), ($\angle POQ$, $\angle QOY$)

($\angle XOP$, $\angle POY$), ($\angle XOQ$, $\angle QOY$)

Linear pair: ($\angle XOP$, $\angle POY$), ($\angle XOQ$, $\angle QOY$)

10. Since, OP and OQ are opposite rays and ray OR stands on PQ.



Therefore,

$$\angle POR + \angle QOR = 180° \quad \text{(Linear pair)}$$

$\Rightarrow$ $5x + (2y - 16°) = 180°$

$\Rightarrow$ $5x + 2y = 180° + 16°$

$\Rightarrow$ $5x + 2y = 196°$ ...(1)

(*i*) If $y = 73°$, then from (1), we get

$5x + 2 \times 73° = 196°$

$\Rightarrow$ $5x + 146° = 196°$

$\Rightarrow$ $5x = 196° - 146°$

$\Rightarrow$ $5x = 50°$

$\Rightarrow$ $x = \dfrac{50°}{5}$

$\Rightarrow$ $\boxed{x = 10°}$

(*ii*) If $x = 14°$, then from (1), we get

$(5 \times 14°) + 2y = 196°$

$\Rightarrow$ $70° + 2y = 196°$

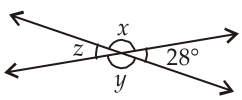
$\Rightarrow$ $2y = 196° - 70°$

$\Rightarrow$ $2y = 126°$

$\Rightarrow$ $y = \dfrac{126°}{2} = 63°$

$\Rightarrow$ $\boxed{y = 63°}$

11.



$\because$ $x + 28° = 180°$ (Linear pair of angles)

$\Rightarrow$ $x = 180° - 28°$

$\boxed{x = 152°}$

$\because$ $x = y$ (Vertically opposite angles)

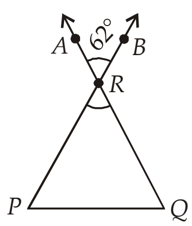
$\Rightarrow$ $\boxed{y = 152°}$ ($\because$ $x = 152°$)

Also, angles z and 28° are vertically opposite angles.

$\therefore$ $\boxed{z = 28°}$

12. Since, in ΔPQR, sides PR and QR are extended to B and A respectively.

Therefore,



$\angle PRQ = \angle ARB$ (Vertically opposite angles)

$\angle PRQ = 62°$ ($\because$ $\angle ARB = 62°$)

$\because$ Ray RB stands on AQ. Then

$\angle ARB + \angle BRQ = 180°$ ($\because$ Linear pair of angles)

$\Rightarrow$ $62° + \angle BRQ = 180°$

$\Rightarrow$ $\angle BRQ = 180° - 62°$

$\angle BRQ = 180°$

Hence, $\angle PRQ = 62°$ and $\angle BRQ = 118°$.

EXERCISE 11.2

1. $\because$ $l \parallel m$ and n is a transversal.

$\angle a = \angle c$ (Vertically opposite angles)

$\Rightarrow$ $\boxed{\angle a = 72°}$ ($\because$ $\angle c = 72°$)

Now, $\angle a = \angle f$ (Corresponding angles)

$\therefore$ $72° = \angle f$

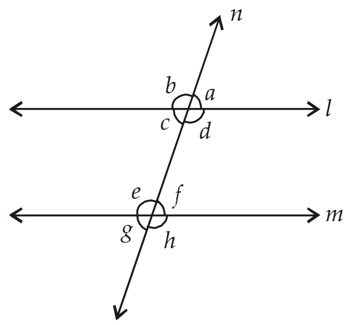
or $\boxed{\angle f = 72°}$

$\Rightarrow$ $\angle f + \angle d = 180°$ (Pair of interior angles)

$\Rightarrow$ $72° + \angle d = 180°$

$\therefore$ $\angle d = 180° - 72°$

$\Rightarrow$ $\boxed{\angle d = 108°}$



$\because$ $\angle e = \angle d$ (Alternate interior angles)

$\Rightarrow$ $\boxed{\angle e = 108°}$ ($\because$ $\angle d = 108°$)

$\because$ $\angle h = \angle e$ (Vertically opposite angles)

$\Rightarrow$ $\boxed{\angle h = 108°}$

$\because$ $\angle f = \angle g$ (Vertically opposite angles)

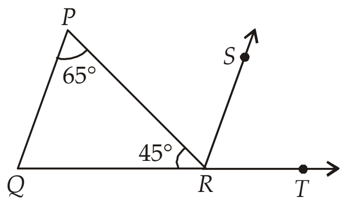
$\Rightarrow$ $\boxed{\angle g = 72°}$ ($\because$ $\angle f = 72°$)

and $\angle d = \angle b$ (Vertically opposite angles)

$\Rightarrow$ $\boxed{\angle b = 108°}$ ($\because$ $\angle d = 108°$)

Hence, $\angle a = 72°$, $\angle b = 108°$, $\angle d = 108°$, $\angle e = 108°$, $\angle f = 72°$, $\angle g = 72°$, $\angle h = 108°$.

2. $\because$ $QP \parallel RS$



$\therefore$ $\angle QPR = \angle PRS$ (Alternate angles)

$\Rightarrow$ $\angle PRS = 65°$ ($\because$ $QPR = 65°$) ...(i)

Now, $\angle PRQ + \angle PRS + \angle SRT = 180°$ (Linear pair)

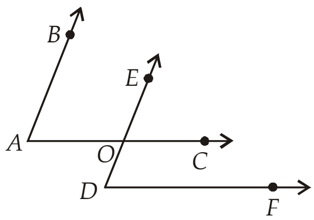
$\Rightarrow$ $45° + 65° + \angle SRT = 180°$

[$\because$ $PRQ = 45°$, and using (i)]

$\Rightarrow$ $\angle SRT = 180° - 110°$

$\Rightarrow$ $\boxed{\angle SRT = 70°}$

3.



$\because$ $AB \parallel DE$, AC is a transversal.

$\therefore$ $\angle BAO = \angle EOC$

(Corresponding angles)...(i)

and $AC \parallel DF$ and DE is a transversal.

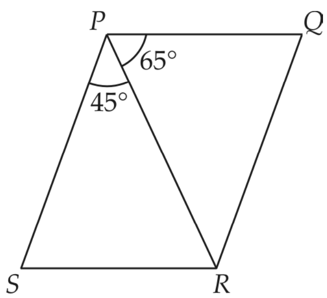
$\therefore$ $\angle EOC = \angle EDF$

(Corresponding angles)...(ii)

From (i) and (ii), we get,

$\angle BAC = \angle EDF$ (Hence proved)

4. Since, $PQ \parallel SR$ and PR is a transversal. Therefore,



$\angle SRP = \angle QPR$ (Alternate angles)

$\Rightarrow$ $\angle SRP = 65°$ ($\because$ $\angle QPR = 65°$)

Again, $PS \parallel QR$ and PR is a transversal.

$\angle SRP = \angle QRP$ (Alternate angles)

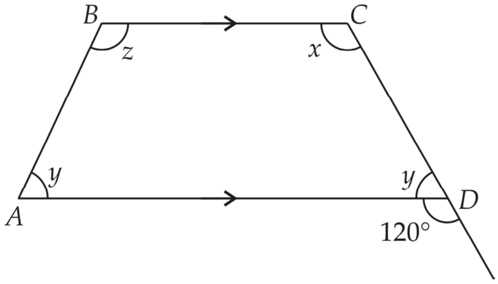
Therefore, $\angle QRP = 45°$ ($\because$ $\angle SPR = 45°$)

Now, $\angle SRQ = \angle SRP + \angle QRP$

$= 65° + 45°$

$\boxed{\angle SRQ = 110°}$

5.



$\because$ $\angle y + 120° = 180°$ (Linear pair of angles)

$\Rightarrow$ $\angle y = 180° - 120°$

$\boxed{\angle y = 60°}$

Since, $BC \parallel AD$ and CD is a transversal.

Therefore, $\angle x + \angle y = 180°$ (Pair of interior angles)

$\Rightarrow$ $\angle x = 180° - 60°$ ($\because$ $y = 60°$)

$\boxed{\angle x = 120°}$

Again, $BC \parallel AD$ and BA is a transversal. Then,

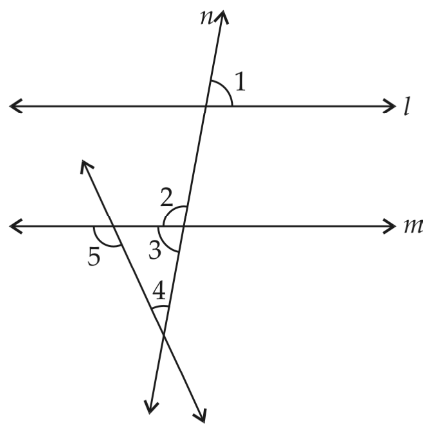
$\angle y + \angle z = 180°$ (Interior angles)

$\angle z = 180° - 60°$ ($\because$ $y = 60°$)

$\boxed{\angle z = 120°}$

Hence, $x = 120°$, $y = 60°$ and $z = 120°$.

6.



$\because$ $l \parallel m$ and n is a transversal.

$\therefore$ $\angle 1 = \angle 3$ (Alternate exterior angles)

$\Rightarrow$ $\boxed{\angle 3 = 80°}$ [$\because$ $\angle 1 = 80°$ (given)]

$\angle 2 + \angle 3 = 180°$ (Linear pair of angles)

$\Rightarrow$ $\angle 2 + 80° = 180°$

$\Rightarrow$ $\angle 2 = 180° - 80°$

$\boxed{\angle 2 = 100°}$

Now, $\angle 3 + \angle 4 = \angle 5$

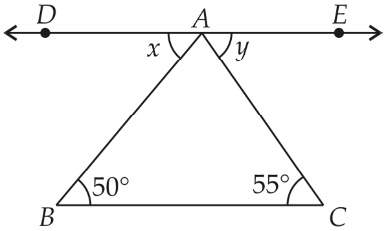
$\Rightarrow$ $\angle 4 = \angle 5 - \angle 3$

$\Rightarrow$ $\angle 4 = 100° - 80°$ [$\because$ $\angle 5 = 100°$ (given)]

$\boxed{\angle 4 = 20°}$

Hence, $\angle 2 = 100°$, $\angle 3 = 80°$, $\angle 4 = 20°$.

7. Since, $DE \parallel BC$ and AB is a transversal.



$\therefore$ $\angle DAB = \angle ABC$ (Alternate interior angles)

$\Rightarrow$ $\boxed{x = 50°}$ ($\because$ $\angle ABC = 50°$)

Again, $DE \parallel BC$ and AC is a transversal. Then,

$\angle EAC = \angle ACB$ (Alternate angles)

$\Rightarrow$ $\boxed{y = 55°}$ ($\because$ $\angle ACB = 55°$)

Hence, $x = 50°$ and $y = 55°$.

8. $\because$ $PQ \parallel RS$ and LM is a transversal.

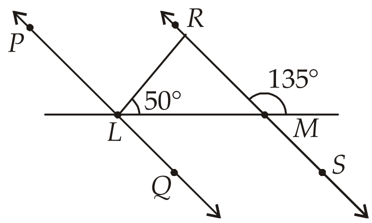
$\because$ $\angle SML = 135°$ (Vertically opposite angles)

$\therefore$ $\angle SML + \angle MLQ = 180°$ (Interior angles)

$\angle MLQ = 180° - 135°$

$\angle MLQ = 45°$

$\because$ LR is a transversal to PQ and RS.



Then,

$\angle LRM + \angle RLQ = 180°$ (Pair of interior angles)

$\Rightarrow$ $\angle LRM + (\angle RLM + \angle MLQ) = 180°$

$\Rightarrow$ $\angle LRM + (50° + 45°) = 180°$

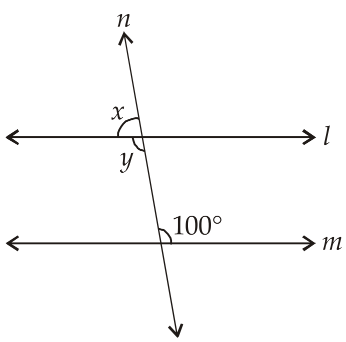
($\because$ $\angle RLM = 50°$)

$\Rightarrow$ $\angle LRM = 180° - 95°$

$\Rightarrow$ $\angle LRM = 85°$

Hence, $\boxed{\angle LRM = 85°}$

9. (*i*) $\because$ $l \parallel m$ and n is a transversal.



$\therefore$ $\angle y = 100°$ (Alternate interior angles)

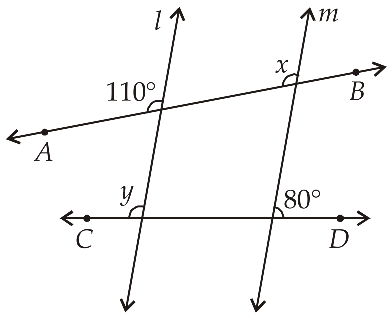
and $\angle x + \angle y = 180°$ (Linear pair of angles)

$\Rightarrow$ $\angle x = 180° - 100°$ ($\because$ $\angle y = 100°$)

$\Rightarrow$ $\angle x = 80°$

Hence, $\angle x = 80°$ and $\angle y = 100°$.

(*ii*) $\because$ $l \parallel m$ and AB is a transversal.



Then, $\angle x = 110°$

(Corresponding exterior angles)

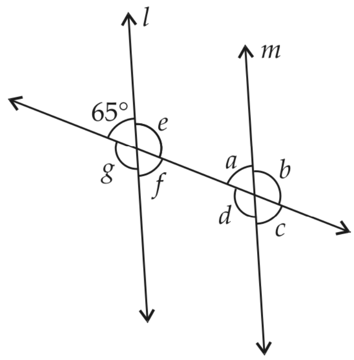
Also, $l \parallel m$ and CD is a transversal.

Then $\angle y = (180° - 80°)$

$\angle y = 100°$

Hence, $\angle x = 110°$ and $\angle y = 100°$.

10.



$\because$ $l \parallel m$

Then $\angle f = 65°$ ($\because$ Vertically opposite angles)

$\therefore$ $\angle a = \angle f = 65°$ ($\because$ Alternate interior angles)

$\because$ $\angle a + \angle e = 180°$ (Pair of interior angles)

$\Rightarrow$ $\angle e = 180° - 65°$

$\Rightarrow$ $\angle e = 115°$

$\because$ $\angle e = \angle g$ (Vertically opposite angles)

$\Rightarrow$ $\angle g = 115°$

$\because$ $\angle e = \angle d$ (Alternate angles)

$\Rightarrow$ $\angle d = 115°$

$\because$ $\angle d = \angle b$ (Vertically opposite angles)

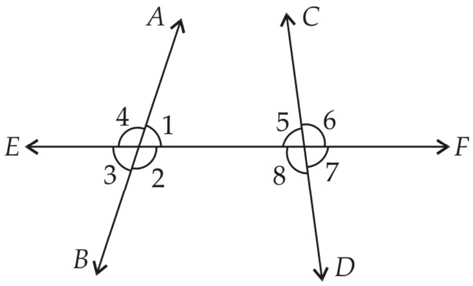
$\Rightarrow$ $\angle b = 115°$

and $\angle c = \angle a$ (Vertically opposite angles)

$\Rightarrow$ $\angle c = 65°$

Hence, $\angle a = 65°$, $\angle b = 115°$, $\angle c = 65°$, $\angle d = 115°$, $\angle e = 115°$, $\angle f = 65°$, $\angle g = 115°$.

11.



(*i*) Corresponding angles: (4, 5), (1, 6), (3, 8), (2, 7)

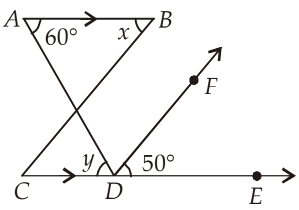
(*ii*) Alternate interior angles: (1, 8), (2, 5)

(*iii*) Alternate angle of $\angle 2$ is $\angle 5$.

(*iv*) Angle corresponding to $\angle 7$ is $\angle 2$.

(*v*) Pairs of interior angles on the same side of the transversal: (1, 5) and (2, 8).

12.



$\because$ $AB \parallel CE$ and BC is a transversal.

$\therefore$ $\angle y = 60°$ (Alternate angles)

Now, $BC \parallel DF$ and CE is a transversal.

$\angle BCE = \angle FDE = 50°$ (Corresponding angles)

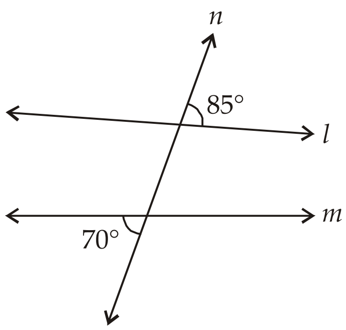
$\angle x = \angle BCE$

($\because$ $AB \parallel CB$ and BC is a transversal)

$\angle x = 50°$

Hence, $\angle x = 50°$ and $\angle y = 60°$.

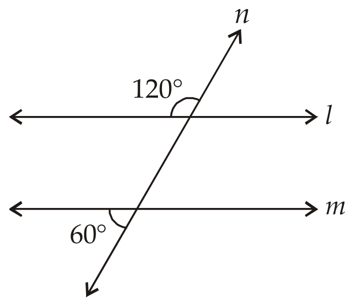
13. (*i*) If $l \parallel m$ and n is a transversal. Then, alternate exterior angles are equal.



But, here alternate angles $\angle 70° \neq \angle 85°$.

So, l is not parallel to m.

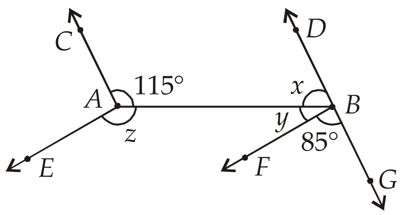
(*ii*) If the sum of the exterior angles on the same side of a transversal is 180°, then both lines are parallel.



Here, $120° + 60° = 180°$.

Hence, $l \parallel m$.

14. $\because$ $AC \parallel BD$ and AB is a transversal.



$\therefore$ $x + 115° = 180°$ (Pair of interior angles)

$\Rightarrow$ $x = 180° - 115°$

$\Rightarrow$ $x = 65°$ ...(*i*)

Now,

$\angle ABD + \angle ABF + \angle FBG = 180°$

(Linear pair of angles)

$\Rightarrow$ $x + y + 85° = 180°$

$\Rightarrow$ $65° + y + 85° = 180°$ [from (*i*)]

$\Rightarrow$ $y = 180° - 150°$

$\Rightarrow$ $y = 30°$ ...(*ii*)

$\because$ $AE \parallel BF$ and AB is a transversal.

$\therefore$ $\angle EAB + \angle ABF = 180°$ (Interior angles)

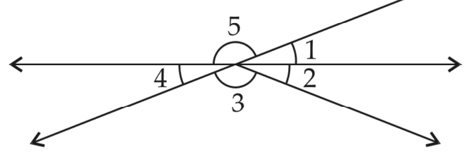
$\Rightarrow$ $z + y = 180°$

$\Rightarrow$ $z = 180° - 30°$ [from (*ii*)]

$\Rightarrow$ $z = 150°$

Hence, $x = 65°$, $y = 30°$ and $z = 150°$.

15.



(*i*) Linear pair of angles (1, 5), (4, 5)

(*ii*) Vertically opposite angles (4, 1)

MULTIPLE CHOICE QUESTIONS

1. When two lines intersect at a point, then 4 pairs of adjacent angles are formed.

Hence, option (*a*) is correct.

2. The complement of 36° = (90° – 36°) = 54°

Hence, option (*b*) is correct.

3. The supplement of 68° = (180° – 68°) = 112°

Hence, option (*d*) is correct.

4. Supplement of 70° = (180° – 70°) = 110°

∵ The measure of two complementary any angles add upto 90°.

∵ It is not possible to have a complement of 110°.

Hence, option (*d*) is correct.

5. The complement of 26° = (90° – 26°)

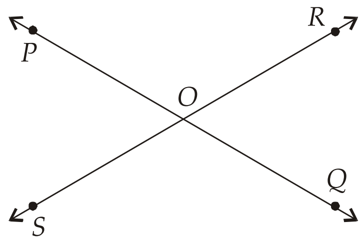
= 64°

Now, supplement of 64° = (180° – 64°)

= 116°

Hence, option (*c*) is correct.

6. Since, *PQ* and *RS* intersect at point *O*. Then,

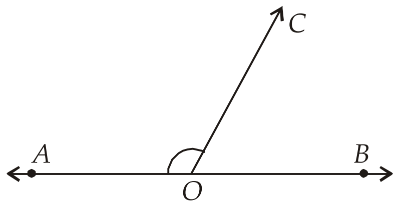


$\angle POS = \angle QOR$ (Vertically opposite angles)

$\Rightarrow \angle QOR = 45°$ ($\because \angle POS = 45°$)

Hence, option (*d*) is correct.

7. ∵ Ray *OC* stands on line *AOB*.



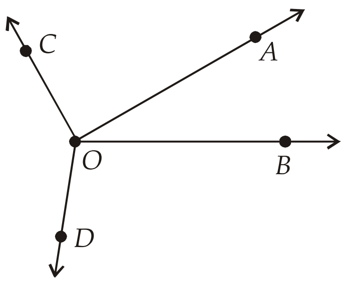
$\therefore \angle AOC + \angle BOC = 180°$ (∵ Linear pair of angles)

$\Rightarrow \angle BOC = 180° - 145° = 35°$

($\because \angle AOC = 145°$)

Hence, option (*c*) is correct.

8.



$\because \angle AOC + \angle AOB + \angle BOD + \angle COD = 360°$

$90° + 30° + 100° + x = 360°$

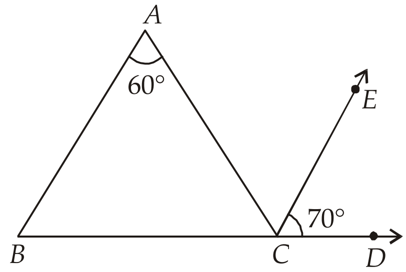
$\Rightarrow 220° + x = 360°$

$\Rightarrow x = 360° - 220°$

$\Rightarrow x = 140°$

Hence, option (*b*) is correct.

9.



∵ *AB* ∥ *EC* and *BC* is a transversal.

$\therefore \angle BAC = \angle ACE$ (Alternate angles)

$\Rightarrow \angle ACE = 60°$ ($\because \angle BAC = 60°$)

Now, $\angle ACB + \angle ACE + \angle ECD = 180°$

(Linear pair of angles)

$\Rightarrow \angle ACB + 60° + 70° = 180°$

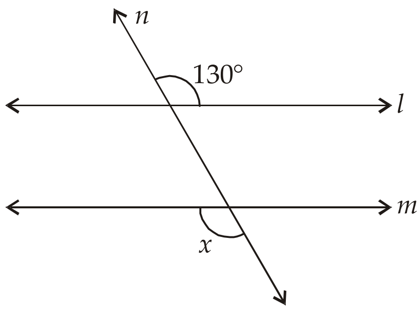
$\Rightarrow \angle ACB = 180° - (60° + 70°)$

$\angle ACB = 180° - 130°$

$\angle ACB = 50°$

Hence, option (*a*) is correct.

10. ∵ *l* ∥ *m* and let *n* be a transversal.



$\therefore \angle x = 130°$ (Alternate exterior angles)

Hence, option (*b*) is correct.

11. Let the complementary be *x*. Then the angle is 5*x*. Then,

$\therefore 5x + x = 90°$

$\Rightarrow 6x = 90°$

$\Rightarrow x = \frac{90°}{6}$

$\Rightarrow x = 15°$

The required angle is 5 × 15° = 75°

Hence, option (*c*) is correct.

12. Two angles can be supplementary, if both of them are right angles.

Hence, option (*c*) is correct.

MENTAL MATHS CORNER

Fill in the blanks:

1. If two angles of a linear pair are equal, then measure of each angle is **90°**.

   Let the equal angels of linear pair be x.

   $\because \quad x + x = 180°$

   $\Rightarrow \quad 2x = 180°$

   $\Rightarrow \quad x = 90°$.

2. If the magnitude of an angle is same as its complement, then measure of the angle is **45°**.

3. If the magnitude of an angle is same as its supplement, then the angle is **90°**.

4. Two angles are such that one of the angles is $\frac{4}{5}$ of its supplement, then the angle is **80°** and its supplement is **100°**.

   Let the supplementary angle be x.

   Then, required angle is $\frac{4}{5}x$.

   $\therefore \quad x + \frac{4}{5}x = 180°$

   $\Rightarrow \quad \frac{9x}{5} = 180°$

   $\Rightarrow \quad 9x = 180° \times 5$

   $\Rightarrow \quad x = \frac{180° \times 5}{9} = 100°$

   $\text{Angle} = \frac{4}{5} \times 100° = 80°.$

5. Two angles forming a linear pair are **supplementary**.

6. If two adjacent angles are supplementary, they form a **linear pair**.

7. If two lines intersect at a point, then the **vertically opposite angles** are always equal.

8. An angle is greater than 45°, then its complementary angle is **less** than 45°.

9. An angle is $\frac{2}{3}$ of its complement, then the angle is **36°** and its complement is **54°**.

   Let the complementary angle be x.

   Then, the angle is $\frac{2}{3}x$.

   $\therefore \quad x + \frac{2}{3}x = 90°$

   $\Rightarrow \quad \frac{5x}{3} = 90°$

   $\Rightarrow \quad x = \frac{90° \times 3}{5} = 54°$

   $\text{Angle} = \frac{2}{3} \times 54° = 36°.$

10. The ratio of two angles of a linear pair is 2 : 3. Then the angles are **72°** and **108°**.

    Let the two angles of a linear pair be $2x$ and $3x$.

    Then,

    $2x + 3x = 180°$

    $\Rightarrow \quad 5x = 180°$

    $\Rightarrow \quad x = \frac{180°}{5}$

    $\Rightarrow \quad x = 36°$

    Hence, angles are 72° and 108°.

11. The difference between the measures of two angles of a linear pair is 80°, then the smallest angle is **50°**.

    Let the smallest angle of linear pair be x.

    Then, other angle = $(80° + x)$

    Therefore,

    $x + (80° + x) = 180°$

    $\Rightarrow \quad 2x + 80° = 180°$

    $\Rightarrow \quad 2x = 180° - 80°$

    $\Rightarrow \quad 2x = 100°$

    $\Rightarrow \quad x = \frac{100°}{2}$

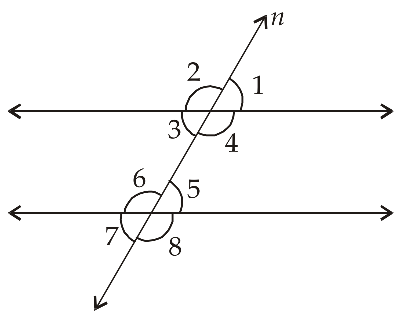
    $\Rightarrow \quad x = 50°$

    Thus, the smallest angle of linear pair is 50°.

12. The supplement of 180° is **0°**.

REVIEW EXERCISE

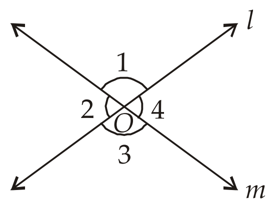
1.



   (*i*) Linear pair: (1, 2), (2, 3), (3, 4), (1, 4), (6, 5), (6, 7), (7, 8), (5, 8).

   (*ii*) Pairs of vertically opposite angles: (2, 4), (3, 1), (6, 8), (5, 7).

2. $\because$ line l and line m intersect at point O. Therefore,



$\therefore \quad \angle 2 = \angle 4$ (Vertically opposite angles)

$\Rightarrow \quad \angle 2 = 70°$ ($\because \angle 4 = 70°$)

Also, $\angle 1 + \angle 2 = 180°$ (Linear pair of angles)

$\Rightarrow \quad \angle 1 + 70° = 180°$

$\Rightarrow \quad \angle 1 = 180° - 70°$

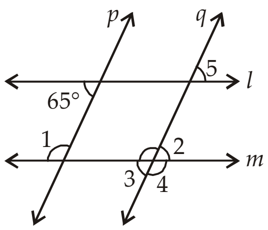
$\Rightarrow \quad \angle 1 = 110°$

and $\quad \angle 1 = \angle 3$ (Vertically opposite angles)

$\Rightarrow \quad \angle 3 = 110°$ ($\because \angle 1 = 110°$)

Hence, $\angle 1 = 110°$, $\angle 2 = 70°$, $\angle 3 = 110°$.

3.



$\because \quad l \parallel m$ and p is a transversal.

$\therefore \quad \angle 1 + 65° = 180°$ (Pair of interior angles)

$\Rightarrow \quad \angle 1 = 180° - 65° = 115°$

$\Rightarrow \quad \angle 1 = 115°$

$\because \quad p \parallel q$ and l is a transversal. Then

$\angle 5 = \angle 65°$ (Alternate exterior angles)

And, $l \parallel m$ and q is a transversal. Then,

$\angle 5 = \angle 2$ (Corresponding angles)

$\Rightarrow \quad \angle 2 = 65°$

Now, $\quad \angle 2 = \angle 3$ (Vertically opposite angles)

$\Rightarrow \quad \angle 3 = 65°$

Also, $\angle 3 + \angle 4 = 180°$ (Linear pair of angles)

$\Rightarrow \quad 65° + \angle 4 = 180°$

$\Rightarrow \quad \angle 4 = 180° - 65°$

$\Rightarrow \quad \angle 4 = 115°$

Hence, $\angle 1 = 115°$, $\angle 2 = 65°$, $\angle 3 = 65°$, $\angle 4 = 115°$, $\angle 5 = 65°$.

4. (*i*) No,

(*ii*) $\because \quad 115° + 65° = 180°$ (Pair of interior angles)

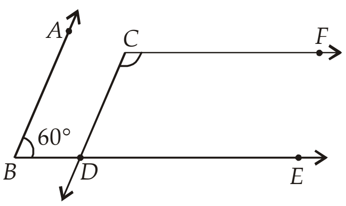
Hence, $l \parallel m$.

(*iii*) If two lines are parallel, then sum of alternate exterior angles is 180°.

$\therefore \quad 121° + 59° = 180°$

Hence, $l \parallel m$.

5.



$\because \quad AB \parallel CD$ and BE is a transversal. Then

$\angle ABD = \angle CDE$ (Corresponding angles)

$\Rightarrow \quad \angle CDE = 60°$ ($\because \angle ABD = 60°$)

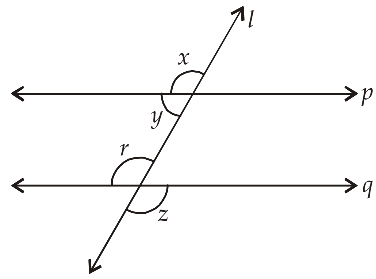
Now, $CF \parallel BE$ and CD is a transversal. Then

$\angle FCD + \angle CDE = 180°$ (Interior angles)

$\Rightarrow \quad \angle FCD = 180° - 60°$ ($\because \angle CDE = 60°$)

$\Rightarrow \quad \angle FCD = 120°$

6. $\because \quad p \parallel q$ and l is a transversal. Then



$\because \quad \angle r = \angle z$ (Vertically opposite angles)

$\Rightarrow \quad \angle r = 110°$ ($\because \angle z = 110°$)

$\therefore \quad \angle x = \angle r$ (Corresponding angles)

$\Rightarrow \quad \angle x = 110°$ ($\because \angle r = 110°$)

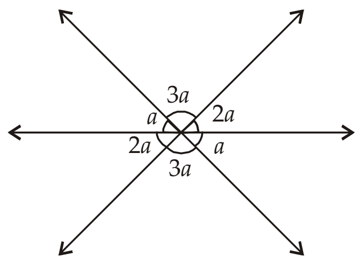
and $\quad \angle y + \angle r = 180°$ (Pair of interior angles)

$\Rightarrow \quad \angle y = 180° - 110°$

$\Rightarrow \quad \angle y = 70°$

Hence, $\quad \angle x = 110°$, $\angle y = 70°$ and $\angle r = 110°$.

7.



Since, vertically opposite angles are equal

$\because \quad a + 3a + 2a + a + 3a + 2a = 360°$ (Complete angle)

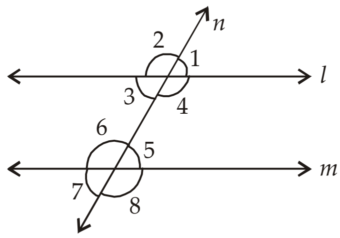
$\Rightarrow \quad 12a = 360°$

$$\Rightarrow \quad a = \frac{360°}{12}$$

$$\Rightarrow \quad \boxed{a = 30°}$$

8. Let $\angle 1$ and $\angle 2$ be $2x$ and $3x$ respectively.

$\therefore \quad l \parallel m$ and n is a transversal.



$\therefore \quad \angle 1 + \angle 2 = 180°$ (Linear pair of angles)

$2x + 3x = 180°$

$\Rightarrow \quad 5x = 180°$

$\Rightarrow \qquad x = \frac{180°}{5} = 36°$

$\therefore \quad \angle 1 = 2 \times 36° = 72°$ and $\angle 2 = 3 \times 36° = 108°$

Then,

$\angle 1 = \angle 5$ (Corresponding angles)

$\Rightarrow \quad \boxed{\angle 5 = 72°}$ $(\because \angle 1 = 72°)$

$\angle 2 = \angle 4$ (Vertically opposite angles)

$\Rightarrow \quad \boxed{\angle 4 = 108°}$ $(\because \angle 2 = 108°)$

$\angle 3 = \angle 1$ (Vertically opposite angles)

$\Rightarrow \quad \boxed{\angle 3 = 72°}$

$\angle 4 = \angle 6$ (Alternate interior angles)

$\Rightarrow \quad \boxed{\angle 6 = 108°}$

$\angle 8 = \angle 6$ (Vertically opposite angles)

$\Rightarrow \quad \boxed{\angle 8 = 108°}$

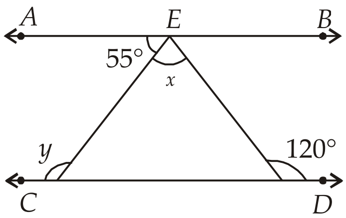
$\angle 7 = \angle 5$ (Vertically opposite angles)

$\Rightarrow \quad \boxed{\angle 7 = 72°}$

Hence, $\angle 3 = 72°$, $\angle 4 = 108°$, $\angle 5 = 72°$, $\angle 6 = 108°$, $\angle 7 = 72°$, $\angle 8 = 108°$.

HOT QUESTIONS

1. $\because \quad AB \parallel CD,$



Then, $\quad 55° + \angle y = 180°$ (Pair of interior angles)

$\Rightarrow \quad \angle y = 180° - 55°$

$y = 125°$

and $\angle BED + 120° = 180°$ (Pair of interior angles)

$\Rightarrow \quad \angle BED = 180° - 120°$

$\angle BED = 60°$

Now, $\angle AEC + \angle CED + \angle BED = 180°$

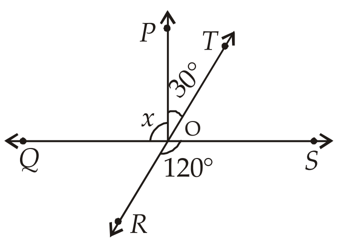
$\Rightarrow \quad 55° + x + 60° = 180°$

$\Rightarrow \quad x = 180° - 115°$

$\Rightarrow \quad x = 65°$

Hence, $\quad x = 65°, y = 125°.$

2. Line QS and TR intersect at point O.



Then, $\quad \angle QOT = \angle ROS$

$(\because$ Vertically opposite angles)

$\angle QOT = 120°$ $(\because \angle ROS = 120°)$

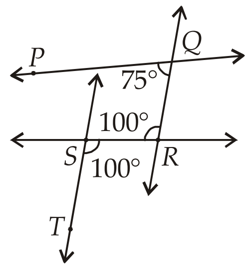
But, $\quad \angle QOT = \angle QOP + \angle POT$

$\Rightarrow \quad 120° = x + 30°$

$\Rightarrow \quad x + 30° = 120°$ $(\because \angle POT = 30°)$

$\Rightarrow \quad x = 120° - 30° = 90°$

3. Since, $\angle Q = 75°$ and $\angle R = 100°$ are interior angles for line PQ and RS.



$\therefore \quad 75° + 100° = 175° \neq 180°$

Thus, PQ is not parallel to SR.

Again, $\angle RST = 100°$ and $\angle SRQ = 100°$ are alternate angles for line ST and QR.

$\angle RST = \angle SRQ = 100°.$

Hence, $ST \parallel QR$.

Puzzle

Let the current time be 'T' (24-hour clock time)

Time after 2 hours = $(T + 2)$

Time after 1 hour = $(T + 1)$

Time at midnight = 24:00

According to question,

$$24 - (T + 2) = \frac{1}{2}[24 - (T + 1)]$$

$$\Rightarrow \quad 24 - T - 2 = \frac{1}{2}(24 - T - 1)$$

$$\Rightarrow \quad 22 - T = \frac{1}{2}(23 - T)$$

$$\Rightarrow \quad 44 - 2T = 23 - T$$

$$\Rightarrow \quad 2T - T = 44 - 23$$

$$\Rightarrow \quad T = 21$$

The current time is 21:00 hours or 9:00 p.m.

Thus, if it were two hours later [*i.e.*, 11 p.m.] from now, it would be half as long until midnight as it would be if it were an hour later (*i.e.*, 10 p.m.).