Chapter - 5
Lines and Angles

Exercise

In questions 1 to 41, there are four options out of which one is correct. Write the correct one.

1. The angles between North and West and South and East are
(a) complementary (b) supplementary (c) both are acute (d) both are obtuse

Solution:
As we know that the angle between North and West and South and East are right angle.
Therefore, the angles between North and West and South and East are supplementary because sum of both angles is $180°$.

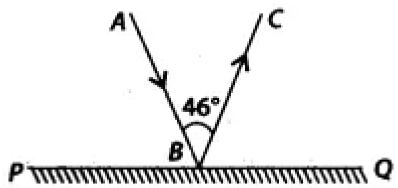
Hence, the correct option is (b).

2. Angles between South and West and South and East are
(a) vertically opposite angles (b) complementary angles
(c) making a linear pair (d) adjacent but not supplementary

Solution:
As we know that angles between South and West and South and East are right angle.
Therefore, angles between South and West and South and East are making a linear pair.

Hence, the correct option is (c).

3. In Fig. 5.9, PQ is a mirror, AB is the incident ray and BC is the reflected ray. If ∠ ABC = 46°, then ∠ ABP is equal to
(a) 44° (b) 67° (c) 13° (d) 62°



Solution:
As we know that angle of incident and angle of reflection is same.
So, $\angle ABP = \angle CBQ$ …(I)
As, PQ is a straight line.
So $\angle ABP + \angle ABC + \angle CBQ = 180°$
$\angle ABP + 46° + \angle ABP = 180°$ [Using equation (I)]
$2\angle ABP = 180° – 46° = 134$

$\angle ABP = \frac{134°}{2} = 67°$

Hence, the correct option is (b).

4. If the complement of an angle is 79°, then the angle will be of
(a) 1° (b) 11° (c) 79° (d) 101°

Solution:
Let the angle be x. Its complement will be 90° – x
Now, according to the question,
90°- x = 79°
x = 90° – 79°
x = 11°
Therefore, the required angle is 11°.

Hence, the correct option is (b).

5. Angles which are both supplementary and vertically opposite are
(a) 95°, 85° (b) 90°, 90° (c) 100°, 80° (d) 45°, 45°

Solution:
As we know that vertically opposite angles are equal.
So, let each angle be x.
x + x = 180° [∵Angles are supplementary]
2x = 180° ⇒ x = 90°
Therefore, the required angles are 90° each.

Hence, the correct option is (b).

6. The angle which makes a linear pair with an angle of 61° is of
(a) 29° (b) 61° (c) 122° (d) 119°

Solution:
Let the angle be x.
x + 61° = 180° [Because linear pair]
x = 180° – 61°
X = 119°
Therefore, the required angle is 119

Hence, the correct option is (d).

7. The angles x and 90° – x are
(a) supplementary (b) complementary (c) vertically opposite (d) making a linear pair

Solution:

Since, x + 90° – x = 90°
So, these angles are complementary.

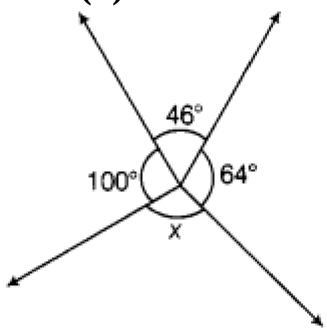
Hence, the correct option is (b).

8. The angles x – 10° and 190° – x are
(a) interior angles on the same side of the transversal
(b) making a linear pair
(c) complementary
(d) supplementary

Solution:
Since, x – 10° + 190° – x = 180°
So, these angles are supplementary.

Hence, the correct option is (d).

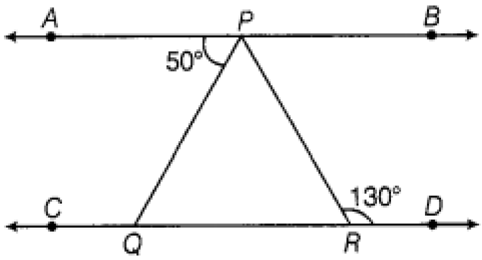
9. In Fig. 5.10, the value of x is
(a) 110° (b) 46° (c) 64° (d) 150°



Solution:
As we know that sum of the angles about a point is 360°
So, x + 64° + 46° +100° – 360°
x + 210° = 360°
x = 360°- 210°
x = 150°

Hence, the correct option is (d).

10. In Fig. 5.11, if AB || CD, ∠ APQ = 50° and ∠PRD = 130°, then ∠ QPR is
(a) 130° (b) 50° (c) 80° (d) 30°



Solution:

Given: AB || CD and PR is a transversal

Now, ∠APR = ∠PRD [Alternate interior angles]

So, ∠APR = 130°

∠APQ + ∠QPR = 130°

50° + ∠QPR – 130°

∠QPR = 130° – 50°

∠QPR = 80°

Hence, the correct option is (c).

11. In Fig. 5.12, lines l and m intersect each other at a point. Which of the following is false? (a) ∠a = ∠b (b) ∠d = ∠c (c) ∠a + ∠d = 180° (d) ∠a = ∠d

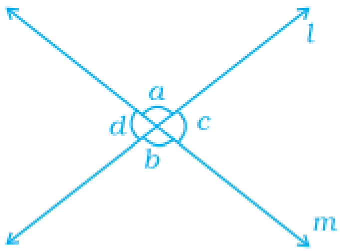


Fig. 5.12

Solution:

See the given figure in the question,

∠a = ∠b [Vertically opposite angles]

∠d = ∠c [Vertically opposite angles]

∠a + ∠d = 180° [Linear Pair]

But ∠a ≠ ∠d

Hence, the correct option is (d).

12. If angle P and angle Q are supplementary and the measure of angle P is 60°, then the measure of angle Q is

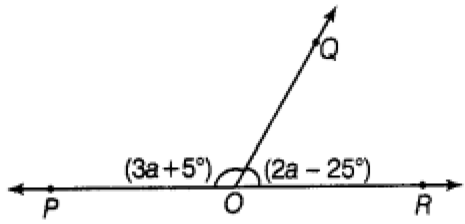
(a) 120° (b) 60° (c) 30° (d) 20°

Solution:

According to the question,
∠P + ∠Q = 180° [∠P and ∠Q are supplementary angles]
60° + 20 = 180°
∠Q = 180° – 60°
∠Q = 120°

Hence, the correct option is (a).

13. In Fig. 5.13, POR is a line. The value of a is
(a) 40° (b) 45° (c) 55° (d) 60°



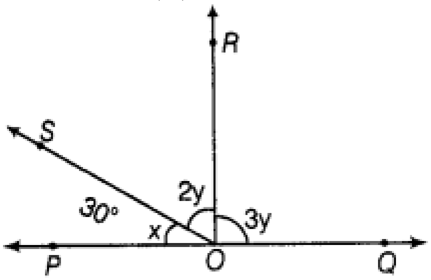
Solution:
Given in the question figure, POR is a straight line.
So, ∠POQ + ∠QOR = 180° [Linear pair]
(3a + 5)° + (2a-25)° = 180°
5a – 20° = 180°
5a = 180° + 20°
5a = 200°

$$a = \frac{200°}{5}$$

$$a = 40°$$

Hence, the correct option is (a).

14. In Fig. 5.14, POQ is a line. If x = 30°, then ∠ QOR is
(a) 90° (b) 30° (c) 150° (d) 60°



Solution:

See the given figure in the question, POQ is a straight line.
So, x + 2y + 3y = 180°
30° + 5y = 180°
5y = 180° – 30°
5y = 150°
$$y = \frac{150°}{5}$$
$$y = 30°$$
So, ∠QOR = 3y = 3× 30° = 90°

Hence, the correct option is (a).

15. The measure of an angle which is four times its supplement is
(a) 36° (b) 144° (c) 16° (d) 64°

Solution:
Let the angle be x.
So, Its supplement = 180° – x
Now, according to question,
x = 4 (180° – x)
x = 720° – 4x
x + 4x = 720°
5x = 720°
$$x = \frac{720°}{5}$$
$$x = 144$$

Hence, the correct option is (b).

16. In Fig. 5.15, the value of y is
(a) 30° (b) 15° (c) 20° (d) 22.5°

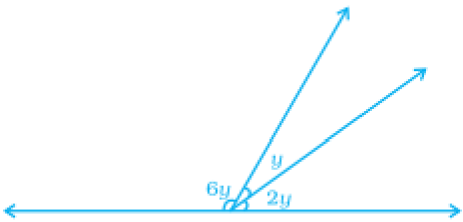


Fig. 5.15

Solution:
As we know that angles are on a straight line.
So, 6y + y + 2y = 180°

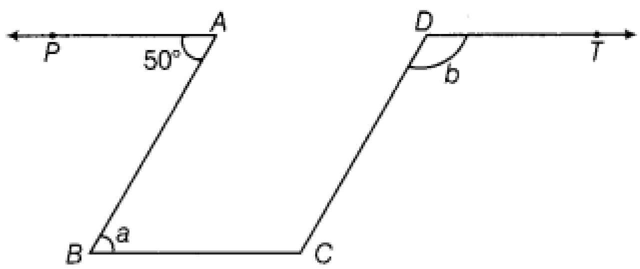
9y = 180°

$$y = \frac{180°}{9}$$

$$y = 20°$$

Hence, the correct option is (c).

17. In Fig. 5.16, PA || BC || DT and AB || DC. Then, the values of a and b are respectively.
(a) 60°, 120° (b) 50°,130° (c) 70°,110° (d) 80°,100°



Solution:
Given: PA || BC and AB is a transversal.
So, ∠PAB = ∠ABC [Alternate interior angles]
50° = a
Since, AB || DC and BC is a transversal.
So, ∠ABC + ∠BCD = 180° [Co-interior angles]
50° + ∠BCD = 180°
∠BCD = 180°- 50°
∠BCD = 130°
Also, BC || DT and DC is a transversal.
So, ∠BCD = ∠CDT [Alternate interior angles]
130° = b
Therefore, a = 50° and b = 130°

Hence, the correct option is (b).

18. The difference of two complementary angles is 30°. Then, the angles are
(a) 60°, 30° (b) 70°, 40° (c) 20°,50° (d) 105°,75°

Solution:
Let the angles be x and y.
So, x + y = 90° …(i) [Angles are complementary]
and x – y = 30° …(ii) [Given]
Now, adding (i) and (ii), get
2x = 120°

$$x = \frac{120°}{2}$$

$x = 60°$

Now, putting the value of x in (i), get

60° + y = 90°

y = 90° – 60°

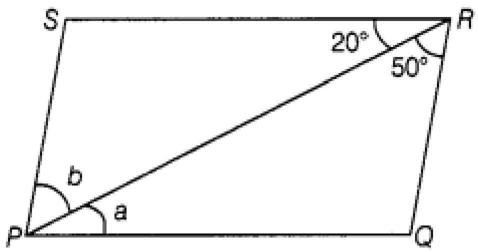
Y = 30°

Therefore, the required angles are 60° and 30°.

Hence, the correct option is (a).

19. In Fig. 5.17, PQ || SR and SP || RQ. Then, angles a and b are respectively

(a) 20°, 50° (b) 50°, 20° (c) 30°,50° (d) 45°, 35°



Solution:

Given: PQ || SR and RP is a transversal

So, a = 20° [Alternate interior angles]

Now, SP || RQ and PR is a transversal.

So, b = 50° [Alternate interior angles]

Hence, the correct option is (a).

20. In Fig. 5.18, a and b are

(a) alternate exterior angles (b) corresponding angles

(c) alternate interior angles (d) vertically opposite angles

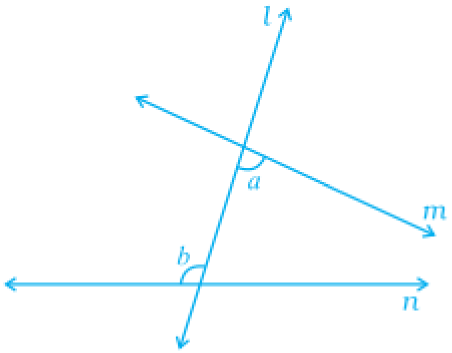


Fig. 5.18

Solution:
See the given figure in the question, m and n are two straight lines and I is a transversal intersecting both lines m and n.
a and b are on the opposite side of transversal l.
So, a and b are alternate interior angles.

Hence, the correct option is (c).

21. If two supplementary angles are in the ratio 1 : 2, then the bigger angle is
(a) 120° (b) 125° (c) 110° (d) 90°

Solution:
Let the two angles be x and 2x.
As angles are supplementary.
So, x + 2x = 180°
3x = 180°
$$x = \frac{180°}{3}$$
$x = 60°$
So, the bigger angle is 2x = 2 × 60° = 120°.

Hence, the correct option is (a).

22. In Fig. 5.19, ∠ROS is a right angle and ∠POR and ∠QOS are in the ratio 1 : 5. Then, ∠ QOS measures
(a) 150° (b) 75° (c) 45° (d) 60°

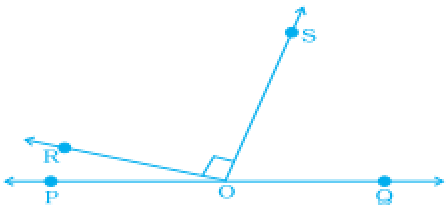


Fig. 5.19

Solution:
Given: POQ is a straight line
So, ∠POR + ∠ROS + ∠QOS = 180°
∠POR + ∠QOS = 180° – 90° = 90° … (i)
Given that. $\frac{\angle POR}{\angle QOS} = \frac{1}{5}$
5 ∠POR = ∠QOS …(ii)
Now, from (i) and (ii), get
∠POR + 5 ∠POR = 90°
6 ∠POR = 90°

$$\angle POR = \frac{90°}{6}$$

$\angle POR = 15°$

So, $\angle QOS = 5$

$\angle POR = 5 \times 15° = 75°$

Hence, the correct option is (b).

23. Statements a and b are as given below:
a : If two lines intersect, then the vertically opposite angles are equal.
b : If a transversal intersects, two other lines, then the sum of two interior angles on the same side of the transversal is 180°.
Then
(a) Both a and b are true (b) a is true and b is false
(c) a is false and b is true (d) both a and b are false

Solution:
Statement a is true but statement b is false because, if a transversal intersects two parallel lines, then the sum of two interior angles on the same side of the transversal is 180°

Hence, the correct option is (b).

24. For Fig. 5.20, statements p and q are given below:
p : a and b are forming a linear pair.
q : a and b are forming a pair of adjacent angles.
Then,
(a) both p and q are true (b) p is true and q is false
(c) p is false and q is true (d) both p and q are false

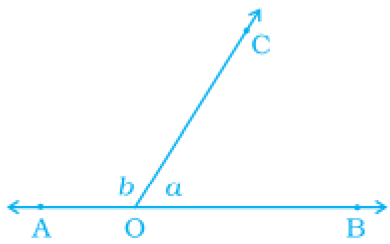


Fig. 5.20

Solution:
Both statements p and q are true. because $\angle AOC$ and $\angle BOC$ have a common vertex O, a common arm OC and also, their non-common arms, OA and OB, are opposite rays.
Hence, the correct option is (a).

25. In Fig. 5.21, ∠AOC and ∠ BOC form a pair of
(a) vertically opposite angles (b) complementary angles

(c) alternate interior angles **(d) supplementary angles**

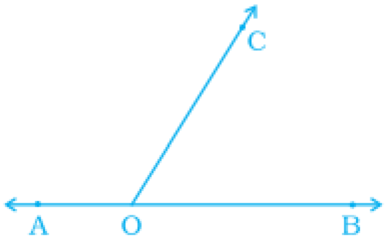


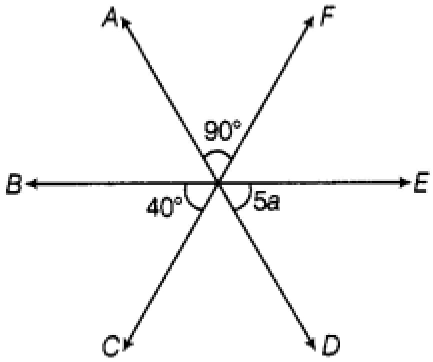
Fig. 5.21

Solution:

See the given figure, ∠AOC and ∠BOC form a pair of supplementary angles.
Hence, the correct option is (d).

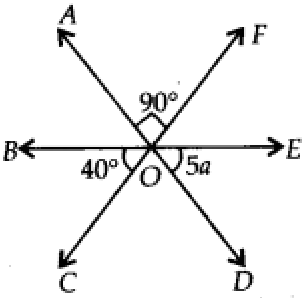
26. In Fig. 5.22, the value of a is

(a) 20° **(b) 15°** **(c) 5°** **(d) 10°**



Solution:

According to the question,

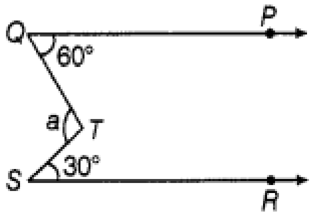


∠AOF=∠COD [Vertically opposite angles]
So, ∠COD = 90°
Now, 40° + 90° + 5a = 180° [Angles on a straight line BOE]
5a + 130° = 180°
5a = 180° – 130°
5a = 50°

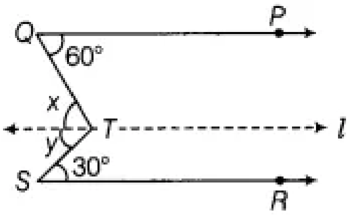
$$a = \frac{50°}{5}$$
$$a = 10°$$

Hence, the correct option is (d).

27. In Fig. 5.23, if QP || SR, the value of a is
(a) 40° (b) 30° (c) 90° (d) 80°



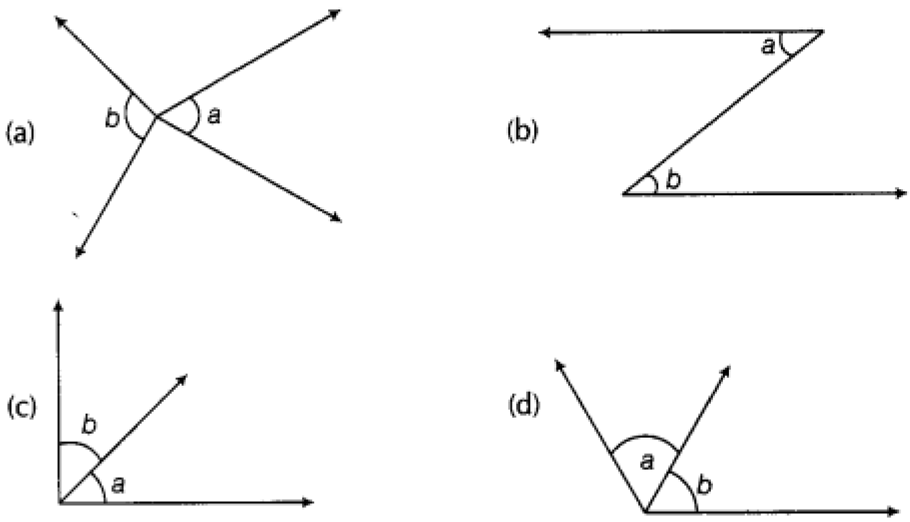
Solution:
Construction: Draw a line l parallel to QP.



Let $\angle PQT = x$
$x = 60°$ [Alternate interior angles]
Also, $\angle RST = y$
$y = 60°$ [Alternate interior angles]
Now, a = x + y
$a = 60° + 30°$
$a = 90°$

Hence, the correct option is (a).

28. In which of the following figures, a and b are forming a pair of adjacent angles?



Solution:

Two angles are called adjacent angles, if they have a common vertex and a common arm but no common interior points.

Hence, the correct option is (d).

29. In a pair of adjacent angles, (i) vertex is always common, (ii) one arm is always common, and (iii) uncommon arms are always opposite rays Then

(a) All (i), (ii) and (iii) are true **(b) (iii) is false**

(c) (i) is false but (ii) and (iii) are true **(d) (ii) is false**

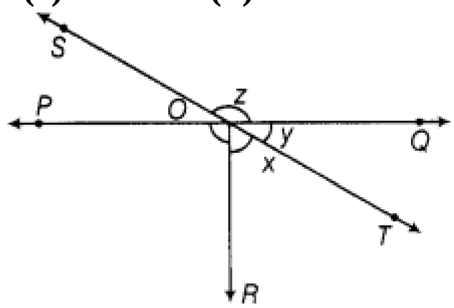
Solution:

Two angles are called adjacent angles, if they have a common vertex and a common arm but no common interior points. It is not necessary that uncommon arms must be always opposite rays.

Hence, the correct option is (b).

30. In Fig. 5.25, lines PQ and ST intersect at O. If ∠POR = 90° and x : y = 3 : 2, then z is equal to

(a) 126° (b) 144° (c) 136° (d) 154°



Solution:
Given: PQ is a straight line.
So, ∠POR + ∠ROT + ∠TOQ = 180°
90° + x + y = 180°
x + y = 180° – 90°
x + y = 90° … (i)

Given that: $\frac{x}{y}=\frac{3}{2}$
Let x = 3k and y – 2k

Now, from equation (i):
3k + 2k = 90°
5k = 90°
$k=\frac{90°}{5}$
$k=18°$

So, y = 2 × 18°
= 36°

Now, SOT is a straight line
z + y = 180° [Linear pair]
z + 36° = 180°
z = 180° – 36°
z = 144°
Hence, the correct option is (b).

31. In Fig. 5.26, POQ is a line, then a is equal to
(a) 35° (b) 100° (c) 80° (d) 135°

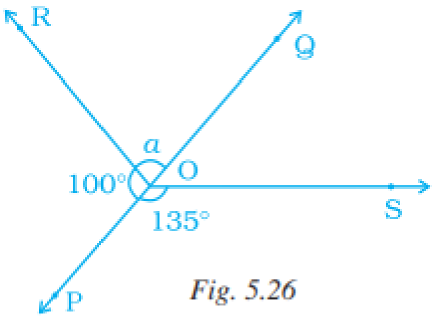


Fig. 5.26

Solution:
Given in the question, POQ is a straight line.
So, ∠POR + ∠ROQ = 180° [Linear pair]
100° + a = 180°
a = 180° – 100°
a = 80°

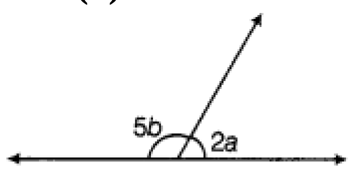
Hence, the correct option is (c).

32. Vertically opposite angles are always
(a) supplementary (b) complementary (c) adjacent (d) equal

Solution:
As we know that vertically opposite angles are always equal.

Hence, the correct option is (d).

33. In Fig. 5.27, a = 40°. The value of b is
(a) 20° (b) 24° (c) 36° (d) 120°



Solution:
As, 5b + 2a = 180° [Linear pair]
5b + 2 × 40° = 180°
5b – 180° – 80° = 100°

$$b = \frac{100°}{5}$$

$$b = 20°$$

Hence, the correct option is (b).

34. If an angle is 60° less than two times of its supplement, then the greater angle is
(a) 100° (b) 80° (c) 60° (d) 120°

Solution:
Let an angle be x.
So, its supplement = 180° – x
Now, according to question,
x = 2(180° – x) – 60°
x = 360° – 2x – 60°
x + 2x = 300°
3x = 300°

$$x = \frac{300°}{3}$$

$$x = 100°$$

Therefore, the greater angle is 100°.

Hence, the correct option is (a).

35. In Fig. 5.28, PQ || RS. If ∠1= (2a+b)° and ∠6 = (3a–b)°, then the measure of ∠2 in terms of b is
(a) (2+b)° (b) (3–b)° (c) (108–b)° (d) (180–b)°

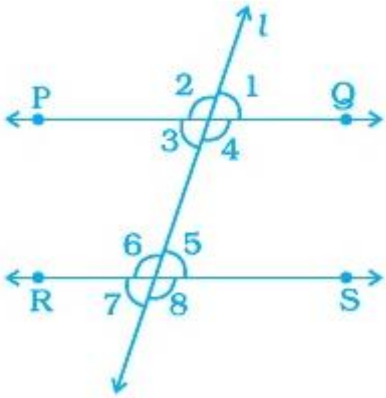


Fig. 5.28

Solution:
Given: PQ || RS and line 1 is a transversal.
So, ∠2 = ∠6= (34 – b)° … (i) [Corresponding angles]
∠1 +∠2 = 180° [Angles on a straight line PQ]
⇒ ∠2 = 180° – (2a+ b)° … (ii) [∠1 = (2a + b)°]
Now, from (i) and (ii), we have
(3a – b)° = 180° – (2a + b)°
3a – b = 180 – 2a – b
3a – b + 2a + b = 180°
5a = 180°

$$a = \frac{180°}{5}$$

$$a = 36°$$

So, a = 36
Now, ∠2-(3a – b)° [From equation (i)]
∠2 = (3 × 36 – b)°
∠2 = (108 – b)°

Hence, the correct option is (c).

36. In Fig. 5.29, PQ||RS and a : b = 3 : 2. Then, f is equal to
(a) 36° (b) 108° (c) 72° (d) 144°

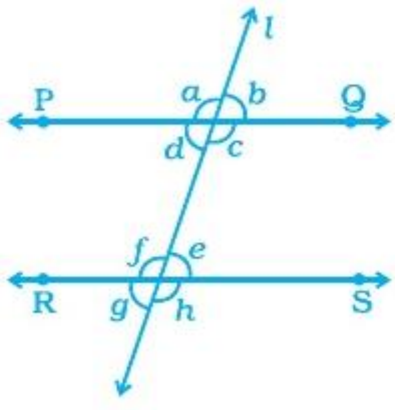


Fig. 5.29

Solution:
Given: a : b = 3 : 2
So, let a = 3x and b – 2x

Now, a + b = 180° [Angles on a straight line PQ]
3x + 2x = 180°
5x = 180°
$x = \frac{180°}{5}$
$x = 36°$
So, a = 3x =
a = 3 × 36°
a = 108°

Also, PQ || RS and line I is a transversal.
So, a = f [Corresponding angles]
f = 108°
Hence, the correct option is (b).

37. In Fig. 5.30, line l intersects two parallel lines PQ and RS. Then, which one of the following is not true?
(a) ∠1 = ∠3 (b) ∠2 = ∠4 (c) ∠6 = ∠7 (d) ∠4 = ∠8

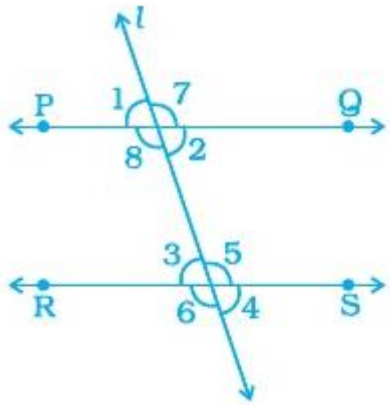


Fig. 5.30

Solution:

Given: PQ I RS and line 1 is a transversal.

So, ∠1 = ∠3 [Corresponding angles]

∠2 = ∠4 [Corresponding angles]

∠6 = ∠7 [Alternate exterior angles]

but ∠4 ≠ ∠8

Hence, the correct option is (d).

38. In Fig. 5.30, which one of the following is not true?

(a) ∠1 + ∠5 = 180° (b) ∠2 + ∠5 = 180° (c) ∠3 + ∠8 = 180° (d) ∠2 + ∠3 = 180°

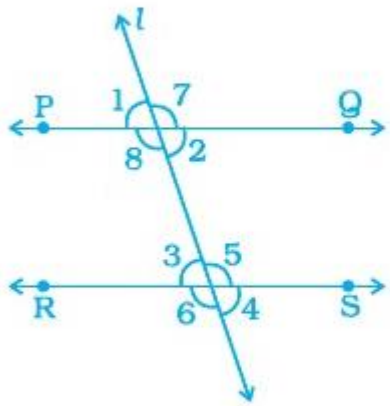


Fig. 5.30

Solution:

Given: PQ || RS, line l is a transversal.

So, ∠2 + ∠5 = 180° … (i) [Co-interior angles]

∠3 + ∠8 = 180° …(ii) [Co-interior angles]

∠1 = ∠2 …(iii) [Vertically opposite angles]

So, ∠1 + ∠5 = 180° [By equation (i) and (iii)]

∠2 = ∠3 [Alternate interior angles]

but ∠2 + ∠3 = 180°

Hence, the correct option is (d).

39. In Fig. 5.30, which of the following is true?
(a) ∠1 = ∠5 (b) ∠4 = ∠8 (c) ∠5 = ∠8 (d) ∠3 = ∠7

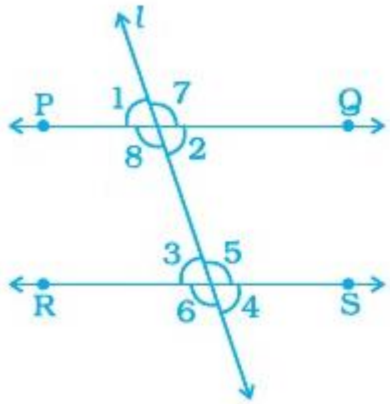


Fig. 5.30

Solution:
Given: PQ || RS, line l is a transversal.
So, ∠5 = ∠8 [Alternate interior angles]
Hence, the correct option is (c).

40. In Fig. 5.31, PQ||ST. Then, the value of x + y is
(a) 125° (b) 135° (c) 145° (d) 120°

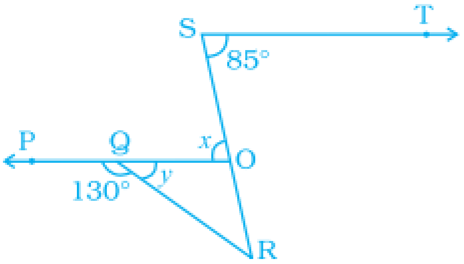
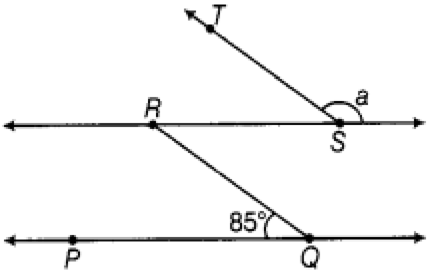


Fig. 5.31

Solution:
Given: PQ || ST and SO is a transversal.
So, x = 85° [Altemate interior angles]
Now, PO is a straight line.
So, ∠PQR + ∠RQO = 180° [Linear pair]
130° + y = 180°
y = 180° – 30°
y = 50°
x + y = 85° + 50°
x + y = 135°
Hence, the correct option is (b).

41. In Fig. 5.32, if PQ||RS and QR||TS, then the value a is
(a) 95° (b) 90° (c) 85° (d) 75°



Solution:
Given: PQ || RS and RQ is a transversal
So, ∠PQR – ∠QRS = 85° …(i) [Alternate interior angles]
Also, RQ || TS and RS is a transversal.
So, ∠QRS – ∠TSR = 85° …(ii) [Using equation (i)] [Alternate interior angles]

Now, RS is a straight line.
So, ∠RST + a = 180° [Linear pair]
85° + a = 180° [Using (ii)]
a = 180° – 85°
a = 95°
Hence, the correct option is (a).

In questions 42 to 56, fill in the blanks to make the statements true.

42. If sum of measures of two angles is 90°, then the angles are _________.

Solution:
If sum of measures of two angles is 90°, then the angles are complementary.

43. If the sum of measures of two angles is 180°, then they are _________.

Solution:
If the sum of measures of two angles is 180°, then they are supplementary.

44. A transversal intersects two or more than two lines at _________ points.

Solution:
A transversal intersects two or more than two lines at distinct points.

If a transversal intersects two parallel lines, then (Q. 45 to 48).

45. Sum of interior angles on the same side of a transversal is ___________.

Solution:
Sum of interior angles on the same side of a transversal is 180°.

46. Alternate interior angles have one common ___________.

Solution:
Alternate interior angles have one common arm.

47. Corresponding angles are on the _________ side of the transversal.

Solution:
Corresponding angles are on the same side of the transversal.

48. Alternate interior angles are on the __________ side of the transversal.

Solution:
Alternate interior angles are on the opposite side of the transversal.

49. Two lines in a plane which do not meet at a point anywhere are called ________ lines.

Solution:
Two lines in a plane which do not meet at a point anywhere are called parallel lines.

50. Two angles forming a __________ pair are supplementary.

Solution:
Two angles forming a linear pair are supplementary.

51. The supplement of an acute is always __________ angle.

Solution:
The supplement of an acute is always obtuse angle.

52. The supplement of a right angle is always _________ angle.

Solution:
The supplement of a right angle is always right angle.

53. The supplement of an obtuse angle is always _________ angle.

Solution:
The supplement of a right angle is always acute angle.

54. In a pair of complementary angles, each angle cannot be more than _________.

Solution:
In a pair of complementary angles, each angle cannot be more than 90°.

55. An angle is 45°. Its complementary angle will be __________ .

Solution:
Given: angle = 45°
So, its complement = $90° - 45° = 45°$
Hence, an angle is 45°.
Its complementary angle will be 45°.

56. An angle which is half of its supplement is of __________.

Solution:
Let the angle be x.
So, its supplement = 180° – x
Now, according to question,

$$x = \frac{180° - x}{2}$$

2x = 180° – x
2x + x = 180°
3x = 180°

$$x = \frac{180°}{3}$$

$$x = 60°$$

Therefore, the angle which is half of its supplement is of 60°.

In questions 57 to 71, state whether the statements are True or False.

57. Two right angles are complementary to each other.

Solution:
The given statement is false because as we know that two right angles are supplementary to each other.

58. One obtuse angle and one acute angle can make a pair of complementary angles.

Solution:
The given statement is false because as we know that two acute angles can make a pair of complementary angles.

59. Two supplementary angles are always obtuse angles.

Solution:

The given statement is false because it is not necessary that they are always obtuse angles.
For example: 60° and 120° are supplementary angles but both are not obtuse.

60. Two right angles are always supplementary to each other.

Solution:

The given statement is true because 90° + 90° = 180°, a supplementary angle.

61. One obtuse angle and one acute angle can make a pair of supplementary angles.

Solution:

The given statement is true.
For example: 60° and 120° are supplementary angles. So, one is 60° i.e. acute angle and other is 120°, i.e. obtuse angle.

62. Both angles of a pair of supplementary angles can never be acute angles.

Solution:

The given statement is true because acute angles are those which are less than 90°.

63. Two supplementary angles always form a linear pair.

Solution:

The given statement is false because linear pair is always in a straight line.

64. Two angles making a linear pair are always supplementary.

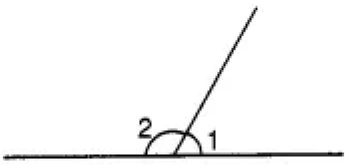
Solution:

The given statement is true because linear pair is always in a straight line and straight line makes 180° angle.

65. Two angles making a linear pair are always adjacent angles.

Solution:

The given statement is true.
For example:



See the above figure, ∠1 and ∠2 form a linear pair and are adjacent angles.

66. Vertically opposite angles form a linear pair.

Solution:

The given statement is false because as vertically opposite angles are always equal but do not form a linear pair.

67. Interior angles on the same side of a transversal with two distinct parallel lines are complementary angles.

Solution:

The given statement is false because as interior angles on the same side of a transversal with two distinct parallel lines are supplementary angles.

68. Vertically opposite angles are either both acute angles and both obtuse angles.

Solution:

The given statement is true because as we know that vertically opposite angles are equal.
So, if one angle is acute, then other angle will be acute and if one angle is obtuse, then the other will be obtuse.

69. A linear pair may have two acute angles.

Solution:

The given statement is false because as a linear pair has one acute angle and one obtuse angle.

70. An angle is more than 45°. Its complementary angle must be less than 45°.

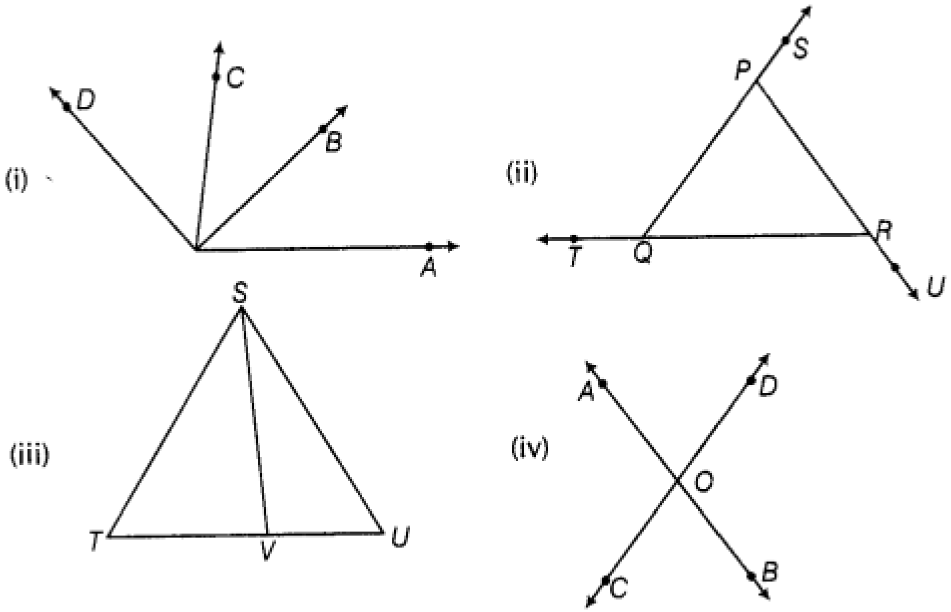
Solution:

Let A and B are two angles making a complementary angle pair and A is greater than 45°.
So,
$A + B = 90°$
$B = 90° – A$
Hence, B will be less than 45°.
So, the given statement is true.

71. Two adjacent angles always form a linear pair.

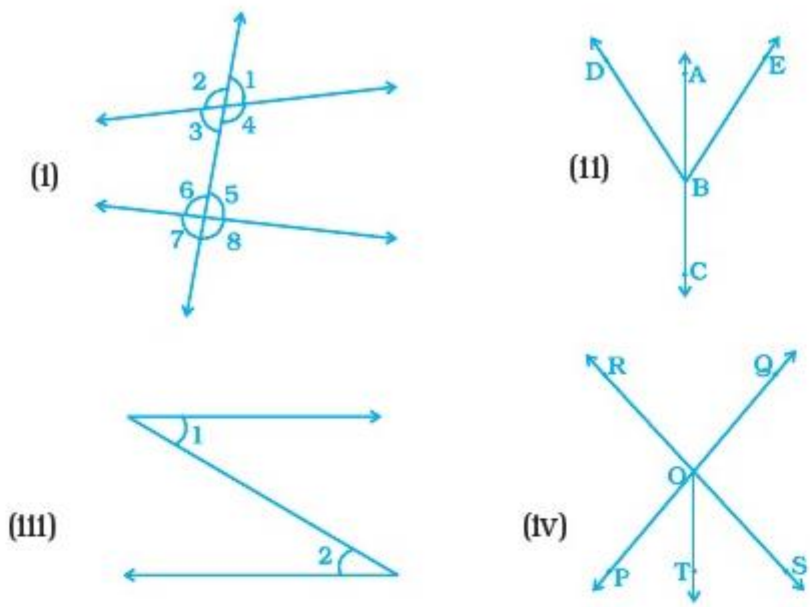
Solution:
The given statement is false because as if both adjacent angles are acute angles, then they do not form a linear pair.

72. Write down each pair of adjacent angles shown in the following figures:



Solution:
(i) ∠AOB and ∠BOC; ∠AOC and ∠COD; ∠AOB and ∠BOD; and ∠BOC and ∠COD are adjacent angles.
(ii) ∠PQT and ∠PQR; ∠ORU and ∠QRP; ∠RPS and ∠RPQ are adjacent angles.
(iii) ∠TSV and ∠USV; ∠SVT and ∠SVU are adjacent angles.
(iv) ∠AOC and ∠AOD; ∠BOC and ∠BOD; ∠AOC and ∠BOC, ∠AOD and ∠BOD are adjacent angles.

73. In each of the following figures, write, if any, (i) each pair of vertically opposite angles, and (ii) each linear pair.



Solution:

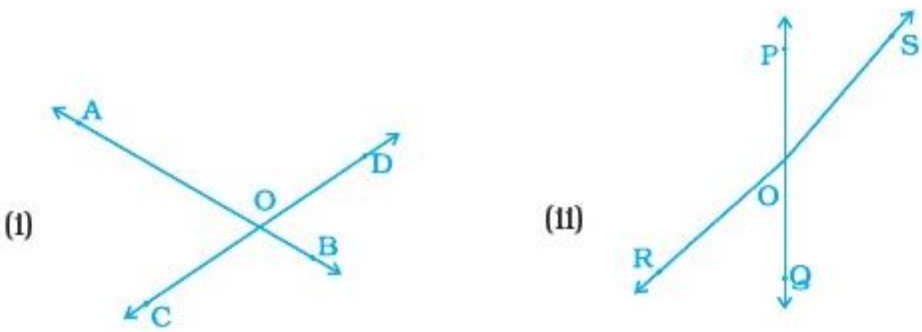
(i) ∠1 and ∠3; ∠2 and ∠4; ∠5 and ∠7; ∠6 and ∠8 are four pairs of vertically opposite angles.
∠1 and ∠2; ∠1 and ∠4; ∠2 and ∠3; ∠3 and ∠4; ∠5 and ∠6; ∠5 and ∠8; ∠6 and ∠7; ∠7 and ∠8 are linear pairs.

(ii) There is no pair of vertically opposite angles.
∠ABD and ∠DBC; ∠ABE and ∠CBE are linear pairs.

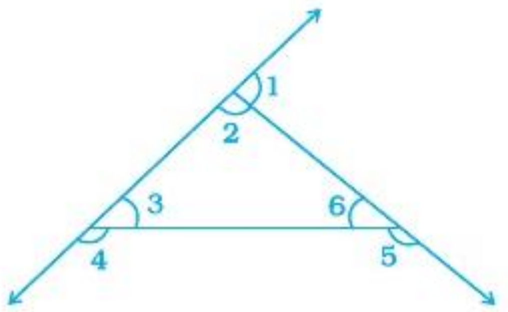
(iii) In this figure, there is no pair of vertically opposite angles and no angles are in the form of linear pair.

(iv) ∠POR and ∠QOS; ∠ROQ and ∠POS are two pairs of vertically opposite angles.
∠POR and ∠ROQ; ∠ROQ and ∠OOS; ∠QOS and ∠SOP; ∠SOP and ∠POR; ∠ROT and ∠TOS; ∠OOT and ∠POT are linear pairs.

74. Name the pairs of supplementary angles in the following figures:



(iii)



Solution:

(i) ∠AOD and ∠DOB; ∠DOB and ∠BOC, ∠BOC and ∠AOC; ∠AOC and ∠AOD are four pairs of supplementary angles.

(ii) ∠POS and ∠SOQ; ∠POR and ∠ROQ are two pairs of supplementary angles.

(iii) ∠1 and ∠2, ∠3 and ∠4, ∠5 and ∠6 are three pairs of supplementary angles.

75. In Fig. 5.36, PQ || RS, TR || QU and ∠PTR = 42°. Find ∠QUR.

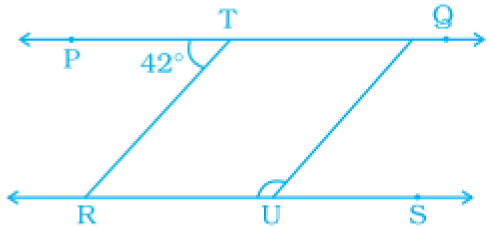


Fig. 5.36

Solution:

Given: PQ || RS and TR is a transversal.

So ∠PTR – ∠TRU= 42° …(i) [Alternate interior angles]

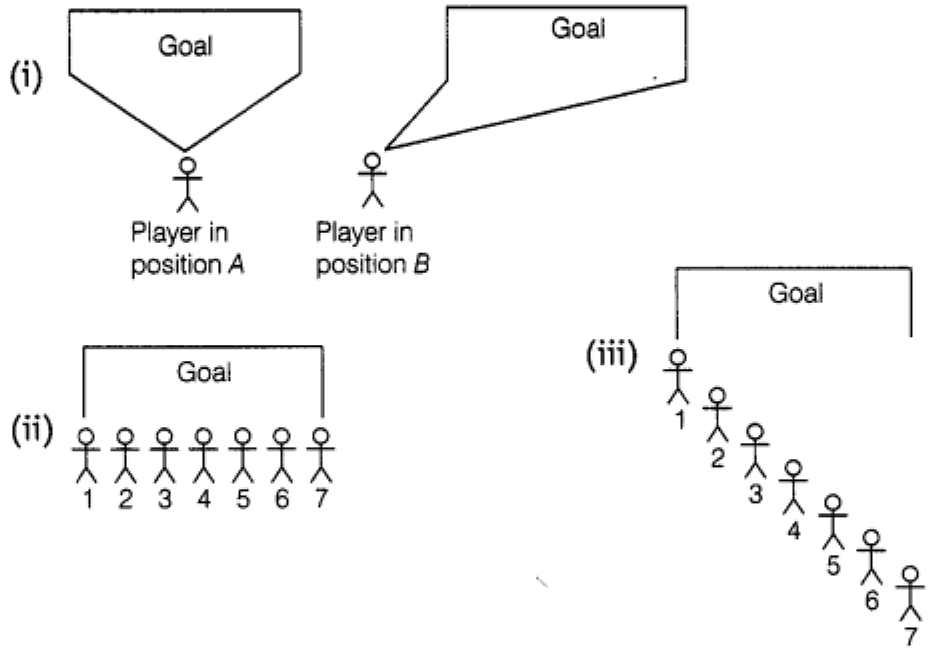
Also, TR || QU and RS is a transversal.

So, ∠TRU + ∠QUR = 180° [Co-interior angles]

42° + ∠QUR = 180° [Using equation (i)]

∠QUR = 180° – 42° = 138°

76. The drawings below (Fig. 5.37), show angles formed by the goalposts at different positions of a football player. The greater the angle, the better chance the player has of scoring a goal. For example, the player has a better chance of scoring a goal from Position A than from Position B.



In Parts (a) and (b) given below it may help to trace the diagrams and draw and measure angles.
(a) Seven football players are practicing their kicks. They are lined up in a straight line in front of the goalpost [Fig.(ii)]. Which player has the best (the greatest) kicking angle?
(b) Now the players are lined up as shown in Fig. (iii). Which player has the best kicking angle?
(c) Estimate atleast two situations such that the angles formed by different positions of two players are complement to each other.

Solution:

(a) 4th player has the greatest kicking angle. So, this player has the best kicking angle.
(b) 4th player has the greatest kicking angle. So, this player has the best kicking angle.
(c) (45°, 45°) and (60°, 30°) are the two pairs of angles formed by different positions of two players such that they are complement to each other.
(∵ 45° + 45° = 90° and 60° + 30°= 90°).

77. The sum of two vertically opposite angles is 166°. Find each of the angles.

Solution:

Given: vertically opposite angles are equal.
Let each angle be x.
Now, according to question,
$x + x = 166°$
$2x = 166°$

$x = \frac{166°}{2}$

$x = 83°$

Thus, both the angles are of 83°.

78. In Fig. 5.38, l ||m ||n. ∠ QPS = 35° and ∠ QRT = 55°. Find ∠PQR.

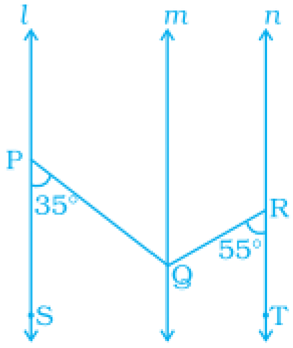
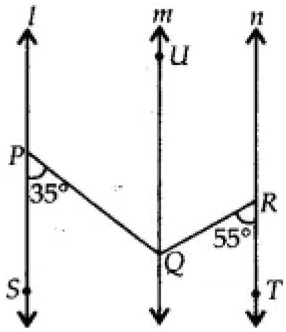


Fig. 5.38

Solution:

According to the question:



Given: l || m and PQ is a transversal

So, ∠SPQ = ∠PQU [Alternate interior angles]

∠PQU = 35° …(i)

Also, m || n and QR is a transversal.

So, ∠QRT = ∠RQU [Alternate interior angles]

∠RQU = 35° …(ii)

Now, ∠PQR = ∠PQU + ∠UQR

∠PQR = 35° + 55° [Using equation (i) & (ii)]

∠PQR = 90°

79. In Fig. 5.39, P, Q and R are collinear points and TQ ⊥ PR, Name; (a) pair of complementary angles (b) two pairs of supplementary angles. (c) four pairs of adjacent angles.

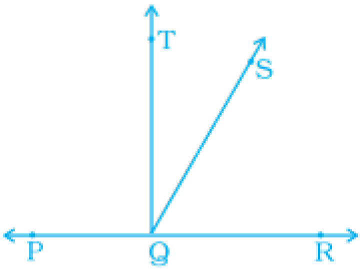
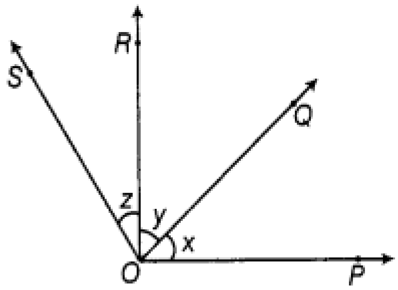


Fig. 5.39

Solution:

(a) ∠TOS and ∠SQR is a pair of complementary angles.
(b) ∠PQT and ∠TOR; ∠SQR and ∠PQS are two pairs of supplementary angles.
(c) ∠PQT and ∠TQS; ∠TQS and SQR; ∠PQT and ∠TOR; ∠PQS and ∠SQR are four pairs of adjacent angles.

80. In Fig. 5.40, OR ⊥ OP.
(i) Name all the pairs of adjacent angles.
(ii) Name all the pairs of complementary angles.



Solution:

(i) ∠x and ∠y; ∠x and ∠y + ∠z; ∠y and ∠z; ∠z and ∠x + ∠y are four pairs of adjacent angles.
(ii) ∠x and ∠y are complementary angles. If ∠x = ∠y = ∠z, then ∠x and ∠y; ∠y and ∠z; ∠z and ∠x are three pairs of complementary angles.

81. If two angles have a common vertex and their arms form opposite rays (Fig. 5.41), Then, (a) how many angles are formed?
(b) how many types of angles are formed?
(c) write all the pairs of vertically opposite angles.

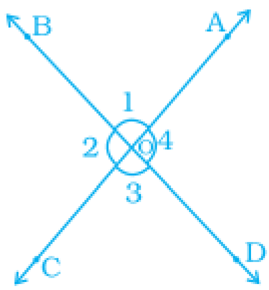


Fig. 5.41

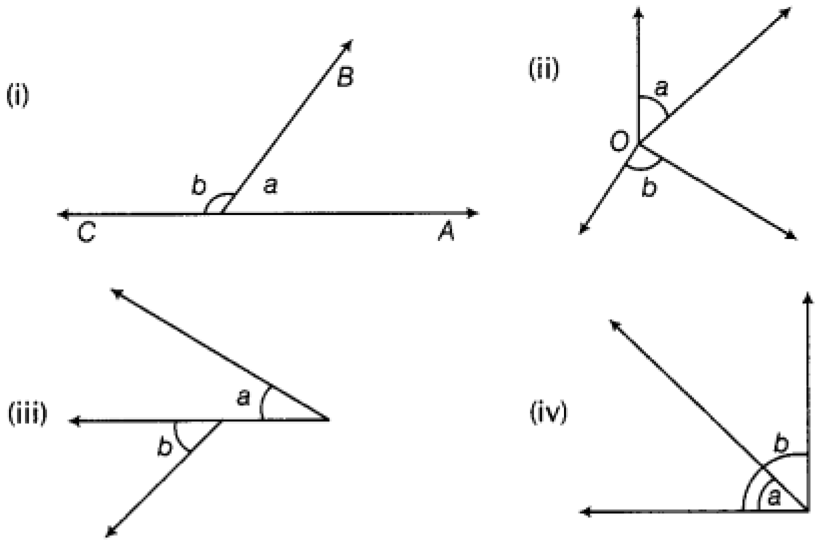
Solution:

(a) 13 angles are formed.

(b) 4 types of angles are formed i.e., vertically opposite angles, adjacent angles, supplementary angles and linear pairs.

(c) ∠1 and ∠3; ∠2 and ∠4 are the two pairs of vertically opposite angles.

82. In (Fig 5.42) are the following pairs of angles adjacent? Justify your answer.



Solution:

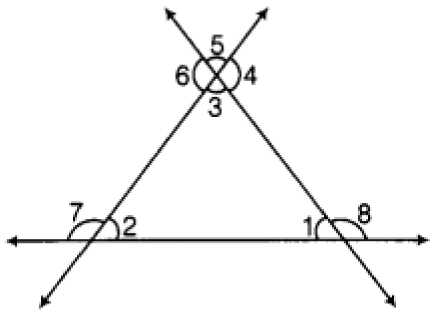
(i) Yes, and b are the adjacent angles as they have a common vertex, one common arm and other non-common arms on the opposite side of the common arm.

(ii) No, a and b are not adjacent angles as they don't have common arm.

(iii) No, a and b are not adjacent angles as they don't have common vertex.

(iv) No, a and b are not adjacent angles as the arms which are not common are on the same side of common arm.

83. In Fig. 5.43, write all the pairs of supplementary angles.



Solution:

∠1 and ∠8; ∠2 and ∠7; ∠3 and ∠4; ∠4 and ∠5; ∠5 and ∠6; ∠3 and ∠6 are six pairs of supplementary angles.

84. What is the type of other angle of a linear pair if
(a) one of its angle is acute?
(b) one of its angles is obtuse?
(c) one of its angles is right?

Solution:

(a) If one of the angles is acute, then other angle of a linear pair is obtuse.
(b) If one of the angles is obtuse, then other angle of a linear pair is acute.
(c) If one of the angles is right, then other angle of a linear pair is also right.

85. Can two acute angles form a pair of supplementary angles? Give reason in support of your answer.

Solution:

No, two acute angles cannot form a pair of supplementary angles. As if both angles are 89° and 89°, even then they cannot make the sum 180°.

86. Two lines AB and CD intersect at O (Fig. 5.44). Write all the pairs of adjacent angles by taking angles 1, 2, 3, and 4 only.

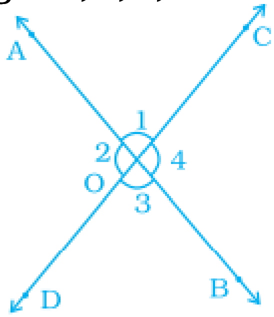


Fig. 5.44

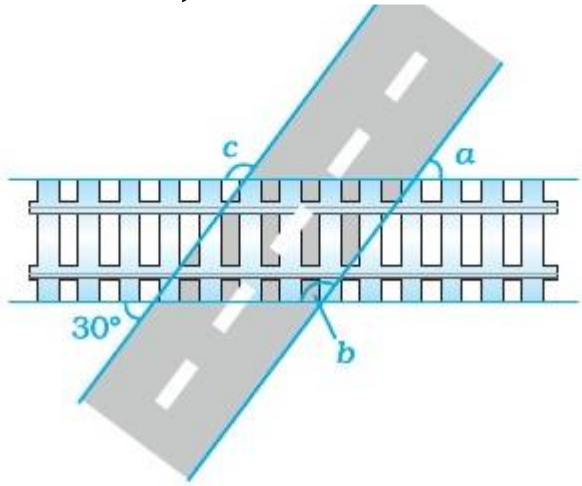
Solution:

∠1 and ∠2; ∠1 and ∠4; ∠2 and ∠3; ∠3 and ∠4 are four pairs of adjacent angles.

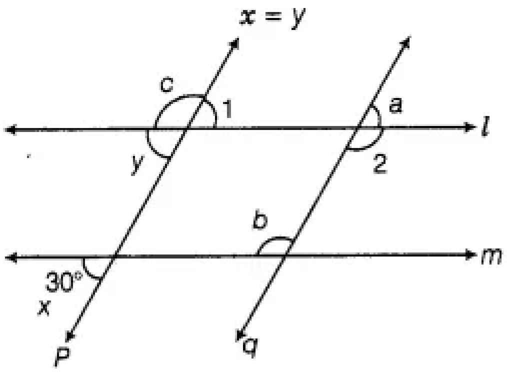
87. If the complement of an angle is 62°, then find its supplement.

Solution:
Let the angle be x.
So, its complement = 90° – x
Now, according to question,
90° – x = 62°
90° – 62° = x
x = 28°
So, supplement of x = 180° – 28°
x =152°

88. A road crosses a railway line at an angle of 30° as shown in Fig.5.45. Find the values of a, b and c.



Solution:
Given: Lines l and m are parallel, P is transversal and x = 30°.



See the above figure:
$y = 30°$ [Corresponding angles]
Now, $c + y = 180°$ [linear pair]

$c + 30° = 180°$

$c = 180° - 30°$

$c = 150°$

$\angle 1 + c = 180°$

$\angle 1 + 150° = 180°$

$\angle 1 = 180° - 150°$

$\angle 1 = 30°$

$\angle 1 = a$ [Corresponding angles]

$a = 30°$

Also, $\angle 2 + 30° = 180°$ [Linear pair]

$\angle 2 + 30° = 180°$

$\angle 2 = 180° - 30°$

$\angle 2 = 150°$

Again, $\angle 2 = b$ [Alternate interior angles]

$b = 150°$

Hence, $a = 30°, b = 150°$ and $c = 150°$.

89. The legs of a stool make an angle of 35° with the floor as shown in Fig. 5.46. Find the angles x and y.

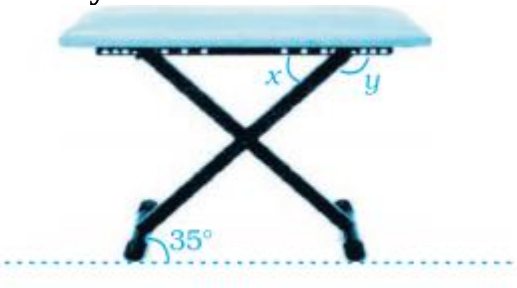
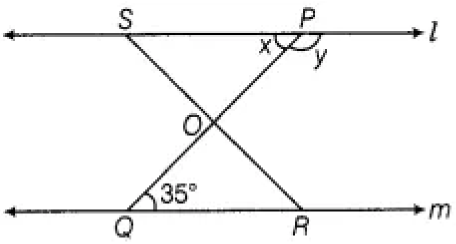


Fig. 5.46

Solution:

According to the question:



See the above figure: l and m are parallel lines and PQ is transversal.

So, $x = \angle PQR$ [Alternate interior angles]

$x = 35°$ [$\angle PQR = 35°$]

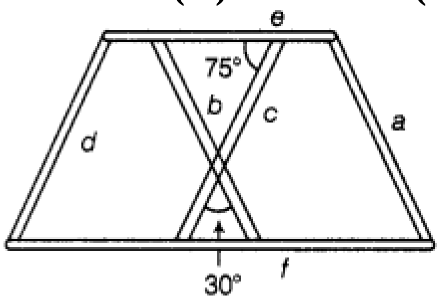
Again, $x + y = 180°$ [linear pair]

$35^\circ + y = 180^\circ$

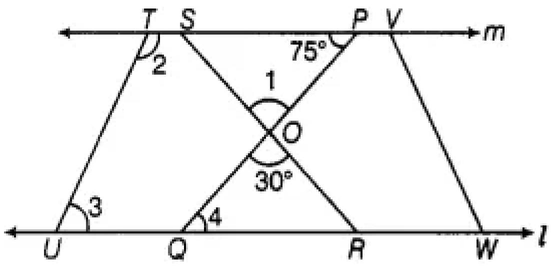
$y = 180^\circ - 35^\circ$

$y = 145^\circ$

90. Iron rods a, b, c, d, e and f are making a design in a bridge as shown in Fig. 5.47, in which a ||b, c ||d, e || f. Find the marked angles between
(i) b and c (ii) d and e (iii) d and f (iv) c and f



Solution:



Given: l and m are two parallel lines and PQ, RS and TU are transversal.
See the given figure,

$\angle 4 = \angle QPS$ [Alternative interior angles]

$\angle 4 = 75^\circ$

Again, $\angle 1 = \angle QOR$ [Vertically opposite angles]

$\angle 1 = 30^\circ$ [$\angle QOR = 30^\circ$]

Also, PQ and TU are parallel and m and l are transversal.

Therefore, $\angle 2 + \angle QPT = 180^\circ$ [Consecutive interior angles]

$\angle 2 = 180^\circ - 75^\circ$

$\angle 2 = 105^\circ$

$\angle 2 + \angle 3 = 180^\circ$

$105^\circ + \angle 3 = 180^\circ$

$\angle 2 = 75^\circ$

Hence, (i) 30° (ii) 105° (iii) 75° (iv) 75°

91. Amisha makes a star with the help of line segments a, b, c, d, e and f, in which a || d, b || e and c || f. Chhaya marks an angle as 120° as shown in Fig.

5.48 and asks Amisha to find the ∠x, ∠y and ∠z. Help Amisha in finding the angles.

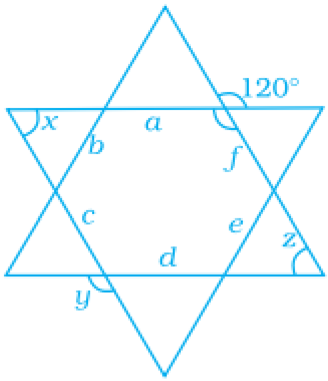
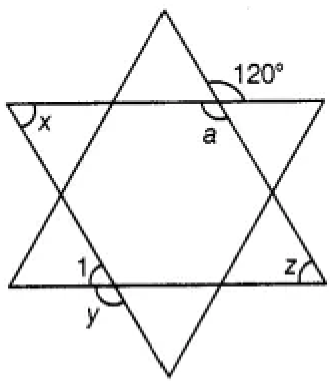


Fig. 5.48

Solution:

From the given figure,



$\angle a = 120°$ [Vertically opposite angles]

$\angle x + \angle a = 180°$ [Consecutive interior angles]

$\angle x + 120° = 180°$

$\angle x = 180° - 120°$

$\angle x = 60°$

Again, $\angle x = \angle 1$ [Alternate interior angles]

$60° = \angle 1$

Also, $\angle 1 + \angle y = 180°$ [Linear pair]

$60° + \angle y = 180°$

$\angle y = 180° - 60°$

$\angle y = 120°$

Also, $\angle z + \angle a = 180°$ [Consecutive interior angles]

$\angle z + 120° = 180°$

$\angle z = 180° - 120°$

$\angle z = 60°$

92. In Fig. 5.49, AB||CD, AF||ED, ∠AFC = 68° and ∠FED = 42°. Find ∠EFD.

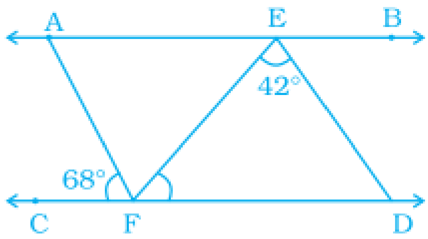


Fig. 5.49

Solution:

AF and ED are parallel and EF is transversal.

Then, $\angle AFE = \angle FED$ [Alternate interior angles]

$\angle AFE = 42°$ [$\angle FED = 42°$]

Now, $\angle AFC + \angle AFE + \angle EFD = 180°$ [Sum of all angles on a straight line is $180°$]

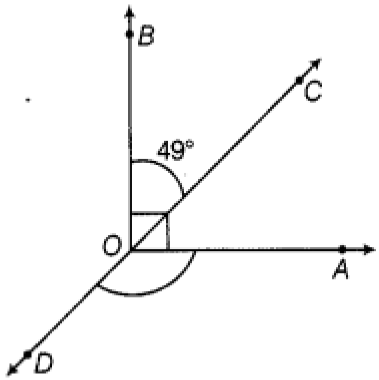
$68° + 42° + \angle EFD = 180°$

$110° + \angle EFD = 180°$

$\angle EFD = 180° - 110°$

$\angle EFD = 70°$

93. In Fig. 5.50, OB is perpendicular to OA and ∠BOC = 49°. Find ∠AOD.



Solution:

From the given figure,

$\angle DOB + \angle BOC = 180°$ [Linear pair]

$\angle DOB + 49° = 180°$ [$\angle BOC = 49°$]

$\angle DOB + \angle BOA + \angle AOB = 360°$ [Sum of all the angles around a point is $360°$]

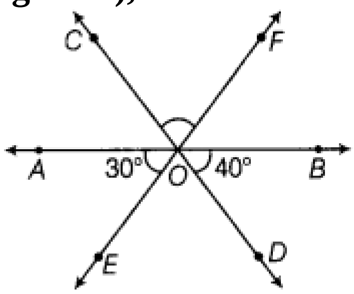
$131° + 90° + \angle AOD = 360°$ [$\angle DOB = 131°, \angle BOA = 90°$]

$221° + \angle AOD = 360°$

$\angle AOD = 360° - 221°$

$\angle AOD = 139°$

94. Three lines AB, CD and EF intersect each other at O. If ∠AOE = 30° and ∠DOB = 40° (Fig. 5.51), find ∠COF.



Solution:

From the given figure,

$\angle AOE + \angle EOD + \angle DOB = 180°$ [Sum of all the angles on a straight line is $180°$]

$30° + \angle EOD + 40° = 180°$

$\angle EOD = 180° - 70°$

$\angle EOD = 110°$

Again, $\angle EOD = \angle COF$ [Vertically opposite angles]

$\angle COF = 110°$

95. Measures (in degrees) of two complementary angles are two consecutive even integers. Find the angles.

Solution:

Let the two consecutive angles be x and x + 2. Since, both angles are complementary. So, their sum will be 90°.

So,

$x + (x + 2) = 90°$

$x + x + 2 = 90°$

$2x = 90° - 2$

$2x = 88°$

$x = 44°$

Therefore, the angles are $44°$ and $44° + 2° = 46°$.

96. If a transversal intersects two parallel lines, and the difference of two interior angles on the same side of a transversal is 20°, find the angles.

Solution:

Let one angle be x and other be y.

As, a transversal intersects two parallel lines, then interior angles on the same side of a transversal are supplementary.

So, x + y = 180° …(i)

and x – y = 20° … (ii) [Given]

Now, adding equation (i) and (ii), get
2x = 180° + 20°
2x = 200°

$$x = \frac{200°}{2}$$

$$x = 100°$$

Now, putting value of x in equation (i), get
100° + y = 180°
y = 180° – 100°
y = 80°
Hence,, one angle is 100° and other is 80°.

97. Two angles are making a linear pair. If one of them is one-third of the other, find the angles.

Solution:

Let one angle be x.
Since, two angles form a linear pair.
So, other angle is 180° – x.
Now, according to question,

$$x = \frac{1}{3}(180° - x)$$

3x = 180° – x
3x + x = 180°
4x = 180°

$$x = \frac{180°}{4}$$

$$x = 45°$$

Hence, one angle is 45° and other is 180° – 45° = 135°

98. Measures (in degrees) of two supplementary angles are consecutive odd integers. Find the angles.

Solution:

Let one angle be 2x + 1, then the other angle is 2x + 3.
We know that the sum of the measures of the supplementary angles is 180°.
According to question,
2x + 1 + 2x + 3 = 180°
4x + 4 = 180°
4x = 180°- 4
4x = 176°

$$x = \frac{176°}{4}$$

$$x = 44°$$

So, 2x + 1 = 2 × 44° + 1 = 88° + 1 = 89°

and 2x + 3 = 2 × 44° + 3 = 88° + 3 = 91°
Hence, one angle is 89° and other is 91°

99. In Fig. 5.52, AE || GF || BD, AB || CG || DF and ∠CHE = 120°. Find ∠ABC and ∠CDE.

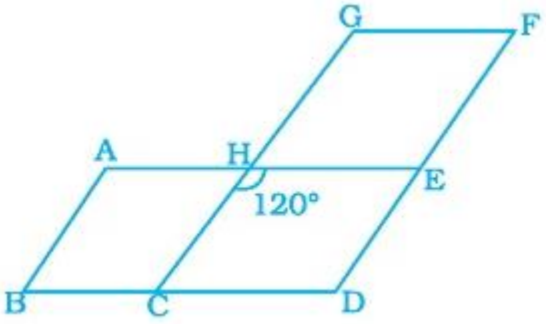


Fig. 5.52

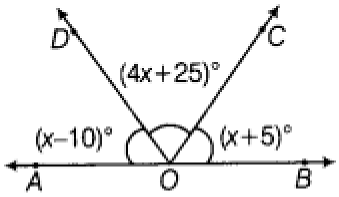
Solution:
Given: AE || BD and CH is a transversal.
So, ∠CHE = ∠HCB – 120° …(i) [Alternate interior angles]

Now, CH || DF and CD is a transversal.
So, ∠HCB =∠CDE [Corresponding angles]
∠CDE-120° …(ii) [Using equation (1)]

Also, AB || DF and BD is a transversal.
So, ∠ABC + ∠CDE = 180° [Co-interior angles]
∠ABC = 180° – 120° [Using equation (ii)]
∠ABC = 60°

Hence, ∠ABC = 60° and ∠CDE = 120°

100. In Fig. 5.53, find the value of ∠BOC, if points A, O and B are collinear.



Solution:
Given points A, O and B are collinear.
So, AOB is a straight line.
(x – 10)° +(4x – 25)° + (x + 5)° = 180° [Angles on a straight line]
(6x – 30) = 180
6x – 180 + 30

6x = 210

$$x = \frac{210°}{6}$$

$x = 35°$

Now, ∠BOC = (x + 5)° = (35 + 5) = 40°

Thus, ∠BOC = 40°

101. In Fig. 5.54, if l ||m, find the values of a and b.

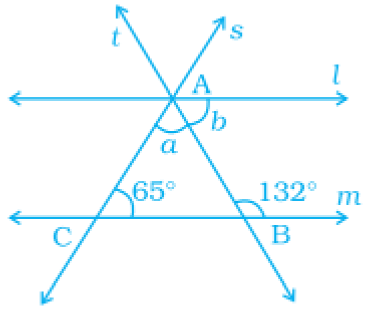


Fig. 5.54

Solution:

Given: l || m and AB is a transversal.

So, b + 132° = 180° [Co-interior angles]

b = 180° – 132°

So, b = 48° …(i)

Now, l || m and AC is a transversal.

So, (a + b) + 65° = 180° [Co-interior angles]

a + 48° + 65° = 180°

a + 113° = 180° [Using equation (i)]

a = 180° - 113°

a = 67°

Hence,, a = 67° and b = 48°.

102. In Fig. 5.55, l || m and a line t intersects these lines at P and Q, respectively. Find the sum 2a + b.

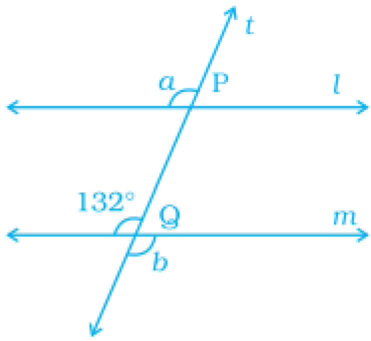


Fig. 5.55

Solution:

Given: *l* || *m* and is a transversal.
So, a = 132 [Corresponding angles]
and b = 132° [Vertically opposite angles]
Now, 2a + b = 2 × 132° + 132° = 264° + 132° = 396°
Hence, the sum of 2a + b is 396°.

103. In Fig. 5.56, QP || RS. Find the values of a and b.

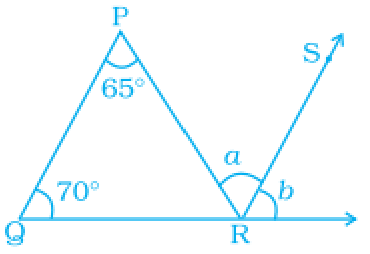
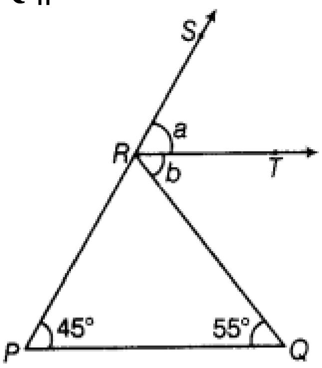


Fig. 5.56

Solution:

Given: QP || RS and QR is a transversal.
So, b = 70° [Corresponding angles]
Now, QP || RS and PR is a transversal.
So, a = 65° [Alternate interior angles]
Hence, a = 65° and b = 70°.

104. In Fig. 5.57, PQ || RT. Find the value of a + b.

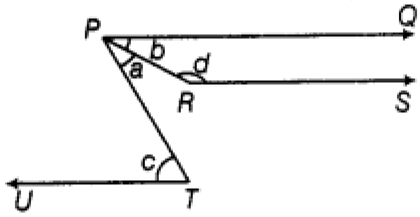


Solution:

Given: PQ || RT and PR is a transversal.
So, a = 45° [Corresponding angles]
Now, PQ || RT and RQ is a transversal.
So, b = 55° [Alternate interior angles]
Now, a + b = 45° + 55° = 100°
Hence, the value of a + b = 100°.

105. In Fig 5.58, PQ, RS and UT are parallel lines.
(i) If c = 570 and a = 3 c , find the value of d.

(ii) If c = 750 and a = 2 5 c, find b.



Solution:

(i) Given: PQ || UT and PT is a transversal.
So, a + b = c [Alternate interior angles]
b = c – a

$b = 57° - \frac{c}{3}$ [Given: $a = \frac{c}{3}$ and $c = 57°$]

$b = 57° - \frac{57°}{3}$

$b = 57° - 19°$

$b = 38°$ … (i)

Now, PQ || RS and PR is a transversal.
So, b + d = 180° [Co-interior angles]
d = 180°- 38° = 142° [Using (i)]
Therefore, d = 142°

(ii) PQ || UT and PT is a transversal.
So, a + b = c [Alternate interior angles]

$b = c - \frac{2}{5}c$ $\left[\text{Given: } a = \frac{2}{5}c\right]$

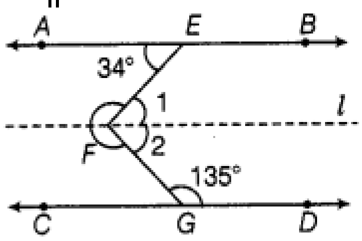
$b = 75° - \frac{2}{5} \times 75°$

$b = 75° - 30°$

$b = 45°$

Hence, $b = 45°$.

106. In Fig. 5.59, AB||CD . Find the reflex ∠ EFG.



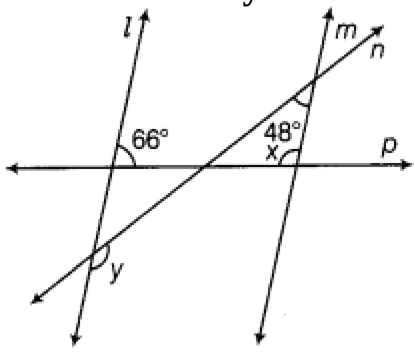
Solution:

Given: AB || l and EF is a transversal.
So, ∠1 = 34° [Alternate interior angles]

Now, l is also parallel to CD and FG is a transversal. .
So, ∠2 + 135° = 180° [Co-interior angles]
∠2 = 180° – 135° = 45°

Also, ∠EFG = ∠1 + ∠2 – 34° +45° = 79°
The reflex ∠EFG = 360° – 79° = 281°

107. In Fig. 5.60, two parallel lines l and m are cut by two transversals n and p. Find the values of x and y.



Solution:

Given: l || m and p is a transversal.
So, x + 66° = 180° [Co-interior angles]
x = 180° – 66° = 114°

Now, l || m and n is a transversal.
So, y + 48° = 180° [Co-interior angles]
y = 180° – 48° = 132°
Thus, x = 114° and y = 132°

108. In Fig. 5.61, l, m and n are parallel lines, and the lines p and q are also parallel. Find the values of a, b and c

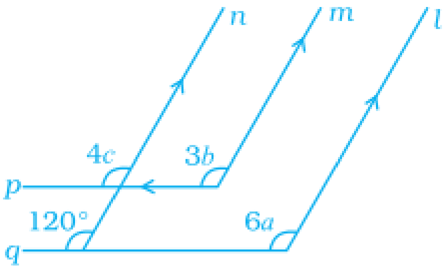


Fig. 5.61

Solution:

Given: l || n and q is a transversal.
So, 6a = 120° [Corresponding angles]

$a = \frac{120°}{6}$

$a = 20°$

Now, p || q and n is a transversal.

So, 4c = 120° [Corresponding angles]

$c = \frac{120°}{4}$

$c = 30°$ … (i)

Also, m || n and p is transversal.

So, 4c = 3b [Corresponding angles]

4 × 30° = 3b [using equation (i)]

$b = \frac{120°}{3}$

$b = 40°$

Hence, a = 20°, b = 40° and c = 30°

109. In Fig. 5.62, state which pair of lines are parallel. Give reason.

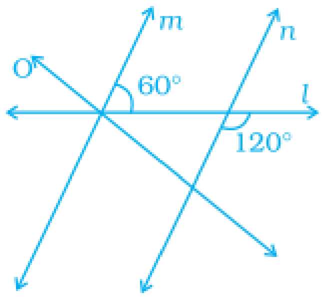
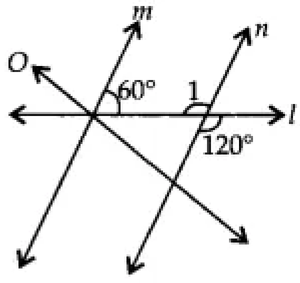


Fig. 5.62

Solution:

Given:



∠1 = 120° [Vertically opposite angles]

Now, 60° + ∠1 = 60° + 120° = 180° and these angles are interior angles on the same side of transversal l.

Hence, m || n as the sum of co-interior angles is 180°

110. In Fig. 5.63, examine whether the following pairs of lines are parallel or not:

(i) EF and GH (ii) AB and CD

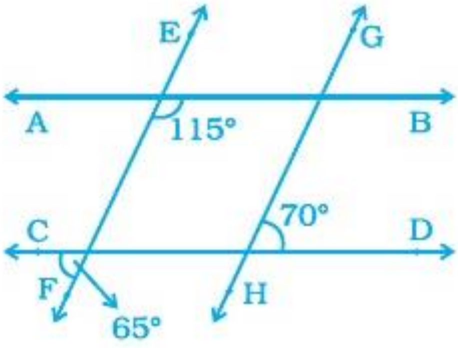
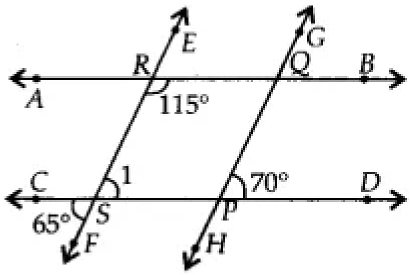


Fig. 5.63

Solution:

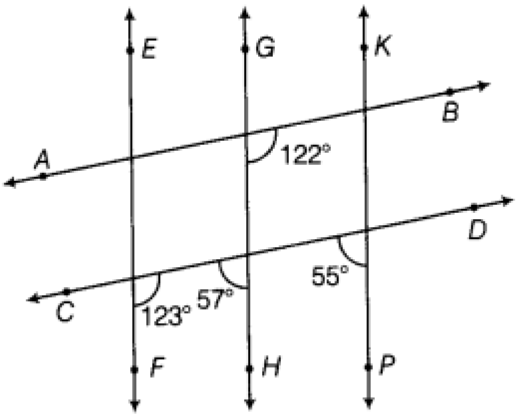
Given:



(i) ∠1 = 65° [Vertically opposite angles]
As ∠RSP and ∠QPD are corresponding angles and are not equal.
Hence, EF and GH are not parallel lines.

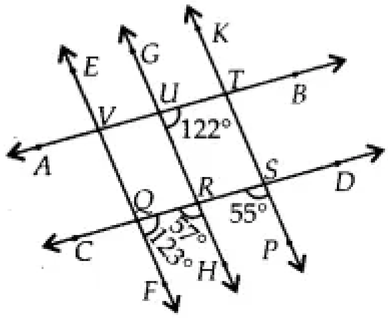
(ii) EF is a straight line.
So, ∠RSC + ∠CSF = 180° [Linear pair]
∠RSC = 180° – 65° = 115°
As angles ∠QRS and ∠CSR are alternate interior angles and are equal.
Hence, AB || CD.

111. In Fig. 5.64, find out which pair of lines are parallel:



Solution:

Given:



∠FOR + ∠QRH = 123° + 57° = 180°
These angles are on the same side of transversal CD.
So, EF || GH

Now, EF || GH and AB is a transversal.
So, ∠TUR = ∠UVQ = 122° [Corresponding angles]
As ∠UVQ and ∠ROF are corresponding angles and are not equal.
Hence, AB and CD are not parallel lines.

112. In Fig. 5.65, show that
(i) AB || CD (ii) EF || GH

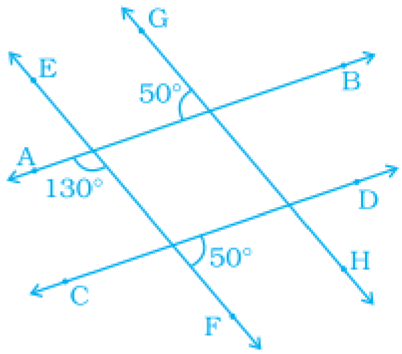
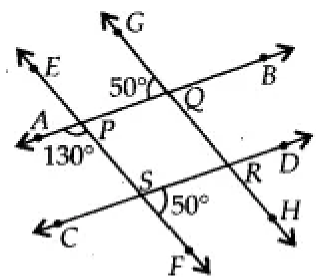


Fig. 5.65

Solution:
Given:

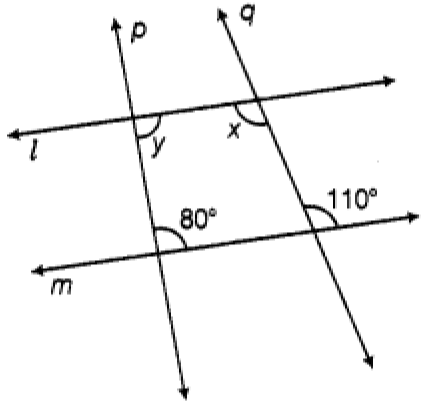


(i) ∠PSC = ∠RSF = 50° [Vertically opposite angles]
∠APS + ∠PSC = 130° + 50° = 180°
As ∠APS and ∠PSC are interior angles on the same side of transversal EF and are supplementary.

Hence, AB || CD

(ii) ∠APS = ∠EPQ = 130° [Vertically opposite angles]
∠EPQ+ ∠GQP = 130° + 50° = 180°
As ∠EPQ and ∠GQP are interior angles on the same side of transversal AB and are supplementary
Hence, EF || GH

113. In Fig. 5.66, two parallel lines l and m are cut by two transversals p and q. Determine the values of x and y.



Solution:

Given: l || m and q is a transversal.
So, x = 110° [Alternate interior angles]
Now, l || m and p is a transversal.
So, y + 80° = 180° [Co-interior angles]

So, y = 180° – 80° = 100°
Hence, x = 110° and y = 100°.