(e) In XYZ,

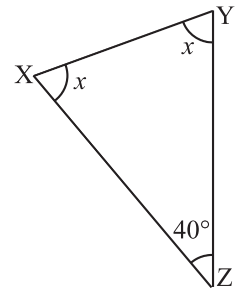
$X \quad Y \quad Z \quad 180$

$x \quad x \quad 40 \quad 180$

$2x \quad 180 \quad 40$

$2x \quad 140$

$x \quad \frac{140}{2} \quad 70$



(f) $x \quad 50$ (vertices opposite angle)

In ABC,

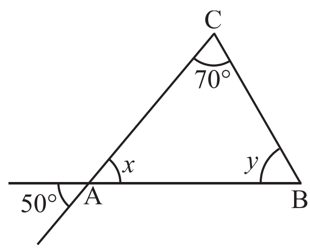
$x \quad y \quad 70 \quad 180$

$50 \quad y \quad 70 \quad 180$

$y \quad 180 \quad 120$

$y \quad 60$

Thus, $y \quad 60$, $x \quad 50$



(g) $y \quad 30$ (vertical opposite angle)

In PQR

$P \quad Q \quad R \quad 180$

$2x \quad x \quad y \quad 180$

$3x \quad 30 \quad 180$

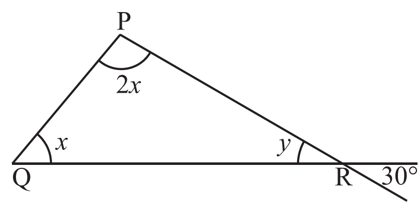
$3x \quad 180 \quad 30$

$3x \quad 150$

$x \quad \frac{150}{3}$

$x \quad 50$

Thus, $x \quad 50$, $y \quad 30$



2. Let the given triangle PQR.

Let $P \quad Q \quad x$ and $R \quad 50$

Then, $P \quad Q \quad R \quad 180$ (sum of three angles of a triangle is 180°)

$x \quad x \quad 50 \quad 180$

$2x \quad 180 \quad 50 \quad 130$

$x \quad \frac{130}{2} \quad 65$

$P \quad Q \quad x \quad 65$

$R \quad 50$

3. Let third angle be x .

Then first angle $\frac{x}{3}$ and second angle $\frac{x}{3}$

Then $x \quad \frac{x}{3} \quad \frac{x}{3} \quad 180$

$\frac{3x \quad x \quad x}{3} \quad 180$

$5x \quad 180 \quad 3$

$$x \quad \frac{\overset{36}{180} \quad 3}{5} \qquad\qquad x \quad 108$$

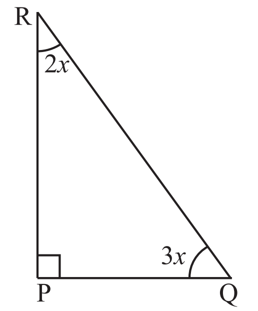
First angle $\frac{108}{3}$ 36 , Second angle $\frac{108}{3}$ 36 and Third angle 108 .

4. Let the acute angles be $2x$ and $3x$

Then In PQR,

$$P \quad Q \quad R \quad 180$$
$$90 \quad 3x \quad 2x \quad 180$$
$$5x \quad 180 \quad 90 \quad 90$$
$$x \quad \frac{90}{5}$$
$$x \quad 18$$

Hence acute angles are 36 ,54



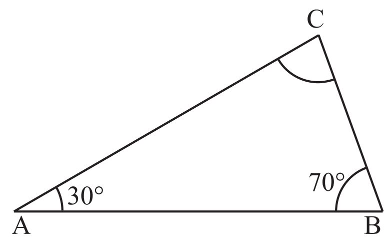
5. Let A 30 , B 70 , C ?

In ABC,

$$A \quad B \quad C \quad 180$$

(Angle sum property)

$$30 \quad 70 \quad C \quad 180$$
$$C \quad 180 \quad 100$$
$$C \quad 80 .$$



Hence, the third angle is 80°.

6. Let the angles be $x, 2x$ and $3x$.

then $x \quad 2x \quad 3x \quad 180$ (Angle sum property)

$$6x \quad 180$$
$$x \quad \frac{180}{6}$$
$$x \quad 30$$

Hence angles are : 30°, 60°, 90°

7. (a) $SRT \quad PRQ$

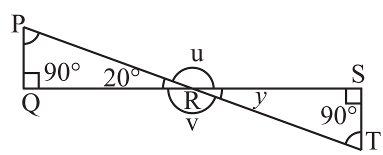
(vertically opposite angles)

$$y \quad 20$$

In PRQ,

$x \quad 20 \quad 90 \quad 180$ (angle sum property)

$$x \quad 110 \quad 180$$
$$x \quad 180 \quad 110 \quad 70$$



Hence, x 70 , y 20

$20 \quad u \quad 180$ (linear pair)

$$u \quad 180 \quad 20 \quad 160$$

$V \quad u$ (vertically opposite angles)

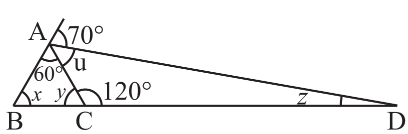
160

(b) $y \quad 120 \quad 180$ (linear pair)

$$y \quad 180 \quad 120 \quad 60$$

In ABC,

$$A \quad B \quad C \quad 180$$
$$60 \quad x \quad y \quad 180$$
$$60 \quad x \quad 60 \quad 180$$



x 180 120 60

60 4 70 180

(sum of all the angles at a point of a straight line is 180°)

u 180 130 50

In ACD,

u 120 z 180 (angle sum property)

50 120 z 180

z 180 170 10

Hence, x 60 , y 60 , u 50 , and z 10 .

(c) x 115 180 (by linear pair)

x 180 115 65

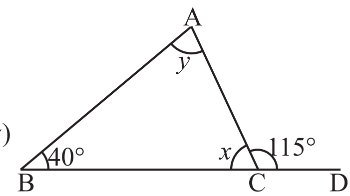
In ABC,

y 40 x 180 (Angle sum property)

y 40 65 180

y 180 105 75

Hence, x 65 y 75



(d) In ACD,

x 45 60 180 (angle sum property)

x 180 105

x 75

y x 180 (by linear pair)

y 75 180

y 180 75

y 105

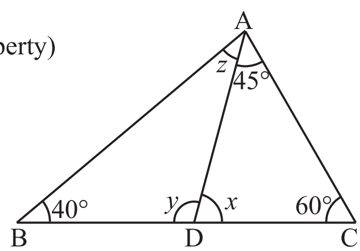
Now, In ABD, we have

z 40 y 180 (angle sum property)

z 40 105 180

z 180 145 35

Hence, x 75 , y 105 , z 35



8. Given DE || BC,

In ABC,

A B C 180

(angle sum property)

30 x 40 180

x 180 70

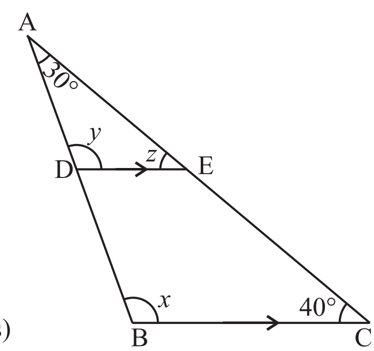
x 110

Since DE || BC and AB is a transversal

y x (corresponding angles)

y 110 and z 40 (corresponding angles)

Hence, x 110 y 110 z 40



9. (a) Yes, sum of three angles of a triangle is 180°. If one of the angle is obtuse angle then the other two are less than 90°.

(b) No, obtuse angle > 90° and as sum of three angles is equal to 180°. Therefore, two angles a can never be 90 .

(c) No, same as above.

(d) No, as sum of three angles = 180° and sum of angle > 60° is greater than 180°. Therefore, it is not possible to have all angles > 60°.

(e) No, if all angles < 60°, their sum will be < 180°.

(f) Yes.

10. One of the angles of a triangle is 75°,

$A \quad 75.$

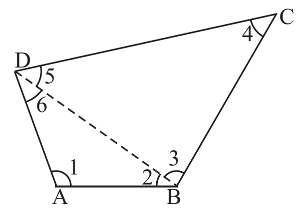
Then $B \quad C \quad 180 \quad A$

$A \quad B \quad C \quad 180 \quad 75 \quad 105.$

Now, the possible measures of the other two angles can be (90°, 15), (60°, 45°), (100 , 5) and so on.

11. Let *ABCD* be a quadrilateral.

Join *B* to *D*. Now, we have two triangles *ABD* and *BCD*.



We know that, in *ABD*

$A \quad B \quad D \quad 180$

(sum of all the angles of a triangle is 180°)

$1 \quad 2 \quad 6 \quad 180$ …(1)

again, in *BCD*

$B \quad C \quad D \quad 180$

$3 \quad 4 \quad 5 \quad 180$ …(2)

adding (1) and (2), we get

$1 \quad 2 \quad 6 \quad 3 \quad 4 \quad 5 \quad 180 \quad 180$

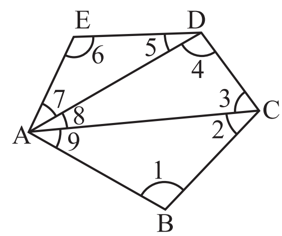
$1 \quad (2 \quad 3) \quad 4 \quad (5 \quad 6) \quad 360$

$A \quad B \quad C \quad D \quad 360$

sum of all the angles of a quadrilateral.

12. Let *ABCDEA* be a pentagon.

Join *A* to *C* and *D*. Now we have three triangles.



In *ABC*,

$A \quad B \quad C \quad 180$ (Angle sum property)

$9 \quad 1 \quad 2 \quad 180$ …(1)

Similarly, In *ACD*, we have

$8 \quad 3 \quad 4 \quad 180$ …(2)

and In *ADE*, we have

$7 \quad 5 \quad 6 \quad 180$ …(3)

Adding (1), (2) & (3), we get

$(9 \quad 1 \quad 2) \quad (8 \quad 3 \quad 4) \quad (7 \quad 5 \quad 6) \quad 180 \quad 180 \quad 180$

$(9 \quad 8 \quad 7) \quad 1 \quad (2 \quad 3) \quad (4 \quad 5) \quad 6 \quad 540$

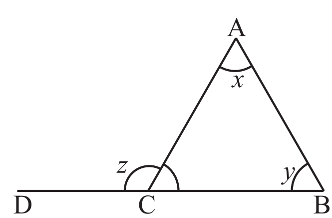
$A \quad B \quad C \quad D \quad E \quad 540$

Hence, sum of all the angles of a pentagon is 540°.

Exercise 10.2

1. An exterior angle of a triangle is equal to the sum of its interior opposite angles.

In this case,



ACD *Z* exterior angle.

CAB and *ABC* is interior angles.

2. No, the exterior angle of a triangle can't be a straight angle.

3. (a) Interior oposite angles are acute.

(b) One of the interior opposite angle may be obtuse (figure 1) or both may be acute angle (figure 2) or one of them is right angle.

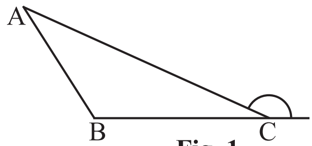


Fig. 1

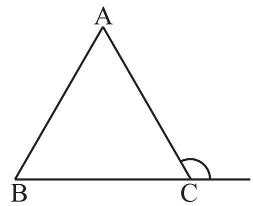


Fig. 2

(c) Sum of interior opposite angles is 90°, i.e., each interior angle < 90°.

4. (a) Yes, since 110 50 60 110

external angle = sum of the interior angles.

(b) Yes, since 95 55 40 95

i.e., external angle = sum of the interior angles.

(c) No, since 70 70 70 140

140 70

external angle sum of interior angles.

(d) Yes, since 120 70 50 120

external angle = sum of interior angles.

5. (a) exterior angle = 40° + 55° = 95°

(b) exterior angle = 60° + 85° = 145°

(c) exterior angle = 75° + 20° = 95°

6. Let other interior opposite angle be x then, we know that

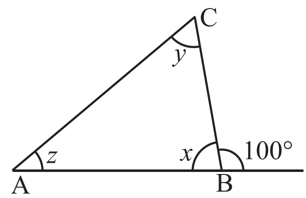
exterior angle 60 x

130 60 x

70 x

x 70

7. (a) exterior angle 100°



x 100 180 (linear pair)

x 180 100

x 80

Let one interior opposite angle be y

Then the other interior opposite angle be z (100 y)

y z 100

So, posible values of y & z can be (60°, 40°), (25°, 75°), (90°, 10°), (80, 20°)

(b) Exterior angle = 80°

x 80 180 (linear pair)

x 180 80 x 100

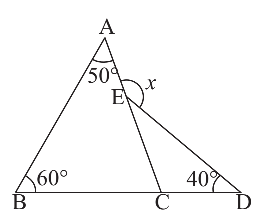
Let one interior opposite angle by y then the other interior opposite angle be

z (80 y)

y z 80

so, possible values of y and z can be (40°, 40°), (30°, 50°), (60°, 20°), (25°, 55°) and (35°, 45°)

8. (a) In ABC, we know that



A B C 180

(sum of all the angles of a triangle)

50 60 C 180

C 180 110 70

Now, ACB ACD 180 (by linear pair)

70 ACD 180

ACD 180 70 110

In ECD, x is the exterior angle so,

x b 40

ACD 40

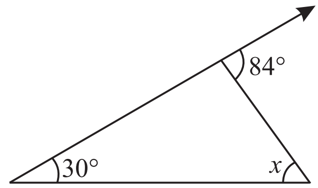
110 40 150 x 150

(b) By exterior angle property

30 x 84

x 84 30

x 54



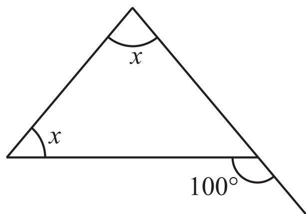
(c) By exterior angle property

x x 100

$2x$ 100

x $\frac{100}{2}$ 50

x 50



9. Let interior opposite angles be $3x$ and $4x$.

exterior angle = 140°

Therefore, by the exterior angle property

$3x$ $4x$ 140 $7x$ 140

x $\frac{140}{7}$ 20

Hence, interior opposite angles are 60° and 80°.

10. Exterior angle = 110°

Let both interior opposite angles x

x x 110 $2x$ 110

x $\frac{110}{2}$ 55

Hence, each interior opposite angle is 55°.

Sum of all the angles of a triangle 180

x x C 180

55 55 C 180

C 180 110 C 70

11. Exterior angle 120

Let interior oppisite angle are $1x$ and $2x$.

$1x$ $2x$ 120 (by exterior angle property)

$3x$ 120

x $\frac{120}{3}$ 40

A 1 x 1 40 40

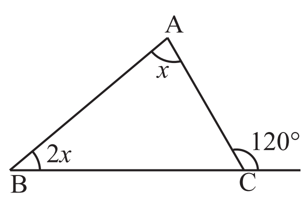
B 2 x 2 40 80

In ABC, we have

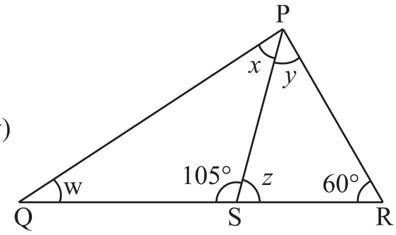
A B C 180

40 80 C 1800

C 180 120 C 60



12. *PS* is the bisector of *QPR*



$x \quad y$

In *PRS*, we have

105 y 60 (exterior angle property)

y 105 60 45

x 45 [∵ x y]

In *PRS*, y z 60 180 (Angle sum property)

45 z 60 180

z 180 105

z 75

In *PQS*, we have

w x z w 45 75

w 75 45 w 30

Hence, x y 45 , w 30 , z 75

13. (a) a 116 180 (by linear pair)

a 180 116 64

now, y a 124

(by exterior angle property)

y 64 124

y 124 64

y 60

(b) b 135 180 (by linear pair)

b 180 135

b 45

Now, y b 110

(by exterior angle propery)

y 45 110

y 110 45 65

Exercise 10.3

1.

S.No.	Equal Sides	Equal Angles
(a)	In *ABC*; *AB* *AC*	*C* *B*
(b)	In *ABC*, *BC* *AC*	*A* *B*
(c)	In *PQR*, *PQ* *PR*	*Q* *R*
(d)	In *ABC*, *AB* *BC*	*C* *A*

2. (a) Given, *AB* *AC* 45 x x 45

(b) Given, *PQ* *PR* 60 x x 60

(c) Given, *DF* *DE* 55 *F* *E* 55

Now, In *DEF*

D *E* *F* 180

y 55 55 180

y 180 110 70

(d) Given, *PQ* *QR* 45 *P* *R* 45

Now, In *PQR*, we have

$P \quad Q \quad R \quad 180$

$45 \quad z \quad 45 \quad 180$

$z \quad 180 \quad 90 \quad 90$

(e) Given, $AB \quad AC$

$C \quad B$ $\qquad C \quad x$

(f) Given, $DE \quad DF$ $\qquad F \quad 62$

Now, $y \quad E \quad F$ (by exterior angle property)

$y \quad 62 \quad 62 \quad 124$

(g) Given $PQ \quad PR$ $\qquad PRQ \quad PQR$

$QPR \quad 80$ (vertically opposite angle)

In PQR, we have

$P \quad Q \quad R \quad 180$

$80 \quad Q \quad R \quad 180$ [$\because$ $R \quad Q$ by (1)]

$2 \quad Q \quad 180 \quad 80$

$Q \quad \frac{100}{2} \quad 50$ $\qquad R \quad 50$

Now, $P \quad Q \quad x$ (by exterior angle property)

$80 \quad 50 \quad x$

$130 \quad x$

$x \quad 130$

(h) Given, $AB \quad AC$

ABC, we have

$A \quad B \quad C \quad 180$

$30 \quad C \quad C \quad 180$

$2 \quad C \quad 180 \quad 30$

$C \quad \frac{150}{2} \quad 75$

Now, $y \quad A \quad C$ (by exterior angle property)

$y \quad 105$

(i) Given, $QR \quad PR$

$P \quad Q$ …(1)

$QRP \quad 98$ …(2) (vertically apposite angle)

In PQR, $P \quad Q \quad R \quad 180$

$Q \quad Q \quad 98 \quad 180$ [from (1) & (2)]

$2 \quad Q \quad 180 \quad 98 \quad 82$

$Q \quad \frac{82}{2} \quad 41$

$x \quad Q$ (vertically opposite angle)

$x \quad 41$

(j) Given, $QR \quad PR$

$x \quad R$ …(1)

$y \quad 106 \quad 180$ (by linear pair)

$y \quad 180 \quad 106 \quad 74$ …(2)

In PQR, we have

$P \quad Q \quad R \quad 180$

$x \quad x \quad y \quad 180$

$2x \quad 74 \quad 180$ [(from (1) &(2)]

$2x \quad 180 \quad 74 \quad 106$

$x \quad \frac{106}{2} \quad 53$.

Hence, x 53 , y 74

(k) Given, $AB \quad DB \quad BC$

since $AB \quad DB$ $\qquad Z \quad 40$

Now, $A \quad Z \quad x$ (by exterior angle property)

$40 \quad 40 \quad x$ $\qquad x \quad 80$

again, $DB \quad BC$ $\qquad C \quad y$ …(1)

But in BCD, we have

$x \quad y \quad c \quad 180$

$80 \quad y \quad y \quad 180$ [by (1)]

$2y \quad 180 \quad 80 \quad 100$

$y \quad \frac{100}{2} \quad 50$

3. Given, $AB \quad AC$ $\qquad C \quad B$ …(1)

In ABC, we have

$A \quad B \quad C \quad 180$

$30 \quad B \quad B \quad 180$ [by (1)]

$2 \quad B \quad 180 \quad 30 \quad 150$

$B \quad \frac{150}{2} \quad 75$

$C \quad B \quad 75$

Now, $ABC \quad x \quad 180$ (by linera pair)

$75 \quad x \quad 180$

$x \quad 180 \quad 75 \quad 105$

again, $ACB \quad y \quad 180$

$75 \quad y \quad 180$

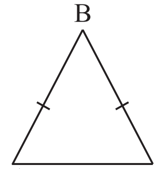
$y \quad 180 \quad 75 \quad 105$

4. Given, $AB \quad BC$ and $B \quad 2 \quad A$ …(1)

Since $AB \quad BC$

$C \quad A$ …(2)

In ABC, we know that



$A \quad B \quad C \quad 180$

$A \quad 2 \quad A \quad A \quad 180$ [from (1) & (2)]

$4 \quad A \quad 180$

$A \quad \frac{180}{4} \quad 45$

$B \quad 2 \quad 45 \quad 90$

$C \quad A \quad 45$

Exercise 10.4

1. (a) 8 cm, 15 cm, 17 cm

Let a 8 cm, b 15 cm, c 17 cm

$a^2 \quad b^2 \quad 8^2 \quad 15^2 \quad 64 \quad 225 \quad 289$

$c^2 \quad 17^2 \quad 289$

Since, $8^2 \quad 15^2 \quad 17^2$

i.e., $a^2 \quad b^2 \quad c^2$

Hence, these are the sides of a right-angled triangle. (By the converse of Pythagoras property)

(b) 3 cm, 3 cm, 9 cm

Let a 3, b 3, c 9

$$a^2 \quad b^2 \quad (3)^2 \quad (3)^2 \quad 9 \quad 9 \quad 18$$

$$c^2 \quad 9^2 \quad 81$$

Since $a^2 \quad b^2 \quad c^2$

(c) Let a 2.5 cm, b 6.5 cm, c 6 cm

$$a^2 \quad c^2 \quad (2.5)^2 \quad (6)^2 \quad 6.25 \quad 36 \quad 42.25 \text{ cm}^2$$

$$b^2 \quad (6.5)^2 \quad 42.25 \text{ cm}^2$$

Since, $a^2 \quad c^2 \quad b^2$

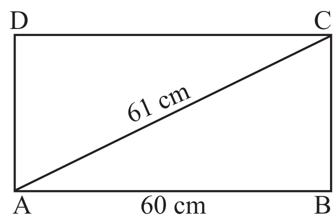
These sides can be the sides of a right triangle.

(d) Let a 16 cm, b 30 cm, c 34 cm

$$a^2 \quad b^2 \quad (16)^2 \quad (30)^2 \quad 256 \quad 900 \quad 1156$$

$$c^2 \quad (34)^2 \quad 1156$$

2. In right ABC,



$$(61)^2 \quad b^2 \quad 60^2$$

$$3721 \quad 3600 \quad b^2$$

$$121 \quad b^2$$

$$b \quad 11$$

$$P \quad 2(l \quad b)$$

$$2(60 \quad 11) \quad 2 \quad 71 \quad 142 \text{ cm}$$

3. Let 0 be the Isha's initial Position.

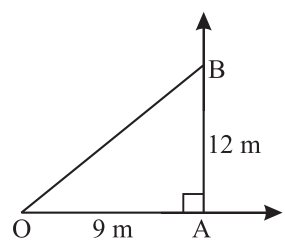
OA 9 m, AB 12 cm

$$OB^2 \quad A^2 \quad AB^2$$

$$OB^2 \quad 9^2 \quad 12^2$$

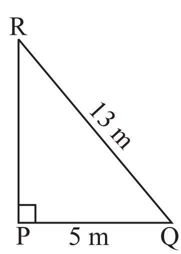
$$81 \quad 144 \quad 225$$

$$OB \quad \sqrt{225} \quad 15 \text{ m}$$



(Isha's initial position)

4. In right angled PQR



$$RQ^2 \quad PR^2 \quad QR^2$$

$$(13)^2 \quad PR^2 \quad (5)^2$$

$$169 \quad 25 \quad PR^2$$

$$PR \quad \sqrt{144}$$

$$PR \quad 12 \text{ m}$$

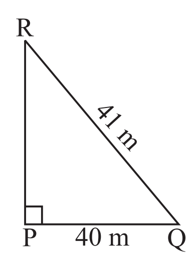
5. Let QR 41 m, PQ 40 m

Then, $PR^2 \quad (41)^2 \quad (40)^2$

$$1681 \quad 1600$$

$$PR \quad \sqrt{81}$$

$$PR \quad 9 \text{ m}$$



6. (a) In right ABC,

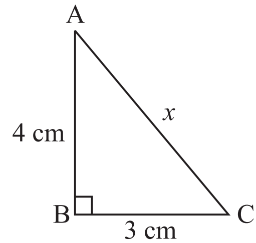
$AC^2 \quad AB^2 \quad BC^2$ by

$x^2 \quad (4)^2 \quad (3)^2$

$x^2 \quad 16 \quad 9 \quad 25$

$x \quad \sqrt{25}$

$x \quad 5\,\text{cm}$



(b) In right PQR

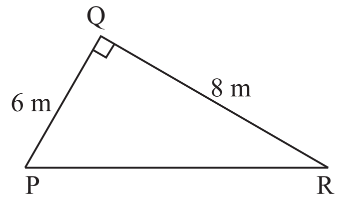
$PR^2 \quad QP^2 \quad QR^2$

$PR^2 \quad 6^2 \quad 8^2$

$36 \quad 64$

100

$PR \quad \sqrt{100} \quad 10\,\text{m}$



(c) In right DEF,

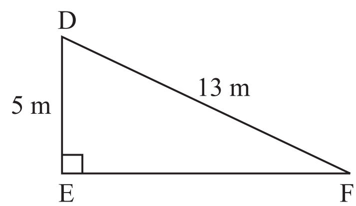
$DF^2 \quad DE^2 \quad EF^2$

$13^2 \quad 5^2 \quad x^2$

$169 \quad 25 \quad x^2$

$\sqrt{144} \quad x$

$x \quad 12\,\text{m}$



(d) In right ACD

$AC^2 \quad AD^2 \quad DC^2$

$(12)^2 \quad 3^2 \quad DC^2$

$144 \quad 9 \quad DC^2$

$135 \quad DC^2$ …(1)

In right ABD,

$AB^2 \quad AD \quad BD^2$

$5^2 \quad 3^2 \quad BD^2$

$25 \quad 9 \quad BD^2$

$BD \quad \sqrt{16} \quad 4$

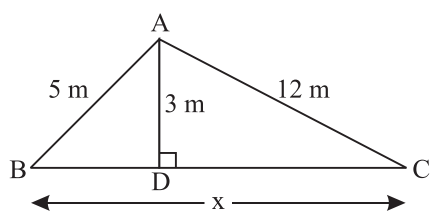
$DC \quad x \quad 4$ …(2)

From (1) & (2)

$135 \quad (x \quad 4)^2$

$\sqrt{135} \quad x \quad 4$

$x \quad 4 \quad \sqrt{135}$



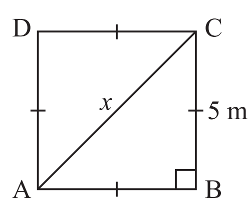
(e) In right ABC

$AC^2 \quad AB^2 \quad CB^2$

$x^2 \quad 5^2 \quad 5^2 \quad 50$

$x \quad \sqrt{50}$

$x \quad 5\sqrt{2}$



(f) In right PQR

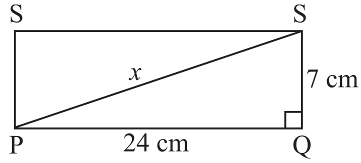
$PS^2 \quad PQ^2 \quad SQ^2$

$x^2 \quad 24^2 \quad 7^2$

$576 \quad 49$

$x^2 \quad 625$

$x \quad \sqrt{625} \qquad x \quad 25\,\text{cm}$



7. Let AC be the width of the road and B be the foot of the ladder.

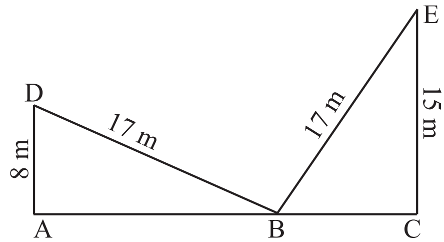
In right BCE,

$(17)^2 \quad (15)^2 \quad BC^2$

$289 \quad 225 \quad BC^2$

$BC^2 \quad 64$

$BC \quad \sqrt{64} \quad 8\,\text{m}$



In right ABD,

$(17)^2 \quad (8)^2 \quad AB^2$

$289 \quad 64 \quad AB^2$

$225 \quad AB^2$

$AB \quad \sqrt{225} \quad 15\,\text{m}$

Hence, width of the road $AC \quad AB \quad BC$

$15 \quad 8 \quad 23\,\text{m}$

8. Given $BC^2 \quad 98\,\text{cm}\ AB \quad AC$

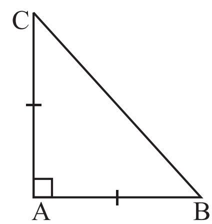
In right ABC, we have

$BC^2 \quad AC^2 \quad AB^2$

$98 \quad AC^2 \quad AC^2$

$AC^2 \quad \frac{98}{2} \quad 49$

$AC \quad \sqrt{49} \quad 7\,\text{cm} \qquad AB \quad AC \quad 7\,\text{cm}$



9. Given $BC^2 \quad 162\,\text{cm}^2$, $AB \quad AC$

In right ABC

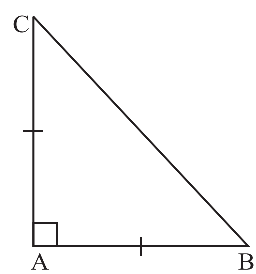
$BC^2 \quad AC^2 \quad AB^2 \qquad [\because AB \quad AC]$

$162 \quad AC^2 \quad AC^2$

$2AC^2 \quad 162$

$AC \quad \sqrt{81}$

$AC \quad 9\,\text{cm}$



Hence, $AB \quad AC \quad 9\,\text{cm}$.

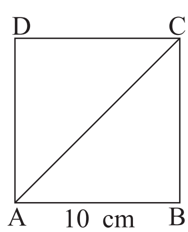
10. In right ABC,

$AC^2 \quad AB^2 \quad BC^2$

$(10)^2 \quad (10)^2$

200

$AC \quad \sqrt{200} \quad 10\sqrt{2}$

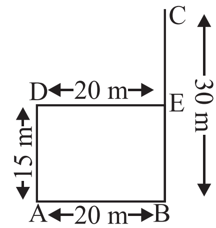


11. $CE \quad BC \quad BE \quad BC \quad AD$ ($\because BE \quad AD \quad 15\,\text{m}$)

$$CE \quad 30 \quad 15 \quad 15$$

In right $\quad CDE$,

$$DC^2 \quad 20^2 \quad 15^2$$
$$400 \quad 225$$
$$DC \quad \sqrt{625}$$
$$DC \quad 25\,\text{m}$$



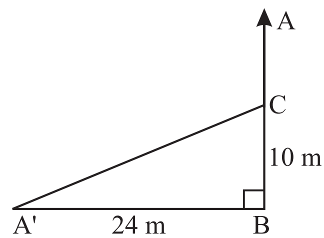
12. Let the actual height of the tree $\quad AB \quad$ where $AC \quad A'C$

In right $\quad A'BC$,

$$(A'C)^2 \quad (10)^2 \quad (24)^2 \quad 100 \quad 576$$
$$A'C \quad \sqrt{676} \quad 26\,\text{m}$$
$$AC \quad A'C \quad 26\,\text{m}$$

Hence, the actual height of the tree $\quad AC \quad BC$

$$26 \quad 10 \quad 36\,\text{m}$$



13. Given, $\quad A \quad 30$, $\quad B \quad 60$, $\quad B \quad 60$

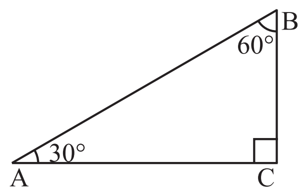
then $\quad C \quad 180 \quad (60 \quad 30\ )$

$$180 \quad 90$$
$$C \quad 90$$

In right $\quad ABC$, we have

$$AB^2 \quad AC^2 \quad BC^2,$$

Which is true for condition (a).

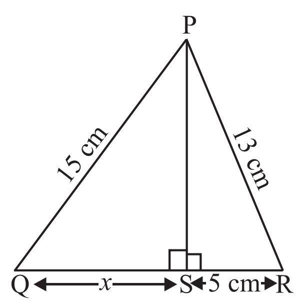


14. In right $\quad PRS$

$$PS^2 \quad (PR)^2 \quad (SR)^2$$
$$13^2 \quad 5^2$$
$$169 \quad 25 \quad 144$$
$$PS \quad \sqrt{144} \quad 12$$

In right $\quad PQS$

$$QS^2 \quad PQ^2 \quad PS^2$$
$$x \quad 15^2 \quad 12^2$$
$$225 \quad 144 \quad 81$$
$$x \quad \sqrt{81} \quad 9\,\text{cm}$$



15. Let $ABCD$ be a rhombus whose diagonals are $AC \quad 10\,\text{cm}$ and $BD \quad 24\,\text{cm}$

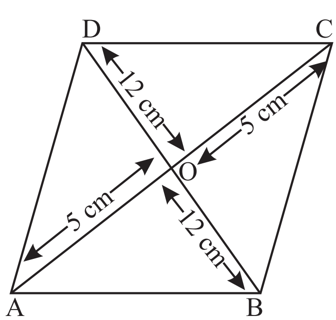
Since diagonals of a rhombus bisect each other at right angles.

$$AO \quad OC \quad \frac{AC}{2} \quad \frac{10}{2} \quad 5\,\text{cm}$$
$$BO \quad OD \quad \frac{BD}{2} \quad \frac{24}{2} \quad 6\,\text{cm}$$

In right $\quad AOB$,

$$AB^2 \quad AO^2 \quad BO^2$$
$$AB^2 \quad (5)^2 \quad (12)^2$$
$$25 \quad 144 \quad 169$$
$$AB \quad \sqrt{169} \quad 13\,\text{cm}$$

Hence, $AB \quad BC \quad CD \quad DA \quad 13\,\text{cm}$



Now, $P \quad AB \quad BC \quad CD \quad DA$

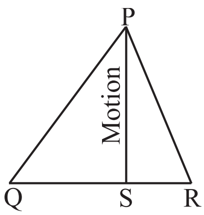
$13 \quad 13 \quad 13 \quad 13$

$P \quad 52\,\text{cm}$

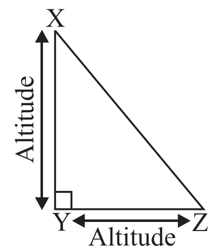
Exercise 10.5

1. **Fill in the blanks :**
   (a) The altitude of a triangle is the **perpendicular** from vertex to the **opposite** side.
   (b) Median of a triangle is a line segment that joins a **vertex** to the **mid-point** of the opposite side.
   (c) If ABC is right angled at C, then $\boldsymbol{BC}$ and $\boldsymbol{AC}$ are two of the altitudes of the triangle.
   (d) In DEF, P is the mid-point of EF.
   DP is **median** DQ is **Altitude**
   $EP \quad \dfrac{\mathbf{EE}}{\mathbf{2}}$

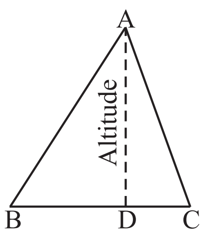
2. (a)



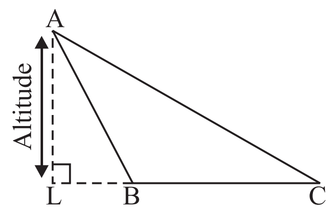
(b)



(c)



(d)



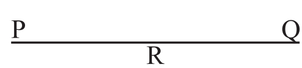
MCQ's

1. (c)	**2.** (c)	**3.** (b)	**4.** (a)
5. d)	**6.** (b)	**7.** (a)	**8.** (c).

11 Congruence of Triangles

Exercise 11.1

1. $\overline{XY} \quad 4.2$ cm,
   $\because \quad \overline{MN} \quad \overline{XY}$
   $\overline{MN} \quad \overline{XY} \quad 4.2$



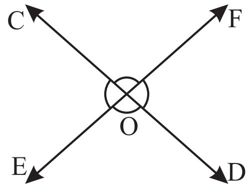
2. $\because$ R is the mid point of $\overline{PQ}$
   $\overline{PR} \quad \overline{RQ}$
   If two line segments are equal in length, they are called identical.
   $\because$ Identical line segments are said to be congruent.
   $\overline{PR} \quad \overline{RQ}$

3. Figure (i), (ii), (iii), (vii), (viii), (ix), (x), (xi), (xiii) are congruent.

4. Here, $COF \quad EOD$ (Vertical opposite angle)

and $COE \quad FOD$ (Vertical opposite angle)

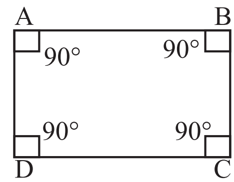
So, $COF \quad EOD$ and $COE \quad FOD$



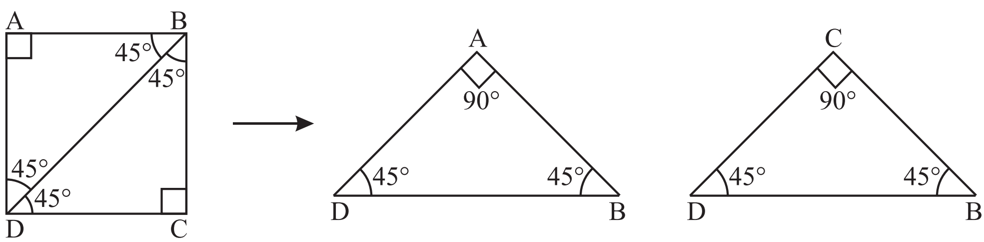
5. Yes, ∵ each of the angle of a rectangle measures 90°.

$A \quad B \quad C \quad D \quad 90$

then any two angles of a rectangle are congruent.



6. A diagonal divides a square into two isosceles triangles.



In ABD and DCB

$AD \quad DC$ (edges of square)

$AB \quad CB$ (edges of square)

$DAB \quad DCB \quad 90$ (angle of square) DB common line segment.

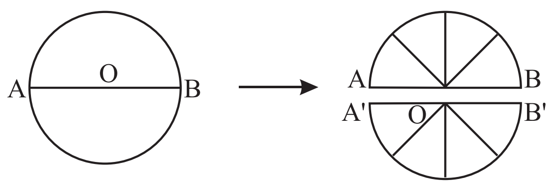
∵ $AB \,||\, DC$

$ABD \quad BDC$ (Alternate angle)

$CBD \quad ADB$ (Alternate angle)

Hence, $ABD \quad DCB$

7.



Yes, diameter divide the circle into two equal (congruent) parts called semicircle.

8. Fill in the blanks :

(a) Two circles are congruent, if they have the same **radius.**

(b) Two angles are congruent, if they are equal in **degree** measure.

(c) If two figures have the same **shape** and **dimension**, they are congruent.

(d) Two rectangles will be **congruent**, if their respective lengths and breadths are equal.

(e) If ABC is superimposed over DEF and DEF is covered completely, then the two triangles are **congruent.**

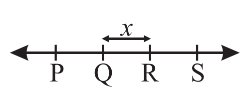
9. ∵ $\overline{PQ} \quad \overline{RS}$

$PQ \quad PS \quad QS$

and $RS \quad PS \quad PR$

∵ $PQ \quad \overline{RS}$

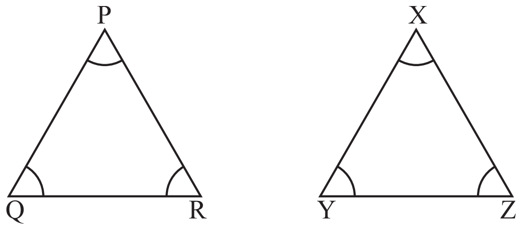
then $PS \quad QS \quad PS \quad PR$



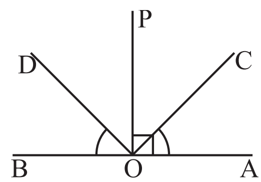
Hence $\quad \frac{QS}{PR} \quad \frac{PR}{QS} \qquad (\because QS \quad PR)$

10. No, because their angles will be used but sides may or may not be equal.

11. $\because \quad PQR \quad XYZ \quad \overline{PQ} \quad \overline{XY}$



12. In the figure, $\overline{OP} \quad \overline{BOA} \quad AOC \quad BOD$



$\because \quad POB \quad POA \quad 90 \qquad (\because \overline{OP} \quad \overline{BOA})$

$(\because \quad POB \quad POD \quad BOD$

and $\quad POA \quad POC \quad COA)$

then $\quad POD \quad DOB \quad POC \quad DOB$

$(\because \quad COA \quad DOB$ Given)

$POD \quad POC \quad DOB \quad DOB$

$POD \quad POC$

Hence, $\quad POD \quad POC.$

Exercise 11.2

1. Here, $\quad BC \quad PR$

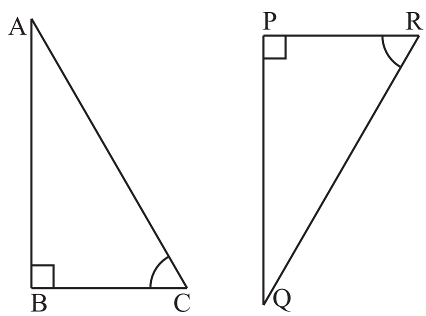
$AC \quad QR$

$C \quad R$

(Included angles)

$ABC \quad PQR$

(by SAS rule of congruence)



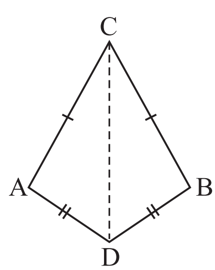
2. Considering $\quad ACD$ and $\quad CDB$, we have

$AC \quad CB$ (Given)

$AD \quad DB$ (Given)

$CD \quad CD$ (Common side)

$ACD \quad CDB$ (By SAS rule of congruence)

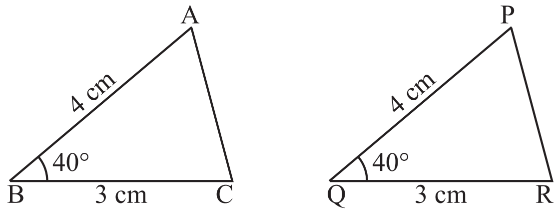


3. (a) Considering $\quad ABC$ and $\quad PQR$ we have

$AB \quad PQ \quad 4$ cm (Given)

$BC \quad QR \quad 3$ cm

$B \quad Q \quad 40$ (Given)



ABC *PQR* (By SAS rule of congruence)

(b) Considering *ABC* and *DEF*

We have *AB* *DE* 6 (Given)

B *E* 50 (Given)

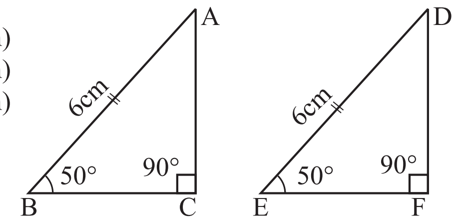
C *F* 90 (Given)

A *D*

(∵ two angles of triangles are equal)

ABC *DEF*

(By Angle side Angle rule of)



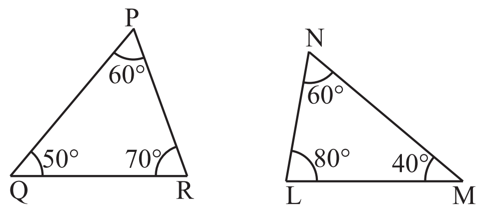
(c) Considering *PQR* and *LMN*

P *N* 60 (Given)

Q *L*

R *M*

triangles cannot be congruence.



4. *AO* *OB* (Given)

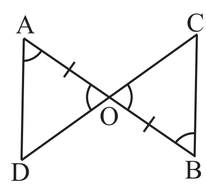
AD || *CB* (Given)

AOD *BOC* (Vertical opposite angles)

CBO *OAD* (∵ *AD* || *CB* Alternate angles)

then *AOD* *COB* (By ASA rule of congruence)

Hence, *OD* *OC* (∵ *AOD* *COB*)



5. Two right triangles congruent, if the hypotenuse and one side of the first triangle are respectively equal to the hypotenuse and one side of the second.

Here *P* *X* 90

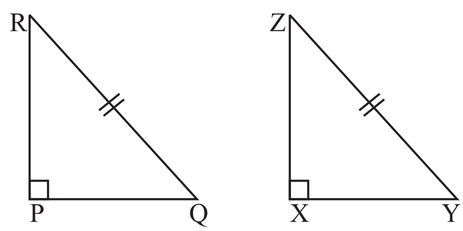
and *QR* *YZ* (Given)

So, the triangle are congruent under

RHS congruent condition

if either *PR* *XZ*

or *PQ* *XY*



6. Considering *ABD* and *ADC*

We have, *AB* *AC*

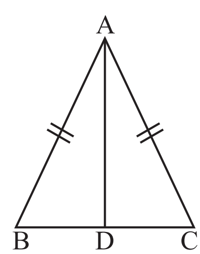
BAD *DAC*

AD *AD*

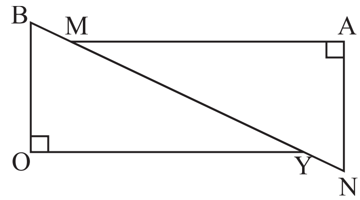
(common side)

ABD *ADC*

(by SAS rule of congruent)



7. Considering BOY and MAN



We have, $BOY \quad MAN \quad 90$ (Given)

$OY \quad AM$ (Given)

$BM \quad YN$ (Given)

$BY \quad BN \quad YN$ ...(i)

and $MN \quad BN \quad BM$

$BN \quad MN \quad BM$

Put the value of BN is the equation (i)

then $BY \quad BN \quad YN$

$MN \quad BM \quad YN$

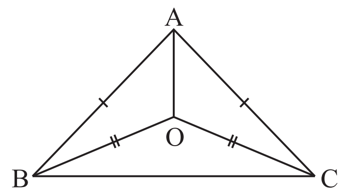
($\because BN \quad MN \quad BM$)

$BY \quad MN \quad YN \quad YN$ ($\because BM \quad YN$)

$BY \quad MN$

So, $BYO \quad NMA$ (By RHS congruent rule)

8. Considering OAB and OAC we have,



$BO \quad OC$ (Given)

$AB \quad AC$ (Given)

$AO \quad OA$ (Common side)

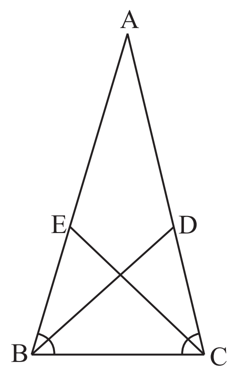
So, $OAB \quad OAC$

(by SSS rule of congruence)

Then, $ABO \quad ACO$

($\because \quad AOB \quad AOC$)

9. Considering BDC and CEB



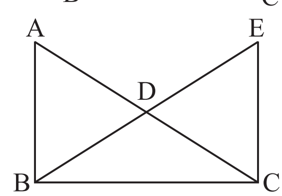
We have $BC \quad BC$ (Common side)

$EBC \quad BCD$ (isosceles triangle)

$BCE \quad DBC$ (bisect angle are equal)

So, $BDC \quad CEB$ (By ASA rule of congruence)

10. (a) Consider ADB and CDE



We have $BD \quad DE$ (Given)

$AD \quad DC$ (Given)

$ADB \quad CDE$ (vertical opposite angle)

$ADB \quad CDE$

(By SAS rule of congruence)

(b) Consider ABC and ECB $BC \quad BC$ (common side)

$A \quad E$ ($\because \quad ABD \quad CDE$)

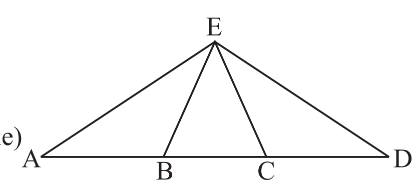
$AB \quad CE$ ($\because \quad ABD \quad CDE$)

$ABC \quad FCB$ (By SAS rule of congruence)

(c) $\because \quad BCA \quad BCE$

Hence, $BCE \quad ABC \quad 90$

11. Consider ABE and CDE we have



$CD \quad AB$ (Given)

$ED \quad EA$ (Given isosceles triangle)

$EAB \quad EDC$ (angle of isosceles triangle)

$ABE \quad CED$

(By SAS rule of congruence)

BE *EC* Hence, *BEC* is also a isosceles triangle.

MCQ's

1. (d) **2.** (d) **3.** (a) **4.** (b) **5.** (c)

12 Practical Geometry

Exercise 12.1

1. Steps to construct :

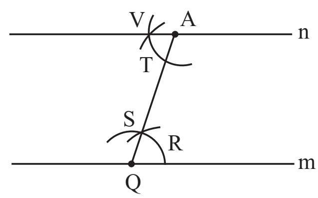
(a) Draw a line m using a ruler and mark a point *A* outside m.

(i) Take any point *Q* on m. Join *AQ*.

(ii) With *Q* as centre and a suitable radius drawn an arc using compas to cut m at *R* and *QA* at *S*.

(iii) With *A* as centre and the same radius drawn an arc, cutting *AQ* at *T*.

(iv) Now place the pointed tip of the compass at *R* and adjust the opening so that the pencil tip is at *S*.



(v) With *T* as centre and the same radius *RS*, draw an arc cutting the previous arc at *V*.

(vi) Join *AV* and produce it on both sides to get the required line *n* parallel to *m.*

(b) Infinite number of lines can be drawn from the point *A*.

(c) One and only one line would be parallel to the line *m*, which is line *n*.

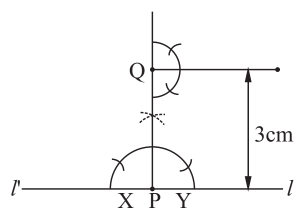
2. Step to construct :

(a) Draw a line (i.e., *l' l* using a ruler).

(b) Mark a point *P* on *l* and with *P* as centre, draw an arc intersecting *l* at *X* and *Y*.

(c) A gain taking *X* as centre and with the same radius, draw an arc intersecting the previous arc *XY* at *M*.

(d) Taking *M* as the centre and with the same radius, draw another arc intersecting arc *XY* at *N*.



(e) With *M* and *N* as centres and with the same radius, draw arcs such that they intersect each other at point *K*. Join *P* and *K* such that *KPl'* 90 *KPl.*

(f) Now mark a point *Q* on perpendicular *PK* such that *QP* 3 cm.

(g) Again construct a right angle at *Q* by following the steps *a* to *e.*
Since *EQD* *QPl* 90 (corresponding angles)
so, *QD* is parallel to *l* or *l' l.*

(h) Line *QD.* thus constructed, is at a distance of 3 cm away from *l' l* and is parallel to line *l* i.e., *QD* || *l.*

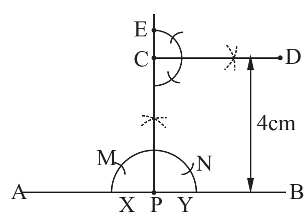
3. Steps to construct :

(a) Draw a line *AB* using a ruler.s

(b) Mark a point *P* on *AB* and with *P* as centre, draw an arc intersecting *AB* at *X* and *Y*.

(c) Again taking *X* as centre and with the same radius, draw an arc intersecting the previous arc *XY* at *M*.

(d) Taking *M* as the centre and with the same radius, draw another arc intersecting arc *XY* at *N*.



(e) With M and N as centres and with the same radius, draw arcs such that they intersect each other at point Q. Join P and Q such that QPA 90 QPB.

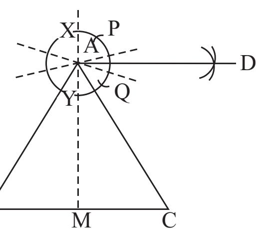
(f) Now mark a point C on perpendicular as PQ such that PC 3 cm.

(g) Again construct a right angle at C by following the steps a to e.
Since ECD CPB 90 (corresponding angles)
so, CD is parallel to AB.

(h) Line CD, thus constructed, is at a distance of 4 cm from AB and is parallel to line AB, i.e., $CD \parallel AB$.

4. Do yourself.

5. Steps to construct :



(a) Draw a line BC using a ruler.

(b) With B as centre and radius more than half of BC, draw an arc on one the uspsid by BC.

(c) Similarly, with C as centre and radius more than half of CB, draw an arc intersecting the first arc at A.

(d) Join B to A and C to A.

(e) Draw perpendicular AM on side BC.

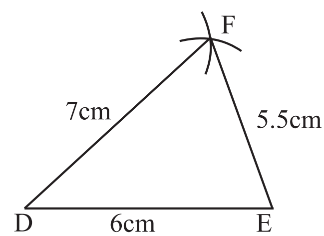
(f) Now with A as centre draw two arcs on produced perpendicular AM intersecting AM at X and Y.

(g) Construct a right angle at A by drawing necessary arcs which intersect at point D.

(h) Join AD. Thus AD is parallel to BC.

Exercise 12.2

1. Steps to construct :



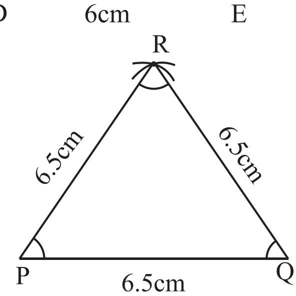
(a) Draw a line segment DE of length 6 cm.

(b) With D as centre and radius 7 cm, draw an arc using a compass.

(c) With E as centre and radius 5.5 cm, draw another arc, cutting the previous arc at F.

(d) Join FD and FE. Then DEF is the required triangle.

2. Steps to construct : given PQ QR RP 6.5 cm.



(a) Draw a line segment PQ 6.5 cm.

(b) With P as centre and radius 6.5 cm, draw an arc using a compass.

(c) With Q as centre and radius 6.5 cm, draw another arc. Cutting the previous arc at R.

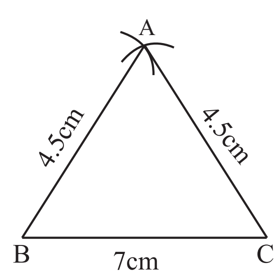
(d) Join RP and RQ. Then PQR is the required triangle.

(e) Measuring P, Q and R 60 .

Thus, we can conclude that in equilateral triangle all the three sides are same and all the three angles are of equal measurement.

3. Given an isosceles in which AB AC 4.5 cm, BC 5.5 cm.

First draw a rough sketch of ABC.



Steps to construct :

(a) Draw a line segment BC 5.5 cm.

(b) With B as centre and radius 4.5 cm, draw an arc using a compass.

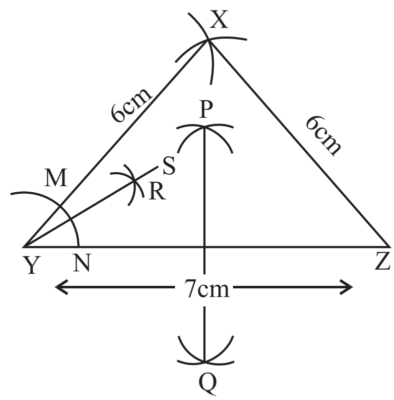
(c) With C as centre and same radius 4.5 cm, draw another arc, cutting the previous arc at A.

(d) Join *AB* and *AC*.
Then *ABC* is the required triangle.
(e) Measuring *B* and *C* with the help of protractor.

4. Given *XYZ* with *XY* 6 cm, *YZ* 7 cm, *ZX* 5.5 cm.

Steps to construct :

(a) Draw a line segment *YZ* 7 cm.
(b) With *Y* as centre and radius 6 cm, draw an arc using a compass.
(c) With *Z* as centre and radius 5.5 cm draw another arc, cutting the previous arc a *X*.
(d) Join *XY* and *XZ*.
then *XYZ* is the required triangle.
(e) Now *Y* and *Z* as centre respectively and radius more than half of radius *YZ* (i.e., length of *YZ*) draw two arc cutting each other on both sides as given.
(f) With *Y* as centre draw an arc of any radius which intersect the side *XY* and side *YZ* at point. *M*, *N* respectively.



(g) Now taking *M* and *N* as centre, draw two arcs of same radius or radius more than half of *MN*, which intersect each other at point *R*.
(h) Finally, produce *YR* to *S*. This line segment *YS*. Bisect *XYZ*.

5. (a) Let *a* 8 cm, *b* 4 cm, *c* 3 cm *a* *b* 8 4 13 cm > 3

b *c* *a*
b *c* 4 3 7 8
b *c* *a*
c *a* 3 8 11 4
c *a* *b*

Since, the sum of two side of the three sides < the third triangle.
Hence, with these sides this triangle can't be constructed.

(b) 7 15 5   15 5 7   5 7 15
with these sides triangle can't be constructed.

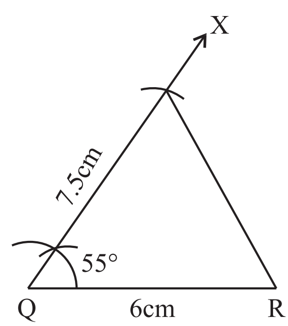
(c) 14 6 9   6 9 14   9 14 6
With these sides triangle can be constructed.

(e) 10 10 20 (third side)
20 10 10 (first side)
10 20 10 (second side)
With these sides triangle can't be constructed.

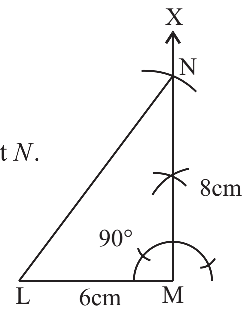
6. First we draw a rough sketch of *PQR*.

Steps to construct :

(a) Draw a line segment *QR* 6 cm.
(b) *ATQ*, construct *XQR* 55 .
(c) With *Q* as centre and radius 7.5 cm, draw an arc cutting *QX* at *P*.
(d) Join *PR*.
Then, *PQR* is the required triangle.



7. First draw a rough sketch of *LMN* as given below.



Steps to construct :

(a) Draw a line segment *LM* 6 cm.

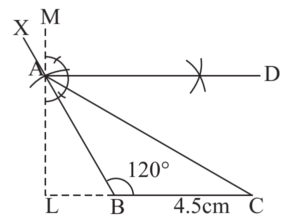
(b) *ATM*, construct *XML* 90 .

(c) With *M* as centre and radius 8 cm, draw an arc cutting *MX* at *N*.

(d) Join *NL*.

Then, *LMN* is the required triangle.

8. First draw a rough sketch of *ABC* as given below.



Steps to construct :

(a) Draw a line segment *BC* 4.5 cm.

(b) At *B*, construct *XBC* 120 .

(c) With *B* as centre and radius 5 cm, draw an arc utting *BX* at *A*.

(d) Join *AC*.

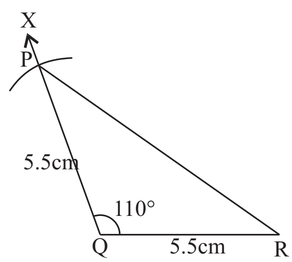
(e) Produce *BC* to *L* and draw a line *LY* passing through point *A*.

(f) Now make angle of 90° at *A* by necessary arcs.

(g) Produce *A* to *D* to get the required line *AD* parallel to *BC*.

9. First draw a rough sketch of *PQR*.

Let *QR* *PQ* 5.5, *LQ* 110 .



Steps to construct :

(a) Draw a line segment *QR* 5.5 cm.

(b) At *Q*, construct *RQX* 110 .

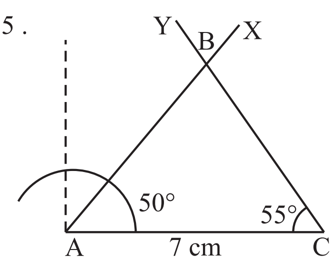
(c) With *Q* as centre and radius 5.5 cm. draw an arc cutting *QX* at *P*.

(d) Join *PR*.

Then, *PQR* is the required triangle.

Exercise 12.3

1. Given : A *ABC* is which *AC* 7 cm, *A* 50 , *C* 55 .



Steps to construct :

(a) Draw *AC* oflength 7 cm.

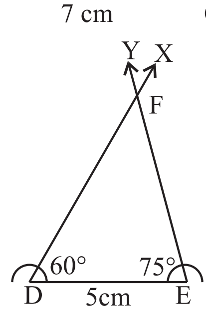
(b) At *A* construct *XAC* 50 by using protractor.

(c) At *C* draw *YCA* 55 by using protractor.

(d) Let *AX* and *CY* intersect at *B*.

Then *ABC* as the required triangle.

2. Given : A *DEF* in which *DE* 5 cm, *D* 60 , *E* 75 .



Steps to construct :

(a) Draw *DE* of length 5 cm.

(b) At *D* construct *XDE* 60 .

(c) At *E* draw *YED* 75 by using protractor or by using arcs.

(d) Let *DX* and *EY* intersect at *F*.

Then *DEF* is the required triangle.

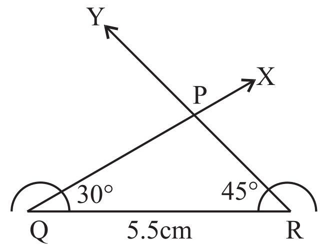
3. **Given :** A *PQR* in which *QR* 5.5 cm,

P 45 , *Q* 30 .

(a) Draw a line segment *QR* 5.5 cm.

(b) At *Q* & *R* draw *XQR* 30 and *YRQ* 45 respectively by using protractor or by using arcs.

(c) Let *QX* and *RY* intersect at *P*.
Then *PQR* is the required triangle.



4. Given : *X* 105 , *X* 75 , *XY* 5.8 cm.

X *Y* *Z* 180 (Angle sum property of triangles)

105 75 *Z* 180

Z 180 180 0

Z 0

But it is not possible that any angle of a triangle be 0°. So, *XYZ* can't be constructed.

5. **Given :** *ABC* in which *BC* 4.5 cm,

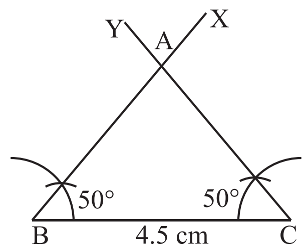
B *C* 50

A 180 (*B* *C*)

180 (50 50)

180 100 80

A 80



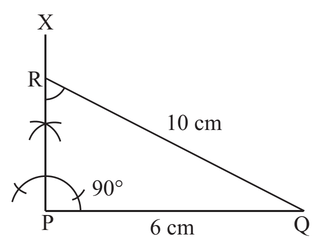
6. **Steps to construct :**

(a) Draw a line segment *PQ* 6 cm.

(b) At *P*, construct *QPX* 90 .

(c) With *Q* as centre and radius 10 cm, draw an arc cutting *PX* at *R*.

(d) Join *RQ*.
Then, *PQR* is the required triangle.



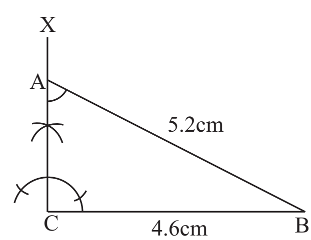
7. **Steps to construct :**

(a) Draw a line *BC* 4.6 cm.

(b) At *C*, construct *BCX* 90 .

(c) With *B* as centre and radius 5.2 cm, draw an arc cutting *CX* at *A*.

(d) Join *AB*.
Then, *ABC* is the required triangle.



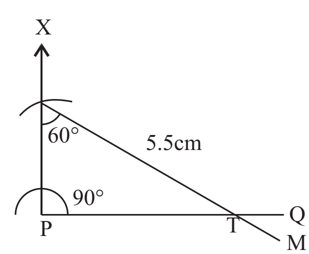
8. **Steps to constructs :**

(a) Draw a line *PQ* of any length.

(b) At *P*, construct *QPX* 90 .

(c) With *R* as centre, construct *MRP* 60 and radius 5.5 cm draw an arc cutting *PQ* at *T*.

(d) Thus, *PRT* is the required triangle.



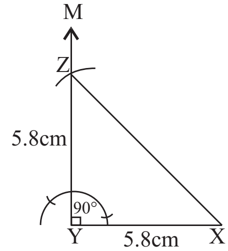
9. Steps to construct :

(a) Draw a line segment *XY*   5.8 cm.

(b) At *Y*, construct   *XYM*   90 .

(c) With *Y* as centre and radius 5.8 cm, draw an arc cutting *YM* at *Z*.

(d) Join *ZX*, then,   *XYZ* is the required isosceles right angle triangle.



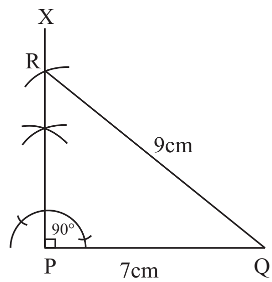
10. Steps to construct :

(a) Draw a line segment *PQ*   7 cm.

(b) At *P*, construct   *QPX*   90 .

(c) With *Q* as centre and radius 9 cm, draw an arc cutting *PX* at *R*.

(d) Join *RQ*. Then,   *PQR* is the required triangle.



11. Steps to construct :

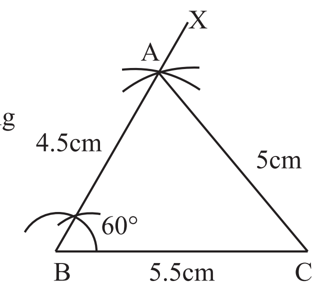
(a) Draw a line segment *BC*   5.5 cm.

(b) At *B*, construct an angle of any degree, here, we construct   *CBX*   60 for convenience.

(c) With *B* as centre and radius 4.5 cm, draw an arc cutting *BX* at *A*.

(d) Similarly, with *C* as centre and radius 5 cm, draw an another arc cutting *BX* at *A*.

(e) Join *AC* then,   *ABC* is the required triangle.



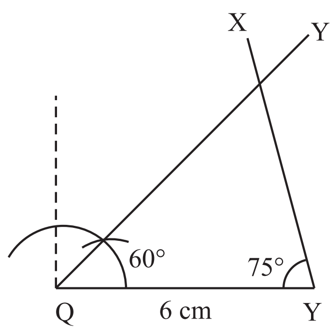
12. Steps to construct :

(a) Draw *QP*   6 cm.

(b) At *Q*, construct   *XQP*   45 .

(c) At *P*, draw   *YPQ*   75 .

(d) Let *QX* and *PY* intersect at *R* then   *PQR* is the required triangle.



13. Steps to construct :

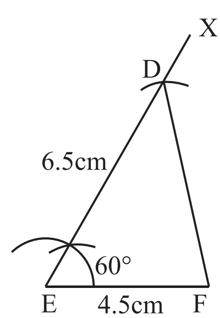
(a) Draw a line segment *EF*   4.5 cm.

(b) At *E*, construct   *XEF*   60 .

(c) With *E* as centre and radius 6.5 cm, draw an arc cutting *EX* at *D*.

(d) Join *DF*.

Then,   *DEF* is the required triangle..



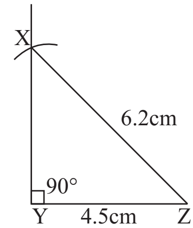
14. **Steps to construct :**

(a) Draw a line segment of length YZ 4.5 cm.

(b) At Y construct XYZ 90 .

(c) With Z as centre and radius 6.2, draw an arc cutting ZX at X.

(d) Join XZ. Then, XYZ is the required triangle.



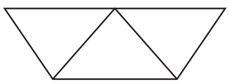
13 Visualising Solid Shapes

Exercise 13.1

1. (c) and (d) are the nets for the cubes.

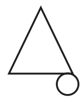
2. No, this figure is not a net for a dice.
The sum of pair of opposite faces should be 7.

3. (a)



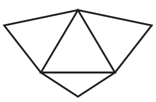
Net or tetraheron

(b)



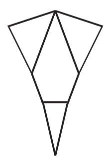
Net of cone

(c)



Net of tri angular prism

(d)

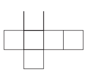
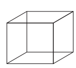


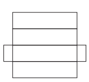
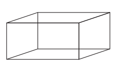
Net of hexagonal pyramid

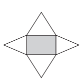
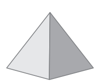
4. Figure 3 can b folded to from a cuboid.

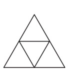
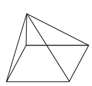
5. (a) Cone (b) Cylinder (c) Trigulan Prisum (d) Squar pyramid.

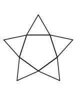
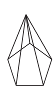
6.

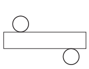
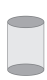
(a)  (iii) 

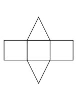
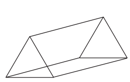
(b)  (iv) 

(c)  (ii) 

(d)  (i) 

(e)  (vi) 

(f)  (vii) 

(g)  (v) 

7. Euler's formula V F E 2

(a) **triangular prism**

Number of faces = 5 Number of vertices = 6
Number of edges = 9
Verification :

$$V \quad F \quad E \quad 2$$
$$6 \quad 5 \quad 9 \quad 2$$
$$11 \quad 9 \quad 2$$
$$2 = 2$$
L.H.S. = R.H.S.

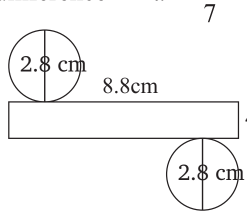
(b) **a cube**
Number of faces = 6 Number of edges = 12 Number of vertices = 8
then, $V \quad F \quad E \quad 2$
$$8 \quad 6 \quad 12 \quad 2$$
$$14 \quad 12 \quad 2$$
$$2 = 2$$
L.H.S. = R.H.S.

(c) a hexagonal pyramid
Number of vertices = 7 Number of faces = 7 Number of edges = 12
Then,
$$V \quad F \quad E \quad 2$$
$$7 \quad 7 \quad 12 \quad 2$$
$$14 \quad 12 \quad 2$$
$$2 = 2$$
L.H.S. = R.H.S.

8. Cylinder has 2 circular and 1 curved face.
Net for cylinder height = 4.5 cm
∵ Diameter = 2.8 cm

$$\text{Circumference} \quad d \quad \frac{22}{7} \quad 2.8 = 8.8 \text{ cm}$$

Then



9. (i) Cone (ii) Cube (iii) Cylinder.

10. $l \quad 8\,\text{cm}, b \quad 8\,\text{cm}, h \quad 6\,\text{cm}$

Volume of cuboid $\quad l \quad b \quad h \quad (8 \quad 5 \quad 6)\,\text{cm}^3 = 240\,\text{cm}^3$

side of cube = 1 cm.

the volume of cube $\quad 1 \quad 1 \quad 1 = 1\,\text{cm}^3$

then

Number of cubes that can be fit into cuboid $\quad \dfrac{\text{Volume of coboid}}{\text{Volume of cube}}$

$$\frac{240\,\text{cm}^3}{1\,\text{cm}^3} = 240 \text{ cubes.}$$

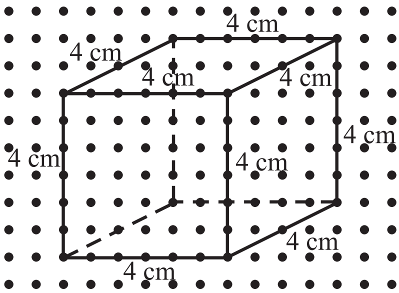
11. **Fill in the blanks :**

(a) **triangular pyramid.** (b) **5** (c) **Triangular prism.**
(d) **cuboid.** (e) **line segment** (f) **12** and **8**

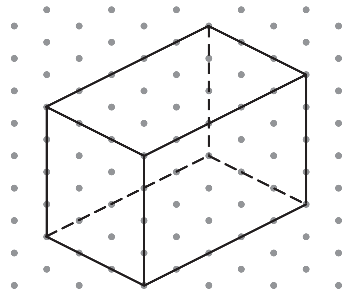
(g) **circular curved** (h) **vertex.**

Exercise 13.2

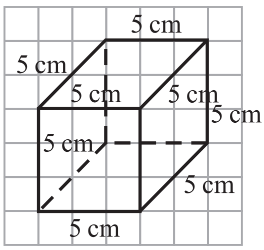
1. (a)



(b)

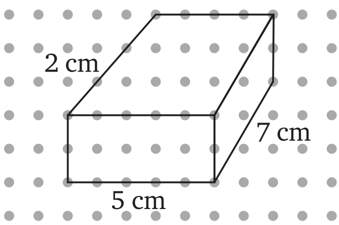


2.



3. Do Yourself.

4.



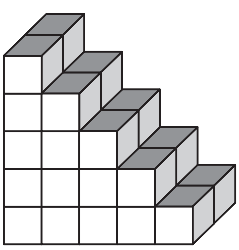
5. Do your self :

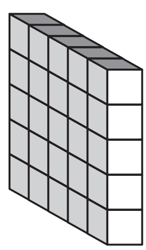
6. Do it yourself. 7. Do it yourslef. 8. Do it yourself.

9. Number of cubical blocks

based 2 5 2 4 2 3 2 2 2 1

10 8 6 4 2 30 blocks





Number cubical blocks used 5 5 25 blocks.

10. Do it yourself. **11.** Do it yourself.

12. (i) Shape of English alphabet *F*. (ii) Shape of English alphabet *T*.

MCQ's

1. (d) **2.** (b) **3.** (a) **4.** (b)

5. (c) **6.** (b) **7.** (c) **8.** (b)