1. In $\triangle$ PQR, D is the mid-point of $\overline{QR}$.

    $\overline{PM}$ is _____

    PD is _____

    Is QM = MR ?
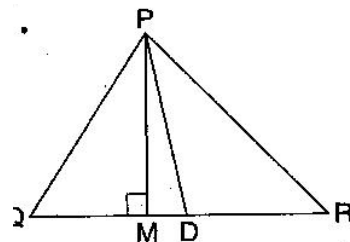
2. Draw rough sketches for the following:
    (a) In $\triangle$ ABC, BE is a median.
    (b) In $\triangle$ PQR, PQ and PR are altitudes of the triangle.
    (c) In $\triangle$ XYZ, YL is an altitude in the exterior of the triangle.

3. Verify by drawing a diagram if the median and altitude of a isosceles triangle can be same.
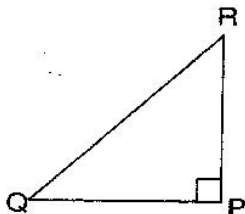
1. Given: QD = DR
    ∴ $\overline{PM}$ is altitude.
             PD is median.
             No, QM ≠ MR as D is the mid-point of QR.

2. (a) Here, BE is a median in ΔABC and AE = EC.
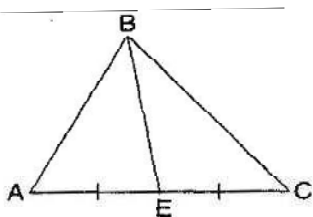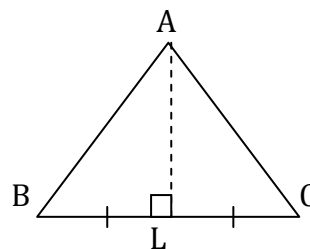

    (b) Here, PQ and PR are the altitudes of the ΔPQR and RP ⊥ QP.

    (c) YL is an altitude in the exterior of ΔXYZ.
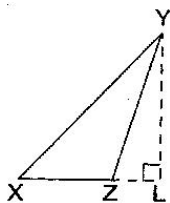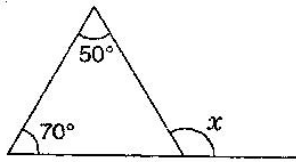

3. Isosceles triangle means any two sides are same.
    Take ΔABC and draw the median when AB = AC.
    AL is the median and altitude of the given triangle.

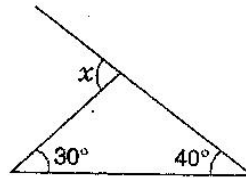
1. Find the value of the unknown exterior angle x in the following diagrams:
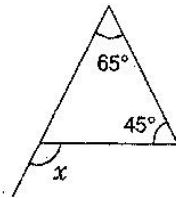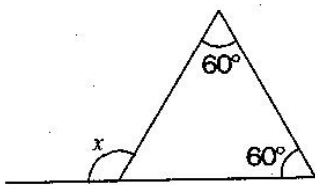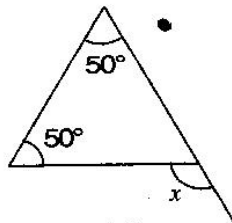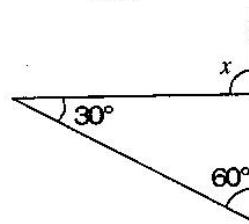
(i)	**(ii)**	**(iii)**

(iv)	**(v)**	**(vi)**

2. Find the value of the unknown interior angle x in the following figures:
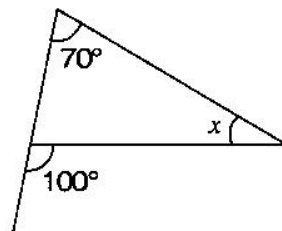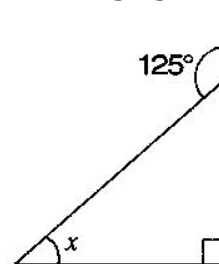
(i)	**(ii)**	**(iii)**
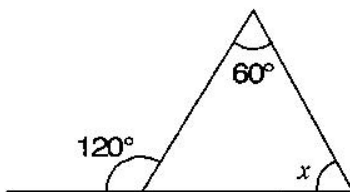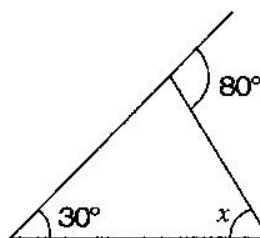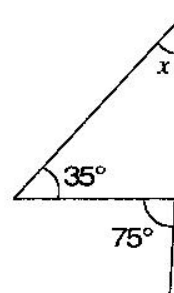
(iv)	**(v)**	**(vi)**

Class –VII Mathematics (Ex. 6.2)
Answers

1. Since, Exterior angle = Sum of interior opposite angles, therefore
   (i) $x = 50° + 70° = 120°$
   (ii) $x = 65° + 45° = 110°$
   (iii) $x = 30° + 40° = 70°$
   (iv) $x = 60° + 60° = 120°$
   (v) $x = 50° + 50° = 100°$
   (vi) $x = 60° + 30° = 90°$

2. Since, Exterior angle = Sum of interior opposite angles, therefore
   (i) $x + 50° = 115°$ $\Rightarrow$ $x = 115° - 50° = 65°$
   (ii) $70° + x = 100°$ $\Rightarrow$ $x = 100° - 70° = 30°$
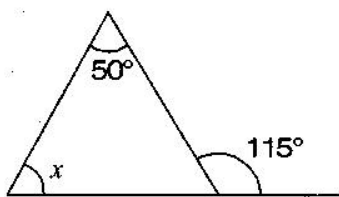   (iii) $x + 90° = 125°$ $\Rightarrow$ $x = 120° - 90° = 35°$
   (iv) $60° + x = 120°$ $\Rightarrow$ $x = 120° - 60° = 60°$
   (v) $30° + x = 80°$ $\Rightarrow$ $x = 80° - 30° = 50°$
   (vi) $x + 35° = 75°$ $\Rightarrow$ $x = 75° - 35° = 40°$

1. Find the value of unknown x in the following diagrams:
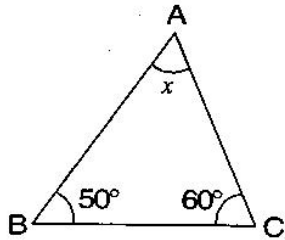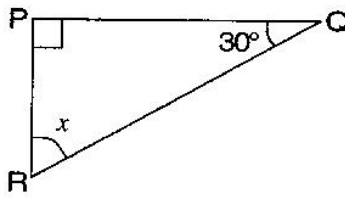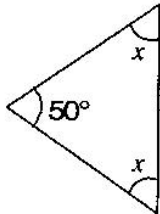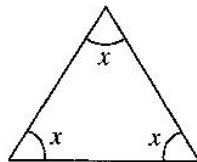
(i)   **(ii)**   **(iii)**

(iv)   **(v)**   **(vi)**

2. Find the values of the unknowns x and y in the following diagrams:

(i)   **(ii)**   **(iii)**

(iv)   **(v)**   **(vi)**

1. (i)   In $\triangle$ABC,

$\angle$ BAC + $\angle$ ACB + $\angle$ ABC = 180°   [By angle sum property of a triangle]

$\Rightarrow$ $x + 50° + 60° = 180°$

$\Rightarrow$ $x + 110° = 180°$ $\Rightarrow$ $x = 180° - 110° = 70°$

(ii)   In $\triangle$ PQR,

$\angle$ RPQ + $\angle$ PQR + $\angle$ RPQ = 180°   [By angle sum property of a triangle]

$\Rightarrow$ $90° + 30° + x = 180°$

$\Rightarrow$ $x + 120° = 180°$ $\Rightarrow$ $x = 180° - 120° = 60°$

(iii)   In $\triangle$ XYZ,

$\angle$ ZXY + $\angle$ XYZ + $\angle$ YZX = 180°   [By angle sum property of a triangle]

$\Rightarrow$ $30° + 110° + x = 180°$

$\Rightarrow$ $x + 140° = 180°$ $\Rightarrow$ $x = 180° - 140° = 40°$

(iv)   In the given isosceles triangle,

$x + x + 50° = 180°$ [By angle sum property of a triangle]

$\Rightarrow$ $2x + 50° = 180°$

$\Rightarrow$ $2x = 180° - 50°$ $\Rightarrow$ $2x = 130°$

$\Rightarrow$ $x = \dfrac{130°}{2} = 65°$

(v)   In the given equilateral triangle,

$x + x + x = 180°$ [By angle sum property of a triangle]

$\Rightarrow$ $3x = 180°$

$\Rightarrow$ $x = \dfrac{180°}{3} = 60°$

(vi)   In the given right angled triangle,

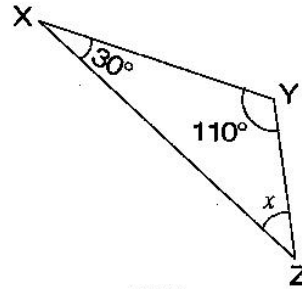$x + 2x + 90° = 180°$ [By angle sum property of a triangle]

$\Rightarrow$ $3x + 90° = 180°$

$\Rightarrow$ $3x = 180° - 90°$ $\Rightarrow$ $3x = 90°$

$\Rightarrow$ $x = \dfrac{90°}{3} = 30°$

2. (i) $50° + x = 120°$ [Exterior angle property of a $\triangle$]

$\Rightarrow$ $x = 120° - 50° = 70°$
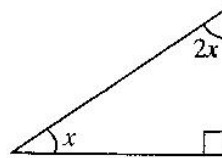
Now, $50° + x + y = 180°$ [Angle sum property of a $\triangle$]

$\Rightarrow$ $50° + 70° + y = 180°$

$\Rightarrow$ $120° + y = 180°$ $\Rightarrow$ $y = 180° - 120° = 60°$

(ii) $y = 80°$ ....(i)   [Vertically opposite angle]

Now, $50° + x + y = 180°$ [Angle sum property of a $\triangle$]

	$\Rightarrow$	$50° + 80° + y = 180°$		[From eq. (i)]
	$\Rightarrow$	$130° + y = 180°$	$\Rightarrow$	$y = 180° - 130° = 50°$

(iii) $50° + 60° = x$ [Exterior angle property of a Δ]

       $\Rightarrow$ $x = 110°$

       Now $50° + 60° + y = 180°$ [Angle sum property of a Δ]

       $\Rightarrow$ $110° + y = 180°$

       $\Rightarrow$ $y = 180° - 110°$ $\Rightarrow$ $y = 70°$

(iv) $x = 60°$ ....(i)   [Vertically opposite angle]

       Now, $30° + x + y = 180°$ [Angle sum property of a Δ]

       $\Rightarrow$ $50° + 60° + y = 180°$ [From eq. (i)]

       $\Rightarrow$ $90° + y = 180°$ $\Rightarrow$ $y = 180° - 90° = 90°$

(v) $y = 90°$ ....(i)   [Vertically opposite angle]

       Now, $y + x + x = 180°$ [Angle sum property of a Δ]

       $\Rightarrow$ $90° + 2x = 180°$ [From eq. (i)]

       $\Rightarrow$ $2x = 180° - 90°$ $\Rightarrow$ $2x = 90°$

       $\Rightarrow$ $x = \dfrac{90°}{2} = 45°$

(vi) $x = y$ ....(i)   [Vertically opposite angle]

       Now, $x + x + y = 180°$ [Angle sum property of a Δ]

       $\Rightarrow$ $2x + x = 180°$ [From eq. (i)]

       $\Rightarrow$ $3x = 180°$ $\Rightarrow$ $x = \dfrac{180°}{3} = 60°$

1. Is it possible to have a triangle with the following sides?
    (i)   2 cm, 3 cm, 5 cm
    (ii)   3 cm, 6 cm, 7 cm
    (iii)   6 cm, 3 cm, 2 cm

2. Take any point O in the interior of a triangle PQR. Is:
    (i)   OP + OQ > PQ ?
    (ii)   OQ + OR > QR ?
    (iii)   OR + OP > RP ?
    Since sum of two sides is greater than third side.
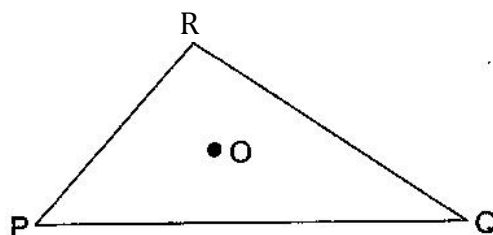
3. AM is a median of a triangle ABC. Is AB + BC + CA > 2AM ?
    (Consider the sides of triangles $\triangle$ ABM and $\triangle$ AMC.)
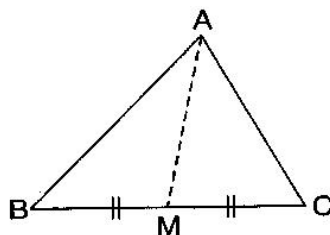
4. ABCD is a quadrilateral. Is AB + BC + CD + DA > AC + BD ?
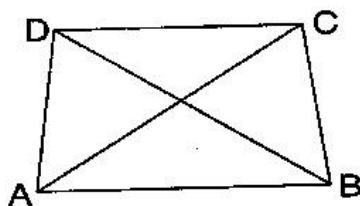
5. ABCD is quadrilateral. Is AB + BC + CD + DA < 2 (AC + BD) ?
6. The lengths of two sides of a triangle are 12 cm and 15 cm. Between what two measures should the length of the third side fall?

1. Since, a triangle is possible whose sum of the lengths of any two sides would be greater than the length of third side.

    (i)   2 cm, 3 cm, 5 cm   (ii) 3 cm, 6 cm, 7 cm
          2 + 3 > 5   No   3 + 6 > 7   Yes
          2 + 5 > 3   Yes   6 + 7 > 3   Yes
          3 + 5 > 2   Yes   3 + 7 > 6   Yes
          This triangle is not possible.   This triangle is possible.

    (iii) 6 cm, 3 cm, 2 cm
          6 + 3 > 2   Yes
          6 + 2 > 3   Yes
          2 + 3 > 6   No
          This triangle is not possible.

2. Join OR, OQ and OP.

    (i)   Is OP + OQ > PQ ?
          Yes, POQ form a triangle.
    (ii) Is OQ + OR > QR ?
          Yes, RQO form a triangle.
    (iii) Is OR + OP > RP ?
          Yes, ROP form a triangle.
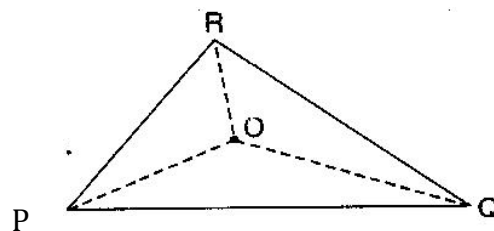
3. Since, the sum of lengths of any two sides in a triangle should be greater than the length of third side.

    Therefore,   In $\triangle$ ABM,   AB + BM > AM   ....(i)
                    In $\triangle$ AMC,   AC + MC > AM   ....(ii)
    Adding eq. (i) and (ii),
                    AB + BM + AC + MC > AM + AM
    $\Rightarrow$ AB + AC + (BM + MC) > 2AM
    $\Rightarrow$ AB + AC + BC > 2AM
    Hence, it is true.

4. Since, the sum of lengths of any two sides in a triangle should be greater than the length of third side.

    Therefore,   In $\triangle$ ABC,   AB + BC > AC   ....(i)
                    In $\triangle$ ADC,   AD + DC > AC   ....(ii)
                    In $\triangle$ DCB,   DC + CB > DB   ....(iii)
                    In $\triangle$ ADB,   AD + AB > DB   ....(iv)

Adding eq. (i), (ii), (iii) and (iv),

AB + BC + AD + DC + DC + CB + AD + AB > AC + AC + DB + DB

$\Rightarrow$ (AB + AB) + (BC + BC) + (AD + AD) + (DC + DC) > 2AC + 2DB

$\Rightarrow$ 2AB + 2BC + 2AD + 2DC > 2(AC + DB)

$\Rightarrow$ 2(AB + BC + AD + DC) > 2(AC + DB)

$\Rightarrow$ AB + BC + AD + DC > AC + DB

$\Rightarrow$ AB + BC + CD + DA > AC + DB
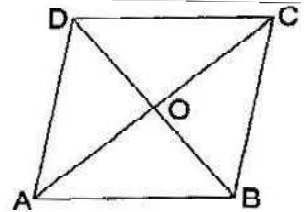
Hence, it is true.

5. Since, the sum of lengths of any two sides in a triangle should be greater than the length of third side.

Therefore, In $\triangle$ AOB,   AB < OA + OB   ....(i)

In $\triangle$ BOC,   BC < OB + OC   ....(ii)

In $\triangle$ COD,   CD < OC + OD   ....(iii)

In $\triangle$ AOD,   DA < OD + OA   ....(iv)

Adding eq. (i), (ii), (iii) and (iv),

AB + BC + CD + DA < OA + OB + OB + OC + OC + OD + OD + OA

$\Rightarrow$ AB + BC + CD + DA < 2OA + 2OB + 2OC + 2OD

$\Rightarrow$ AB + BC + CD + DA < 2[(AO + OC) + (DO + OB)]

$\Rightarrow$ AB + BC + CD + DA < 2(AC + BD)

Hence, it is proved.

6. Since, the sum of lengths of any two sides in a triangle should be greater than the length of third side.

It is given that two sides of triangle are 12 cm and 15 cm.

Therefore, the third side should be less than 12 + 15 = 27 cm.

And also the third side cannot be less than the difference of the two sides.

Therefore, the third side has to be more than 15 – 12 = 3 cm.

Therefore, the third side could be the length more than 3 cm and less than 27 cm.

1. PQR is a triangle, right angled at P. If PQ = 10 cm and PR = 24 cm, find QR.
2. ABC is a triangle, right angled at C. If AB = 25 cm and AC = 7 cm, find BC.
3. A 15 m long ladder reached a window 12 m high from the ground on placing it against a wall at a distance a. Find the distance of the foot of the ladder from the wall.
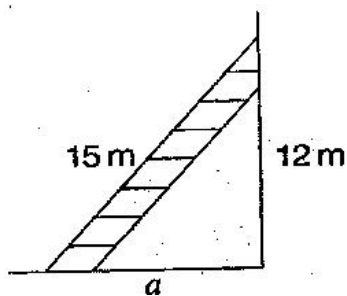
4. Which of the following can be the sides of a right triangle?
   (i)   2.5 cm, 6.5 cm, 6 cm
   (ii)   2 cm, 2 cm, 5 cm
   (iii)   1.5 cm, 2 cm, 2.5 cm
   In the case of right angled triangles, identify the right angles.

5. A tree is broken at a height of 5 m from the ground and its top touches the ground at a distance of 12 m from the base of the tree. Find the original height of the tree.
6. Angles Q and R of a $\triangle$ PQR are 25° and 65°.
   Write which of the following is true:
   (i) $PQ^2 + QR^2 = RP^2$
   (ii) $PQ^2 + RP^2 = QR^2$
   (iii) $RP^2 + QR^2 = PQ^2$
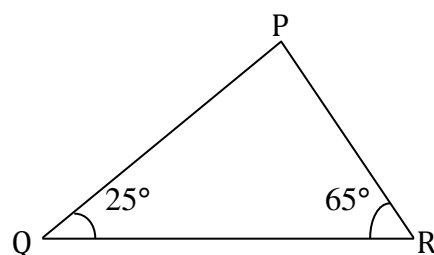
7. Find the perimeter of the rectangle whose length is 40 cm and a diagonal is 41 cm.
8. The diagonals of a rhombus measure 16 cm and 30 cm. Find its perimeter.

1. Given: PQ = 10 cm, PR = 24 cm
   Let QR be x cm.
   In right angled triangle QPR,
   $\qquad$ (Hypotenuse)^2 = (Base)^2 + (Perpendicular)^2
   $\qquad\qquad\qquad\qquad\qquad$ [By Pythagoras theorem]
   $\Rightarrow \qquad$ (QR)^2 = (PQ)^2 + (PR)^2
   $\Rightarrow \qquad x^2 = (10)^2 + (24)^2$
   $\Rightarrow \qquad x^2$ = 100 + 576 = 676
   $\Rightarrow \qquad x = \sqrt{676}$ = 26 cm
   Thus, the length of QR is 26 cm.
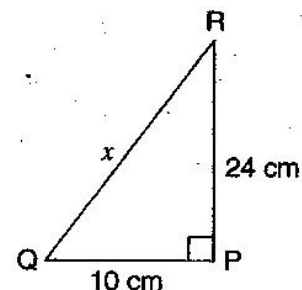
2. Given: AB = 25 cm, AC = 7 cm
   Let BC be x cm.
   In right angled triangle ACB,
   $\qquad$ (Hypotenuse)^2 = (Base)^2 + (Perpendicular)^2
   $\qquad\qquad\qquad\qquad\qquad$ [By Pythagoras theorem]
   $\Rightarrow \qquad$ (AB)^2 = (AC)^2 + (BC)^2
   $\Rightarrow \qquad (25)^2 = (7)^2 + x^2$
   $\Rightarrow \qquad 625 = 49 + x^2$
   $\Rightarrow \qquad x^2$ = 625 – 49 = 576
   $\Rightarrow \qquad x = \sqrt{576}$ = 24 cm
   Thus, the length of BC is 24 cm.
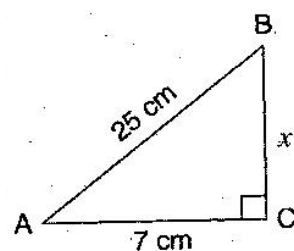
3. Let AC be the ladder and A be the window.
   Given: AC = 15 m, AB = 12 m, CB = a m
   In right angled triangle ACB,
   $\qquad$ (Hypotenuse)^2 = (Base)^2 + (Perpendicular)^2
   $\qquad\qquad\qquad\qquad\qquad$ [By Pythagoras theorem]
   $\Rightarrow \qquad$ (AC)^2 = (CB)^2 + (AB)^2
   $\Rightarrow \qquad (15)^2 = (a)^2 + (12)^2$
   $\Rightarrow \qquad 225 = a^2 + 144$
   $\Rightarrow \qquad a^2$ = 225 – 144 = 81
   $\Rightarrow \qquad a = \sqrt{81}$ = 9 cm
   Thus, the distance of the foot of the ladder from the wall is 9 m.
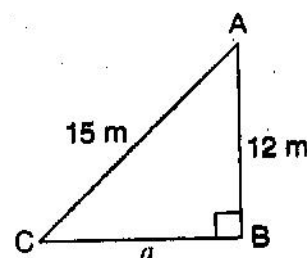
4. Let us consider, the larger side be the hypotenuse and also using Pythagoras theorem,
   (Hypotenuse)^2 = (Base)^2 + (Perpendicular)^2

   (i)   2.5 cm, 6.5 cm, 6 cm

   In $\triangle ABC$, $(AC)^2 = (AB)^2 + (BC)^2$

   L.H.S. $= (6.5)^2 = 42.25$ cm

   R.H.S. $= (6)^2 + (2.5)^2 = 36 + 6.25 = 42.25$ cm

   Since,   L.H.S. = R.H.S.
   Therefore, the given sides are of the right angled triangle.
   Right angle lies on the opposite to the greater side 6.5 cm, i.e., at B.
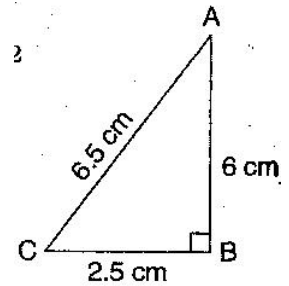
   (ii) 2 cm, 2 cm, 5 cm

   $$(5)^2 = (2)^2 + (2)^2$$

   L.H.S. $= (5)^2 = 25$

   R.H.S. $= (2)^2 + (2)^2 = 4 + 4 = 8$

   Since,   L.H.S. $\neq$ R.H.S.
   Therefore, the given sides are not of the right angled triangle.

   (iii) 1.5 cm, 2 cm, 2.5 cm
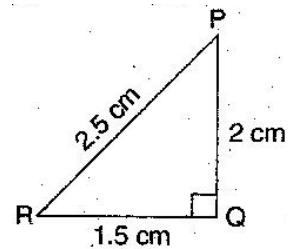
   In $\triangle PQR$, $(PR)^2 = (PQ)^2 + (RQ)^2$

   L.H.S. $= (2.5)^2 = 6.25$ cm

   R.H.S. $= (1.5)^2 + (2)^2 = 2.25 + 4 = 6.25$ cm

   Since,   L.H.S. = R.H.S.
   Therefore, the given sides are of the right angled triangle.
   Right angle lies on the opposite to the greater side 2.5 cm, i.e., at Q.

5. Let A'CB represents the tree before it broken at the point C and let the
   top A' touches the ground at A after it broke. Then $\triangle ABC$ is a right
   angled triangle, right angled at B.
   AB = 12 m and BC = 5 m
   Using Pythagoras theorem, In $\triangle ABC$

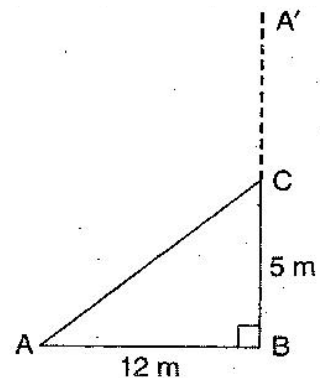 $$(AC)^2 = (AB)^2 + (BC)^2$$
   $\Rightarrow$ $(AC)^2 = (12)^2 + (5)^2$
   $\Rightarrow$ $(AC)^2 = 144 + 25$
   $\Rightarrow$ $(AC)^2 = 169$
   $\Rightarrow$ AC = 13 m

   Hence, the total height of the tree = AC + CB = 13 + 5 = 18 m.

6. In $\triangle$ PQR,

$\angle$ PQR + $\angle$ QRP + $\angle$ RPQ = 180°   [By Angle sum property of a $\triangle$]

$\Rightarrow$ 25° + 65° + $\angle$RPQ = 180° $\Rightarrow$ 90° + $\angle$RPQ=180°

$\Rightarrow$ $\angle$ RPQ = 180° − 90° = 90°

Thus, $\triangle$ PQR is a right angled triangle, right angled at P.

$\therefore$ (Hypotenuse)^2 = (Base)^2 + (Perpendicular)^2 [By Pythagoras theorem]

$\Rightarrow$ $\left(QR\right)^2 = \left(PR\right)^2 + \left(QP\right)^2$

Hence, Option (ii) is correct.

7. Given diagonal (PR) = 41 cm, length (PQ) = 40 cm

Let breadth (QR) be x cm.

Now, in right angled triangle PQR,

$\left(PR\right)^2 = \left(RQ\right)^2 + \left(PQ\right)^2$

[By Pythagoras theorem]

$\Rightarrow$ $\left(41\right)^2 = x^2 + \left(40\right)^2$

$\Rightarrow$ 1681 = x^2 + 1600 $\Rightarrow$ x^2 = 1681 − 1600

$\Rightarrow$ x^2 = 81 $\Rightarrow$ $x = \sqrt{81} = 9$ cm
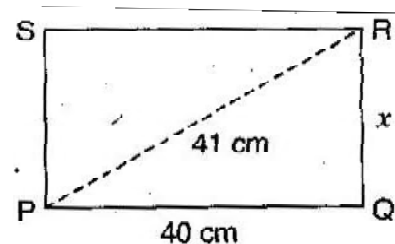
Therefore the breadth of the rectangle is 9 cm.

Perimeter of rectangle = 2(length + breadth)

                     = 2 (9 + 49)

                     = 2 x 49 = 98 cm

Hence the perimeter of the rectangle is 98 cm.

8. Given: Diagonals AC = 30 cm and DB = 16 cm.

Since the diagonals of the rhombus bisect at right angle to each other.

Therefore,   OD = $\dfrac{DB}{2} = \dfrac{16}{2}$ = 8 cm

And   OC = $\dfrac{AC}{2} = \dfrac{30}{2}$ = 15 cm

Now,   In right angle triangle DOC,

$\left(DC\right)^2 = \left(OD\right)^2 + \left(OC\right)^2$ [By Pythagoras theorem]

$\Rightarrow$ $\left(DC\right)^2 = \left(8\right)^2 + \left(15\right)^2$

$\Rightarrow$ $\left(DC\right)^2$ = 64 + 225 = 289

$\Rightarrow$ DC = $\sqrt{289}$ = 17 cm

Perimeter of rhombus = 4 x side

                    = 4 x 17 = 68 cm

Thus, the perimeter of rhombus is 68 cm.