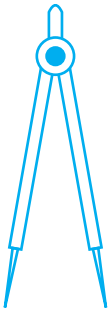
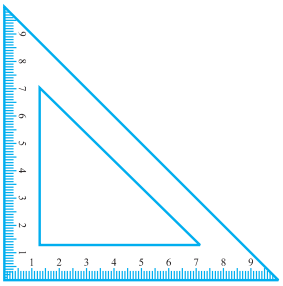
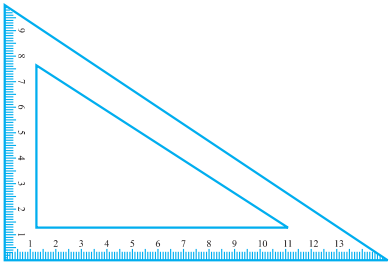
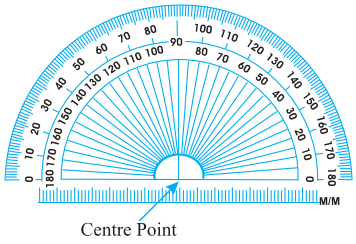
3.	The Divider		A pair of pointers	To compare lengths.
4.	Set-Squares	 	Two triangular pieces – one of them has 45°, 45°, 90° angles at the vertices and the other has 30°, 60°, 90° angles at the vertices.	To draw perpendicular and parallel lines.
5.	The Protractor		A semi-circular device graduated into 180 degree-parts. The measure starts from 0° on the right hand side and ends with 180° on the left hand side and vice-versa.	To draw and measure angles.

We are going to consider **"Ruler and compasses constructions"**, using ruler, only to draw lines, and compasses, only to draw arcs.

Be careful while doing these constructions.

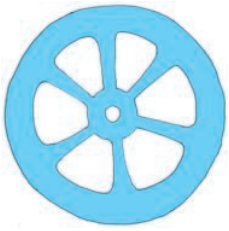
Here are some tips to help you.

(a) Draw thin lines and mark points lightly.

(b) Maintain instruments with sharp tips and fine edges.

(c) Have two pencils in the box, one for insertion into the compasses and the other to draw lines or curves and mark points.

14.2 The Circle



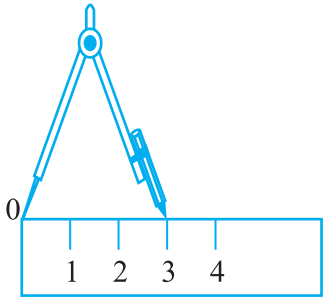
Look at the wheel shown here. Every point on its boundary is at an equal distance from its centre. Can you mention a few such objects and draw them? Think about five such objects which have this shape.

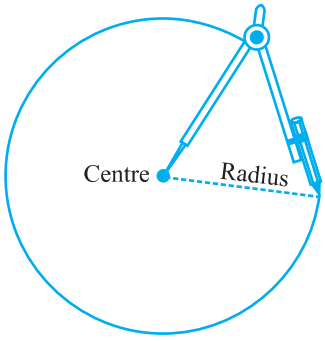
14.2.1 Construction of a circle when its radius is known

Suppose we want to draw a circle of radius 3 cm. We need to use our compasses. Here are the steps to follow.

Step 1 Open the compasses for the required radius of 3cm.

Step 2 Mark a point with a sharp pencil where we want the centre of the circle to be. Name it as O.



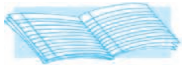


Step 3 Place the pointer of the compasses on O.

Step 4 Turn the compasses slowly to draw the circle. Be careful to complete the movement around in one instant.

Think, discuss and write

How many circles can you draw with a given centre O and a point, say P?



EXERCISE 14.1

1. Draw a circle of radius 3.2 cm.
2. With the same centre O, draw two circles of radii 4 cm and 2.5 cm.
3. Draw a circle and any two of its diameters. If you join the ends of these diameters, what is the figure obtained? What figure is obtained if the diameters are perpendicular to each other? How do you check your answer?
4. Draw any circle and mark points A, B and C such that
   (a) A is on the circle. (b) B is in the interior of the circle.
   (c) C is in the exterior of the circle.
5. Let A, B be the centres of two circles of equal radii; draw them so that each one of them passes through the centre of the other. Let them intersect at C and D. Examine whether $\overline{AB}$ and $\overline{CD}$ are at right angles.

14.3 A Line Segment

Remember that a line segment is bounded by two end-points. This makes it possible to measure its length with a ruler.

If we know the length of a line segment, it becomes possible to represent it by a diagram. Let us see how we do this.

14.3.1 Construction of a line segment of a given length

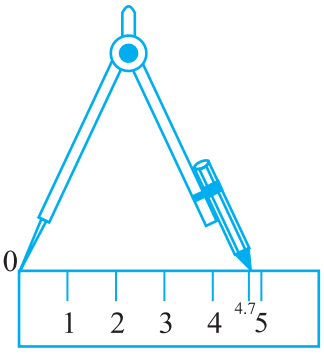
Suppose we want to draw a line segment of length 4.7 cm. We can use our ruler and mark two points A and B which are 4.7 cm apart. Join A and B and get $\overline{AB}$. While marking the points A and B, we should look straight down at the measuring device. Otherwise we will get an incorrect value.

Use of ruler and compasses

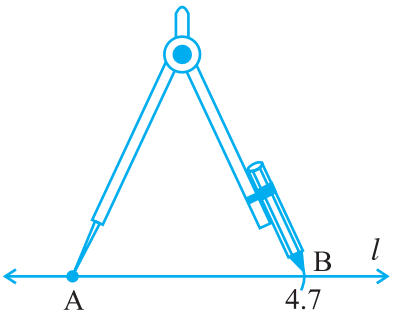
A better method would be to use compasses to construct a line segment of a given length.

Step 1 Draw a line l. Mark a point A on a line l.

Step 2 Place the compasses pointer on the zero mark of the ruler. Open it to place the pencil point upto the 4.7cm mark.



Step 3 Taking caution that the opening of the compasses has not changed, place the pointer on A and swing an arc to cut l at B.



Step 4 $\overline{AB}$ is a line segment of required length.

EXERCISE 14.2

1. Draw a line segment of length 7.3 cm using a ruler.
2. Construct a line segment of length 5.6 cm using ruler and compasses.
3. Construct $\overline{AB}$ of length 7.8 cm. From this, cut off $\overline{AC}$ of length 4.7 cm. Measure $\overline{BC}$.
4. Given $\overline{AB}$ of length 3.9 cm, construct $\overline{PQ}$ such that the length of $\overline{PQ}$ is twice that of $\overline{AB}$. Verify by measurement.

(**Hint :** Construct $\overline{PX}$ such that length of $\overline{PX}$ = length of $\overline{AB}$; then cut off $\overline{XQ}$ such that $\overline{XQ}$ also has the length of $\overline{AB}$.)

5. Given $\overline{AB}$ of length 7.3 cm and $\overline{CD}$ of length 3.4 cm, construct a line segment $\overline{XY}$ such that the length of $\overline{XY}$ is equal to the difference between the lengths of $\overline{AB}$ and $\overline{CD}$. Verify by measurement.

14.3.2 Constructing a copy of a given line segment

Suppose you want to draw a line segment whose length is equal to that of a given line segment $\overline{AB}$.

A quick and natural approach is to use your ruler (which is marked with centimetres and millimetres) to measure the length of $\overline{AB}$ and then use the same length to draw another line segment $\overline{CD}$.

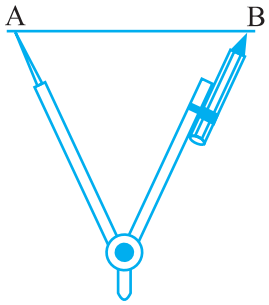
A second approach would be to use a transparent sheet and trace $\overline{AB}$ onto another portion of the paper. But these methods may not always give accurate results.

A better approach would be to use ruler and compasses for making this construction.

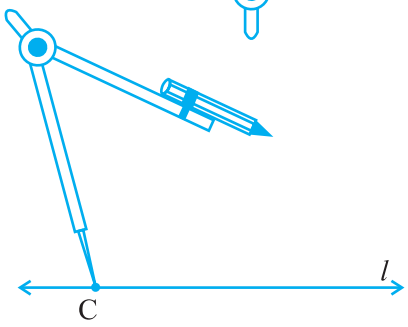
To make a copy of $\overline{AB}$.

Step 1 Given $\overline{AB}$ whose length is not known.

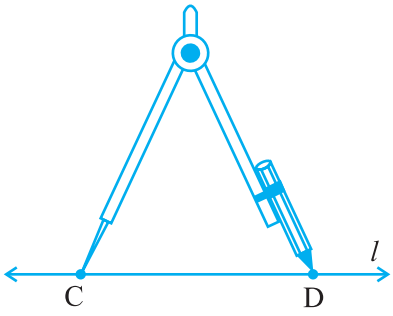
Step 2 Fix the compasses pointer on A and the pencil end on B. The opening of the instrument now gives the length of $\overline{AB}$.



Step 3 Draw any line l. Choose a point C on l. Without changing the compasses setting, place the pointer on C.



Step 4 Swing an arc that cuts l at a point, say, D. Now $\overline{CD}$ is a copy of $\overline{AB}$.



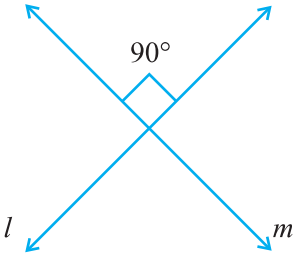
EXERCISE 14.3

1. Draw any line segment $\overline{PQ}$. Without measuring $\overline{PQ}$, construct a copy of $\overline{PQ}$.
2. Given some line segment $\overline{AB}$, whose length you do not know, construct $\overline{PQ}$ such that the length of $\overline{PQ}$ is twice that of $\overline{AB}$.

14.4 Perpendiculars

You know that two lines (or rays or segments) are said to be perpendicular if they intersect such that the angles formed between them are right angles.

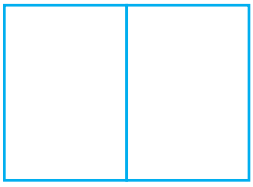
In the figure, the lines l and m are perpendicular.

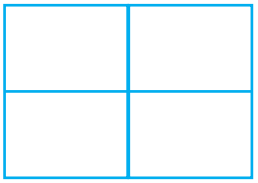


The corners of a foolscap paper or your notebook indicate lines meeting at right angles.

Do This

Where else do you see perpendicular lines around you?

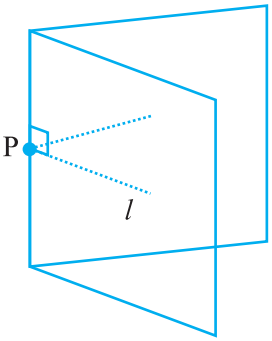




Take a piece of paper. Fold it down the middle and make the crease. Fold the paper once again down the middle in the other direction. Make the crease and open out the page. The two creases are perpendicular to each other.

14.4.1 Perpendicular to a line through a point on it

Given a line l drawn on a paper sheet and a point P lying on the line. It is easy to have a perpendicular to l through P.



We can simply fold the paper such that the lines on both sides of the fold overlap each other.

Tracing paper or any transparent paper could be better for this activity. Let us take such a paper and draw any line l on it. Let us mark a point P anywhere on l.

Fold the sheet such that l is reflected on itself; adjust the fold so that the crease passes through the marked point P. Open out; the crease is perpendicular to l.

Think, discuss and write

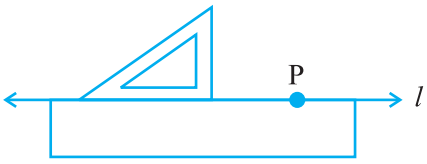
How would you check if it is perpendicular? Note that it passes through P as required.

A challenge : Drawing perpendicular using ruler and a set-square (An optional activity).

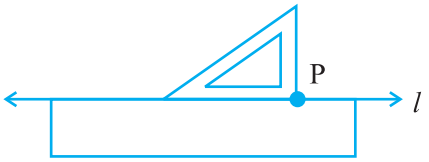
Step 1 A line l and a point P are given. Note that P is on the line l.

Step 2 Place a ruler with one of its edges along l. Hold this firmly.

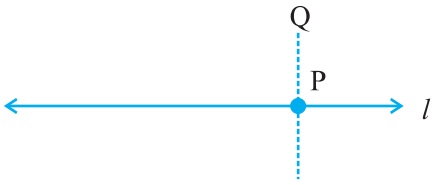
Step 3 Place a set-square with one of its edges along the already aligned edge of the ruler such that the right angled corner is in contact with the ruler.



Step 4 Slide the set-square along the edge of ruler until its right angled corner coincides with P.



Step 5 Hold the set-square firmly in this position. Draw $\overline{PQ}$ along the edge of the set-square.



$\overline{PQ}$ is perpendicular to l. (How do you use the $\perp$ symbol to say this?).

Verify this by measuring the angle at P.

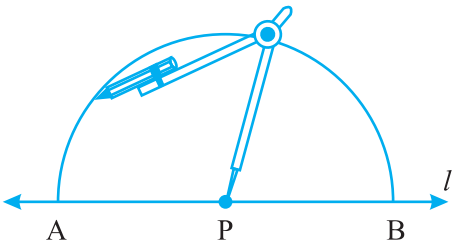
Can we use another set-square in the place of the 'ruler'? Think about it.

Method of ruler and compasses

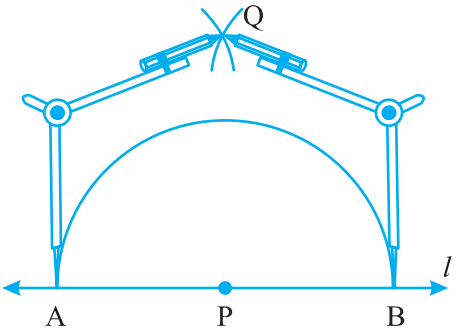
As is the preferred practice in Geometry, the dropping of a perpendicular can be achieved through the "ruler-compasses" construction as follows :

Step 1 Given a point P on a line l.

Step 2 With P as centre and a convenient radius, construct an arc intersecting the line l at two points A and B.

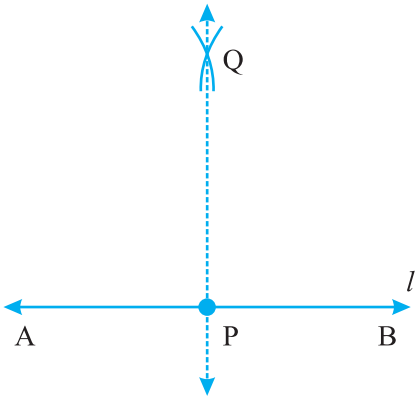


Step 3 With A and B as centres and a radius greater than AP construct two arcs, which cut each other at Q.



Step 4 Join PQ. Then $\overleftrightarrow{PQ}$ is perpendicular to l.

We write $\overleftrightarrow{PQ} \perp l$.

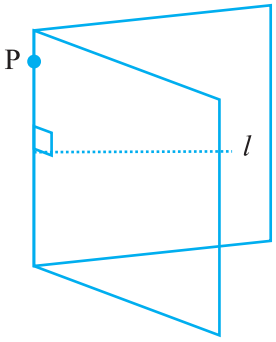


14.4.2 Perpendicular to a line through a point not on it

Do This

(Paper folding)

If we are given a line l and a point P not lying on it and we want to draw a perpendicular to l through P, we can again do it by a simple paper folding as before.



Take a sheet of paper (preferably transparent).

Draw any line l on it.

Mark a point P away from l.

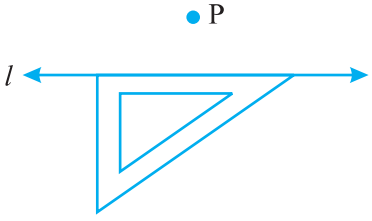
Fold the sheet such that the crease passes through P. The parts of the line l on both sides of the fold should overlap each other.

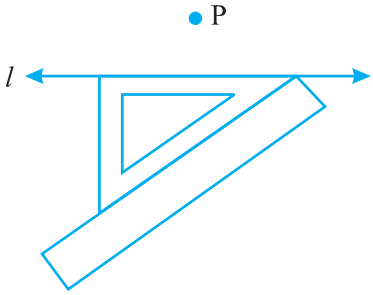
Open out. The crease is perpendicular to l and passes through P.

Method using ruler and a set-square (An optional activity)

Step 1 Let l be the given line and P be a point outside l.

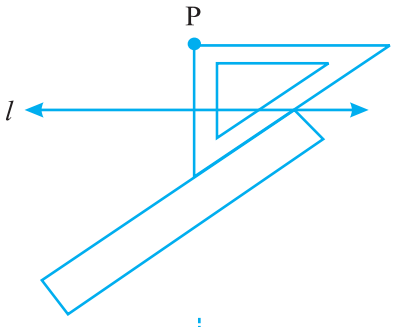
Step 2 Place a set-square on l such that one arm of its right angle aligns along l.





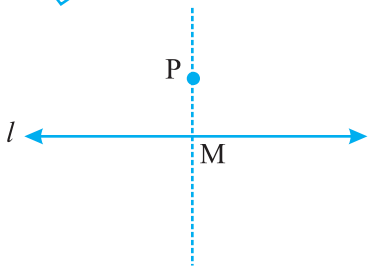
Step 3 Place a ruler along the edge opposite to the right angle of the set-square.

Step 4 Hold the ruler fixed. Slide the set-square along the ruler till the point P touches the other arm of the set-square.



Step 5 Join PM along the edge through P, meeting l at M.

Now $\overline{PM} \perp l$.

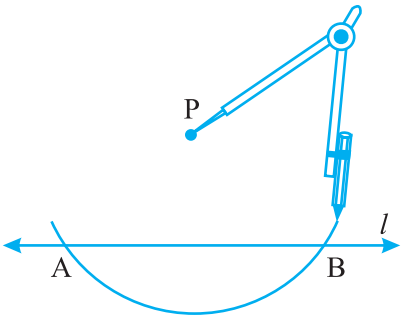


Method using ruler and compasses

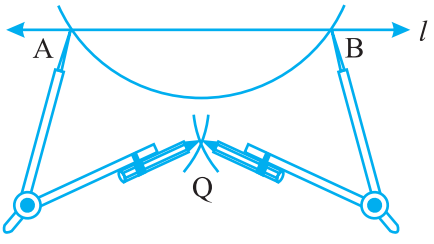
A more convenient and accurate method, of course, is the ruler-compasses method.

Step 1 Given a line l and a point P not on it.

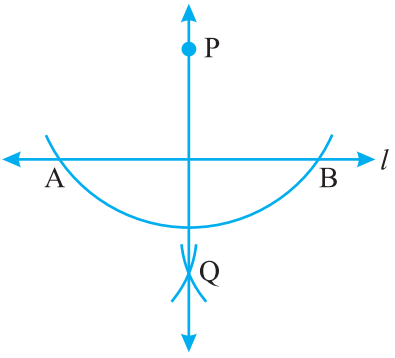
Step 2 With P as centre, draw an arc which intersects line l at two points A and B.



Step 3 Using the same radius and with A and B as centres, construct two arcs that intersect at a point, say Q, on the other side.



Step 4 Join PQ. Thus, $\overleftrightarrow{PQ}$ is perpendicular to l.



EXERCISE 14.4

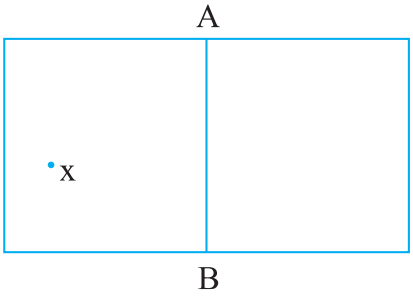
1. Draw any line segment $\overline{AB}$. Mark any point M on it. Through M, draw a perpendicular to $\overline{AB}$. (use ruler and compasses)
2. Draw any line segment $\overline{PQ}$. Take any point R not on it. Through R, draw a perpendicular to $\overline{PQ}$. (use ruler and set-square)
3. Draw a line l and a point X on it. Through X, draw a line segment $\overline{XY}$ perpendicular to l.

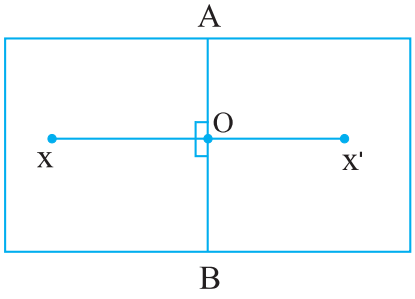
   Now draw a perpendicular to $\overline{XY}$ at Y. (use ruler and compasses)

14.4.3 The perpendicular bisector of a line segment

Do This

Fold a sheet of paper. Let $\overline{AB}$ be the fold. Place an ink-dot X, as shown, anywhere. Find the image X' of X, with $\overline{AB}$ as the mirror line.





Let $\overline{AB}$ and $\overline{XX'}$ intersect at O.

Is OX = OX'? Why?

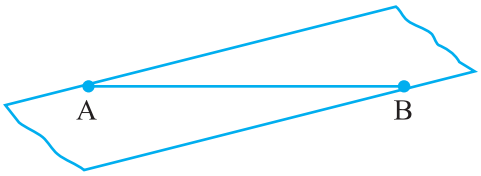
This means that $\overline{AB}$ divides $\overline{XX'}$ into two parts of equal length. $\overline{AB}$ bisects $\overline{XX'}$ or $\overline{AB}$ is a bisector of $\overline{XX'}$. Note also that $\angle AOX$ and $\angle BOX$ are right angles. (Why?).

Hence, $\overline{AB}$ is the perpendicular bisector of $\overline{XX'}$. We see only a part of $\overline{AB}$ in the figure. Is the perpendicular bisector of a line joining two points the same as the axis of symmetry?

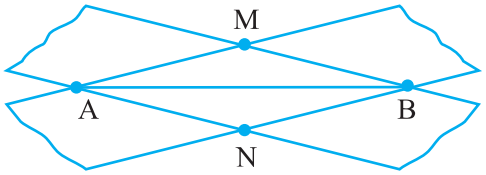
Do This

(Transparent tapes)

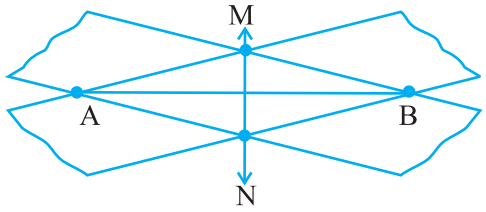
Step 1 Draw a line segment $\overline{AB}$.



Step 2 Place a strip of a transparent rectangular tape diagonally across $\overline{AB}$ with the edges of the tape on the end points A and B, as shown in the figure.



Step 3 Repeat the process by placing another tape over A and B just diagonally across the previous one. The two strips cross at M and N.

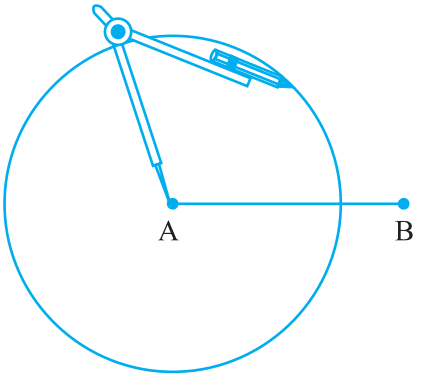


Step 4 Join M and N. Is $\overline{MN}$ a bisector of $\overline{AB}$? Measure and verify. Is it also the perpendicular bisector of $\overline{AB}$? Where is the mid point of $\overline{AB}$?

Construction using ruler and compasses

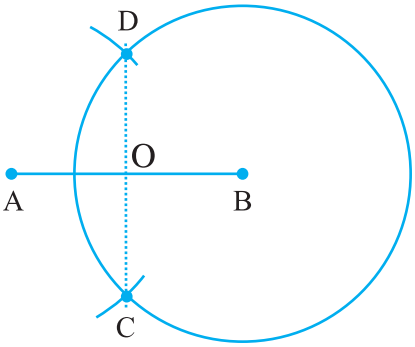
Step 1 Draw a line segment $\overline{AB}$ of any length.

Step 2 With A as centre, using compasses, draw a circle. The radius of your circle should be more than half the length of $\overline{AB}$.



Step 3 With the same radius and with B as centre, draw another circle using compasses. Let it cut the previous circle at C and D.

Step 4 Join $\overline{CD}$. It cuts $\overline{AB}$ at O. Use your divider to verify that O is the midpoint of $\overline{AB}$. Also verify that $\angle COA$ and $\angle COB$ are right angles. Therefore, $\overline{CD}$ is the perpendicular bisector of $\overline{AB}$.



In the above construction, we needed the two points C and D to determine $\overline{CD}$. Is it necessary to draw the whole circle to find them? Is it not enough if we draw merely small arcs to locate them? In fact, that is what we do in practice!

Try These

In Step 2 of the construction using ruler and compasses, what would happen if we take the length of radius to be smaller than half the length of $\overline{AB}$?

EXERCISE 14.5

1. Draw $\overline{AB}$ of length 7.3 cm and find its axis of symmetry.
2. Draw a line segment of length 9.5 cm and construct its perpendicular bisector.
3. Draw the perpendicular bisector of $\overline{XY}$ whose length is 10.3 cm.
   (a) Take any point P on the bisector drawn. Examine whether PX = PY.
   (b) If M is the mid point of $\overline{XY}$, what can you say about the lengths MX and XY?
4. Draw a line segment of length 12.8 cm. Using compasses, divide it into four equal parts. Verify by actual measurement.
5. With $\overline{PQ}$ of length 6.1 cm as diameter, draw a circle.
6. Draw a circle with centre C and radius 3.4 cm. Draw any chord $\overline{AB}$. Construct the perpendicular bisector of $\overline{AB}$ and examine if it passes through C.
7. Repeat Question 6, if $\overline{AB}$ happens to be a diameter.
8. Draw a circle of radius 4 cm. Draw any two of its chords. Construct the perpendicular bisectors of these chords. Where do they meet?
9. Draw any angle with vertex O. Take a point A on one of its arms and B on another such that OA = OB. Draw the perpendicular bisectors of $\overline{OA}$ and $\overline{OB}$. Let them meet at P. Is PA = PB ?

14.5 Angles

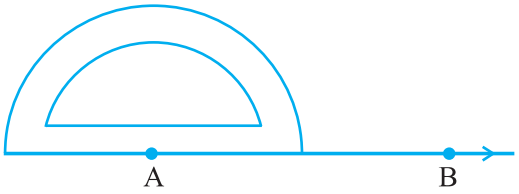
14.5.1 Constructing an angle of a given measure

Suppose we want an angle of measure 40°.

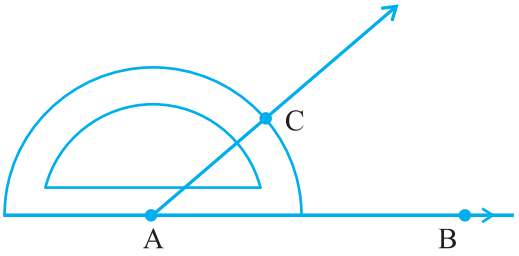
Here are the steps to follow :

Step 1 Draw $\overline{AB}$ of any length.

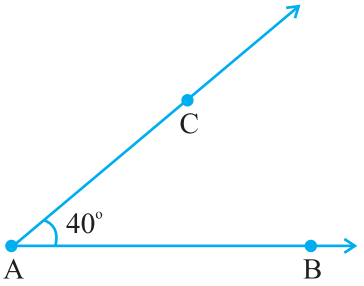
Step 2 Place the centre of the protractor at A and the zero edge along $\overline{AB}$.



Step 3 Start with zero near B. Mark point C at 40°.

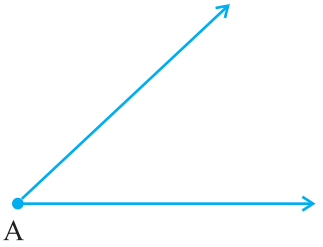


Step 4 Join AC. ∠BAC is the required angle.



14.5.2 Constructing a copy of an angle of unknown measure

Suppose an angle (whose measure we do not know) is given and we want to make a copy of this angle. As usual, we will have to use only a straight edge and the compasses.

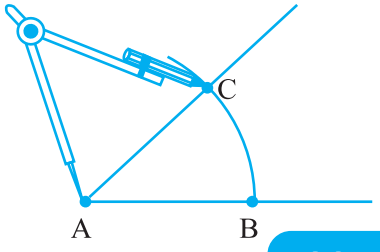


Given ∠A , whose measure is not known.

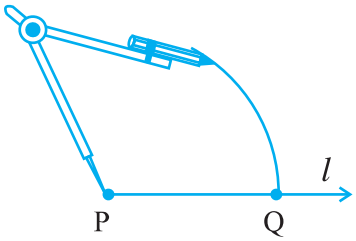
Step 1 Draw a line *l* and choose a point P on it.

Step 2 Place the compasses at A and draw an arc to cut the rays of ∠A at B and C.

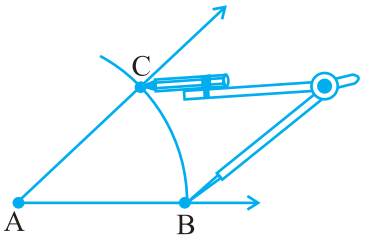
Step 3 Use the same compasses setting to draw



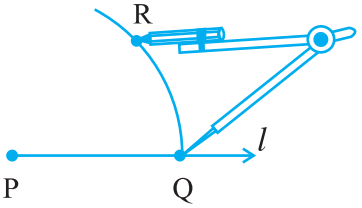
an arc with P as centre, cutting l in Q.



Step 4 Set your compasses to the length BC with the same radius.

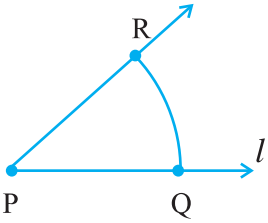


Step 5 Place the compasses pointer at Q and draw the arc to cut the arc drawn earlier in R.



Step 6 Join PR. This gives us $\angle P$. It has the same measure as $\angle A$.

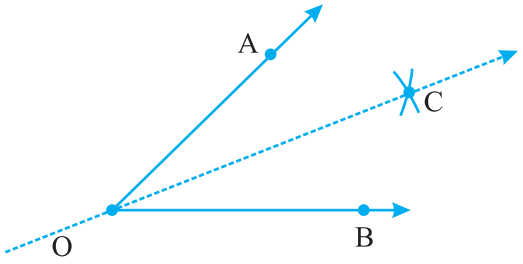
This means $\angle QPR$ has same measure as $\angle BAC$.



14.5.3 Bisector of an angle

Do This

Take a sheet of paper. Mark a point O on it. With O as initial point, draw two rays $\overrightarrow{OA}$ and $\overrightarrow{OB}$. You get $\angle AOB$. Fold the sheet through O such that the rays $\overrightarrow{OA}$ and $\overrightarrow{OB}$ coincide. Let OC be the crease of paper which is obtained after unfolding the paper.



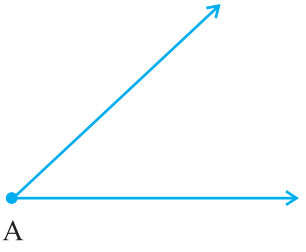
OC is clearly a line of symmetry for $\angle AOB$.

Measure $\angle AOC$ and $\angle COB$. Are they equal? OC the line of symmetry, is therefore known as the angle bisector of $\angle AOB$.

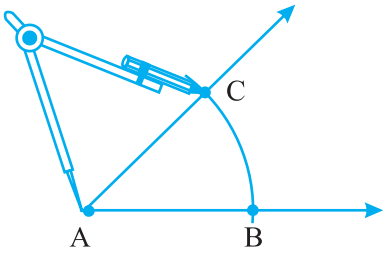
Construction with ruler and compasses

Let an angle, say, $\angle A$ be given.

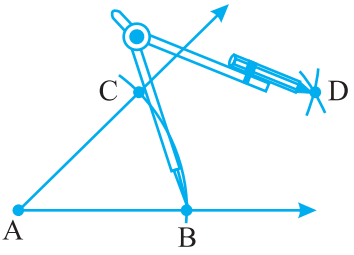
Step 1 With A as centre and using compasses, draw an arc that cuts both rays of $\angle A$. Label the points



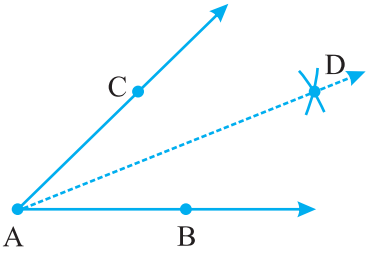
of intersection as B and C.



Step 2 With B as centre, draw (in the interior of $\angle A$) an arc whose radius is more than half the length BC.



Step 3 With the same radius and with C as centre, draw another arc in the interior of $\angle A$. Let the two arcs intersect at D. Then $\overline{AD}$ is the required bisector of $\angle A$.



Try These

In Step 2 above, what would happen if we take radius to be smaller than half the length BC?

14.5.4 Angles of special measures

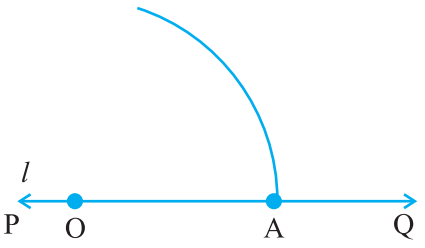
There are some elegant and accurate methods to construct some angles of special sizes which do not require the use of the protractor. We discuss a few here.

Constructing a 60° angle

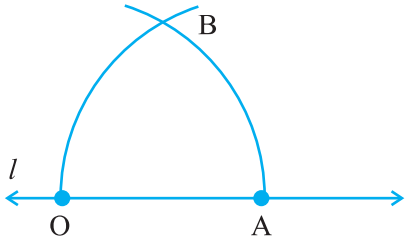
Step 1 Draw a line l and mark a point O on it.

Step 2 Place the pointer of the compasses at O and draw an arc of convenient radius which cuts the line $\overleftrightarrow{PQ}$ at a point say, A.

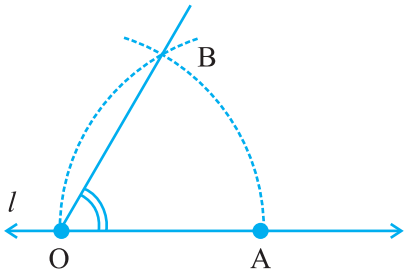
Step 3 With the pointer at A (as centre),



now draw an arc that passes through O.



Step 4 Let the two arcs intersect at B. Join OB. We get ∠BOA whose measure is 60°.



Constructing a 30° angle

Construct an angle of 60° as shown earlier. Now, bisect this angle. Each angle is 30°, verify by using a protractor.

Try These

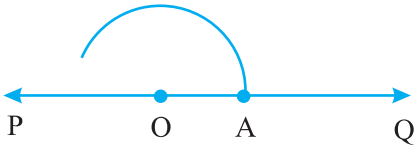
How will you construct a 15° angle?

Constructing a 120° angle

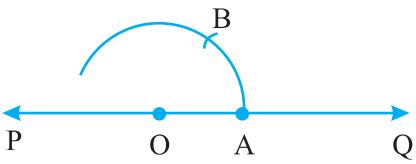
An angle of 120° is nothing but twice of an angle of 60°. Therefore, it can be constructed as follows :

Step 1 Draw any line PQ and take a point O on it.

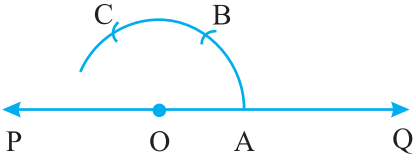
Step 2 Place the pointer of the compasses at O and draw an arc of convenient radius which cuts the line at A.



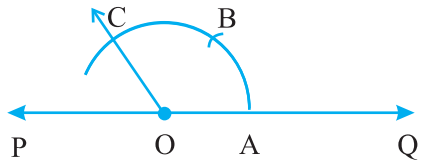
Step 3 Without disturbing the radius on the compasses, draw an arc with A as centre which cuts the first arc at B.



Step 4 Again without disturbing the radius on the compasses and with B as centre, draw an arc which cuts the first arc at C.



Step 5 Join OC, ∠COA is the required angle whose measure is 120°.



Try These

How will you construct a 150° angle?

Try These

How will you construct a 45° angle?

Constructing a 90° angle

Construct a perpendicular to a line from a point lying on it, as discussed earlier. This is the required 90° angle.

EXERCISE 14.6

1. Draw ∠POQ of measure 75° and find its line of symmetry.
2. Draw an angle of measure 147° and construct its bisector.
3. Draw a right angle and construct its bisector.
4. Draw an angle of measure 153° and divide it into four equal parts.
5. Construct with ruler and compasses, angles of following measures:
   (a) 60° (b) 30° (c) 90° (d) 120° (e) 45° (f) 135°
6. Draw an angle of measure 45° and bisect it.
7. Draw an angle of measure 135° and bisect it.
8. Draw an angle of 70°. Make a copy of it using only a straight edge and compasses.
9. Draw an angle of 40°. Copy its supplementary angle.

What have we discussed ?

This chapter deals with methods of drawing geometrical shapes.

1. We use the following mathematical instruments to construct shapes:
   (i) A graduated ruler (ii) The compasses
   (iii) The divider (iv) Set-squares
   (v) The protractor
2. Using the ruler and compasses, the following constructions can be made:
   (i) A circle, when the length of its radius is known.
   (ii) A line segment, if its length is given.

(iii) A copy of a line segment.

(iv) A perpendicular to a line through a point

(a) on the line (b) not on the line.

(v) The perpendicular bisector of a line segment of given length.

(vi) An angle of a given measure.

(vii) A copy of an angle.

(viii) The bisector of a given angle.

(ix) Some angles of special measures such as

(a) 90° (b) 45° (c) 60° (d) 30° (e) 120° (f) 135°

ANSWERS

EXERCISE 1.1

1. (a) Ten
(b) Ten
(c) Ten
(d) Ten
(e) Ten

2. (a) 73,75,307
(b) 9,05,00,041
(c) 7,52, 21,302
(d) 58,423,202
(e) 23,30,010

3. (a) 8,75,95,762 — Eight crore seventy-five lakh ninety-five thousand seven hundred sixty two.
(b) 85,46,283 — Eighty-five lakh forty-six thousand two hundred eighty-three.
(c) 9,99,00,046 — Nine crore ninety-nine lakh forty six.
(d) 9,84,32,701 — Nine crore eighty-four lakh, thirty-two thousand seven hundred one.

4. (a) 78,921,092 — Seventy-eight million, nine hundred twenty-one thousand, ninety-two.
(b) 7,452,283 — Seven million four hundred fifty-two thousand two hundred eighty-three.
(c) 99,985,102 — Ninety-nine million nine hundred eighty-five thousand, one hundred two.
(d) 48,049,831 — Forty-eight million forty-nine thousand eight hundred thirty one.

EXERCISE 1.2

1. 7,707 tickets
2. 3,020 runs
3. 2,28,800 votes
4. ₹ 6,86,659; second week, ₹ 1,14,877
5. 52,965
6. 87,575 screws
7. ₹ 30,592
8. 65,124
9. 18 shirts, 1 m 30 cm
10. 177 boxes
11. 22 km 500 m
12. 180 glasses.

EXERCISE 1.3

1. (a) 1,700 (b) 500
(c) 16,000
(d) 7,000

2. (a) 5,000 ; 5,090 (b) 61,100 ; 61,130
(c) 7,800 ; 7,840
(d) 4,40,900 ; 4,40,980

3. (a) 1,20,000 (b) 1,75,00,000 (c) 7,80,000 (d) 3,00,000

EXERCISE 2.1

1. 11,000 ; 11,001 ; 11,002
2. 10,000 ; 9,999 ; 9,998
3. 0
4. 20
5. (a) 24,40,702 (b) 1,00,200 (c) 11,000,00 (d) 23,45,671
6. (a) 93 (b) 9,999 (c) 2,08,089 (e) 76,54,320

7. (a) 503 is on the left of 530 ; 530 > 503
(b) 307 is on the left of 370 ; 370 > 307
(c) 56,789 is on the left of 98,765 ; 98,765 > 56,789
(d) 98,30,415 is on the left of 1,00,23,001 ; 98,30,415 < 1,00,23,001

8. (a) F (b) F (c) T (d) T (e) T (f) F (g) F (h) F (i) T (j) F (k) F (l) T (m) F

EXERCISE 2.2

1. (a) 1,408 (b) 4,600

2. (a) 1,76,800 (b) 16,600 (c) 2,91,000 (d) 27,90,000 (e) 85,500 (f) 10,00,000

3. (a) 5,940 (b) 54,27,900 (c) 81,26,500 (d) 1,92,25,000

4. (a) 76,014 (b) 87,108 (c) 2,60,064 (d) 1,68,840

5. ₹ 3,960 **6.** ₹ 1,500

7. (i) ⟶ (c) (ii) ⟶ (a) (iii) ⟶ (b)

EXERCISE 2.3

1. (a) **2.** Yes

3. Both of them will be 'l'

4. (a) 73,528 (b) 54,42,437 (c) 20,600 (d) 5,34,375 (e) 17,640

5. 123456 × 8 + 6 = 987654
1234567 × 8 + 7 = 9876543

EXERCISE 3.1

1. (a) 1, 2, 3, 4, 6, 8, 12, 24 (b) 1, 3, 5, 15
(c) 1, 3, 7, 21 (d) 1, 3, 9, 27
(e) 1, 2, 3, 4, 6, 12 (f) 1, 2, 4, 5, 10, 20
(g) 1, 2, 3, 6, 9, 18 (h) 1, 23 (i) 1, 2, 3, 4, 6, 9, 12, 18, 36

2. (a) 5, 10, 15, 20, 25 (b) 8, 16, 24, 32, 40 (c) 9, 18, 27, 36, 45

3. (i) ⟶ (b) (ii) ⟶ (d) (iii) ⟶ (a)
(iv) ⟶ (f) (v) ⟶ (e)

4. 9, 18, 27, 36, 45, 54, 63, 72, 81, 90, 99

EXERCISE 3.2

1. (a) even number (b) even number

2. (a) F (b) T (c) T (d) F
(e) F (f) F (g) F (h) T
(i) F (j) T

3. 17 and 71, 37 and 73, 79 and 97

4. Prime numbers : 2, 3, 5, 7, 11, 13, 17, 19
Composite numbers : 4, 6, 8, 9, 10, 12, 14, 15, 16, 18 **5.** 7

6. (a) 3 + 41 (b) 5 + 31 (c) 5 + 19 (d) 5 + 13
(This could be one of the ways. There can be other ways also.)

7. 3, 5; 5, 7 ; 11, 13

8. (a) and (c) **9.** 90, 91, 92 , 93, 94, 95, 96

10. (a) 3 + 5 + 13 (b) 3 + 5 + 23

(c) 13 + 17 + 23 (d) 7 + 13 + 41

(This could be one of the ways. There can be other ways also.)

11. 2, 3 ; 2, 13; 3, 17; 7, 13; 11, 19

12. (a) prime number (b) composite number

(c) prime number, composite number (d) 2 (e) 4 (f) 2

EXERCISE 3.3

1.

Number	Divisible by								
	2	3	4	5	6	8	9	10	11
990	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes
1586	Yes	No	No	No	No	No	No	No	No
275	No	No	No	Yes	No	No	No	No	Yes
6686	Yes	No	No	No	No	No	No	No	No
639210	Yes	Yes	No	Yes	Yes	No	No	Yes	Yes
429714	Yes	Yes	No	No	Yes	No	Yes	No	No
2856	Yes	Yes	Yes	No	Yes	Yes	No	No	No
3060	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No
406839	No	Yes	No	No	No	No	No	No	No

2. Divisible by 4 : (a) , (b), (c), (d), (f), (g), (h), (i)

Divisible by 8 : (b), (d), (f), (h)

3. (a), (f), (g), (i) **4.** (a), (b), (d), (e), (f)

5. (a) 2 and 8 (b) 0 and 9 **6.** (a) 8 (b) 6

EXERCISE 3.4

1. (a) 1, 2, 4 (b) 1, 5 (c) 1, 5 (d) 1, 2, 4, 8

2. (a) 1, 2, 4 (b) 1, 5

3. (a) 24, 48, 72 (b) 36, 72, 108

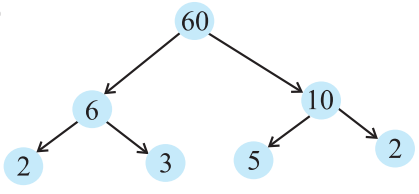
4. 12, 24, 36, 48, 60, 72, 84, 96

5. (a), (b), (e), (f) **6.** 60 **7.** 1, 2, 3, 4, 6

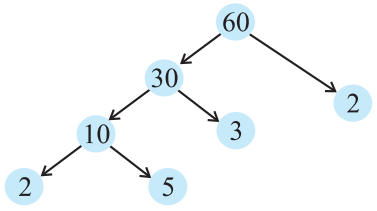
EXERCISE 3.5

1. (a) F (b) T (c) F (d) T (e) F (f) F (g) T (h) T (i) F

2. (a)



(b)



3. 1 and the number itself

4. 9999, $9999 = 3 \times 3 \times 11 \times 101$

5. 10000, $10000 = 2 \times 2 \times 2 \times 2 \times 5 \times 5 \times 5 \times 5$

6. $1729 = 7 \times 13 \times 19$

The difference of two consecutive prime factors is 6

7. (i) $2 \times 3 \times 4 = 24$ is divisible by 6.

(ii) $5 \times 6 \times 7 = 210$ is divisible by 6.

9. (b), (c)

10. Yes

11. No. Number 12 is divisible by both 4 and 6; but 12 is not divisible by 24.

12. $2 \times 3 \times 5 \times 7 = 210$

EXERCISE 3.6

1. (a) 6 (b) 6 (c) 6 (d) 9 (e) 12 (f) 34 (g) 35 (h) 7
(i) 9 (j) 3

2. (a) 1 (b) 2 (c) 1

3. No ; 1

EXERCISE 3.7

1. 3 kg **2.** 6930 cm **3.** 75 cm **4.** 120

5. 960 **6.** 7 minutes 12 seconds past 7 a.m.

7. 31 litres **8.** 95 **9.** 1152

10. (a) 36 (b) 60 (c) 30 (d) 60

Here, in each case LCM is a multiple of 3

Yes, in each case LCM = the product of two numbers

11. (a) 20 (b) 18 (c) 48 (d) 45

The LCM of the given numbers in each case is the larger of the two numbers.

EXERCISE 4.1

1. (a) O, B, C, D, E.

(b) Many answers are possible. Some are: $\overrightarrow{DE}$, $\overrightarrow{DO}$, $\overrightarrow{DB}$, $\overrightarrow{EO}$ etc.

(c) Many answers are possible. Some are: $\overrightarrow{DB}$, $\overrightarrow{DE}$, $\overrightarrow{OB}$, $\overrightarrow{OE}$, $\overrightarrow{EB}$ etc.

(d) Many answers are possible. Some are: $\overline{DE}$, $\overline{DO}$, $\overline{EO}$, $\overline{OB}$, $\overline{EB}$ etc.

2. $\overrightarrow{AB}$, $\overrightarrow{AC}$, $\overrightarrow{AD}$, $\overrightarrow{BA}$, $\overrightarrow{BC}$, $\overrightarrow{BD}$, $\overrightarrow{CA}$, $\overrightarrow{CB}$, $\overrightarrow{CD}$, $\overrightarrow{DA}$, $\overrightarrow{DB}$, $\overrightarrow{DC}$.

3. (a) Many answers. One answer is $\overrightarrow{AE}$.

(b) Many answers. One answer is $\overrightarrow{AE}$.

(c) $\overrightarrow{CO}$ or $\overrightarrow{OC}$

(d) Many answers are possible. Some are, $\overrightarrow{CO}$, $\overrightarrow{AE}$ and $\overrightarrow{AE}$, $\overrightarrow{EF}$.

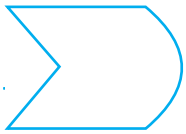
4. (a) Countless (b) Only one.

6. (a) T (b) T (c) T (d) F (e) F
(f) F (g) T (h) F (i) F (j) F (k) T

EXERCISE 4.2

1. Open : (a), (c); Closed : (b), (d), (e).

4. (a) Yes (b) Yes

5. (a)  (b)  (c) Not possible.

EXERCISE 4.3

1. $\angle$ A or $\angle$ DAB; $\angle$ B or $\angle$ ABC; $\angle$ C or $\angle$ BCD; $\angle$ D or $\angle$ CDA

2. (a) A (b) A, C, D. (c) E, B, O, F.

EXERCISE 4.4

2. (a) ΔABC, ΔABD, ΔADC.

(b) Angles: $\angle$ B, $\angle$ C, $\angle$ BAC, $\angle$ BAD, $\angle$ CAD, $\angle$ ADB, $\angle$ ADC

(c) Line segments: $\overline{AB}$, $\overline{AC}$, $\overline{BC}$, $\overline{AD}$, $\overline{BD}$, $\overline{DC}$

(d) ΔABC, ΔABD

EXERCISE 4.5

1. The diagonals will meet in the interior of the quadrilateral.

2. (a) $\overline{KL}$, $\overline{NM}$ and $\overline{KN}$, $\overline{ML}$ (b) $\angle$ K, $\angle$ M and $\angle$ N, $\angle$ L

(c) $\overline{KL}$, $\overline{KN}$ and $\overline{NM}$, $\overline{ML}$ or $\overline{KL}$, $\overline{LM}$ and $\overline{NM}$, $\overline{NK}$

(d) $\angle$ K, $\angle$ L and $\angle$ M, $\angle$ N or $\angle$ K, $\angle$ L and $\angle$ L, $\angle$ M etc.

EXERCISE 4.6

1. (a) O (b) $\overline{OA}$, $\overline{OB}$, $\overline{OC}$ (c) $\overline{AC}$ (d) $\overline{ED}$

(e) O, P (f) Q (g) OAB (Shaded portion)

(h) Segment ED (Shaded portion)

2. (a) Yes (b) No

4. (a) True (b) True

EXERCISE 5.1

1. Chances of errors due to improper viewing are more.

2. Accurate measurement will be possible.

3. Yes. (because C is 'between' A and B).

4. B lies between A and C.

5. D is the mid point of $\overline{AG}$ (because, AD = DG = 3 units).

6. AB = BC and BC = CD, therefore, AB = CD

7. The sum of the lengths of any two sides of a triangle can never be less than the length of the third side.

EXERCISE 5.2

1. (a) $\frac{1}{2}$ (b) $\frac{1}{4}$ (c) $\frac{1}{4}$ (d) $\frac{3}{4}$ (e) $\frac{3}{4}$ (f) $\frac{3}{4}$

2. (a) 6 (b) 8 (c) 8 (d) 2

3. (a) West (b) West (c) North (d) South

(To answer (d), it is immaterial whether we turn clockwise or anticlockwise, because one full revolution will bring us back to the original position).

4. (a) $\frac{3}{4}$ (b) $\frac{3}{4}$ (c) $\frac{1}{2}$

5. (a) 1 (b) 2 (c) 2 (d) 1 (e) 3 (f) 2

6. (a) 1 (b) 3 (c) 4 (d) 2 (clockwise or anticlockwise).

7. (a) 9 (b) 2 (c) 7 (d) 7

(We should consider only clockwise direction here).

EXERCISE 5.3

1. (i) → (c); (ii) → (d); (iii) → (a); (iv) → (e); (v) → (b).

2. Acute : (a) and(f); Obtuse : (b); Right: (c); Straight: (e); Reflex : (d).

EXERCISE 5.4

1. (i) 90°; (ii) 180°.

2. (a) T (b) F (c) T (d) T (e) T

3. (a) Acute: 23°, 89°; (b) Obtuse: 91°, 179°.

7. (a) acute (b) obtuse (if the angle is less than 180°)

(c) straight (d) acute (e) an obtuse angle.

9. 90°, 30°, 180°

10. The view through a magnifying glass will not change the angle measure.

EXERCISE 5.5

1. (a) and (c) **2.** 90°

3. One is a 30° – 60° – 90° set square; the other is a 45° – 45° – 90° set square. The angle of measure 90° (i.e. a right angle) is common between them.

4. (a) Yes (b) Yes (c) $\overline{BH}$, $\overline{DF}$ (d) All are true.

EXERCISE 5.6

1. (a) Scalene triangle (b) Scalene triangle (c) Equilateral triangle

(d) Right triangle (e) Isosceles right triangle (f) Acute-angled triangle

2. (i) → (e); (ii) → (g); (iii) → (a); (iv) → (f); (v) → (d); (vi) → (c); (vii) → (b).

3. (a) Acute-angled and isosceles. (b) Right-angled and scalene.

(c) Obtuse-angled and isosceles. (d) Right-angled and isosceles.

(e) Equilateral and acute angled. (f) Obtuse-angled and scalene.

4. (b) is not possible. (Remember : The sum of the lengths of any two sides of a triangle has to be greater than the third side.)

EXERCISE 5.7

1. (a) T (b) T (c) T (d) T (e) F (f) F

2. (a) A rectangle with all sides equal becomes a square.
(b) A parallelogram with each angle a right angle becomes a rectangle.
(c) A rhombus with each angle a right angle becomes a square.
(d) All these are four-sided polygons made of line segments.
(e) The opposite sides of a square are parallel, so it is a parallelogram.

3. A square is a 'regular' quadrilateral

EXERCISE 5.8

1. (a) is not a closed figure and hence is not a polygon.
(b) is a polygon of six sides.
(c) and (d) are not polygons since they are not made of line segments.

2. (a) A Quadrilateral (b) A Triangle (c) A Pentagon (5-sided) (d) An Octagon

EXERCISE 5.9

1. (a) → (ii); (b) → (iv); (c) → (v); (d) → (iii); (e) → (i).

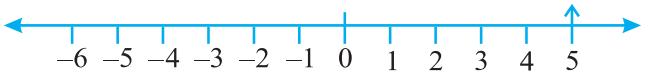
2. (a), (b) and (c) are cuboids; (d) is a cylinder; (e) is a sphere.

EXERCISE 6.1

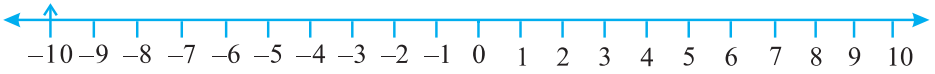
1. (a) Decrease in weight (b) 30 km south (c) 326 A.D.
(d) Gain of Rs 700 (e) 100 m below sea level

2. (a) + 2000 (b) – 800 (c) + 200 (d) – 700

3. (a) + 5



(b) – 10



(c) + 8

(d) – 1

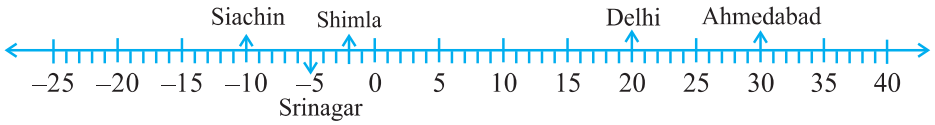
(e) – 6

4. (a) F (b) negative integer (c) B → + 4, E → – 10

(d) E (e) D, C, B, A, O, H, G, F, E

5. (a) – 10°C, – 2°C, + 30°C, + 20°C, – 5°C

(b)



(c) Siachin (d) Ahmedabad and Delhi

6. (a) 9 (b) – 3 (c) 0 (d) 10 (e) 6 (f) 1

7. (a) – 6, – 5, – 4, – 3, – 2, – 1 (b) – 3,– 2, – 1, 0, 1, 2, 3

(c) – 14, – 13, – 12, – 11, – 10, – 9

(d) – 29, – 28, – 27, – 26, – 25, – 24

8. (a) – 19, – 18, – 17, – 16 (b) – 11, – 12, – 13, – 14

9. (a) T (b) F; – 100 is to the left of – 50 on number line

(c) F; greatest negative integer is – 1

(d) F; – 26 is smaller than – 25

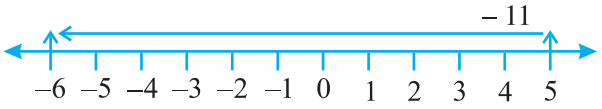
10. (a) 2 (b) – 4 (c) to the left (d) to the right

EXERCISE 6.2

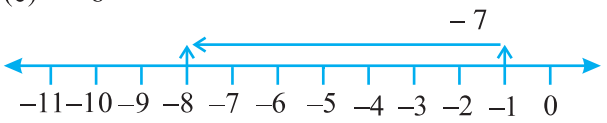
1. (a) 8 (b) 0 (c) – 4 (d) – 5

2. (a) 3

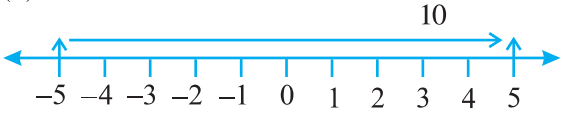
(b) – 6



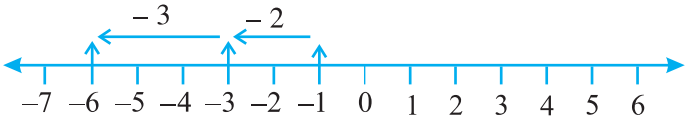
(c) – 8



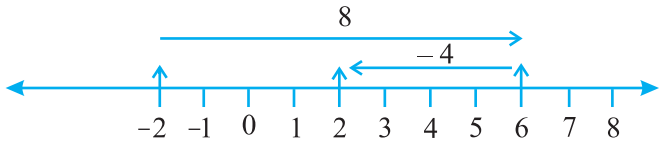
(d) 5



(e) – 6



(f) 2



3. (a) 4 (b) 5 (c) 9 (d) –100 (e) – 650 (f) – 317

4. (a) – 217 (b) 0 (c) – 81 (d) 50

5. (a) 4 (b) –38

EXERCISE 6.3

1. (a) 15 (b) – 18 (c) 3 (d) – 33 (e) 35 (f) 8

2. (a) < (b) > (c) > (d) >

3. (a) 8 (b) – 13 (c) 0 (d) – 8 (e) 5

4. (a) 10 (b) 10 (c) – 105 (d) 92

EXERCISE 7.1

1. (i) $\frac{2}{4}$ (ii) $\frac{8}{9}$ (iii) $\frac{4}{8}$ (iv) $\frac{1}{4}$ (v) $\frac{3}{7}$ (vi) $\frac{3}{12}$
(vii) $\frac{10}{10}$ (viii) $\frac{4}{9}$ (ix) $\frac{4}{8}$ (x) $\frac{1}{2}$

3. Shaded portions do not represent the given fractions.

4. $\frac{8}{24}$ **5.** $\frac{40}{60}$

6. (a) Arya will divide each sandwich into three equal parts, and give one part of each sandwich to each one of them.

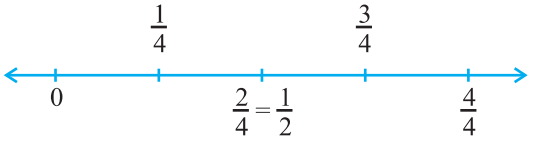
(b) $\frac{1}{3}$ **7.** $\frac{2}{3}$ **8.** 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12; $\frac{5}{11}$

9. 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113; $\frac{4}{12}$

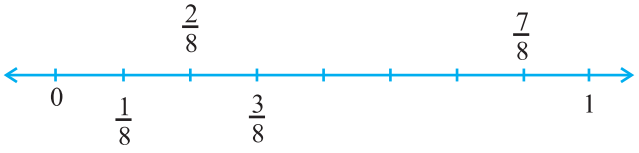
10. $\frac{4}{8}$ **11.** $\frac{3}{8}, \frac{5}{8}$

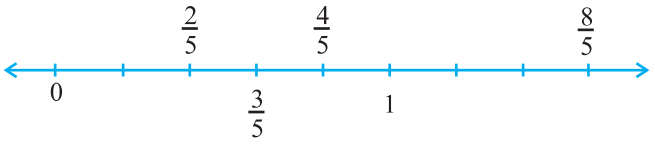
EXERCISE 7.2

1. (a)



(b)



(c) 

2. (a) $6\frac{2}{3}$ (b) $2\frac{1}{5}$ (c) $2\frac{3}{7}$ (d) $5\frac{3}{5}$ (e) $3\frac{1}{6}$ (f) $3\frac{8}{9}$

3. (a) $\frac{31}{4}$ (b) $\frac{41}{7}$ (c) $\frac{17}{6}$ (d) $\frac{53}{5}$ (e) $\frac{66}{7}$ (f) $\frac{76}{9}$

EXERCISE 7.3

1. (a) $\frac{1}{2}, \frac{2}{4}, \frac{3}{6}, \frac{4}{8}$; Yes (b) $\frac{4}{12}, \frac{3}{9}, \frac{2}{6}, \frac{1}{3}, \frac{6}{15}$; No

2. (a) $\frac{1}{2}$ (b) $\frac{4}{6}$ (c) $\frac{3}{9}$ (d) $\frac{2}{8}$ (e) $\frac{3}{4}$ (i) $\frac{6}{18}$

(ii) $\frac{4}{8}$ (iii) $\frac{12}{16}$ (iv) $\frac{8}{12}$ (v) $\frac{4}{16}$

(a), (ii); (b), (iv); (c), (i); (d), (v); (e), (iii)

3. (a) 28 (b) 16 (c) 12 (d) 20 (e) 3

4. (a) $\frac{12}{20}$ (b) $\frac{9}{15}$ (c) $\frac{18}{30}$ (d) $\frac{27}{45}$

5. (a) $\frac{9}{12}$ (b) $\frac{3}{4}$

6. (a) equivalent (b) not equivalent (c) not equivalent

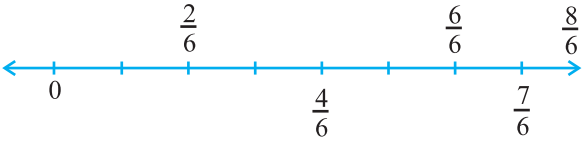
7. (a) $\frac{4}{5}$ (b) $\frac{5}{2}$ (c) $\frac{6}{7}$ (d) $\frac{3}{13}$ (e) $\frac{1}{4}$

8. Ramesh $\rightarrow \frac{10}{20}=\frac{1}{2}$, Sheelu $\rightarrow \frac{25}{50}=\frac{1}{2}$, Jamaal $\rightarrow \frac{40}{80}=\frac{1}{2}$. Yes

9. (i) $\rightarrow$ (d) (ii) $\rightarrow$ (e) (iii) $\rightarrow$ (a) (iv) $\rightarrow$ (c) (v) $\rightarrow$ (b)

EXERCISE 7.4

1. (a) $\frac{1}{8}<\frac{3}{8}<\frac{4}{8}<\frac{6}{8}$ (b) $\frac{3}{9}<\frac{4}{9}<\frac{6}{9}<\frac{8}{9}$

(c) 

$\frac{5}{6}>\frac{2}{6}, \frac{3}{6}>\frac{0}{6}, \frac{1}{6}<\frac{6}{6}, \frac{8}{6}>\frac{5}{6}$

2. (a) $\frac{3}{6} < \frac{5}{6}$ (b) $\frac{1}{7} < \frac{1}{4}$ (c) $\frac{4}{5} > \frac{5}{5}$ (d) $\frac{3}{5} < \frac{3}{7}$

4. (a) $\frac{1}{6} < \frac{1}{3}$ (b) $\frac{3}{4} > \frac{2}{6}$ (c) $\frac{2}{3} > \frac{2}{4}$ (d) $\frac{6}{6} = \frac{3}{3}$

(e) $\frac{5}{6} < \frac{5}{5}$

5. (a) $\frac{1}{2} > \frac{1}{5}$ (b) $\frac{2}{4} = \frac{3}{6}$ (c) $\frac{3}{5} < \frac{2}{3}$ (d) $\frac{3}{4} > \frac{2}{8}$

(e) $\frac{3}{5} < \frac{6}{5}$ (f) $\frac{7}{9} > \frac{3}{9}$ (g) $\frac{1}{4} = \frac{2}{8}$ (h) $\frac{6}{10} < \frac{4}{5}$

(i) $\frac{3}{4} < \frac{7}{8}$ (j) $\frac{6}{10} < \frac{4}{5}$ (k) $\frac{5}{7} = \frac{15}{21}$

6. (a) $\frac{1}{6}$ (b) $\frac{1}{5}$ (c) $\frac{4}{25}$ (d) $\frac{4}{25}$ (e) $\frac{1}{6}$ (f) $\frac{1}{5}$

(g) $\frac{1}{5}$ (h) $\frac{1}{6}$ (i) $\frac{4}{25}$ (j) $\frac{1}{6}$ (k) $\frac{1}{6}$ (l) $\frac{4}{25}$

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

7. (a) No ; $\frac{5}{9} = \frac{25}{45}, \frac{4}{5} = \frac{36}{45}$ and $\frac{25}{45} \neq \frac{36}{45}$

(b) No ; $\frac{9}{16} = \frac{81}{144}, \frac{5}{9} = \frac{80}{144}$ and $\frac{81}{144} \neq \frac{80}{144}$ (c) Yes ; $\frac{4}{5} = \frac{16}{20}$

(d) No ; $\frac{1}{15} = \frac{2}{30}$ and $\frac{2}{30} \neq \frac{4}{30}$

8. Ila has read less **9.** Rohit

10. Same fraction ($\frac{4}{5}$) of students got first class in both the classes.

EXERCISE 7.5

1. (a) + (b) – (c) +

2. (a) $\frac{1}{9}$ (b) $\frac{11}{15}$ (c) $\frac{2}{7}$ (d) 1 (e) $\frac{1}{3}$

(f) 1 (g) $\frac{1}{3}$ (h) $\frac{1}{4}$ (i) $\frac{3}{5}$

3. The complete wall.

4. (a) $\frac{4}{10}\left(=\frac{2}{5}\right)$ (b) $\frac{8}{21}$ (c) $\frac{6}{6}\ (=1)$ (d) $\frac{7}{27}$

5. $\frac{2}{7}$

EXERCISE 7.6

1. (a) $\frac{17}{21}$ (b) $\frac{23}{30}$ (c) $\frac{46}{63}$ (d) $\frac{22}{21}$ (e) $\frac{17}{30}$

(f) $\frac{22}{15}$ (g) $\frac{5}{12}$ (h) $\frac{3}{6}\left(=\frac{1}{2}\right)$ (i) $\frac{23}{12}$ (j) $\frac{6}{6}\ (=1)$ (k) 5

(l) $\frac{95}{12}$ (m) $\frac{9}{5}$ (n) $\frac{5}{6}$

2. $\frac{23}{20}$ metre **3.** $2\frac{5}{6}$

4. (a) $\frac{7}{8}$ (b) $\frac{7}{10}$ (c) $\frac{1}{3}$

5. (a)

$\frac{2}{3}$	$\frac{4}{3}$	2
$\frac{1}{3}$	$\frac{2}{3}$	1
$\frac{1}{3}$	$\frac{2}{3}$	1

(b)

$\frac{1}{2}$	$\frac{1}{3}$	$\frac{5}{6}$
$\frac{1}{3}$	$\frac{1}{4}$	$\frac{7}{12}$
$\frac{1}{6}$	$\frac{1}{12}$	$\frac{1}{4}$

6. Length of the other piece = $\frac{5}{8}$ metre

7. The distance walked by Nandini = $\frac{4}{10}\left(=\frac{2}{5}\right)$ km

8. Asha's bookshelf is more full; by $\frac{13}{30}$

9. Rahul takes less time; by $\frac{9}{20}$ minutes

EXERCISE 8.1

1.

	Hundreds (100)	Tens (10)	Ones (1)	Tenths $(\frac{1}{10})$
(a)	0	3	1	2
(b)	1	1	0	4

2.

	Hundreds (100)	Tens (10)	Ones (1)	Tenths ($\frac{1}{10}$)
(a)	0	1	9	4
(b)	0	0	0	3
(c)	0	1	0	6
(d)	2	0	5	9

3. (a) 0.7 (b) 20.9 (c) 14.6 (d) 102.0 (e) 600.8

4. (a) 0.5 (b) 3.7 (c) 265.1 (d) 70.8 (e) 8.8
(f) 4.2 (g) 1.5 (h) 0.4 (i) 2.4 (j) 3.6
(k) 4.5

5. (a) $\frac{6}{10}, \frac{3}{5}$ (b) $\frac{25}{10}, \frac{5}{2}$ (c) 1, 1 (d) $\frac{38}{10}, \frac{19}{5}$ (e) $\frac{137}{10}, \frac{137}{10}$
(f) $\frac{212}{10}, \frac{106}{5}$ (g) $\frac{64}{10}, \frac{32}{5}$

6. (a) 0.2cm (b) 3.0 cm (c) 11.6 cm (d) 4.2 cm
(e) 16.2 cm (f) 8.3 cm

7. (a) 0 and 1; 1 (b) 5 and 6; 5 (c) 2 and 3; 3 (d) 6 and 7; 6
(e) 9 and 10; 9 (f) 4 and 5; 5

8.

9. A, 0.8 cm; B, 1.3 cm; C, 2.2 cm; D, 2.9 cm

10. (a) 9.5 cm (b) 6.5 cm

EXERCISE 8.2

1.

	Ones	Tenths	Hundredths	Number
(a)	0	2	6	0.26
(b)	1	3	8	1.38
(c)	1	2	8	1.28

2. (a) 3.25 (b) 102.63 (c) 30.025 (d) 211.902 (e) 12.241

3.

	Hundreds	Tens	Ones	Tenths	Hundredths	Thousandths
(a)	0	0	0	2	9	0
(b)	0	0	2	0	8	0
(c)	0	1	9	6	0	0
(d)	1	4	8	3	2	0
(e)	2	0	0	8	1	2

4. (a) 29.41 (b) 137.05 (c) 0.764 (d) 23.206 (e) 725.09

5. (a) Zero point zero three (b) One point two zero
(c) One hundred eight point five six (d) Ten point zero seven
(e) Zero point zero three two (f) Five point zero zero eight

6. (a) 0 and 0.1 (b) 0.4 and 0.5 (c) 0.1 and 0.2
(d) 0.6 and 0.7 (e) 0.9 and 1.0 (f) 0.5 and 0.6

7. (a) $\frac{3}{5}$ (b) $\frac{1}{20}$ (c) $\frac{3}{4}$ (d) $\frac{9}{50}$ (e) $\frac{1}{4}$
(f) $\frac{1}{8}$ (g) $\frac{33}{500}$

EXERCISE 8.3

1. (a) 0.4 (b) 0.07 (c) 3 (d) 0.5 (e) 1.23
(f) 0.19 (g) both are same (h) 1.490 (i) both are same (j) 5.64

EXERCISE 8.4

1. (a) ₹ 0.05 (b) ₹ 0.75 (c) ₹ 0.20 (d) ₹ 50.90 (e) ₹ 7.25

2. (a) 0.15 m (b) 0.06 m (c) 2.45 m (d) 9.07 m (e) 4.19 m

3. (a) 0.5 cm (b) 6.0 cm (c) 16.4 cm (d) 9.8 cm (e) 9.3 cm

4. (a) 0.008 km (b) 0.088 km (c) 8.888 km (d) 70.005 km

5. (a) 0.002 kg (b) 0.1 kg (c) 3.750 kg (d) 5.008 kg (e) 26.05 kg

EXERCISE 8.5

1. (a) 38.587 (b) 29.432 (c) 27.63 (d) 38.355 (e) 13.175 (f) 343.89

2. ₹ 68.35 **3.** ₹ 26.30 **4.** 5.25 m

5. 3.042 km **6.** 22.775 km **7.** 18.270 kg

EXERCISE 8.6

1. (a) ₹ 2.50 (b) 47.46 m (c) ₹ 3.04 (d) 3.155 km (e) 1.793 kg

2. (a) 3.476 (b) 5.78 (c) 11.71 (d) 1.753

3. ₹ 14.35 **4.** ₹ 6.75 **5.** 15.55 m

6. 9.850 km **7.** 4.425 kg

EXERCISE 9.1

1.

Marks	Tally marks	Number of students
1	||	2
2	|||	3
3	|||	3
4	$\cancel{\|\|\|\|}$ ||	7
5	$\cancel{\|\|\|\|}$ |	6
6	$\cancel{\|\|\|\|}$ ||	7
7	$\cancel{\|\|\|\|}$	5
8	||||	4
9	|||	3

(a) 12 (b) 8

2.

Sweets	Tally marks	Number of students
Ladoo	𝍸 𝍸 I	11
Barfi	III	3
Jalebi	𝍸 II	7
Rasgulla	𝍸 IIII	9
		30

(b) Ladoo

3.

Numbers	Tally marks	How many times?
1	𝍸 II	7
2	𝍸 I	6
3	𝍸	5
4	IIII	4
5	𝍸 𝍸 I	11
6	𝍸 II	7

(a) 4 (b) 5 (c) 1 and 6

4. (i) Village D (ii) Village C (iii) 3 (iv) 28

5. (a) VIII (b) No (c) 12

6. (a) Number of bulbs sold on Friday are 14. Similarly, number of bulbs sold on other days can be found.

(b) Maximum number of bulbs were sold on Sunday.

(c) Same number of bulbs were sold on Wednesday and Saturday.

(d) Minimum number of bulbs were sold on Wednesday and Saturday.

(e) 10 Cartons

7. (a) Martin (b) 700 (c) Anwar, Martin, Ranjit Singh

EXERCISE 9.2

1.

	⊗ - 10 animals
Village A	⊗ ⊗ ⊗ ⊗ ⊗ ⊗ ⊗ ⊗
Village B	⊗ ⊗ ⊗ ⊗ ⊗ ⊗ ⊗ ⊗ ⊗ ⊗ ⊗ ⊗
Village C	⊗ ⊗ ⊗ ⊗ ⊗ ⊗ ⊗ ⊗ ⊗
Village D	⊗ ⊗ ⊗ ⊗
Village E	⊗ ⊗ ⊗ ⊗ ⊗ ⊗

(a) 6 (b) Village B (c) Village C

2.

	🧍 - 100 students
1996	🧍🧍🧍🧍
1998	🧍🧍🧍🧍🧍
2000	🧍🧍🧍🧍
2002	🧍🧍🧍🧍🧍🧍
2004	🧍🧍🧍🧍🧍🧍🧍

A (a) 6 (b) 5 complete and 1 incomplete

B Second

EXERCISE 9.3

1. (a) 2002 (b) 1998

2. (a) This bar graph shows the number of shirts sold from Monday to Saturday

(b) 1 unit = 5 shirts (c) Saturday, 60

(d) Tuesday (e) 35

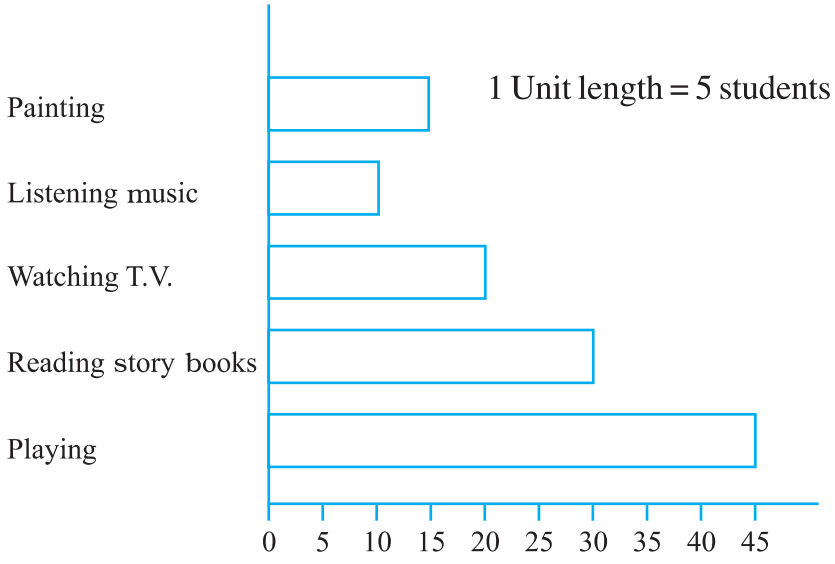
3. (a) This bar graph shows the marks obtained by Aziz in different subjects.

(b) Hindi (c) Social Studies

(d) Hindi – 80, English – 60, Mathematics – 70, Science – 50 and Social Studies – 40.

EXERCISE 9.4

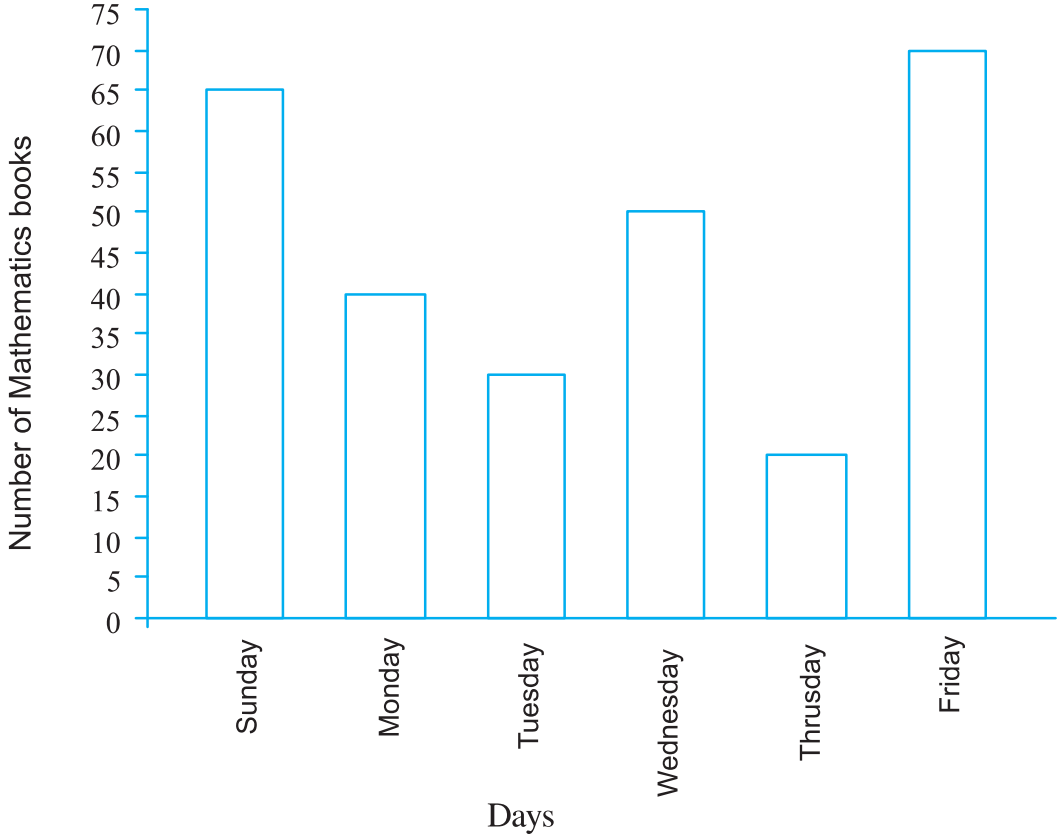
1.



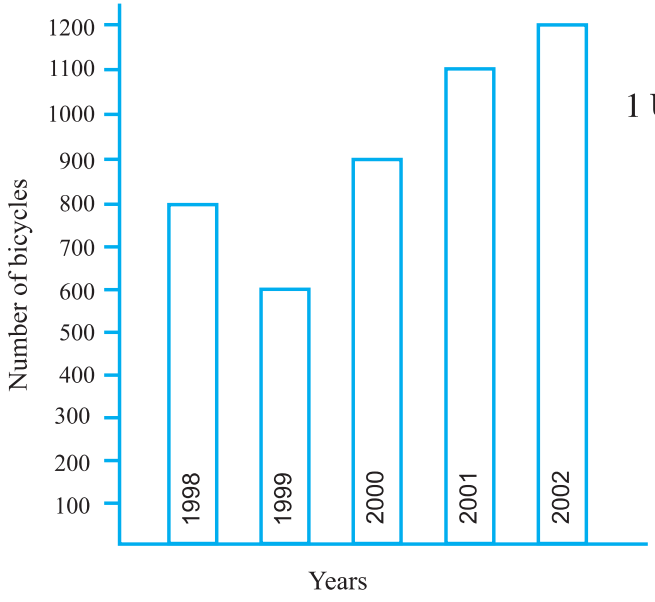
Reading story books.

2.

1 Unit length = 5 books



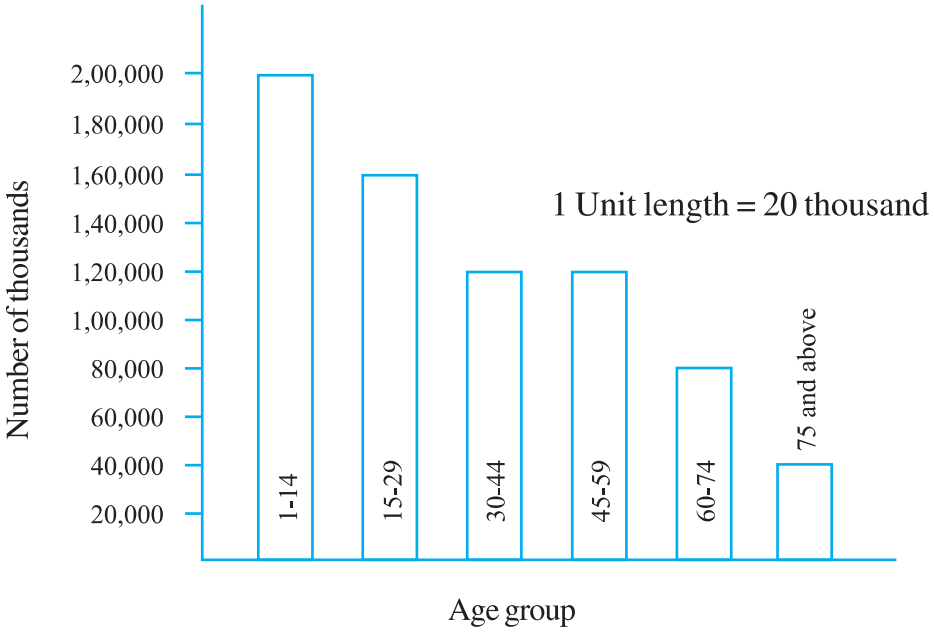
3.



1 Unit length = 100 bicycles

(a) 2002 (b) 1999

4.



(a) 30 – 44, 45 – 59

(b) 1 lakh 20 thousand

EXERCISE 10.1

1. (a) 12 cm (b) 133 cm (c) 60 cm (d) 20 cm (e) 15 cm
(f) 52 cm **2.** 100 cm or 1 m **3.** 7.5 m **4.** 106 cm
5. 9.6 km **6.** (a) 12 cm (b) 27 cm (c) 22 cm
7. 39 cm **8.** 48 m **9.** 5 m **10.** 20 cm
11. (a) 7.5 cm (b) 10 cm (c) 5 cm **12.** 10 cm
13. Rs 20,000 **14.** Rs 7200 **15.** Bulbul
16. (a) 100 cm (b) 100 cm (c) 100 cm (d) 100 cm
All the figures have same perimeter.
17. (a) 6 m (b) 10 m (c) Cross has greater perimeter

EXERCISE 10.2

1. (a) 9 sq units (b) 5 sq units (c) 4 sq units (d) 8 sq units (e) 10 sq units
(f) 4 sq units (g) 6 sq units (h) 5 sq units (i) 9 sq units (j) 4 sq units
(k) 5 sq units (l) 8 sq units (m) 14 sq units (n) 18 sq units

EXERCISE 10.3

1. (a) 12 sq cm (b) 252 sq cm (c) 6 sq km (d) 1.40 sq m
2. (a) 100 sq cm (b) 196 sq cm (c) 25 sq m

3. (c) largest area (b) smallest area
4. 6 m **5.** Rs 8000 **6.** 3 sq m **7.** 14 sq m
8. 11 sq m **9.** 15 sq m
10. (a) 28 sq cm (b) 9 sq cm
11. (a) 40 sq cm (b) 245 sq cm (c) 9 sq cm
12. (a) 240 tiles (b) 42 tiles

EXERCISE 11.1

1. (a) $2n$ (b) $3n$ (c) $3n$ (d) $2n$ (e) $5n$
(f) $5n$ (g) $6n$
2. (a) and (d); The number of matchsticks required in each of them is 2
3. $5n$ **4.** $50b$ **5.** $5s$
6. t km **7.** $8r$, 64, 80 **8.** $(x - 4)$ years **9.** $l + 5$
10. $2x + 10$
11. (a) $3x + 1$, x = number of squares
(b) $2x + 1$, x = number of triangles

EXERCISE 11.2

1. $3l$ **2.** $6l$ **3.** $12l$ **4.** $d = 2r$
5. (a + b) + c = a + (b + c)

EXERCISE 11.3

2. (c), (d)
3. (a) Addition, subtraction, addition, subtraction
(b) Multiplication, division, multiplication
(c) Multiplication and addition, multiplication and subtraction
(d) Multiplication, multiplication and addition, multiplication and subtraction

4. (a) $p + 7$ (b) $p - 7$ (c) $7p$ (d) $\frac{p}{7}$
(e) $-m - 7$ (f) $-5p$ (g) $\frac{-p}{5}$ (h) $-5p$

5. (a) $2m + 11$ (b) $2m - 11$ (c) $5y + 3$ (d) $5y - 3$
(e) $-8y$ (f) $-8y + 5$ (g) $16 - 5y$ (h) $-5y + 16$

6. (a) $t + 4$, $t - 4$, $4t$, $\frac{t}{4}$, $\frac{4}{t}$, $4 - t$, $4 + t$ (b) $2y + 7$, $2y - 7$, $7y + 2$, ..., ...,

EXERCISE 11.4

1. (a) (i) $y + 5$ (ii) $y - 3$ (iii) $6y$ (iv) $6y - 2$ (v) $3y + 5$
(b) $(3b - 4)$ metres (c) length = $5h$ cm, breadth = $5h - 10$ cm
(d) $s + 8$, $s - 7$, $4s - 10$ (e) $(5v + 20)$ km
2. (a) A book costs three times the cost of a notebook.
(b) Tony's box contains 8 times the marbles on the table.

(c) Total number of students in the school is 20 times that of our class.

(d) Jaggu's uncle is 4 times older than Jaggu and Jaggu's aunt is 3 years younger than his uncle.

(e) The total number of dots is 5 times the number of rows.

EXERCISE 11.5

1. (a) an equation with variable x (e) an equation with variable x

(f) an equation with variable x (h) an equation with variable n

(j) an equation with variable p (k) an equation with variable y

(o) an equation with variable x

2. (a) No (b) Yes (c) No (d) No

(e) No (f) Yes (g) No (h) No

(i) Yes (j) Yes (k) No (l) No

(m) No (n) No (o) No (p) No (q) Yes

3. (a) 12 (b) 8 (c) 10 (d) 14

(e) 4 (f) – 2

4. (a) 6 (b) 7 (c) 12 (d) 10

5. (i) 22 (ii) 16 (iii) 17 (iv) 11

EXERCISE 12.1

1. (a) 4 : 3 (b) 4 : 7

2. (a) 1 : 2 (b) 2 : 5

3. (a) 3 : 2 (b) 2 : 7 (c) 2 : 7

4. 3 : 4 **5.** 5, 12, 25, Yes

6. (a) 3 : 4 (b) 14 : 9 (c) 3 : 11 (d) 2 : 3

7. (a) 1 : 3 (b) 4 : 15 (c) 11 : 20 (d) 1 : 4

8. (a) 3 : 1 (b) 1 : 2

9. 17 : 550

10. (a) 115 : 216 (b) 101 : 115 (c) 101 : 216

11. (a) 3 : 1 (b) 16 : 15 (c) 5 : 12

12. 15 : 7 **13.** 20 ; 100 **14.** 12 and 8 **15.** 20 and 16

16. (a) 3 : 1 (b) 10 : 3 (c) 13 : 6 (d) 15 : 1

EXERCISE 12.2

1. (a) Yes (b) No (c) No (d) No

(e) Yes (f) Yes

2. (a) T (b) T (c) F (d) T

(e) F (f) T

3. (a) T (b) T (c) T (d) T (e) F

4. (a) Yes, Middle Terms – 1 m, ₹ 40; Extreme Terms – 25 cm, ₹ 160

(b) Yes, Middle Terms – 65 litres, 6 bottles; Extreme Terms – 39 litres, 10 bottles

(c) No.

(d) Yes, Middle Terms – 2.5 litres, ₹ 4 ; Extreme Terms – 200 ml, ₹ 50

EXERCISE 12.3

1. ₹ 210 **2.** ₹ 4500 **3.** 644 mm

4. (a) ₹ 48.80 (b) 10 kg

5. 5 degrees **6.** ₹ 30, 000 **7.** 10 bananas **8.** 5 kg

9. 300 litres **10.** Manish **11.** Anup

EXERCISE 13.1

1. Four examples are the blackboard, the table top, a pair of scissors, the computer disc etc.

2. The line l_2

3. Except (c) all others are symmetric.

EXERCISE 13.2

1. (a) 4 (b) 4 (c) 4 (d) 1

(e) 6 (f) 6 (g) 0 (h) 0 (i) 5

3. Number of lines of symmetry are :

Equilateral triangle – 3; Square – 4; Rectangle – 2; Isosceles triangle – 1;

Rhombus – 2; Circle – countless.

4. (a) Yes; an isosceles triangle. (b) No.

(c) Yes; an equilateral triangle. (d) Yes; a scalene triangle.

7. (a) A,H,I,M,O,T,U,V,W,X,Y (b) B, C, D, E, H, I, K, O, X

(c) F, G, J, L, N, P, Q, R, S, Z

EXERCISE 13.3

1. Number of lines of symmetry to be marked :

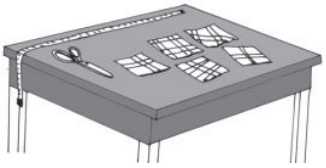
(a) 4 (b) 1 (c) 2 (d) 2

(e) 1 (f) 2

BRAIN-TEASERS

1. From a basket of mangoes when counted in twos there was one extra, counted in threes there were two extra, counted in fours there were three extra, counted in fives there were four extra, counted in sixes there were five extra. But counted in sevens there were no extra. Atleast how many mangoes were there in the basket?

2. A boy was asked to find the LCM of 3, 5, 12 and another number. But while calculating, he wrote 21 instead of 12 and yet came with the correct answer. What could be the fourth number?
3. There were five pieces of cloth of lengths 15 m, 21 m, 36 m, 42 m, 48 m. But all of them could be measured in whole units of a measuring rod. What could be the largest length of the rod?



4. There are three cans. One of them holds exactly 10 litres of milk and is full. The other two cans can hold 7 litres and 3 litres respectively. There is no graduation mark on the cans. A customer asks for 5 litres of milk. How would you give him the amount he ask? He would not be satisfied by eye estimates.
5. Which two digit numbers when added to 27 get reversed?
6. Cement mortar was being prepared by mixing cement to sand in the ratio of 1:6 by volume. In a cement mortar of 42 units of volume, how much more cement needs to be added to enrich the mortar to the ratio 2:9?
7. In a solution of common salt in water, the ratio of salt to water was 30:70 as per weight. If we evaporate 100 grams of water from one kilogram of this solution, what will be the ratio of the salt to water by weight?
8. Half a swarm of bees went to collect honey from a mustard field. Three fourth of the rest went to a rose garden. The rest ten were still undecided. How many bees were there in all?
9. Fifteen children are sitting in a circle. They are asked to pass a handkerchief to the child next to the child immediately after them.

The game stops once the handkerchief returns to the child it started from. This can be written as follows :

1→3→5→7→9→11→13→15→2→4→6→8 → 10→12 →14→1. Here, we see that every child gets the handkerchief.

(i) What would happen if the handkerchief were passed to the left leaving two children in between? Would every child get the handkerchief?

(ii) What if we leave three children in between? What do you see?

In which cases every child gets the handkerchief and in which cases not?

Try the same game with 16, 17, 18, 19, 20 children. What do you see?

10. Take two numbers 9 and 16. Divide 9 by 16 to get the remainder. What is the remainder when 2 × 9 is divided by 16, 3 × 9 divided by 16, 4 × 9 divided by 16, 5 × 9 divided by 16... 15 × 9 divided by 16. List the remainders. Take the numbers 12 and 14. List the remainders of 12, 12 × 2, 12 × 3, 12 × 4, 12 × 5, 12 × 6, 12 × 7, 12 × 8, 12 × 9, 12 × 10, 12 × 11, 12 × 12, 12 × 13 when divided by 14. Do you see any difference between above two cases?

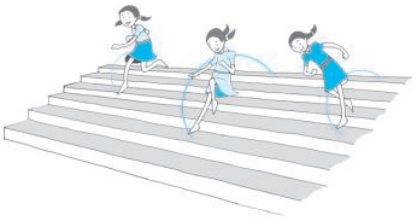
11. You have been given two cans with capacities 9 and 5 litres respectively. There is no graduation marks on the cans nor is eye estimation possible. How can you collect 3 litres of water from a tap? (You are allowed to pour out water from the can). If the cans had capacities 8 and 6 litres respectively, could you collect 5 litres?

12. The area of the east wall of an auditorium is 108 sq m, the area of the north wall is 135 sq m and the area of the floor is 180 sq m. Find the height of the auditorium.

13. If we subtract 4 from the digit at the units place of a two digit number and add 4 to the digit at the tens place then the resulting number is doubled. Find the number.

14. Two boatmen start simultaneously from the opposite shores of a river and they cross each other after 45 minutes of their starting from the respective shores. They rowed till they reached the opposite shore and returned immediately after reaching the shores. When will they cross each other again?

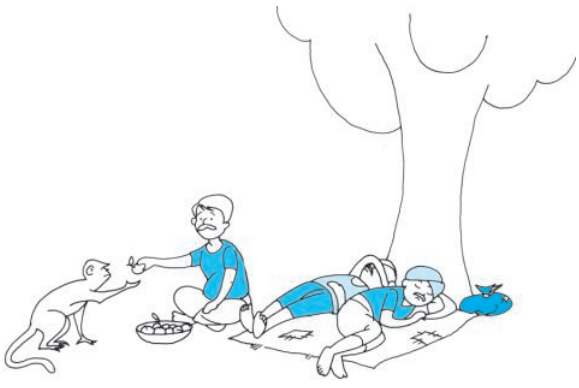
15. Three girls are climbing down a staircase. One girl climbs down two steps at one go. The second girl three steps at one go and the third climbs down four steps. They started together from



the beginning of the staircase leaving their foot marks. They all came down in complete steps and had their foot marks together at the bottom of the staircase. In how many steps would there be only one pair of foot mark?

Are there any steps on which there would be no foot marks.

16. A group of soldiers was asked to fall in line making rows of three. It was found that there was one soldier extra. Then they were asked to stand in rows of five. It was found there were left 2 soldiers. They were asked to stand in rows of seven. Then there were three soldiers who could not be adjusted. At least how many soldiers were there in the group?
17. Get 100 using four 9's and some of the symbols like +, –, ×, ¸ etc.
18. How many digits would be in the product $2 \times 2 \times 2 \ldots\ldots \times 2$ (30 times)?
19. A man would be 5 minutes late to reach his destination if he rides his bike at 30 km. per hour. But he would be 10 minutes early if he rides at the speed of 40 km per hour. What is the distance of his destination from where he starts?
20. The ratio of speeds of two vehicles is 2:3. If the first vehicle covers 50 km in 3 hours, what distance would the second vehicle covers in 2 hours?
21. The ratio of income to expenditure of Mr. Natarajan is 7:5. If he saves Rs. 2000 a month, what could be his income?
22. The ratio of the length to breadth of a lawn is 3:5. It costs ₹ 3200 to fence it at the rate of ₹ 2 a metre. What would be the cost of developing the lawn at the rate of ₹10 per square metre.
23. If one counts one for the thumb, two for the index finger, three for the middle finger, four for the ring finger, five for the little finger and continues counting backwards, six for the ring finger, seven for the middle finger, eight for the index finger, 9 for the thumb, ten for the index finger, eleven for the middle finger, twelve for the ring finger, thirteen for the little finger, fourteen for the ring finger and so on. Which finger will be counted as one thousand?
24. Three friends plucked some mangoes from a mango grove and collected them together in a pile and took nap after that. After some time, one of the friends woke up and divided the mangoes into three equal numbers. There was one mango extra. He gave it to a monkey nearby, took one



part for himself and slept again. Next the second friend got up unaware of what has happened, divided the rest of the mangoes into three equal shares. There was an extra mango. He gave it to the monkey, took one share for himself and slept again. Next the third friend got up not knowing what happened and divided the mangoes into three equal shares. There was an extra mango. He gave it to the monkey, took one share for himself and went to sleep again. After some time, all of them got up together to find 30 mangoes. How many mangoes did the friends pluck initially?

25. **The peculiar number**

There is a number which is very peculiar. This number is three times the sum of its digits. Can you find the number?

26. Ten saplings are to be planted in straight lines in such way that each line has exactly four of them.

27. What will be the next number in the sequence?

(a) 1, 5, 9, 13, 17, 21, ...

(b) 2, 7, 12, 17, 22, ...

(c) 2, 6, 12, 20, 30, ...

(d) 1, 2, 3, 5, 8, 13, ...

(e) 1, 3, 6, 10, 15, ...

28. Observe the pattern in the following statement:

$31 \times 39 = 13 \times 93$

The two numbers on each side are co-prime and are obtained by **reversing the digits** of respective numbers. Try to write some more pairs of such numbers.

ANSWERS

1. 119
2. 28
3. 3 m
4. The man takes an empty vessel other than these.

With the help of 3 litres can he takes out 9 litres of milk from the 10 litres can and pours it in the extra can. So, 1 litre milk remains in the 10 litres can. With the help of 7 litres can he takes out 7 litres of milk from the extra can and pours it in the 10 litres can. The 10 litres can now has $1 + 7 = 8$ litres of milk.

With the help of 3 litres can he takes out 3 litres milk from the 10 litres can. The 10 litres can now has $8 - 3 = 5$ litres of milk, which he gives to the customer.

5. 14, 25, 36, 47, 58, 69
6. 2 units
7. 1 : 2
8. 80
9. (i) No, all children would not get it.

   (ii) All would get it.
10. 9, 2, 11, 4, 13, 6, 15, 8, 1, 10, 3, 12, 5, 14, 7.

    12, 10, 8, 6, 4, 2, 0, 12, 10, 8, 6, 4.
11. Fill the 9 litres can. Remove 5 litres from it using the 5 litres can. Empty the 5 litres can. Pour 4 litres remaining in the 9 litres can to the 5 litres can.

    Fill the 9 litres can again. Fill the remaining 5 litres can from the water in it. This leaves 8 litres in the 9 litres can. Empty the 5 litres can. Fill it from the 9 litres can. You now have 3 litres left in the 9 litres can.
12. Height = 9m
13. 36
14. 90 minutes
15. Steps with one pair of foot marks – 2, 3, 9, 10

    Steps with no foot marks – 1, 5, 7, 11
16. 52
17. $99 + \frac{9}{9}$
18. 10
19. 30 km
20. 50 km
21. ₹ 7000 per month
22. ₹ 15,00,000
23. Index finger
24. 106 mangoes
25. 27
26. One arrangement could be 
27. (a) 25 (b) 27 (c) 42 (d) 21 (e) 21
28. One such pair is $13 \times 62 = 31 \times 26$.