EXERCISE 20.2

1. Find the area, in square metres, of the trapezium whose bases and altitudes are as under:
   (i) bases = 12 dm and 20 dm, altitude = 10 dm
   (ii) bases = 28 cm and 3 dm, altitude = 25 cm
   (iii) bases = 8 m and 60 dm, altitude = 40 dm
   (iv) bases = 150 cm and 30 dm, altitude = 9 dm

Solution:
(i) Given that,
   Length of bases of trapezium = 12 dm and 20 dm
   Length of altitude = 10 dm
   We know that, 10 dm = 1 m
   \[ \therefore \text{Length of bases in m} = 1.2 \text{ m and 2 m} \]
   Similarly, length of altitude in m = 1 m
   Area of trapezium = \( \frac{1}{2} \) (Sum of lengths of parallel sides) \( \times \) altitude
   Area of trapezium = \( \frac{1}{2} \) (1.2 + 2.0) \( \times \) 1
   Area of trapezium = \( \frac{1}{2} \times 3.2 = 1.6 \)
   So, Area of trapezium = 1.6m\(^2\)

(ii) Given that,
   Length of bases of trapezium = 28 cm and 3 dm
   Length of altitude = 25 cm
   We know that, 10 dm = 1 m
   \[ \therefore \text{Length of bases in m} = 0.28 \text{ m and 0.3 m} \]
   Similarly, length of altitude in m = 0.25 m
   Area of trapezium = \( \frac{1}{2} \) (Sum of lengths of parallel sides) \( \times \) altitude
   Area of trapezium = \( \frac{1}{2} \) (0.28 + 0.3) \( \times \) 0.25
   Area of trapezium = \( \frac{1}{2} \times 0.58 \times 0.25 = 0.0725 \)
   So, Area of trapezium = 0.0725m\(^2\)

(iii) Given that,
   Length of bases of trapezium = 8 m and 60 dm
   Length of altitude = 40 dm
   We know that, 10 dm = 1 m
   \[ \therefore \text{Length of bases in m} = 8 \text{ m and 6 m} \]
   Similarly, length of altitude in m = 4 m
   Area of trapezium = \( \frac{1}{2} \) (Sum of lengths of parallel sides) \( \times \) altitude
   Area of trapezium = \( \frac{1}{2} \) (8 + 6) \( \times \) 4
Area of trapezium = \( \frac{1}{2} \times 56 = 28 \)
So, Area of trapezium = \( 28 \text{ m}^2 \)

(iv) Given that,
Length of bases of trapezium = 150 cm and 30 dm
Length of altitude = 9 dm
We know that, 10 dm = 1 m
\therefore \) Length of bases in m = 1.5 m and 3 m
Similarly, length of altitude in m = 0.9 m
Area of trapezium = \( \frac{1}{2} \) (Sum of lengths of parallel sides) \times altitude
Area of trapezium = \( \frac{1}{2} (1.5 + 3) \times 0.9 \)
Area of trapezium = \( \frac{1}{2} \times 4.5 \times 0.9 = 2.025 \)
So, Area of trapezium = \( 2.025 \text{ m}^2 \)

2. Find the area of trapezium with base 15 cm and height 8 cm, if the side parallel to the given base is 9 cm long.
Solution:
Given that,
Length of bases of trapezium = 15 cm and 9 cm
Length of altitude = 8 cm
We know that,
Area of trapezium = \( \frac{1}{2} \) (Sum of lengths of parallel sides) \times altitude
Area of trapezium = \( \frac{1}{2} (15 + 9) \times 8 \)
Area of trapezium = \( \frac{1}{2} \times 192 = 96 \)
So, Area of trapezium = \( 96 \text{ m}^2 \)

3. Find the area of a trapezium whose parallel sides are of length 16 dm and 22 dm and whose height is 12 dm.
Solution:
Given that,
Length of bases of trapezium = 16 dm and 22 dm
Length of altitude = 12 dm
We know that, 10 dm = 1 m
\therefore \) Length of bases in m = 1.6 m and 2.2 m
Similarly, length of altitude in m = 1.2 m
Area of trapezium = \( \frac{1}{2} \) (Sum of lengths of parallel sides) \times altitude
Area of trapezium = \( \frac{1}{2} (1.6 + 2.2) \times 1.2 \)
Area of trapezium = \( \frac{1}{2} \times 3.8 \times 1.2 = 2.28 \)
So, Area of trapezium = \( 2.28 \text{ m}^2 \)
4. Find the height of a trapezium, the sum of the lengths of whose bases (parallel sides) is 60 cm and whose area is 600 cm².
Solution:
Given that,
Length of bases of trapezium = 60 cm
Area = 600 cm²
We know that,
Area of trapezium = \( \frac{1}{2} \) (Sum of lengths of parallel sides) \times altitude
600 = \( \frac{1}{2} \) (60) \times altitude
600 = 30 \times altitude
Which implies, altitude = 600/30 = 20
∴ Length of altitude is 20 cm

5. Find the altitude of a trapezium whose area is 65 cm² and whose base are 13 cm and 26 cm.
Solution:
Given that,
Length of bases of trapezium = 13 cm and 26 cm
Area = 65 cm²
We know that,
Area of trapezium = \( \frac{1}{2} \) (Sum of lengths of parallel sides) \times altitude
65 = \( \frac{1}{2} \) (13 + 26) \times altitude
65 = 39/2 \times altitude
Which implies, altitude = (65\times2) /39 = 130/39 = 10/3
∴ Length of altitude = 10/3 cm

6. Find the sum of the lengths of the bases of a trapezium whose area is 4.2 m² and whose height is 280 cm.
Solution:
Given that,
Height of trapezium = 280 cm = 2.8 m
Area = 4.2 m²
We know that,
Area of trapezium = \( \frac{1}{2} \) (Sum of lengths of parallel sides) \times altitude
To calculate the length of parallel sides we can rewrite the above equation as,
Sum of lengths of parallel sides = (2 \times Area) \div altitude
Sum of lengths of parallel sides = (2 \times 4.2) \div 2.8 = 8.4\div2.8 = 3
∴ Sum of lengths of parallel sides = 3 m
7. Find the area of a trapezium whose parallel sides of lengths 10 cm and 15 cm are at a distance of 6 cm from each other. Calculate this area as,
(i) the sum of the areas of two triangles and one rectangle.
(ii) the difference of the area of a rectangle and the sum of the areas of two triangles.
Solution:

We know that, Area of a trapezium ABCD
= area (ΔDFA) + area (rectangle DFEC) + area (ΔCEB)
= \(\frac{1}{2} \times AF \times DF\) + \(FE \times DF\) + \(\frac{1}{2} \times EB \times CE\)
= \(\frac{1}{2} \times AF \times h\) + \(FE \times h\) + \(\frac{1}{2} \times EB \times h\)
= \(\frac{1}{2} \times h \times (AF + 2FE + EB)\)
= \(\frac{1}{2} \times h \times (AF + FE + EB + FE)\)
= \(\frac{1}{2} \times h \times (AB + FE)\)
= \(\frac{1}{2} \times h \times (AB + CD)\) [Opposite sides of rectangle are equal]
= \(\frac{1}{2} \times 6 \times (15 + 10)\)
= \(\frac{1}{2} \times 6 \times 25 = 75\)
\[\therefore \text{Area of trapezium} = 75 \text{ cm}^2\]

8. The area of a trapezium is 960 cm\(^2\). If the parallel sides are 34 cm and 46 cm, find the distance between them.
Solution:
We know that,
Area of trapezium = \(\frac{1}{2} \times \text{(Sum of lengths of parallel sides)} \times \text{distance between parallel sides}\)
i.e., Area of trapezium = \(\frac{1}{2} \times \text{Sum of sides} \times \text{distance between parallel sides}\)
To calculate the distance between parallel sides we can rewrite the above equation as,
Distance between parallel sides = \(\frac{2 \times \text{Area}}{\text{Sum of sides}}\)
\[\frac{2 \times 960}{34 + 46} = \frac{2 \times 960}{80} = 1920/80 = 24\]
\[\therefore \text{Distance between parallel sides} = 24 \text{ cm}\]
9. Find the area of Fig. 20.35 as the sum of the areas of two trapezium and a rectangle.

Solution:
From the figure we can write,
Area of figure = Area of two trapeziums + Area of rectangle
Given that,
Length of rectangle = 50 cm
Breadth of rectangle = 10 cm
Length of parallel sides of trapezium = 30 cm and 10 cm
Distance between parallel sides of trapezium = (70–50)/2 = 20/2 = 10
So, Distance between parallel sides of trapezium = 10 cm
Area of figure = 2 × 1/2 (Sum of lengths of parallel sides) × altitude + Length × Breadth
Area of figure = 2 × 1/2 (30+10) × 10 + 50 × 10
Area of figure = 40 × 10 + 50 × 10
Area of figure = 400 + 500 = 900
∴ Area of figure = 900 cm²

10. Top surface of a table is trapezium in shape. Find its area if its parallel sides are 1 m and 1.2 m and perpendicular distance between them is 0.8 m.
Solution:
Given that,
Length of parallel sides of trapezium = 1.2m and 1m
Distance between parallel sides of trapezium = 0.8m
We know that,
Area of trapezium = 1/2 (Sum of lengths of parallel sides) × distance between parallel sides
i.e., Area of trapezium = 1/2 (Sum of sides) × distance between parallel sides
Area of trapezium = 1/2 (1.2 + 1) × 0.8
Area of trapezium = 1/2 × 2.2 × 0.8 = 0.88
So, Area of trapezium = 0.88m²

11. The cross-section of a canal is a trapezium in shape. If the canal is 10 m wide at the top 6 m wide at the bottom and the area of cross-section is 72 m² determine its depth.
Solution:
Given that,
Length of parallel sides of trapezium = 10m and 6m
Area = 72 m²
Let the distance between parallel sides of trapezium = x meter
We know that,
Area of trapezium = 1/2 (Sum of lengths of parallel sides) × distance between parallel sides
i.e., Area of trapezium = $\frac{1}{2}$ (Sum of sides) $\times$ distance between parallel sides

$72 = \frac{1}{2} (10 + 6) \times x$

$72 = 8 \times x$

$x = \frac{72}{8} = 9$

∴ The depth is 9m.

12. The area of a trapezium is 91 cm$^2$ and its height is 7 cm. If one of the parallel sides is longer than the other by 8 cm, find the two parallel sides.

Solution:

Given that,

Let the length of one parallel side of trapezium = $x$ meter

Length of other parallel side of trapezium = $(x+8)$ meter

Area of trapezium = 91 cm$^2$

Height = 7 cm

We know that,

Area of trapezium = $\frac{1}{2}$ (Sum of lengths of parallel sides) $\times$ altitude

$91 = \frac{1}{2} (x+x+8) \times 7$

$91 = \frac{1}{2}(2x+8) \times 7$

$91 = (x+4) \times 7$

$(x+4) = \frac{91}{7}$

$x+4 = 13$

$x = 13 - 4$

$x = 9$

∴ Length of one parallel side of trapezium = 9 cm

And, Length of other parallel side of trapezium = $x+8 = 9+8 = 17$ cm

13. The area of a trapezium is 384 cm$^2$. Its parallel sides are in the ratio 3:5 and the perpendicular distance between them is 12 cm. Find the length of each one of the parallel sides.

Solution:

Given that,

Let the length of one parallel side of trapezium = $3x$ meter

Length of other parallel side of trapezium = $5x$ meter

Area of trapezium = 384 cm$^2$

Distance between parallel sides = 12 cm

We know that,

Area of trapezium = $\frac{1}{2}$ (Sum of lengths of parallel sides) $\times$ distance between parallel sides

i.e., Area of trapezium = $\frac{1}{2}$ (Sum of sides) $\times$ distance between parallel sides
384 = \frac{1}{2} (3x + 5x) \times 12
384 = \frac{1}{2} (8x) \times 12
4x = \frac{384}{12}
4x = 32
x = 8
∴ Length of one parallel side of trapezium = 3x = 3 \times 8 = 24 \text{ cm}
And, Length of other parallel side of trapezium = 5x = 5 \times 8 = 40 \text{ cm}

14. Mohan wants to buy a trapezium shaped field. Its side along the river is parallel and twice the side along the road. If the area of this field is 10500 m$^2$ and the perpendicular distance between the two parallel sides is 100 m, find the length of the side along the river.

Solution:
Given that,
Let the length of side of trapezium shaped field along road = x m
Length of other side of trapezium shaped field along road = 2x m
Area of trapezium = 10500 cm$^2$
Distance between parallel sides = 100 m
We know that,
Area of trapezium = \frac{1}{2} (\text{Sum of lengths of parallel sides}) \times \text{distance between parallel sides}
\text{i.e., Area of trapezium} = \frac{1}{2} (\text{Sum of sides}) \times \text{distance between parallel sides}
10500 = \frac{1}{2} (x + 2x) \times 100
10500 = \frac{1}{2} (3x) \times 100
3x = 10500/50
3x = 210
x = 210/3 = 70
x = 70
∴ Length of side of trapezium shaped field along road = 70 m
And, Length of other side of trapezium shaped field along road = 2x = 70× 2 = 140 m

15. The area of a trapezium is 1586 cm\(^2\) and the distance between the parallel sides is 26 cm. If one of the parallel sides is 38 cm, find the other.
Solution:
Given that,
Let the length of other parallel side of trapezium = x cm
Length of one parallel side of trapezium = 38 cm
Area of trapezium = 1586 cm\(^2\)
Distance between parallel sides = 26 cm
We know that,
Area of trapezium = 1/2 (Sum of lengths of parallel sides) × distance between parallel sides
i.e., Area of trapezium = 1/2 (Sum of sides) × distance between parallel sides
1586 = 1/2 (x + 38) × 26
1586 = (x + 38) × 13
(x + 38) = 1586/13
x = 122 – 38
x = 84
∴ Length of the other parallel side of trapezium = 84 cm

16. The parallel sides of a trapezium are 25 cm and 13 cm; its nonparallel sides are equal, each being 10 cm, find the area of the trapezium.
Solution:
In ΔCEF,
CE = 10 cm and EF = 6 cm
Using Pythagoras theorem:

\[ CE^2 = CF^2 + EF^2 \]
\[ CF^2 = CE^2 - EF^2 \]
\[ CF^2 = 10^2 - 6^2 \]
\[ CF^2 = 100 - 36 \]
\[ CF^2 = 64 \]
\[ CF = 8 \text{ cm} \]

From the figure we can write,
Area of trapezium = Area of parallelogram AECD + Area of triangle CEF
Area of trapezium = base × height + 1/2 (base × height)
Area of trapezium = 13 × 8 + 1/2 (12 × 8)
Area of trapezium = 104 + 48 = 152
\[ \therefore \text{Area of trapezium} = 152 \text{ cm}^2 \]

17. Find the area of a trapezium whose parallel sides are 25 cm, 13 cm and the other sides are 15 cm each.

Solution:

In ΔCEF,
CE = 10 cm and EF = 6 cm
Using Pythagoras theorem:

\[ CE^2 = CF^2 + EF^2 \]
\[ CF^2 = CE^2 - EF^2 \]
\[ CF^2 = 15^2 - 6^2 \]
\[ CF^2 = 225 - 36 \]
\[ CF^2 = 189 \]
\[ CF = \sqrt{189} \]
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\[ \sqrt{(9 \times 21)} = 3\sqrt{21} \text{ cm} \]

From the figure we can write,

Area of trapezium = Area of parallelogram AECD + Area of triangle CEF

Area of trapezium = height + \( \frac{1}{2} \) (sum of parallel sides)

Area of trapezium = \( 3\sqrt{21} \times \frac{1}{2} (25 + 13) \)

Area of trapezium = \( 3\sqrt{21} \times 19 = 57\sqrt{21} \)

\[ \therefore \text{Area of trapezium} = 57\sqrt{21} \text{ cm}^2 \]

18. If the area of a trapezium is 28 cm\(^2\) and one of its parallel sides is 6 cm, find the other parallel side if its altitude is 4 cm.

Solution:

Given that,

Let the length of other parallel side of trapezium = \( x \) cm

Length of one parallel side of trapezium = 6 cm

Area of trapezium = 28 cm\(^2\)

Length of altitude of trapezium = 4 cm

We know that,

Area of trapezium = \( \frac{1}{2} \) (Sum of lengths of parallel sides) \times distance between parallel sides

i.e., Area of trapezium = \( \frac{1}{2} \) (Sum of sides) \times distance between parallel sides

\[ 28 = \frac{1}{2} (6 + x) \times 4 \]

\[ 28 = (6 + x) \times 2 \]

\[ 6 + x = 28/2 \]

\[ 6 + x = 14 \]

\[ x = 14 - 6 \]

\[ x = 8 \]

\[ \therefore \text{Length of the other parallel side of trapezium} = 8 \text{ cm} \]

19. In Fig. 20.38, a parallelogram is drawn in a trapezium, the area of the parallelogram is 80 cm\(^2\), find the area of the trapezium.
In $\triangle CEF$,
$CE = 10 \text{ cm}$ and $EF = 6\text{ cm}$
Using Pythagoras theorem:
$CE^2 = CF^2 + EF^2$
$CF^2 = CE^2 - EF^2$
$CF^2 = 10^2 - 6^2$
$CF^2 = 100 - 36$
$CF^2 = 64$
$CF = 8 \text{ cm}$
Area of parallelogram $= 80 \text{ cm}^2$
From the figure we can write,
Area of trapezium $= \text{Area of parallelogram } AECD + \text{Area of } \triangle CEF$
Area of trapezium $= \text{base } \times \text{height} + \frac{1}{2} (\text{base } \times \text{height})$
Area of trapezium = $10 \times 8 + \frac{1}{2} (12 \times 8)$
Area of trapezium = $80 + 48 = 128$
∴ Area of trapezium = $128 \text{ cm}^2$

20. Find the area of the field shown in Fig. 20.39 by dividing it into a square, a rectangle and a trapezium.

Solution:
From the figure we can write,
Area of given figure = Area of square ABCD + Area of rectangle DEFG + Area of rectangle GHIJ + Area of triangle FHI
i.e., Area of given figure = side × side + length × breadth + length × breadth + 1/2 × base × altitude
Area of given figure = 4 × 4 + 8 × 4 + 3 × 4 + 1/2 × 5 × 5
Area of given figure = 16 + 32 + 12 + 10 = 70
∴ Area of given figure = 70 cm²