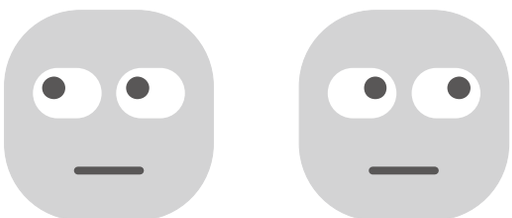
English Version

Exercise 5B

Fundamental Questions

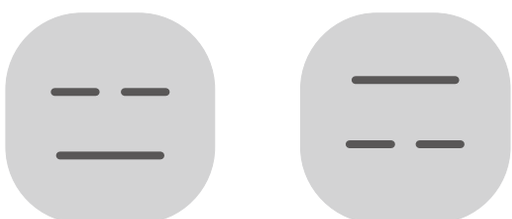
1. In each of the following, determine whether the pair of plane figures are congruent by observation.

(a)



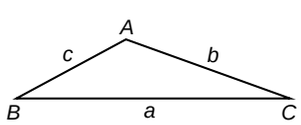
(b)

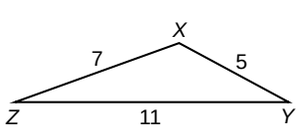
(c)



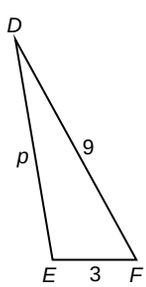
Find the unknowns in each of the following. (**2** – **9**)

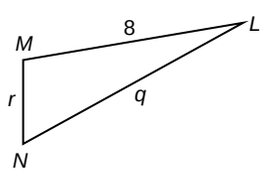
2. $\Delta ABC \cong \Delta XYZ$





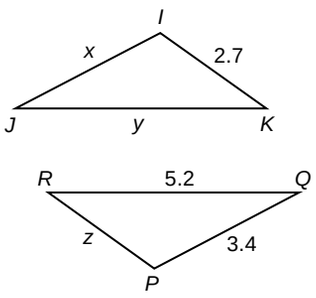
3. $\Delta DEF \cong \Delta LMN$

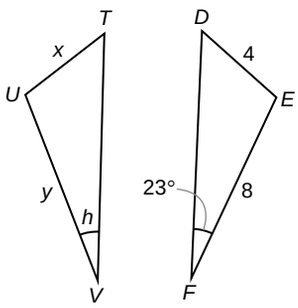




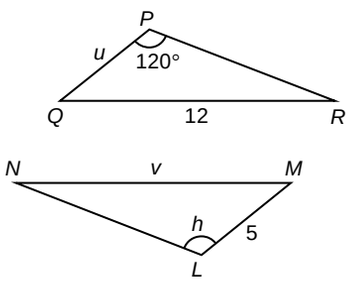
4. $\Delta IJK \cong \Delta PQR$

5. $\Delta TUV \cong \Delta DEF$

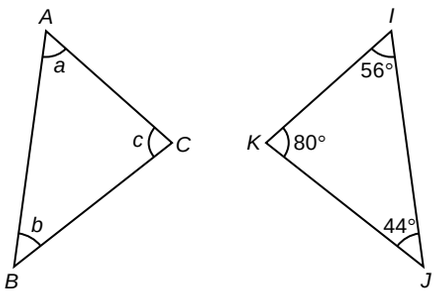




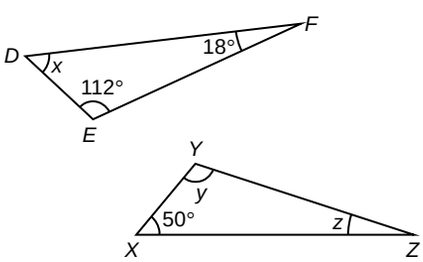
6. $\Delta PQR \cong \Delta LMN$



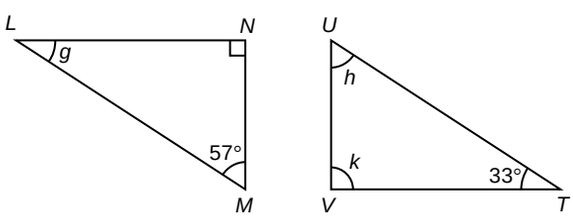
7. $\Delta ABC \cong \Delta IJK$



8. $\Delta DEF \cong \Delta XYZ$



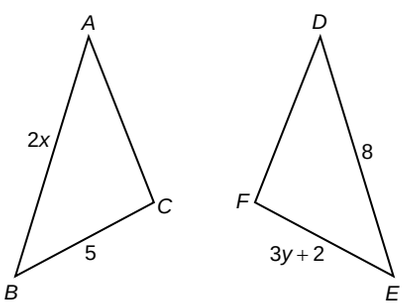
9. $\Delta LMN \cong \Delta TUV$



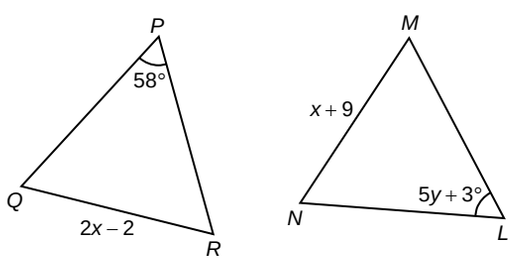
Consolidation Questions

Find the unknowns in each of the following. (**10** – **15**)

10. $\Delta ABC \cong \Delta DEF$

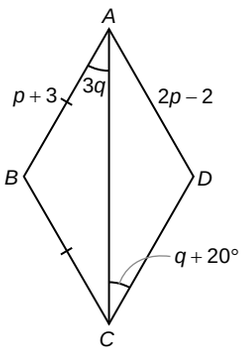


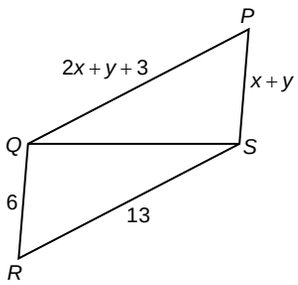
11. $\Delta PQR \cong \Delta LMN$



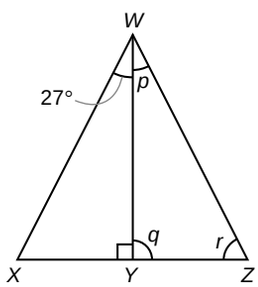
12. $\Delta ABC \cong \Delta ADC$

13. $\Delta PQS \cong \Delta RSQ$

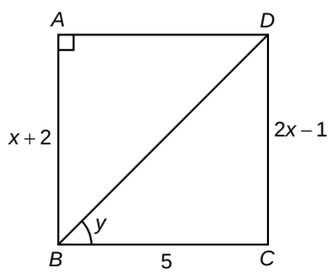




14. $\Delta WXY \cong \Delta WZY$



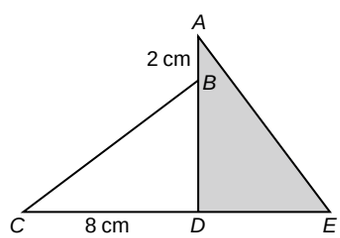
15. $\Delta ABD \cong \Delta CDB$



16. In the figure, ABD is a straight line and D is the foot of perpendicular from A to CE. If $\Delta BCD \cong \Delta EAD$,

(a) find the length of DE,

(b) find the area of ΔADE.



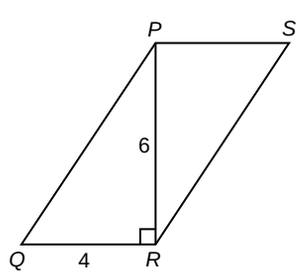
Challenging Questions

17. It is given that $\Delta LMN \cong \Delta XYZ$. If $XY = 7$, $\angle MLN = 42°$ and $\angle XYZ = 38°$,

(a) find the length of LM,

(b) find $\angle XZY$.

18. In the figure, $\Delta PQR \cong \Delta RSP$.



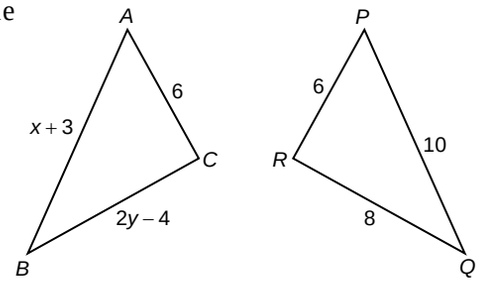
(a) Find the length of PS.

(b) A rectangular coordinate system, with R as the origin, is introduced such that QR lies on the negative x-axis, PR lies on the positive y-axis and the coordinates of Q are $(-4, 0)$.

(i) Write down the coordinates of P and S.

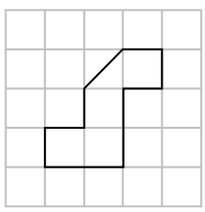
(ii) If $\Delta TPS \cong \Delta RSP$, write down the possible coordinates of T.

19. The figure shows two congruent triangles. Find all possible sets of values of x and y.



20. **(a)** Divide the figure into 3 congruent figures.

(b) If the figure can be divided into n congruent triangles, find the least number of n.



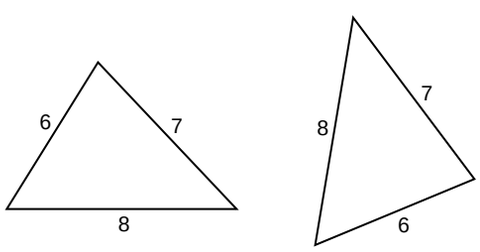
Exercise 5C

[The figures in this exercise may not be drawn to scale.]

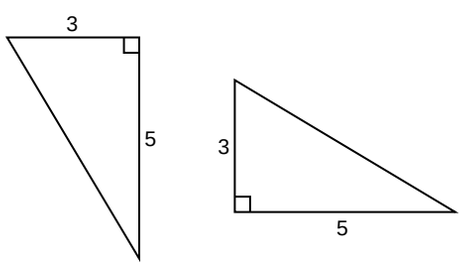
Fundamental Questions

In each of the following, two congruent triangles are given. State the reason for each pair of congruent triangles. (**1** – **2**)

1.

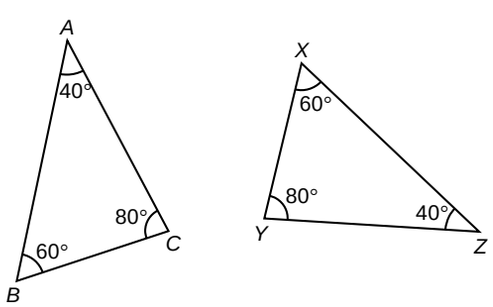


2.

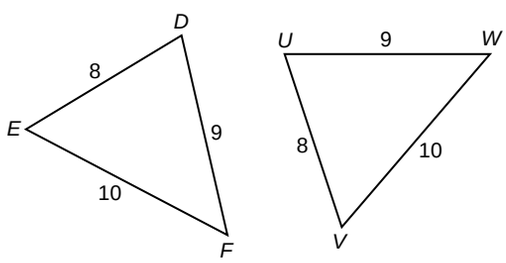


Determine whether each of the following pairs of triangles must be congruent. If they are, write down the pair of congruent triangles and give the reason. (**3** – **10**)

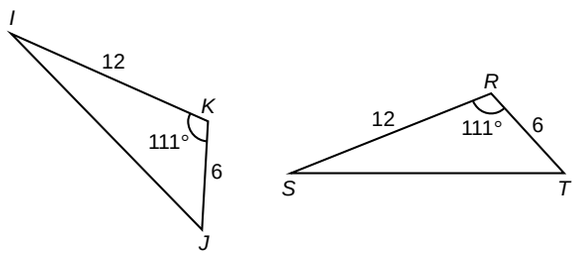
3.



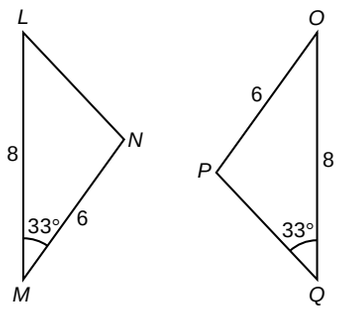
4.



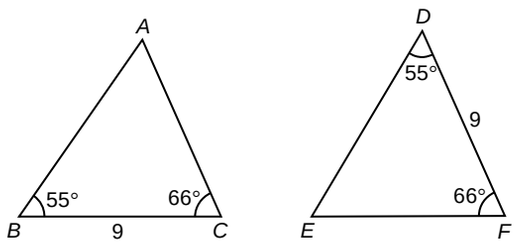
5.



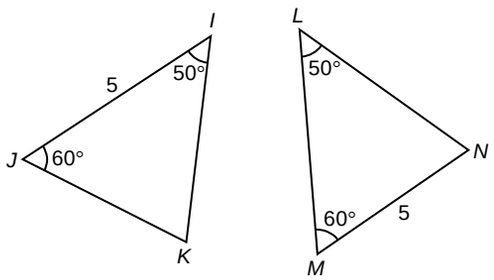
6.



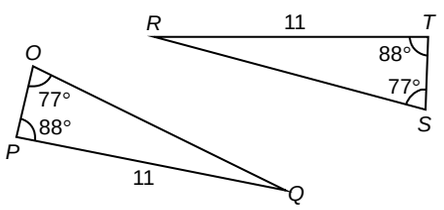
7.



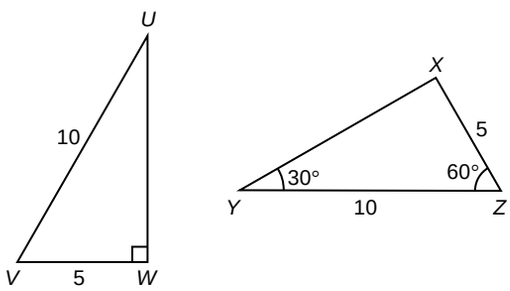
8.



9.



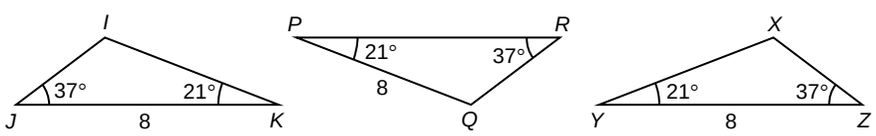
10.



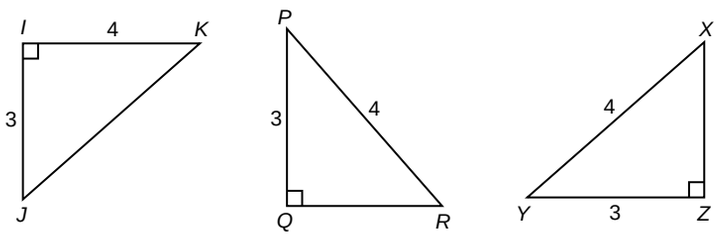
Consolidation Questions

In each of the following, which triangles must be congruent? Give the reason. (**11** – **15**)

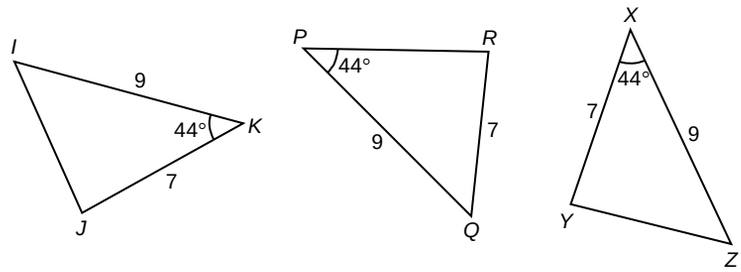
11.



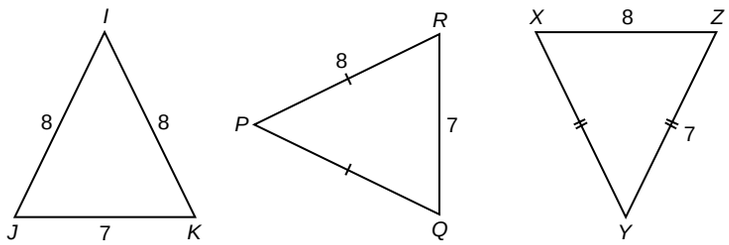
12.



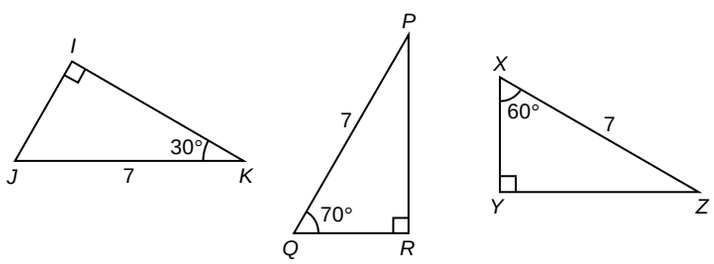
13.



14.



15.



For each of the following, determine whether ΔABC must have only one possible size and shape. (**16** – **20**)

16. $AB = 6$ cm, $BC = 5$ cm, $CA = 7$ cm

17. $BC = 11$ cm, $\angle BAC = 88°$, $\angle ACB = 22°$

18. $AB = 9$ cm, $BC = 7$ cm, $\angle ABC = 90°$

19. $\angle BAC = 77°$, $\angle ABC = 52°$, $\angle ACB = 51°$

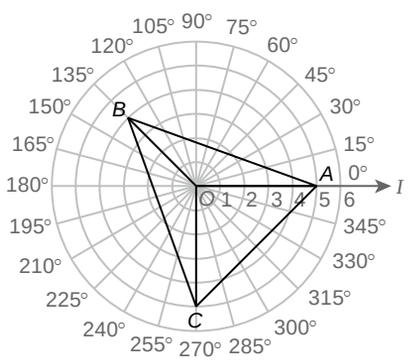
20. $AC = 9$ cm, $\angle BAC = 111°$, $\angle ACB = 22°$

Challenging Questions

21. **(a)** Find the lengths of OA, OB and OC.

(b) Find $\angle AOB$ and $\angle BOC$.

(c) Write down a pair of congruent triangles and give the reason.



22. $A(0, 7)$ is rotated anticlockwise about the origin O through

90° to B. C is the reflection image of B with respect to the y-axis.

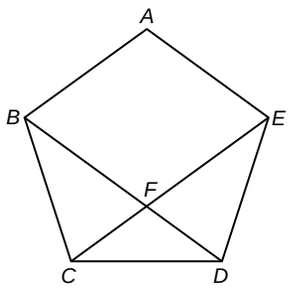
(a) Write down the coordinates of B and C.

(b) Find the lengths of OB and OC.

(c) Write down a pair of congruent triangles and give the reason.

(d) Billy claims that ΔABC is an isosceles triangle. Do you agree? Explain your answer.

23. In the figure, $ABCDE$ is a regular pentagon. BD and CE intersect at F.



(a) Are ΔBCD and ΔEDC congruent? If they are, give the reason.

(b) Write down another pair of congruent triangles.

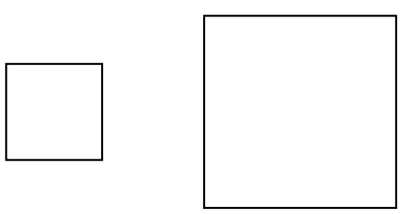
Exercise 5D

[The figures in this exercise may not be drawn to scale.]

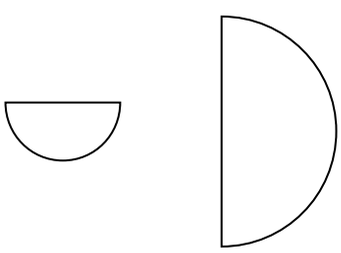
Fundamental Questions

1. In each of the following, determine whether the pair of plane figures are similar by observation.

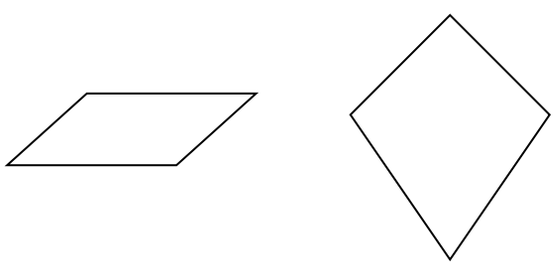
(a)



(b)



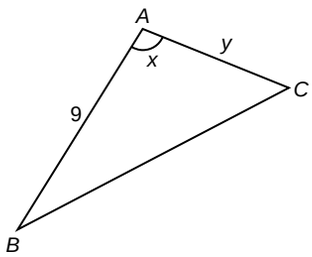
(c)

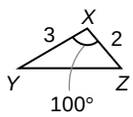


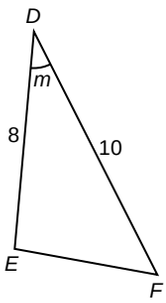
Find the unknowns in each of the following. (**2** – **7**)

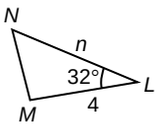
2. $\Delta ABC \sim \Delta XYZ$

3. $\Delta DEF \sim \Delta LMN$

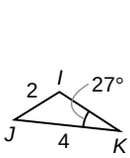


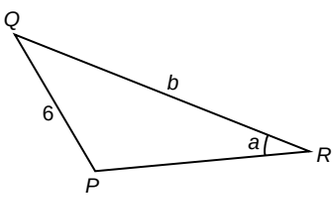




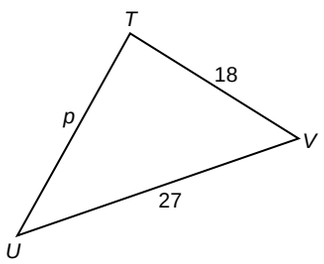


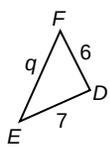
4. $\Delta IJK \sim \Delta PQR$



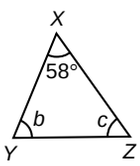


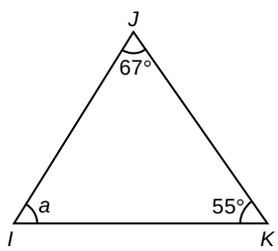
5. $\Delta TUV \sim \Delta DEF$



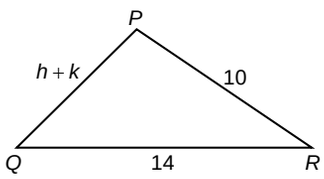


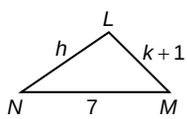
6. $\Delta XYZ \sim \Delta IJK$





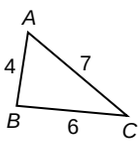
7. $\Delta PQR \sim \Delta LMN$

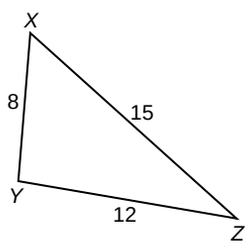




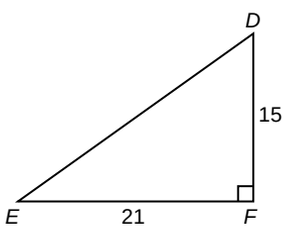
Determine whether each of the following pairs of triangles must be similar. If they are, write down the pair of similar triangles and give the reason. (**8** – **11**)

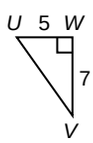
8.



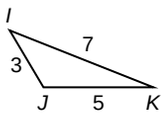


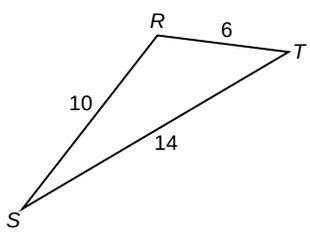
9.



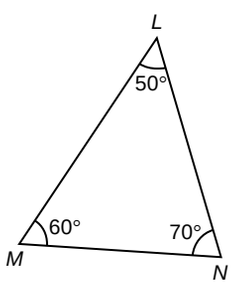


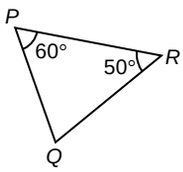
10.





11.

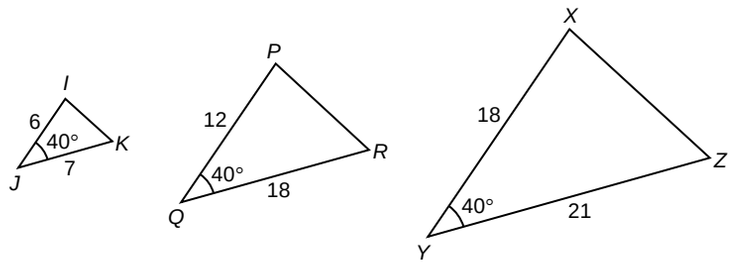




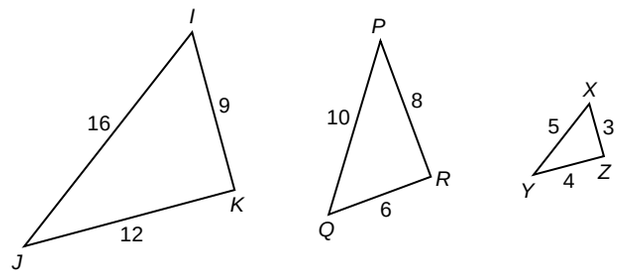
Consolidation Questions

In each of the following, which triangles must be similar? Give the reason. (**12** – **14**)

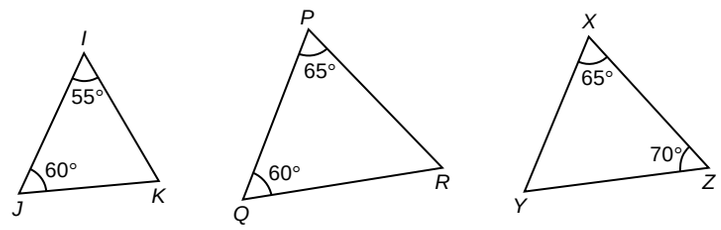
12.



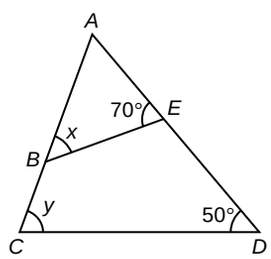
13.



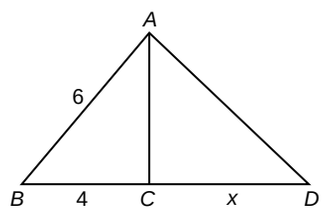
14.



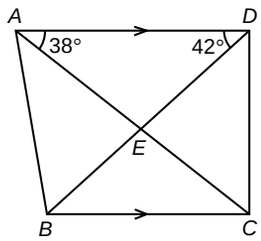
15. In the figure, *ABC* and *AED* are straight lines. If $\Delta ABE \sim \Delta ADC$, find x and y.



16. In the figure, *BCD* is a straight line. If $\Delta ABC \sim \Delta DBA$, find x.



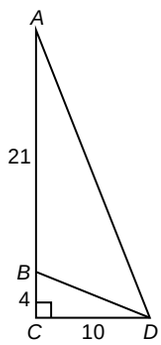
17. In the figure, *ABCD* is a trapezium, where $AD // BC$. *AC* and *BD* intersect at *E*.



(a) Find $\angle ACB$ and $\angle CBD$.

(b) Write down a pair of similar triangles and give the reason.

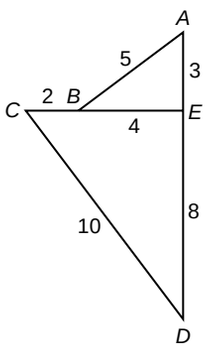
18. In the figure, ABC is a straight line.



(a) Are ΔACD and ΔDCB similar? If they are, give the reason.

(b) Emma claims that BD is shorter than half of AD. Do you agree? Explain your answer.

19. In the figure, AED and CBE are straight lines.



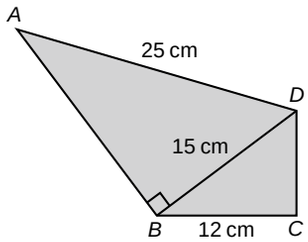
(a) Are ΔABE and ΔCDE similar? If they are, give the reason.

(b) Find $\angle AEB$.

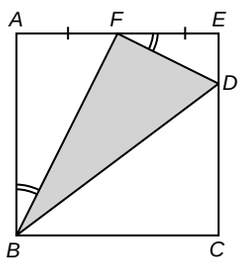
Challenging Questions

20. It is given that $\Delta ABC \sim \Delta XYZ$. If $AB = AC$ and $\angle YXZ = 50°$, find $\angle XYZ$.

21. In the figure, $\Delta ABD \sim \Delta BCD$. Find the area of $ABCD$.



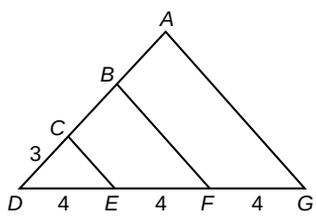
22. In the figure, the perimeter of the square $ABCE$ is 64 cm. D and F are points lying on CE and AE respectively.



(a) Write down a pair of similar triangles and give the reason.

(b) Find the area of ΔBDF.

23. In the figure, $ABCD$ and $DEFG$ are straight lines. It is given that $\Delta ADG \sim \Delta BDF \sim \Delta CDE$.



(a) Do DE, DF and DG form an arithmetic sequence? Explain your answer.

(b) Do DC, DB and DA form an arithmetic sequence? Explain your answer.

Answers

Exercise 5B *(page 5.2)*

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

2. $a = 11$, $b = 7$, $c = 5$

3. $p = 8$, $q = 9$, $r = 3$

4. $x = 3.4$, $y = 5.2$, $z = 2.7$

5. $h = 23°$, $x = 4$, $y = 8$

6. $h = 120°$, $u = 5$, $v = 12$

7. $a = 56°$, $b = 44°$, $c = 80°$

8. $x = 50°$, $y = 112°$, $z = 18°$

9. $g = 33°$, $h = 57°$, $k = 90°$

10. $x = 4$, $y = 1$

11. $x = 11$, $y = 11°$

12. $p = 5$, $q = 10°$

13. $x = 4$, $y = 2$

14. $p = 27°$, $q = 90°$, $r = 63°$

15. $x = 3$, $y = 45°$

16. **(a)** 6 cm **(b)** 24 cm^2

17. **(a)** 7 **(b)** 100°

18. **(a)** 4
(b) **(i)** $P(0, 6)$, $S(4, 6)$
(ii) (4, 0), (4, 12)

19. $x = 7$, $y = 6$ or $x = 5$, $y = 7$

20. **(b)** 9

Exercise 5C *(page 5.6)*

1. S.S.S.

2. S.A.S.

3. No

4. Yes; $\Delta DEF \cong \Delta UVW$ (S.S.S.)

5. Yes; $\Delta IJK \cong \Delta STR$ (S.A.S.)

6. No

7. Yes; $\Delta ABC \cong \Delta EDF$ (A.S.A.)

8. No

9. Yes; $\Delta OPQ \cong \Delta STR$ (A.A.S.)

10. Yes; $\Delta UVW \cong \Delta YZX$ (R.H.S.)

11. $\Delta IJK \cong \Delta XZY$ (A.S.A.)

12. $\Delta PQR \cong \Delta YZX$ (R.H.S.)

13. $\Delta IJK \cong \Delta ZYX$ (S.A.S.)

14. $\Delta IJK \cong \Delta PQR$ (S.S.S.)
or $\Delta IJK \cong \Delta PRQ$ (S.S.S.)

15. $\Delta IJK \cong \Delta YXZ$ (A.S.A.)
or $\Delta IJK \cong \Delta YXZ$ (A.A.S.)

16. Yes

17. Yes

18. Yes

19. No

20. Yes

21. **(a)** $OA = 5$ units, $OB = 4$ units, $OC = 5$ units
(b) $\angle AOB = 135°$, $\angle BOC = 135°$
(c) $\Delta OAB \cong \Delta OCB$ (S.A.S.)

22. **(a)** $B(-7, 0)$, $C(7, 0)$
(b) $OB = 7$ units, $OC = 7$ units
(c) $\Delta AOB \cong \Delta AOC$ (S.A.S.)
or $\Delta AOB \cong \Delta COA$ (S.A.S.)
(d) Yes

23. **(a)** Yes; $\Delta BCD \cong \Delta EDC$ (S.A.S.)
(b) $\Delta BCF \cong \Delta EDF$

Exercise 5D *(page 5.9)*

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

2. $x = 100°$, $y = 6$

3. $m = 32°$, $n = 5$

4. $a = 27°$, $b = 12$

5. $p = 21$, $q = 9$

6. $a = 58°$, $b = 67°$, $c = 55°$

7. $h = 5$, $k = 3$

8. No

9. Yes; $\Delta DEF \sim \Delta UVW$ (ratio of 2 sides, inc. $\angle$)

10. Yes; $\Delta IJK \sim \Delta TRS$ (3 sides proportional)

11. Yes; $\Delta LMN \sim \Delta RPQ$ (A.A.A.)

12. $\Delta IJK \sim \Delta XYZ$ (ratio of 2 sides, inc. $\angle$)

13. $\Delta PQR \sim \Delta YXZ$ (3 sides proportional)

14. $\Delta IJK \sim \Delta RQP$ (A.A.A.)

15. $x = 50°$, $y = 70°$

16. 5

17. **(a)** $\angle ACB = 38°$, $\angle CBD = 42°$
(b) $\Delta AED \sim \Delta CEB$ (A.A.A.)

18. **(a)** Yes; ratio of 2 sides, inc. $\angle$

(b) Yes

19. **(a)** Yes; 3 sides proportional
(b) 90°

20. 65°

21. 204 cm^2

22. **(a)** $\Delta ABF \sim \Delta EFD$ (A.A.A.)
(b) 80 cm^2

23. **(a)** Yes
(b) Yes

English Version

10 Mensuration

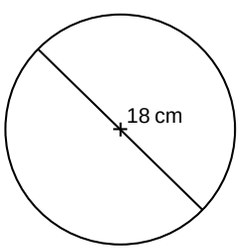
Exercise 10A

[In this exercise, unless otherwise stated, give your answers correct to 1 decimal place if necessary.]

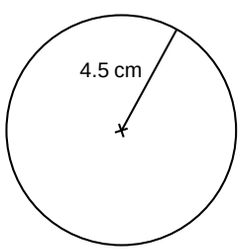
Fundamental Questions

Find the circumference of each of the following circles. (**1** – **2**)

1.



2.



3. Find the circumference of each of the following circles.

(a) A circle of diameter 35 cm (Take $\pi = 3.14$.)

(b) A circle of radius 19.6 cm (Take $\pi = \frac{22}{7}$.)

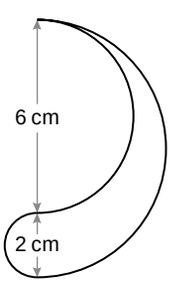
4. If the circumference of a circle is 75.36 m, find the radius of the circle. (Take $\pi = 3.14$.)

5. The circumference of a circular plate is 44 cm. Find the diameter of the plate. (Take $\pi = \frac{22}{7}$.)

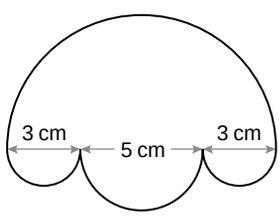
Consolidation Questions

The following figures are formed by semi-circles. Find the perimeter of each figure. (Express your answers in terms of π.) (**6** – **8**)

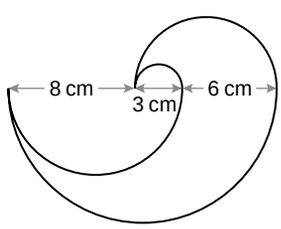
6.



7.



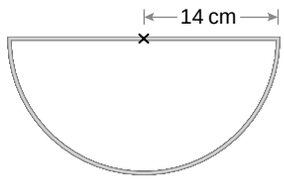
8.



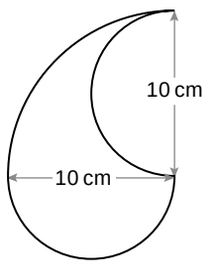
9. A rope of 198 cm long is used to surround the circular base of a can 6 times. Find the diameter of the base of the can.

10. The tip of the hour hand of a clock moves 100.48 cm in a day. Find the length of the hour hand. (Take $\pi = 3.14$.)

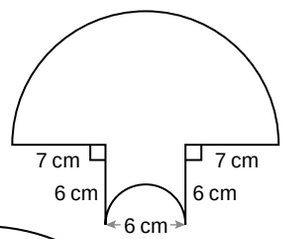
11. Judy bends a wire into a semi-circle of radius 14 cm. Find the length of the wire.



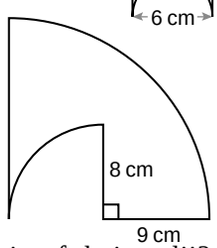
12. The figure is formed by a quadrant and semi-circles. Find the perimeter of the figure.



13. The figure is formed by semi-circles and straight lines. Find the perimeter of the figure.



14. The figure is formed by quadrants and straight lines. Find the perimeter of the figure.

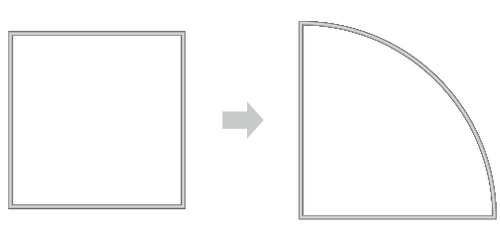


15. The ratio of the circumferences of two circles is 5 : 3. What is the ratio of their radii?

16. The diameter of a car wheel is 48 cm. If the wheel makes 550 revolutions per minute, find the speed of the car in km/h.

17. The radius of a bicycle wheel is 0.3 m. If Eva rides the bicycle at a constant speed of 10 km/h for 20 minutes, how many revolutions does the wheel make? (Give your answer correct to the nearest integer.)

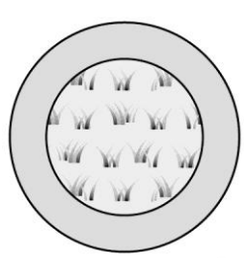
Challenging Questions



18. In the figure, the square is formed by a wire and its area is 484 cm^2.

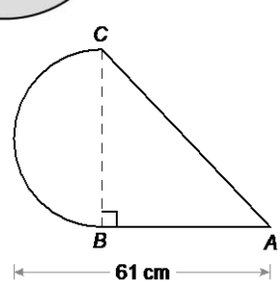
(a) Find the length of the wire.

(b) If the wire is bent into a quadrant, find the radius of the quadrant.



19. In the figure, a circular lawn is surrounded by a path of uniform width. The difference between the circumferences of the lawn and the outer edge of the path is 11 m. Find the width of the path. (Give your answer correct to 3 significant figures.)

20. The figure is formed by a semi-circle and a right-angled



triangle ABC. $AB : BC = 20 : 21$.

(a) Find the radius of the semi-circle.

(b) Find the perimeter of the figure.

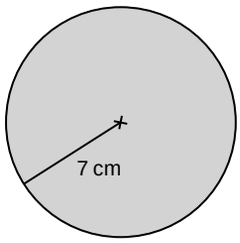
Exercise 10B

[In this exercise, unless otherwise stated, give your answers correct to 1 decimal place if necessary.]

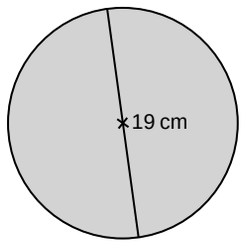
Fundamental Questions

Find the area of each of the following circles. (**1** – **2**)

1.



2.



3. Find the area of each of the following circles.

(a) A circle of radius 15 cm (Take $\pi = 3.14$.)

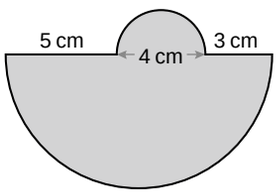
(b) A circle of diameter 25.2 cm (Take $\pi = \frac{22}{7}$.)

4. The area of a discus is $350\ \text{cm}^2$. Find the radius of the discus.

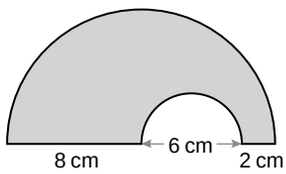
Consolidation Questions

The following figures are formed by semi-circles and straight lines. Find the area of each figure. (Express your answers in terms of π.) (**5** – **7**)

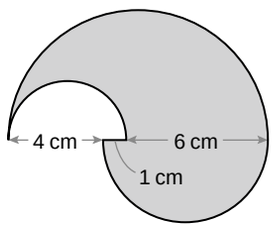
5.



6.



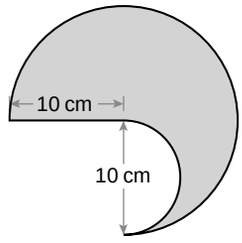
7.



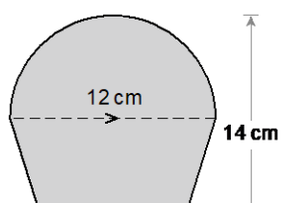
8. The circumference of a circular flying disc is 75 cm. Find the area of the flying disc.

9. A circular farm of area $42\ \text{m}^2$ is surrounded by a fence. Find the length of the fence.

10. The figure is formed by a quadrant, semi-circles and a straight line. Find the area of the figure.

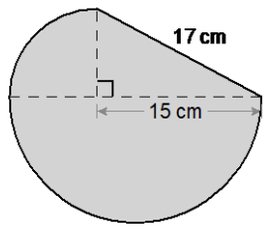


11. The figure is formed by a semi-circle and straight lines. Find the

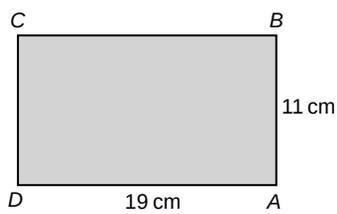


area of the figure.

12. The figure is formed by a quadrant, a semi-circle and a straight line. Find the area of the figure.



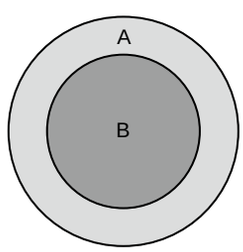
13. Daisy wants to cut the largest circle from the rectangular cardboard *ABCD* as shown in the figure. Find the area of the circle obtained by Daisy.



14. The figure consists of two concentric circles. The ratio of the radius of the inner circle to that of the outer circle is 2 : 3. The circumference of the inner circle is 12π cm.

(a) Find the radius of the outer circle.

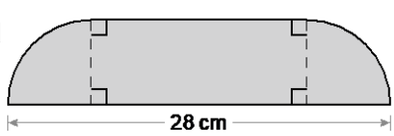
(b) What is the difference between the areas of region A and region B? (Express your answer in terms of π.)



15. The figure is formed by two quadrants of radii r cm each and straight lines. The perimeter of the figure is 63 cm.

(a) Find the value of r.

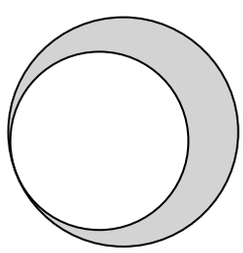
(b) Find the area of the figure.



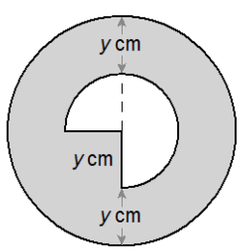
16. In the figure, the ratio of the radii of two circles is 7 : 9.

(a) Find the ratio of the area of the smaller circle to that of the larger circle.

(b) If the area of the shaded region is $48\,\text{cm}^2$, find the area of the smaller circle.

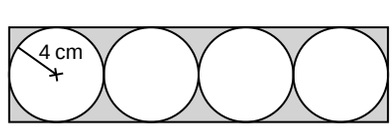


17. The figure is formed by a circle, three identical quadrants and straight lines. If the area of the shaded region is $273\,\text{cm}^2$, find the value of y.

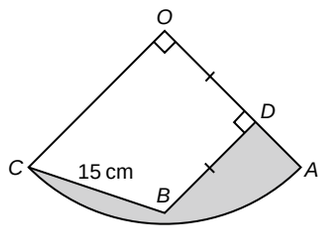


Challenging Questions

18. In the figure, four circles of radii 4 cm each is enclosed by a rectangle. Find the area of the shaded region.



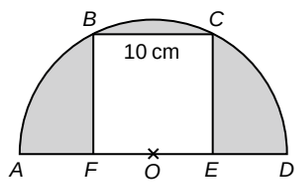
19. The figure shows a quadrant. D is a point lying on OA such that $OA \perp BD$ and $OD = BD = 2AD$. $BC = 15$ cm.



(a) Find the length of OC.

(b) Find the area of the shaded region.

20. In the figure, $ABCD$ is a semi-circle with centre O. E and F are points lying on AD. The length of the side of square $BCEF$ is 10 cm. $OE = OF$.



(a) Find the radius of the semi-circle.

(b) What percentage of the figure is shaded?

21. The difference between the radii of two circles is 10 cm and the difference between the areas of these two circles is $660\ \text{cm}^2$.

(a) Find the sum of the radii of two circles.

(b) Find the radii of two circles.

(c) Howard claims that the sum of the areas of two circles is greater than $900\ \text{cm}^2$. Do you agree? Explain your answer.

(Express your answers in terms of π if necessary.)

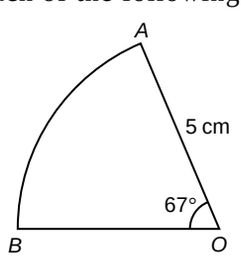
Exercise 10C

[In this exercise, unless otherwise stated, give your answers correct to 3 significant figures if necessary.]

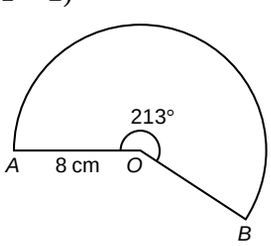
Fundamental Questions

In each of the following figures, find the length of $\overset{\frown}{AB}$. (**1** – **2**)

1.

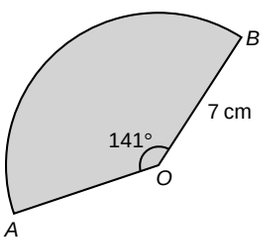


2.

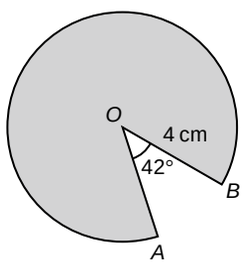


In each of the following figures, find the area of sector AOB. (**3** – **4**)

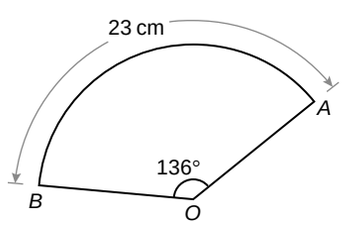
3.



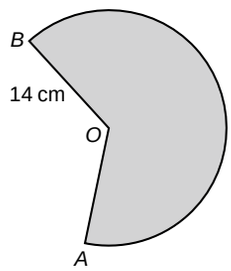
4.



5. In the figure, the length of $\overset{\frown}{AB}$ is 23 cm and $\angle AOB = 136°$. Find the radius of the sector.



6. In the figure, the area of sector AOB is $400\ \text{cm}^2$. Find the angle at the centre of the sector.



Consolidation Questions

7. The angle at the centre and the area of a sector are $125°$ and $50\pi\ \text{cm}^2$ respectively.

(a) Find the radius of the sector.

(b) Find the perimeter of the sector.

8. The arc length and the area of a sector are 10π cm and $30\pi\ \text{cm}^2$ respectively.

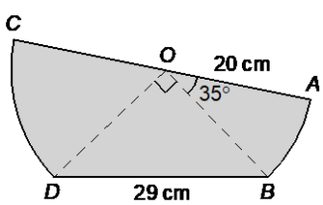
(a) Find the radius of the sector.

(b) Find the angle at the centre of the sector.

9. The figure is formed by ΔOBD, sector OAB and sector OCD. AOC is a straight line.

(a) Find the length of OD.

(b) Find the area of the figure.



10. A sector is formed by a wire of 70 cm long and the angle at the centre of the sector is $48°$.

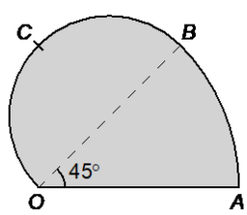
(a) Find the radius of the sector.

(b) If the wire is bent into a new sector and the radius of the new sector is half of that obtained in **(a)**, find the angle at the centre of the new sector.

11. In the figure, OAB is a sector and OCB is a semi-circle. The perimeter of the figure is 65 cm.

(a) Find the length of OA.

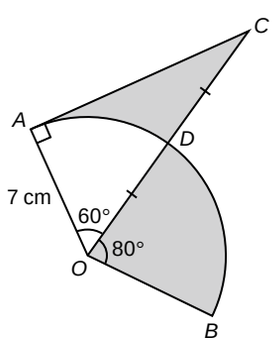
(b) Find the area of the figure.



12. In the figure, OAB is a sector. OC and $\overset{\frown}{AB}$ intersect at D such that $OD = DC$.

(a) Find the length of AC.

(b) Find the area of the shaded region.

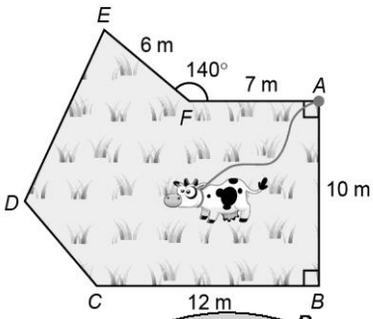


13. The figure shows a piece of grassland *ABCDEF*. A cow is tied to the post at *A* with a rope. Find the area of grassland that the cow can eat in each of the following situations.

(a) The rope is 5 m long.

(b) The rope is 9 m long.

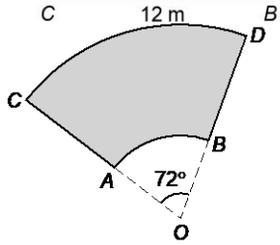
(Ignore the size of the cow in the calculation.)



14. In the figure, *OAB* and *OCD* are two sectors with centre *O*. The perimeter of the shaded region is $(20\pi + 40)$ cm and $OA : AC = 3 : 4$.

(a) Find the length of *OA*.

(b) Find the area of the shaded region in terms of π.



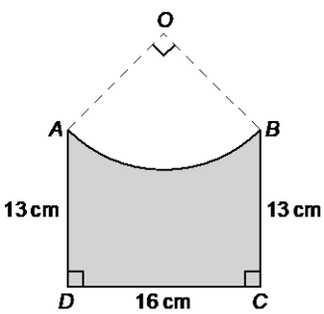
Challenging Questions

15. In the figure, *O* is the centre of sector *AOB*.

(a) Find the length of *OA*.

(b) Find the perimeter of the shaded region.

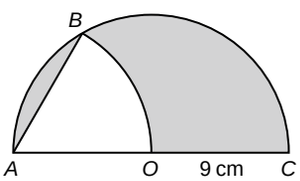
(c) Find the area of the shaded region.



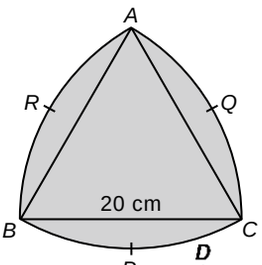
16. In the figure, *O* is the centre of semi-circle *ABC* and *A* is the centre of arc *OB*.

(a) Find the perimeter of the shaded region.

(b) Find the area of the shaded region.



17. In the figure, ΔABC is an equilateral triangle of side 20 cm. The centres of $\overset{\frown}{BPC}$, $\overset{\frown}{AQC}$ and $\overset{\frown}{ARB}$ are *A*, *B* and *C* respectively. Find the area of the shaded region.

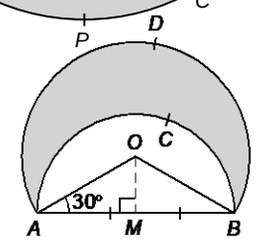


18. In the figure, *OADB* is a sector and *ACB* is a semi-circle. *M* is the mid-point of *AB*. $OM = 5$ cm and $OA = 10$ cm.

(a) Find the length of *AM*.

(b) Find the angle at the centre of sector *OADB*.

(c) Find the area of the shaded region.



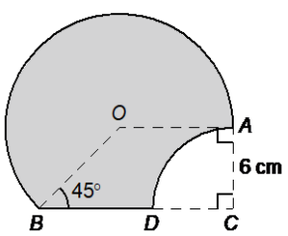
19. In the figure, *O* and *C* are the centres of sectors *OAB* and *CAD* respectively. *BDC* is a straight line.

(a) Find the angle at the centre of sector *OAB*.

(b) Find the length of *OB*.

(c) Find the perimeter of the shaded region.

(d) Find the area of the shaded region.



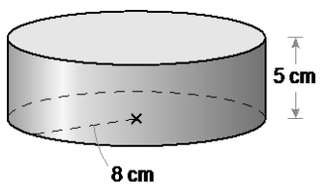
Exercise 10D

[In this exercise, unless otherwise stated, give your answers correct to 3 significant figures if necessary.]

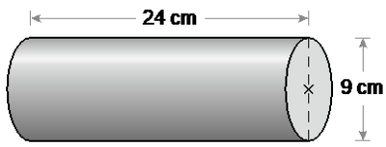
Fundamental Questions

Find the volume of each of the following cylinders. (Express your answers in terms of π.) (**1** – **2**)

1.

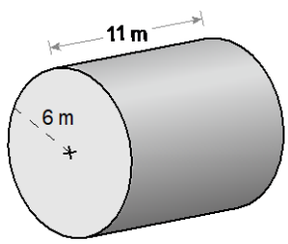


2.

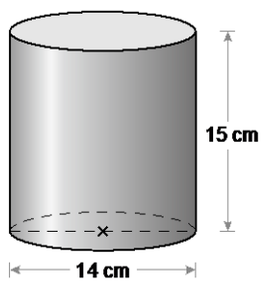


Find the total surface area of each of the following cylinders. (Express your answers in terms of π.) (**3** – **4**)

3.



4.



5. The height and the capacity of a cylindrical rubbish bin without a lid are 32 cm and $2\,888\pi$ cm^3 respectively.

(a) Find the base radius of the rubbish bin.

(b) Find the total surface area of the rubbish bin.

6. The base diameter and the total surface area of a cylinder are 16 cm and 240π cm^2 respectively.

(a) Find the height of the cylinder.

(b) Find the volume of the cylinder in terms of π.

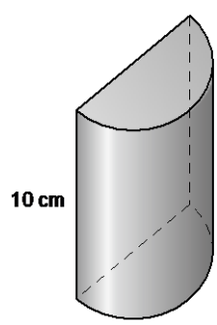
Consolidation Questions

7. The curved surface area of a cylinder is 110π cm^2 and the circumference of its base is 10π cm.

(a) Find the height of the cylinder.

(b) Find the volume of the cylinder.

8. In the figure, the uniform cross-section of a solid is a semi-circle and the volume of the solid is 125π cm^3.



(a) Find the base radius of the solid.

(b) If the cost of painting the solid is \$0.8/cm^2, find the total painting cost.

9. The base diameter and the height of a cylinder are the same. The

total surface area of the cylinder is $486\pi\ \text{cm}^2$.

(a) Find the height of the cylinder.

(b) Find the volume of the cylinder in terms of π.

10. A cylindrical container of base radius 5 cm is filled with water of volume $240\ \text{cm}^3$. After putting 4 identical weights into the container, the depth of water becomes 4.4 cm. Find the volume of a weight.

11. Figure I shows a spiral staircase formed by 4 steps of height 15 cm each. The uniform cross-section of each step is a sector of radius 40 cm. The angles at the centre of these 4 sectors are 30°, 60°, 90° and 120° (see Figure II). Find the volume of the spiral staircase.

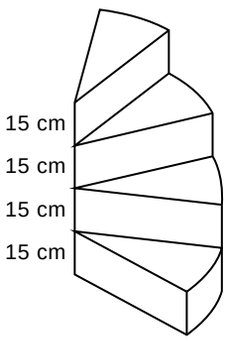


Figure I

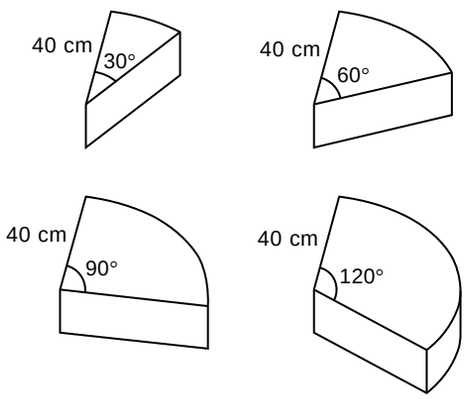
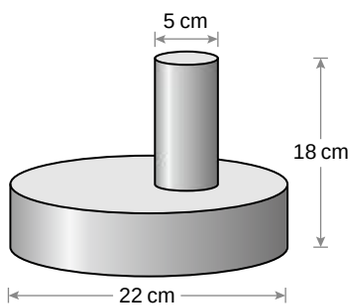


Figure II

12. The solid in the figure is formed by two cylinders. The base diameters of the upper and the lower cylinders are 5 cm and 22 cm respectively. The height of the solid is 18 cm and the height of the upper cylinder is twice that of the lower cylinder. Find the total surface area of the solid. (Express your answer in terms of π.)



13. A metal cylinder of base radius 5 cm and height 24 cm is melted and recast into 12 smaller identical metal cylinders of height 12.5 cm each.

(a) Find the base radius of each smaller metal cylinder.

(b) Find the percentage increase in the total surface area of the metal cylinder.

14. Figure I shows a hollow paper cylinder of base radius 4 cm. Its curved surface area is $144\pi\ \text{cm}^2$.

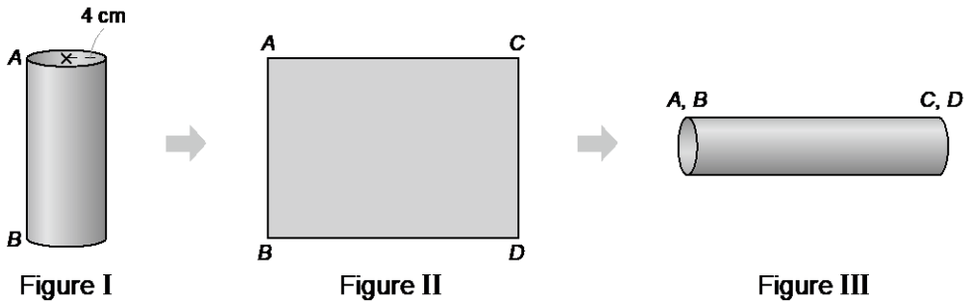
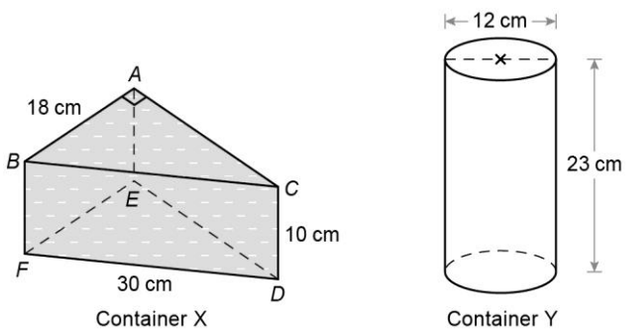


Figure I Figure II Figure III

(a) Find the height of the hollow cylinder.

(b) The cylinder is cut along AB vertically and flattened out to become a rectangular paper (see Figure II). The paper is then rolled up until AC touches BD, and two bases are added to form the cylinder in Figure III. Kyle claims that the volume of the cylinder in Figure III is greater than $630\ \text{cm}^3$. Do you agree? Explain your answer.

15. The figure shows two containers X and Y in the shapes of a triangular prism and a cylinder respectively. Container X is fully filled with water.



(a) Find the length of AC.

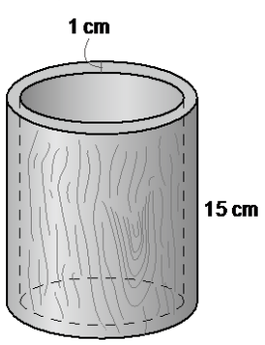
(b) All water in container X is poured into container Y.

(i) Find the depth of water in container Y.

(ii) Now, n marbles of volume $8\ \text{cm}^3$ each are put into container Y. If the marbles are immersed in water and no water overflows, find the maximum value of n.

Challenging Questions

16. The figure shows a wooden cylindrical cup of height 15 cm and uniform thickness 1 cm (including the base). The ratio of the area of the outer curved surface to that of the inner curved surface is 5 : 4.



(a) Find the inner base radius of the cup.

(b) Find the volume of wood required to make the cup.

17. Figure I shows the uniform cross-section of a container for minced shrimp. It is given that O is the centre of $\overset{\frown}{ACB}$ and $\overset{\frown}{DFE}$, $OA = OB = 2$ cm, $AD = BE = 0.5$ cm and $\angle AOB = 125°$. The length of the container is 10 cm (see Figure II).

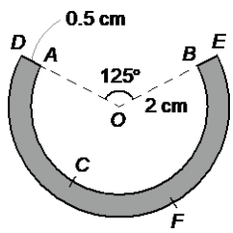


Figure I

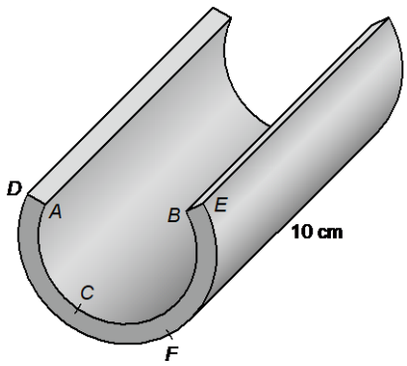
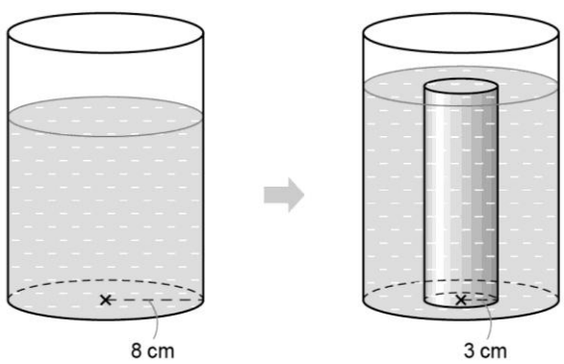


Figure II

(a) Find the lengths of $\overset{\frown}{ACB}$ and $\overset{\frown}{DFE}$.

(b) Find the total surface area of the container.

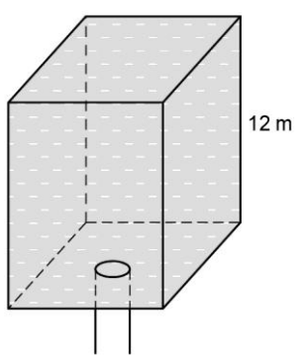
18. The figure shows a cylindrical container of base radius 8 cm with some water inside. The total area of the wet surface of the container is 304π cm^2.



(a) Find the depth of water.

(b) A solid cylinder of base radius 3 cm is put into the container vertically and it is just immersed in water. Find the rise in water level.

19. The figure shows a rectangular tank with square base and the tank is fully filled with water. The height and the total area of all lateral surfaces of the tank are 12 m and 432 m^2 respectively.



(a) Find the length of the side of the base of the tank.

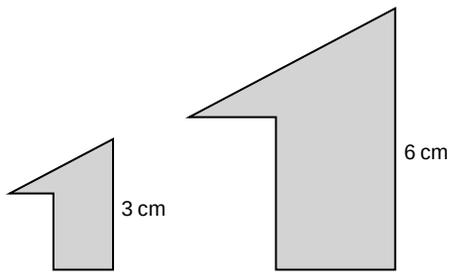
(b) A pipe is connected at the bottom of the tank. The cross-section of the pipe is a circle of diameter 40 cm, and the water in the tank is released through the pipe at 0.9 m/s. Find the time required to release all water from the tank. (Give your answer correct to the nearest minute.)

Exercise 10E

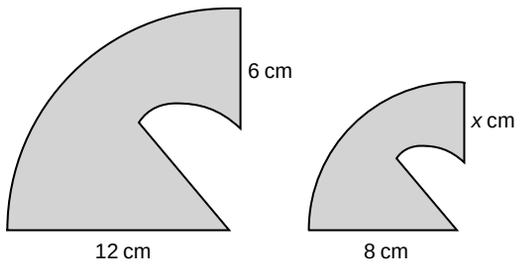
Fundamental Questions

Find the unknowns in each of the following pairs of similar figures. (**1** – **4**)

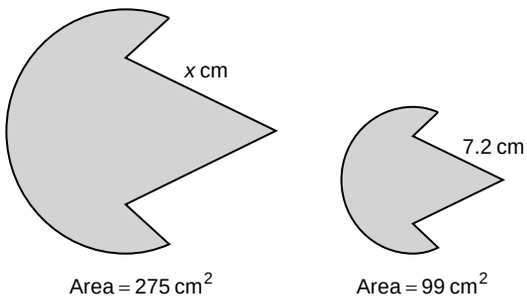
1.



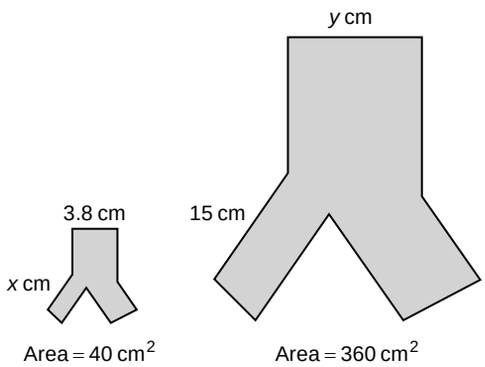
2.



3.

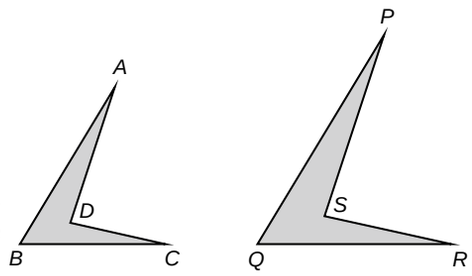


4.

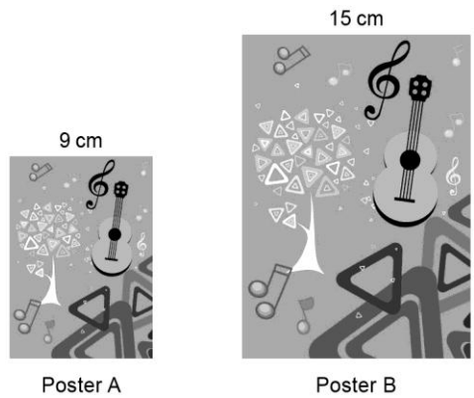


Consolidation Questions

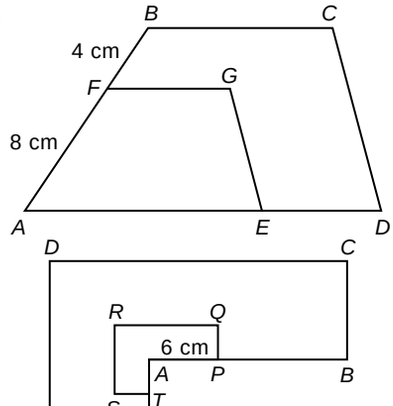
5. The figure shows two similar quadrilaterals $ABCD$ and $PQRS$ of perimeters 45 cm and 60 cm respectively. If the area of quadrilateral $PQRS$ is 208 cm^2, find the area of quadrilateral $ABCD$.



6. The figure shows two similar posters A and B of widths 9 cm and 15 cm respectively. What is the area of poster A as a percentage of that of poster B?



7. In the figure, $ABCD$ and $AFGE$ are two similar figures. If the area of $AFGE$ is 56 cm^2, find the area of $ABCD$.

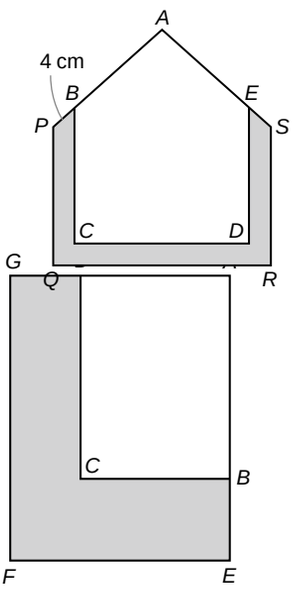


8. In the figure, *ABCDEF* and *APQRST* are two similar figures. Their areas are 125 cm^2 and 20 cm^2 respectively. If $AP = 6\text{ cm}$, find the length of *PB*.

9. The scale of the floor plan of a flat is 1 cm to 1.5 m. If the area of the sitting room on the floor plan is 8.1 cm^2, find its actual area.

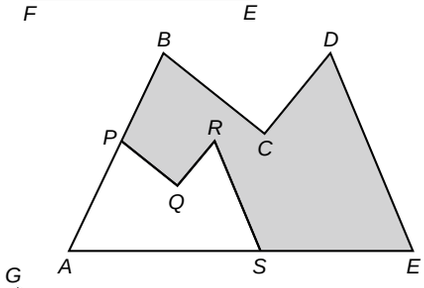
Challenging Questions

10. In the figure, *ABCDE* and *APQRS* are two similar pentagons. The areas of *ABCDE* and the shaded region are 64 cm^2 and 36 cm^2 respectively. If $BP = 4\text{ cm}$, find the length of *AB*.

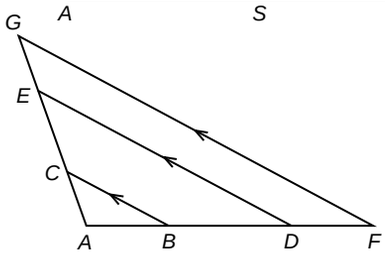


11. In the figure, *ABCD* and *AEFG* are two similar rectangles. If the area of the shaded region is $\frac{24}{25}$ of the area of *ABCD*, find $\frac{AE}{AB}$.

12. In the figure, *ABCDE* and *APQRS* are two similar pentagons. It is given that $AP : PB = 5 : 4$ and the area of the shaded region is larger than that of *APQRS* by 93 cm^2. Find the area of *APQRS*.



13. In the figure, $AB : AD : AF = 2 : 5 : 7$. Find the ratio of the area of *BCED* to that of *DEGF*.



Exercise 10F

Fundamental Questions

1. The length and width of a rectangular signboard are measured as 2.3 m and 1.2 m respectively, correct to 1 decimal place.

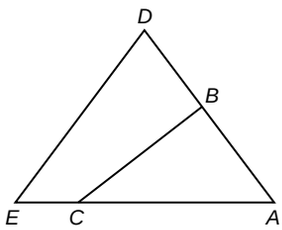
(a) Find the upper limit and lower limit of the length.

(b) Find the upper limit and lower limit of the width.

2. The figure shows ΔABC and ΔADE. The lengths of *AB* and *BD* are measured as 13.6 cm and 10.9 cm respectively, correct to 3 significant figures.

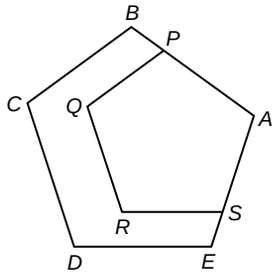
(a) Find the upper limit and lower limit of *AB*.

(b) Find the upper limit and lower limit of *BD*.



(c) Find the upper limit and lower limit of AD.

3. The figure shows two pentagons $ABCDE$ and $APQRS$. The lengths of AB and AP are measured as 8.47 cm and 6.21 cm respectively, correct to 2 decimal places. Find the possible range of PB.



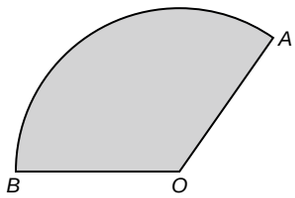
Consolidation Questions

4. The diameter of a circle is measured as 12 cm, correct to 2 significant figures.

(a) Find the upper limit and lower limit of the diameter.

(b) Find the upper limit and lower limit of the actual area of the circle. (Express your answers in terms of π.)

5. The figure shows sector AOB. The length of OA is measured as 14 cm, correct to the nearest cm. $\angle AOB$ is measured as 125°, correct to the nearest degree.

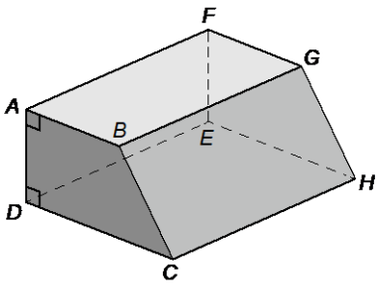


(a) Find the upper limit and lower limit of OA.

(b) Find the upper limit and lower limit of $\angle AOB$.

(c) Find the least possible area of sector AOB. (Express your answer in terms of π.)

6. The figure shows a right prism. By measurement, $AB = 2.4$ m, $AD = 2.2$ m, $DC = 3.0$ m and $AF = 3.2$ m, correct to 1 decimal place.



(a) **(i)** Find the upper limit and lower limit of AB.

(ii) Find the upper limit and lower limit of AD.

(iii) Find the upper limit and lower limit of DC.

(iv) Find the upper limit and lower limit of AF.

(b) Is it possible for the actual volume of the prism to be $21\ \text{m}^3$? Explain your answer.

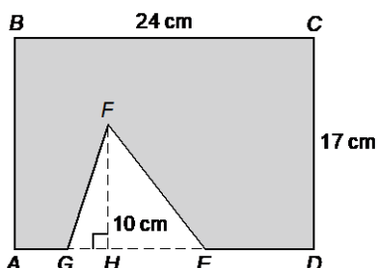
7. The length of a wire is measured as 110 cm, correct to 3 significant figures. The wire is then bent into a square.

(a) Find the upper limit and lower limit of the length of the side of the square.

(b) Find the possible range of the actual area of the square.

Challenging Questions

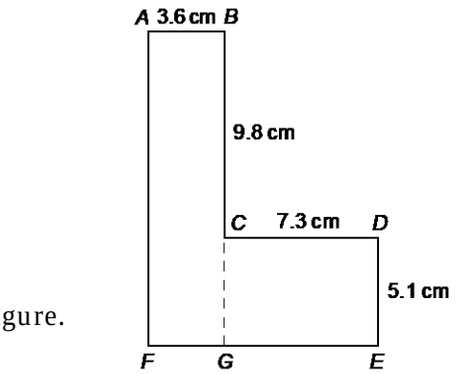
8. In the figure, $ABCDEFG$ is formed by removing ΔEFG from rectangle $ABCD$, where all the measurements are correct to 2 significant figures.



(a) Find the upper limit and lower limit of the actual area of rectangle *ABCD*.

(b) Find the upper limit and lower limit of the actual area of ΔEFG.

(c) Find the possible range of the actual area of *ABCDEFG*.

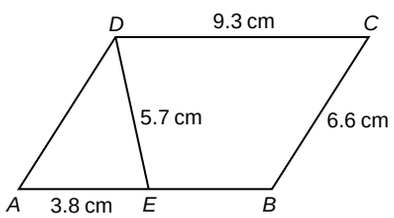


9. The figure is formed by two rectangles *ABGF* and *CDEG*, where all the measurements are correct to the nearest 0.1 cm.

(a) Write down the maximum absolute error of the measurements.

(b) The actual perimeter of the figure is x cm. Find the range of values of x.

(c) Find the percentage error in calculating the perimeter of the figure. (Give your answer correct to 3 significant figures.)



10. The figure shows parallelogram *ABCD*. *AEB* is a straight line. It is given that all the measurements are correct to 2 significant figures.

(a) Find the upper limit and lower limit of *CD*.

(b) Find the upper limit and lower limit of *BE*.

(c) Find the possible range of the actual perimeter of *BCDE*.

(d) Find the percentage error in calculating the perimeter of *BCDE*. (Give your answer correct to 3 significant figures.)

Answers

Exercise 10A *(page 10.1)*

1. 56.5 cm

2. 28.3 cm

3. **(a)** 109.9 cm **(b)** 123.2 cm

4. 12 m

5. 14 cm

6. 8π cm

7. 11π cm

8. 20π cm

9. 10.5 cm

10. 8 cm

11. 72.0 cm

12. 47.1 cm

13. 66.8 cm

14. 73.3 cm

15. 5 : 3

16. 49.8 km/h

17. 1 768

18. **(a)** 88 cm **(b)** 24.6 cm

19. 1.75 m

20. **(a)** 21 cm **(b)** 164.0 cm

Exercise 10B *(page 10.3)*

1. 153.9 cm^2

2. 283.5 cm^2

3. **(a)** 706.5 cm^2 **(b)** 498.96 cm^2

4. 10.6 cm

5. 20π cm^2

6. $\frac{55\pi}{2}$ cm^2

7. $\frac{145\pi}{8}$ cm^2

8. 447.6 cm^2

9. 23.0 m

10. 196.3 cm^2

11. 132.5 cm^2

12. 318.0 cm^2

13. 95.0 cm^2

14. **(a)** 9 cm **(b)** 9π cm^2

15. **(a)** 6.1 **(b)** 155.6 cm^2

16. **(a)** 49 : 81 **(b)** 73.5 cm^2

17. 5.2

18. 54.9 cm^2

19. **(a)** 20.1 cm **(b)** 93.1 cm^2

20. **(a)** 11.2 cm **(b)** 49.1%

21. (a) $\frac{66}{\pi}$ cm

(b) $\left(5+\frac{33}{\pi}\right)$ cm, $\left(\frac{33}{\pi}-5\right)$ cm

(c) No

Exercise 10C *(page 10.6)*

1. 5.85 cm

2. 29.7 cm

3. 60.3 cm^2

4. 44.4 cm^2

5. 9.69 cm

6. 234°

7. (a) 12 cm **(b)** 50.2 cm

8. (a) 6 cm **(b)** 300°

9. (a) 21 cm **(b)** 544 cm^2

10. (a) 24.7 cm **(b)** 211°

11. (a) 19.4 cm **(b)** 295 cm^2

12. (a) 12.1 cm **(b)** 51.0 cm^2

13. (a) 19.6 m^2 **(b)** 65.0 m^2

14. (a) 15 cm **(b)** 200π cm^2

15. (a) 11.3 cm **(b)** 59.8 cm
(c) 171 cm^2

16. (a) 55.7 cm **(b)** 84.8 cm^2

17. 282 cm^2

18. (a) 8.66 cm **(b)** 240°
(c) 135 cm^2

19. (a) 225° **(b)** 8.49 cm
(c) 51.2 cm **(d)** 182 cm^2

Exercise 10D *(page 10.9)*

1. 320π cm^3

2. 486π cm^3

3. 204π m^2

4. 308π cm^2

5. (a) 9.5 cm **(b)** 2 190 cm^2

6. (a) 7 cm **(b)** 448π cm^3

7. (a) 11 cm **(b)** 864 cm^3

8. (a) 5 cm **(b)** \$268

9. (a) 18 cm **(b)** $1\,458\pi$ cm^3

10. 26.4 cm^3

11. 62 800 cm^3

12. 434π cm^2

13. (a) 2 cm **(b)** 140%

14. (a) 18 cm **(b)** Yes

15. (a) 24 cm
(b) (i) 19.1 cm **(ii)** 55

16. (a) 6 cm **(b)** 726 cm^3

17. (a) Length of $\overset{\frown}{ACB} = 8.20$ cm, length of $\overset{\frown}{DFE} = 10.3$ cm
(b) 204 cm^2

18. (a) 15 cm **(b)** 2.45 cm

19. (a) 9 m **(b)** 143 min

Exercise 10E *(page 10.14)*

1. 4

2. $x = 4$, $y = 94.5$

3. 12

4. $x = 5$, $y = 11.4$

5. 117 cm^2

6. 36%

7. 126 cm^2

8. 9 cm

9. 18.225 m^2

10. 16 cm

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

12. 75 cm^2

13. 7 : 8

Exercise 10F *(page 10.16)*

1. (a) Upper limit = 2.35 m, lower limit = 2.25 m
(b) Upper limit = 1.25 m, lower limit = 1.15 m

2. (a) Upper limit = 13.65 cm, lower limit = 13.55 cm
(b) Upper limit = 10.95 cm, lower limit = 10.85 cm
(c) Upper limit = 24.6 cm, lower limit = 24.4 cm

3. 2.25 cm $\leq PB <$ 2.27 cm

4. (a) Upper limit = 12.5 cm, lower limit = 11.5 cm
(b) Upper limit = $39.062\,5\pi$ cm^2,
lower limit = $33.062\,5\pi$ cm^2

5. (a) Upper limit = 14.5 cm, lower limit = 13.5 cm
(b) Upper limit = 125.5°, lower limit = 124.5°
(c) $63.028\,125\pi$ cm^2

6. (a) (i) Upper limit = 2.45 m, lower limit = 2.35 m
(ii) Upper limit = 2.25 m, lower limit = 2.15 m
(iii) Upper limit = 3.05 m, lower limit = 2.95 m
(iv) Upper limit = 3.25 m, lower limit = 3.15 m
(b) No

7. (a) Upper limit = 27.625 cm, lower limit = 27.375 cm
(b) 749.390 625 $cm^2 \leq$ Actual area of the square $<$ 763.140 625 cm^2

8. (a) Upper limit = 428.75 cm^2, lower limit = 387.75 cm^2
(b) Upper limit = 60.375 cm^2, lower limit = 49.875 cm^2
(c) 327.375 $cm^2 \leq$ Actual area of *ABCDEFG* $<$ 378.875 cm^2

9. (a) 0.05 cm

(b) $51.2 \leq x < 52$

(c) 0.775%

10. (a) Upper limit = 9.35 cm, lower limit = 9.25 cm

(b) Upper limit = 5.6 cm, lower limit = 5.4 cm

(c) 26.85 cm ≤ Actual perimeter of $BCDE$ < 27.35 cm

(d) 0.923%

English Version

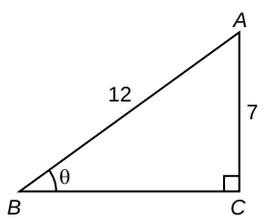
12 Trigonometric Ratios

Exercise 12A

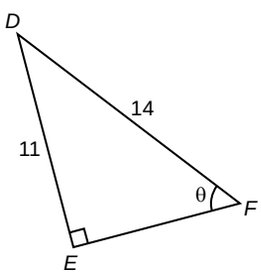
Fundamental Questions

Find the value of $\sin\theta$ in each of the following figures. (**1 – 3**)

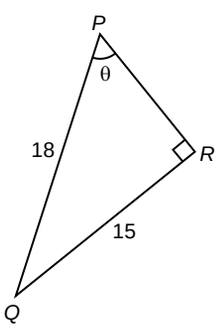
1.



2.

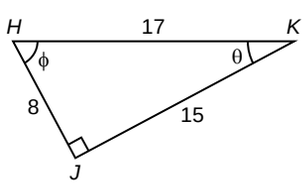


3.

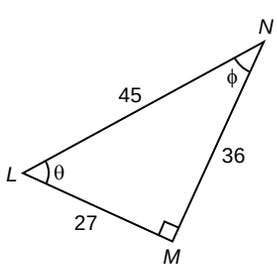


Find the values of $\sin\theta$ and $\sin\phi$ in each of the following figures. (**4 – 6**)

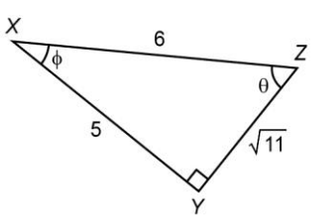
4.



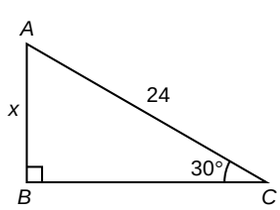
5.



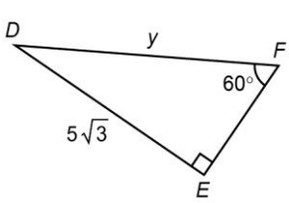
6.



7. It is given that $\sin 30° = 0.5$. Find x in the figure.



8. It is given that $\sin 60° = \dfrac{\sqrt{3}}{2}$. Find y in the figure.



Consolidation Questions

9. Find the values of the following. (Give your answers correct to 3 significant figures.)

(a) $\sin 23°$

(b) $2\sin 35°$

(c) $\dfrac{5}{\sin 16°}$

(d) $\sin 74° + 1.5$

(e) $\sin 66° + \sin 34°$

(f) $\sin 86° - 2\sin 12°$

(g) $\dfrac{\sin 28°}{\sin 62°}$

(h) $\dfrac{2\sin 20° - \sin 40°}{\sin 10°}$

10. Find θ in the following. (Give your answers correct to 1 decimal place if necessary.)

(a) $\sin\theta = 0.2$

(b) $\sin\theta = \dfrac{12}{55}$

(c) $\sin\theta = \dfrac{\sqrt{2}}{5}$

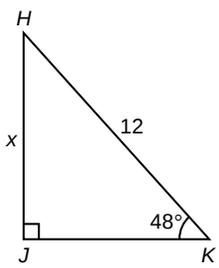
(d) $5\sin\theta = 3$

(e) $\sin\theta = \sin 10° \sin 80°$

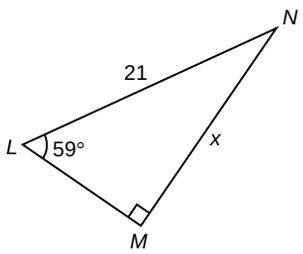
(f) $\sin\theta = \dfrac{\sin 36°}{2\sin 18°}$

Find *x* in each of the following figures correct to 3 significant figures. (**11** – **13**)

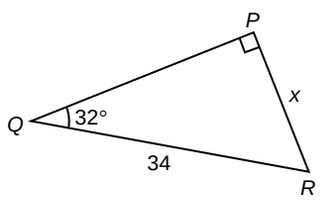
11.



12.

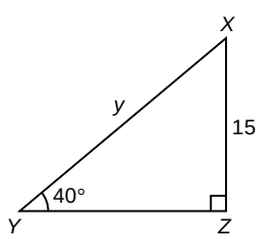


13.

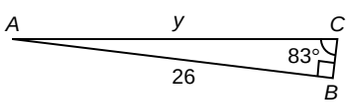


Find *y* in each of the following figures correct to 1 decimal place. (**14** – **16**)

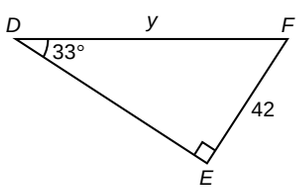
14.



15.

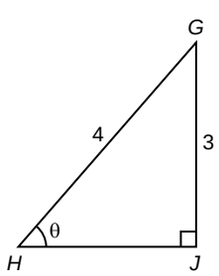


16.

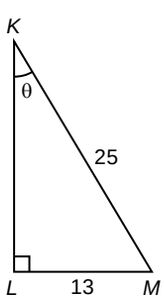


Find θ in each of the following figures correct to the nearest degree. (**17** – **22**)

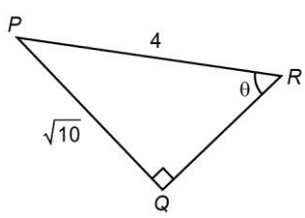
17.



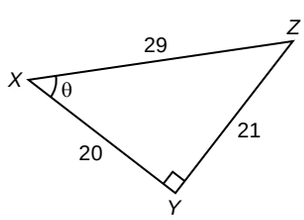
18.



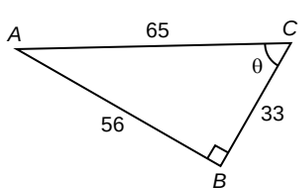
19.



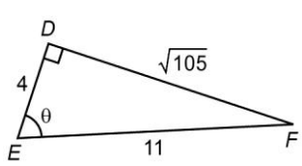
20.



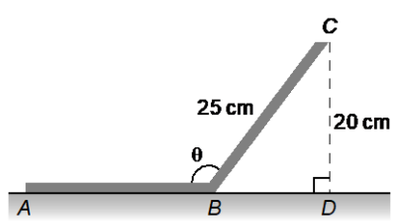
21.



22.



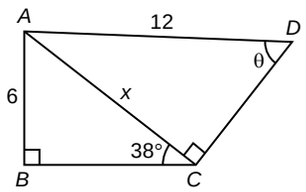
23. A notebook computer is opened as shown in the figure. Find θ. (Give your answer correct to 3 significant figures.)



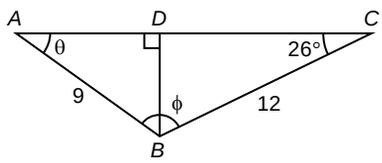
Challenging Questions

Find the unknowns in the following figures. (Give your answers correct to 3 significant figures if necessary.) (**24** – **27**)

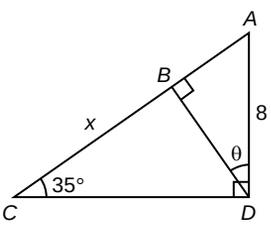
24.



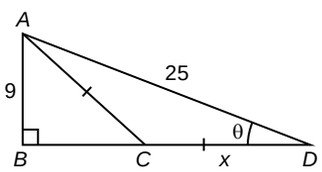
25. *ADC* is a straight line.



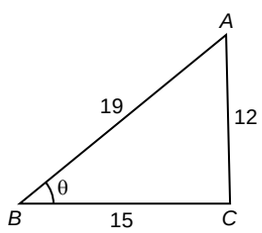
26. *ABC* is a straight line.



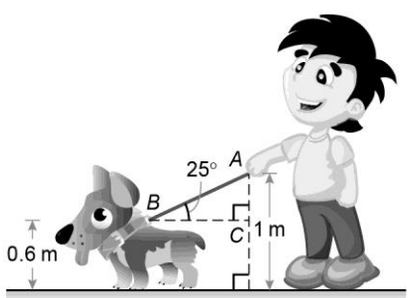
27. *BCD* is a straight line.



28. The figure shows ΔABC. Alvin claims that $\sin\theta = \dfrac{AC}{AB}$. Do you agree? Explain your answer.



29. A boy walks with his dog in the figure. He holds a rope at *A* and the rope is connected to the dog's collar at *B*. The rope is stretched tight and it makes an angle of 25° with the horizontal. It is given that *A* and *B* are 1 m and 0.6 m above the horizontal ground respectively. Find the length of the rope *AB*. (Give your answer correct to 3 significant figures.)

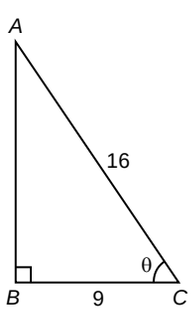


Exercise 12B

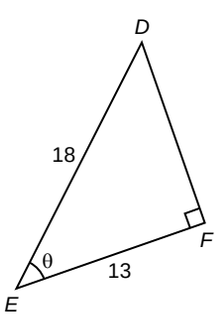
Fundamental Questions

Find the value of $\cos\theta$ in each of the following figures. (**1** – **3**)

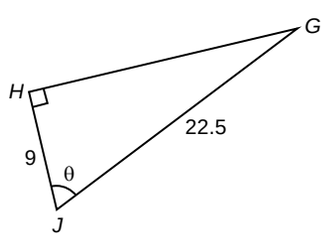
1.



2.

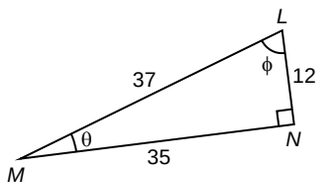


3.

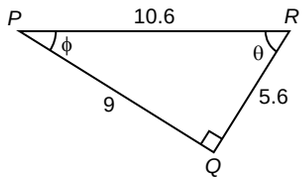


Find the values of $\cos\theta$ and $\cos\phi$ in each of the following figures. (**4** – **6**)

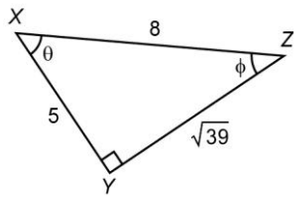
4.



5.



6.



Consolidation Questions

7. Find the values of the following. (Give your answers correct to 3 significant figures.)

(a) $\cos 17°$

(b) $3\cos 8°$

(c) $\dfrac{9}{\cos 74°}$

(d) $\cos 36° - 0.2$

(e) $\cos 10° - \cos 50°$

(f) $2\cos 28° + 3\cos 53°$

(g) $\dfrac{\cos 44°}{3\cos 22°}$

(h) $\dfrac{\cos 5°}{3\cos 70° - 2\cos 82°}$

8. Find θ in the following. (Give your answers correct to 1 decimal place if necessary.)

(a) $\cos\theta = 0.6$

(b) $\cos\theta = \dfrac{23}{37}$

(c) $\cos\theta = \dfrac{1}{\sqrt{6}}$

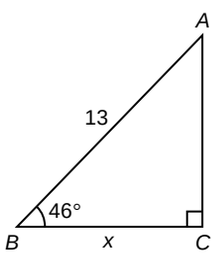
(d) $2\cos\theta = \sqrt{3}$

(e) $\cos\theta = 2\cos 50° \cos 42°$

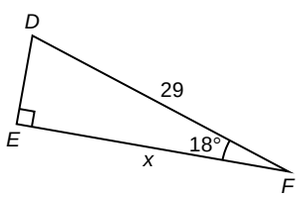
(f) $\cos\theta = \dfrac{2\cos 85°}{\cos 15°}$

Find x in each of the following figures correct to 3 significant figures. (**9** – **11**)

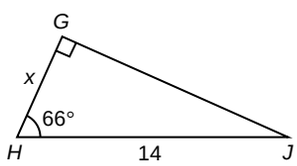
9.



10.

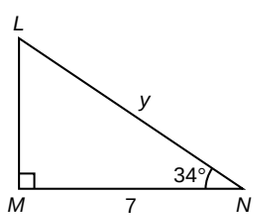


11.

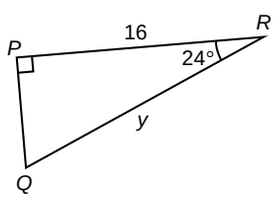


Find y in each of the following figures correct to 1 decimal place. (**12** – **14**)

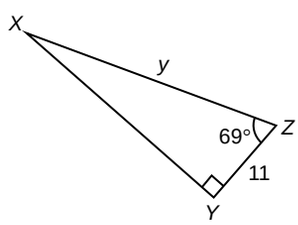
12.



13.

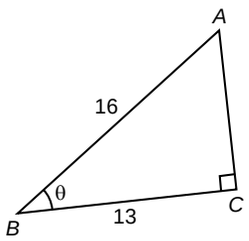


14.

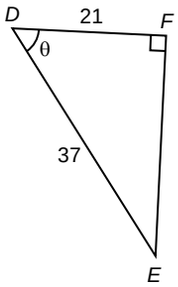


Find θ in each of the following figures correct to the nearest degree. (**15** – **17**)

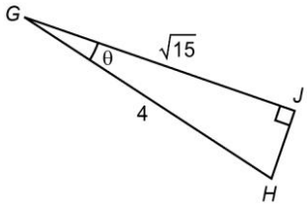
15.



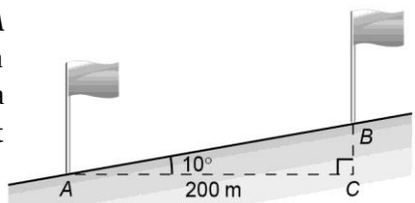
16.



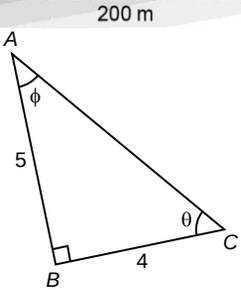
17.



18. The figure shows two flagpoles standing vertically at points *A* and *B* on a slope, where the horizontal distance between them is 200 m. Find the time taken by Marco to walk from *A* to *B* at a speed of 3 m/s. (Give your answer correct to 3 significant figures.)



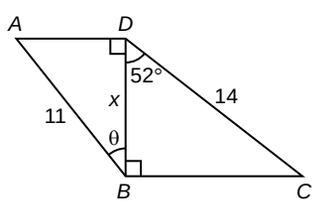
19. In the figure, ΔABC is a right-angled triangle. Without finding θ and ϕ, find the value of $\dfrac{\cos\theta}{\cos\phi}$.



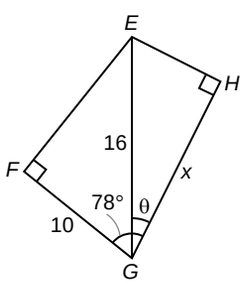
Challenging Questions

Find the unknowns in the following figures. (Give your answers correct to 3 significant figures.) (**20** – **23**)

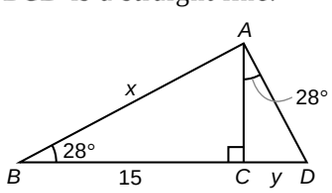
20.



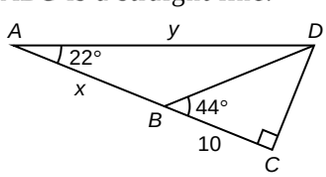
21.



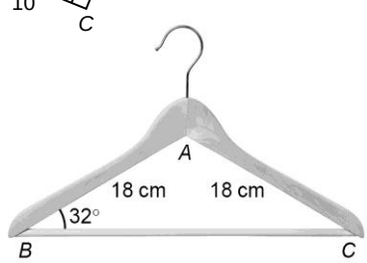
22. *BCD* is a straight line.



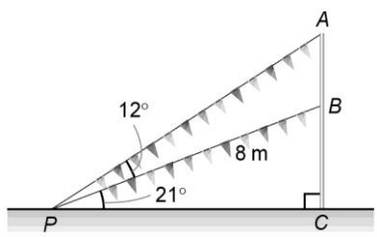
23. *ABC* is a straight line.



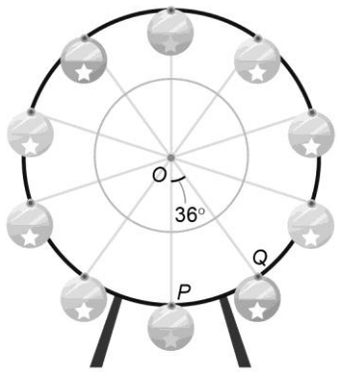
24. The figure shows a hanger, where $AB = AC = 18\text{ cm}$ and $\angle ABC = 32°$. Find the length of *BC*. (Give your answer correct to 3 significant figures.)



25. In the figure, two ribbons *AP* and *BP* connect a rod *ABC* to the ground at *P*. By how much is the length of *AP* longer than that of *BP*? (Give your answer correct to 3 significant figures.)



26. The figure shows a Ferris wheel with centre O and the radius of 20 m. P and Q are the highest points of two cabins of the Ferris wheel, where P is vertically below the centre O and $\angle POQ = 36°$. If P is 10 m above the ground, find the height of Q above the ground. (Give your answer correct to 3 significant figures.)

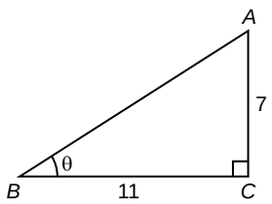


Exercise 12C

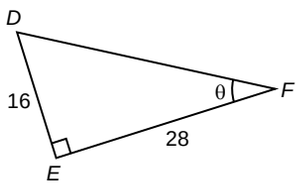
Fundamental Questions

Find the value of $\tan\theta$ in each of the following figures. (**1** – **3**)

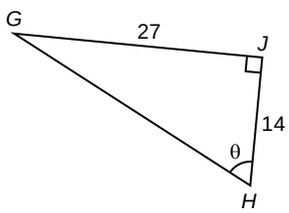
1.



2.

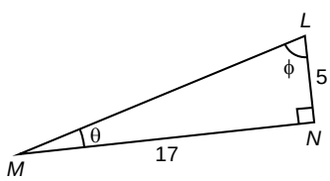


3.

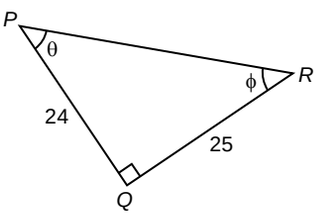


Find the values of $\tan\theta$ and $\tan\phi$ in each of the following figures. (**4** – **6**)

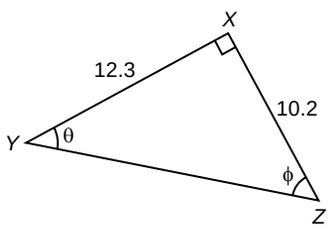
4.



5.



6.



Consolidation Questions

7. Find the values of the following. (Give your answers correct to 3 significant figures.)

(a) $\tan 54°$

(b) $\dfrac{\tan 22°}{4}$

(c) $\dfrac{12}{\tan 35°}$

(d) $\tan 38° \tan 67°$

(e) $\tan 80° - \tan 70°$

(f) $3\tan 22° + 2\tan 6°$

(g) $\dfrac{\tan 25°}{5\tan 15°}$

(h) $\dfrac{\tan 43° - \tan 21°}{\tan 10°}$

8. Find θ in the following. (Give your answers correct to 1 decimal place.)

(a) $\tan\theta = 1.7$

(b) $\tan\theta = \dfrac{15}{28}$

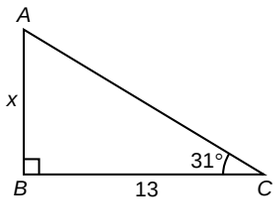
(c) $\tan\theta = \dfrac{4}{\sqrt{3}}$

(d) $4\tan\theta = 3\sqrt{2}$

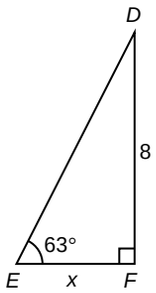
(e) $\tan\theta = 4\tan 37°\tan 74°$ **(f)** $\tan\theta = \dfrac{\tan 84°}{7\tan 12°}$

Find x in each of the following figures correct to 3 significant figures. (**9** – **14**)

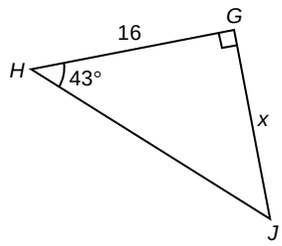
9.



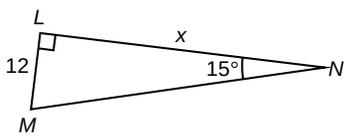
10.



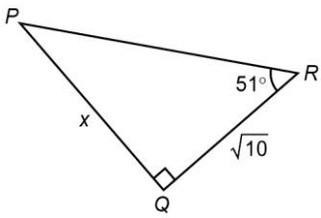
11.



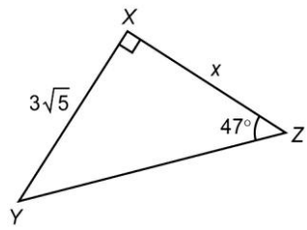
12.



13.

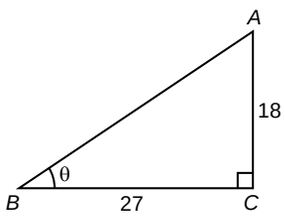


14.

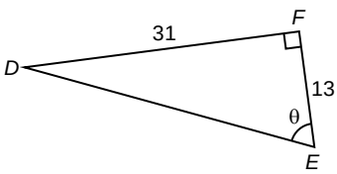


Find θ in each of the following figures correct to the nearest degree. (**15** – **17**)

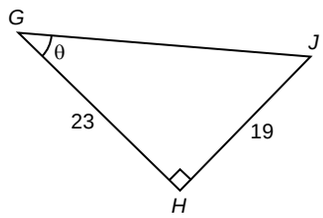
15.



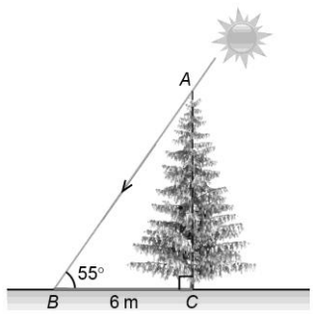
16.



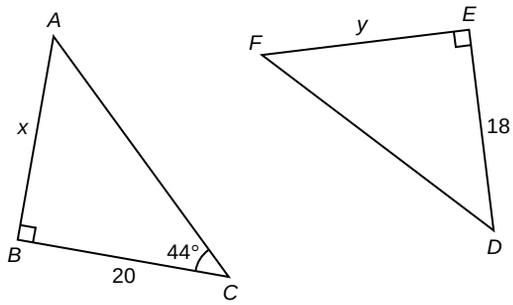
17.



18. In the figure, the sun rays make an angle of 55° with the horizontal ground, and the tree casts a shadow BC of 6 m long. Find the height of the tree. (Give your answer correct to 3 significant figures.)



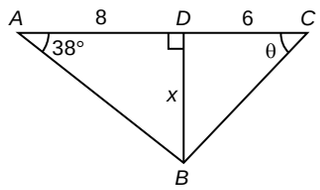
19. In the figure, $\Delta ABC \sim \Delta DEF$. Find x and y correct to 3 significant figures.



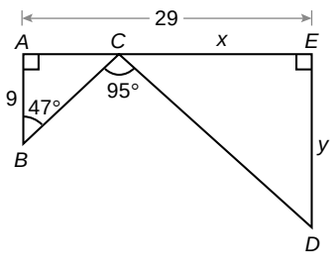
Challenging Questions

Find the unknowns in the following figures. (Give your answers correct to 3 significant figures if necessary.) (**20** – **23**)

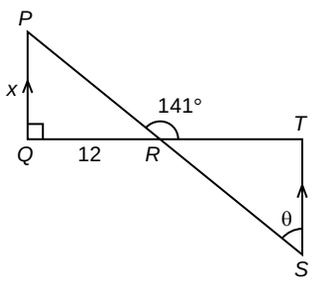
20. *ADC* is a straight line.



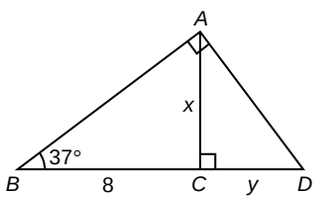
21. *ACE* is a straight line.



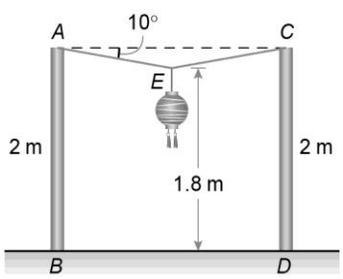
22. *PRS* and *QRT* are straight lines.



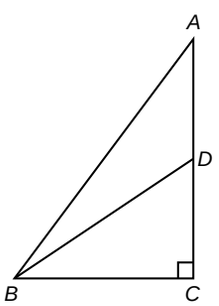
23. *BCD* is a straight line.



24. In the figure, the rods *AB* and *CD* are both 2 m high. A lantern is hanged at point *E* on the rope joining *A* and *C*, where $AE = CE$. It is given that *AE* makes an angle of 10° with *AC* and *E* is 1.8 m above the ground. Find the distance between the rods *AB* and *CD*. (Give your answer correct to 3 significant figures.)



25. In the figure, ΔABC is a right-angled triangle. *D* is a point on *AC* such that $AD : DC : BC = 2 : 2 : 3$. Judy claims that $\angle ABD = \angle DBC$. Do you agree? Explain your answer.



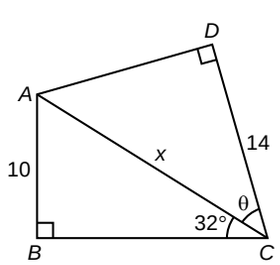
Exercise 12D

[In this exercise, give your answers correct to 3 significant figures if necessary.]

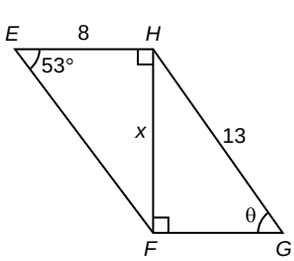
Fundamental Questions

Find the unknowns in the following figures. (**1** – **6**)

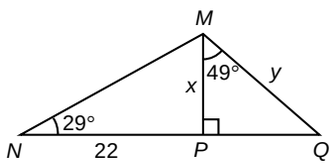
1.



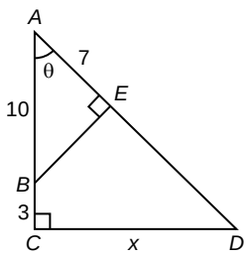
2.



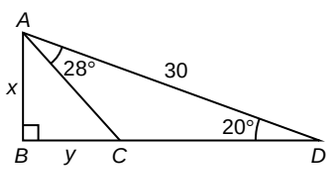
3. *NPQ* is a straight line.



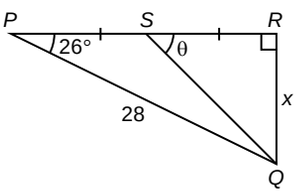
4. *ABC* and *AED* are straight lines.



5. *BCD* is a straight line.

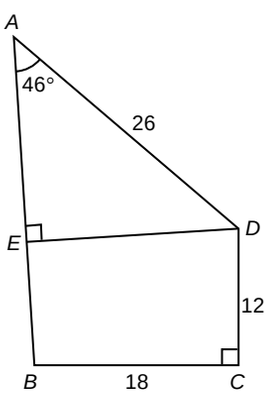


6. *PSR* is a straight line.

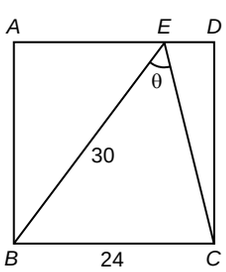


Consolidation Questions

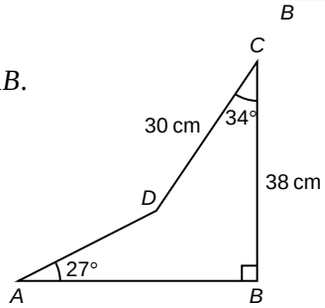
7. In the figure, *ABCD* is a quadrilateral. *E* is a point on *AB* such that $AB \perp DE$. Find $\angle CDE$.



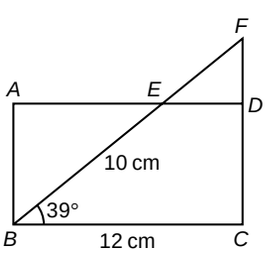
8. In the figure, *ABCD* is a square. *E* is a point on *AD*. Find θ.



9. In the figure, *ABCD* is a quadrilateral. Find *AB*.



10. In the figure, *ABCD* is a rectangle. *AED*, *BEF* and *FDC* are straight lines.



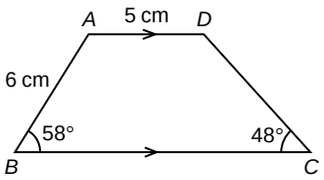
(a) Find *AB* and *AE*.

(b) Find *FD*.

(c) Tina claims that the sum of the areas of ΔABE and ΔDEF is smaller than half of the area of *ABCD*. Do you agree?

Explain your answer.

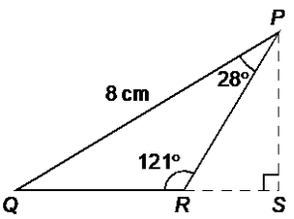
11. In the figure, $ABCD$ is a trapezium, where $AD // BC$.



(a) Find the length of BC.

(b) Find the area of the trapezium $ABCD$.

12. In the figure, S is a point on QR produced such that $PS \perp QS$.



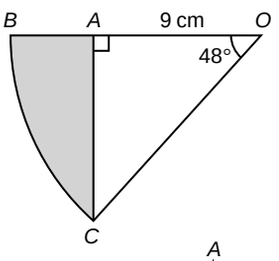
(a) Find the length of PS.

(b) Find the length of QR.

(c) Find the area of ΔPQR.

(d) Find the perpendicular distance from R to PQ.

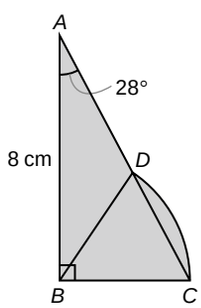
13. In the figure, OBC is a sector. A is a point on OB such that $AC \perp OB$. It is given that $OA = 9$ cm and $\angle BOC = 48°$.



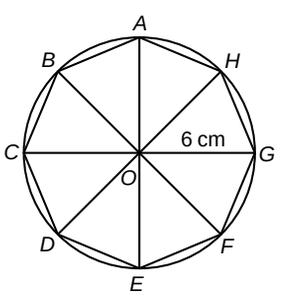
(a) Find the radius of the sector OBC.

(b) Find the area of the shaded region.

14. In the figure, ΔABC is a right-angled triangle, where $\angle A = 28°$. D is a point on AC such that BCD is a sector. Find the area of the figure.



15. In the figure, O is the centre of a circle of radius 6 cm. A, B, C, D, E, F, G and H are points on the circle such that $ABCDEFGH$ is a regular octagon.

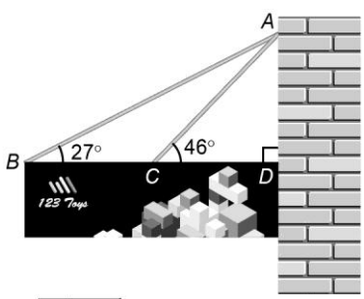


(a) Find the perimeter of the octagon.

(b) Find the area of the octagon.

Challenging Questions

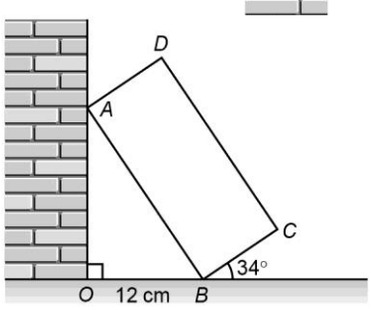
16. In the figure, a rectangular advertising board is hung on the vertical wall by two rods AB and AC. It is given that the total length of the two rods is 8 m.



(a) Find the height of A above the advertising board.

(b) Find the length BD of the advertising board.

17. In the figure, a rectangular block leans against the vertical wall, where BC makes an angle of 34° with the horizontal ground. It is given that the height of D above the ground is 23 cm.



(a) Find the lengths of AB and AD.

(b) Find the distance of C from the wall.

18. Figure I shows a piece of rectangular paper. The paper is folded as shown in Figure II. Let $AE = x$ cm.

(a) Find the length of BF.

(b) Find the value of x.

(c) Which one of $\angle FEC$ and $\angle FCB$ is greater? Explain your answer.

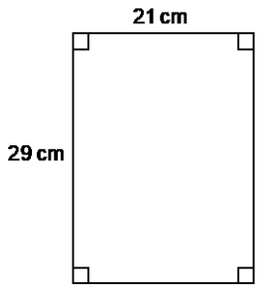


Figure I

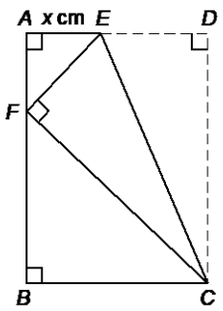


Figure II

Answers

Exercise 12A *(page 12.1)*

1. $\frac{7}{12}$

2. $\frac{11}{14}$

3. $\frac{5}{6}$

4. $\sin\theta = \frac{8}{17}$, $\sin\phi = \frac{15}{17}$

5. $\sin\theta = \frac{4}{5}$, $\sin\phi = \frac{3}{5}$

6. $\sin\theta = \frac{5}{6}$, $\sin\phi = \frac{\sqrt{11}}{6}$

7. 12

8. 10

9. **(a)** 0.391
(b) 1.15
(c) 18.1
(d) 2.46
(e) 1.47
(f) 0.582
(g) 0.532
(h) 0.238

10. **(a)** 11.5°
(b) 12.6°
(c) 16.4°
(d) 36.9°
(e) 9.8°
(f) 72°

11. 8.92

12. 18.0

13. 18.0

14. 23.3

15. 26.2

16. 77.1

17. 49°

18. 31°

19. 52°

20. 46°

21. 59°

22. 69°

23. 127°

24. $x = 9.75$, $\theta = 54.3°$

25. $\theta = 35.8°$, $\phi = 118°$

26. $\theta = 35°$, $x = 9.36$

27. $\theta = 21.1°$, $x = 13.4$

28. No

29. 0.946 m

Exercise 12B *(page 12.4)*

1. $\frac{9}{16}$

2. $\frac{13}{18}$

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

4. $\cos\theta = \frac{35}{37}$, $\cos\phi = \frac{12}{37}$

5. $\cos\theta = \frac{28}{53}$, $\cos\phi = \frac{45}{53}$

6. $\cos\theta = \frac{5}{8}$, $\cos\phi = \frac{\sqrt{39}}{8}$

7. **(a)** 0.956
(b) 2.97
(c) 32.7
(d) 0.609
(e) 0.342
(f) 3.57
(g) 0.259
(h) 1.33

8. **(a)** 53.1°
(b) 51.6°
(c) 65.9°
(d) 30°

(e) 17.2°
(f) 79.6°

9. 9.03
10. 27.6
11. 5.69
12. 8.4
13. 17.5
14. 30.7
15. 36°
16. 55°
17. 14°
18. 67.7 s
19. $\frac{4}{5}$
20. $x = 8.62, \theta = 38.4°$
21. $\theta = 26.7°, x = 14.3$
22. $x = 17.0, y = 4.24$
23. $x = 13.9, y = 25.8$
24. 30.5 cm
25. 0.905 m
26. 13.8 m

Exercise 12C *(page 12.7)*

1. $\frac{7}{11}$
2. $\frac{4}{7}$
3. $\frac{27}{14}$
4. $\tan\theta = \frac{5}{17}, \tan\phi = \frac{17}{5}$
5. $\tan\theta = \frac{25}{24}, \tan\phi = \frac{24}{25}$
6. $\tan\theta = \frac{34}{41}, \tan\phi = \frac{41}{34}$
7. **(a)** 1.38
(b) 0.101
(c) 17.1
(d) 1.84
(e) 2.92
(f) 1.42
(g) 0.348
(h) 3.11
8. **(a)** 59.5°
(b) 28.2°
(c) 66.6°
(d) 46.7°
(e) 84.6°
(f) 81.1°
9. 7.81
10. 4.08
11. 14.9
12. 44.8
13. 3.91
14. 6.26
15. 34°
16. 67°
17. 40°
18. 8.57 m
19. $x = 19.3, y = 18.6$
20. $x = 6.25, \theta = 46.2°$
21. $x = 19.3, y = 17.4$
22. $x = 9.72, \theta = 51°$
23. $x = 6.03, y = 4.54$
24. 2.27 m
25. No

Exercise 12D *(page 12.11)*

1. $x = 18.9, \theta = 42.1°$
2. $x = 10.6, \theta = 54.8°$
3. $x = 12.2, y = 18.6$
4. $\theta = 45.6°, x = 13.3$
5. $x = 10.3, y = 9.24$
6. $x = 12.3, \theta = 44.3°$
7. 86.5°
8. 50.9°
9. 42.5 cm
10. **(a)** $AB = 6.29$ cm, $AE = 7.77$ cm
(b) 3.42 cm
(c) Yes
11. **(a)** 12.8 cm
(b) 45.2 cm^2
12. **(a)** 4.12 cm
(b) 4.38 cm
(c) 9.03 cm^2
(d) 2.26 cm
13. **(a)** 13.5 cm
(b) 30.8 cm^2
14. 18.4 cm^2
15. **(a)** 36.7 cm
(b) 102 cm^2
16. **(a)** 2.23 m
(b) 4.37 m
17. **(a)** $AB = 21.5$ cm, $AD = 9.32$ cm
(b) 19.7 cm
18. **(a)** 20 cm
(b) $\frac{60}{7}$
(c) $\angle FEC$