

Circles: Area, Squaring & Pi

Contents

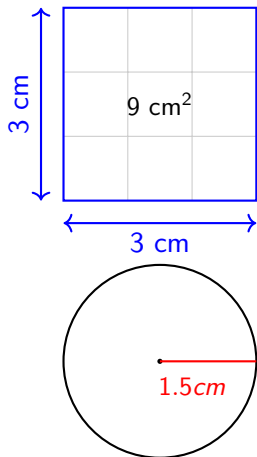
Questions and short answers

- ▶ Starter 1
- ▶ Starter 2
- ▶ Starter 3
- ▶ Starter 4

Worked solutions

- ▶ Starter 1
- ▶ Starter 2
- ▶ Starter 3
- ▶ Starter 4

Starter 1



1. $4 \times 4 = ?$

2. $7 \times 7 = ?$

3. $10^2 = ?$

4. $3^2 = ?$

5. 2×6 and 6^2 — are these the same?

6. $3.14 \times 9 = \underline{\hspace{2cm}}$

7. $3.14 \times 25 = \underline{\hspace{2cm}}$

7. A circle has **diameter** 14 cm. Find:

(a) the radius $\underline{\hspace{2cm}}$

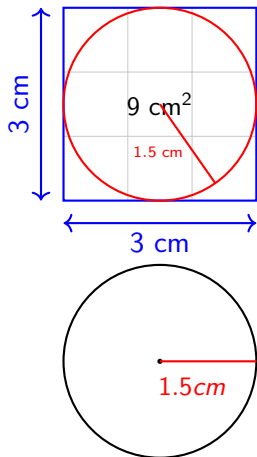
(b) the circumference $\underline{\hspace{2cm}}$.

($\pi \approx 3.14$)

8. A circle has **radius** 5 cm. What is the circumference? $\underline{\hspace{2cm}}$

9. The square has side 3 cm and area 9 cm². A circle has radius 1.5 cm. Is the circle's area more or less than 9 cm²?

Starter 1



1. $4 \times 4 = 16$

2. $7 \times 7 = 49$

3. $10^2 = 100$

4. $3^2 = 9$

5. 2×6 and 6^2 — are these the same? **No:**
 $12 \neq 36$.

6. $3.14 \times 9 = 28.26$

7. $3.14 \times 25 = 78.5$

7. A circle has **diameter** 14 cm. Find:

(a) the radius **7 cm**

(b) the circumference **43.96 cm**.

($\pi \approx 3.14$)

8. A circle has **radius** 5 cm. What is the circumference? **31.4 cm**

9. The square has side 3 cm and area 9 cm². A circle has radius 1.5 cm. Is the circle's area more or less than 9 cm²? **Less:**
 $\pi(1.5)^2 \approx 7.07 \text{ cm}^2$.

Worked Solution: Starter 1, Question 1

Question: $4 \times 4 = ?$

Worked Solution:

Worked Solution: Starter 1, Question 1

Question: $4 \times 4 = 16$

Worked Solution: $4 \times 4 = 16$ because $4 + 4 + 4 + 4 = 16$.

Worked Solution: Starter 1, Question 2

Question: $7 \times 7 = ?$

Worked Solution:

Worked Solution: Starter 1, Question 2

Question: $7 \times 7 = 49$

Worked Solution: $7 \times 7 = 49$, from the 7 times table or
 $7 + 7 + 7 + 7 + 7 + 7 + 7 = 49$.

Worked Solution: Starter 1, Question 3

Question: $10^2 = ?$

Worked Solution:

Worked Solution: Starter 1, Question 3

Question: $10^2 = 100$

Worked Solution: $10^2 = 10 \times 10 = 100.$

Worked Solution: Starter 1, Question 4

Question: $3^2 = ?$

Worked Solution:

Worked Solution: Starter 1, Question 4

Question: $3^2 = 9$

Worked Solution: $3^2 = 3 \times 3 = 9.$

Worked Solution: Starter 1, Question 5

Question: Are 2×6 and 6^2 the same?

Worked Solution:

Worked Solution: Starter 1, Question 5

Question: Are 2×6 and 6^2 the same?

Worked Solution: No. $2 \times 6 = 12$, while $6^2 = 36$. Since $12 \neq 36$, they are not the same.

Worked Solution: Starter 1, Question 6

Question: $3.14 \times 9 = \underline{\hspace{2cm}}$

Worked Solution:

Worked Solution: Starter 1, Question 6

Question: $3.14 \times 9 = 28.26$

Worked Solution: $3.14 \times 9 = 3.14 \times (10 - 1) = 31.4 - 3.14 = 28.26.$

Worked Solution: Starter 1, Question 7

Question: $3.14 \times 25 = \underline{\hspace{2cm}}$

Worked Solution:

Worked Solution: Starter 1, Question 7

Question: $3.14 \times 25 = 78.5$

Worked Solution: $3.14 \times 25 = 3.14 \times \frac{100}{4} = \frac{314}{4} = 78.5.$

Worked Solution: Starter 1, Question 8

Question: A circle has diameter 14 cm. Find: (a) the radius _____ and (b) the circumference _____. ($\pi \approx 3.14$)

Worked Solution:

Worked Solution: Starter 1, Question 8

Question: A circle has diameter 14 cm. Find: (a) the radius **7 cm** and (b) the circumference **43.96 cm**. ($\pi \approx 3.14$)

Worked Solution: Radius = $\frac{14}{2} = 7$ cm. Circumference
 $= \pi d = 3.14 \times 14 = 43.96$ cm.

Worked Solution: Starter 1, Question 9

Question: A circle has radius 5 cm. What is the circumference?

Worked Solution:

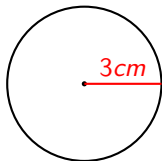
Worked Solution: Starter 1, Question 9

Question: A circle has radius 5 cm. What is the circumference?

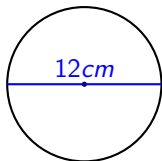
31.4 cm

Worked Solution: $C = 2\pi r = 2 \times 3.14 \times 5 = 31.4 \text{ cm}.$

Starter 2



Circle A

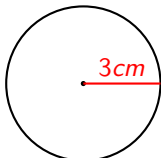


Circle B

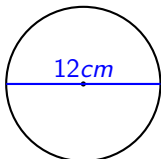
1. Halve 12 cm ____
2. Halve 9.4 cm

3. $6^2 = ?$
4. $1.5^2 = ?$
5. $3 \times 4^2 = \underline{\hspace{1cm}}$
6. True or false?
 $\pi \times (2r) = 2 \times \pi \times r$
7. Consider circle A
 - (a) What is the circumference? _____
 - (b) What is the area? _____
8. Consider circle B
 - (a) What is the circumference? _____
 - (b) What is the area? _____
9. Is the ratio of the circumferences of circle's A and B the same as the ratio of the areas?

Starter 2



Circle A



Circle B

1. Halve 12 cm **6 cm**
2. Halve 9.4 cm
4.7 cm
3. $6^2 =$ **36**
4. $1.5^2 =$ **2.25**
5. $3 \times 4^2 =$ **48**
6. True or false?
 $\pi \times (2r) = 2 \times \pi \times r$
True
7. Consider circle A
 - (a) What is the circumference? **18.84 cm**
 - (b) What is the area? **28.26 cm²**
8. Consider circle B
 - (a) What is the circumference? **37.68 cm**
 - (b) What is the area? **113.04 cm²**
9. Is the ratio of the circumferences of circle's A and B the same as the ratio of the areas? **No: 1 : 2 vs 1 : 4.**

Worked Solution: Starter 2, Question 1

Question: Halve 12 cm. _____

Worked Solution:

Worked Solution: Starter 2, Question 1

Question: Halve 12 cm. 6 cm

Worked Solution: $12 \div 2 = 6$, so the answer is 6 cm.

Worked Solution: Starter 2, Question 2

Question: Halve 9.4 cm. _____

Worked Solution:

Worked Solution: Starter 2, Question 2

Question: Halve 9.4 cm. 4.7 cm

Worked Solution: $9.4 \div 2 = 4.7$, so the answer is 4.7 cm.

Worked Solution: Starter 2, Question 3

Question: $6^2 = ?$

Worked Solution:

Worked Solution: Starter 2, Question 3

Question: $6^2 = 36$

Worked Solution: $6^2 = 6 \times 6 = 36$.

Worked Solution: Starter 2, Question 4

Question: $1.5^2 = ?$

Worked Solution:

Worked Solution: Starter 2, Question 4

Question: $1.5^2 = 2.25$

Worked Solution: $1.5 \times 1.5 = 2.25$.

Worked Solution: Starter 2, Question 5

Question: $3 \times 4^2 = \underline{\hspace{1cm}}$

Worked Solution:

Worked Solution: Starter 2, Question 5

Question: $3 \times 4^2 = 48$

Worked Solution: Square first: $4^2 = 16$, then $3 \times 16 = 48$.

Worked Solution: Starter 2, Question 6

Question: True or false? $\pi \times (2r) = 2 \times \pi \times r$

Worked Solution:

Worked Solution: Starter 2, Question 6

Question: True or false? $\pi \times (2r) = 2 \times \pi \times r$

Worked Solution: True. By commutativity, $\pi(2r) = 2\pi r$, so both sides are equal.

Worked Solution: Starter 2, Question 7

Question: Circle A has radius 3 cm. Find: (a) the circumference _____ and (b) the area _____.

Worked Solution:

Worked Solution: Starter 2, Question 7

Question: Circle A has radius 3 cm. Find: (a) the circumference 18.84 cm and (b) the area 28.26 cm².

Worked Solution: $C = 2\pi r = 2 \times 3.14 \times 3 = 18.84$ cm.

$A = \pi r^2 = 3.14 \times 3^2 = 3.14 \times 9 = 28.26$ cm².

Worked Solution: Starter 2, Question 8

Question: Circle B has diameter 12 cm. Find: (a) the circumference _____ and (b) the area _____.

Worked Solution:

Worked Solution: Starter 2, Question 8

Question: Circle B has diameter 12 cm. Find: (a) the circumference **37.68 cm** and (b) the area **113.04 cm²**.

Worked Solution: Radius = $12 \div 2 = 6$ cm.

$$C = \pi d = 3.14 \times 12 = 37.68 \text{ cm.}$$

$$A = \pi r^2 = 3.14 \times 6^2 = 3.14 \times 36 = 113.04 \text{ cm}^2.$$

Worked Solution: Starter 2, Question 9

Question: Is the ratio of the circumferences of circles A and B the same as the ratio of the areas?

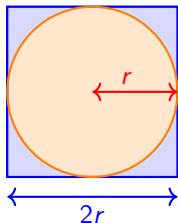
Worked Solution:

Worked Solution: Starter 2, Question 9

Question: Is the ratio of the circumferences of circles A and B the same as the ratio of the areas?

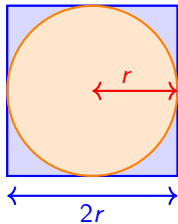
Worked Solution: No. Circumference ratio is $18.84 : 37.68 = 1 : 2$, while area ratio is $28.26 : 113.04 = 1 : 4$. Lengths scale by 2, but areas scale by $2^2 = 4$.

Starter 3



1. $5 \times 5 = ?$
2. $8^2 = ?$
3. $2.5^2 = ?$
4. $3.14 \times 9 = \underline{\hspace{2cm}}$
5. Area of a $7 \text{ cm} \times 4 \text{ cm}$ rectangle $= ?$
6. What fraction of 360° is 90° ?
7. Write an expression for the area of the circle in the picture
8. Write an expression for the area of the shaded blue region in the picture
9. If the square has a perimeter of 48 cm , what is the area of the shaded blue region?

Starter 3



1. $5 \times 5 = 25$
2. $8^2 = 64$
3. $2.5^2 = 6.25$
4. $3.14 \times 9 = 28.26$
5. Area of a $7 \text{ cm} \times 4 \text{ cm}$ rectangle = 28 cm^2
6. What fraction of 360° is 90° ? $\frac{1}{4}$
7. Write an expression for the area of the circle in the picture πr^2
8. Write an expression for the area of the shaded blue region in the picture $4r^2 - \pi r^2$
9. If the square has a perimeter of 48 cm , what is the area of the shaded blue region? 30.96 cm^2

Worked Solution: Starter 3, Question 1

Question: $5 \times 5 = ?$

Worked Solution:

Worked Solution: Starter 3, Question 1

Question: $5 \times 5 = 25$

Worked Solution: $5 \times 5 = 25$.

Worked Solution: Starter 3, Question 2

Question: $8^2 = ?$

Worked Solution:

Worked Solution: Starter 3, Question 2

Question: $8^2 = 64$

Worked Solution: $8^2 = 8 \times 8 = 64.$

Worked Solution: Starter 3, Question 3

Question: $2.5^2 = ?$

Worked Solution:

Worked Solution: Starter 3, Question 3

Question: $2.5^2 = 6.25$

Worked Solution: $2.5 \times 2.5 = 6.25$.

Worked Solution: Starter 3, Question 4

Question: $3.14 \times 9 = \underline{\hspace{2cm}}$

Worked Solution:

Worked Solution: Starter 3, Question 4

Question: $3.14 \times 9 = 28.26$

Worked Solution: $3.14 \times 9 = 3.14 \times (10 - 1) = 31.4 - 3.14 = 28.26.$

Worked Solution: Starter 3, Question 5

Question: Area of a $7\text{ cm} \times 4\text{ cm}$ rectangle $=?$

Worked Solution:

Worked Solution: Starter 3, Question 5

Question: Area of a $7\text{ cm} \times 4\text{ cm}$ rectangle = 28 cm^2

Worked Solution: $7 \times 4 = 28$, so the area is 28 cm^2 .

Worked Solution: Starter 3, Question 6

Question: What fraction of 360° is 90° ?

Worked Solution:

Worked Solution: Starter 3, Question 6

Question: What fraction of 360° is 90° ?

Worked Solution: $\frac{90}{360} = \frac{1}{4}$.

Worked Solution: Starter 3, Question 7

Question: Write an expression for the area of the circle in the picture, which has radius r .

Worked Solution:

Worked Solution: Starter 3, Question 7

Question: Write an expression for the area of the circle in the picture, which has radius r .

Worked Solution: $A = \pi r^2$.

Worked Solution: Starter 3, Question 8

Question: Write an expression for the area of the shaded blue region in the picture, where the square has side $2r$ and the circle has radius r .

Worked Solution:

Worked Solution: Starter 3, Question 8

Question: Write an expression for the area of the shaded blue region in the picture, where the square has side $2r$ and the circle has radius r .

Worked Solution: Square area $= (2r)^2 = 4r^2$. Shaded area $= 4r^2 - \pi r^2$.

Worked Solution: Starter 3, Question 9

Question: If the square has a perimeter of 48 cm, what is the area of the shaded blue region?

Worked Solution:

Worked Solution: Starter 3, Question 9

Question: If the square has a perimeter of 48 cm, what is the area of the shaded blue region?

Worked Solution: Side = $48 \div 4 = 12$ cm, so $2r = 12$ and $r = 6$ cm.
Square area = $12^2 = 144$ cm². Circle area = $\pi \times 6^2 = 3.14 \times 36 = 113.04$ cm². Shaded area = $144 - 113.04 = 30.96$ cm².

Starter 4

1. $9^2 = ?$

2. $3.5^2 = ?$

3. 3.14×16

4. 3.14×49

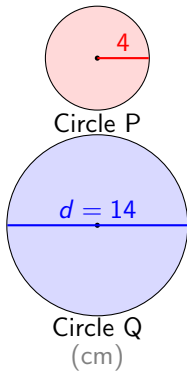
5. Halve 14 cm. Then square your answer.

6. A square has area 64 cm^2 . What is its side length ?

7. **Spot the mistake:** "Circle Q has diameter 14 cm, so its area is $\pi \times 14^2 \approx 615 \text{ cm}^2$." What error was made? Write the correct solution.

8. **Circle P**, radius 4 cm. Find: (a) the area _____ (b) the circumference _____.

9. **Circle Q**, diameter 14 cm. Find: (a) the area _____ (b) the circumference _____.



Starter 4

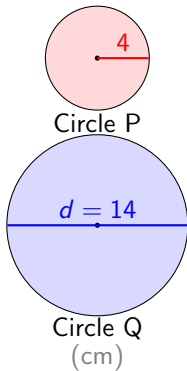
1. $9^2 = 81$

2. $3.5^2 = 12.25$

3. $3.14 \times 16 = 50.24$ 4. $3.14 \times 49 = 153.86$

5. Halve 14 cm. Then square your answer.
7 cm, so 49 cm^2

6. A square has area 64 cm^2 . What is its side length **8 cm**



7. **Spot the mistake:** "Circle Q has diameter 14 cm, so its area is $\pi \times 14^2 \approx 615 \text{ cm}^2$." What error was made? Write the correct solution. **Used diameter not radius: $\pi \times 7^2 \approx 153.86 \text{ cm}^2$.**

8. **Circle P**, radius 4 cm. Find: (a) the area **50.24 cm^2** (b) the circumference **25.12 cm .**

9. **Circle Q**, diameter 14 cm. Find: (a) the area **153.86 cm^2** (b) the circumference

Worked Solution: Starter 4, Question 1

Question: $9^2 = ?$

Worked Solution:

Worked Solution: Starter 4, Question 1

Question: $9^2 = 81$

Worked Solution: $9^2 = 9 \times 9 = 81.$

Worked Solution: Starter 4, Question 2

Question: $3.5^2 = ?$

Worked Solution:

Worked Solution: Starter 4, Question 2

Question: $3.5^2 = 12.25$

Worked Solution: $3.5 \times 3.5 = \frac{7}{2} \times \frac{7}{2} = \frac{49}{4} = 12.25.$

Worked Solution: Starter 4, Question 3

Question: $3.14 \times 16 = ?$

Worked Solution:

Worked Solution: Starter 4, Question 3

Question: $3.14 \times 16 = ?$

Worked Solution:

$$3.14 \times 16 = 3.14 \times (10 + 6) = 31.4 + 18.84 = 50.24.$$

Worked Solution: Starter 4, Question 4

Question: $3.14 \times 49 = ?$

Worked Solution:

Worked Solution: Starter 4, Question 4

Question: $3.14 \times 49 = ?$

Worked Solution: $49 = 50 - 1$, so

$$3.14 \times 49 = 3.14 \times 50 - 3.14 = 157 - 3.14 = 153.86.$$

Worked Solution: Starter 4, Question 5

Question: Halve 14 cm, then square your answer.

Worked Solution:

Worked Solution: Starter 4, Question 5

Question: Halve 14 cm, then square your answer.

Worked Solution: Halving gives $14 \div 2 = 7$ cm. Squaring gives $7^2 = 49$, so the answer is 49 cm^2 .

Worked Solution: Starter 4, Question 6

Question: A square has area 64 cm^2 . What is its side length? ?

Worked Solution:

Worked Solution: Starter 4, Question 6

Question: A square has area 64 cm^2 . What is its side length? 8
cm

Worked Solution: Since $8^2 = 64$, the side length is $\sqrt{64} = 8 \text{ cm}$.

Worked Solution: Starter 4, Question 7

Question: Spot the mistake: “Circle Q has diameter 14 cm, so its area is $\pi \times 14^2 \approx 615 \text{ cm}^2$.” What error was made? Write the correct solution.

Worked Solution:

Worked Solution: Starter 4, Question 7

Question: Spot the mistake: “Circle Q has diameter 14 cm, so its area is $\pi \times 14^2 \approx 615 \text{ cm}^2$.” What error was made? Write the correct solution.

Worked Solution: The diameter was used instead of the radius. The radius is $14 \div 2 = 7 \text{ cm}$, so the correct area is $\pi \times 7^2 = 3.14 \times 49 \approx 153.86 \text{ cm}^2$.

Worked Solution: Starter 4, Question 8

Question: Circle P has radius 4 cm. Find: (a) the area _____
and (b) the circumference _____.

Worked Solution:

Worked Solution: Starter 4, Question 8

Question: Circle P has radius 4 cm. Find: (a) the area 50.24 cm^2 and (b) the circumference 25.12 cm .

Worked Solution: $A = \pi r^2 = 3.14 \times 4^2 = 3.14 \times 16 = 50.24 \text{ cm}^2$.

$C = 2\pi r = 2 \times 3.14 \times 4 = 25.12 \text{ cm}$.

Worked Solution: Starter 4, Question 9

Question: Circle Q has diameter 14 cm. Find: (a) the area _____ and (b) the circumference _____.

Worked Solution:

Worked Solution: Starter 4, Question 9

Question: Circle Q has diameter 14 cm. Find: (a) the area 153.86 cm^2 and (b) the circumference 43.96 cm .

Worked Solution: Radius $= 14 \div 2 = 7 \text{ cm}$.

$$A = \pi r^2 = 3.14 \times 7^2 = 3.14 \times 49 = 153.86 \text{ cm}^2.$$

$$C = \pi d = 3.14 \times 14 = 43.96 \text{ cm}.$$

Worked Solution: Starter 4, Question 10

Question: Which has the greater area, P or Q? By approximately how many cm^2 ?

Worked Solution:

Worked Solution: Starter 4, Question 10

Question: Which has the greater area, P or Q? By approximately how many cm^2 ?

Worked Solution: Area P is 50.24 cm^2 , and area Q is 153.86 cm^2 .
Therefore Q is greater by $153.86 - 50.24 = 103.62 \text{ cm}^2$.