

Name _____

Date _____

15.3 Units of area — worked answers

Understand the relationships between mm^2 , cm^2 , m^2 , hectares and km^2 , and convert between them. · 71 questions

A · Fluency — Convert between mm^2 , cm^2 , m^2 , hectares and km^2 .

- 1 How many mm^2 are there in 1 cm^2 ?

Answer: 100

$1 \text{ cm} = 10 \text{ mm}$, so $1 \text{ cm}^2 = 10 \times 10 = 100 \text{ mm}^2$. Then $1 \times 100 = 100 \text{ mm}^2$.

- 2 How many mm^2 are there in 2 cm^2 ?

Answer: 200

$1 \text{ cm} = 10 \text{ mm}$, so $1 \text{ cm}^2 = 10 \times 10 = 100 \text{ mm}^2$. Then $2 \times 100 = 200 \text{ mm}^2$.

- 3 How many mm^2 are there in 3 cm^2 ?

Answer: 300

$1 \text{ cm} = 10 \text{ mm}$, so $1 \text{ cm}^2 = 10 \times 10 = 100 \text{ mm}^2$. Then $3 \times 100 = 300 \text{ mm}^2$.

- 4 How many mm^2 are there in 5 cm^2 ?

Answer: 500

$1 \text{ cm} = 10 \text{ mm}$, so $1 \text{ cm}^2 = 10 \times 10 = 100 \text{ mm}^2$. Then $5 \times 100 = 500 \text{ mm}^2$.

- 5 How many mm^2 are there in 7 cm^2 ?

Answer: 700

$1 \text{ cm} = 10 \text{ mm}$, so $1 \text{ cm}^2 = 10 \times 10 = 100 \text{ mm}^2$. Then $7 \times 100 = 700 \text{ mm}^2$.

- 6 How many mm^2 are there in 10 cm^2 ?

Answer: 1000

$1 \text{ cm} = 10 \text{ mm}$, so $1 \text{ cm}^2 = 10 \times 10 = 100 \text{ mm}^2$. Then $10 \times 100 = 1000 \text{ mm}^2$.

- 7 How many cm^2 are there in 1 m^2 ?

Answer: 10000

$1 \text{ m} = 100 \text{ cm}$, so $1 \text{ m}^2 = 100 \times 100 = 10000 \text{ cm}^2$. Then $1 \times 10000 = 10000 \text{ cm}^2$.

- 8 How many cm^2 are there in 2 m^2 ?

Answer: 20000

$1 \text{ m} = 100 \text{ cm}$, so $1 \text{ m}^2 = 100 \times 100 = 10000 \text{ cm}^2$. Then $2 \times 10000 = 20000 \text{ cm}^2$.

- 9 How many cm^2 are there in 3 m^2 ?

Answer: 30000

$1 \text{ m} = 100 \text{ cm}$, so $1 \text{ m}^2 = 100 \times 100 = 10000 \text{ cm}^2$. Then $3 \times 10000 = 30000 \text{ cm}^2$.

- 10 How many cm^2 are there in 5 m^2 ?

Answer: 50000

$1 \text{ m} = 100 \text{ cm}$, so $1 \text{ m}^2 = 100 \times 100 = 10000 \text{ cm}^2$. Then $5 \times 10000 = 50000 \text{ cm}^2$.

- 11** How many cm^2 are there in 7 m^2 ?

Answer: 70000

$1 \text{ m} = 100 \text{ cm}$, so $1 \text{ m}^2 = 100 \times 100 = 10000 \text{ cm}^2$. Then $7 \times 10000 = 70000 \text{ cm}^2$.

- 12** How many cm^2 are there in 10 m^2 ?

Answer: 100000

$1 \text{ m} = 100 \text{ cm}$, so $1 \text{ m}^2 = 100 \times 100 = 10000 \text{ cm}^2$. Then $10 \times 10000 = 100000 \text{ cm}^2$.

- 13** How many m^2 are there in 1 km^2 ?

Answer: 1000000

$1 \text{ km} = 1000 \text{ m}$, so $1 \text{ km}^2 = 1000 \times 1000 = 1000000 \text{ m}^2$. Then $1 \times 1000000 = 1000000 \text{ m}^2$.

- 14** How many m^2 are there in 2 km^2 ?

Answer: 2000000

$1 \text{ km} = 1000 \text{ m}$, so $1 \text{ km}^2 = 1000 \times 1000 = 1000000 \text{ m}^2$. Then $2 \times 1000000 = 2000000 \text{ m}^2$.

- 15** How many m^2 are there in 3 km^2 ?

Answer: 3000000

$1 \text{ km} = 1000 \text{ m}$, so $1 \text{ km}^2 = 1000 \times 1000 = 1000000 \text{ m}^2$. Then $3 \times 1000000 = 3000000 \text{ m}^2$.

- 16** How many m^2 are there in 5 km^2 ?

Answer: 5000000

$1 \text{ km} = 1000 \text{ m}$, so $1 \text{ km}^2 = 1000 \times 1000 = 1000000 \text{ m}^2$. Then $5 \times 1000000 = 5000000 \text{ m}^2$.

- 17** How many m^2 are there in 7 km^2 ?

Answer: 7000000

$1 \text{ km} = 1000 \text{ m}$, so $1 \text{ km}^2 = 1000 \times 1000 = 1000000 \text{ m}^2$. Then $7 \times 1000000 = 7000000 \text{ m}^2$.

- 18** How many m^2 are there in 10 km^2 ?

Answer: 10000000

$1 \text{ km} = 1000 \text{ m}$, so $1 \text{ km}^2 = 1000 \times 1000 = 1000000 \text{ m}^2$. Then $10 \times 1000000 = 10000000 \text{ m}^2$.

- 19** How many cm^2 are there in 100 mm^2 ?

Answer: 1

Going the other way you divide: $100 \div 100 = 1 \text{ cm}^2$.

- 20** How many cm^2 are there in 200 mm^2 ?

Answer: 2

Going the other way you divide: $200 \div 100 = 2 \text{ cm}^2$.

- 21** How many cm^2 are there in 400 mm^2 ?

Answer: 4

Going the other way you divide: $400 \div 100 = 4 \text{ cm}^2$.

- 22** How many cm^2 are there in 600 mm^2 ?

Answer: 6

Going the other way you divide: $600 \div 100 = 6 \text{ cm}^2$.

- 23** How many m^2 are there in 10000 cm^2 ?

Answer: 1

Going the other way you divide: $10000 \div 10000 = 1 \text{ m}^2$.

- 24 How many m^2 are there in 20000 cm^2 ?

Answer: 2

Going the other way you divide: $20000 \div 10000 = 2 \text{ m}^2$.

- 25 How many m^2 are there in 40000 cm^2 ?

Answer: 4

Going the other way you divide: $40000 \div 10000 = 4 \text{ m}^2$.

- 26 How many m^2 are there in 60000 cm^2 ?

Answer: 6

Going the other way you divide: $60000 \div 10000 = 6 \text{ m}^2$.

- 27 How many km^2 are there in 1000000 m^2 ?

Answer: 1

Going the other way you divide: $1000000 \div 1000000 = 1 \text{ km}^2$.

- 28 How many km^2 are there in 2000000 m^2 ?

Answer: 2

Going the other way you divide: $2000000 \div 1000000 = 2 \text{ km}^2$.

- 29 How many km^2 are there in 4000000 m^2 ?

Answer: 4

Going the other way you divide: $4000000 \div 1000000 = 4 \text{ km}^2$.

- 30 How many km^2 are there in 6000000 m^2 ?

Answer: 6

Going the other way you divide: $6000000 \div 1000000 = 6 \text{ km}^2$.

- 31 How many square metres are there in 1 hectare?

Answer: 10000

A hectare is a square 100 m by 100 m, so $1 \text{ ha} = 100 \times 100 = 10000 \text{ m}^2$. Then $1 \times 10000 = 10000 \text{ m}^2$.

- 32 How many square metres are there in 2 hectares?

Answer: 20000

A hectare is a square 100 m by 100 m, so $1 \text{ ha} = 100 \times 100 = 10000 \text{ m}^2$. Then $2 \times 10000 = 20000 \text{ m}^2$.

- 33 How many square metres are there in 3 hectares?

Answer: 30000

A hectare is a square 100 m by 100 m, so $1 \text{ ha} = 100 \times 100 = 10000 \text{ m}^2$. Then $3 \times 10000 = 30000 \text{ m}^2$.

- 34 How many square metres are there in 5 hectares?

Answer: 50000

A hectare is a square 100 m by 100 m, so $1 \text{ ha} = 100 \times 100 = 10000 \text{ m}^2$. Then $5 \times 10000 = 50000 \text{ m}^2$.

- 35 How many square metres are there in 10 hectares?

Answer: 100000

A hectare is a square 100 m by 100 m, so $1 \text{ ha} = 100 \times 100 = 10000 \text{ m}^2$. Then $10 \times 10000 = 100000 \text{ m}^2$.

- 36 How many square metres are there in 7 hectares?

Answer: 70000

A hectare is a square 100 m by 100 m, so $1 \text{ ha} = 100 \times 100 = 10000 \text{ m}^2$. Then $7 \times 10000 = 70000 \text{ m}^2$.

37 How many hectares are there in 20000 m²?

Answer: 2

Divide by 10000: $20000 \div 10000 = 2$ ha.

38 How many hectares are there in 50000 m²?

Answer: 5

Divide by 10000: $50000 \div 10000 = 5$ ha.

39 How many hectares are there in 80000 m²?

Answer: 8

Divide by 10000: $80000 \div 10000 = 8$ ha.

40 How many hectares are there in 120000 m²?

Answer: 12

Divide by 10000: $120000 \div 10000 = 12$ ha.

41 How many hectares are there in 35000 m²?

Answer: 3.5

Divide by 10000: $35000 \div 10000 = 3.5$ ha.

42 How many hectares are there in 450000 m²?

Answer: 45

Divide by 10000: $450000 \div 10000 = 45$ ha.

43 How many hectares are there in 1 km²?

Answer: 100

$1 \text{ km}^2 = 1000 \times 1000 = 1000000 \text{ m}^2$, and $1000000 \div 10000 = 100$ ha. Then $1 \times 100 = 100$ ha.

44 How many hectares are there in 2 km²?

Answer: 200

$1 \text{ km}^2 = 1000 \times 1000 = 1000000 \text{ m}^2$, and $1000000 \div 10000 = 100$ ha. Then $2 \times 100 = 200$ ha.

45 How many hectares are there in 5 km²?

Answer: 500

$1 \text{ km}^2 = 1000 \times 1000 = 1000000 \text{ m}^2$, and $1000000 \div 10000 = 100$ ha. Then $5 \times 100 = 500$ ha.

46 How many hectares are there in 0.5 km²?

Answer: 50

$1 \text{ km}^2 = 1000 \times 1000 = 1000000 \text{ m}^2$, and $1000000 \div 10000 = 100$ ha. Then $0.5 \times 100 = 50$ ha.

B · Reasoning — Why the factor is squared, and which unit to choose.

47 Why is 1 m² equal to 10 000 cm² and not 100 cm²?

- ☐ Because metres are big
- ☐ Because both sides are multiplied by 100, so the area is multiplied by 100×100
- ☐ It is a mistake
- ☐ Because of the metric system

Answer: Because both sides are multiplied by 100, so the area is multiplied by 100×100

The length factor gets squared. This single idea explains every area conversion there is.

48 1 cm = 10 mm. So 1 cm² = ...

- ☐ 10 mm²
- ☐ 20 mm²
- ☐ 100 mm²
- ☐ 1000 mm²

Answer: 100 mm²

10 × 10 = 100. Picture a 1 cm square divided into a 10 by 10 grid of millimetre squares.

49 A hectare is ...

- ☐ 100 m²
- ☐ 1000 m²
- ☐ 10 000 m²
- ☐ 100 000 m²

Answer: 10 000 m²

A square 100 m by 100 m — roughly two football pitches.

50 Which unit would you use for the area of a farm?

- ☐ mm²
- ☐ cm²
- ☐ m²
- ☐ hectares

Answer: hectares

Farms are measured in hectares precisely because m² would run to hundreds of thousands.

51 Which unit would you use for the area of a postage stamp?

- ☐ mm²
- ☐ m²
- ☐ hectares
- ☐ km²

Answer: mm²

Small object, small unit — the numbers stay sensible.

52 Is 1 km² equal to 1000 m²?

- ☐ Yes
- ☐ No

Answer: No

It is 1000 × 1000 = 1 000 000 m². Squaring catches people out every time.

53 Going from a big unit to a small one, the number ...

- ☐ gets smaller
- ☐ gets bigger
- ☐ stays the same
- ☐ it depends

Answer: gets bigger

It takes many small squares to fill one big one, so multiply.

54 Going from a small unit to a big one, you ...

- ☐ multiply
- ☐ divide
- ☐ add
- ☐ subtract

Answer: divide

Fewer big squares are needed, so the number falls.

55 1 km² is how many hectares?

- ☐ 10
- ☐ 100
- ☐ 1000
- ☐ 10 000

Answer: 100

$1\,000\,000 \div 10\,000 = 100$.

56 Does the area conversion factor equal the length conversion factor?

- ☐ Yes
- ☐ No

Answer: No

It is the length factor squared. $1\text{ m} = 100\text{ cm}$ but $1\text{ m}^2 = 10\,000\text{ cm}^2$.

C · Challenge — Mixed units, and areas that need converting first.

57 A rectangle is 2 m by 50 cm. What is its area, in square metres?

Answer: 1

Convert first: $50\text{ cm} = 0.5\text{ m}$. Then $2 \times 0.5 = 1\text{ m}^2$.

58 A rectangle is 2 m by 50 cm. What is its area, in square centimetres?

Answer: 10000

In centimetres it is 200 cm by 50 cm, so $200 \times 50 = 10000\text{ cm}^2$. That agrees with $1\text{ m}^2 = 10000\text{ cm}^2$.

59 A field is 300 m by 200 m. What is its area, in hectares?

Answer: 6

$300 \times 200 = 60000\text{ m}^2$, and $60000 \div 10000 = 6\text{ ha}$.

60 A tile is 15 cm by 20 cm. What is its area, in square millimetres?

Answer: 30000

$15 \times 20 = 300\text{ cm}^2$, and $300 \times 100 = 30000\text{ mm}^2$.

61 A farm covers 4.5 km². How many hectares is that?

Answer: 450

$4.5 \times 100 = 450\text{ ha}$.

62 A room is 4 m by 3 m. How many 20 cm by 20 cm tiles cover it?

Answer: 300

The room is $12\text{ m}^2 = 120000\text{ cm}^2$. Each tile is $20 \times 20 = 400\text{ cm}^2$, and $120000 \div 400 = 300$ tiles.

63 A garden is 2500 m². What fraction of a hectare is that? Give the answer as a decimal.

Answer: 0.25

$2500 \div 10000 = 0.25\text{ ha}$.

D · Word problems — Farms, parks, screens and solar panels.

- 64** A farmer owns 3 fields of 2 ha, 3 ha and 5 ha. How many square metres does he own altogether?

Answer: 100000

$2 + 3 + 5 = 10$ ha, and $10 \times 10000 = 100000 \text{ m}^2$.

- 65** A nature reserve is 12 km^2 . How many hectares is that?

Answer: 1200

$12 \times 100 = 1200$ ha.

- 66** A phone screen is 7 cm by 15 cm. What is its area, in square millimetres?

Answer: 10500

$7 \times 15 = 105 \text{ cm}^2$, and $105 \times 100 = 10500 \text{ mm}^2$.

- 67** A city park is $45\,000 \text{ m}^2$. How many hectares is that?

Answer: 4.5

$45000 \div 10000 = 4.5$ ha.

- 68** A sheet of paper is 210 mm by 297 mm. What is its area, in square millimetres?

Answer: 62370

$210 \times 297 = 62370 \text{ mm}^2$. This is A4.

- 69** A carpet is 5 m by 4 m. What is its area, in square centimetres?

Answer: 200000

$5 \times 4 = 20 \text{ m}^2$, and $20 \times 10000 = 200000 \text{ cm}^2$.

- 70** Land costs \$8 per square metre. What does 0.5 ha cost, in dollars?

Answer: 40000

$0.5 \text{ ha} = 5000 \text{ m}^2$, and $5000 \times 8 = 40000$ dollars.

- 71** A solar farm covers $80\,000 \text{ m}^2$. Each panel needs 2 m^2 . How many panels fit?

Answer: 40000

$80000 \div 2 = 40000$ panels. That is 8 hectares of land.