The Singapore Syllabus

ALIGNED TO THE LATEST 2027 EDITION MOE SYLLABUS

Secondary 2 Mathematics

ASSESSMENT BOOK



- **Notes** with worked examples
- **Practice questions** with marks shown
- **Answers** with full working
- **A full practice exam** with mark scheme

11 chapters **391** pages **247** questions

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CHAPTER 1

Map Scales, Direct and Inverse Proportion

Part 1: Notes and Worked Examples



In the notes

12 ideas. Read each idea and its worked example, then try the Try This question before you check its answer. The practice questions start on page 17.

- Map Scales: the Ratio 1 : n and Distances
- Areas on Maps
- Scale Drawings, Models and Floor Plans
- Direct Proportion
- Recognising Direct Proportion: Tables and Graphs
- Direct Proportion to a Power or a Root
- Inverse Proportion
- Inverse Proportion to a Power or a Root
- Changing One Variable: Percentage Change and Ratio
- Workers and Time
- Common Mistakes
- Formulas to Remember

Name: _____ Class: _____ Date: _____

SECONDARY 2 · MATHEMATICS · MAP SCALES AND PROPORTION

Map Scales, Direct and Inverse Proportion

Theory and worked examples

Map Scales: the Ratio 1 : n and Distances

A map scale compares a length on the map with the actual length on the ground. It may be written as a statement, such as '1 cm to 2 km' (1 cm represents 2 km), or as a ratio 1 : n with no units. The ratio 1 : n means that 1 cm on the map represents n cm on the ground. To change one form into the other, write both lengths in the same unit.

KEY IDEA

In 1 : n both numbers are in the same unit, usually cm. To change km to cm, multiply by 100 000.

- Units: 1 km = 1000 m = 100 000 cm and 1 m = 100 cm.
- Statement to ratio: 1 cm to 2 km. 2 km = 200 000 cm, so the scale is 1 : 200 000.
- Ratio to statement: 1 : 50 000. 1 cm represents 50 000 cm = 500 m = 0.5 km.
- Map distance to actual distance: multiply by the length that 1 cm represents. Actual distance to map distance: divide by it.
- A model or scale drawing works the same way. For a model car made to a scale of 1 : 20, each length on the model is $\frac{1}{20}$ of the real length.

WORKED EXAMPLE

On a map, 6 cm represents 1.5 km. (a) Express the scale of the map in the form 1 : n. (b) The distance between two bus interchanges is 4.2 km. Find the distance between them on the map. (c) A canal is 9.4 cm long on the map. Find its actual length in kilometres.

1. (a) 1.5 km = 1.5 × 100 000 = 150 000 cm.
2. 6 : 150 000 = 1 : 25 000 (divide both by 6).
3. (b) 1 cm represents 25 000 cm = 0.25 km.
4. Map distance = 4.2 ÷ 0.25 = 16.8 cm.
5. (c) Actual length = 9.4 × 0.25 = 2.35 km.

(a) 1 : 25 000 (b) 16.8 cm (c) 2.35 km

TRY THIS

A map has a scale of 1 : 80 000. Find the actual distance, in kilometres, represented by 5.5 cm on the map.

Answer: 4.4 km

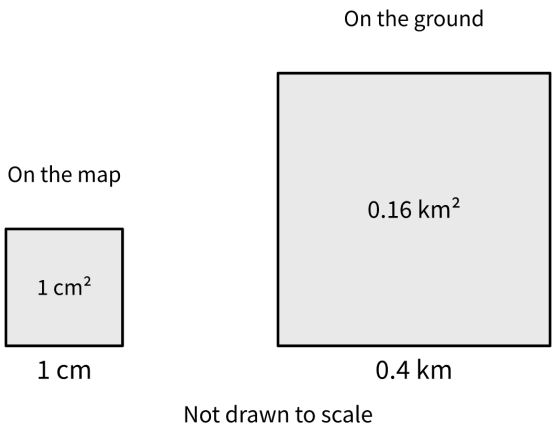
Areas on Maps

Area is length × length, so the area scale is the square of the length scale. If 1 cm on a map represents k km, then a 1 cm by 1 cm square on the map represents a k km by k km square on the ground: 1 cm² represents k^2 km².

KEY IDEA

Length scale 1 cm : k km gives area scale 1 cm² : k^2 km². Square the length scale before you use it on an area.

- Scale 1 : 40 000: 1 cm represents 0.4 km, so 1 cm² represents $0.4^2 = 0.16$ km².
- Map area to actual area: multiply by k^2. Actual area to map area: divide by k^2.
- Area units: 1 km² = 1 000 000 m², 1 m² = 10 000 cm² and 1 hectare = 10 000 m².
- Given an area statement such as '4 cm² represents 36 km²', first find what 1 cm² represents (9 km²), then take the square root to get the length scale (1 cm represents 3 km).



WORKED EXAMPLE

A map is drawn to a scale of 1 : 40 000. (a) A reservoir has an area of 5.5 cm² on the map. Find its actual area in km². (b) On a second map, the same reservoir has an area of 22 cm². Find the scale of the second map in the form 1 : n.

1. 1 cm represents 40 000 cm = 0.4 km, so 1 cm² represents $0.4^2 = 0.16$ km².
2. (a) Actual area = 5.5 × 0.16 = 0.88 km².
3. (b) On the second map, 22 cm² represents 0.88 km².
4. 1 cm² represents 0.88 ÷ 22 = 0.04 km².
5. 1 cm represents $\sqrt{0.04}$ = 0.2 km = 20 000 cm.
6. The scale is 1 : 20 000.

(a) 0.88 km² (b) 1 : 20 000

TRY THIS

On a map, 2 cm² represents 18 km². Express the scale of the map in the form 1 : n.

Answer: 1 : 300 000

Scale Drawings, Models and Floor Plans

A floor plan, a scale drawing and a model are all 'maps' of a smaller object, so the same rules apply: lengths use the length scale and areas use its square. For rooms and buildings it is easier to work in metres: a scale of 1 : 50 means 1 cm represents 50 cm = 0.5 m.

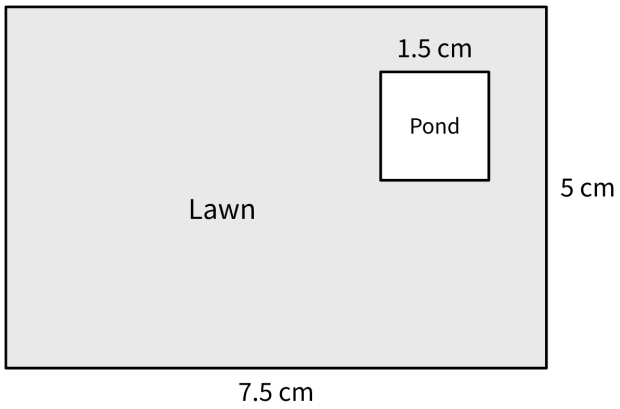
KEY IDEA

Lengths: × n. Areas: × n^2. Do the area on the plan first, then convert it once.

- Model built to 1 : 200: 1 cm represents 2 m, so 1 cm² represents 4 m².
- The actual object is the larger one: an actual length is n times the model length.
- To check a claim or work out a cost, find the actual area first, in the unit used by the claim or the price.

WORKED EXAMPLE

The plan of a garden is drawn to a scale of 1 : 400. On the plan, the rectangular lawn measures 7.5 cm by 5 cm, and inside it is a square pond of side 1.5 cm. (a) Find the actual length and breadth of the lawn. (b) Turf is laid on the lawn but not on the pond. Find the actual area to be turfed. (c) Turf costs \$12 per m². Find the cost of the turf.



Not drawn to scale

1. 1 cm represents 400 cm = 4 m, so 1 cm² represents $4^2 = 16$ m².
2. (a) Length = $7.5 \times 4 = 30$ m and breadth = $5 \times 4 = 20$ m.
3. (b) Area on the plan = $7.5 \times 5 - 1.5^2 = 37.5 - 2.25 = 35.25$ cm².
4. Actual area = $35.25 \times 16 = 564$ m².
5. (c) Cost = $564 \times \$12 = \$6768$.

(a) 30 m by 20 m (b) 564 m² (c) \$6768

TRY THIS

A model of a building is made to a scale of 1 : 200. The roof of the model has an area of 150 cm². Find the actual area of the roof in m².

Answer: 600 m²

Direct Proportion

y is directly proportional to x, written $y \propto x$, when $y = kx$ for some constant k ($k \neq 0$). The number k is the constant of proportionality. When x is doubled, y is doubled; when x is halved, y is halved. The quotient $\frac{y}{x}$ is always k.

KEY IDEA

$y \propto x$ means $y = kx$. Find k from the given pair, then write the equation with the number in place of k.

Name: _____ Class: _____ Date: _____

SECONDARY 2 · MATHEMATICS · MAP SCALES AND PROPORTION

Map Scales, Direct and Inverse Proportion

INSTRUCTIONS

- 21 questions, 65 marks in total.
- Answer all questions in the spaces provided.
- Show your working clearly. Marks are given for correct working.

Section A: Short Questions

1 On a map, 5 cm represents 2 km. Express the scale of the map in the form 1 : n.

Ans: _____ [1]

2 A map is drawn to a scale of 1 : 60 000. The distance between two schools on the map is 7.5 cm. Find the actual distance between the schools, in kilometres.

Ans: _____ km [1]

3 A map has a scale of 1 : 150 000. The actual distance between two towns is 18 km. Find the distance between the towns on the map.

Ans: _____ cm [1]

4 It is given that y is directly proportional to x, and that y = 21 when x = 6. Find the value of y when x = 10.

Ans: _____ [2]

5 It is given that y is inversely proportional to x, and that y = 9 when x = 4. Find the value of x when y = 12.

Ans: _____ [2]

6 A stall sells 4 bottles of juice for $5.60 and 10 bottles of the same juice for $13.50. Is the cost directly proportional to the number of bottles bought? Justify your answer.

[2]

7 It takes 6 cleaners 15 hours to clean an exhibition hall. How many hours would 9 cleaners take to clean the same hall, if they all work at the same rate?

Ans: _____ hours [2]

8 It is given that y is inversely proportional to x^2, and that y = 6 when x = 4. Find the value of y when x = 3.

Ans: _____ [2]

Chapter 1: Map Scales, Direct and Inverse Proportion (Answer Key)

21 questions, 65 marks. M: method mark, A: answer mark, B: mark for the answer alone.

1. 1 : 40 000 **[1]**

B1 1 : 40 000 (2 km = 200 000 cm; 5 : 200 000)

2. 4.5 km **[1]**

B1 $7.5 \times 60\,000 = 450\,000$ cm = 4.5 km

3. 12 cm **[1]**

B1 1 cm represents 1.5 km; $18 \div 1.5 = 12$ cm

4. 35 **[2]**

M1 $21 = 6k$, $k = 3.5$ ($y = 3.5x$)

A1 35

5. 3 **[2]**

M1 $9 = \frac{k}{4}$, $k = 36$ ($xy = 36$)

A1 3

6. No. Cost of 1 bottle: \$5.60 ÷ 4 = \$1.40 and \$13.50 ÷ 10 = \$1.35. The cost per bottle is not the same, so the cost is not directly proportional to the number of bottles. **[2]**

M1 both costs per bottle, \$1.40 and \$1.35 (or equivalent comparison)

A1 No, with the reason

7. 10 hours **[2]**

M1 $6 \times 15 = 90$ cleaner-hours

A1 $90 \div 9 = 10$ hours

8. $\frac{32}{3} = 10\frac{2}{3}$ **[2]**

M1 $6 = \frac{k}{16}$, $k = 96$

A1 $\frac{96}{9} = 10\frac{2}{3}$

9. Disagree. The graph is a straight line, but it does not pass through the origin: when $t = 0$, $C = 5$, not 0. (Also, when t is doubled from 1 to 2, C goes from 9 to 13, not 18.) **[2]**

B1 Disagree

B1 the line does not pass through the origin ($C = 5$ when $t = 0$)