



BRITISH LEARNING CENTRE

PEARSON EDEXCEL INTERNATIONAL GCSE · 4MA1

Mathematics

Number

Specification area 1, Numbers and the number system, of Pearson Edexcel International GCSE Mathematics A (4MA1) for Foundation and Higher tiers: key knowledge, practice, original exam-style questions and full mark schemes.

Name:

Key knowledge · Practice · Exam-style questions · Mark schemes

How to use this workbook

1

Key knowledge

Read the notes, worked examples and common mistakes.

2

Practice

Build the skill on Sheet A.

3

Exam-style

Answer exam-style questions on Sheet B. Marks are shown in [].

4

Check & reflect

Mark your work with the mark scheme, then colour the tracker.

My progress tracker

Colour each row: **Red** = not yet · **Amber** = nearly · **Green** = secure.

#	Spec ref	Topic · I can...	R	A	G
1	1.1 Foundation & Higher	Integers: primes, HCF and LCM I can use factors, multiples and primes and find the HCF and LCM of numbers.			
2	1.2 Foundation & Higher	Fractions I can calculate with fractions and mixed numbers and use fractions in problems.			
3	1.3 Foundation & Higher	Decimals and recurring decimals I can calculate with decimals and convert between fractions and terminating or recurring decimals.			
4	1.4 Foundation & Higher	Powers and roots I can work with powers and roots and use index laws, including negative and fractional indices.			
5	1.4 Higher	Surds I can simplify surds, expand brackets containing surds and rationalise denominators.			
6	1.5 Foundation & Higher	Set language and notation I can use set notation and Venn diagrams to describe and solve problems.			
7	1.6 Foundation & Higher	Percentages I can find percentages of amounts, percentage changes, profit, loss and simple interest.			
8	1.6 Foundation & Higher	Repeated change and reverse percentages I can solve compound interest, depreciation, repeated change and reverse percentage problems.			
9	1.7 Foundation & Higher	Ratio and proportion I can simplify and use ratios, share in a ratio and solve proportion and scale problems.			
10	1.8 Foundation & Higher	Degree of accuracy and bounds I can round, estimate, write error intervals and, for Higher, calculate with bounds.			
11	1.9 Foundation & Higher	Standard form I can convert to and from standard form and calculate with numbers in standard form.			
12	1.10, 1.11 Foundation & Higher	Applying number and using a calculator I can solve everyday problems with units, time, money and speed and use a calculator efficiently.			



CHECK

Starting point check

Starting point check

Name _____ Date _____ Score _____ / 12

Answer these questions to find out what you already know. You may use a calculator.

1 Express 60 as a product of its prime factors.

2 Find the LCM of 8 and 12.

3 Work out $3/4 - 2/5$.

4 Write 0.36 as a fraction in its simplest form.

5 Work out 4^3 .

6 $E = \{1, 2, \dots, 8\}$, $A = \{1, 2, 3\}$, $B = \{2, 4, 6, 8\}$. List $A \cap B$.

7 Find 15% of 340.

8 Share 56 in the ratio 3 : 4.

9 Round 0.083 62 to 2 significant figures.

10 Write 52 000 in standard form.

11 Change 3.5 hours into minutes.

12 (Higher) Simplify $\sqrt{50}$.

Integers: primes, HCF and LCM

I can... use factors, multiples and primes and find the HCF and LCM of numbers.

Spec ref: 1.1 · Foundation & Higher

A **factor** divides into a number exactly; a **multiple** is in its times table. Every integer greater than 1 can be written as a product of **prime factors**. A Venn diagram of the prime factors gives the HCF and LCM quickly.

Key points

- Prime numbers to know: 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, ... (2 is the only even prime).
- HCF (highest common factor): the biggest number that divides into both.
- LCM (lowest common multiple): the smallest number both divide into.
- Words such as 'next time together' usually need the LCM; 'largest equal pieces' usually needs the HCF.

Key words

factor

multiple

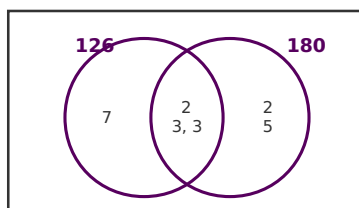
prime factor

HCF

LCM

Worked example

Find the HCF and the LCM of 126 and 180.



$$126 = 2 \times 3 \times 3 \times 7 \text{ and } 180 = 2 \times 2 \times 3 \times 3 \times 5$$

Put the shared primes (2, 3, 3) in the overlap of a Venn diagram.

$$\text{HCF} = \text{product of the overlap} = 2 \times 3 \times 3 = \mathbf{18}$$

$$\text{LCM} = \text{product of everything in the diagram} = 7 \times 2 \times 3 \times 3 \times 2 \times 5 = \mathbf{1260}$$

Common mistakes

- Stopping a factor tree at a number that is not prime, e.g. $588 = 4 \times 147$.
- Giving a common factor that is not the highest one.

Exam tip: In a 'product of prime factors' answer, write the primes with $\times$ signs (or in index form), not as a list.

Answer each question. Show working where it helps.

1 Express 168 as a product of its prime factors.

2 Express 245 as a product of its prime factors.

3 Express 432 as a product of its prime factors.

4 Express 990 as a product of its prime factors.

5 Find the HCF of 60 and 84.

6 Find the HCF of 45 and 75.

7 Find the LCM of 12 and 20.

8 Find the LCM of 14 and 21.

9 Write down all the factors of 48.

10 Write down the first five multiples of 13.

11 Is 57 a prime number? Give a reason.

12 List the prime numbers between 60 and 80.

13 Which of 64, 81, 100, 125 is both a square number and a cube number?

14 Work out the sum of the first four prime numbers.

15 77 is the product of two prime numbers. Find them.

16 Find the HCF of $2^3 \times 3^2 \times 5$ and $2^2 \times 3^3$. Leave it in index form.

17 Find the LCM of $2^3 \times 3^2 \times 5$ and $2^2 \times 3^3$. Leave it in index form.

18 Write $2^2 \times 3 \times 5^2$ as an ordinary number.

19 Find the smallest number that 2, 3, 4, 5 and 6 all divide into exactly.

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Answer all questions. Write your answers in the spaces provided. You must write down all the stages in your working.

- 1 (a) Express 588 as a product of its prime factors. Show your working clearly. [2]

Answer

- (b) Find the highest common factor (HCF) of 588 and 210. [2]

Answer

- (c) Find the lowest common multiple (LCM) of 588 and 210. [2]

Answer

- 2 A minibus leaves a hotel for the airport every 15 minutes.
A minibus leaves the same hotel for the market every 36 minutes.
Both minibuses leave the hotel at 07 30.

- (a) When is the next time both minibuses leave the hotel together? [3]

Answer

- (b) When is the next time after that? [1]

- 3 Paper cups are sold in packs of 24. Paper plates are sold in packs of 40.
Lina wants to buy exactly the same number of cups and plates.

- (a) Find the smallest number of packs of cups and the smallest number of packs of plates she can buy. [3]

Answer cups plates

- (b) How many cups does she buy? [1]

- 4 Two pieces of ribbon are 360 cm and 420 cm long.
Both pieces are cut into equal lengths with nothing left over. Each length is as long as possible.

Find the length of each piece and the total number of pieces.

[3]

Answer length cm pieces

- 5 (a) $2^x \times 3^y = 648$. Find the value of x and the value of y .

[2]

Answer $x = \dots\dots\dots$ $y = \dots\dots\dots$

- (b) $N = 2^3 \times 5 \times 7^2$. Find the smallest whole number m such that $N \div m$ is a square number.

[2]

Answer $m = \dots\dots\dots$

- 6 Here is a list of numbers: 21 22 23 24 25 26 27 28
From the list, write down

(a) a prime number, [1]

(b) a number that is a multiple of both 4 and 7, [1]

(c) a square number, [1]

(d) a cube number. [1]

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Fractions

I can... calculate with fractions and mixed numbers and use fractions in problems.

Spec ref: 1.2 · Foundation & Higher

You can use a calculator in every 4MA1 paper, but many questions say '**Show that...**'. Then you must show each step of the fraction working, not just the answer.

Key points

- Equivalent fractions: multiply or divide the top and bottom by the same number.
- Add or subtract: write with a common denominator first.
- Multiply: top $\times$ top and bottom $\times$ bottom (cancel first if you can).
- Divide: multiply by the reciprocal of the second fraction.

Key words

numerator

denominator

mixed number

improper fraction

reciprocal

Worked example 1

Show that $1\frac{2}{3} + 2\frac{3}{4} = 4\frac{5}{12}$.

Improper fractions: $\frac{5}{3} + \frac{11}{4}$

Common denominator 12: $\frac{20}{12} + \frac{33}{12} = \frac{53}{12}$

$\frac{53}{12} = 4\frac{5}{12}$ ✓

Worked example 2

Find $\frac{3}{8}$ of 96 kg.

$96 \div 8 = 12$, then $12 \times 3 = 36$ kg

Common mistakes

- Adding the denominators: $\frac{3}{10} + \frac{2}{5} \neq \frac{5}{15}$.
- Dividing mixed numbers without changing them into improper fractions first.

Exam tip: In a 'show that' question, the last line must be the exact result you were asked to show.

Answer each question. Show working where it helps.**1** Simplify $18/48$.**2** $3/5 = \square / 40$ **3** Find $5/6$ of 42.**4** Write $23/7$ as a mixed number.**5** Write $4 \frac{3}{5}$ as an improper fraction.**6** Write in order, smallest first: $2/3$, $5/8$, $7/12$ **7** $3/10 + 2/5 = \square$ **8** $7/8 - 1/6 = \square$ **9** $2 \frac{1}{3} - 1 \frac{5}{6} = \square$ **10** $5/12 \times 9/10 = \square$ **11** $7/9 \div 14/15 = \square$ **12** $3 \frac{3}{4} \div 5 = \square$ **13** $2 \frac{2}{5} \times 1 \frac{1}{4} = \square$ **14** $1 - (1/4 + 1/3) = \square$ **15** Write 24 as a fraction of 60 in its simplest form. **16** Write down the reciprocal of $3 \frac{1}{2}$.**17** What fraction of an hour is 45 minutes?**18** What fraction of 2 kg is 350 g? **19** Find the fraction halfway between $1/3$ and $1/2$. **20** Write 0.375 as a fraction in its simplest form. Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Answer all questions. Write your answers in the spaces provided. You must write down all the stages in your working.

- 1 Show that $3\frac{1}{4} - 1\frac{5}{6} = 1\frac{5}{12}$ [3]

- 2 Show that $2\frac{4}{7} \times 1\frac{1}{6} = 3$ [3]

- 3 Show that $4\frac{1}{2} \div 2\frac{5}{8} = 1\frac{5}{7}$ [3]

- 4 There are 840 students in a school.
 $\frac{3}{8}$ of the students walk to school. $\frac{2}{5}$ of the students come by bus. The rest come by car.

- (a) Work out the number of students who come by car. [3]

Answer

- (b) $\frac{4}{9}$ of the students who walk are in Year 7. How many of the students who walk are in Year 7? [2]

Answer

- (c) What fraction of the students who walk are **not** in Year 7? [1]

- 5 A water tank is $\frac{3}{4}$ full. 72 litres of water are used. The tank is now $\frac{5}{12}$ full.

- (a) Work out the capacity of the tank. [3]

Answer litres

- (b) Water is then added at 9 litres per minute. How long does it take to fill the tank? [2]

Answer minutes

6 Here are four fractions: $\frac{5}{9}$ $\frac{4}{7}$ $\frac{11}{20}$ $\frac{13}{24}$

(a) Write the fractions in order of size. Start with the smallest.

[2]

Answer

(b) Find the fraction that is exactly halfway between $\frac{4}{7}$ and $\frac{5}{9}$.

[2]

Answer

(c) Work out $\frac{4}{7} - \frac{5}{9}$

[1]

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Decimals and recurring decimals

I can... calculate with decimals and convert between fractions and terminating or recurring decimals.

Spec ref: 1.3 · Foundation & Higher

A fraction in its simplest form gives a **terminating** decimal only when its denominator has no prime factors except 2 and 5. Otherwise the decimal **recurs**, e.g. $2/11 = 0.181818...$

Key points

- To order decimals, give them the same number of decimal places: $0.45 = 0.450 > 0.405$.
- To divide by a decimal, multiply both numbers by a power of 10 first: $17.6 \div 0.08 = 1760 \div 8$.
- *Higher*: to convert a recurring decimal, multiply by 10, 100 or 1000 so the repeating parts line up, then subtract.

Key words

place value

terminating decimal

recurring decimal

prove algebraically

Worked example 1

Write $9/40$ as a decimal. Explain why it terminates.

$$9 \div 40 = \mathbf{0.225}$$

$40 = 2^3 \times 5$: the denominator has no prime factors other than 2 and 5, so the decimal terminates.

Worked example 2

(Higher) Prove algebraically that $0.454545... = 5/11$.

Let $x = 0.454545...$ so $100x = 45.454545...$

Subtract: $99x = 45$, so $x = 45/99 = \mathbf{5/11}$

Common mistakes

- Thinking $0.307 > 0.37$ because it has more digits.
- Using $10x$ when two digits repeat — you need $100x$.

Exam tip: 'Prove algebraically' means you must start with $x = ...$ and show the subtraction, not just divide on a calculator.

Answer each question. Show working where it helps.

1 $3.4 \times 0.06 =$

2 $0.84 \div 0.4 =$

3 $12.5 - 3.68 =$

4 $0.7 \times 0.7 =$

5 Order, smallest first: 0.45, 0.405, 0.5, 0.045

6 Write $5/16$ as a decimal.

7 Write $2/11$ as a recurring decimal.

8 Write 0.0125 as a fraction in its simplest form.

9 Does $7/40$ give a terminating or a recurring decimal?

10 Does $5/12$ give a terminating or a recurring decimal?

11 Write $1/3 + 0.25$ as a decimal.

12 Write 2.07 as a mixed number.

13 (Higher) Write 0.8333... as a fraction.

14 (Higher) Write 0.123123... as a fraction.

15 (Higher) Write 1.090909... as an improper fraction.

16 (Higher) Write 0.2181818... as a fraction.

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Answer all questions. Write your answers in the spaces provided. You must write down all the stages in your working.

1 (a) Write these numbers in order of size. Start with the smallest.
0.307 0.37 0.3 0.073 0.317 [1]

(b) Work out 2.65×0.4 [1]

(c) Work out $17.6 \div 0.08$ [1]

(d) Work out $0.3^2 - 0.03$ [1]

2 (a) Write $7/8$ as a decimal. [1]

(b) Write $5/33$ as a recurring decimal. [1]

(c) Without dividing, explain why $9/40$ is a terminating decimal. [1]

(d) Which one of $3/20$, $4/15$, $7/64$ gives a recurring decimal? [1]

3 (Higher)

(a) Prove algebraically that the recurring decimal $0.272727\ldots$ can be written as $3/11$. [2]

(b) Hence write $0.0272727\ldots$ as a fraction in its simplest form. [1]

4 (Higher)

(a) Prove algebraically that the recurring decimal $0.3181818\ldots$ can be written as $7/22$. [3]

(b) Hence write $2.3181818\ldots$ as an improper fraction. [1]

5 (Higher)

(a) Express $1.2333\ldots$ as a mixed number in its simplest form. [3]

Answer

(b) Given that $0.090909\ldots = 1/11$, write $0.454545\ldots$ as a fraction in its simplest form. [1]

6 A builder buys 3.75 m of pipe at \$4.80 per metre and 12 brackets at \$0.65 each.

(a) He pays with a \$50 note. Work out how much change he should get.

[3]

Answer \$

(b) The price of the pipe increases by \$0.35 per metre. Work out the new cost of 3.75 m of pipe. Give your answer to the nearest cent.

[2]

Answer \$

(c) He cuts 13.5 m of cable into 6 equal pieces. How long is each piece?
m

.....

[1]

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Powers and roots

I can... work with powers and roots and use index laws, including negative and fractional indices.

Spec ref: 1.4 · Foundation & Higher

Powers show repeated multiplication: $6^3 = 6 \times 6 \times 6 = 216$. Roots go the other way: $\sqrt[3]{216} = 6$. The index laws below only work when the base numbers are the same.

Key points

- $a^m \times a^n = a^{m+n}$ $a^m \div a^n = a^{m-n}$ $(a^m)^n = a^{mn}$
- $a^0 = 1$ and $a^{-n} = 1/a^n$.
- Higher: $a^{1/n}$ is the n th root; $a^{m/n} = (\sqrt[n]{a})^m$.
- To solve $5^{2x-1} = 125$, write both sides with the same base and compare the powers.

Key words

power (index)

root

index laws

negative index

fractional index

Worked example 1

Simplify $(3^4 \times 3^5) \div 3^6$ and work out its value.

Top: $3^4 + 5 = 3^9$. Divide: $3^9 \div 3^6 = 3^3$

Value: **27**

Worked example 2

(Higher) Find the value of $64^{-2/3}$.

Negative power $\rightarrow$ reciprocal: $1 \div 64^{2/3}$

$\sqrt[3]{64} = 4$, then $4^2 = 16$. Answer: **1/16**

Common mistakes

- Thinking $5^{-2} = -25$ (it is $1/25$).
- Multiplying the bases: $2^3 \times 2^4$ is 2^7 , not 4^7 .

Exam tip: For a negative fractional index, deal with each part in turn: the minus sign (flip), the denominator (root), the numerator (power).

Answer each question. Show working where it helps.

1 15^2

2 $\sqrt{361}$

3 6^3

4 $\sqrt[3]{1000}$

5 $(-4)^2$

6 $\sqrt{0.09}$

7 Simplify $2^7 \times 2^3$

8 Simplify $9^8 \div 9^5$

9 Simplify $(2^4)^5$

10 Simplify $(7^3 \times 7^4) \div 7^6$

11 4^0

12 6^{-1}

13 5^{-2}

14 $(1/2)^{-3}$

15 Find n : $3^n = 243$

16 (Higher) $100^{1/2}$

17 (Higher) $8^{2/3}$

18 (Higher) $81^{-1/4}$

19 (Higher) $(9/16)^{1/2}$

20 (Higher) $(27/64)^{-1/3}$

21 Use a calculator: 1.3^4

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Answer all questions. Write your answers in the spaces provided. You must write down all the stages in your working.

- 1
- (a) Find the value of $3^4 - 2^5$ [1]
- (b) Find the value of $\sqrt{3^2 + 4^2}$ [1]
- (c) Find the cube root of 2744 [1]
- (d) Write 1 000 000 as a power of 10. [1]

- 2 Simplify, giving each answer as a power.
- (a) $8^5 \times 8^3$ [1]
- (b) $5^9 \div 5^3$ [1]
- (c) $(11^2)^4$ [1]
- (d) $2^x \times 2^5 = 2^{12}$. Find the value of x . $x =$ [1]

- 3 (Higher) Find the value of
- (a) $49^{-1/2}$ [1]
- (b) $1000^{2/3}$ [1]
- (c) $0.25^{1/2}$ [1]
- (d) $(16/81)^{-3/4}$ [2]

Answer

- 4 (Higher) $8^{1/2} \times 4^3 \div 2^{-1} = 2^n$
Find the value of n . [3]

Answer $n =$

5 (Higher) Solve

(a) $5^{2x-1} = 125$

[2]

Answer $x =$

(b) $27^x = 3 \times 9^{x+2}$

[3]

Answer $x =$

6

(a) Work out $(6.4^2 - \sqrt{20.25}) \div 2.5^3$

Write down all the figures on your calculator display.

[2]

Answer

(b) Write your answer to part (a) correct to 2 significant figures.

.....

[1]

(c) Work out 1.5^{-2} . Give your answer as a fraction.

.....

[1]

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Surds

I can... simplify surds, expand brackets containing surds and rationalise denominators.

Spec ref: 1.4 · Higher

A **surd** is an irrational root such as $\sqrt{7}$. Leaving an answer as a surd keeps it **exact**. Look for the largest square factor: $\sqrt{288} = \sqrt{(144 \times 2)} = 12\sqrt{2}$.

Key points

- $\sqrt{ab} = \sqrt{a} \times \sqrt{b}$ $\sqrt{(a/b)} = \sqrt{a} \div \sqrt{b}$ $(\sqrt{a})^2 = a$
- Only like surds can be added: $2\sqrt{5} + 4\sqrt{5} = 6\sqrt{5}$.
- To rationalise $k/(a + \sqrt{b})$, multiply top and bottom by the conjugate $a - \sqrt{b}$.

Key words

surd

exact value

rationalise

conjugate

Worked example 1

Simplify $\sqrt{98} - \sqrt{32}$.

$$\sqrt{98} = \sqrt{49 \times 2} = 7\sqrt{2} \text{ and } \sqrt{32} = \sqrt{16 \times 2} = 4\sqrt{2}$$

$$7\sqrt{2} - 4\sqrt{2} = \mathbf{3\sqrt{2}}$$

Worked example 2

Rationalise the denominator of $5/(2 + \sqrt{3})$.

Multiply top and bottom by $2 - \sqrt{3}$

$$\text{Bottom: } (2 + \sqrt{3})(2 - \sqrt{3}) = 4 - 3 = 1$$

$$\text{Answer: } \mathbf{10 - 5\sqrt{3}}$$

Common mistakes

- Simplifying $\sqrt{(16 + 9)}$ as $4 + 3$.
- Rationalising and forgetting to multiply the numerator too.

Exam tip: When a question asks for 'the form $a + b\sqrt{c}$ ', give integers for a , b and c .

Answer each question. Show working where it helps.

1 Simplify $\sqrt{28}$

2 Simplify $\sqrt{63}$

3 Simplify $\sqrt{150}$

4 Simplify $\sqrt{288}$

5 Simplify $\sqrt{27} + \sqrt{48}$

6 Simplify $2\sqrt{5} + \sqrt{80}$

7 Simplify $\sqrt{2} \times \sqrt{18}$

8 Simplify $\sqrt{15} \times \sqrt{3}$

9 Simplify $(3\sqrt{2})^2$

10 Simplify $\sqrt{72} \div \sqrt{8}$

11 Rationalise $6/\sqrt{2}$

12 Rationalise $5/\sqrt{10}$

13 Rationalise $2/(3\sqrt{5})$

14 Simplify $(4 - \sqrt{3})(4 + \sqrt{3})$

15 Simplify $(\sqrt{2} + 1)^2$

16 Simplify $\sqrt{3}(2 - \sqrt{3})$

17 Simplify $(\sqrt{5} + \sqrt{2})(\sqrt{5} - \sqrt{2})$

18 Rationalise $1/(\sqrt{2} + 1)$

19 Simplify $(2\sqrt{3})^3$

20 Simplify $\sqrt{2 \frac{1}{4}}$

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Answer all questions. Write your answers in the spaces provided. You must write down all the stages in your working.

1 (a) Simplify $\sqrt{343}$ [1]

(b) Simplify $\sqrt{500} - \sqrt{125}$ [2]

Answer

(c) Write $\sqrt{12} \times \sqrt{15}$ in the form $a\sqrt{5}$, where a is an integer. [1]

(d) Simplify $(\sqrt{7})^3$ [1]

2 Expand and simplify

(a) $(3 + \sqrt{5})^2$ [2]

Answer

(b) $(2\sqrt{3} - 1)(\sqrt{3} + 4)$ [2]

Answer

(c) $(\sqrt{6} + \sqrt{2})(\sqrt{6} - \sqrt{2})$ [1]

3 Rationalise the denominator. Simplify your answers.

(a) $21/\sqrt{7}$ [2]

Answer

(b) $1/(2\sqrt{5})$ [1]

(c) $(\sqrt{3} + 1)/(\sqrt{3} - 1)$ [3]

Answer

4 Show that $(\sqrt{18} + \sqrt{8})^2 = 50$ [2]

- 5 A right-angled triangle has two shorter sides of length $(4 + \sqrt{3})$ cm and $(4 - \sqrt{3})$ cm.

(a) Work out the area of the triangle. Give your answer as a fraction. [2]

Answer cm²

(b) Find the length of the hypotenuse. Give your answer as a surd. [2]

Answer cm

- 6 $(a + \sqrt{3})^2 = 19 + b\sqrt{3}$, where a and b are positive integers.

Find the value of a and the value of b . [3]

Answer $a = \dots\dots\dots$ $b = \dots\dots\dots$

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Set language and notation

I can... use set notation and Venn diagrams to describe and solve problems.

Spec ref: 1.5 · Foundation & Higher

A set is a collection of members written in curly brackets, such as $\{2, 4, 6\}$. $\mathcal{E}$, the universal set, is everything being considered. Venn diagrams help you count members in each region.

Key points

- $A \cap B$: members of A **and** B. $A \cup B$: members of A **or** B (or both). A' : members of $\mathcal{E}$ not in A.
- $n(A)$ is the number of members. $\emptyset$ or $\{\}$ is the empty set.
- *Higher*: $A \subset B$ means A is a subset of B. Three-set Venn diagrams: fill the centre first.

Key words

set

member $\in$

intersection $\cap$

union $\cup$

complement A'

empty set $\emptyset$

Worked example 1

60 people were asked if they like tea (T) or coffee (C). 34 like tea, 30 like coffee and 11 like neither. How many like both?

People in $T \cup C$: $60 - 11 = 49$

Both: $34 + 30 - 49 = \mathbf{15}$. Then T only = 19, C only = 15.

Worked example 2

(Higher) List the set $\{x : x \text{ is prime, } x < 12\}$.

$\{2, 3, 5, 7, 11\}$

Common mistakes

- Counting the overlap twice when finding $n(A \cup B)$.
- Leaving out the members outside the circles.

Exam tip: When you complete a Venn diagram, check the numbers add up to $n(\mathcal{E})$.

Answer each question. Show working where it helps.

1 $\mathcal{E} = \{1, 2, \dots, 16\}$, $F = \{\text{factors of } 16\}$, $T = \{\text{multiples of } 3\}$. List F .

2 Using question 1, list T .

3 Using question 1, what is $F \cap T$?

4 Using question 1, find $n(F \cup T)$.

5 Using question 1, find $n(F')$.

6 Write $\in$ or $\notin$: 12 T

7 $G = \{\text{even numbers in } \mathcal{E}\}$. List $F \cap G$.

8 Using question 7, find $n(G \cup T)$.

9 Using question 7, list $G' \cap T$.

10 $A = \{\text{letters in BANGKOK}\}$, $B = \{\text{letters in HONG KONG}\}$. List $A \cap B$.

11 Using question 10, find $n(A \cup B)$.

12 $n(\mathcal{E}) = 35$, $n(P) = 18$, $n(Q) = 20$, $n(P \cap Q) = 9$. Find $n((P \cup Q)')$.

13 Using question 12, find $n(P \cap Q')$.

14 (Higher) List $\{x : x \text{ is a square number, } 10 < x < 70\}$.

15 (Higher) True or false: $\{3, 9\} \subset T$ (from question 1).

16 (Higher) $A \cap B = A$. What does this tell you about A and B ?

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Answer all questions. Write your answers in the spaces provided. You must write down all the stages in your working.

1 $\mathcal{E} = \{20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30\}$

$E = \{\text{even numbers}\}$ $M = \{\text{multiples of 3}\}$

(a) List the members of the set $E \cap M$ [1]

(b) Find $n(E \cup M)$ [1]

(c) Is it true that $29 \in E \cup M$? Give a reason. [1]

(d) List the members of the set $(E \cup M)'$ [1]

2 (a) On Diagram 1, shade the region $A \cap B'$. [1]

(b) On Diagram 2, shade the region $(A \cap B)'$. [1]

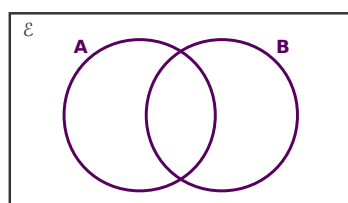


Diagram 1

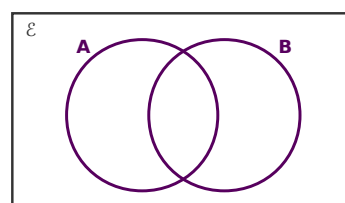


Diagram 2

(c) Describe the shaded region in Diagram 3 using set notation. [1]

(d) (Higher) Describe the shaded region in Diagram 4 using set notation. [1]

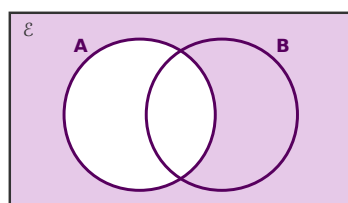


Diagram 3

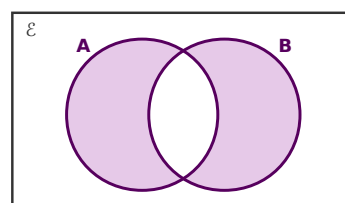
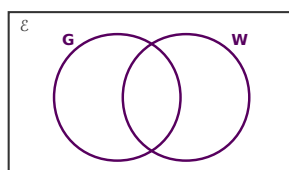


Diagram 4

Answer

3 80 tourists were asked if they had visited the Grand Palace (G) or Wat Arun (W).
47 had visited the Grand Palace, 38 had visited Wat Arun and 12 had visited neither.

(a) Complete the Venn diagram to show this information. [3]

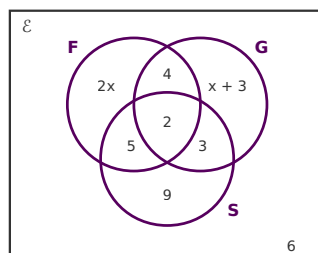


(b) How many tourists had visited exactly one of these places? [1]

(c) Find $n(G \cap W)$ [1]

- 4 (Higher) 50 students were asked which languages they study: French (F), German (G) and Spanish (S).

The Venn diagram shows the numbers of students in each region.



- (a) Find the value of x . [2]

Answer $x =$

- (b) Find $n(F)$ [1]

- (c) Find $n(F \cap G)$ [1]

- (d) Find $n((F \cup G)')$ [1]

- 5 (Higher) $A = \{x : 2 < x \leq 9, x \text{ is an integer}\}$ $B = \{x : x \text{ is a factor of } 18\}$

- (a) List the members of A [1]

- (b) List the members of $A \cap B$ [1]

- (c) Is $B \subset A$? Give a reason for your answer. [1]

- (d) Find $n(A \cup B)$ [1]

- 6 $n(E) = 52$, $n(A) = 26$, $n(B) = 19$, $n(A \cap B) = x$ and $n((A \cup B)') = 2x$.

- (a) Find the value of x . [2]

Answer $x =$

- (b) Find $n(A \cap B')$ [1]

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Percentages

I can... find percentages of amounts, percentage changes, profit, loss and simple interest.

Spec ref: 1.6 · Foundation & Higher

'Per cent' means 'out of 100'. To write one amount as a percentage of another, divide and then multiply by 100. On a calculator, the quickest way to increase or decrease by a percentage is to use a **multiplier**.

Key points

- Increase by 15%: $\times 1.15$. Decrease by 15%: $\times 0.85$.
- Percentage change = $(\text{change} \div \text{original amount}) \times 100$.
- Percentage profit or loss uses the cost price as the original amount.
- Simple interest = $\text{amount} \times \text{rate}/100 \times \text{number of years}$.

Key words

percentage

multiplier

percentage change

profit and loss

simple interest

VAT

Worked example 1

Express 54 as a percentage of 360.

$$54 \div 360 = 0.15$$

$$0.15 \times 100 = \mathbf{15\%}$$

Worked example 2

A jacket costs \$64. In a sale the price is reduced by 15%. Work out the sale price.

$$100\% - 15\% = 85\%, \text{ so the multiplier is } 0.85$$

$$64 \times 0.85 = \mathbf{\$54.40}$$

Common mistakes

- Dividing by the new amount in percentage change questions.
- Writing 4.5% as 0.45 instead of 0.045.

Exam tip: When you compare two scores, write both percentages down before you give your conclusion.

Answer each question. Show working where it helps.**1** Find 12% of 450. **2** Find 2.5% of 3600. **3** Find 120% of 35. **4** Express 27 as a percentage of 180.**5** Express 0.6 kg as a percentage of 2.4 kg. **6** Increase 640 by 15%. **7** Decrease 3.5 by 40%. **8** Write down the multiplier for an increase of 23%. **9** Write down the multiplier for a decrease of 4.5%. **10** Find the percentage change from 250 to 310. **11** Find the percentage change from 80 to 68. **12** Cost \$45, sold for \$63. Find the percentage profit. **13** Cost \$120, sold for \$102. Find the percentage loss. **14** Find the simple interest on \$2400 at 3.5% per year for 4 years. **15** Write $\frac{7}{25}$ as a percentage. **16** Write 32.5% as a decimal. **17** Tax is 17.5%. Find the tax on 2400 baht. **18** Which is bigger, $\frac{3}{8}$ or 36%? Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Answer all questions. Write your answers in the spaces provided. You must write down all the stages in your working.

- 1 An adult ticket for a water park costs 1250 baht. A child ticket costs 30% less than an adult ticket.

(a) Work out the cost of a child ticket. [2]

Answer baht

(b) A family buys 2 adult tickets and 3 child tickets. They get a 10% discount on the total cost.

Work out how much the family pays. [3]

Answer baht

- 2 Somchai scored 54 out of 72 in a test. Priya scored 41 out of 52 in a different test. Who got the higher percentage score? You must show your working. [3]

- 3 A shop adds VAT at 7% to its prices.

(a) A laptop costs 24 900 baht before VAT. Work out the price including VAT. [2]

Answer baht

(b) The VAT on a monitor is 434 baht. Work out the price of the monitor before VAT. [2]

Answer baht

- 4 Mai earns \$2400 each month. She gets a pay rise of 3.5%.

(a) Work out her new monthly pay. [2]

Answer \$

(b) She saves 15% of her new monthly pay. How much does she save in one year? [2]

Answer \$

5

(a) Kim bought some shares for \$1850 and sold them for \$2146. Work out her percentage profit. [2]

Answer %

(b) Joe bought a car for \$8500 and sold it for \$6970. Work out his percentage loss. [2]

Answer %

6 Leo invests \$3200 at $r\%$ per year **simple** interest. After 5 years he has received \$560 interest.

(a) Work out the value of r . [3]

Answer $r =$

(b) How many complete years would it take for the total interest to be at least \$1000? [2]

Answer

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Repeated change and reverse percentages

I can... solve compound interest, depreciation, repeated change and reverse percentage problems.

Spec ref: 1.6 · Foundation & Higher

When a percentage change happens again and again, use the multiplier as many times as there are changes. For a **reverse percentage**, the amount you are given is already the changed value, so you divide by the multiplier.

Key points

- Value after n years = original $\times$ (multiplier) ^{n} .
- Different changes: multiply the multipliers, e.g. $0.85 \times 0.9 \times 0.9$.
- Overall change: $1.15 \times 0.85 = 0.9775$, a 2.25% decrease.
- Original = new amount $\div$ multiplier.

Key words

compound interest

depreciation

repeated percentage change

reverse percentage

Worked example 1

\$8000 is invested at 2.75% per year compound interest. Work out its value after 3 years.

Multiplier 1.0275 for each year

$$8000 \times 1.0275^3 = 8678.316... = \text{\$8678.32}$$

Worked example 2

After a 12% decrease a price is \$4400. Work out the original price.

\$4400 is 88% of the original, so original $\times 0.88 = 4400$

$$\text{Original} = 4400 \div 0.88 = \text{\$5000}$$

Common mistakes

- Finding 22% of the sale price and adding it back on.
- Adding percentages: +15% then -15% is not 0%.

Exam tip: Write down the multiplier before you calculate — it often earns the first method mark.

Answer each question. Show working where it helps.**1**

Write down the multiplier for an increase of 4% per year for 2 years.

2

\$1500 is invested at 4% compound interest. Find the value after 2 years.

3

A machine worth \$20 000 depreciates by 12% per year. Find its value after 3 years.

4

A population of 6400 grows by 5% per year. Find it after 2 years.

5

A price rises by 3.2% and then by 2.5%. Find the overall percentage increase.

6

A price is increased by 20% and then decreased by 20%. Find the overall change.

7

After an 8% increase, a price is 1782 baht. Find the original price.

8

In a 35% off sale, a shirt costs \$52. Find the original price.

9

A price including 7% VAT is 3745 baht. Find the price before VAT.

10

After 2 years of 10% depreciation a car is worth \$8100. Find the original value.

11

\$500 is invested at 6% compound interest. After how many years is it first worth more than \$700?

12

A value starts at 1024 and is multiplied by 0.75 each year. Find it after 5 years.

13

Write down the multiplier for a decrease of 2.5% per year for 4 years.

14

Which is bigger after 3 years: \$1000 at 5% simple interest or at 5% compound interest?

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Answer all questions. Write your answers in the spaces provided. You must write down all the stages in your working.

- 1 Kiri invests 150 000 baht in a bank account. The account pays 1.8% per year compound interest.

(a) Work out the value of her investment after 4 years. Give your answer to the nearest baht.

[3]

Answer baht

(b) How much interest has she earned in total? baht [1]

- 2 Arun buys a motorbike for 68 000 baht.

In the first year its value decreases by 15%. In each of the next two years its value decreases by 10%.

Work out the value of the motorbike after 3 years. [3]

Answer baht

- 3 (a) In a sale, all prices are reduced by 22%. The sale price of a sofa is \$741.

Work out the price of the sofa before the sale. [3]

Answer \$

(b) The value of a house increased by 6% to \$371 000. Work out the value before the increase. [2]

Answer \$

- 4 At the start of 2024 the population of a town was 58 000. The population increases by 2.4% each year.

(a) Work out the population at the start of 2027. Give your answer to the nearest whole number.

[2]

Answer

(b) At the start of which year will the population first be more than 65 000?

[3]

Answer

- 5 The price of a phone is increased by 15%. The new price is then decreased by 15%. Zara says, 'The phone is now back to its original price.'
Is Zara correct? Show how you decide.

[3]

- 6 Tom invested \$5000 at $r\%$ per year compound interest. After 2 years his investment was worth \$5832.

(a) Work out the value of r .

[3]

Answer $r =$

(b) Work out the value of the investment after a further 2 years at the same rate. Give your answer to the nearest cent.

[2]

Answer \$

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Ratio and proportion

I can... simplify and use ratios, share in a ratio and solve proportion and scale problems.

Spec ref: 1.7 · Foundation & Higher

Ratios compare amounts of the same kind, in the same units.

Find the value of **one part** first, then scale up. A ratio such as 3 :

7 also tells you the fractions: $\frac{3}{10}$ and $\frac{7}{10}$.

Key points

- Form 1 : n : divide both parts by the first number.
- Sharing: total parts $\rightarrow$ one part $\rightarrow$ each share.
- Best value: compare the price of the same amount (e.g. per 100 g).
- Map scale 1 : 25 000 means 1 cm on the map is 25 000 cm (0.25 km) in real life.

Key words

ratio

proportion

unitary method

scale

best value

Worked example 1

Blue and white paint are mixed in the ratio 3 : 5. Ali uses 12 litres of blue. How much white does he use?

3 parts = 12 litres, so 1 part = 4 litres

White = $5 \times 4 =$ **20 litres** (total 32 litres)

Worked example 2

Write 25 cm : 4 m in the form 1 : n .

Same units: 25 cm : 400 cm

Divide both by 25: **1 : 16**

Common mistakes

- Using $\frac{3}{5}$ instead of $\frac{3}{8}$ for a ratio of 3 : 5.
- Not changing units before simplifying.

Exam tip: In 'show that' ratio questions, write the value of one part clearly.

Answer each question. Show working where it helps.

1 Simplify $36 : 84$

2 Simplify $2.5 \text{ kg} : 750 \text{ g}$

3 Simplify $45 \text{ min} : 2 \text{ hours}$

4 Simplify $0.6 : 1.5$

5 Simplify $3/4 : 1/6$

6 Write $5 : 8$ in the form $1 : n$.

7 Write $12 : 5$ in the form $n : 1$.

8 Share 96 in the ratio $7 : 5$.

9 Share \$2.70 in the ratio $2 : 7$.

10 Share 450 in the ratio $2 : 3 : 4$.

11 Cats : dogs = $3 : 7$. What fraction are cats?

12 Red : blue = $5 : 2$. There are 35 red. How many blue?

13 3 notebooks cost 105 baht. Find the cost of 7.

14 8 m of fabric costs \$26. Find the cost of 5 m.

15 A recipe uses 4 eggs for 6 people. How many eggs for 15 people?

16 Scale $1 : 200\,000$. Map distance 4.5 cm. Real distance?

17 Scale $1 : 50\,000$. Real distance 12 km. Map distance?

18 $A : B = 2 : 5$ and $B : C = 3 : 4$. Find $A : B : C$.

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Answer all questions. Write your answers in the spaces provided. You must write down all the stages in your working.

- 1 A salad dressing is made from oil and vinegar in the ratio 5 : 2 by volume.

(a) How much vinegar is in 350 ml of dressing? [2]

Answer ml

(b) Nok has 400 ml of oil and 150 ml of vinegar. Work out the greatest amount of dressing she can make. [3]

Answer ml

- 2 Ploy, Nam and Tan share 2730 baht in the ratio of their ages, 6 : 8 : 7.

(a) Work out how much Nam receives. [2]

Answer baht

(b) One year later they share another 2730 baht in the ratio of their new ages. Show that Tan receives the same amount as before. [2]

- 3 Coffee is sold in two sizes. A 250 g bag costs 189 baht. A 400 g bag costs 299 baht. Which bag is the better value for money? You must show your working. [3]

4 A map has a scale of 1 : 25 000.

(a) Two schools are 8.4 cm apart on the map. Work out the real distance in kilometres. [2]

Answer km

(b) Ella walks between the schools at 4.2 km/h. How many minutes does it take? [2]

Answer minutes

(c) A park is a rectangle measuring 2 cm by 1.5 cm on the map. Work out its real area in km^2 . [2]

Answer km^2

5 In a chess club the ratio of boys to girls is 4 : 5.

6 more boys join the club. The ratio of boys to girls is now 1 : 1.

How many girls are in the club? [3]

Answer

6 A box contains red, green and yellow pens in the ratio 2 : 3 : 5.

(a) What fraction of the pens are green? [1]

(b) There are 24 more yellow pens than red pens. Work out the total number of pens in the box. [3]

Answer

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Degree of accuracy and bounds

I can... round, estimate, write error intervals and, for Higher, calculate with bounds.

Spec ref: 1.8 · Foundation & Higher

A rounded value hides the exact value inside an **error interval**. The lower bound is included ($\leq$), but the upper bound is not ($<$) because it would round up.

Key points

- Bounds: add and subtract half of the unit you rounded to, e.g. 2.65 kg (3 s.f.) $\rightarrow 2.645 \leq m < 2.655$.
- Estimate by rounding each number to 1 significant figure.
- *Higher*: maximum of $a \div b$ = upper $a \div$ lower b ; minimum of $a - b$ = lower $a -$ upper b .
- *Higher*: a 'suitable degree of accuracy' is one where both bounds round to the same value.

Key words

significant figures

estimate

error interval

upper bound

lower bound

Worked example 1

Estimate the value of $(412 \times 0.58) \div 19.7$.

Round to 1 significant figure: $(400 \times 0.6) \div 20$
 $= 240 \div 20 = \mathbf{12}$

Worked example 2

A length, l , is 6.3 cm correct to 1 decimal place. Write down the error interval.

Half of 0.1 is 0.05
 $6.25 \leq l < 6.35$

Common mistakes

- Using $\leq$ at both ends of an error interval.
- Using the upper bound of the divisor to make a quotient as large as possible.

Exam tip: Always write down every bound you use before calculating — it earns the B1 mark.

Answer each question. Show working where it helps.

1 Round 7.0846 to 2 decimal places.

2 Round 7.0846 to 3 significant figures.

3 Round 52 963 to 1 significant figure.

4 Round 0.003 548 to 2 significant figures.

5 Round 149.97 to 1 decimal place.

6 Round 0.6666 to 3 decimal places.

7 Estimate 39.8×5.12

8 Estimate $6123 \div 29.6$

9 Estimate $\sqrt{63.7}$

10 Estimate $(2.94 + 7.12) \div 0.512$

11 Write down the bounds of 85 kg, correct to the nearest 5 kg.

12 Write down the bounds of 2.4 m, correct to 1 d.p.

13 Write down the bounds of 13 s, correct to the nearest second.

14 Write down the bounds of 6000, correct to 1 s.f.

15 Write the error interval for $x = 4.7$ (1 d.p.).

16 (Higher) $a = 12$ and $b = 3$, both to the nearest integer. Find the upper bound of ab .

17 (Higher) Using the same a and b , find the lower bound of $a \div b$ (3 s.f.).

18 (Higher) Using the same a and b , find the upper bound of $a - b$.

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Answer all questions. Write your answers in the spaces provided. You must write down all the stages in your working.

- 1
- (a) Round 0.040 96 to 2 significant figures. [1]
- (b) Round 6949 to the nearest hundred. [1]
- (c) Round 3.995 to 2 decimal places. [1]
- (d) Round 4 096 000 to 3 significant figures. [1]

- 2
- (a) Work out an estimate for the value of $(203 \times 7.92) \div 0.396$. You must show your working. [2]
-
- Answer [1]
- (b) Use your calculator to work out the exact value of $(203 \times 7.92) \div 0.396$ [1]
- (c) Is your estimate an overestimate or an underestimate? Use your answers to explain. [1]
-

- 3
- (a) The length, L metres, of a bridge is 340 m correct to 2 significant figures. Write down the error interval for L . [2]
- Answer $\leq L <$ [1]
- (b) The mass, m kg, of a bag is 2.65 kg correct to 3 significant figures. Write down the error interval for m . [2]
- Answer $\leq m <$ [1]
- (c) There were 12 000 people at a concert, correct to the nearest thousand. What is the least possible number of people? [1]

- 4 (Higher) A metal block has a mass of 840 g, correct to the nearest 10 g. Its volume is 108 cm^3 , correct to the nearest cm^3 . Density = mass $\div$ volume.
- (a) Work out the upper bound for the density of the metal. Give your answer correct to 3 significant figures. [3]
-
- Answer g/cm^3 [1]
- (b) By considering bounds, work out the density of the metal to a suitable degree of accuracy. Give a reason for your answer. [2]
-

5 (*Higher*) A triangle has base 9.4 cm and height 6.2 cm, both correct to the nearest 0.1 cm.

(a) Calculate the lower bound for the area of the triangle. **[3]**

Answer cm²

(b) Calculate the upper bound for the area of the triangle. cm² **[1]**

6 (*Higher*) Ali has a rope of length 50 m, correct to the nearest metre.
He wants to cut pieces of length 1.6 m, correct to the nearest 0.1 m.
Work out the greatest number of pieces he can be certain to cut. **[3]**

Answer

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Standard form

I can... convert to and from standard form and calculate with numbers in standard form.

Spec ref: 1.9 · Foundation & Higher

In standard form a number is written as $a \times 10^n$, where $1 \leq a < 10$ and n is an integer. Positive powers give big numbers; negative powers give numbers less than 1.

Key points

- Multiplying: multiply the a values and add the powers.
Dividing: divide the a values and subtract the powers.
- If the result is not between 1 and 10, adjust it: $0.625 \times 10^8 = 6.25 \times 10^7$.
- Adding or subtracting: write both numbers with the same power of 10 first.

Key words

standard form

power of 10

negative power

significant figures

Worked example 1

Write 0.000 030 6 in standard form.

Move the decimal point 5 places to the right to get 3.06

$$3.06 \times 10^{-5}$$

Worked example 2

Work out $(5 \times 10^6) \div (8 \times 10^{-2})$. Give your answer in standard form.

$$5 \div 8 = 0.625 \text{ and } 10^6 - (-2) = 10^8$$

$$0.625 \times 10^8 = 6.25 \times 10^7$$

Common mistakes

- Writing 81×10^3 as a final answer — it is not standard form.
- Adding the a values when the powers are different.

Exam tip: Use the $\times 10^x$ (or EXP) key and put brackets around each number in standard form.

Answer each question. Show working where it helps.

1 Write 7 400 000 in standard form.

2 Write 0.0091 in standard form.

3 Write 60 500 in standard form.

4 Write 0.000 000 8 in standard form.

5 Write 3.9×10^4 as an ordinary number.6 Write 1.06×10^{-2} as an ordinary number.7 Write 81×10^3 in standard form.8 Write 0.27×10^6 in standard form.9 Order, smallest first: 4.5×10^{-3} , 4.1×10^{-2} , 5×10^{-3} 10 $(3 \times 10^4) \times (3 \times 10^5)$ 11 $(6 \times 10^7) \times (5 \times 10^{-3})$ 12 $(9 \times 10^8) \div (3 \times 10^2)$ 13 $(1.2 \times 10^5) \div (4 \times 10^{-3})$ 14 $(2 \times 10^{-3})^3$ 15 $5 \times 10^6 + 7 \times 10^5$ 16 $4 \times 10^{-2} - 3 \times 10^{-3}$ 17 $(3.65 \times 10^6) \times (4.2 \times 10^3)$ 18 $(9.1 \times 10^{-5}) \div (3.5 \times 10^4)$ 19 $(5.2 \times 10^4)^2$ 20 $\sqrt[3]{(2.7 \times 10^{10})}$ Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Answer all questions. Write your answers in the spaces provided. You must write down all the stages in your working.

1 (a) Write 0.000 052 in standard form. [1]

(b) Write 4.08×10^6 as an ordinary number. [1]

(c) Work out $(6 \times 10^5) \div (1.5 \times 10^{-3})$. Give your answer in standard form. [2]

Answer

(d) Which is larger, 2.1×10^{-4} or 0.000 09? [1]

2 The mass of the Earth is 5.97×10^{24} kg. The mass of the Moon is 7.35×10^{22} kg.

(a) How many times heavier is the Earth than the Moon? Give your answer correct to 3 significant figures. [2]

Answer

(b) Work out the total mass of the Earth and the Moon. Give your answer in standard form correct to 3 significant figures. [2]

Answer kg

(c) What percentage of the total mass is the mass of the Moon? % [1]

3 A virus has a diameter of 1.2×10^{-7} m.

How many of these viruses, placed side by side, would stretch across a line 3 mm long? Give your answer in standard form. [3]

Answer

4 A data centre stores 3.6×10^{15} bytes of data. One film uses 4.5×10^9 bytes.

(a) How many films could the data centre store? Give your answer in standard form. [2]

Answer

(b) The data centre adds 2.5×10^{14} bytes of storage. Work out the new total in standard form. [2]

Answer bytes

5 $x = 4 \times 10^n$, where n is an integer. Give each answer in standard form, in terms of n .

(a) Find x^2 . [2]

Answer

(b) Find $1/x$. [2]

Answer

6 Light travels at 3×10^8 m/s. The distance from the Sun to the star Proxima Centauri is about 4.0×10^{16} m.

(a) Work out the time, in seconds, for light to travel this distance. Give your answer in standard form to 3 significant figures. [2]

Answer s

(b) Change your answer to years. Use 1 year = 365 days. Give your answer to 3 significant figures. [2]

Answer years

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Applying number and using a calculator

I can... solve everyday problems with units, time, money and speed and use a calculator efficiently.

Spec ref: 1.10, 1.11 · Foundation & Higher

Many 4MA1 questions put number skills into real situations: bills, wages, timetables, currency and measurements. Read the question carefully, write down each step and check that the units match.

Key points

- Length: 1 km = 1000 m, 1 m = 100 cm. Mass: 1 kg = 1000 g. Capacity: 1 litre = 1000 ml = 1000 cm³.
- Area and volume: 1 m² = 10 000 cm², 1 m³ = 1 000 000 cm³.
- Speed = distance ÷ time, with time in hours as a decimal (50 min = 50/60 h).
- On a calculator, use brackets for a whole numerator or denominator; write down the full display before rounding.

Key words

metric units

24-hour clock

average speed

exchange rate

calculator display

Worked example 1

€1 = \$1.17. Change €350 into dollars.

Euros → dollars: multiply by 1.17

$$350 \times 1.17 = \$409.50$$

Worked example 2

Change 2.5 m² into cm².

$$1 \text{ m} = 100 \text{ cm, so } 1 \text{ m}^2 = 100 \times 100 = 10\,000 \text{ cm}^2$$

$$2.5 \times 10\,000 = \mathbf{25\,000 \text{ cm}^2}$$

Common mistakes

- Writing 2 h 50 min as 2.5 h.
- Converting m² to cm² by multiplying by 100 instead of 10 000.

Exam tip: 'Write down all the figures on your calculator display' means at least 6 or 7 digits — do not round.

Answer each question. Show working where it helps.

1 Change 3.2 km into metres.

2 Change 450 cm into metres.

3 Change 2.75 kg into grams.

4 Change 1.8 litres into millilitres.

5 Change 3 m^2 into cm^2 .6 Change 5000 cm^3 into litres.

7 Change 2.5 hours into minutes.

8 Change 135 minutes into hours.

9 Write 14 35 using the 12-hour clock.

10 How long is it from 08 50 to 13 15?

11 A car travels 210 km in 3 h 30 min.
Find its average speed.12 How far do you travel in 1 h 20 min
at 45 km/h?13 €1 = \$1.17. Change €350 into
dollars.14 £1 = 44.6 baht. Change 2230 baht
into pounds.15 Find the cost of 3.4 kg of fruit at 85
baht per kg.16 Use a calculator: $(8.3 + 1.7^2) \div \sqrt{5.29}$
to 3 s.f.17 Use a calculator: $1/0.24 + 2.5^2$ to 3
s.f.18 Use a calculator: $4.5 \times 10^3 \div 0.009$ Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Answer all questions. Write your answers in the spaces provided. You must write down all the stages in your working.

- 1** An electricity company charges
- 3.25 baht per unit for the first 150 units
 - 4.20 baht per unit for all other units
 - a fixed charge of 38.22 baht.
- VAT at 7% is then added to the total. A household uses 412 units.
Work out the total bill. **[4]**

Answer baht

- 2** Ben changes £850 into euros when the exchange rate is £1 = €1.16.

(a) How many euros does he get? € **[1]**

(b) He spends €720. He changes the rest back into pounds when the rate is £1 = €1.19.
How many pounds does he get? Give your answer to the nearest penny. **[2]**

Answer £

(c) A camera costs €389 in Paris and £329 in London. Use £1 = €1.16. In which city is it cheaper, and by how much? **[2]**

- 3** A ferry leaves Pattaya at 09 45. The journey to Hua Hin takes 2 hours 50 minutes. The distance is 113 km.

(a) At what time does the ferry arrive in Hua Hin? **[1]**

(b) Work out the average speed of the ferry. Give your answer to 3 significant figures. **[2]**

Answer km/h

(c) The return ferry leaves at 16 20 and arrives at 19 05. Work out its average speed. **[2]**

Answer km/h

4 A swimming pool is a cuboid 25 m long and 12 m wide. The water is 1.6 m deep.

(a) Work out the volume of water in m^3 m^3 [1]

(b) Write your answer to (a) in litres. ($1 \text{ m}^3 = 1000$ litres) litres [1]

(c) The pool is filled at 150 litres per minute. How long does it take? Give your answer in hours and minutes. [2]

Answer

5

(a) Work out $(\sqrt{17.64} + 2.3^2) \div (1.2 \times 4.35)$

Write down all the figures on your calculator display. [2]

Answer

(b) Give your answer to part (a) correct to 3 significant figures. [1]

6 Ana is paid \$14.60 per hour for the first 37.5 hours she works each week.
For any extra hours she is paid at 1.5 times her normal rate. One week she works 43 hours.

(a) Work out her total pay for this week. [3]

Answer \$

(b) She pays tax of 12% on all pay over \$500. Work out the tax she pays this week.
\$ [1]

Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure



CHECK

End-of-book check

End-of-book check

Name _____ Date _____ Score _____ / 12

Answer these questions to check what you have learnt. You may use a calculator.

1

Find the HCF of $2^3 \times 3^2 \times 5$ and $2^2 \times 3 \times 7$.

2

Work out $2\frac{2}{3} \div 1\frac{1}{9}$. Give your answer as a mixed number.

3

(Higher) Write 0.151515... as a fraction in its simplest form.

4

(Higher) Find the value of $32^{3/5}$.

5

(Higher) Rationalise the denominator of $6/\sqrt{3}$.

6

 $n(A) = 20$, $n(B) = 14$ and $n(A \cup B) = 27$. Find $n(A \cap B)$.

7

After a 15% increase a price is \$69. Find the original price.

8

\$2000 is invested at 3% compound interest. Find its value after 3 years.

9

 $x : y = 3 : 8$ and $y - x = 35$. Find x .

10

 $x = 7.6$ correct to 1 d.p. Write down the error interval for x .

11

Work out $(8 \times 10^{-3}) \times (6 \times 10^7)$ in standard form.

12

A bus travels 63 km in 45 minutes. Find its average speed.



Practice paper

Name _____ Date _____ Marks _____ / 60

Time: 1 hour 15 minutes
Calculator allowed
Total: 60 marks
Questions marked (*Higher*) are Higher tier content.

Answer all questions. Write your answers in the spaces provided. You must write down all the stages in your working.

- 1 (a) Express 396 as a product of its prime factors. [2]

Answer

- (b) Find the highest common factor (HCF) of 396 and 84. [1]

- (c) Find the lowest common multiple (LCM) of 396 and 84. [2]

Answer

- 2 Show that $1\frac{3}{5} \times 2\frac{1}{12} = 3\frac{1}{3}$ [3]

- 3 $\mathcal{E} = \{1, 2, 3, \dots, 15\}$ $A = \{\text{multiples of } 3\}$ $B = \{\text{factors of } 30\}$

- (a) List the members of $A \cap B$. [1]

- (b) Find $n(A \cup B)$. [1]

- (c) List the members of $(A \cup B)'$. [1]

- (d) Is it true that $9 \in B$? Give a reason. [1]

- 4 (a) A laptop costs \$860. In a sale its price is reduced by 15%. Work out the sale price. [2]

Answer \$

- (b) In the same sale, a phone with 20% off costs \$356. Work out the price of the phone before the sale. [3]

Answer \$

- 5 Amy, Ben and Cara share some sweets in the ratio 3 : 4 : 5. Cara gets 18 more sweets than Amy.

- (a) Work out the total number of sweets. [3]

Answer

- (b) Ben gives one third of his sweets to Amy. Find the new ratio Amy : Ben : Cara in its simplest form. [3]

Answer : :

- 6 A grain of sand has a mass of 6.5×10^{-4} grams.

- (a) Write 6.5×10^{-4} as an ordinary number. [1]

- (b) How many grains of sand are there in 2.6 kg of sand? Give your answer in standard form. [3]

Answer

- 7 (Higher) Prove algebraically that the recurring decimal 0.1363636... can be written as $\frac{3}{22}$.

- 8 (Higher)

- (a) Find the value of $125^{-2/3}$. [2]

Answer

- (b) $2^x = 8^{1/2} \times 4$. Find the value of x. [2]

Answer $x =$

9 (Higher)

(a) Rationalise the denominator and simplify $8/(3 + \sqrt{5})$. [3]

Answer

(b) Expand and simplify $(2 + \sqrt{5})^2$. [2]

Answer

10 Priya invests \$12 000 for 5 years at 2.6% per year compound interest.

(a) Work out the value of her investment after 5 years. Give your answer to the nearest cent.

Answer \$

(b) How much interest does she earn? \$ [1]

11 (Higher) A car travels 145 km, correct to the nearest km, in 1.8 hours, correct to the nearest 0.1 hour.

Work out the upper bound for the average speed of the car. Give your answer correct to 3 significant figures. [3]

Answer km/h

12 A taxi fare is 35 baht plus 6.50 baht for each kilometre.

(a) Work out the fare for a journey of 18.4 km. [2]

Answer baht

(b) Another fare is 224.50 baht. Work out the length of this journey to 1 decimal place. [2]

Answer km

(c) The 18.4 km journey is at an average speed of 32 km/h. How long does it take? Give your answer in minutes and seconds. [2]

Answer

13

(a) Work out $(3.7^3 - \sqrt{48.6}) \div (1.25 + 0.4^2)$

Write down all the figures on your calculator display.

[2]

Answer

(b) Give your answer to part (a) correct to 3 significant figures.

[1]

14

There are 12 000 bees in a hive. The number of bees decreases by 6% each week.

(a) Work out the number of bees after 4 weeks.

[2]

Answer

(b) After how many weeks will there first be fewer than 8000 bees?

[3]

Answer



FOR TEACHERS & PARENTS

Answers & mark schemes

Mark schemes list the points that earn marks. Accept equivalent answers and follow-through where working is correct. M = method mark, A = accuracy mark, B = independent mark.

Starting point check

- 1 $2^2 \times 3 \times 5$
- 2 24
- 3 $7/20$
- 4 $9/25$
- 5 64
- 6 {2}
- 7 51
- 8 24 and 32
- 9 0.084
- 10 5.2×10^4
- 11 210 minutes
- 12 $5\sqrt{2}$

Unit 1 · Sheet A — Integers: primes, HCF and LCM

- 1 $2^3 \times 3 \times 7$
- 2 5×7^2
- 3 $2^4 \times 3^3$
- 4 $2 \times 3^2 \times 5 \times 11$
- 5 12
- 6 15
- 7 60
- 8 42
- 9 1, 2, 3, 4, 6, 8, 12, 16, 24, 48
- 10 13, 26, 39, 52, 65
- 11 No, $57 = 3 \times 19$
- 12 61, 67, 71, 73, 79
- 13 64
- 14 17
- 15 7 and 11
- 16 $2^2 \times 3^2$
- 17 $2^3 \times 3^3 \times 5$
- 18 300
- 19 60

Unit 1 · Sheet B — Integers: primes, HCF and LCM

- 1 (a) M1 for at least two correct steps in a factor tree or division ladder; A1 for $2^2 \times 3 \times 7^2$ oe [2] (b) M1 for $210 = 2 \times 3 \times 5 \times 7$ or a correct method; A1 for 42 cao [2] (c) M1 for $2^2 \times 3 \times 5 \times 7^2$ oe; A1 for 2940 cao [2]
- 2 (a) M1 for multiples of 15 and 36 or prime factors; A1 for LCM 180 (minutes); A1 for 10 30 or 10:30 am [3] (b) ft B1 for 13 30 [1]
- 3 (a) M1 for listing multiples of 24 and 40; M1 for 120; A1 for 5 packs of cups and 3 packs of plates [3] (b) ft B1 for 120 [1]
- 4 M1 for finding a common factor of 360 and 420; A1 for 60 cm; A1 for 13 pieces [3]
- 5 (a) M1 for $648 = 2^3 \times 3^4$ or correct factor tree; A1 for $x = 3$ and $y = 4$ [2] (b) M1 for identifying the odd powers of 2 and 5; A1 for 10 [2]
- 6 (a) B1 for 23 [1] (b) B1 for 28 [1] (c) B1 for 25 [1] (d) B1 for 27 [1]

Unit 2 · Sheet A — Fractions

- 1 $3/8$
- 2 24
- 3 35
- 4 $3\frac{2}{7}$
- 5 $23/5$
- 6 $7/12, 5/8, 2/3$
- 7 $7/10$
- 8 $17/24$
- 9 $1/2$
- 10 $3/8$
- 11 $5/6$
- 12 $3/4$
- 13 3
- 14 $5/12$
- 15 $2/5$
- 16 $2/7$
- 17 $3/4$
- 18 $7/40$
- 19 $5/12$
- 20 $3/8$

Unit 2 · Sheet B — Fractions

- 1** M1 for $13/4 - 11/6$ oe; M1 for $39/12 - 22/12$ oe; A1 for $17/12 = 1\frac{5}{12}$ with full working **[3]**
- 2** M1 for $18/7 \times 7/6$ oe; M1 for $126/42$ or cancelling; A1 for 3 with full working **[3]**
- 3** M1 for $9/2 \div 21/8$; M1 for $9/2 \times 8/21$ oe; A1 for $72/42 = 12/7 = 1\frac{5}{7}$ **[3]**
- 4 (a)** M1 for $3/8 \times 840 (= 315)$ or $2/5 \times 840 (= 336)$; M1 for $840 - 315 - 336$ oe; A1 for 189 **[3]** **(b)** M1 for $4/9 \times 315$; A1 for 140 **[2]** **(c)** B1 for $5/9$ **[1]**
- 5 (a)** M1 for $3/4 - 5/12 = 1/3$; M1 for $72 \div 1/3$ oe; A1 for 216 **[3]** **(b)** M1 for $7/12 \times 216 (= 126)$; A1 for 14 (minutes) **[2]**
- 6 (a)** M1 for converting at least three to decimals or a common denominator; A1 for $13/24, 11/20, 5/9, 4/7$ **[2]** **(b)** M1 for $(36/63 + 35/63) \div 2$ oe; A1 for $71/126$ **[2]** **(c)** B1 for $1/63$ **[1]**

Unit 3 · Sheet A — Decimals and recurring decimals

- 1** 0.204
- 2** 2.1
- 3** 8.82
- 4** 0.49
- 5** 0.045, 0.405, 0.45, 0.5
- 6** 0.3125
- 7** 0.181818...
- 8** $1/80$
- 9** terminating
- 10** recurring
- 11** 0.58333...
- 12** $2\frac{7}{100}$
- 13** $5/6$
- 14** $41/333$
- 15** $12/11$
- 16** $12/55$

Unit 3 · Sheet B — Decimals and recurring decimals

- 1 (a)** B1 for 0.073, 0.3, 0.307, 0.317, 0.37 **[1]** **(b)** B1 for 1.06 **[1]** **(c)** B1 for 220 **[1]** **(d)** B1 for 0.06 **[1]**
- 2 (a)** B1 for 0.875 **[1]** **(b)** B1 for 0.151515... **[1]** **(c)** B1 for $40 = 2^3 \times 5$ — the only prime factors of the denominator are 2 and 5 **[1]** **(d)** B1 for $4/15$ **[1]**
- 3 (a)** M1 for $100x = 27.2727...$ and subtracting $x = 0.2727...$; A1 for $27/99 = 3/11$ with full working **[2]** **(b)** B1 for $3/110$ **[1]**
- 4 (a)** M1 for two recurring decimals that subtract to a terminating decimal, e.g. $1000x = 318.1818...$ and $10x = 3.1818...$; M1 for $990x = 315$; A1 for $315/990 = 7/22$ **[3]** **(b)** B1 for $51/22$ **[1]**
- 5 (a)** M1 for $10x = 12.333...$ and $100x = 123.333...$ oe; M1 for $90x = 111$; A1 for $1\frac{7}{30}$ **[3]** **(b)** B1 for $5/11$ **[1]**
- 6 (a)** M1 for $3.75 \times 4.80 (= 18)$ or $12 \times 0.65 (= 7.80)$; M1 for $50 - (18 + 7.80)$; A1 for 24.20 **[3]** **(b)** M1 for 3.75×5.15 ; A1 for 19.31 **[2]** **(c)** B1 for 2.25 **[1]**

Unit 4 · Sheet A — Powers and roots

- 1** 225
- 2** 19
- 3** 216
- 4** 10
- 5** 16
- 6** 0.3
- 7** 2^{10}
- 8** 9^3
- 9** 2^{20}
- 10** 7
- 11** 1
- 12** $1/6$
- 13** $1/25$
- 14** 8
- 15** 5
- 16** 10
- 17** 4
- 18** $1/3$
- 19** $3/4$
- 20** $4/3$
- 21** 2.8561

Unit 4 · Sheet B — Powers and roots

- 1 (a)** B1 for 49 **[1]** **(b)** B1 for 5 **[1]** **(c)** B1 for 14 **[1]** **(d)** B1 for 10^6 **[1]**
- 2 (a)** B1 for 8^8 **[1]** **(b)** B1 for 5^6 **[1]** **(c)** B1 for 11^8 **[1]** **(d)** B1 for 7 **[1]**
- 3 (a)** B1 for $1/7$ **[1]** **(b)** B1 for 100 **[1]** **(c)** B1 for 0.5 oe **[1]** **(d)** M1 for $(81/16)^{3/4}$ or $(2/3)^3$ or $(3/2)^3$; A1 for $27/8$ oe **[2]**
- 4** M1 for $8^{1/2} = 2^{3/2}$ or $4^3 = 2^6$; M1 for $3/2 + 6 - (-1)$; A1 for $17/2$ oe **[3]**
- 5 (a)** M1 for $2x - 1 = 3$; A1 for 2 **[2]** **(b)** M1 for 3^{3x} or $3^{2(x+2)}$; M1 for $3x = 1 + 2x + 4$; A1 for 5 **[3]**
- 6 (a)** M1 for 36.46 or 15.625 seen; A1 for 2.33344 **[2]** **(b)** ft B1 for 2.3 **[1]** **(c)** B1 for $4/9$ **[1]**

Unit 5 · Sheet A — Surds

- 1 $2\sqrt{7}$
- 2 $3\sqrt{7}$
- 3 $5\sqrt{6}$
- 4 $12\sqrt{2}$
- 5 $7\sqrt{3}$
- 6 $6\sqrt{5}$
- 7 6
- 8 $3\sqrt{5}$
- 9 18
- 10 3
- 11 $3\sqrt{2}$
- 12 $\sqrt{10}/2$
- 13 $2\sqrt{5}/15$
- 14 13
- 15 $3 + 2\sqrt{2}$
- 16 $2\sqrt{3} - 3$
- 17 3
- 18 $\sqrt{2} - 1$
- 19 $24\sqrt{3}$
- 20 $3/2$

Unit 5 · Sheet B — Surds

- 1 (a) B1 for $7\sqrt{7}$ [1] (b) M1 for $10\sqrt{5}$ or $5\sqrt{5}$; A1 for $5\sqrt{5}$ [2] (c) B1 for $6\sqrt{5}$ [1] (d) B1 for $7\sqrt{7}$ [1]
- 2 (a) M1 for $9 + 3\sqrt{5} + 3\sqrt{5} + 5$; A1 for $14 + 6\sqrt{5}$ [2] (b) M1 for 3 terms correct of $6 + 8\sqrt{3} - \sqrt{3} - 4$; A1 for $2 + 7\sqrt{3}$ [2] (c) B1 for 4 [1]
- 3 (a) M1 for $21\sqrt{7}/7$; A1 for $3\sqrt{7}$ [2] (b) B1 for $\sqrt{5}/10$ [1] (c) M1 for multiplying by $(\sqrt{3} + 1)/(\sqrt{3} + 1)$; M1 for $(4 + 2\sqrt{3})/2$; A1 for $2 + \sqrt{3}$ [3]
- 4 M1 for $3\sqrt{2} + 2\sqrt{2} = 5\sqrt{2}$ or expansion $18 + 2\sqrt{144} + 8$; A1 for 50 with full working [2]
- 5 (a) M1 for $(16 - 3) \div 2$; A1 for $13/2$ oe [2] (b) M1 for $(19 + 8\sqrt{3}) + (19 - 8\sqrt{3})$; A1 for $\sqrt{38}$ [2]
- 6 M1 for $a^2 + 2a\sqrt{3} + 3$; M1 for $a^2 + 3 = 19$; A1 for $a = 4$ and $b = 8$ [3]

Unit 6 · Sheet A — Set language and notation

- 1 {1, 2, 4, 8, 16}
- 2 {3, 6, 9, 12, 15}
- 3 $\emptyset$ (the empty set)
- 4 10
- 5 11
- 6 $\in$
- 7 {2, 4, 8, 16}
- 8 11
- 9 {3, 9, 15}
- 10 {g, k, n, o}
- 11 7
- 12 6
- 13 9
- 14 {16, 25, 36, 49, 64}
- 15 True
- 16 $A \subset B$ (A is a subset of B)

Unit 6 · Sheet B — Set language and notation

- 1 (a) B1 for {24, 30} [1] (b) B1 for 8 [1] (c) B1 for No, 29 is not even and not a multiple of 3 [1] (d) B1 for {23, 25, 29} [1]
- 2 (a) B1 for A only shaded [1] (b) B1 for everything except the overlap shaded [1] (c) B1 for A' [1] (d) B1 for $(A \cup B) \cap (A \cap B)'$ oe [1]
- 3 (a) M1 for $47 + 38 - 68$ or 17 in the overlap; A1 for 30 and 21; B1 for 12 outside [3] (b) ft B1 for 51 [1] (c) ft B1 for 30 [1]
- 4 (a) M1 for $3x + 32 = 50$ oe; A1 for 6 [2] (b) ft B1 for 23 [1] (c) ft B1 for 17 [1] (d) B1 for 15 [1]
- 5 (a) B1 for {3, 4, 5, 6, 7, 8, 9} [1] (b) B1 for {3, 6, 9} [1] (c) B1 for No, e.g. $1 \in B$ but $1 \notin A$ [1] (d) B1 for 10 [1]
- 6 (a) M1 for $26 + 19 - x + 2x = 52$ oe; A1 for 7 [2] (b) ft B1 for 19 [1]

Unit 7 · Sheet A — Percentages

- 1 54
- 2 90
- 3 42
- 4 15%
- 5 25%
- 6 736
- 7 2.1
- 8 1.23
- 9 0.955
- 10 24% increase
- 11 15% decrease
- 12 40%
- 13 15%
- 14 \$336
- 15 28%
- 16 0.325
- 17 420 baht
- 18 $3/8$ (37.5%)

Unit 7 · Sheet B — Percentages

- 1 (a) M1 for 1250×0.7 oe; A1 for 875 [2] (b) M1 for $2 \times 1250 + 3 \times 875$ (= 5125); M1 for $\times 0.9$ oe; A1 for 4612.50 [3]
- 2 M1 for $54 \div 72 \times 100$ (= 75); M1 for $41 \div 52 \times 100$ (= 78.8...); A1 for Priya with both percentages [3]
- 3 (a) M1 for $24\,900 \times 1.07$ oe; A1 for 26 643 [2] (b) M1 for $434 \div 0.07$ oe; A1 for 6200 [2]
- 4 (a) M1 for 2400×1.035 oe; A1 for 2484 [2] (b) M1 for $2484 \times 0.15 \times 12$; A1 for 4471.20 [2]
- 5 (a) M1 for $(2146 - 1850) \div 1850 \times 100$; A1 for 16 [2] (b) M1 for $(8500 - 6970) \div 8500 \times 100$; A1 for 18 [2]
- 6 (a) M1 for $560 \div 5$ (= 112); M1 for $112 \div 3200 \times 100$; A1 for 3.5 [3] (b) M1 for $1000 \div 112$ (= 8.9...); A1 for 9 [2]

Unit 8 · Sheet A — Repeated change and reverse percentages

- 1 $1.04^2 = 1.0816$
- 2 \$1622.40
- 3 \$13 629.44
- 4 7056
- 5 5.78%
- 6 4% decrease
- 7 1650 baht
- 8 \$80
- 9 3500 baht
- 10 \$10 000
- 11 6
- 12 243
- 13 0.975^4
- 14 compound (\$1157.63 > \$1150)

Unit 8 · Sheet B — Repeated change and reverse percentages

- 1
(a) M1 for 1.018 seen; M1 for $150\,000 \times 1.018^4$; A1 for 161 095 [3]
(b) ft B1 for 11 095 [1]
- 2 M1 for $68\,000 \times 0.85$ (= 57 800); M1 for $\times 0.9^2$; A1 for 46 818 [3]
- 3 (a) M1 for 78% = 741 or $741 \div 0.78$; M1 for complete method; A1 for 950 [3] (b) M1 for $371\,000 \div 1.06$; A1 for 350 000 [2]
- 4 (a) M1 for $58\,000 \times 1.024^3$; A1 for 62 277 [2] (b) M1 for trials of $58\,000 \times 1.024^n$; M1 for 63 772 ($n = 4$) and 65 302 ($n = 5$) seen; A1 for 2029 [3]
- 5 M1 for 1.15×0.85 or a worked example with a price; A1 for 0.9775; A1 for No — the price is 2.25% lower than the original [3]
- 6 (a) M1 for $5832 \div 5000$ (= 1.1664); M1 for $\sqrt{1.1664}$ (= 1.08); A1 for 8 [3] (b) M1 for 5832×1.08^2 ; A1 for 6802.44 [2]

Unit 9 · Sheet A — Ratio and proportion

- 1 3 : 7
- 2 10 : 3
- 3 3 : 8
- 4 2 : 5
- 5 9 : 2
- 6 1 : 16
- 7 2.4 : 1
- 8 56 and 40
- 9 \$0.60 and \$2.10
- 10 100, 150, 200
- 11 $\frac{3}{10}$
- 12 14
- 13 245 baht
- 14 \$16.25
- 15 10
- 16 9 km
- 17 24 cm
- 18 6 : 15 : 20

Unit 9 · Sheet B — Ratio and proportion

- 1 (a) M1 for $350 \div 7$ (= 50); A1 for 100 [2] (b) M1 for $400 \div 5$ (= 80) or $150 \div 2$ (= 75); M1 for 75×7 ; A1 for 525 [3]
- 2 (a) M1 for $2730 \div 21$ (= 130); A1 for 1040 [2] (b) M1 for ratio 7 : 9 : 8 and $2730 \div 24$; A1 for $8 \times 113.75 = 910$ and $7 \times 130 = 910$ [2]
- 3 M1 for $189 \div 250$ or $189 \div 2.5$ (= 75.6 per 100 g); M1 for $299 \div 4$ (= 74.75 per 100 g) oe; A1 for 400 g bag with correct figures [3]
- 4 (a) M1 for $8.4 \times 25\,000$ (= 210 000 cm); A1 for 2.1 [2] (b) ft M1 for $2.1 \div 4.2$; A1 for 30 [2] (c) M1 for 0.5×0.375 ; A1 for 0.1875 [2]
- 5 M1 for $4k + 6 = 5k$ oe; M1 for $k = 6$; A1 for 30 [3]
- 6 (a) B1 for $\frac{3}{10}$ [1] (b) M1 for $5 - 2 = 3$ parts; M1 for $24 \div 3$ (= 8); A1 for 80 [3]

Unit 10 · Sheet A — Degree of accuracy and bounds

- 1 7.08
- 2 7.08
- 3 50 000
- 4 0.0035
- 5 150.0
- 6 0.667
- 7 $40 \times 5 = 200$
- 8 $6000 \div 30 = 200$
- 9 ≈ 8
- 10 $10 \div 0.5 = 20$
- 11 82.5 kg, 87.5 kg
- 12 2.35 m, 2.45 m
- 13 12.5 s, 13.5 s
- 14 5500, 6500
- 15 $4.65 \leq x < 4.75$
- 16 43.75
- 17 3.29
- 18 10

Unit 10 · Sheet B — Degree of accuracy and bounds

- 1 (a) B1 for 0.041 [1] (b) B1 for 6900 [1] (c) B1 for 4.00 [1] (d) B1 for 4 100 000 [1]
- 2 (a) M1 for $(200 \times 8) \div 0.4$; A1 for 4000 [2] (b) B1 for 4060 [1] (c) B1 for underestimate, since $4000 < 4060$ [1]
- 3 (a) B1 for 335; B1 for 345 (with $\leq$ and $<$) [2] (b) B1 for 2.645; B1 for 2.655 [2] (c) B1 for 11 500 [1]
- 4 (a) B1 for 845 or 107.5 seen; M1 for $845 \div 107.5$; A1 for 7.86 (7.860...) [3] (b) M1 for lower bound $835 \div 108.5$ (= 7.695...); A1 for 8 g/cm³, as both bounds round to 8 to 1 s.f. [2]
- 5 (a) B1 for 9.35 or 6.15 seen; M1 for $0.5 \times 9.35 \times 6.15$; A1 for 28.75125 (accept 28.8) [3] (b) B1 for 29.53125 (accept 29.5) [1]
- 6 B1 for 49.5 or 1.65 seen; M1 for $49.5 \div 1.65$; A1 for 30 [3]

Unit 11 · Sheet A — Standard form

- 1 7.4×10^6
- 2 9.1×10^{-3}
- 3 6.05×10^4
- 4 8×10^{-7}
- 5 39 000
- 6 0.0106
- 7 8.1×10^4
- 8 2.7×10^5
- 9 4.5×10^{-3} , 5×10^{-3} , 4.1×10^{-2}
- 10 9×10^9
- 11 3×10^5
- 12 3×10^6
- 13 3×10^7
- 14 8×10^{-9}
- 15 5.7×10^6
- 16 3.7×10^{-2}
- 17 1.533×10^{10}
- 18 2.6×10^{-9}
- 19 2.704×10^9
- 20 3×10^3

Unit 11 · Sheet B — Standard form

- 1 (a) B1 for 5.2×10^{-5} [1] (b) B1 for 4 080 000 [1] (c) M1 for 4 and 10^8 seen; A1 for 4×10^8 [2] (d) B1 for 2.1×10^{-4} [1]
- 2 (a) M1 for $5.97 \times 10^{24} \div 7.35 \times 10^{22}$; A1 for 81.2 [2] (b) M1 for $5.97 \times 10^{24} + 0.0735 \times 10^{24}$ oe; A1 for 6.04×10^{24} [2] (c) B1 for 1.22 (1.216...) [1]
- 3 B1 for $3 \text{ mm} = 3 \times 10^{-3} \text{ m}$; M1 for $3 \times 10^{-3} \div 1.2 \times 10^{-7}$; A1 for 2.5×10^4 [3]
- 4 (a) M1 for $3.6 \times 10^{15} \div 4.5 \times 10^9$; A1 for 8×10^5 [2] (b) M1 for $3.6 \times 10^{15} + 0.25 \times 10^{15}$; A1 for 3.85×10^{15} [2]
- 5 (a) M1 for 16×10^{2n} ; A1 for $1.6 \times 10^{2n+1}$ [2] (b) M1 for 0.25×10^{-n} ; A1 for $2.5 \times 10^{-n-1}$ [2]
- 6 (a) M1 for $4.0 \times 10^{16} \div 3 \times 10^8$; A1 for 1.33×10^8 [2] (b) M1 for $\div (365 \times 24 \times 60 \times 60)$; A1 for 4.23 [2]

Unit 12 · Sheet A — Applying number and using a calculator

- 1 3200 m
- 2 4.5 m
- 3 2750 g
- 4 1800 ml
- 5 30 000 cm^2
- 6 5 litres
- 7 150 min
- 8 2.25 h
- 9 2.35 pm
- 10 4 h 25 min
- 11 60 km/h
- 12 60 km
- 13 \$409.50
- 14 £50
- 15 289 baht
- 16 4.87
- 17 10.4
- 18 500 000

Unit 12 · Sheet B — Applying number and using a calculator

- 1 M1 for 150×3.25 (= 487.50); M1 for 262×4.20 (= 1100.40); M1 for $(487.50 + 1100.40 + 38.22) \times 1.07$; A1 for 1739.95 [4]
- 2 (a) B1 for 986 [1] (b) M1 for $(986 - 720) \div 1.19$; A1 for 223.53 [2] (c) M1 for $389 \div 1.16$ (= 335.34); A1 for London, by £6.34 [2]
- 3 (a) B1 for 12 35 [1] (b) M1 for $113 \div 2.833...$; A1 for 39.9 [2] (c) M1 for $113 \div 2.75$; A1 for 41.1 [2]
- 4 (a) B1 for 480 [1] (b) ft B1 for 480 000 [1] (c) M1 for $480 000 \div 150$ (= 3200 min); A1 for 53 h 20 min [2]
- 5 (a) M1 for 9.49 or 5.22 seen; A1 for 1.818007662... [2] (b) ft B1 for 1.82 [1]
- 6 (a) M1 for 37.5×14.60 (= 547.50); M1 for $5.5 \times 14.60 \times 1.5$ (= 120.45); A1 for 667.95 [3] (b) ft B1 for 20.15 [1]

End-of-book check

- 1 12
- 2 $2 \frac{2}{5}$
- 3 $\frac{5}{33}$
- 4 8
- 5 $2\sqrt{3}$
- 6 7
- 7 \$60
- 8 \$2185.45
- 9 21
- 10 $7.55 \leq x < 7.65$
- 11 4.8×10^5
- 12 84 km/h

Practice paper

- 1 (a)** M1 for at least two correct steps; A1 for $2^2 \times 3^2 \times 11$ **[2]** **(b)** B1 for 12 **[1]** **(c)** M1 for $84 = 2^2 \times 3 \times 7$ or $2^2 \times 3^2 \times 7 \times 11$; A1 for 2772 **[2]**
- 2** M1 for $8/5 \times 25/12$; M1 for $200/60$ or cancelling; A1 for $10/3 = 3\frac{1}{3}$ with full working **[3]**
- 3 (a)** B1 for {3, 6, 15} **[1]** **(b)** B1 for 9 **[1]** **(c)** B1 for {4, 7, 8, 11, 13, 14} **[1]** **(d)** B1 for No, 9 is not a factor of 30 **[1]**
- 4 (a)** M1 for 860×0.85 oe; A1 for 731 **[2]** **(b)** M1 for $80\% = 356$; M1 for $356 \div 0.8$; A1 for 445 **[3]**
- 5 (a)** M1 for $5 - 3 = 2$ parts = 18; M1 for 9×12 ; A1 for 108 **[3]** **(b)** M1 for 27, 36, 45; M1 for $39 : 24 : 45$; A1 for $13 : 8 : 15$ **[3]**
- 6 (a)** B1 for 0.000 65 **[1]** **(b)** B1 for 2600 g; M1 for $2600 \div 6.5 \times 10^{-4}$; A1 for 4×10^6 **[3]**
- 7** M1 for $1000x = 136.3636\dots$ and $10x = 1.3636\dots$ oe; M1 for $990x = 135$; A1 for $135/990 = 3/22$ **[3]**
- 8 (a)** M1 for $1/125^{2/3}$ or $1/5^2$; A1 for $1/25$ **[2]** **(b)** M1 for $2^{3/2} \times 2^2$; A1 for $7/2$ oe **[2]**
- 9 (a)** M1 for $\times (3 - \sqrt{5})/(3 - \sqrt{5})$; M1 for denominator 4; A1 for $6 - 2\sqrt{5}$ **[3]** **(b)** M1 for $4 + 2\sqrt{5} + 2\sqrt{5} + 5$; A1 for $9 + 4\sqrt{5}$ **[2]**
- 10 (a)** M1 for 1.026 seen; M1 for $12\,000 \times 1.026^5$; A1 for 13 643.26 **[3]** **(b)** ft B1 for 1643.26 **[1]**
- 11** B1 for 145.5 or 1.75 seen; M1 for $145.5 \div 1.75$; A1 for 83.1 (83.14...) **[3]**
- 12 (a)** M1 for $35 + 6.5 \times 18.4$; A1 for 154.60 **[2]** **(b)** M1 for $(224.50 - 35) \div 6.5$; A1 for 29.2 (29.15...) **[2]** **(c)** M1 for $18.4 \div 32 (= 0.575 \text{ h})$; A1 for 34 min 30 s **[2]**
- 13 (a)** M1 for 43.682... or 1.41 seen; A1 for 30.97987... **[2]** **(b)** ft B1 for 31.0 **[1]**
- 14 (a)** M1 for $12\,000 \times 0.94^4$; A1 for 9369 **[2]** **(b)** M1 for trials of $12\,000 \times 0.94^n$; M1 for 8278 (6 weeks) and 7782 (7 weeks) seen; A1 for 7 **[3]**