



BRITISH LEARNING CENTRE

CAMBRIDGE IGCSE · 0580

Mathematics

Number

Every Number statement in the Cambridge IGCSE Mathematics 0580 syllabus (C1 and E1), with key knowledge, practice, original exam-style questions for Papers 1–4 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.

#	Syllabus ref	Topic · I can...	R	A	G
1	C1.1, E1.1 Core & Extended	Types of number I can use primes, factors, multiples, HCF, LCM and the different types of number.			
2	C1.2, E1.2 Core & Extended	Sets and Venn diagrams I can use set notation and draw and read Venn diagrams.			
3	C1.3, C1.7, E1.3, E1.7 Core & Extended	Powers, roots and indices I can work with powers and roots and use the laws of indices.			
4	C1.4, C1.5, E1.4, E1.5 Core & Extended	Fractions, decimals, percentages and ordering I can convert between fractions, decimals and percentages and put numbers in order.			
5	C1.6, E1.6 Core & Extended	The four operations I can calculate with integers, fractions and decimals, using the correct order of operations.			
6	C1.8, E1.8 Core & Extended	Standard form I can write numbers in standard form and calculate with them, with and without a calculator.			
7	C1.9, C1.14, E1.9, E1.14 Core & Extended	Rounding, estimation and calculators I can round, estimate answers and use a calculator efficiently.			
8	C1.10, E1.10 Core & Extended	Limits of accuracy I can find upper and lower bounds and, for Extended, use them in calculations.			
9	C1.11, E1.11 Core & Extended	Ratio and proportion I can simplify ratios, share in a ratio and solve direct and inverse proportion problems.			
10	C1.12, C1.15, C1.16, E1.12 Core & Extended	Rates, time and money I can solve problems with speed, density, other rates, time and money.			
11	C1.13, E1.13 Core & Extended	Percentages I can solve percentage problems, including interest and, for Extended, reverse percentages.			
12	E1.17 Extended	Exponential growth and decay I can use multipliers to model repeated percentage growth and decay.			
13	E1.18 Extended	Surds I can simplify surds, expand brackets with surds and rationalise denominators.			



CHECK

Starting point check

Starting point check

Name _____ Date _____ Score _____ / 12

Answer these questions to find out what you already know. Do questions 1–7 without a calculator.

1 Write 90 as a product of prime factors.

2 Find the HCF of 18 and 30.

3 $\mathcal{E} = \{1, 2, \dots, 10\}$, $A = \{\text{even numbers}\}$.
Find $n(A')$.

4 Work out 3^{-2} .

5 Write 0.0052 in standard form.

6 Write 0.65 as a fraction in its simplest form.

7 Work out $2/3 + 1/4$.

8 Round 3.0567 to 3 significant figures.

9 A length is 12 cm to the nearest cm. Write down its lower bound.

10 Share 45 in the ratio 4 : 5.

11 Increase 80 by 15%.

12 A car travels 120 km in 1 hour 30 minutes. Find its average speed.

Types of number

I can... use primes, factors, multiples, HCF, LCM and the different types of number.

Syllabus ref: C1.1, E1.1 · Core & Extended

Natural numbers are 1, 2, 3, ... **Integers** also include 0 and negative whole numbers. A **prime number** has exactly two factors, 1 and itself (so 1 is not prime).

A **rational** number can be written as a fraction a/b of two integers. Numbers such as $\sqrt{2}$ and π are **irrational**: their decimals never end and never repeat.

Key words

prime

factor

multiple

HCF / LCM

reciprocal

irrational

Key points

- Square numbers: 1, 4, 9, 16, ... Cube numbers: 1, 8, 27, 64, ...
Triangle numbers: 1, 3, 6, 10, 15, ...
- The **reciprocal** of a/b is b/a ; the reciprocal of 4 is $1/4$.
- Every integer greater than 1 is a product of primes, e.g.
 $360 = 2^3 \times 3^2 \times 5$.
- HCF: multiply the common primes using the **lowest** powers. LCM: use every prime with the **highest** power.

Worked example 1

Find the HCF and LCM of 360 and 84.

$$360 = 2^3 \times 3^2 \times 5 \text{ and } 84 = 2^2 \times 3 \times 7$$

$$\text{HCF: common primes, lowest powers} \rightarrow 2^2 \times 3 = \mathbf{12}$$

$$\text{LCM: every prime, highest powers} \rightarrow 2^3 \times 3^2 \times 5 \times 7 = \mathbf{2520}$$

Common mistakes

- Saying 1 is prime, or that 9 or 15 is prime.
- Swapping HCF and LCM: the HCF can never be bigger than the smaller number.
- Thinking $\sqrt{9}$ or $\sqrt{16}$ is irrational — they equal 3 and 4.

Exam tip: Multiply your prime factors back together to check they give the original number.

Answer each question. Show working where it helps.

1 Write 84 as a product of prime factors.

2 Write 150 as a product of prime factors.

3 Write 196 as a product of prime factors.

4 Write 616 as a product of prime factors.

5 Write 1000 as a product of prime factors.

6 Find the HCF of 48 and 180.

7 Find the HCF of 56 and 98.

8 Find the LCM of 9 and 12.

9 Find the LCM of 16 and 24.

10 List all the factors of 60.

11 List the prime numbers between 30 and 50.

12 From 1, 4, 7, 9, 15, 21, 23 write down the prime numbers.

13 Write down the reciprocal of 5.

14 Write down the reciprocal of $2/7$.

15 Write down the reciprocal of 1.25.

16 Write down the 7th triangle number.

17 Write down the square number between 150 and 180.

18 Write down the cube number between 200 and 300.

19 From $\sqrt{16}$, $\sqrt{20}$, $0.333\dots$, $22/7$, π write down the irrational numbers.

20 Write down a multiple of 7 between 60 and 70.

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

Answer all the questions. Show all your working.

1 (non-calculator) Show all your working.

(a) Write 1176 as a product of its prime factors.

[2]

Answer

(b) Find the highest common factor (HCF) of 1176 and 420.

[2]

Answer

(c) Find the lowest common multiple (LCM) of 1176 and 420.

[2]

Answer

2 Here is a list of numbers.

13 18 27 36 41 49 $\sqrt{50}$

From the list, write down

(a) the prime numbers,

[1]

(b) the square numbers,

[1]

(c) a cube number,

[1]

(d) an irrational number,

[1]

(e) the factors of 54.

[1]

3 (non-calculator) Two lighthouses flash their lights at regular intervals.

Lighthouse A flashes every 18 seconds. Lighthouse B flashes every 24 seconds.

They both flash at exactly 21 00.

Find the next time that they both flash at the same time.

[3]

Answer

- 4 (non-calculator) A rectangular courtyard measures 4.2 m by 5.4 m. It is covered with identical square tiles. The tiles do not overlap and are not cut. The side length of each tile is a whole number of centimetres.

(a) Find the largest possible side length of a tile. [2]

Answer cm

(b) Find how many of these tiles are needed. [2]

Answer

5 $N = 2^3 \times 3^2 \times 7$

(a) Write N as an ordinary number. [1]

(b) Find the smallest positive integer k such that Nk is a square number. [2]

Answer $k =$

(c) Find the smallest positive integer m such that Nm is a cube number. [2]

Answer $m =$

6 (a) Write down the reciprocal of 0.4. [1]

(b) Write down an irrational number between 6 and 7. [1]

(c) Explain why 0.36 is a rational number. [1]

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

Sets and Venn diagrams

I can... use set notation and draw and read Venn diagrams.

Syllabus ref: C1.2, E1.2 · Core & Extended

A **set** is a collection of objects called elements, written in curly brackets. The **universal set** $\mathcal{E}$ contains everything being considered. In a Venn diagram $\mathcal{E}$ is a rectangle and each set is a circle.

Key points

- $A \cap B$ (intersection): in A **and** B. $A \cup B$ (union): in A **or** B or both.
- A' (complement): not in A. $n(A)$: the number of elements in A. $\in$ means 'is an element of'; $\emptyset$ is the empty set.
- *Extended:* $A \subseteq B$ means every element of A is also in B. $\{x : x > 3\}$ is read 'the set of x such that $x > 3$ '.
- $n(A \cup B) = n(A) + n(B) - n(A \cap B)$

Key words

universal set $\mathcal{E}$

intersection $\cap$

union $\cup$

complement A'

$n(A)$

subset $\subseteq$

Worked example 1

$\mathcal{E} = \{1, 2, 3, \dots, 12\}$, $A = \{\text{multiples of 3}\}$, $B = \{\text{factors of 12}\}$. List $A \cap B$ and $A \cup B$. Find $n(A')$.

$A = \{3, 6, 9, 12\}$, $B = \{1, 2, 3, 4, 6, 12\}$

$A \cap B$ (in both) = $\{3, 6, 12\}$; $A \cup B$ (in either) = $\{1, 2, 3, 4, 6, 9, 12\}$

A' has $12 - 4 = 8$ elements, so $n(A') = 8$

Worked example 2

In a class of 30, 18 play football, 14 play tennis and 5 play neither. How many play both?

Students in $F \cup T$: $30 - 5 = 25$

Both = $18 + 14 - 25 = 7$

Common mistakes

- Writing elements in the overlap twice, once in each circle.
- Confusing $\cap$ (and) with $\cup$ (or).

Exam tip: Check that the numbers in all the regions add up to $n(\mathcal{E})$.

Answer each question. Show working where it helps.

1 $\mathcal{E} = \{1, 2, 3, \dots, 15\}$, $P = \{\text{prime numbers}\}$, $E = \{\text{even numbers}\}$.

List the elements of P .

2 Using the sets in question 1, list $P \cap E$.

3 Using the sets in question 1, find $n(P \cup E)$.

4 Using the sets in question 1, list $P' \cap E'$.

5 Using the sets in question 1, find $n(P')$.

6 Write $\in$ or $\notin$: $9 \quad \square \quad P$

7 $A = \{a, e, i, o, u\}$, $B = \{\text{letters in the word PATTAYA}\}$. List B .

8 Using the sets in question 7, list $A \cap B$.

9 $n(\mathcal{E}) = 40$, $n(A) = 22$, $n(B) = 25$, $n(A \cap B) = 12$. Find $n(A \cup B)$.

10 Using question 9, find $n((A \cup B)')$.

11 Using question 9, find $n(A \cap B')$.

12 What does $\emptyset$ mean?

13 (Extended) True or false: $\{2, 4\} \subseteq \{\text{even numbers}\}$

14 (Extended) List $\{x : x \text{ is an integer, } -2 < x \leq 3\}$.

15 (Extended) List $\{x : x^2 = 16\}$.

16 Write down $n(\{\text{factors of } 18\})$.

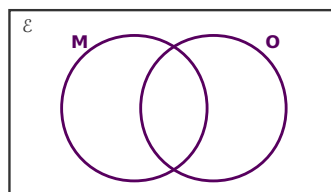
Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Answer all the questions. Show all your working.

- 1 $\mathcal{E} = \{x : x \text{ is an integer, } 11 \leq x \leq 24\}$
 $M = \{\text{multiples of 3}\}$ $O = \{\text{odd numbers}\}$

(a) Complete the Venn diagram.

[2]



(b) Find $n((M \cup O)')$

[1]

(c) List the elements of $M' \cap O$

[1]

(d) Write $\in$ or $\notin$ in the box: $22 \square M \cup O$

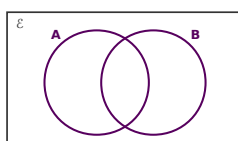
[1]

(e) Find $n(M)$

[1]

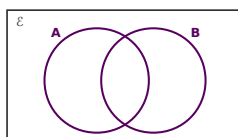
- 2 (a) Shade the region $A' \cap B$.

[1]



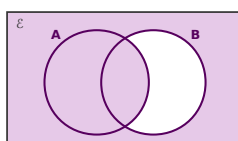
(b) Shade the region $(A \cup B)'$.

[1]



(c) (Extended) Use set notation to describe the shaded region.

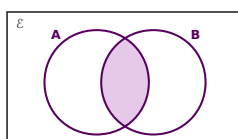
[1]



Answer

(d) Use set notation to describe the shaded region.

[1]



Answer

- 3 50 students were asked if they play football (F) or tennis (T).
28 play football, 23 play tennis, x play both and 6 play neither.

(a) Show that $x = 7$.

[2]

(b) Find $n(F \cap T')$

[1]

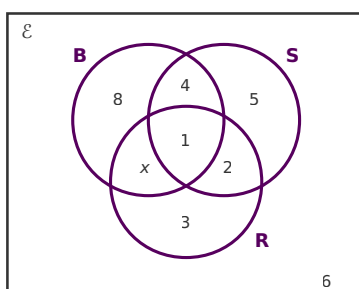
(c) Find $n(F' \cup T)$

[1]

(d) Find $n(F \cup T)$

[1]

- 4 (Extended) 40 students were asked which sports they play: badminton (B), swimming (S) and running (R). The Venn diagram shows the results.



(a) Find the value of x .

[1]

Answer $x = \dots\dots\dots$

(b) Find $n((B \cup S)')$

[1]

(c) Find $n(B \cap S \cap R')$

[1]

(d) Find $n(R)$

[1]

(e) Find $n(B \cup R)$

[1]

- 5 (Extended) $\mathcal{E} = \{x : x \text{ is an integer, } 1 \leq x \leq 20\}$
 $A = \{x : x \text{ is a multiple of 4}\}$ $B = \{x : x \text{ is a factor of 24}\}$

(a) List the elements of $A \cap B$

[1]

(b) Find $n(A \cup B)$

[1]

(c) $C = \{x : x^2 < 10\}$. Is $C \subseteq B$? Give a reason.

[2]

(d) Find $n(A' \cap B)$

[1]

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

Powers, roots and indices

I can... work with powers and roots and use the laws of indices.

Syllabus ref: C1.3, C1.7, E1.3, E1.7 · Core & Extended

In 5^3 the **index** 3 tells you to multiply three 5s: $5 \times 5 \times 5 = 125$.

Roots undo powers: $\sqrt{144} = 12$ because $12^2 = 144$, and $\sqrt[3]{-8} = -2$ because $(-2)^3 = -8$.

Key points

- $a^m \times a^n = a^{m+n}$ $a^m \div a^n = a^{m-n}$ $(a^m)^n = a^{mn}$
- $a^0 = 1$ $a^{-n} = 1/a^n$ (a reciprocal, **not** a negative number)
- *Extended:* $a^{1/n} = \sqrt[n]{a}$ and $a^{m/n} = (\sqrt[n]{a})^m$

Key words

square / cube

square root

cube root

index (power)

reciprocal

fractional index

Worked example 1

Simplify $5^7 \times 5^{-3} \div 5^2$ and evaluate.

Add then subtract the indices: $7 + (-3) - 2 = 2$

$$5^2 = 25$$

Worked example 2

(Extended) Evaluate $27^{2/3}$ and $8^{-2/3}$.

$$27^{2/3} = (\sqrt[3]{27})^2 = 3^2 = 9$$

$$8^{-2/3} = 1 \div (\sqrt[3]{8})^2 = 1 \div 2^2 = 1/4$$

Common mistakes

- Multiplying the indices instead of adding them: $3^2 \times 3^4 = 3^6$, not 3^8 .
- Thinking $2^{-3} = -8$. It is $1/8$.
- Writing $4^0 = 0$. Any non-zero number to the power 0 is 1.

Exam tip: With a fractional index, take the root first (the denominator) — the numbers stay small.

Answer each question. Show working where it helps.

1 13^2

2 $\sqrt{196}$

3 4^3

4 $\sqrt[3]{125}$

5 $\sqrt{0.49}$

6 $(-3)^3$

7 $\sqrt[3]{-64}$

8 2^5

9 Write as a single power: $7^4 \times 7^5$

10 Write as a single power: $3^{10} \div 3^4$

11 Write as a single power: $(5^2)^3$

12 9^0

13 2^{-3}

14 10^{-2}

15 $(2/3)^{-2}$

16 (Extended) $49^{1/2}$

17 (Extended) $64^{1/3}$

18 (Extended) $16^{3/4}$

19 (Extended) $125^{-2/3}$

20 Find n : $2^n = 1/32$

21 Use a calculator: 1.2^5

22 Use a calculator: $\sqrt{30}$ to 3 s.f.

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

Answer all the questions. Show all your working.**1** (*non-calculator*) Work out

(a) $2^4 \times 3^2$ **[1]**

(b) $\sqrt{16 \times 25}$ **[1]**

(c) $\sqrt[3]{0.008}$ **[1]**

2 (*non-calculator*) Simplify, leaving your answers in index form.

(a) $6^8 \times 6^{-3}$ **[1]**

(b) $(4^5)^2 \div 4^7$ **[1]**

(c) $5^n \times 5^4 = 5^{-2}$. Find the value of n . $n =$ **[1]**

3 (*non-calculator*) (*Extended*) Find the value of

(a) $36^{1/2}$ **[1]**

(b) $32^{-2/5}$ **[2]**

Answer

(c) $(8/27)^{-2/3}$ **[2]**

Answer**4** (*non-calculator*) (*Extended*) Find the value of x .

(a) $2^{x+1} = 64$ **[1]**

Answer $x =$

(b) $9^x = 27$ **[2]**

Answer $x =$

(c) $4^x \times 2^5 = 2^{-1}$ **[2]**

Answer $x =$

5 Use your calculator to work out

(a) $\sqrt{(5.6^2 + 3.3^2)}$ [1]

(b) $\sqrt[3]{(17.5 \times 4.2^2)}$, giving your answer correct to 3 significant figures, [2]

Answer

(c) 2.5^{-3} , giving your answer as a decimal, [1]

(d) 1.05^{10} , giving your answer correct to 4 significant figures. [1]

6 (non-calculator)

(a) Write $2^{10} \times 4^3$ as a single power of 2. [2]

Answer

(b) Write 0.125 as a power of 2. [1]

(c) (Extended) Write $\sqrt{8}$ as a power of 2. [1]

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

Fractions, decimals, percentages and ordering

I can... convert between fractions, decimals and percentages and put numbers in order.

Syllabus ref: C1.4, C1.5, E1.4, E1.5 · Core & Extended

Fractions, decimals and percentages are three ways of writing the same value: $\frac{3}{4} = 0.75 = 75\%$. To compare numbers, change them all to decimals and line up the decimal points.

Key points

- Fraction $\rightarrow$ decimal: divide the numerator by the denominator. Decimal $\rightarrow$ % : multiply by 100.
- Symbols: = equal, $\neq$ not equal, < less than, > greater than, $\leq$ less than or equal to, $\geq$ greater than or equal to.
- On a number line, -5 is to the left of -3, so $-5 < -3$.
- *Extended*: to change a recurring decimal to a fraction, multiply by 10, 100, ... so that the repeating parts line up, then subtract.

Key words

equivalent

terminating

recurring

inequality

simplest form

Worked example 1

Write in order, smallest first: $\frac{3}{8}$, 0.37, 38%, 0.333...

Change to decimals: $\frac{3}{8} = 0.375$, 0.37, 38% = 0.38, 0.333...

Order: **0.333..., 0.37, $\frac{3}{8}$, 38%**

Worked example 2

(Extended) Write 0.2777... as a fraction in its simplest form.

Let $x = 0.2777...$, so $10x = 2.777...$ and $100x = 27.777...$

$100x - 10x: 90x = 25$, so $x = \frac{25}{90} = \mathbf{\frac{5}{18}}$

Common mistakes

- Thinking $0.6 < 0.58$ because $58 > 6$. Compare 0.60 with 0.58.
- Ordering negative numbers by size of the digits: -2.55 is smaller than -2.05.
- Using the wrong power of 10 when two digits recur: 0.3636... needs $100x$.

Exam tip: When ordering, write each number as a decimal to the same number of places, then rewrite the list in its original form.

Answer each question. Show working where it helps.

1 Write $\frac{3}{8}$ as a decimal.

2 Write $\frac{7}{20}$ as a percentage.

3 Write 0.045 as a fraction in its simplest form.

4 Write 64% as a fraction in its simplest form.

5 Write $1\frac{3}{5}$ as a decimal.

6 Write $\frac{2}{3}$ as a percentage to 1 d.p.

7 Simplify $\frac{15}{24}$.

8 Write $\frac{7}{12}$ as a recurring decimal.

9 Write $<$, $>$ or $=$: $\frac{4}{7}$ 0.57

10 Write $<$, $>$ or $=$: 0.65 $\frac{13}{20}$

11 Write $<$, $>$ or $=$: -3 -5

12 Order, smallest first: 0.6, $\frac{5}{8}$, 61%, 0.606

13 Order, smallest first: -2.5 , -2.05 , -2.55

14 List the integers n such that $-3 < n \leq 2$.

15 Write using a symbol: x is at least 5.

16 (Extended) Write $0.777\ldots$ as a fraction.

17 (Extended) Write $0.363636\ldots$ as a fraction.

18 (Extended) Write $0.1666\ldots$ as a fraction.

19 (Extended) Write $0.0454545\ldots$ as a fraction.

20 (Extended) Write $2.1333\ldots$ as a mixed number.

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

Answer all the questions. Show all your working.

- 1** (*non-calculator*) Write these numbers in order of size, starting with the smallest.

7/16 0.43 44% 0.4333... 3/7

[2]**Answer**

- 2** (*non-calculator*)

(a) Write 0.85 as a fraction in its simplest form. **[1]**

(b) Write $\frac{3}{40}$ as a percentage. **[1]**

(c) Write $\frac{11}{8}$ as a decimal. **[1]**

(d) Write $2\frac{3}{4}$ as a percentage. **[1]**

(e) Write 0.007 as a fraction. **[1]**

- 3** (*non-calculator*) Write one of the symbols <, = or > in each box.

(a) $\frac{2}{3}$ ☐ 0.67 **[1]**

(b) 0.3^2 ☐ 0.3 **[1]**

(c) $(-2)^3$ ☐ -2^3 **[1]**

(d) 0.444... ☐ $\frac{4}{9}$ **[1]**

- 4** (*non-calculator*) (*Extended*)

(a) Show that $0.2454545... = \frac{27}{110}$. **[3]**

(b) Write 0.5181818... as a fraction in its simplest form. **[3]**

Answer

- 5 (non-calculator) A shop sells $\frac{3}{5}$ of its stock of rice in the morning.
It then sells 0.25 of the remaining stock in the afternoon.

(a) What percentage of the original stock is left at the end of the day? [3]

Answer %

(b) What percentage of the original stock was sold in the afternoon? % [1]

- 6 (non-calculator) Here are five numbers.

-1.5 $\frac{3}{4}$ -2 0.7 1.2

(a) Write the numbers in order, starting with the **largest**. [2]

Answer

(b) Which number is closest to 1? [1]

(c) Work out the difference between the largest and the smallest number. [1]

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

The four operations

I can... calculate with integers, fractions and decimals, using the correct order of operations.

Syllabus ref: C1.6, E1.6 · Core & Extended

Papers 1 and 2 are non-calculator, so you must be fluent with written methods. Work out calculations in this order: **B**rackets, **I**ndices, **D**ivision and **M**ultiplication (left to right), **A**ddition and **S**ubtraction (left to right).

For mixed numbers, change to improper fractions first.

Key words

order of operations

integer

mixed number

improper fraction

reciprocal

Key points

- Same signs multiply or divide to give a positive; different signs give a negative.
- Subtracting a negative is the same as adding: $6 - (-8) = 6 + 8$.
- Add or subtract fractions using a common denominator.
Multiply fractions: numerators $\times$ numerators, denominators $\times$ denominators.
- To divide by a fraction, multiply by its reciprocal: $\div \frac{2}{3}$ is $\times \frac{3}{2}$.

Worked example 1

Work out $2\frac{3}{4} \div 1\frac{5}{6}$. Give your answer as a mixed number.

Improper fractions: $\frac{11}{4} \div \frac{11}{6}$

Multiply by the reciprocal: $\frac{11}{4} \times \frac{6}{11} = \frac{66}{44} = \frac{3}{2}$

= **$1\frac{1}{2}$**

Common mistakes

- Working left to right and ignoring BIDMAS: $3 + 4 \times 5$ is 23, not 35.
- Adding denominators: $\frac{2}{5} + \frac{1}{3}$ is not $\frac{3}{8}$.
- Squaring a negative without brackets: $-2^2 = -4$ but $(-2)^2 = 4$.

Exam tip: Show every step of a fraction calculation; the method marks are for the improper fractions and the common denominator.

Answer each question. Show working where it helps.

1 $-7 + 12 =$

2 $-4 - 9 =$

3 $6 - (-8) =$

4 $(-5) \times (-6) =$

5 $-48 \div 6 =$

6 $3 + 4 \times 5 =$

7 $(3 + 4) \times 5 =$

8 $20 - 12 \div 4 + 1 =$

9 $2 \times 3^2 =$

10 $(18 - 6) \div (2 + 1) =$

11 $2/5 + 1/3 =$

12 $5/6 - 3/8 =$

13 $3/4 \times 8/15 =$

14 $4/9 \div 2/3 =$

15 $1\frac{1}{2} + 2\frac{2}{3} =$

16 $3\frac{1}{3} \times 1\frac{4}{5} =$

17 $3.6 \times 0.4 =$

18 $7.2 \div 0.06 =$

19 $36 \times 24 =$

20 $918 \div 27 =$

21 Insert brackets to make this true: $6 + 2 \times 5 - 3 = 16$

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

Answer all the questions. Show all your working.**1** (*non-calculator*) Show all your working.**(a)** Work out $4\frac{2}{3} - 1\frac{4}{5}$.

Give your answer as a mixed number in its simplest form.

[3]**Answer****(b)** Work out $2\frac{1}{4} \times 1\frac{5}{9}$.

Give your answer as a mixed number in its simplest form.

[3]**Answer****2** (*non-calculator*) At 06 00 the temperature in Harbin was -14°C and in Bangkok it was 27°C .**(a)** Work out the difference between these two temperatures. $^{\circ}\text{C}$ **[1]****(b)** By 12 00 the temperature in Harbin had risen by 9°C . Find the temperature in Harbin at 12 00. $^{\circ}\text{C}$ **[1]****(c)** The temperatures in Harbin at four times on one day were -14°C , -5°C , 3°C and -8°C . Work out the mean of these temperatures. **[2]****Answer** $^{\circ}\text{C}$ **3** (*non-calculator*)**(a)** Work out $15 - 3 \times (-4) + (-2)^2$. **[2]****Answer****(b)** Insert one pair of brackets to make this calculation correct.

$$3 + 9 \div 3 - 1 = 6$$

[1]

4 (non-calculator) Show all your working.

(a) A school buys 38 boxes of exercise books. Each box costs \$14.65.

Work out the total cost.

[3]

Answer \$

(b) 952 books are packed into boxes of 28. How many boxes are needed?

[2]

Answer

5 (non-calculator) Malee spends $\frac{2}{5}$ of her monthly money on rent and $\frac{1}{4}$ of the remaining money on food.

She has 6300 baht left.

Work out how much money she had at the start of the month.

[4]

Answer baht

6 (non-calculator)

(a) Work out 0.24×0.3 .

[1]

Answer

(b) Work out $4.8 \div 0.012$.

[1]

Answer

(c) $47 \times 63 = 2961$. Use this to write down the value of

(i) 4.7×0.63 (ii) $296.1 \div 6.3$

[2]

Answer (i) (ii)

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

Standard form

I can... write numbers in standard form and calculate with them, with and without a calculator.

Syllabus ref: C1.8, E1.8 · Core & Extended

Standard form is a short way of writing very large or very small numbers. A number in standard form looks like $A \times 10^n$, where $1 \leq A < 10$ and n is an integer.

Key points

- Large numbers have a positive power: $45\,000 = 4.5 \times 10^4$.
- Small numbers have a negative power: $0.000\,72 = 7.2 \times 10^{-4}$.
- To multiply or divide: deal with the numbers, then use the laws of indices for the powers of 10. Then check that A is between 1 and 10. To add or subtract, change to ordinary numbers first.

Key words

standard form

power of 10

ordinary number

significant figure

Worked example 1

Work out $(6 \times 10^5) \times (4 \times 10^{-2})$. Give your answer in standard form.

Multiply the numbers: $6 \times 4 = 24$. Add the powers: $10^{5 + (-2)} = 10^3$

24×10^3 is not in standard form: $24 = 2.4 \times 10^1$

Answer: 2.4×10^4

Worked example 2

Work out $(3.6 \times 10^7) \div (9 \times 10^3)$.

$3.6 \div 9 = 0.4$ and $10^7 \div 10^3 = 10^4$

$0.4 \times 10^4 = 4 \times 10^3$

Common mistakes

- Leaving an answer as 24×10^3 or 0.4×10^4 — this is not standard form.
- Typing 10^5 as $10 \times 10 \wedge 5$ on a calculator. Use the $\times 10^x$ key.

Exam tip: To order numbers in standard form, compare the powers of 10 first, then the values of A .

Give answers in standard form where asked. Do questions 1–15 without a calculator.

1 Write 45 000 in standard form.

2 Write 0.000 72 in standard form.

3 Write 3 080 000 in standard form.

4 Write 0.06 in standard form.

5 Write 5.1×10^5 as an ordinary number.

6 Write 2.07×10^{-3} as an ordinary number.

7 Write 34×10^5 in standard form.

8 Write 0.5×10^{-3} in standard form.

9 Write in order, smallest first:

3.2×10^4 , 5×10^3 , 2.9×10^4

10 $(2 \times 10^3) \times (4 \times 10^5)$

11 $(5 \times 10^4) \times (3 \times 10^2)$

12 $(8 \times 10^9) \div (2 \times 10^3)$

13 $(3 \times 10^4) \div (6 \times 10^{-2})$

14 $(4 \times 10^5) + (3 \times 10^4)$

15 $(6 \times 10^{-3})^2$

16 $(2.6 \times 10^5) \times (3.4 \times 10^7)$

17 $(7.8 \times 10^{-4}) \div (1.3 \times 10^2)$

18 $\sqrt{6.4 \times 10^9}$

19 $1 \div (2.5 \times 10^{-4})$

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

Answer all the questions. Show all your working.**1** (non-calculator)**(a)** Write 0.000 405 in standard form. [1]**(b)** Write 6.2×10^5 as an ordinary number. [1]**(c)** Work out $(7 \times 10^8) \times (5 \times 10^{-3})$.
Give your answer in standard form. [2]**Answer****(d)** Write these numbers in order, smallest first.
 3.1×10^{-2} 0.0029 3×10^{-3} [1]**2** (non-calculator) Give each answer in standard form.**(a)** Work out $(4.8 \times 10^6) \div (1.6 \times 10^{-2})$. [2]**Answer****(b)** Work out $6 \times 10^4 - 8 \times 10^3$. [2]**Answer****3** The distance from the Earth to the Sun is approximately 1.496×10^8 km.
Light travels at 3.00×10^5 km per second.**(a)** Work out the time, in seconds, for light to travel from the Sun to the Earth.
Give your answer correct to 3 significant figures. [2]**Answer** s**(b)** Write your answer to part (a) in minutes and seconds, to the nearest second. [1]

4 In one year, the population of Thailand was 7.18×10^7 and its land area was $5.13 \times 10^5 \text{ km}^2$.

(a) Work out the population density (people per km^2).

Give your answer correct to 3 significant figures.

[2]

Answer

(b) In the same year the population of Bangkok was 1.05×10^7 .

Work out the population of Bangkok as a percentage of the population of Thailand.

[2]

Answer %

5 The mass of one hydrogen atom is 1.67×10^{-24} grams.

(a) How many hydrogen atoms are there in 5 grams of hydrogen?

Give your answer in standard form, correct to 3 significant figures.

[2]

Answer

(b) Work out the mass, in grams, of 4.5×10^{20} hydrogen atoms.

Give your answer in standard form.

[2]

Answer g

6 (non-calculator) (Extended)

(a) $p = 2 \times 10^7$ and $q = 5 \times 10^{-3}$. Find pq , giving your answer in standard form.

[2]

Answer

(b) Write $(3 \times 10^k)^2$ in standard form.

[1]

(c) Write $(5 \times 10^k)^2$ in standard form.

[2]

Answer

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

Rounding, estimation and calculators

I can... round, estimate answers and use a calculator efficiently.

Syllabus ref: C1.9, C1.14, E1.9, E1.14 · Core & Extended

The first significant figure is the first non-zero digit. To **estimate**, round every number to 1 significant figure and work out the easier calculation. Estimates check that calculator answers are sensible.

Key points

- $0.047\ 382 = 0.0474$ (3 s.f.); zeros at the front are not significant.
- Keep place value: $38\ 650 = 39\ 000$ (2 s.f.), not 39.
- On a calculator use brackets around a whole numerator or denominator, and write down more figures than you need before rounding.

Key words

decimal place (d.p.)

significant figure (s.f.)

estimate

approximately $\approx$

Worked example 1

Estimate the value of $(48.7 \times 0.312) \div 19.6$. Show your rounding.

Round each number to 1 significant figure: $(50 \times 0.3) \div 20$

$= 15 \div 20 = \mathbf{0.75}$

Worked example 2

Use your calculator to work out $(3.7^2 + 2.1) \div (\sqrt{18.5} - 1.3)$. Give your answer to 3 s.f.

Top: $13.69 + 2.1 = 15.79$. Bottom: $4.3011\dots - 1.3 = 3.0011\dots$

$15.79 \div 3.0011\dots = 5.2613\dots = \mathbf{5.26}$

Common mistakes

- Rounding too early in a calculation — keep full calculator values until the end.
- Dividing by 0.5 and getting a smaller answer: $\div 0.5$ doubles the number.

Exam tip: If a question says 'show your working' for an estimate, write the rounded numbers you used.

Answer each question. Show working where it helps.

1 Round 6.4853 to 2 decimal places.

2 Round 0.047 382 to 3 significant figures.

3 Round 38 650 to 2 significant figures.

4 Round 9.9963 to 3 decimal places.

5 Round 0.000 401 9 to 1 significant figure.

6 Round 2045.5 to the nearest 10.

7 Round 89 999 to 3 significant figures.

8 Round 0.0905 to 2 significant figures.

9 Estimate 6.92×49.3 10 Estimate $812 \div 39$ 11 Estimate $(21.4 + 38.9) \div 0.48$ 12 Estimate $\sqrt{97.6}$ 13 Estimate 3.14×5.9^2 14 Estimate 0.59^2 15 Use a calculator: $(4.6 + 7.8) \div (2.3 \times 0.9)$ to 3 s.f.16 Use a calculator: $\sqrt{(12.5^2 - 3.5^2)}$ 17 Use a calculator: $3.2^3 - \sqrt{50}$ to 3 s.f.18 Use a calculator: $(5 + 1/4) \div (2 - 3/8)$ to 3 s.f.Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Answer all the questions. Show all your working.**1** (*non-calculator*)**(a)** Round 0.006 081 9 to 3 significant figures. **[1]****(b)** Round 54 296 to 2 significant figures. **[1]****(c)** Round 2.0496 to 2 decimal places. **[1]****(d)** By rounding each number to 1 significant figure, estimate the value of $(61.8 \times 3.04) \div 0.487$.You must show your working. **[2]****Answer****2****(a)** Use your calculator to work out $(13.6 - 2.7^2) \div (\sqrt{4.41} + 3.19)$.Write down all the figures on your calculator display. **[2]****Answer****(b)** Write your answer to part (a) correct to 3 significant figures. **[1]****3** A car uses 7.8 litres of fuel for every 100 km.

Ravi drives 432 km. Fuel costs 38.45 baht per litre.

(a) By rounding each number to 1 significant figure, estimate the cost of the fuel for Ravi's journey.Show your working. **[3]****Answer** baht**(b)** Calculate the actual cost of the fuel, correct to the nearest baht. **[2]****Answer** baht

4 (non-calculator) $2.8 \times 61 = 170.8$

Use this to write down the value of

(a) 28×6.1 [1]

(b) 0.28×0.061 [1]

(c) $1708 \div 6.1$ [1]

(d) $17.08 \div 0.28$ [1]

5 (Extended) Use your calculator to work out

(a) $(1/3 + 2/7) \div (4/5 - 1/9)$, giving your answer as a fraction in its simplest form, [2]

Answer

(b) $2.7^{-2} + 1.4^{3/2}$, giving your answer correct to 4 significant figures, [2]

Answer

(c) your answer to part (b) correct to 2 decimal places. [1]

6 (non-calculator)

(a) Write down the two consecutive integers that $\sqrt{150}$ lies between. [1]
and

(b) Without using a calculator, explain why $3 \times \sqrt{80.5}$ is less than 27. [2]

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

Limits of accuracy

I can... find upper and lower bounds and, for Extended, use them in calculations.

Syllabus ref: C1.10, E1.10 · Core & Extended

A rounded measurement could be anywhere in an interval. The **lower bound** is the smallest value that rounds to it; the **upper bound** is the largest value — it would round up, so we use $<$ on that side.

Key points

- Bounds = value $\pm$ half of the degree of accuracy: 60 kg (nearest kg) gives $59.5 \leq m < 60.5$.
- *Extended*: for the largest answer, add or multiply the upper bounds; for subtraction and division use upper $\div$ lower or upper $-$ lower.
- *Extended*: smallest $a - b$ = lower $a -$ upper b ; smallest $a \div b$ = lower $a \div$ upper b .

Key words

lower bound

upper bound

limits of accuracy

degree of accuracy

Worked example 1

The length l of a pencil is 7.4 cm, correct to 1 decimal place. Write the limits of accuracy.

Half of 0.1 is 0.05

$$7.35 \leq l < 7.45$$

Worked example 2

(Extended) A runner travels 120 m (nearest 5 m) in 14.2 s (nearest 0.1 s). Find the upper bound of the speed.

Upper bound of speed = upper distance $\div$ lower time

$$122.5 \div 14.15 = 8.657... = \mathbf{8.66 \text{ m/s}} \text{ (3 s.f.)}$$

Common mistakes

- Using the full step instead of half: 3.7 m (1 d.p.) has bounds 3.65 and 3.75, not 3.6 and 3.8.
- Using the upper bound of b to find the largest $a - b$.

Exam tip: Write down the bounds of every measurement first — this often earns a B1 mark even if the rest is wrong.

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

Write the lower and upper bounds of 60 kg, to the nearest kg.

2

Write the lower and upper bounds of 3.7 m, to 1 d.p..

3

Write the lower and upper bounds of 2400, to the nearest 100.

4

Write the lower and upper bounds of 0.48, to 2 d.p..

5

Write the lower and upper bounds of 45, to the nearest 5.

6

Write the lower and upper bounds of 5.2, to 2 s.f..

7

Write the lower and upper bounds of 300, to 1 s.f..

8

Write the lower and upper bounds of 8 cm, to the nearest 2 cm.

9A time t is 16 s to the nearest second. Write an inequality for t .**10**A mass m is 2.50 kg to 2 d.p. Write an inequality for m .**11***(Extended)* $a = 8$ and $b = 5$, both to the nearest whole number. Find the upper bound of $a + b$.**12***(Extended)* Same a and b . Find the lower bound of $a - b$.**13***(Extended)* Same a and b . Find the upper bound of ab .**14***(Extended)* Same a and b . Find the lower bound of $a \div b$ (3 s.f.).**15***(Extended)* A square has side 6.0 cm (1 d.p.). Find the upper bound of its perimeter.**16***(Extended)* A rectangle is 4.2 cm by 3.8 cm (both 1 d.p.). Find the lower bound of its area.Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Answer all the questions. Show all your working.

- 1 (a) The mass, m kg, of a parcel is 2.8 kg, correct to the nearest 100 g.
Complete the statement about m . [2]

Answer $\leq m <$

- (b) The height, h cm, of a student is 170 cm, correct to the nearest 10 cm.
Complete the statement about h . [2]

Answer $\leq h <$

- (c) There are 30 children on a bus, correct to the nearest 10.
Write down the smallest possible number of children on the bus. [1]

- 2 A shop has 40 bags of rice. The mass of each bag is 5.0 kg, correct to the nearest 0.1 kg.

- (a) Work out the lower bound for the total mass of the 40 bags. [2]

Answer kg

- (b) Work out the upper bound for the total mass of the 40 bags. kg [1]

- 3 (Extended) A rectangle measures 12.4 cm by 7.6 cm, each correct to the nearest 0.2 cm.

- (a) Calculate the upper bound for the area of the rectangle. [3]

Answer cm^2

- (b) Calculate the lower bound for the perimeter of the rectangle. [2]

Answer cm

- 4 (Extended) Kanya runs 250 m, correct to the nearest 10 m.
Her time is 31.4 seconds, correct to the nearest 0.1 second.

- (a) Write down the upper bound of her time. s [1]

- (b) Calculate the lower bound of her average speed.
Give your answer correct to 3 significant figures. [3]

Answer m/s

5 (Extended) $p = 18$, correct to the nearest whole number.

$q = 4.5$, correct to 1 decimal place.

(a) Calculate the upper bound of $p \div q$. Give your answer correct to 3 significant figures. [3]

Answer

(b) Calculate the lower bound of $p - q$. [2]

Answer

6 The length of one side of a field is 85 m, correct to the nearest metre.

A farmer has 34 fence panels. The length of each panel is 2.5 m, correct to the nearest 0.1 m.

Show that 34 panels might **not** be enough to fence this side of the field. [3]

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

Ratio and proportion

I can... simplify ratios, share in a ratio and solve direct and inverse proportion problems.

Syllabus ref: C1.11, E1.11 · Core & Extended

A **ratio** compares quantities. Make the units the same before simplifying. In **direct proportion** both quantities increase together; in **inverse proportion** one goes up as the other goes down.

Key points

- Simplify by dividing every part by the HCF: $24 : 36 = 2 : 3$.
- To share, add the parts, find one part, then multiply.
- Unitary method: find the value of one item first.
- *Extended*: to increase 60 in the ratio $5 : 4$, work out $60 \times \frac{5}{4} = 75$.

Key words

ratio

simplest form

direct proportion

inverse proportion

scale

Worked example 1

Share \$840 in the ratio 2 : 3 : 7.

Total parts: $2 + 3 + 7 = 12$. One part: $840 \div 12 = 70$

Shares: $2 \times 70, 3 \times 70, 7 \times 70 = \text{\$140, \$210, \$490}$

Worked example 2

6 workers take 15 days to paint a school. How long would 9 workers take?

More workers $\rightarrow$ fewer days (inverse proportion).

Total work: $6 \times 15 = 90$ worker-days. $90 \div 9 = \text{10 days}$

Common mistakes

- Dividing by the wrong total: for $2 : 3 : 7$ there are 12 parts, not 7.
- Forgetting to change 1.2 kg into 1200 g before simplifying.

Exam tip: Check your shares add up to the original amount.

Answer each question. Show working where it helps.

1 Simplify $24 : 36$

2 Simplify $450 \text{ g} : 1.2 \text{ kg}$

3 Simplify $1.5 : 2.25$

4 Simplify $2/3 : 5/6$

5 Write $4 : 10$ in the form $1 : n$.

6 Share 72 in the ratio $5 : 3$.

7 Share 3.6 kg in the ratio $1 : 2 : 3$.

8 Boys : girls = $4 : 5$. There are 35 girls.
How many boys?

9 250 g of flour makes 10 cookies.
How much flour for 18 cookies?

10 5 pens cost \$4.40. Find the cost of 8 pens.

11 4 taps fill a tank in 9 hours. How long do 6 taps take?

12 Map scale $1 : 25\,000$. 6 cm on the map is how many km?

13 (Extended) Increase 60 in the ratio $5 : 4$.

14 (Extended) Decrease 84 in the ratio $3 : 7$.

15 $A : B = 3 : 4$ and $B : C = 6 : 5$. Find $A : B : C$.

16 Two numbers are in the ratio $7 : 4$. Their difference is 15. Find their sum.

17 A recipe uses sugar and flour in the ratio $2 : 5$. Write the sugar as a fraction of the total.

18 Write $35 \text{ cm} : 2 \text{ m}$ in its simplest form.

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

Answer all the questions. Show all your working.

- 1** Anan, Ben and Chai share \$1500 in the ratio 4 : 5 : 6.

(a) Show that Chai receives \$600. [2]

(b) Ben gives $\frac{1}{5}$ of his share to Anan.

Find the new ratio Anan : Ben : Chai in its simplest form. [3]

Answer : :

- 2** Concrete is made by mixing cement, sand and gravel in the ratio 1 : 2 : 4 by mass.
A builder has 50 kg of cement, 120 kg of sand and 180 kg of gravel.

(a) Work out the largest mass of concrete the builder can make. [3]

Answer kg

(b) How much sand is left over? kg [1]

- 3** A recipe for 6 people uses 300 g of rice and 450 ml of coconut milk.

(a) Work out the amounts needed for 10 people. [2]

Answer rice g coconut milk ml

(b) Coconut milk is sold in 400 ml cans. How many cans are needed for 10 people? [1]

- 4** (Extended) 8 identical machines complete an order in 15 hours.

(a) How long would 12 of these machines take to complete the same order? [2]

Answer hours

(b) The order must be completed in 6 hours. How many machines are needed? [2]

Answer

5 (Extended)

(a) $x : y = 3 : 5$ and $y : z = 2 : 7$. Find $x : z$ in its simplest form. **[2]**

Answer

(b) In a bag, the ratio of red counters to blue counters is $2 : 7$.

6 red counters are added. The ratio is now $1 : 2$.

Work out the number of blue counters in the bag. **[3]**

Answer

6 A map has a scale of $1 : 50\,000$.

(a) The distance between two villages on the map is 7.2 cm. Work out the actual distance in kilometres. **[2]**

Answer km

(b) (Extended) A lake has an area of 3 cm^2 on the map. Work out the actual area of the lake in km^2 . **[2]**

Answer km^2

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

Rates, time and money

I can... solve problems with speed, density, other rates, time and money.

Syllabus ref: C1.12, C1.15, C1.16, E1.12 · Core & Extended

A **rate** compares two different quantities, such as km per hour or baht per litre. Always change a time in hours and minutes into hours before you use it: 2 h 15 min = 2.25 h, not 2.15 h.

Key points

- Speed = distance ÷ time Density = mass ÷ volume
Pressure = force ÷ area
- Average speed = total distance ÷ total time (include any stops).
- Exchange: multiply by the rate to change \$ into baht; divide to change back.
- *Extended:* km/h → m/s: $\times 1000 \div 3600$ (or $\div 3.6$).

Key words

average speed

density

pressure

exchange rate

24-hour clock

Worked example 1

A coach travels 150 km in 2 hours 15 minutes. Work out its average speed.

Change the time to hours: 15 min = $15/60 = 0.25$ h, so 2.25 h

Speed = $150 \div 2.25 = 66.66\dots = \mathbf{66.7 \text{ km/h}}$ (3 s.f.)

Worked example 2

(Extended) Change 72 km/h into m/s.

72 km/h = 72 000 m in 3600 s

$72\,000 \div 3600 = \mathbf{20 \text{ m/s}}$

Common mistakes

- Treating 2 h 15 min as 2.15 hours.
- Finding the mean of two speeds instead of total distance ÷ total time.

Exam tip: Write the units with every answer (km/h, g/cm³) — it shows you used the right formula.

Answer each question. Show working where it helps.

1 Find the average speed: 180 km in 2.5 hours.

2 How long does it take to travel 84 km at 56 km/h?

3 How far do you travel in 45 minutes at 64 km/h?

4 (Extended) Change 15 m/s into km/h.

5 (Extended) Change 90 km/h into m/s.

6 Find the density: mass 540 g, volume 200 cm³.

7 Density 7.9 g/cm³. Find the mass of 50 cm³.

8 A force of 600 N acts on 1.5 m². Find the pressure.

9 2.4 million people live in 1600 km². Find the population density.

10 Which is better value: 500 ml for 45 baht or 750 ml for 64 baht?

11 A tap fills 240 litres in 8 minutes. Find the rate of flow.

12 Write 3 hours 24 minutes in hours as a decimal.

13 Write 2.65 hours in hours and minutes.

14 How long is it from 09 45 to 14 20?

15 Write 7.40 pm using the 24-hour clock.

16 \$1 = 34.50 baht. Change \$120 into baht.

17 \$1 = 34.50 baht. Change 2760 baht into dollars.

18 €1 = 38.20 baht. Change €500 into baht.

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

Answer all the questions. Show all your working.

- 1 A train leaves Bangkok at 18 10 and arrives in Chiang Mai at 07 15 the next day.
The distance is 751 km.

(a) Work out the time taken for the journey. [1]

(b) Calculate the average speed of the train. Give your answer correct to 3 significant figures. [2]

Answer km/h

(c) The train stops at stations for a total of 95 minutes.
Calculate the average speed of the train while it is moving. [2]

Answer km/h

- 2 A cuboid of gold measures 2 cm by 3 cm by 5 cm. The density of gold is 19.3 g/cm^3 .

(a) Calculate the mass of the cuboid. [2]

Answer g

(b) A piece of silver has the same mass. The density of silver is 10.5 g/cm^3 .
Calculate the volume of the silver. Give your answer correct to 3 significant figures. [2]

Answer cm^3

- 3 Water is sold in two packs.

Pack A: 6 bottles of 1.5 litres for 129 baht. **Pack B:** 4 bottles of 2.25 litres for 149 baht.

Which pack is better value? Show how you decide. [3]

4 (Extended) A car travels at a constant speed of 108 km/h.

(a) Change 108 km/h into metres per second. [2]

Answer m/s

(b) How far does the car travel in 25 seconds? m [1]

(c) A cheetah can run at 29 m/s. Is the cheetah faster than the car? Show how you decide. [2]

5 Nina changes \$650 into Thai baht when the exchange rate is \$1 = 35.20 baht.

(a) How many baht does she receive? baht [1]

(b) She spends 18 400 baht. She changes the rest back into dollars when the rate is \$1 = 36.40 baht.

How many dollars does she receive? Give your answer correct to the nearest cent. [2]

Answer \$

6 Mai cycles 24 km at 16 km/h. She rests for 30 minutes. She then cycles 18 km at 12 km/h.

(a) Calculate her average speed for the whole journey, including the rest. [4]

Answer km/h

(b) On the way home she cycles the 42 km in 2 hours 48 minutes. Calculate her average speed. km/h [1]

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

Percentages

I can... solve percentage problems, including interest and, for Extended, reverse percentages.

Syllabus ref: C1.13, E1.13 · Core & Extended

A **multiplier** makes percentage questions quick. An increase of 12% means 112% of the original, so multiply by 1.12. A decrease of 35% leaves 65%, so multiply by 0.65.

Key points

- Percentage change = $\text{change} \div \text{original} \times 100$.
- Simple interest: the same interest every year = $P \times r/100 \times n$.
- Compound interest: value = $P \times (1 + r/100)^n$.
- *Extended*: reverse percentage: original = new value $\div$ multiplier.

Key words

multiplier

percentage change

simple interest

compound interest

reverse percentage

Worked example 1

(Extended) After a 15% discount a bicycle costs \$340. Find the original price.

The sale price is $100\% - 15\% = 85\%$ of the original, so multiplier 0.85

Original = $340 \div 0.85 = \text{\$400}$

Worked example 2

\$2500 is invested at 3.2% per year compound interest. Find its value after 4 years.

Multiplier 1.032, used 4 times: 2500×1.032^4

= 2835.690... = **\\$2835.69**

Common mistakes

- Finding 15% of the sale price and adding it on, instead of dividing by 0.85.
- Dividing by the new value when finding percentage change.

Exam tip: For money answers, give the final answer to the nearest cent (2 d.p.) unless told otherwise.

Answer each question. Show working where it helps.**1** Find 35% of 260. **2** Find 17.5% of 80. **3** Write 48 as a percentage of 64.
4 Increase 250 by 12%. **5** Decrease 84 by 35%. **6** Write down the multiplier for an increase of 7%. **7** Write down the multiplier for a decrease of 18%. **8** Find the percentage change from 40 to 46. **9** Find the percentage change from 125 to 95. **10** Find the simple interest on \$600 at 4% per year for 3 years. **11** \$5000 is invested at 2% compound interest. Find the value after 3 years.
12 A watch bought for \$80 is sold for \$92. Find the percentage profit.
13 Find 1.5% of 2.4 million. **14** Add 7% VAT to 1200 baht.
15 (*Extended*) After a 20% increase a price is \$540. Find the original price.
16 (*Extended*) After a 30% decrease a value is 315. Find the original value.
17 Write $\frac{3}{8}$ as a percentage. **18** Which is larger: 40% of 70 or 70% of 40? Reflect: ☐ Red — not yet ☐ Amber — nearly ☐ Green — secure

Answer all the questions. Show all your working.

1

(a) A phone costs 18 500 baht. In a sale the price is reduced by 12%.

Calculate the sale price.

[2]

Answer baht

(b) (Extended) The sale price of a laptop is 23 800 baht. This is after a reduction of 15%.

Calculate the original price.

[3]

Answer baht

2

Mai invests \$4000 at a rate of 2.5% per year **simple** interest.

(a) Calculate the interest she receives in 6 years.

[2]

Answer \$

(b) After how many complete years will the total value of her investment first be more than \$5000?

[2]

Answer

3

Tom invests \$4000 at a rate of 2.4% per year **compound** interest.

(a) Calculate the value of his investment after 6 years. Give your answer correct to the nearest cent.

[2]

Answer \$

(b) Use your answer to question 2(a). After 6 years, how much more does Tom's investment have than Mai's? \$

[1]

4 The population of a village increased from 2450 to 2793 in one year.

(a) Calculate the percentage increase.

[2]

Answer %

(b) In the next year the population decreased by 14%. Ana says the population is now 2450 again.

Is Ana correct? Show your working.

[2]

(c) Find the overall percentage change over the two years.

[2]

Answer %

5 (Extended) In 2025 a school had 1288 students. This was 12% more than in 2024. Calculate the number of students in 2024.

[3]

Answer

6 A trader buys 150 shirts for \$8 each. He sells 120 of the shirts for \$13.50 each and sells the rest in a sale at 40% off this price. Calculate his percentage profit.

[4]

Answer %

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

Exponential growth and decay

I can... use multipliers to model repeated percentage growth and decay.

Syllabus ref: E1.17 · Extended

When a quantity changes by the same **percentage** every time period, it grows or decays exponentially. Value after n periods = starting value $\times$ (multiplier) ^{n} .

Key points

- Growth of $r\%$: multiplier $1 + r/100$ (greater than 1). Decay of $r\%$: multiplier $1 - r/100$ (less than 1).
- **Depreciation** is a loss in value over time.
- To find when a value passes a target, try values of n until it first goes past it.
- To find the start value, divide by (multiplier) ^{n} .

Key words

exponential growth

exponential decay

depreciation

multiplier

half-life

Worked example 1

A car bought for \$24 000 loses 15% of its value each year. Find its value after 3 years.

Multiplier for a 15% decrease: 0.85

$$24\,000 \times 0.85^3 = \mathbf{\$14\,739}$$

Worked example 2

There are 500 bacteria. The number doubles every 20 minutes. How many are there after 3 hours?

3 hours = 180 minutes = 9 lots of 20 minutes

$$500 \times 2^9 = \mathbf{256\,000}$$

Common mistakes

- Using simple interest (the same amount each year) instead of compound.
- Multiplying by 0.15 for a 15% decrease instead of by 0.85.

Exam tip: In 'how many years' questions, show the values just below and just above the target.

Answer each question. Show working where it helps.

1 \$800 grows by 5% per year. Find its value after 3 years.

2 12 000 decreases by 20% per year. Find its value after 2 years.

3 Work out 5000×1.03^{10} to the nearest cent.

4 A population of 45 000 grows by 2.5% per year. Find it after 4 years (nearest whole number).

5 64 g of a substance halves every 5 years. How much is left after 20 years?

6 Write down the multiplier for a decrease of 6% per year.

7 $V = 2000 \times 1.04^n$. What is the yearly percentage increase?

8 \$3000 becomes \$3307.50 after 2 years of compound interest. Find the rate.

9 A value of 10 000 decreases by 9% per year. After how many complete years is it first below 5000?

10 200 bacteria triple every hour. How many after 4 hours?

11 After 3 years of 10% growth a value is 1331. Find the starting value.

12 Find the overall percentage increase after three years of 10% growth.

13 80 mg of a medicine halves every 6 hours. How much is left after 24 hours?

14 Which is exponential growth: $y = 3x + 2$ or $y = 3 \times 2^x$?

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

Answer all the questions. Show all your working.

- 1** The value of a house is \$180 000. Its value increases by 4% each year.

(a) Calculate the value of the house after 5 years. Give your answer correct to the nearest dollar. [2]

Answer \$

(b) Find the number of complete years until the value of the house is first more than \$250 000. [3]

Answer

- 2** A new car costs \$32 000.

In the first year its value decreases by 18%. In each following year its value decreases by 12%.

(a) Calculate the value of the car after 4 years. [3]

Answer \$

(b) Calculate the overall percentage decrease in the value over the 4 years. % [1]

- 3** The number of fish, P , in a lake after t years is modelled by $P = 2400 \times 0.92^t$.

(a) Write down the number of fish at the start. [1]

(b) Write down the percentage decrease each year. % [1]

(c) Calculate the number of fish after 6 years. [2]

Answer

(d) After how many complete years will there first be fewer than 1000 fish? [2]

Answer

- 4 \$6000 is invested at $r\%$ per year compound interest.
After 3 years the investment is worth \$6749.18, correct to the nearest cent.
Find the value of r . [3]

Answer $r =$

- 5 A machine loses 6% of its value each year. After 4 years it is worth \$39 037.45.
Calculate the value of the machine when it was new. [3]

Answer \$

- 6 At 08 00 there are 1500 bacteria in a dish. The number increases by 35% every hour.

(a) Calculate the number of bacteria at 13 00. [2]

Answer

(b) At what time does the number of bacteria first become more than 20 000? [2]

Answer

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

Surds

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

Syllabus ref: E1.18 · Extended

A **surd** is a root that cannot be written exactly, such as $\sqrt{2}$.
 Surds give exact answers. To simplify, find the largest square factor: $\sqrt{72} = \sqrt{(36 \times 2)} = 6\sqrt{2}$.

Key points

- $\sqrt{a} \times \sqrt{b} = \sqrt{ab}$ $\sqrt{a} \div \sqrt{b} = \sqrt{(a/b)}$ $\sqrt{a} \times \sqrt{a} = a$
- You can only add like surds: $6\sqrt{2} + 5\sqrt{2} = 11\sqrt{2}$, but $\sqrt{2} + \sqrt{3}$ cannot be simplified.
- Rationalise $a/\sqrt{b}$: multiply top and bottom by $\sqrt{b}$.
- Rationalise $1/(a - \sqrt{b})$: multiply by $(a + \sqrt{b})$; the bottom becomes $a^2 - b$.

Key words

surd

simplest form

rationalise

denominator

Worked example 1

Simplify $\sqrt{72} + \sqrt{50}$.

$$\sqrt{72} = \sqrt{36 \times 2} = 6\sqrt{2} \text{ and } \sqrt{50} = \sqrt{25 \times 2} = 5\sqrt{2}$$

$$6\sqrt{2} + 5\sqrt{2} = \mathbf{11\sqrt{2}}$$

Worked example 2

Rationalise the denominator of $4/(3 - \sqrt{5})$.

Multiply top and bottom by $3 + \sqrt{5}$: $4(3 + \sqrt{5}) / ((3 - \sqrt{5})(3 + \sqrt{5}))$

Bottom: $9 - 5 = 4$. Answer: $\mathbf{3 + \sqrt{5}}$

Common mistakes

- Writing $\sqrt{9} + \sqrt{16} = \sqrt{25}$. In fact $3 + 4 = 7$.
- Forgetting the middle terms when squaring: $(5 - \sqrt{3})^2 \neq 25 + 3$.

Exam tip: Surd questions are on the non-calculator paper — write every line of working.

Answer each question. Show working where it helps.

1 Simplify $\sqrt{12}$

2 Simplify $\sqrt{45}$

3 Simplify $\sqrt{200}$

4 Simplify $\sqrt{98}$

5 Simplify $\sqrt{8} + \sqrt{18}$

6 Simplify $\sqrt{75} - \sqrt{27}$

7 Simplify $\sqrt{3} \times \sqrt{12}$

8 Simplify $\sqrt{6} \times \sqrt{10}$

9 Rationalise: $(2\sqrt{5})^2$

10 Simplify $\sqrt{50} \div \sqrt{2}$

11 Rationalise: $1/\sqrt{7}$

12 Rationalise: $10/\sqrt{5}$

13 Rationalise: $9/(2\sqrt{3})$

14 Simplify $(3 + \sqrt{2})(3 - \sqrt{2})$

15 Rationalise: $(1 + \sqrt{3})^2$

16 Simplify $\sqrt{5}(\sqrt{5} + 2)$

17 Simplify $(2 + \sqrt{5})(3 - \sqrt{5})$

18 Rationalise: $2/(\sqrt{3} - 1)$

19 Simplify $\sqrt{48} \div \sqrt{3}$

20 Simplify $\sqrt{(4/9)}$

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

Answer all the questions. Show all your working.**1** (*non-calculator*)**(a)** Simplify $\sqrt{180}$ [1]**(b)** Simplify $\sqrt{20} + \sqrt{125} - \sqrt{45}$. [2]**Answer****(c)** Write $\sqrt{8} \times \sqrt{14}$ in the form $a\sqrt{b}$, where a and b are integers and b is prime. [1]**2** (*non-calculator*) Expand and simplify.**(a)** $(5 - \sqrt{3})^2$ [2]**Answer****(b)** $(\sqrt{7} + 2)(\sqrt{7} - 3)$ [2]**Answer****3** (*non-calculator*) Rationalise the denominator and simplify.**(a)** $14/\sqrt{7}$ [2]**Answer****(b)** $6/(\sqrt{5} + 1)$ [3]**Answer**

4 (non-calculator) A rectangle has sides of length $(3 + \sqrt{2})$ cm and $(3 - \sqrt{2})$ cm.

(a) Work out the area of the rectangle. [2]

Answer cm^2

(b) Work out the perimeter of the rectangle. cm [1]

(c) Show that the length of a diagonal of the rectangle is $\sqrt{22}$ cm. [2]

5 (non-calculator)

(a) Show that $(\sqrt{12} + \sqrt{27}) \div \sqrt{3} = 5$. [2]

(b) Write $1/\sqrt{2} + \sqrt{8}$ in the form $k\sqrt{2}$. [2]

Answer

6 (non-calculator) A square has an area of 72 cm^2 .

(a) Find the length of a side of the square. Give your answer in the form $a\sqrt{b}$. [2]

Answer cm

(b) Find the perimeter of the square in its simplest surd form. cm [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. Do questions 1–7 and 11 without a calculator.

1 Find the LCM of $2^2 \times 3 \times 5$ and $2 \times 3^2 \times 7$. Give your answer as an ordinary number.

2 $n(A) = 15$, $n(B) = 12$, $n(A \cap B) = 4$. Find $n(A \cup B)$.

3 Find the value of $81^{3/4}$.

4 Write $0.0363636\ldots$ as a fraction in its simplest form.

5 Work out $(4.2 \times 10^5) \times (3 \times 10^{-8})$ in standard form.

6 Estimate $(9.87 \times 0.203) \div 0.0496$.

7 $a = 6.4$ and $b = 2.1$, both to 1 d.p. Find the upper bound of $a - b$.

8 After a 25% decrease, a price is \$240. Find the original price.

9 \$3500 is invested at 3% per year compound interest. Find its value after 5 years.

10 $x : y = 2 : 3$ and $x + y = 75$. Find y .

11 Simplify $\sqrt{300} - \sqrt{12}$.

12 Change 25 m/s into km/h.



Practice paper

Name _____ Date _____ Marks _____ / 60

Time: 1 hour 15 minutes

Questions 1–7: no calculator (Paper 1/2 style). Questions 8–15: calculator allowed (Paper 3/4 style).

Total: 60 marks

Questions marked *(Extended)* are for Extended candidates.

Answer all questions. Show all your working. Give non-exact answers correct to 3 significant figures unless told otherwise.

1 *(non-calculator)***(a)** Write 252 as a product of its prime factors. [2]

Answer

(b) Find the lowest common multiple (LCM) of 252 and 120. [2]

Answer

2 *(non-calculator)* Work out $3\frac{1}{8} \div 1\frac{7}{8}$.

Give your answer as a mixed number in its simplest form. [3]

Answer

3 *(non-calculator)* $\mathcal{E} = \{1, 2, 3, \dots, 12\}$ $A = \{\text{factors of } 12\}$ $B = \{\text{odd numbers}\}$ **(a)** List the elements of $A \cap B$ [1]**(b)** Find $n(A)$ [1]**(c)** Find $n((A \cup B)')$ [1]**(d)** Use set notation to describe the set $\{8, 10\}$ [1]

4 (non-calculator) Find the value of

(a) $5^0 + 5^{-1}$ [1]

(b) (Extended) $125^{2/3}$ [1]

(c) n , when $3^n = 1/81$ $n =$ [1]

(d) (Extended) $(1/4)^{-3/2}$ [2]

Answer

5 (non-calculator) Give your answers in standard form.

(a) $(9 \times 10^4) \times (7 \times 10^{-9})$ [2]

Answer

(b) $(2.4 \times 10^5) + (6 \times 10^4)$ [2]

Answer

6 (non-calculator) (Extended) Write the recurring decimal 0.4363636... as a fraction in its simplest form.

Show all your working.

[3]

Answer

7 (non-calculator) (Extended)

(a) Simplify $(2\sqrt{3})^3$ [1]

(b) Rationalise the denominator and simplify $12/(3 - \sqrt{3})$. [3]

Answer

- 8 A fish tank is a cuboid. It measures 80 cm by 45 cm by 30 cm, each correct to the nearest centimetre.

(a) (Extended) Calculate the upper bound of the volume of the tank in litres. [3]

Answer litres

(b) (Extended) Calculate the lower bound of the volume of the tank in litres. [2]

Answer litres

- 9 The price of a television increased by 8% to 15 120 baht.

(a) (Extended) Calculate the price before the increase. [2]

Answer baht

(b) The new price is then reduced by 8%. Calculate the reduced price. [1]
baht

(c) Calculate the overall percentage change from the original price. [2]

Answer %

- 10 The population of a town is 86 000. The population decreases by 1.5% each year.

(a) Calculate the population after 5 years. Give your answer to the nearest whole number. [2]

Answer

(b) (Extended) After how many complete years will the population first be less than 75 000? [3]

Answer

- 11 Kofi and Lin share the profit from a business in the ratio 5 : 3.
Kofi receives \$1250 more than Lin.

(a) Calculate the total profit. [3]

Answer \$

(b) Lin gives $\frac{1}{4}$ of her share to charity. How much does she give? \$ [1]

- 12** A plane leaves Bangkok at 23 40 local time. It lands in London at 06 05 London time the next day.

London time is 6 hours behind Bangkok time. The flight distance is 9580 km.

(a) Work out the flight time.

[2]

Answer

(b) Calculate the average speed of the plane.

[2]

Answer km/h

(c) The return flight takes 30 minutes less. Calculate its average speed.
km/h

[1]

- 13** **(a)** Use your calculator to work out $\sqrt{(7.3^2 - 2.4^3)} \div (1.8 + 0.65^2)$.

Give your answer correct to 4 significant figures.

[2]

Answer

(b) Write your answer to part (a) correct to 1 decimal place.

[1]

- 14** A laptop costs S\$1849 in Singapore. The same laptop costs 47 990 baht in Bangkok. The exchange rate is S\$1 = 26.34 baht.

In which city is the laptop cheaper, and by how many baht?

[3]

- 15** Water flows into an empty tank at a rate of 12.5 litres per minute.

The tank holds 2.4 m^3 . ($1 \text{ m}^3 = 1000 \text{ litres}$)

Calculate the time taken to fill the tank. Give your answer in hours and minutes.

[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 $2 \times 3^2 \times 5$
- 2 6
- 3 5
- 4 $1/9$
- 5 5.2×10^{-3}
- 6 $13/20$
- 7 $11/12$
- 8 3.06
- 9 11.5 cm
- 10 20 and 25
- 11 92
- 12 80 km/h

Unit 1 · Sheet A — Types of number

- 1 $2^2 \times 3 \times 7$
- 2 $2 \times 3 \times 5^2$
- 3 $2^2 \times 7^2$
- 4 $2^3 \times 7 \times 11$
- 5 $2^3 \times 5^3$
- 6 12
- 7 14
- 8 36
- 9 48
- 10 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60
- 11 31, 37, 41, 43, 47
- 12 7, 23
- 13 $1/5$
- 14 $7/2$
- 15 $0.8 (= 4/5)$
- 16 28
- 17 169
- 18 216
- 19 $\sqrt{20}, \pi$
- 20 63

Unit 1 · Sheet B — Types of number

- 1 (a) M1 at least two correct divisions or factor tree; A1 $2^3 \times 3 \times 7^2$ [2] (b) M1 $420 = 2^2 \times 3 \times 5 \times 7$ oe; A1 84 [2] (c) M1 $2^3 \times 3 \times 5 \times 7^2$ oe; A1 5880 [2]
- 2 (a) B1 13, 41 [1] (b) B1 36, 49 [1] (c) B1 27 [1] (d) B1 $\sqrt{50}$ [1] (e) B1 18, 27 [1]
- 3 M1 lists multiples of 18 and 24 or uses prime factors; A1 LCM = 72 seconds; A1 21 01 12 (72 s after 21 00) [3]
- 4 (a) M1 HCF of 420 and 540; A1 60 cm [2] (b) M1 $(420 \div 60) \times (540 \div 60)$ oe; A1 63 [2]
- 5 (a) B1 504 [1] (b) M1 identifies odd powers 2^3 and 7^1 ; A1 14 [2] (c) M1 needs 3×7^2 oe; A1 147 [2]
- 6 (a) B1 2.5 oe [1] (b) B1 e.g. $\sqrt{40}$ (any $\sqrt{n}$ with $36 < n < 49$, n not square, or $\pi + 3$) [1] (c) B1 it can be written as a fraction of integers, e.g. $9/25$ [1]

Unit 2 · Sheet A — Sets and Venn diagrams

- 1 {2, 3, 5, 7, 11, 13}
- 2 {2}
- 3 12
- 4 {1, 9, 15}
- 5 9
- 6 $\notin$
- 7 {p, a, t, y}
- 8 {a}
- 9 35
- 10 5
- 11 10
- 12 the empty set
- 13 True
- 14 {-1, 0, 1, 2, 3}
- 15 {-4, 4}
- 16 6

Unit 2 · Sheet B — Sets and Venn diagrams

- 1 (a) B2 M only 12, 18, 24; M n O 15, 21; O only 11, 13, 17, 19, 23; outside 14, 16, 20, 22 (B1 for 3 regions correct) [2] (b) B1 4 [1] (c) B1 {11, 13, 17, 19, 23} [1] (d) B1 $\notin$ [1] (e) B1 5 [1]
- 2 (a) B1 B only shaded [1] (b) B1 region outside both circles shaded [1] (c) B1 $(A \cup B)' \cup A$ or $A \cup B'$ oe [1] (d) B1 $A \cap B$ [1]
- 3 (a) M1 $(28 - x) + x + (23 - x) + 6 = 50$ oe; A1 $57 - x = 50$ so $x = 7$ [2] (b) B1 21 [1] (c) B1 29 [1] (d) B1 44 [1]
- 4 (a) B1 11 [1] (b) B1 9 [1] (c) B1 4 [1] (d) ft B1 17 ($= x + 6$) [1] (e) ft B1 29 [1]
- 5 (a) B1 {4, 8, 12} [1] (b) B1 9 [1] (c) B1 C = {1, 2, 3}; B1 yes, 1, 2 and 3 are all factors of 24 [2] (d) B1 4 [1]

Unit 3 · Sheet A — Powers, roots and indices

- 1 169
- 2 14
- 3 64
- 4 5
- 5 0.7
- 6 -27
- 7 -4
- 8 32
- 9 7^9
- 10 3^6
- 11 5^6
- 12 1
- 13 $1/8$
- 14 $1/100$ (0.01)
- 15 $9/4$
- 16 7
- 17 4
- 18 8
- 19 $1/25$
- 20 -5
- 21 2.48832
- 22 5.48

Unit 3 · Sheet B — Powers, roots and indices

- 1 (a) B1 144 [1] (b) B1 20 [1] (c) B1 0.2 [1]
- 2 (a) B1 6^5 [1] (b) B1 4^3 [1] (c) B1 -6 [1]
- 3 (a) B1 6 [1] (b) M1 $(\sqrt[5]{32})^2 = 4$ or $1/32^{2/5}$ seen; A1 $1/4$ [2] (c) M1 $(27/8)^{2/3}$ or $(2/3)^2$ seen; A1 $9/4$ [2]
- 4 (a) B1 5 [1] (b) M1 $3^{2x} = 3^3$; A1 $3/2$ [2] (c) M1 $2^{2x+5} = 2^{-1}$; A1 -3 [2]
- 5 (a) B1 6.5 [1] (b) M1 6.756... seen; A1 6.76 [2] (c) B1 0.064 [1] (d) B1 1.629 [1]
- 6 (a) M1 $4^3 = 2^6$; A1 2^{16} [2] (b) B1 2^{-3} [1] (c) B1 $2^{3/2}$ [1]

Unit 4 · Sheet A — Fractions, decimals, percentages and ordering

- 1 0.375
- 2 35%
- 3 $9/200$
- 4 $16/25$
- 5 1.6
- 6 66.7%
- 7 $5/8$
- 8 0.58333...
- 9 >
- 10 =
- 11 >
- 12 0.6, 0.606, 61%, $5/8$
- 13 -2.55, -2.5, -2.05
- 14 -2, -1, 0, 1, 2
- 15 $x \geq 5$
- 16 $7/9$
- 17 $4/11$
- 18 $1/6$
- 19 $1/22$
- 20 $2 \frac{2}{15}$

Unit 4 · Sheet B — Fractions, decimals, percentages and ordering

- 1 M1 at least three converted correctly to decimals (0.4375, 0.44, 0.4285...); A1 $3/7$, 0.43, 0.4333..., $7/16$, 44% [2]
- 2 (a) B1 $17/20$ [1] (b) B1 7.5% [1] (c) B1 1.375 [1] (d) B1 275% [1] (e) B1 $7/1000$ [1]
- 3 (a) B1 < [1] (b) B1 < [1] (c) B1 = [1] (d) B1 = [1]
- 4 (a) M1 $10x = 2.4545...$ and $1000x = 245.4545...$ oe; M1 $990x = 243$; A1 $243/990 = 27/110$ with no errors [3] (b) M1 two correct multiples, e.g. $10x$ and $1000x$; M1 $990x = 513$; A1 $57/110$ [3]
- 5 (a) M1 $2/5$ remaining after morning; M1 $2/5 \times 0.75$ oe; A1 30% [3] (b) B1 10% [1]
- 6 (a) B2 1.2, $3/4$, 0.7, -1.5, -2 (B1 one error) [2] (b) B1 1.2 [1] (c) B1 3.2 [1]

Unit 5 · Sheet A — The four operations

- 1 5
- 2 -13
- 3 14
- 4 30
- 5 -8
- 6 23
- 7 35
- 8 18
- 9 18
- 10 4
- 11 11/15
- 12 11/24
- 13 2/5
- 14 2/3
- 15 4 1/6
- 16 6
- 17 144
- 18 120
- 19 864
- 20 34
- 21 $(6 + 2) \times (5 - 3)$

Unit 5 · Sheet B — The four operations

- 1 (a) M1 $14/3 - 9/5$ oe; M1 $70/15 - 27/15$ oe common denominator; A1 2 $13/15$ [3] (b) M1 $9/4 \times 14/9$; M1 $126/36$ or cancelling; A1 $3\frac{1}{2}$ [3]
- 2 (a) B1 41 [1] (b) B1 -5 [1] (c) M1 $(-14 - 5 + 3 - 8) \div 4$ oe; A1 -6 [2]
- 3 (a) M1 $15 + 12 + 4$ seen; A1 31 [2] (b) B1 $(3 + 9) \div (3 - 1)$ — accept two pairs that give 6 [1]
- 4 (a) M1 correct method for 38×1465 or 38×14.65 ; A1 55670 seen; A1 \$556.70 [3] (b) M1 $952 \div 28$ with a correct method; A1 34 [2]
- 5 M1 $1 - 2/5 = 3/5$; M1 $1/4 \times 3/5 = 3/20$ (food); M1 $9/20$ left or $6300 \div 9 \times 20$; A1 14 000 [4]
- 6 (a) B1 0.072 [1] (b) B1 400 [1] (c) B1 (i) 2.961; B1 (ii) 47 [2]

Unit 6 · Sheet A — Standard form

- 1 4.5×10^4
- 2 7.2×10^{-4}
- 3 3.08×10^6
- 4 6×10^{-2}
- 5 510 000
- 6 0.002 07
- 7 3.4×10^6
- 8 5×10^{-4}
- 9 5×10^3 , 2.9×10^4 , 3.2×10^4
- 10 8×10^8
- 11 1.5×10^7
- 12 4×10^6
- 13 5×10^5
- 14 4.3×10^5
- 15 3.6×10^{-5}
- 16 8.84×10^{12}
- 17 6×10^{-6}
- 18 8×10^4
- 19 4×10^3

Unit 6 · Sheet B — Standard form

- 1 (a) B1 4.05×10^{-4} [1] (b) B1 620 000 [1] (c) M1 35×10^5 oe; A1 3.5×10^6 [2] (d) B1 0.0029, 3×10^{-3} , 3.1×10^{-2} [1]
- 2 (a) M1 3 and 10^8 seen; A1 3×10^8 [2] (b) M1 60 000 – 8000 oe; A1 5.2×10^4 [2]
- 3 (a) M1 $1496 \times 10^8 \div 3.00 \times 10^5$; A1 499 [2] (b) B1 8 min 19 s [1]
- 4 (a) M1 $7.18 \times 10^7 \div 5.13 \times 10^5$; A1 140 [2] (b) M1 $1.05 \times 10^7 \div 7.18 \times 10^7 \times 100$; A1 14.6 [2]
- 5 (a) M1 $5 \div 1.67 \times 10^{-24}$; A1 2.99×10^{24} [2] (b) M1 $4.5 \times 10^{20} \times 1.67 \times 10^{-24}$; A1 7.52×10^{-4} (accept 7.515×10^{-4}) [2]
- 6 (a) M1 10×10^4 ; A1 1×10^5 [2] (b) B1 9×10^{2k} [1] (c) M1 25×10^{2k} ; A1 $2.5 \times 10^{2k+1}$ [2]

Unit 7 · Sheet A — Rounding, estimation and calculators

- 1 6.49
- 2 0.0474
- 3 39 000
- 4 9.996
- 5 0.0004
- 6 2050
- 7 90 000
- 8 0.091
- 9 $7 \times 50 = 350$
- 10 $800 \div 40 = 20$
- 11 $60 \div 0.5 = 120$
- 12 ≈ 10
- 13 $3 \times 6^2 = 108$
- 14 $0.6^2 = 0.36$
- 15 5.99
- 16 12
- 17 25.7
- 18 3.23

Unit 7 · Sheet B — Rounding, estimation and calculators

- 1 (a) B1 0.006 08 [1] (b) B1 54 000 [1] (c) B1 2.05 [1] (d) M1 $(60 \times 3) \div 0.5$ seen; A1 360 [2]
- 2 (a) M1 6.31 or 5.29 seen; A1 1.192816635... [2] (b) ft B1 1.19 [1]
- 3 (a) M1 8 litres per 100 km and 400 km; M1 32×40 ; A1 1280 [3] (b) M1 $432 \div 100 \times 7.8 \times 38.45$; A1 1296 [2]
- 4 (a) B1 170.8 [1] (b) B1 0.017 08 [1] (c) B1 280 [1] (d) B1 61 [1]
- 5 (a) M1 $13/21$ or $31/45$ seen; A1 $195/217$ [2] (b) M1 0.1371... or 1.6565... seen; A1 1.794 [2] (c) ft B1 1.79 [1]
- 6 (a) B1 12 and 13 [1] (b) B1 $\sqrt{80.5} < \sqrt{81} = 9$; B1 so $3 \times \sqrt{80.5} < 3 \times 9 = 27$ [2]

Unit 8 · Sheet A — Limits of accuracy

- 1 59.5 kg, 60.5 kg
- 2 3.65 m, 3.75 m
- 3 2350, 2450
- 4 0.475, 0.485
- 5 42.5, 47.5
- 6 5.15, 5.25
- 7 250, 350
- 8 7 cm, 9 cm
- 9 $15.5 \leq t < 16.5$
- 10 $2.495 \leq m < 2.505$
- 11 14
- 12 2
- 13 46.75
- 14 1.36
- 15 24.2 cm
- 16 15.5625 cm^2

Unit 8 · Sheet B — Limits of accuracy

- 1 (a) B1 2.75; B1 2.85 [2] (b) B1 165; B1 175 [2] (c) B1 25 [1]
- 2 (a) M1 40×4.95 ; A1 198 [2] (b) B1 202 [1]
- 3 (a) B1 12.5 or 7.7 seen; M1 12.5×7.7 ; A1 96.25 [3] (b) M1 $2 \times (12.3 + 7.5)$; A1 39.6 [2]
- 4 (a) B1 31.45 [1] (b) B1 245 seen; M1 $245 \div 31.45$; A1 7.79 [3]
- 5 (a) B1 18.5 or 4.45 seen; M1 $18.5 \div 4.45$; A1 4.16 (4.157...) [3] (b) M1 $17.5 - 4.55$; A1 12.95 [2]
- 6 B1 85.5 or 2.45 seen; M1 $34 \times 2.45 (= 83.3)$; A1 $83.3 < 85.5$ with conclusion [3]

Unit 9 · Sheet A — Ratio and proportion

- 1 2 : 3
- 2 3 : 8
- 3 2 : 3
- 4 4 : 5
- 5 1 : 2.5
- 6 45 and 27
- 7 0.6 kg, 1.2 kg, 1.8 kg
- 8 28
- 9 450 g
- 10 \$7.04
- 11 6 hours
- 12 1.5 km
- 13 75
- 14 36
- 15 9 : 12 : 10
- 16 55
- 17 $2/7$
- 18 7 : 40

Unit 9 · Sheet B — Ratio and proportion

- 1 (a) M1 $1500 \div 15 (= 100)$; A1 $6 \times 100 = 600$ [2] (b) M1 Ben 500, gives 100; M1 $500 : 400 : 600$; A1 5 : 4 : 6 [3]
- 2 (a) M1 compares 50, $120 \div 2$, $180 \div 4$; M1 45×7 or $45 + 90 + 180$; A1 315 [3] (b) ft B1 30 [1]
- 3 (a) B1 500 g; B1 750 ml [2] (b) ft B1 2 [1]
- 4 (a) M1 $8 \times 15 \div 12$; A1 10 [2] (b) M1 $120 \div 6$; A1 20 [2]
- 5 (a) M1 6 : 10 : 35; A1 6 : 35 [2] (b) M1 $(2k + 6) : 7k = 1 : 2$; M1 $4k + 12 = 7k$; A1 28 [3]
- 6 (a) M1 $7.2 \times 50\ 000 (= 360\ 000 \text{ cm})$; A1 3.6 [2] (b) M1 $1 \text{ cm}^2 = 0.5^2 \text{ km}^2$ or 3×0.25 ; A1 0.75 [2]

Unit 10 · Sheet A — Rates, time and money

- 1 72 km/h
- 2 1 h 30 min
- 3 48 km
- 4 54 km/h
- 5 25 m/s
- 6 2.7 g/cm^3
- 7 395 g
- 8 400 N/m^2
- 9 1500 people per km^2
- 10 750 ml (8.53 baht per 100 ml)
- 11 30 litres/min
- 12 3.4 h
- 13 2 h 39 min
- 14 4 h 35 min
- 15 19 40
- 16 4140 baht
- 17 \$80
- 18 19 100 baht

Unit 10 · Sheet B — Rates, time and money

- 1 (a) B1 13 h 5 min [1] (b) $M1\ 751 \div 13.08\dots$; A1 57.4 [2] (c) $M1\ 751 \div 11.5$; A1 65.3 [2]
- 2 (a) $M1\ 30 \times 19.3$; A1 579 [2] (b) $M1\ 579 \div 10.5$; A1 55.1 [2]
- 3 M1 9 litres in each pack; $M1\ 129 \div 9$ (14.33) and $149 \div 9$ (16.56) oe; A1 Pack A [3]
- 4 (a) $M1\ 108 \times 1000 \div 3600$; A1 30 [2] (b) ft B1 750 [1] (c) $M1\ 29 \times 3.6 = 104.4 \text{ km/h}$ or compares 29 with 30 m/s; A1 No, the car is faster [2]
- 5 (a) B1 22 880 [1] (b) $M1\ (22\ 880 - 18\ 400) \div 36.40$; A1 123.08 [2]
- 6 (a) $M1\ 24 \div 16 = 1.5 \text{ h}$; $M1\ 18 \div 12 = 1.5 \text{ h}$; $M1\ 42 \div (1.5 + 1.5 + 0.5)$; A1 12 [4] (b) B1 15 [1]

Unit 11 · Sheet A — Percentages

- 1 91
- 2 14
- 3 75%
- 4 280
- 5 54.6
- 6 1.07
- 7 0.82
- 8 15% increase
- 9 24% decrease
- 10 \$72
- 11 \$5306.04
- 12 15%
- 13 36 000
- 14 1284 baht
- 15 \$450
- 16 450
- 17 37.5%
- 18 Equal (28)

Unit 11 · Sheet B — Percentages

- 1 (a) $M1\ 18\ 500 \times 0.88$ oe; A1 16 280 [2] (b) $M1\ 85\% = 23\ 800$ oe; $M1\ 23\ 800 \div 0.85$; A1 28 000 [3]
- 2 (a) $M1\ 4000 \times 2.5/100 \times 6$; A1 600 [2] (b) $M1\ 1000 \div 100 = 10$ (gives exactly \$5000); A1 11 [2]
- 3 (a) $M1\ 4000 \times 1.024^6$; A1 4611.69 [2] (b) ft B1 11.69 [1]
- 4 (a) $M1\ (2793 - 2450) \div 2450 \times 100$; A1 14 [2] (b) $M1\ 2793 \times 0.86$; A1 2402 (2401.98), so No [2] (c) $M1\ 1.14 \times 0.86 = 0.9804$; A1 1.96% decrease [2]
- 5 $M1\ 112\% = 1288$ oe; $M1\ 1288 \div 1.12$; A1 1150 [3]
- 6 $M1\ 120 \times 13.50 (= 1620)$; $M1\ 30 \times 13.50 \times 0.6 (= 243)$; $M1\ (1863 - 1200) \div 1200 \times 100$; A1 55.25 [4]

Unit 12 · Sheet A — Exponential growth and decay

- 1 \$926.10
- 2 7680
- 3 6719.58
- 4 49 672
- 5 4 g
- 6 0.94
- 7 4%
- 8 5%
- 9 8
- 10 16 200
- 11 1000
- 12 33.1%
- 13 5 mg
- 14 $y = 3 \times 2^x$

Unit 12 · Sheet B — Exponential growth and decay

- 1 (a) $M1\ 180\ 000 \times 1.04^5$; A1 218 998 [2] (b) $M1\ 180\ 000 \times 1.04^n$ for at least two values of $n \geq 6$; $M1\ 1.04^8 \rightarrow 246\ 342$ and $1.04^9 \rightarrow 256\ 196$ seen; A1 9 [3]
- 2 (a) $M1\ 32\ 000 \times 0.82$; $M1 \times 0.88^3$; A1 17 881.83 (accept 17 882) [3] (b) ft B1 44.1 [1]
- 3 (a) B1 2400 [1] (b) B1 8 [1] (c) $M1\ 2400 \times 0.92^6$; A1 1455 [2] (d) $M1$ trials of 0.92^t with 1043 ($t = 10$) or 960 ($t = 11$) seen; A1 11 [2]
- 4 $M1\ 6000 \times (1 + r/100)^3 = 6749.18$; $M1\ \sqrt[3]{(6749.18 \div 6000)}$; A1 4 [3]
- 5 $M1\ 0.94^4$ seen; $M1\ 39\ 037.45 \div 0.94^4$; A1 50 000 [3]
- 6 (a) $M1\ 1500 \times 1.35^5$; A1 6726 [2] (b) $M1\ 1500 \times 1.35^8$ (16 549) and 1.35^9 (22 341) seen; A1 17 00 [2]

Unit 13 · Sheet A — Surds

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

Unit 13 · Sheet B — Surds

- 1 (a) B1 $6\sqrt{5}$ [1] (b) M1 two of $2\sqrt{5}$, $5\sqrt{5}$, $3\sqrt{5}$; A1 $4\sqrt{5}$ [2] (c) B1 $4\sqrt{7}$ [1]
- 2 (a) M1 $25 - 5\sqrt{3} - 5\sqrt{3} + 3$; A1 $28 - 10\sqrt{3}$ [2] (b) M1 $7 - 3\sqrt{7} + 2\sqrt{7} - 6$; A1 $1 - \sqrt{7}$ [2]
- 3 (a) M1 $14\sqrt{7/7}$; A1 $2\sqrt{7}$ [2] (b) M1 $\times (\sqrt{5} - 1)/(\sqrt{5} - 1)$; M1 denominator 4; A1 $3(\sqrt{5} - 1)/2$ oe [3]
- 4 (a) M1 $9 - 3\sqrt{2} + 3\sqrt{2} - 2$; A1 7 [2] (b) B1 12 [1] (c) M1 $(3 + \sqrt{2})^2 + (3 - \sqrt{2})^2 = (11 + 6\sqrt{2}) + (11 - 6\sqrt{2})$; A1 22 so $\sqrt{22}$ [2]
- 5 (a) M1 $2\sqrt{3} + 3\sqrt{3} = 5\sqrt{3}$; A1 $5\sqrt{3} \div \sqrt{3} = 5$ [2] (b) M1 $\sqrt{2/2}$ or $2\sqrt{2}$ seen; A1 $(5/2)\sqrt{2}$ [2]
- 6 (a) M1 $\sqrt{72}$; A1 $6\sqrt{2}$ [2] (b) ft B1 $24\sqrt{2}$ [1]

End-of-book check

- 1 1260
- 2 23
- 3 27
- 4 $2/55$
- 5 1.26×10^{-2}
- 6 $(10 \times 0.2) \div 0.05 = 40$
- 7 4.4
- 8 \$320
- 9 \$4057.46
- 10 45
- 11 $8\sqrt{3}$
- 12 90 km/h

Practice paper

- 1
(a) M1 correct factor tree or repeated division; A1 $2^2 \times 3^2 \times 7$ [2]
(b) M1 $120 = 2^3 \times 3 \times 5$ or lists multiples; A1 2520 [2]
- 2 M1 $25/8 \div 15/8$; M1 $25/8 \times 8/15$ oe; A1 $1\frac{2}{3}$ [3]
- 3 (a) B1 {1, 3} [1] (b) B1 6 [1] (c) B1 2 [1] (d) B1 (A $\cup$ B)' oe (A' $\cap$ B') [1]
- 4 (a) B1 $1\frac{1}{5}$ or $6/5$ [1] (b) B1 25 [1] (c) B1 -4 [1] (d) M1 $4^{3/2}$ or $(\sqrt{4})^3$; A1 8 [2]
- 5 (a) M1 63×10^{-5} ; A1 6.3×10^{-4} [2] (b) M1 240 000 + 60 000; A1 3×10^5 [2]
- 6 M1 $10x = 4.3636\dots$ and $1000x = 436.3636\dots$; M1 $990x = 432$; A1 $24/55$ [3]
- 7 (a) B1 $24\sqrt{3}$ [1] (b) M1 $\times (3 + \sqrt{3})/(3 + \sqrt{3})$; M1 denominator 6; A1 $6 + 2\sqrt{3}$ [3]
- 8 (a) B1 80.5, 45.5, 30.5 seen; M1 product $\div 1000$; A1 112 (111.7...) [3] (b) M1 $79.5 \times 44.5 \times 29.5 \div 1000$; A1 104 (104.36...) [2]
- 9 (a) M1 $15\,120 \div 1.08$; A1 14 000 [2] (b) B1 13 910.40 [1] (c) M1 $1.08 \times 0.92 = 0.9936$ oe; A1 0.64% decrease [2]
- 10 (a) M1 $86\,000 \times 0.985^5$; A1 79 741 [2] (b) M1 0.985^n trials; M1 75 063 (9 years) and 73 937 (10 years) seen; A1 10 [3]
- 11 (a) M1 2 parts = 1250; M1 625×8 ; A1 5000 [3] (b) ft B1 468.75 [1]
- 12 (a) M1 23 40 Bangkok = 17 40 London; A1 12 h 25 min [2] (b) ft M1 $9580 \div 12.416\dots$; A1 772 (771.5...) [2]
(c) ft B1 804 (803.9...) [1]
- 13 (a) M1 6.2821... or 2.2225 seen; A1 2.827 [2] (b) ft B1 2.8 [1]
- 14 M1 1849×26.34 ; A1 48 702.66; A1 Bangkok, by 712.66 baht [3]
- 15 M1 2400 litres; M1 $2400 \div 12.5$ (= 192 min); A1 3 h 12 min [3]