KING EDWARD VI
HANDSWORTH GRAMMAR
SCHOOL FOR BOYS

KING EDWARD VI
ACADEMY TRUST
BIRMINGHAM

Year 9

2025 Mathematics 2026

Unit 11 Tasks – Part 1

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Unit 11 Tasks – Part 2

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1 Fraction Arithmetic

(a) Show that $\frac{3}{4} \div \frac{15}{16} = \frac{4}{5}$

(b) Show that $\frac{23}{24} - \frac{3}{8} = \frac{7}{12}$

(c) Show that $\frac{5}{8} \div \frac{7}{12} = 1\frac{1}{14}$

(d) Show that $\frac{3}{4} + \frac{4}{5} = 1\frac{11}{20}$

(a) Show that $1\frac{1}{2} \div 1\frac{1}{4} = 1\frac{1}{5}$

(b) Show that $2\frac{1}{4} \div 3\frac{1}{2} = \frac{9}{14}$

(c) Show that $2\frac{5}{8} \div 1\frac{1}{6} = 2\frac{1}{4}$

(d) Show that $3\frac{1}{2} \times 2\frac{2}{3} = 9\frac{1}{3}$

(e) Show that $4\frac{2}{3} \div 3\frac{5}{9} = 1\frac{5}{16}$

(a) Show that $\frac{5}{9} + \frac{1}{6} = \frac{13}{18}$

(b) Show that $\frac{7}{8} - \frac{5}{6} = \frac{1}{24}$

(c) Show that $1\frac{2}{3} + 2\frac{3}{4} = 4\frac{5}{12}$

(d) Show that $5\frac{1}{4} - 1\frac{2}{3} = 3\frac{7}{12}$

(e) Show that $7\frac{1}{2} - 4\frac{2}{3} = 2\frac{5}{6}$

(a) Show that $2\frac{1}{3} \times \frac{5}{6} \times \frac{9}{10} = 1\frac{3}{4}$

(b) Show that $2\frac{2}{3} - 1\frac{1}{4} \div 1\frac{1}{8} = 1\frac{5}{9}$

Fluency Practice

(a)	(b)	(c)	(d)
Write 32 out of 80 as a fraction in its simplest form.	Find $\frac{3}{7}$ of $63\ cm$	Work out $\frac{5}{11}$ of $26.4\ kg$	Write $\frac{26}{3}$ as a mixed number.
(e)	**(f)**	**(g)**	**(h)**
Write these fractions in order, smallest first. $\frac{7}{12}, \frac{3}{4}, \frac{15}{24}, \frac{2}{3}$	$\frac{5}{6}$ of a number is 65. Find the number.	There are 45 children and 75 adults at a cinema. Write the fraction of children at the cinema in its simplest form.	Work out $2\frac{4}{7}+\frac{3}{4}$
(i)	**(j)**	**(k)**	**(l)**
Work out $\frac{5}{12}\times 4$, giving your answer as a mixed number in its simplest form.	Work out $4\frac{7}{12}-2\frac{1}{4}$ giving your answer as a mixed number in its simplest form.	Work out $4\frac{1}{5}\div 1\frac{3}{7}$, giving your answer as a mixed number.	Work out $7\frac{4}{5}+2\frac{6}{7}$
(m)		**(n)**	
Show that $2\frac{5}{8}\div 1\frac{1}{6}=2\frac{1}{4}$		Show that $5\frac{1}{2}-3\frac{5}{6}\div 1\frac{2}{3}=3\frac{1}{5}$	

Fluency Practice

A1 Show that: $\frac{2}{3}+\frac{2}{5}=1\frac{1}{15}$	**A2** Show that: $\frac{3}{4}-\frac{1}{5}=\frac{11}{20}$	**A3** Show that: $\frac{2}{5}\times\frac{3}{4}=\frac{3}{10}$	**A4** Show that: $\frac{3}{5}\div\frac{2}{3}=\frac{9}{10}$
B1 Show that: $2\frac{4}{5}+\frac{3}{7}=3\frac{8}{35}$	**B2** Show that: $3\frac{1}{3}-\frac{4}{7}=2\frac{16}{21}$	**B3** Show that: $2\frac{1}{6}\times\frac{3}{4}=1\frac{5}{8}$	**B4** Show that: $2\frac{2}{7}\div\frac{3}{5}=3\frac{17}{21}$
C1 Show that: $2\frac{1}{4}+3\frac{5}{6}=6\frac{1}{12}$	**C2** Show that: $3\frac{3}{7}-2\frac{2}{3}=\frac{16}{21}$	**C3** Show that: $1\frac{2}{3}\times2\frac{3}{7}=4\frac{1}{21}$	**C4** Show that: $3\frac{3}{5}\div1\frac{2}{3}=2\frac{4}{25}$
D1 Show that: $\frac{3}{4}+\frac{2}{3}\times\frac{3}{7}=1\frac{1}{28}$	**D2** Show that: $\frac{4}{5}\times\left(\frac{3}{4}-\frac{1}{3}\right)=\frac{1}{3}$	**D3** Show that: $\frac{3}{5}\times2+1\frac{3}{7}=2\frac{22}{35}$	**D4** Show that: $1\frac{2}{5}\times\frac{3}{4}\div\left(\frac{2}{3}\right)^2=2\frac{29}{80}$

Section One

Calculate each of the following

(1) $\frac{3}{8} \times 1\frac{5}{7}$ (2) $2\frac{1}{3} - 1\frac{2}{5}$ (3) $4\frac{1}{2} \times 1\frac{2}{9}$ (4) $2\frac{1}{3} + \frac{4}{5}$

(5) $2\frac{3}{8} \div \frac{5}{16}$ (6) $\frac{5}{12} \times 2\frac{2}{9}$ (7) $6\frac{1}{5} - 2\frac{1}{3}$ (8) $2\frac{3}{8} \div \frac{5}{16}$

(9) $3\frac{2}{5} - 1\frac{3}{4}$ (10) $1\frac{1}{8} \div \frac{3}{4}$ (11) $1\frac{3}{5} + 2\frac{4}{7}$ (12) $1\frac{2}{3} \times 2$

Section Two

Calculate each of the following

(1) $\frac{2}{3}\left(\frac{1}{5} + \frac{3}{4}\right)$ (2) $\frac{2}{7}\left(1\frac{3}{4} + \frac{3}{8}\right)$ (3) $\frac{1}{7}\left(2\frac{1}{4} + 3\frac{1}{5}\right)$ (4) $\frac{2}{3}\left(\frac{1}{6} + \frac{1}{2}\right)$

(5) $\frac{3}{8}\left(\frac{1}{3} - \frac{1}{5}\right)$ (6) $\frac{1}{2}\left(2\frac{3}{10} + \frac{3}{4}\right)$ (7) $\frac{3}{8}\left(3\frac{1}{6} - \frac{4}{5}\right)$ (8) $\left(\frac{1}{2} + \frac{1}{3}\right)\left(\frac{1}{2} - \frac{1}{3}\right)$

Section Three

Calculate each of the following

(1) $\frac{5}{6}$ *of* $\frac{2}{3} + 1\frac{1}{6}$ (2) $1\frac{5}{9}$ *of* $2\frac{1}{7} \times \frac{1}{5}$ (3) $\frac{3}{8} \times 1\frac{5}{7}$ *of* $4\frac{2}{3}$

(4) $\frac{4}{5} + \frac{2}{5}$ *of* $3\frac{1}{2}$ (5) $2\frac{1}{3} + \frac{5}{6}$ *of* $1\frac{2}{5}$ (6) $\frac{2}{7}$ *of* $\left(1\frac{3}{4} + \frac{3}{8}\right)$

REHEARSE 1

Calculate the following (give your answer in its simplest form):

a) $\frac{1}{5}+\frac{2}{5}$ b) $\frac{6}{7}-\frac{2}{7}$ c) $\frac{1}{4}+\frac{1}{6}$

d) $\frac{8}{9}-\frac{2}{3}$ e) $\frac{2}{5}+\frac{4}{7}$ f) $\frac{7}{10}-\frac{2}{9}$

g) $1\frac{8}{9}-1\frac{2}{3}$ h) $2\frac{3}{5}+\frac{7}{8}$ i) $3\frac{5}{9}-1\frac{3}{4}$

REASON

On Monday, a student reads $\frac{1}{3}$ of a book. On Tuesday they read $\frac{1}{2}$ of what was left. What proportion of the book do they have left to read?

REHEARSE 2

Calculate the following (give your answer in its simplest form):

a) $\frac{1}{5}\times\frac{2}{5}$ b) $\frac{3}{7}\times\frac{1}{6}$ c) $\frac{3}{4}\times\frac{2}{9}$

d) $\frac{4}{7}\times\frac{5}{12}$ e) $\frac{2}{5}\times 1\frac{5}{7}$ f) $2\frac{3}{4}\times 1\frac{2}{9}$

EXPLAIN

Caroline calculates $2\frac{4}{5}+1\frac{2}{3}$

She says "2 + 1 = 3, $\frac{4}{5}+\frac{2}{3}=\frac{22}{15}$, so the answer is $3\frac{22}{15}$"

Do you agree? You must explain your answer

REHEARSE 3

Calculate the following (give your answer as a mixed number in its simplest form):

a) $\frac{1}{5}\div\frac{2}{5}$ b) $\frac{3}{4}\div\frac{5}{2}$ c) $\frac{1}{4}\div\frac{1}{6}$

d) $\frac{8}{9}\div\frac{2}{3}$ e) $\frac{2}{5}\div\frac{4}{7}$ f) $\frac{7}{10}\div\frac{2}{9}$

TOPIC +

A bag contains only red counters, blue counters, green counters and yellow counters. $\frac{2}{9}$ of the counters are red, $\frac{1}{5}$ of the counters are blue. There are the same number of green and yellow counters. What is the probability of choosing a yellow counter from the bag?

Purposeful Practice

Adding and Subtracting Fractions Worded Problems

(a)

Alex ate $\frac{2}{5}$ of a pizza. Adil ate $\frac{1}{4}$ of the same pizza. What fraction of the pizza has been eaten in total?

(b)

At a restaurant $\frac{3}{10}$ of diners choose chicken and $\frac{1}{8}$ choose burger. What fraction of the diners choose chicken or burger?

(c)

Jo spends $\frac{1}{3}$ of her time asleep and $\frac{2}{7}$ of her time at school. What fraction of her time does she have left for doing other things?

(d)

In her garden, Ayesha has a lawn which is $2\frac{1}{3}$ m^2 and a patio which is $1\frac{1}{2}$ m^2. What is the total area of the lawn and patio?

(e)

George spends $2\frac{3}{4}$ hours on his homework. Awais spends $1\frac{5}{6}$ hours on his homework. What is the difference between the time each of them spends on homework?

(f)

A farmer has two fields – one has an area of $6\frac{2}{7}$ acres and the other is $3\frac{2}{3}$ acres. What is the total area of both fields?

(g)

A triangular field has fences on all three sides. The fences are $1\frac{3}{4}$ m, $2\frac{2}{3}$ m and $3\frac{1}{6}$ m long. Calculate the perimeter of the field.

(h)

Tobi buys 5 cartons of juice. He drinks $1\frac{2}{5}$ cartons on Monday, $\frac{7}{8}$ of a carton on Tuesday and $2\frac{3}{20}$ of a carton on Wednesday. How many cartons of juice does Tobi have left?

(a) Becky eats $\frac{1}{3}$ of an apple pie and Joe eats $\frac{2}{5}$ of the same pie. What fraction of the apple pie has been eaten?
(b) Boris spends $\frac{2}{7}$ of his salary on rent and $\frac{1}{6}$ on bills. What fraction of his salary has he spent on rent and bills?
(c) A fuel tank is $\frac{3}{4}$ full. Bill drives to York and uses $\frac{1}{10}$ of a tank of fuel. What fraction of fuel remains in the tank?

(a) In a class, $\frac{3}{5}$ of students are girls. Of these girls, $\frac{2}{3}$ wear glasses. What fraction of the class are girls who wear glasses?
(b) Jorge has $\frac{3}{4}$ kg of pastry. Each pie takes $\frac{1}{12}$ kg of pastry. How many pies can Jorge make with the pastry he has?

(a) Katy eats $\frac{2}{7}$ of a pizza and then Yusuf eats $\frac{1}{4}$ of the same pizza. What fraction of pizza is still uneaten?
(b) Henrik spends $\frac{2}{9}$ of his allowance on snacks and $\frac{1}{5}$ of his allowance on books. What fraction of his allowance does he have left to spend?

(a) In a theatre, 70% of people are adults. The rest are children. Of these children $\frac{1}{3}$ are girls. What fraction of all the people at the theatre are boys?
(b) At a gym all members choose either treadmill, weights or bike. 35% choose bike and $\frac{3}{7}$ choose weights. What fraction of gym members have chosen treadmill?

Purposeful Practice

For each set of numbers find: (i) the mean, (ii) the median, (iii) the range.

Leave your answers in their simplest form.

a) $\frac{1}{2}$ $\frac{1}{4}$ 1

b) $\frac{1}{2}$ $\frac{1}{3}$ 1

c) $\frac{1}{2}$ $\frac{2}{3}$ $\frac{3}{4}$

d) $\frac{1}{5}$ $-\frac{1}{2}$ $\frac{1}{10}$

e) $\frac{1}{3}$ $\frac{1}{4}$ $-\frac{1}{12}$

f) $\frac{4}{15}$ $-\frac{2}{5}$ $-\frac{1}{6}$

g) $\frac{5}{7}$ $\frac{2}{7}$ $\frac{2}{3}$

h) $\frac{2}{3}$ $\frac{2}{5}$ $\frac{3}{5}$

i) $1\frac{2}{3}$ $2\frac{1}{15}$ $1\frac{3}{5}$

j) $3\frac{1}{3}$ $6\frac{1}{6}$ $2\frac{1}{2}$

k) $2\frac{1}{2}$ $5\frac{2}{3}$ $-2\frac{1}{6}$

l) $5\frac{1}{7}$ $9\frac{6}{7}$ $5\frac{1}{4}$

m) $\frac{2}{5}$ $\frac{9}{10}$ $\frac{1}{5}$ $\frac{1}{10}$

n) $\frac{2}{3}$ $\frac{1}{3}$ $\frac{1}{2}$ $\frac{1}{6}$

o) $1\frac{1}{8}$ $\frac{1}{4}$ $\frac{1}{8}$ $\frac{1}{2}$

p) $-\frac{2}{3}$ $-\frac{3}{4}$ $\frac{1}{3}$ $\frac{3}{4}$

q) $2\frac{2}{3}$ $-\frac{5}{7}$ $-1\frac{1}{7}$ $\frac{1}{3}$

r) $-2\frac{1}{8}$ $-2\frac{5}{6}$ $4\frac{5}{6}$ $5\frac{5}{8}$

Purposeful Practice

1) Assuming that each pair of numbers is the start of an arithmetic sequence, find:
(i) the next three terms, (ii) the nth term rule, (iii) the 200^{th} term.

2) Assuming that each pair of numbers is the start of a geometric sequence, find:
(i) the next three terms, (ii) the ratio between the first and third terms,
(iii) the ratio between the second and fifth terms.

a) $\frac{1}{2}, \frac{3}{2}$

b) $\frac{1}{2}, \frac{3}{4}$

c) $\frac{1}{2}, \frac{3}{8}$

d) $\frac{1}{3}, 3$

e) $\frac{1}{3}, \frac{1}{4}$

f) $\frac{1}{4}, \frac{2}{3}$

g) $\frac{1}{4}, 1\frac{2}{3}$

h) $\frac{1}{4}, -1\frac{1}{2}$

i) $2\frac{1}{3}, 3\frac{1}{2}$

j) $3\frac{1}{2}, 2\frac{1}{3}$

k) $2\frac{1}{3}, -3\frac{1}{2}$

l) $-3\frac{1}{2}, 2\frac{1}{3}$

2 Highest Common Factor and Lowest Common Multiple

Fluency Practice

Find the HCF and LCM of

1) $2^2 \times 3^3$
$2^3 \times 3^2$

2) $2^2 \times 3^3$
$2^3 \times 3^3$

3) $2^2 \times 3^3 \times 5$
$2^3 \times 3^3$

4) $2^2 \times 3^3 \times 5$
$2^3 \times 3^3 \times 7$

5) $2^2 \times 3^3 \times 5$
$2^3 \times 3^3 \times 5^2 \times 7$

6) $2^2 \times 3^3 \times 5 \times 7$
$2^3 \times 3^3 \times 5^2$

7) $2^2 \times 3^3 \times 5 \times 7$
$2^3 \times 3^3 \times 5^2 \times 11$

8) $2^2 \times 5$
$3^3 \times 11$

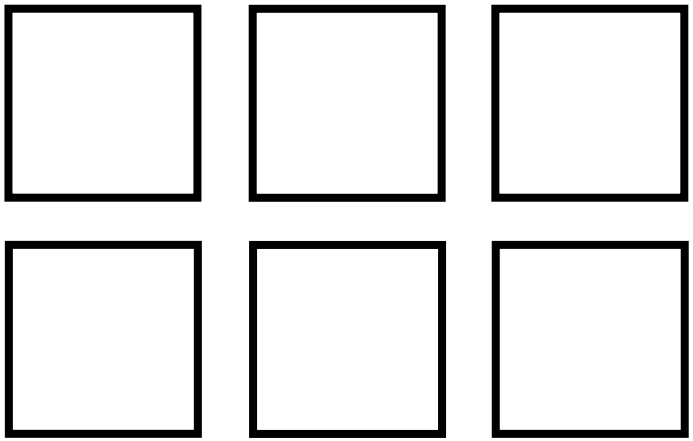
9) $2^2 \times 5$
$2^2 \times 5$

Fluency Practice

Q	Find the:	Answers	Q	Find the:	Answers
1	HCF of 20 and 35		11	HCF of 20, 35 and 45	
2	LCM of 20 and 35		12	LCM of 20, 35 and 45	
3	HCF of 40 and 35		13	HCF of 3, 12 and 15	
4	LCM of 40 and 35		14	LCM of 3, 12 and 15	
5	HCF of 60 and 72		15	HCF of 21, 42 and 63	
6	LCM of 60 and 72		16	LCM of 21, 42 and 63	
7	HCF of 80 and 112		17	HCF of 18, 24 and 32	
8	LCM of 80 and 112		18	LCM of 18, 24 and 32	
9	HCF of 210 and 350		19	HCF of 25, 55 and 85	
10	LCM of 210 and 350		20	LCM of 25, 55 and 85	

Purposeful Practice

Using the digits 1 to 9 only once fill in the following boxes to form two $3-$digit numbers:



Find the HCF and LCM of the two numbers above.

Extension

a) Find 2 numbers with HCF = 1

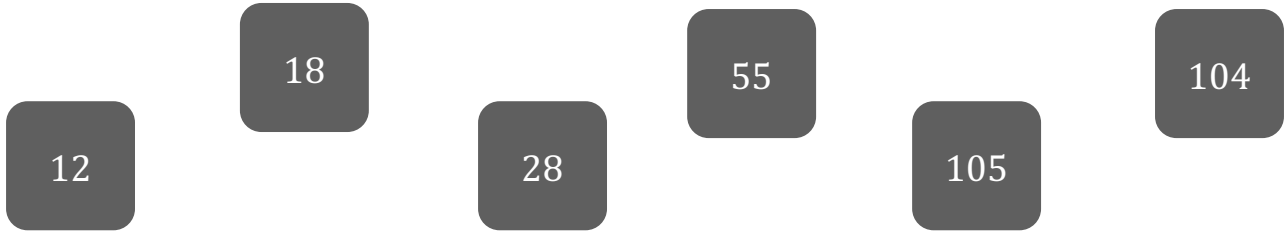
b) Find 2 numbers with HCF as big as possible

Purposeful Practice

Pick pairs of numbers from below and find the HCF and LCM of this pair.

Cross off your answer in the grid.

Repeat



What is the total of the numbers you have not crossed off?

6	36	18	990	5
1540	4	9	660	936
84	12	5720	24	3
2	630	17	1	312
420	252	1155	10920	7

Fluency Practice

Find two possible numbers for each question:

1) The HCF of two numbers is 4. The LCM of two numbers is 24.

2) The HCF of two numbers is 5. The LCM of two numbers is 30.

3) The HCF of two numbers is 6. The LCM of two numbers is 36.

4) The HCF of two numbers is 6. The LCM of two numbers is a multiple of 10.

5) The HCF of two numbers is 15. The LCM of two numbers is a multiple of 33.

6) The HCF of two numbers is 10. The LCM of two numbers is a multiple of 35.

7) The HCF of two numbers is 6. The LCM of two numbers is a multiple of 15.

8) The HCF of two numbers is 30. The LCM of two numbers is a multiple of 75.

9) The HCF of two numbers is 30. The LCM of two numbers is a multiple of 18.

Fluency Practice

A1 Express 204 as a product of its prime factors. Show your working clearly.	**A2** Write 792 as a product of its prime factors. Show your working clearly.	**A3** $1400 = 2^p \times 5^2 \times 7$ Find the value of p.	**A4** Given that $120 = 2^3 \times 3 \times 5$ And that $n = 120 \times 108$ Write n as a product of powers of its prime factors.
B1 Find the highest common factor (HCF) of 90 and 252	**B2** Find the lowest common multiple (LCM) of 24 and 42	**B3** Find the highest common factor (HCF) and lowest common multiple (LCM) of 168 and 180	**B4** Find the highest common factor (HCF) and lowest common multiple (LCM) of 72, 180 and 540
C1 $A = 2^3 \times 3 \times 5^2$ $B = 2^2 \times 3$ Find the HCF and LCM of A and B.	**C2** $M = 2^4 \times 3^2 \times 7$ $N = 2^2 \times 3^2 \times 5$ Find the HCF and LCM of M and N.	**C3** $2520 = 2^3 \times 3^2 \times 5 \times 7$ $3024 = 2^4 \times 3^3 \times 7$ Find the HCF & LCM of 2520 and 3024. Write your answer as a product of prime factors.	**C4** $740\,880 = 2^4 \times 3^3 \times 5 \times 7^3$ $980\,100 = 2^2 \times 3^4 \times 5^2 \times 11^2$ Find the highest common factor (HCF) of 740 800 and 980 100
D1 The highest common factor (HCF) of 90 and x is 18 The lowest common multiple (LCM) of 90 and x is 540 Find the value of x.	**D2** The highest common factor (HCF) of x and 12 is 6 The lowest common multiple (LCM) of x and 12 is 180 Find the value of x.	**D3** Find two numbers between 100 and 150 that have a HCF of 22.	**D4** $360 = 2^4 \times 3^2 \times 5$ Write down three different factors of 360 with a sum between 90 and 100.

Purposeful Practice

1. **Explain** why the lowest common multiple of 75 and 60 is 300
2. **Explain** why the lowest common multiple of 450 and 288 is 7200
3. **Explain** why the highest common factor of 2400 and 2850 is 150
4. Denise says she has a quick way to work out a lowest common multiple. For example: 12 and 18
   "Write it as a fraction and cancel it down $\frac{12}{18} = \frac{2}{3}$
   I needed to divide them both by 6, so I do $2 \times 3 \times 6 = 36$ which is the lowest common multiple"
   Try this method with **15 and 21** and with **75 and 60**. Why does it work? Can you **explain**?
5. The lowest common multiple of 45 and another number is 540. Work out what the other number could be. Are there any other possibilities?

Can you write an expression for the following?

	The LCM of A, B and C is…
If A is a factor of B and B is a factor of C	
If B is equal to the product of A and C	
If A is NOT a factor of C but B IS a factor of C	
If C is the HCF of A and B	
If A, B and C are all distinct prime numbers	

LCM or HCF?

For each question, do you need to calculate
the **Lowest Common Multiple** or the **Highest Common Factor**?

a) Rashid is buying glasses & plates for a wedding. Glasses come in packs of 20 & plates come in packs of 32. How many packs of each does he need to buy to have an equal amount of glasses & plates?

b) Kyle goes to the gym every 6 days. Tracy goes to the gym every 2 weeks. If they met at the gym on the 1st of December, when will they next meet at the gym?

c) c) Tammy has a 42 cm length of liquorice & a 0.7 m strip of liquorice. Using the two pieces, she wants to cut equal-length strips & waste nothing. What is the maximum length of the equal-sized pieces?

d) A company stacks two types of boxes next to each other.
One type of box is 22 cm tall, the other is 18 cm tall.
What is the lowest height where both stacks are equal in height?

e) Ms Yates is making classroom packs for other teachers.
She has 64 board pens & 36 protractors that she wants to split equally.
How many packs can she make with no pens or protractors left behind?
How many pens & protractors are in each pack?

f) For PE Mr Jones wants to split boys & girls equally into as many different mixed groups as possible. There are 168 boys & 60 girls.
How many groups can be made? How many boys & girls are in each group?

g) On a 12-hour shift, Tom has a break every 45 minutes. Jess has a break every 1 hour & 10 minutes. They both started work at 9:30 am.
Will they meet at the break room during their shifts? If so, when?

h) Workbooks come in packs of 45. Revision guides come in packs of 105.
Mr Smyth wants to have an equal number of both.
What is the minimum quantity of each pack he must buy?

Purposeful Practice

(1) as an aid effort, food and drink is distributed to each person in a refugee camp
if the total ration for a day is 136 apples, 204 oat biscuits and 340 small bottles of water, what is the most refugees there could be in the camp?

(2) what is the largest possible number of students if 294 blue smarties, 252 pink smarties and 210 yellow smarties so that each student has the same number of each colour, with none left over?

(3) in a number of boxes with the same number of chocolates in each there are, in total: 90 dark ginger, 198 white and 126 hazelnut; what is the largest possible number of boxes of chocolates?

(4) a person has a rectangular plot of land measuring 8.4 m by 5.6 m
to survey the numbers of dandelions they want to divide it equally into the minimum number of square plots; what is the size of each square plot and how many such squares will there be?

(5) someone wants to cut identical squares, as big as they can, from a piece of paper measuring 168 mm by 196 mm.; what is the length of each square?

(6) when on a school trip, 56 girls and 91 boys were divided into as many groups as possible so that there were the same number of girls and same number of boys in each group; how many groups?

(7) a small bus company has two bus services that both start at 9 am
bus number 801 leaves at 16-min intervals and bus 304 leaves at 20-min intervals
how many times do both bus services leave together between 9 am to 12 noon inclusive?

Purposeful Practice

(8) Franz, Gertrude and Hugo are grasshoppers, jumping up a large flight of stairs:
- Franz jumps 2 steps at a time
- Gertrude 3 steps at time
- Hugo 4 steps at a time

if they all start at the bottom at the same time, on which step will they all land together for the first time?

(9) if Jamie helps wash up at a vegetarian restaurant every 9 days while his sister helps every 12 days, how often do they both help out?

(10) for Y7 sports, students can be put into smaller groups of either 6, 15 and 18 without anyone being left out; what is the smallest possible number of students?

(11) Jess has a stall at the market once every 64 days and
Carlo has a stall at the same market once every 72 days
when they are at the market on the same day they meet up for a coffee
if they meet one day, how many more days will it be until they meet again?

(12) three planks are to be cut into smaller pieces - all of the same size
the planks have lengths 84 cm, 156 cm and 180 cm
what is the greatest possible length of each of the smaller pieces?

(13) the front wheels of a toy truck are 9 cm in circumference
the back wheels are bigger, with a 12 cm in circumference
if the truck travels down a long slope, in a straight line and without slipping, how far will the truck have travelled when the front wheels have made 10 more revolutions than the back wheels?

(14) three amounts of money are to be split up into equal amounts
the amounts are: £441, £567 and £693
what is the greatest possible amount that these can be split into?

3 Standard Form

Intelligent Practice

Write the following numbers in standard form

1) 200

2) $2{,}000$

3) $20{,}000$

4) $29{,}000$

5) $29{,}400$

6) $29{,}470$

7) $294{,}700$

8) $994{,}700$

9) $1{,}994{,}700$

10) $19{,}947$

11) $10{,}000$

12) $10{,}100$

13) $10{,}010$

14) $1{,}001{,}000{,}000$

15) 10.01×10^8

16) 100.1×10^7

Intelligent Practice

Write the following numbers in standard form

1) 7210×10^{6}

2) 721×10^{6}

3) 72.1×10^{7}

4) 0.721×10^{7}

5) 0.0721×10^{7}

6) 0.0721×10^{8}

7) 0.00721×10^{7}

8) 0.00721×10^{6}

9) 0.721×10^{9}

10) 721×10^{3}

11) 0.863×10^{-6}

12) 0.0863×10^{-6}

13) 0.863×10^{-5}

14) 8.63×10^{-5}

15) 86.3×10^{-5}

16) 86.3×10^{-4}

17) 863×10^{-5}

18) 8630×10^{-4}

19) 8630×10^{-7}

20) 8630000×10^{-6}

Intelligent Practice

Write the following numbers in standard form

1) 0.2
2) 0.02
3) 0.002
4) 0.0023
5) 0.00239
6) 0.002039
7) 0.0020309
8) 0.0010309
9) 0.001
10) 0.0010
11) 0.0090
12) 0.00000090
13) 0.00000099
14) 0.00000199
15) 0.199×10^{-5}
16) 0.0199×10^{-4}

Intelligent Practice

Write the following as ordinary numbers

1) 3.2×10^3

2) 3.3×10^3

3) 3.37×10^3

4) 3.37×10^6

5) 3.378×10^6

6) 1.3378×10^6

7) 1.3378×10^9

8) 1.03378×10^9

9) 9×10^{11}

10) 9.003378×10^{11}

Intelligent Practice

Write the following as ordinary numbers

1) 4.2×10^{-3}

2) 4.3×10^{-3}

3) 4.37×10^{-3}

4) 4.37×10^{-6}

5) 4.378×10^{-6}

6) 4.2378×10^{-6}

7) 4.2378×10^{-9}

8) 4.02378×10^{-9}

9) 4×10^{-11}

10) 4.002378×10^{-11}

Write each of the following numbers in standard form:

(a) 6000 (b) 40000

(c) 500 (d) 90000000

(e) 3700 (f) 5100000

(g) 40 (h) 780

(i) 2890 (j) 3.8

Write each of these standard form numbers as ordinary numbers:

(a) 3×10^5 (b) 8×10^2

(c) 7×10^8 (d) 2×10^4

(e) 5.4×10^4 (f) 2.3×10^6

(g) 6×10^1 (h) 8.5×10^3

(i) 7.2×10^0 (j) 4.23×10^5

Copy and complete the table:

Ordinary Number	Standard Form
630000	
	7.9×10^3
	1.34×10^5
223	
	3.15×10^1

Put these numbers in order, smallest to biggest:

(a) $56000, 5.8 \times 10^3, 5.2 \times 10^4$

(b) $1.12 \times 10^4, 102000, -1.2 \times 10^5$

(c) $3.22, 3.32 \times 10^0, 3.2 \times 10^1$

Convert these numbers into standard form:

(a) 200×10^2 (b) 30×10^6

(c) 75×10^4 (d) 389×10^5

Write each of the following numbers in standard form:

(a) 0.005 (b) 0.00007

(c) 0.02 (d) 0.00000008

(e) 0.0056 (f) 0.000034

(g) 0.87 (h) 0.0061

(i) 0.000032 (j) 0.0352

Write each of these standard form numbers as ordinary numbers:

(a) 5×10^{-3} (b) 7×10^{-2}

(c) 6×10^{-5} (d) 2×10^{-4}

(e) 7.3×10^{-3} (f) 2.8×10^{-6}

(g) 4×10^{-1} (h) 8.5×10^{-4}

(i) 5.6×10^{0} (j) 2.95×10^{-1}

Copy and complete the table:

Ordinary Number	Standard Form
0.0006	
	8.1×10^{-3}
	6.27×10^{-5}
0.0223	
	5.13×10^{-1}

Put these numbers in order, smallest to biggest:

(a) $0.0039, 3.7 \times 10^{-3}, 3.4 \times 10^{-2}$

(b) $1.1 \times 10^{-4}, 0.0002, 1.2 \times 10^{-5}$

(c) $0.87, 8.5 \times 10^{0}, 9.2 \times 10^{-1}$

Convert these numbers into standard form:

(a) 30×10^{-4} (b) 700×10^{-1}

(c) 75×10^{-3} (d) 564×10^{-5}

Decide whether each of these numbers is in standard form.

(a) 4×10^5 (b) 35×10^6

(c) 6.5×10^{-2} (d) 0.93×10^8

(e) $8 \times 10^{1.5}$ (f) 9.99×10^1

Write these numbers in standard form.

(a) 3000 (b) 900000

(c) 60 (d) 87000000

(e) 789000 (f) 2.5

(g) 0.0009 (h) 0.005

(i) 0.03 (j) 0.000082

(k) 0.0273 (l) 0.79

Write as ordinary numbers.

(a) 2×10^5 (b) 7×10^8

(c) 8×10^2 (d) 1.2×10^7

(e) 3.46×10^5 (f) 7.05×10^1

(g) 9×10^{-6} (h) 7×10^{-2}

(i) 5×10^{-7} (j) 3.1×10^{-3}

(k) 5.4×10^{-4} (l) 6.53×10^{-8}

(m) 1.85×10^{-1} (n) 3.216×10^0

Convert each of these numbers into standard form.

(a) 25×10^4 (b) 870×10^3

(c) 0.6×10^5 (d) 60×10^{-3}

(e) 0.9×10^{-8} (f) 0.05×10^{-5}

Write each of these scientific numbers in standard form.

'There are between 100 billion and 400 billion stars in our galaxy. The milky way galaxy is 13.51 billion years old. '

Fluency Practice

Q	Convert from ordinary to standard form OR standard form to ordinary:	Answers
1	12300	
2	9.87×10^{6}	
3	321000	
4	7.89×10^{3}	
5	0.000123	
6	9.87×10^{-6}	
7	0.0000321	
8	7.89×10^{-3}	
9	50050	
10	5.0055×10^{7}	
11	0.055005	
12	5.055005×10^{-3}	

Purposeful Practice

BIG answers Give each answer as an **ordinary number** and in **standard form**.

1) The distance from New York to San Francisco is 4000 km.
How many metres is that?

2) The Eiffel Tower weighs 10,000 tonnes. How many grams does it weigh?

3) Earth has a volume of 1,000,000,000,000 km^3. The Moon is about 2% of the Earth's volume. What is the volume of the Moon?

5) A biscuit factory runs 300 days a year and produces 12000 biscuits a day. How many biscuits does the factory produce in one year?

4) A football pitch measures 100 m by 70 m. There are approximately 100,000 blades of grass in every 1 m^2.
How many blades of grass are on the whole pitch?

6) A rain drop contains about 0.0002 litres of water. An Olympic size swimming pool contains 2,500,000 litres. How many raindrops does it take to fill a swimming pool that size?

7) A 24/7 TV factory produces 500 TVs a day. Each TV has 1920x1080 pixels. How many pixels does the factory produce each year?

8) In one hour a human walks about 4 kilometres. If someone spent 10 hours a day walking to the moon (384,000 km away), how many days would it take them?

9) A standard piece of paper is about 0.01 cm thick. The Eiffel Tower is 133 metres tall. How many pieces of paper do we need to stack to equal that height?

10) If we assume an average tree has about two hundred thousand leaves and that there are 3 billion trees in the UK, how many leaves are there in the UK?

11) Gregor is 192 centimetres tall. How many kilometres tall is he?

12) An ant weighs about 0.003 grams. How many tonnes does an ant weigh?

13) There are approximately 20,000,000,000,000 ants on earth. In tonnes, what is their combined weight?

14) The mass of our Sun is approximately 2×10^{30} kilograms. Earth weighs approximately 6×10^{24}. How many Earths weigh the same as the Sun?

Intelligent Practice

Work out

1) $(4 \times 10^5) \times (2 \times 10^4)$

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

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

4) $(2 \times 10^5) \times (8 \times 10^4)$

5) $(8 \times 10^5) \times (2 \times 10^4)$

6) $(8.1 \times 10^5) \times (2 \times 10^4)$

7) $(8.01 \times 10^5) \times (2 \times 10^4)$

8) $(2 \times 10^5) \times (8.01 \times 10^4)$

9) $(2 \times 10^5) \times (8.01 \times 10^{-4})$

10) $(2 \times 10^{-5}) \times (8.01 \times 10^4)$

11) $(2 \times 10^{-5}) \times (8.01 \times 10^{-4})$

WORDED: MULTIPLYING STANDARD FORM NUMBERS

Express each answer in standard form.
Try expressing the results using words.

1) A factory produces 4×10^6 biscuits a year. Due to increased demand, the company decides to build another identical factory. How many biscuits in total does the company expect the two factories to produce every year?

2) A restaurant chain has 5×10^3 locations around the world. On average, each restaurant serves 100 people a day. Approximate the total number of customers the restaurant chain serves every day.

3) A distribution company has 2×10^4 employees. Each employee is paid approximately $\$(3 \times 10^2)$ per day.

What is the wage bill for the company every day?

What is the wage bill over a 4-day work week?

4) A phone company sells the X2-A model for $200. Over one month the company sold 6000 X2-A phones.

Convert both quantities into standard form.

How much revenue does the company make over one month?

10% of each sale price is profit.

How much profit does the company make over one month?

5) There are 5×10^3 houses in Wickley Town. If the average value of each property is $£(4 \times 10^5)$, how much is all the residential property in Wickley Town worth?

6) A truck company has 2.5×10^5 trucks on the road. Each truck travels approximately 6000 km per month. Over 3 years how much distance will all the company trucks cover?

7) Scientists estimate there are 3×10^{16} ants on earth. An ant is approximately half a centimetre long, or 5×10^{-6} kilometres in length. The distance from the earth to the sun is 150 million kilometres. If all the ants on earth formed a line (with no gaps between them) would it reach the sun?

Intelligent Practice

Work out

1) $(9 \times 10^6) \div (3 \times 10^2)$

2) $(6 \times 10^6) \div (3 \times 10^2)$

3) $(3 \times 10^6) \div (6 \times 10^2)$

4) $(3 \times 10^2) \div (6 \times 10^6)$

5) $(3 \times 10^{-2}) \div (6 \times 10^6)$

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

7) $(3 \times 10^6) \div (1.5 \times 10^2)$

8) $(1.5 \times 10^6) \div (3 \times 10^2)$

9) $(1.5 \times 10^{-6}) \div (3 \times 10^2)$

10) $(1.5 \times 10^6) \div (6 \times 10^{-2})$

11) $(1.5 \times 10^{-6}) \div (6 \times 10^{-2})$

12) $(6 \times 10^{-6}) \div (1.5 \times 10^{-2})$

Purposeful Practice

Fill in the blanks:

a) $(\square \times 10^{8}) \times (2 \times 10^{9}) = 3.4 \times 10^{17}$

b) $(3.7 \times \square) \times (2.1 \times 10^{12}) = 9.25 \times 10^{15}$

c) $(2.3 \times \square) \times (\square \times 10^{5}) = 7.2 \times 10^{11}$

d) $(3 \times 10^{4}) \times (\square \times 10^{5}) = 1.2 \times 10^{10}$

e) $(7 \times \square) \times (\square \times 10^{3}) = 3.5 \times 10^{10}$

f) $(\square \times \square) \times (\square \times \square) = 8.1 \times 10^{14}$

Purposeful Practice

1. Factual recall

Simplify:

a) $10^5 \div 10^2$

b) $10^{-3} \div 10^5$

c) $10^{-3} \div 10^{-6}$

Write in standard form:

a) 25×10^6

b) 0.73×10^4

2. Carry out a routine procedure

Calculate:

a) $(9 \times 10^6) \div (3 \times 10^3)$

b) $(2 \times 10^5) \div (5 \times 10^2)$

c) $\dfrac{3 \times 10^{-3}}{4 \times 10^{-2}}$

3. Classify some mathematical object

Which calculation gives the greatest answer?

a)

$(9.3 \times 10^8) \div (3.1 \times 10^3)$

or

$(8 \times 10^2) \times (4 \times 10^2)$

b)

$(6 \times 10^{-2}) \div (8 \times 10^{-7})$

or

$(8 \times 10^4) - (5 \times 10^3)$

4. Interpret a situation or answer

Proxima Centauri is the closest star other than the sun to the earth. It is estimated to be $4.02 \times 10^{13} Km$ away from the earth.

If light travels at a speed of $3 \times 10^6 Km/s$.

How long does it take the light of Proxima Centauri to reach the earth. Give your units in years.

Standard Form: Division

5. Prove, show, justify

The diameter of the Moon is $3.5 \times 10^6\ km$.

The diameter of the Sun is $1.4 \times 10^3\ km$.

The ratio of the diameters of the Moon to the Sun can be written in the ratio 1:n.

Show that n is a multiple of 20.

6. Extend a concept

$20 = 2 \times 10^1$ in standard form

$20 = 1.0100 \times 2^4$ in base 2 standard form.

Given that $20 = 10100$, $10 = 1010$, $5 = 101$ in base 2.

Calculate

a) $(1.0100 \times 2^4) \div (1.01 \times 2^2)$

b) $(1.0100 \times 2^4) \div (1.010 \times 2^3)$

c) $(1.010 \times 2^3) \div (1.01 \times 2^2)$

Try leaving your answers in base 2 standard form

7. Construct an instance

Write 2 standard form divisions that give the same answers.

8. Criticise a fallacy

A student answers the following question, identify and amend all mistakes.

$(4 \times 10^5) \div (8 \times 10^7)$

$= (8 \div 4) \times (10^5 \div 10^7)$

$= 2 \times 10^2$

Intelligent Practice

Work out

1) $(5 \times 10^4) + (4 \times 10^4)$

2) $(15 \times 10^4) + (4 \times 10^4)$

3) $(150 \times 10^4) + (4 \times 10^4)$

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

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

6) $(5 \times 10^4) + (4 \times 10^3)$

7) $(30 \times 10^3) + (4 \times 10^4)$

8) $(3 \times 10^4) + (40 \times 10^3)$

9) $(30 \times 10^3) + (40 \times 10^3)$

10) $(0.3 \times 10^2) + (4 \times 10^4)$

11) $(35 \times 10^{-2}) + (4.5 \times 10^4)$

Problem Solving

$$\square \times 10^{\square} + \square \times 10^{\square}$$

Placing all four of the numbers below into the boxes above can you…

6 7 8 9

a) Find the biggest value possible.
b) Find the smallest value possible.

Go back to your answer for part a). Make it…

a) 10 times bigger
b) 2 times bigger

Intelligent Practice

Work out

1) $(5 \times 10^4) - (4 \times 10^4)$

2) $(15 \times 10^4) - (5.1 \times 10^4)$

3) $(15 \times 10^4) - (3 \times 10^4)$

4) $(5 \times 10^{-4}) - (4 \times 10^{-4})$

5) $(5 \times 10^5) - (4 \times 10^4)$

6) $(50 \times 10^4) - (4 \times 10^5)$

7) $(30 \times 10^{-3}) - (4 \times 10^{-4})$

8) $136000 - (40 \times 10^3)$

9) $(0.045 \times 10^4) - (35 \times 10^{-2})$

10) $(1360 \times 10^{-2}) - (0.004 \times 10^3)$

Fluency Practice

Work out

1) $(7 \times 10^{-2}) - (2 \times 10^{-3})$

2) $(6 \times 10^{-3}) - (5 \times 10^{-4})$

3) $(3 \times 10^{-2}) + (2 \times 10^{-4})$

4) $(8 \times 10^{-2}) - (8 \times 10^{-4})$

5) $(4 \times 10^{-2}) + (6 \times 10^{-4})$

6) $(8 \times 10^{-1}) - (9 \times 10^{-2})$

7) $(4 \times 10^{-1}) - (4 \times 10^{-2})$

8) $(8 \times 10^{-2}) + (2 \times 10^{-3})$

9) $(2 \times 10^{-2}) + (6 \times 10^{-3})$

10) $(2 \times 10^{-3}) + (5 \times 10^{-4})$

Purposeful Practice

Standard Form: Addition and Subtraction

1. Factual recall

Convert to standard form:

a) 2900000

b) 0.0000094

Convert to an ordinary number:

a) 3.12×10^7

b) 2.4×10^{-5}

2. Carry out a routine procedure

Calculate:

a) $3 \times 10^7 + 2 \times 10^5$

b) $2.1 \times 10^{-3} + 3 \times 10^{-4}$

c) $1.9 \times 10^5 + 7.96 \times 10^3$

d) $7.3 \times 10^{-2} - 8.1 \times 10^{-4}$

3. Classify some mathematical object

For each of the following, say whether the calculation is true or false.

a) $7 \times 10^4 + 9 \times 10^5 = 7.9 \times 10^4$

b) $8.1 \times 10^{-2} - 1.2 \times 10^{-3} = 7.98 \times 10^{-2}$

c) $3.1 \times 10^2 + 7.1 \times 10^{-2} = 3.10071 \times 10^2$

4. Interpret a situation or answer

The following table shows the diameters of the outer ring planets in meters.

Planet	Diameter (m)
Jupiter	1.40×10^8
Saturn	1.16×10^8
Uranus	5.07×10^7
Neptune	4.92×10^7

Calculate the biggest difference between 2 planets diameter.

5. Prove, show, justify

The table shows the length of coastlines for the following countries in Km.

Country	L of Coastline
Canada	2.03×10^5
Norway	8.31×10^4
Indonesia	5.47×10^4
Russia	3.77×10^4

Show that Canada's is longer than the sum of the other countries.

6. Extend a concept

Using the fact

$x \times 10^a + y \times 10^b = z \times 10^b$

Create an equation for z

7. Construct an instance

Form two calculations:
An addition of standard form.
A subtraction of standard form.
That gives the same answer.

8. Criticise a fallacy

A student attempts the following question:

$(7.1 \times 10^5) + (4.2 \times 10^4)$

$= 11.3 \times 10^9$

$= 1.13 \times 10^8$

Identify and explain all the student's mistakes.

Fluency Practice

Q	Give your answer in standard form:	Answers	Q	Give your answer in standard form:	Answers
1	$(9.87\times10^{6})+(1.234\times10^{5})$		9	$(9.41\times10^{-1})+(5.27\times10^{-3})$	
2	$(9.87\times10^{6})-(1.234\times10^{5})$		10	$(9.41\times10^{-1})-(5.27\times10^{-3})$	
3	$(9.87\times10^{6})\times(1.234\times10^{5})$		11	$(9.41\times10^{-1})\times(5.27\times10^{-3})$	
4	$(9.87\times10^{6})\div(1.234\times10^{5})$		12	$(9.41\times10^{-1})\div(5.27\times10^{-3})$	
5	$(1.49\times10^{2})+(7.53\times10^{-2})$		13	$(98.7\times10^{6})+(123.4\times10^{5})$	
6	$(1.49\times10^{2})-(7.53\times10^{-2})$		14	$(98.7\times10^{6})-(123.4\times10^{5})$	
7	$(1.49\times10^{2})\times(7.53\times10^{-2})$		15	$(98.7\times10^{6})\times(123.4\times10^{5})$	
8	$(1.49\times10^{2})\div(7.53\times10^{-2})$		16	$(98.7\times10^{6})\div(123.4\times10^{5})$	

Problem Solving

Using the digits from 1 to 9 at most once each, fill in the gaps to give an answer as close as possible to 60 000

$\square \times 10^{\square} + \square \times 10^{\square}$

?

Using the digits from 1 to 9 at most once each, fill in the gaps to give an answer as close as possible to 60 000

$\square \times 10^{\square} - \square \times 10^{\square}$

?

Using the digits from 1 to 9 at most once each, fill in the gaps to give an answer as close as possible to 60 000

$\square.\square \times 10^{\square} + \square.\square \times 10^{\square}$

?

Using the digits from 1 to 9 at most once each, fill in the gaps to give an answer as close as possible to 60 000

$\square.\square \times 10^{\square} - \square.\square \times 10^{\square}$

?

Using the digits from 1 to 9 at most once each, fill in the gaps to give an answer as close as possible to 0.002

$\square \times 10^{\square} + \square \times 10^{\square}$

?

Fluency Practice

QU 1 - Operate in standard form

Calculate:

$$\frac{(3.7 \times 10^4) + (3 \times 10^3)}{(2 \times 10^2)}$$

QU 2 - Operate in standard form

Calculate:

$$\frac{(3.2 \times 10^4) + (2.7 \times 10^2)}{(2 \times 10^2)}$$

QU 3 - Operate in standard form

Calculate:

$$\frac{(4 \times 10^3) + (2 \times 10^2)}{(2 \times 10^2)}$$

QU 4 - Operate in standard form

Calculate:

$$\frac{(3.3 \times 10^4) + (3 \times 10^2)}{(2 \times 10^2)}$$

QU 5 - Operate in standard form

Calculate:

$$\frac{(3.9 \times 10^4) + (2.6 \times 10^2)}{(2 \times 10^2)}$$

QU 6 - Operate in standard form

Calculate:

$$\frac{(4.1 \times 10^4) + (1.8 \times 10^3)}{(2 \times 10^2)}$$

QU 7 - Operate in standard form

Calculate:

$$\frac{(4.7 \times 10^4) + (2.4 \times 10^2)}{(2 \times 10^2)}$$

QU 8 - Operate in standard form

Calculate:

$$\frac{(3.6 \times 10^3) + (1.2 \times 10^2)}{(2 \times 10^2)}$$

QU 9 - Operate in standard form

Calculate:

$$\frac{(3.6 \times 10^4) + (1.7 \times 10^2)}{(2 \times 10^2)}$$

Question 1: Write each of the following numbers in standard form.

(a) 40000 (b) 2000000 (c) 8000000 (d) 7000

(e) 100000000 (f) 900 (g) 250000 (h) 1900

(i) 54000000 (j) 11000000 (k) 89000 (l) 3600000000

(m) 43500 (n) 91900000 (o) 1230000000 (p) 71120

(q) 9804000 (r) 471500 (s) 55403 (t) 2936000

(u) 93508000 (v) 333810000 (w) 9800200000 (x) 49300

(y) 804000 (z) 69702000000

Question 2: Write each of the following as ordinary numbers

(a) 3×10^4 (b) 9×10^3 (c) 6×10^6 (d) 2×10^{10}

(e) 5×10^7 (f) 1.2×10^2 (g) 2.9×10^5 (h) 8.4×10^8

(i) 7.7×10^4 (j) 3.51×10^5 (k) 9.89×10^7 (l) 1.27×10^9

(m) 4.05×10^6 (n) 1.616×10^5 (o) 2.0651×10^3 (p) 8.829×10^7

(q) 1.0051×10^6 (r) 2.143578×10^4

Question 3: Write each of the following numbers in standard form.

(a) 0.002 (b) 0.0005 (c) 0.9 (d) 0.00000004

(e) 0.00065 (f) 0.0022 (g) 0.0361 (h) 0.000558

(i) 0.00000423 (j) 0.0000000981 (k) 0.00407 (l) 0.02052

(m) 0.0000515 (n) 0.006015 (o) 0.0000000082 (p) 0.00007005

(q) 0.000000024 (r) 0.00000000000005

Question 4: Write each of the following as ordinary numbers

(a) 2×10^{-3} (b) 7×10^{-2} (c) 3×10^{-6} (d) 9×10^{-8}

(e) 4.8×10^{-4} (f) 6.7×10^{-3} (g) 9.2×10^{-6} (h) 4.1×10^{-2}

(i) 3.16×10^{-5} (j) 8.62×10^{-4} (k) 7.09×10^{-6} (l) 5.71×10^{-3}

(m) 2.05×10^{-8} (n) 4.112×10^{-2} (o) 1.651×10^{-3} (p) 2.0019×10^{-7}

Question 5: Write these numbers in standard form

(a) one million (b) nine thousand (c) forty thousand (d) nine billion

(e) 500^2 (f) 200^3 (g) $30{,}000^2$ (h) two thousandths

Question 6: Write each of these numbers in standard form

(a) 72×10^3 (b) 84×10^6 (c) 500×10^2 (d) 210×10^4

(e) 0.8×10^7 (f) 0.46×10^5 (g) 0.06×10^8 (h) 0.007×10^{12}

(i) 3000×10^{14} (j) 24×10^{-5} (k) 0.8×10^{-10} (l) 0.0055×10^{-2}

(m) 0.0372×10^{-9} (n) 65213×10^{-7} (o) 2933×10^{21} (p) 759300×10^{-1}

Question 7: Work out the answers to the following multiplications.
You may not use a calculator.

(a) $2 \times 10^3 \times 3 \times 10^4$ (b) $(4 \times 10^8) \times (2 \times 10^5)$ (c) $1.2 \times 10^4 \times 6 \times 10^4$

(d) $(3 \times 10^{-9}) \times (3 \times 10^3)$ (e) $4 \times 10^{-7} \times 3 \times 10^{-2}$ (f) $6 \times 10^{10} \times 4 \times 10^8$

(g) $7 \times 10^{12} \times 8 \times 10^{-9}$ (h) $3.7 \times 10^5 \times 5 \times 10^6$ (i) $(8 \times 10^3) \times (5 \times 10^5)$

(j) $5 \times 10^{-14} \times 4 \times 10^{-7}$ (k) $1.8 \times 10^2 \times 2 \times 10^{-8}$ (l) $5.8 \times 10^6 \times 4 \times 10^7$

(m) $4.5 \times 10^{20} \times 9 \times 10^{-14}$ (n) $(1.1 \times 10^{-5}) \times (1.2 \times 10^{-2})$ (o) $6.2 \times 10^4 \times 7 \times 10^9$

(p) $2.8 \times 10^8 \times 1.3 \times 10^7$ (q) $1.25 \times 10^{-16} \times 3.2 \times 10^{10}$ (r) $8.7 \times 10^2 \times 9.2 \times 10^6$

(s) $2 \times 10^2 \times 3 \times 10^7 \times 6 \times 10^4$ (t) $3 \times 10^6 \times 2.1 \times 10^{-8} \times 5 \times 10^{12}$

Question 8: Work out the answers to the following divisions.
You may not use a calculator.

(a) $(8 \times 10^5) \div (2 \times 10^3)$ (b) $(9 \times 10^9) \div (3 \times 10^4)$ (c) $(5 \times 10^6) \div (2 \times 10^2)$

(d) $(9 \times 10^9) \div (4 \times 10^9)$ (e) $(1.2 \times 10^4) \div (3 \times 10^8)$ (f) $(3.5 \times 10^2) \div (5 \times 10^9)$

(g) $(4.8 \times 10^{15}) \div (3 \times 10^4)$ (h) $(6.4 \times 10^3) \div (8 \times 10^{16})$ (i) $(2.7 \times 10^{-3}) \div (9 \times 10^7)$

(j) $(1.44 \times 10^8) \div (12 \times 10^{-5})$ (k) $(2 \times 10^{10}) \div (5 \times 10^{-2})$ (l) $(1 \times 10^{-5}) \div (4 \times 10^{-2})$

(m) $(5 \times 10^{-6}) \div (8 \times 10^{-14})$ (n) $(8.1 \times 10^{-9}) \div (2.7 \times 10^3)$ (o) $(1.6 \times 10^7) \div (8 \times 10^2)$

(p) $(3 \times 10^{22}) \div (8 \times 10^9)$ (q) $(3.92 \times 10^8) \div (1.4 \times 10^{-6})$ (r) $(3 \times 10^{-4}) \div (1.2 \times 10^7)$

Question 9: Work out the answers to the following.
You may not use a calculator.

(a) $(3 \times 10^3)^2$ (b) $(2 \times 10^6)^2$ (c) $(5 \times 10^4)^2$ (d) $(8 \times 10^5)^2$

(e) $(9 \times 10^{10})^2$ (f) $(6 \times 10^{-3})^2$ (g) $(2.5 \times 10^{-6})^2$ (h) $(1.2 \times 10^8)^2$

(i) $(2 \times 10^5)^3$ (j) $(4 \times 10^9)^3$ (k) $(3 \times 10^{15})^3$ (l) $(5 \times 10^{-7})^3$

(m) $(2 \times 10^6)^4$ (n) $(1 \times 10^{-4})^6$ (o) $(8.3 \times 10^{-2})^2$ (p) $(9.7 \times 10^3)^2$

Question 10: Work out each of the following

(a) $5 \times 10^4 + 3 \times 10^4$ (b) $4 \times 10^3 - 2 \times 10^3$ (c) $2.5 \times 10^5 + 3.3 \times 10^5$

(d) $7 \times 10^{-2} + 2 \times 10^{-2}$ (e) $6 \times 10^3 + 8 \times 10^2$ (f) $2 \times 10^6 - 8 \times 10^5$

(g) $2.6 \times 10^8 + 4.5 \times 10^9$ (h) $5.12 \times 10^5 - 1.89 \times 10^4$ (i) $(8 \times 10^7) + (3 \times 10^5)$

(j) $5.07 \times 10^{10} + 2.77 \times 10^9$ (k) $6.12 \times 10^{-3} - 1.07 \times 10^{-2}$ (l) $4 \times 10^{-7} + 9 \times 10^{-5}$

(m) $3.44 \times 10^8 + 7.03 \times 10^6 + 9.89 \times 10^7$

Question 11: Using a calculator, work out the following

(a) $3.57 \times 10^3 \times 6.7 \times 10^7$ (b) $9.5 \times 10^4 + 3.8 \times 10^5$ (c) $1.8 \times 10^9 \times 5.2 \times 10^9$

(d) $7 \times 10^{-8} \times 2 \times 10^{-6}$ (e) $(7.71 \times 10^{15}) \div (6 \times 10^4)$ (f) $(8 \times 10^9)^3$

(g) $(5 \times 10^{-7})^{-3}$ (h) $2.55 \times 10^7 \times 8.02 \times 10^4 \times 1.1 \times 10^5$

Apply

Question 1: The distance between London and New York is 5,567,000 metres.
Write this number in standard form.

Question 2: The distance from the Sun to Pluto is 3.67 billion miles.
Write this number in standard form.

Question 3: The length of a cell is 0.016 mm
Write this number in standard form.

Question 4: The population of a country is 6.51×10^5
Write the population of the country as an ordinary number.

Question 5: 32,010 people attend a football match between West Ham and Southampton.
Write this number in standard form.

Question 6: There are approximately 5×10^4 grains of rice in a one kilogram bag of rice.
Approximately how many grains of rice will be in 20 one kilogram bags of rice?

Question 7: A penny weighs 0.0036kg.
Find the total mass of £400 worth of pennies.

Question 8: $A = 6 \times 10^5$ $B = 30000$ $C = 5 \times 10^{-2}$

(a) Work out AB

(b) Work out C^2

Question 9: The population of the United Kingdom in 1950 was 5.06×10^7
The population of the United Kingdom in 2015 was 6.47×10^7
Work out how many more people live in the United Kingdom in 2015 than 1950.
Give your answer as an ordinary number.

Question 10: Peter has multiplied two numbers using his calculator.
The calculator shows the answer.
He can remember that one number was 5000.
What was the other number used in the multiplication?

Question 11: An asteroid travels at 25 kilometres per second.
How far does it travel in one hour?
Give your answer in standard form.

Question 12: Without using a calculator, work out.

$$\sqrt{4.9 \times 10^{11}}$$

Question 13: The mass of Earth is 5.97×10^{24}
The mass of Jupiter is 1.898×10^{27}
Using a calculator, work out how many times heavier Jupiter is than Earth.
Give your answer to one decimal place.

Question 14: The density of Nitrogen is 1.25×10^{-6} kg/cm^3
Calculate the mass of one cubic metre of Nitrogen.

Fluency Practice

Standard Form	Ordinary Form
1.69×10^{3}	
	8937.9
	0.006
5×10^{-2}	
	1.87

Order these numbers, from smallest to largest:

A
1.69×10^{3}

B
325×10^{-2}

C
23.5×10^{1}

D
8×10^{2}

_____ _____ _____ _____

Fill in the missing indices:

$2.09 \times 10^{\square} = 209$

$5.4 \times 10^{\square} = 0.054$

$14 \times 10^{\square} = 0.14$

$3.5 \times 10^{\square} = 3.5$

Explain why 34.6×10^{3} is not in standard form.

Explain why it is easier to compare the size of numbers when they are written in standard form.

Fluency Practice

A1 Convert 32 567 into standard form	**A2** Convert 0.00436 into standard form	**A3** Write 7 867 030 in standard form.	**A4** Write 0.0000512 in standard form
B1 Convert 2.37×10^5 into an ordinary number.	**B2** Write 7.83×10^{-4} as an ordinary number.	**B3** Write 5.71×10^7 as an ordinary number.	**B4** Convert 9.28×10^{-6} into an ordinary number.
C1 List in ascending order: 1.4×10^9 1.3×10^9 3.2×10^8 9.7×10^7 1.2×10^8	**C2** List in descending order: 2.97×10^6 1.25×10^6 4.22×10^5 4.38×10^5 1.59×10^6	**C3** List in ascending order: 1.2×10^{-4} 1.4×10^{-5} 5.0×10^{-4} 6.8×10^{-3} 1.2×10^{-5}	**C4** List in descending order: 1.4×10^{-3} 1.3×10^4 3.2×10^{-4} 9.7×10^3 1.2×10^{-3}
D1 Add 7.35×10^4 and 8.21×10^3 Give your answer in standard form	**D2** Subtract 3.21×10^6 from 6.14×10^7 Give your answer in standard form	**D3** Multiply 6.1×10^3 and 2.2×10^4 Give your answer in standard form	**D4** Divide 1.2×10^7 by 4.8×10^2 Give your answer in standard form

Purposeful Practice

(a)	(b)	(c)	(d)
Write $60\,000\,000$ in standard form.	Write $163\,000$ in standard form.	Write 0.07 in standard form.	Write 0.002945 in standard form.
(e)	**(f)**	**(g)**	**(h)**
Write 6×10^5 as an ordinary number.	Write 7.23×10^6 as an ordinary number.	Write 9×10^{-3} as an ordinary number.	Write 3.92×10^{-5} as an ordinary number.
(i)	**(j)**	**(k)**	**(l)**
Put these numbers in order, smallest to biggest: $8 \times 10^{-2}, 0.076, 87 \times 10^{-3}$	Work out the value of $(7.22 \times 10^6) \div (5 \times 10^{-3})$ Give your answer in standard form.	Work out the value of $(3.2 \times 10^3) \times (8 \times 10^5)$ Give your answer in standard form.	Work out the value of $(9.2 \times 10^{-3}) - (5.6 \times 10^{-5})$ Give your answer in standard form.
(m)		**(n)**	
The diameter of the Sun is $1.4 \times 10^6\ km$. The diameter of Mars is $6.8 \times 10^3\ km$. Find the ratio of the diameter of Mars to the diameter of the Sun. Give your answer in the form $1 : n$, where n is rounded to the nearest integer.		The land area of India is $3.29 \times 10^6\ km$. The land area of Turkey is $7.84 \times 10^5\ km$. The land area of South Africa is $1.22 \times 10^6\ km$. Find the mean land area of the three countries, giving your answer in standard form to 3 significant figures.	

Fluency Practice

Standard Form Without a Calculator			
(a)	**(b)**	**(c)**	**(d)**
Calculate $(4 \times 10^{83}) \times (2 \times 10^{61})$	Calculate $(1.25 \times 10^{95}) \times (6 \times 10^{37})$	Calculate $(4 \times 10^{74}) \times (7 \times 10^{50})$	Calculate $\frac{9 \times 10^{143}}{3 \times 10^{53}}$
(e)	**(f)**	**(g)**	**(h)**
Calculate $(9.6 \times 10^{187}) \div (6 \times 10^{32})$	Calculate $\frac{2.4 \times 10^{105}}{8 \times 10^{23}}$	Calculate $\sqrt{(4 \times 10^{100})}$	Calculate $(8 \times 10^{129}) + (1 \times 10^{129})$
(i)	**(j)**	**(k)**	**(l)**
Calculate $(7.5 \times 10^{193}) - (2.1 \times 10^{193})$	Calculate $(4 \times 10^{100}) + (3 \times 10^{101})$	Calculate $(6.2 \times 10^{88}) - (9 \times 10^{87})$	Calculate $(1 \times 10^{112}) - (8 \times 10^{110})$
(m)	**(n)**	**(o)**	**(p)**
Calculate $\frac{(4 \times 10^{95}) + (8 \times 10^{94})}{1.2 \times 10^{40}}$	Calculate $\frac{(3 \times 10^{108}) - (3 \times 10^{107})}{9 \times 10^{72}}$	Calculate $(6 \times 10^{50})^2 + 4.5 \times 10^{103}$	Calculate $\sqrt{\frac{(5 \times 10^{150}) - (1 \times 10^{149})}{4 \times 10^{23}}}$

Answers should be given in standard form.

1. Work out:

   a) $7\times10^{5} + 2\times10^{4}$

   b) $8\times10^{9} + 3\times10^{11}$

   c) $8\times10^{-2} + 5\times10^{-4}$

   d) $4.1\times10^{8} + 6\times10^{7}$

   e) $3.2\times10^{6} + 3.2\times10^{5}$

   f) $5.5\times10^{-5} + 7.5\times10^{-4}$

2. a) p and q are integers.

   $p\times10^{6} + q\times10^{2} = 7{,}000{,}400$

   State the values of p and q.

   b) n is a number and $1 \leq n < 10$.

   $n\times10^{-2} + n\times10^{-5} = 0.042042$

   State the value of n.

3. Work out:

   a) $5\times10^{6} - 4\times10^{5}$

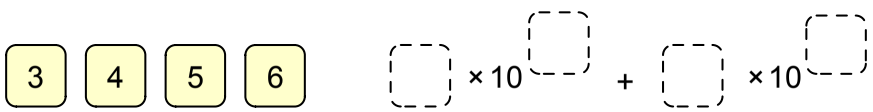
   b) $4\times10^{-3} - 9\times10^{-4}$

   c) $4.2\times10^{6} - 1\times10^{4}$

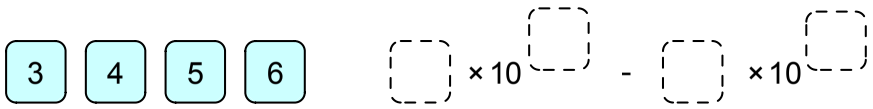
   d) $3.5\times10^{-6} - 2\times10^{-5}$

4. Arrange the cards to give the **largest** possible answers.

   a)

   b)

5. Work out:

   a) $5\times10^{8} \times 3$

   b) $5 \times 6\times10^{-4}$

   c) $3.2\times10^{3} \times 4$

   d) $200 \times 8.2\times10^{-3}$

6. Work out:

a) $4 \times 10^6 \times 2 \times 10^5$

b) $3 \times 10^{-4} \times 3 \times 10^7$

c) $3.1 \times 10^5 \times 8 \times 10^2$

d) $2.7 \times 10^{-4} \times 4 \times 10^{-10}$

e) $(5 \times 10^{-7})^2$

f) $(1.5 \times 10^{12})^2$

7. Work out:

a) $(6.3 \times 10^{-1}) \div 10^8$

b) $\dfrac{8.6 \times 10^3}{4}$

c) $(7 \times 10^5) \div (2 \times 10^4)$

d) $(6.4 \times 10^{-5}) \div (4 \times 10^{-1})$

e) $\dfrac{4 \times 10^9}{5}$

f) $\dfrac{1.2 \times 10^4}{4 \times 10^{-4}}$

8. Arrange the cards to give the **largest** possible answers.

a)

1	4	-7	-8

$\square \times 10^{\square} \times \square \times 10^{\square}$

b)

-2	4	6	8

$\square \times 10^{\square} \times \square \times 10^{\square}$

9. Work out:

a) $\sqrt{9 \times 10^4}$

b) $\sqrt{4 \times 10^{-6}}$

c) $\sqrt[3]{8 \times 10^{12}}$

10. a) In 1 second, light travels 3×10^8m. Convert this to km.

b) A ream of 500 sheets of paper is 48mm thick. How thick is each sheet of paper? Answer in standard form.

c) The mass of a proton is 1.7×10^{-27}kg. Work out the total mass of 80 protons.

d) The distance from the sun to Earth is 1.5×10^8km. The distance from the sun to Neptune is 4.5×10^9. How many times further is Neptune from the sun than Earth is from the sun?

BRONZE QUESTIONS

1. Write these as ordinary numbers:

(a) 3.6×10^4 (b) 4.76×10^7 (c) 2.41×10^{-3}

(d) 9.02×10^{-5} (e) 8.77×10^3 (f) 6.10×10^{-4}

2. Write these numbers in standard form:

(a) 345 610 (b) 54 million (c) 7590

(d) 135.7 (e) 32.01 (f) 0.738

(g) 0.000034 (h) 0.000524 (i) 0.0102

(j) 409×10^5 (k) 57.2×10^{-4} (l) 0.034×10^8

3. (a) Write these numbers in order, largest to smallest:

3.42×10^4 7.80×10^3 4.2×10^4 8.7×10^3 3.42×10^6

(b) Write these numbers in order, smallest first:

9.34×10^{-3} 3.94×10^{-2} 3.49×10^{-3} 9.34×10^{-5} 4.93×10^{-2}

(c) Write these numbers in order, smallest to largest:

1.52×10^6 1.52×10^{-6} 2.51×10^{-5} 2.15×10^5 2.15×10^{-5}

SILVER QUESTIONS

1. Without a calculator, work out the following, giving your answers in standard form:

(a) $7.72 \times 10^4 + 5.21 \times 10^4$ (b) $8.18 \times 10^5 + 3.45 \times 10^4$ (c) $9.97 \times 10^5 + 5.30 \times 10^4$

(d) $6.23 \times 10^7 - 5.96 \times 10^7$ (e) $5.12 \times 10^6 - 4.62 \times 10^5$ (f) $1.03 \times 10^6 - 9.98 \times 10^5$

2. Without a calculator, work out the following, giving your answers in standard form:

(a) $(4.2 \times 10^6) \times (2.1 \times 10^4)$ (b) $(5.2 \times 10^3) \times (3.4 \times 10^5)$ (c) $(4.2 \times 10^7) \times (3.2 \times 10^{-3})$

(d) $(3.6 \times 10^6) \div (1.8 \times 10^3)$ (e) $(1.4 \times 10^5) \div (5.6 \times 10^2)$ (f) $(1.2 \times 10^5) \div (9.6 \times 10^{-2})$

GOLD QUESTIONS

1. $x = 3 \times 10^m$ and $y = 4 \times 10^n$ where m and n are integers.
Find, in standard from, expressions for:

(a) x^2

(b) y^2

(c) xy

2. $P = (2.4 \times 10^m) \times (6.5 \times 10^n)$, where m and n are integers.
Express P in terms of m and n.
Give your answer in standard form.

3. $a \times 10^3 + b \times 10^4 = c \times 10^4$

Write an expression for c in terms of a and b.

4. $p = 8 \times 10^m$ and $q = 2 \times 10^n$ where m and n are integers.
Find, in standard from, expressions for:

(a) $\frac{p}{q}$

(b) $\frac{q}{p}$

5. Each of the numbers 2×10^a, 5×10^b and $x \times 10^c$ is in standard form.

$$\frac{2 \times 10^a}{5 \times 10^b} = x \times 10^c$$

(a) Find the value of x.

(b) Write an expression for c in terms of a and b.

6. Each of the numbers $p \times 10^{10}$, $q \times 10^{10}$ and $r \times 10^x$ is in standard form.

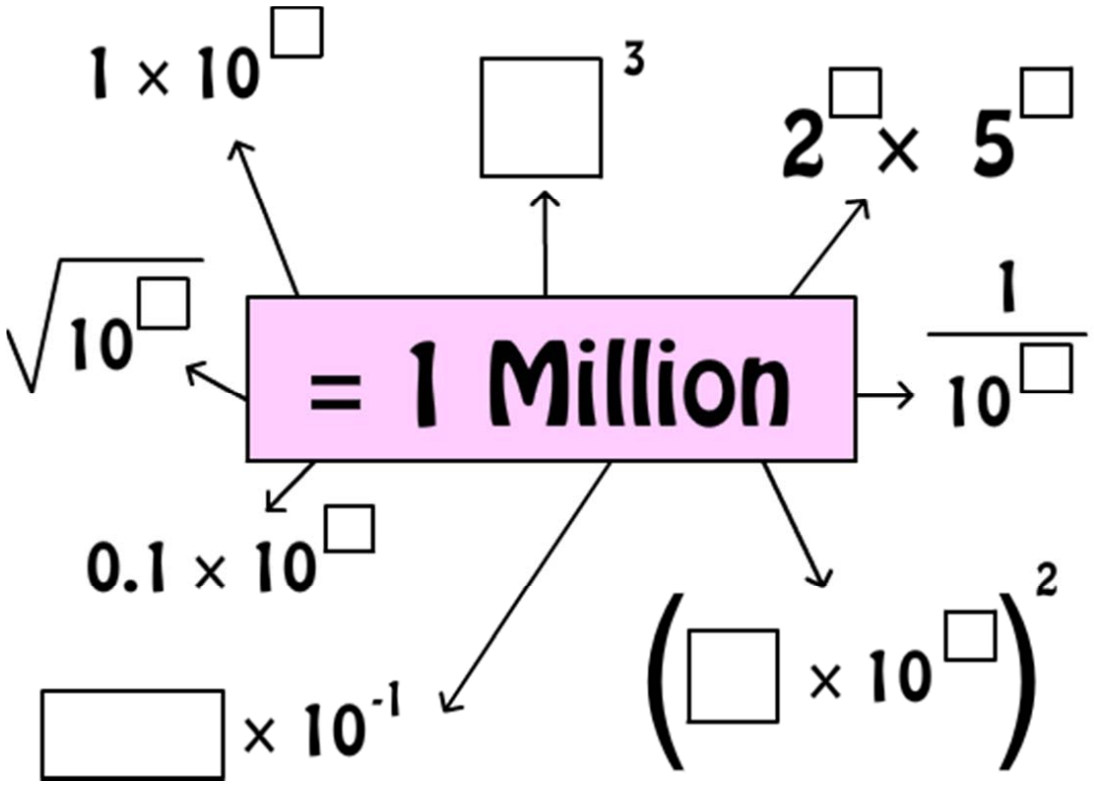
$$p \times 10^{10} + q \times 10^{10} = r \times 10^x$$

$$p + q > r$$

(a) Find the value of x.

(b) Write an expression for r in terms of p and q.

Purposeful Practice



Problem A

Use each of the digits 0 to 9, once only. How close to 1 million can you get?

$\square \times 10^{\square} + \square \times 10^{\square} + \square \times 10^{\square} + \square \times 10^{\square} + \square \times 10^{\square}$

Problem B

Put a different digit in each box. Can you make 1 million exactly?

$\square \times 10^{\square} \times \square \times 10^{\square} + \square \times 10^{\square}$

Problem C

Put a different digit in each box. How close to 1 million can you get?

$$\frac{\square \times 10^{\square}}{\square \times 10^{\square}}$$

target 1 million

Problem A

Use each of the digits 0 to 9, once only. How close to 1 million can you get?

$\square \times 10^{\square} + \square \times 10^{\square} + \square \times 10^{\square} + \square \times 10^{\square} + \square \times 10^{\square}$

Problem B

Put a different digit in each box. Can you make 1 million exactly?

$\square \times 10^{\square} \times \square \times 10^{\square} + \square \times 10^{\square}$

Problem C

Put a different digit in each box. How close to 1 million can you get?

$$\frac{\square \times 10^{\square}}{\square \times 10^{\square}}$$

target 1 million

Purposeful Practice

Practical Standard Form

(a)

The table shows the diameter of some planets in the solar system.

Planet	Diameter (km)
Earth	1.3×10^4
Mercury	4.8×10^3
Neptune	4.9×10^4
Saturn	1.2×10^5

(i) Calculate the difference, in km, between the diameter of Earth and the diameter of Saturn. Give your answer in standard form.

(ii) The diameter of Neptune is k times bigger than the diameter of Mercury. Find the value of k to 1 decimal place.

(iii) Find the ratio of the diameter of Saturn to the diameter of Mercury in the form $n : 1$

(b)

The table shows the populations of some European countries.

Country	Population
Belgium	1.16×10^7
Estonia	1.33×10^6
Iceland	3.41×10^5
Russia	1.46×10^8

(i) Calculate the total population of these four countries. Give your answer in standard form to 3 significant figures.

(ii) How many more people live in Estonia than live in Iceland? Give your answer in standard form.

(iii) Calculate the ratio of the population of Belgium to the population of Russia. Give your answer in the form $1 : n$, where n is rounded to 1 decimal place.

(c)

The table shows the areas in square kilometres of four Asian countries.

Country	Area (km^2)
China	9.6×10^6
Hong Kong	1.11×10^3
Japan	3.78×10^5
Pakistan	7.96×10^5

(i) Calculate the total area of China, Japan and Hong Kong. Give your answer in standard form to 3 significant figures.

(ii) Calculate the difference in area between China and Pakistan. Give your answer in standard form.

(iii) The population of Hong Kong is $7.48\ million$. Find the population density of Hong Kong to the nearest integer, where:

$$Population\ density = Population \div Area$$

Using a calculator, work out the following, giving your answer in standard form.

(a) $(1.25 \times 10^5) + (3.4 \times 10^5)$

(b) $(2.7 \times 10^{-4}) - (1.28 \times 10^{-5})$

(c) $(3.87 \times 10^{-2}) \times (5.3 \times 10^4)$

(d) $\frac{4.152 \times 10^6}{1.73 \times 10^{-2}}$

(e) $(7.3 \times 10^{-2})^2$

(f) $\sqrt{(3.6 \times 10^{11})}$

(a) Given that $F = ma$, find F when $m = 1.2 \times 10^{-12}\ g$ and $a = 4.5 \times 10^9 m/s^2$.

(b) Denmark has a population of 5.36×10^6 and Jamaica has a population of 2.56×10^6. How many more people live in Denmark than in Jamaica?

(a) The mass of Saturn is 5.686×10^{26} tonnes and the mass of the Earth is 6.04×10^{21} tonnes. How many times heavier is Saturn than Earth?

(b) In 2009 the world population was 6.77×10^9. In 2019 it was 7.73×10^9. Calculate the percentage increase in population between 2009 and 2019.

(a) The population of Wales is 3.14×10^6 people. The annual spend on healthcare is £8 billion. Calculate the amount spent on healthcare per person in Wales each year, to the nearest pound.

(b) The volume of four different oceans in km^3 are 1.88×10^7, 3.1×10^8, 2.64×10^8 and 7.18×10^7. Find the mean volume of the four oceans, giving your answer in standard form.

Purposeful Practice

This headline appeared in a newspaper.

Every day 7% of Americans eat at Giantburger restaurants

Decide whether this headline is true using the following information.

- There are about 8×10^3 Giantburger restaurants in America.
- Each restaurant serves about 2.5×10^3 people every day.
- There are about 3×10^8 Americans.

Explain your reasons and show clearly how you figured it out.

Fill in the gaps, giving all answers in standard form.

	w	h	Area	Perimeter
1)	3×10^6	4×10^6		
2)	9×10^5	1.2×10^6		
3)		3×10^4	2.4×10^8	
4)	3×10^5			6.6×10^6
5)		3×10^4	6×10^7	
6)			6×10^{12}	1×10^7

Purposeful Practice

1) $x + 3\times10^{6} = 5\times10^{6}$

2) $0.7x + 3.3\times10^{6} = 5.4\times10^{6}$

3) $1.3x - 3.7\times10^{-3} = 5.4\times10^{-3}$

4) $(2.3\times10^{3})x = 9.2\times10^{-5}$

5) $(6.1\times10^{11})x = 1.92\times10^{6} - (3.5\times10^{11})x$

6) $3\times10^{-2} + 5x = 3x + 8\times10^{-2}$

7) $(3\times10^{-5})x + 5 = 3 + (8\times10^{-5})x$

8) $8x + 2.6\times10^{8} = 12x + 1.2\times10^{8}$

9) $x + 3\times10^{5} = 5\times10^{6}$

10) $0.7x - 1.1\times10^{4} = 5.4\times10^{6}$

11) $1.3x + 5.3\times10^{-4} = 9\times10^{-7}$

12) $(9.2\times10^{3})x = 2.3\times10^{-5}$

13) $(1.2\times10^{11})x = 8\times10^{6} - (5\times10^{9})x$

14) $3\times10^{-2} + 5x = 3x + 8\times10^{-3}$

15) $(2\times10^{-2})x - 7 = 11 + (8\times10^{-3})x$

16) $11x + 2.4\times10^{8} = 1.2\times10^{12} - 13x$

Purposeful Practice

1) Assuming that each pair of numbers is the start of an arithmetic sequence, find: (i) the next three terms, (ii) the nth term rule, (iii) the 200^{th} term.
2) Assuming that each pair of numbers is the start of a geometric sequence, find: (i) the next three terms, (ii) the ratio between the first and third terms, (iii) the ratio between the second and fifth terms.

a) $2\times10^3, 6\times10^3$

b) $2\times10^3, 2\times10^4$

c) $2\times10^3, 2.4\times10^3$

d) $2\times10^3, 3\times10^4$

e) $2\times10^3, 1.8\times10^4$

f) $2\times10^3, 1.8\times10^3$

g) $2\times10^3, 2\times10^5$

h) $2\times10^3, 2\times10^2$

i) $2\times10^{-2}, 6\times10^{-2}$

j) $2\times10^{-3}, 1.2\times10^{-2}$

Question 1.

Work out $4\times10^{7}\times6\times10^{-5}$. Give your answer in standard form.

[2]

Question 2.

Work out $\dfrac{3.2\times10^{8}}{4\times10^{4}}$. Give your answer in standard form.

[2]

Question 3.

Work out $\left(4\times10^{5}\right)^{2}$. Give your answer in standard form.

[2]

Question 4.

$$p = 8\times10^{3}$$
$$q = 2\times10^{4}$$

Calculate the value of the following, giving your answers in standard form.

(a) pq

[2]

(b) p + q

[2]

(c) p ÷ q

[2]

Question 5.

Last year the population of the UK was approximately 5.3×10^{7}.

An average of £680 per person was spent on food last year in the UK.

What was the total amount spent on food last year in the UK? Give your answer in standard form.

[3]

Question 6.

A publisher prints 1.25×10^6 copies of a magazine. Each magazine consists of 18 sheets of paper.

(a) Calculate the number of sheets of paper needed to print all the magazines.
Give your answer in standard form.

[2]

To make the magazine, the sheets of paper are folded as shown

(b) The height if a pile of magazines is 79.1 cm. The pile contains 232 magazines.
Calculate, in centimetres, the thickness of one sheet of paper.

[3]

Question 7.

A rectangular picture measures 1.2×10^2 cm by 4.3×10^3 cm.

Calculate the following, giving your answer in standard form. Remember to state the units with your answers.

(a) The perimeter of the picture

[2]

(b) The area of the picture

[3]

Question 8.

It is estimated that a water tank contains about 1.12×10^7 drops of rain water.

By taking samples, it is further estimated that the water contains about 5.80×10^9 microbes.

Assuming an even distribution, give an estimate of the number of microbes per drop of rain water.

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

[4]

Standard form – used to write very large and very small numbers in an easier way.
You can use your calculator to enter standard form numbers using the EXP button.
5.3 x 10^6 would be entered as 5.3 EXP 6. Remember to use brackets when doing calculations!

4 Types of Numbers

Question 1: Write down 3 rational numbers

Question 2: Write down 3 irrational numbers

Question 3: List any irrational numbers from the box below

8	π	$\frac{2}{3}$	$\sqrt{4}$
$\frac{1}{2}$	$\sqrt{5}$	$0.\dot{1}$	

Question 4: Write down an irrational number between 4 and 6.

Question 5: Write down an irrational number between 3 and 4.

Question 6: Write down an irrational number between 6 and 7.

Question 7: $\sqrt{y}$ is a rational number between $\sqrt{33}$ and $\sqrt{50}$

Find a value for y.

Question 8: $\sqrt{z}$ is a rational number between $\sqrt{125}$ and $\sqrt{150}$

Find a value for z.

Question 9: $\sqrt[3]{a}$ is a rational number between $\sqrt[3]{100}$ and $\sqrt[3]{200}$

Find a value of a.

Apply

Question 1: Hannah says "**all integers are rational**."
Is Hannah correct?

Question 2: Kate says "**0.3333... is irrational because it is a recurring decimal.**"
Is Kate correct?

Question 3: Does this equation have rational or irrational solutions?

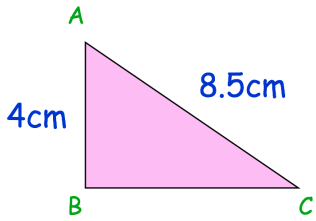
$$\frac{2}{3}x^2 = 40$$

Question 4: The equation below can have rational or irrational solutions.

$$5x^2 = k$$

(a) Write down a value for k which gives rational solutions.
(b) Write down a value for k which gives irrational solutions.

Question 5: ABC is a right angled triangle.
Is the length BC rational or irrational?



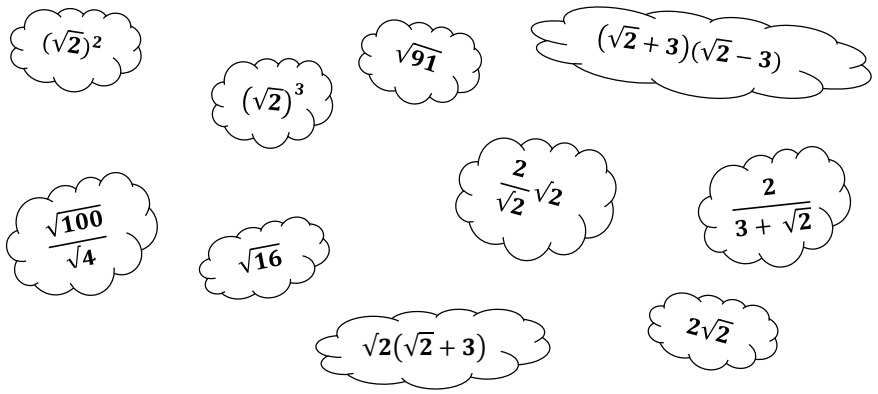
Question 6: Show $(7 - \sqrt{2})(7 + \sqrt{2})$ is rational

Question 7: Find two surds that when multiplied together give a rational answer.

Question 8: Show $\dfrac{2\sqrt{27}}{5\sqrt{3}}$ is rational

Purposeful Practice

Sort these expressions into the table below:



Rational Numbers	Irrational Numbers

* Challenge *

Explain why $(2+\sqrt{3})(2-\sqrt{3})$ is a rational number.

Always, Sometimes, Never?

Rational and Irrational Numbers

For each of these statements, decide whether they are always, sometimes or never true. Explain your reasoning and support your argument with examples.

The sum of two rational numbers is a rational number	**The circumference of a circle is an irrational number**
The difference between two irrational numbers is an irrational number	**The product of two rational numbers is an irrational number**
The area of a square is a rational number	**The product of a rational number and an irrational number is irrational**

5 Multiplying and Simplifying Surds

Intelligent Practice

Simplify

1) $\sqrt{8}$

2) $\sqrt{12}$

3) $\sqrt{32}$

4) $\sqrt{64}$

5) $\sqrt{128}$

6) $\sqrt{192}$

7) $\sqrt{320}$

8) $\sqrt{80}$

9) $\sqrt{40}$

10) $\sqrt{90}$

10) $\sqrt{160}$

11) $\sqrt{1600}$

12) $\sqrt{200}$

13) $\sqrt{250}$

14) $\sqrt{175}$

15) $\sqrt{350}$

16) $\sqrt{351}$

17) $\sqrt{353}$

Intelligent Practice

Simplify

1) $\left(\sqrt{2}\right)^2$

2) $\left(\sqrt{3}\right)^2$

3) $\left(\sqrt{5}\right)^2$

4) $\left(\sqrt{10}\right)^2$

5) $\left(2\sqrt{10}\right)^2$

6) $\left(3\sqrt{10}\right)^2$

7) $3\left(\sqrt{10}\right)^2$

8) $5\left(\sqrt{10}\right)^2$

9) $10\left(\sqrt{10}\right)^2$

10) $10\left(\sqrt{2}\right)^2$

11) $10\left(2\sqrt{2}\right)^2$

12) $\left(2\sqrt{2}\right)^2$

13) $\left(2\sqrt{2}\right)^3$

14) $\left(\sqrt{2}\right)^3$

15) $\left(\sqrt{3}\right)^3$

16) $\left(\sqrt{5}\right)^3$

17) $\left(\sqrt{5}\right)^4$

18) $\left(\sqrt{5}\right)^5$

Intelligent Practice

Simplify

1) $\sqrt{8}$

2) $2\sqrt{8}$

3) $3\sqrt{8}$

4) $\sqrt{72}$

5) $5\sqrt{72}$

6) $5\sqrt{144}$

7) $5\sqrt{1440}$

8) $5\sqrt{720}$

9) $5\sqrt{360}$

10) $5\sqrt{36}$

11) $6\sqrt{36}$

12) $7\sqrt{49}$

13) $7\sqrt{98}$

14) $7\sqrt{147}$

15) $14\sqrt{147}$

16) $7\sqrt{294}$

17) $7\sqrt{295}$

18) $7\sqrt{2950}$

Intelligent Practice

Write the following as a single root

1) $2\sqrt{2}$

2) $3\sqrt{2}$

3) $2\sqrt{3}$

4) $4\sqrt{6}$

5) $5\sqrt{7}$

6) $5\sqrt{8}$

7) $5\sqrt{9}$

8) 15

9) 15^2

Fluency Practice

1 Simplify the following:

a $\sqrt{8} =$?

b $\sqrt{18} =$?

c $\sqrt{50} =$?

d $\sqrt{80} =$?

e $\sqrt{72} =$?

2 Simplify the following:

a $5\sqrt{80} =$?

b $2\sqrt{125} =$?

c $8\sqrt{12} =$?

d $3\sqrt{72} =$?

e $2\sqrt{28} =$?

3 Simplify the following:

a $\sqrt{3}\times\sqrt{2}\times\sqrt{5} = \sqrt{}$?

b $\sqrt{27}\times\sqrt{3} =$?

c $4\sqrt{3}\times 2 =$?

d $5\times 2\sqrt{5} = 1$?

e $2\sqrt{2}\times 2\sqrt{2} = 8$?

f $7\sqrt{3}\times 2\sqrt{5} = 1$?

g $6\sqrt{3}\times 2\sqrt{3} = 3$?

4 Simplify the following:

a $\sqrt{8}\times 3\sqrt{2} = 1$?

b $\sqrt{27}\times 2\sqrt{3} = 1$?

c $3\sqrt{18}\times\sqrt{2} = 1$?

d $2\sqrt{12}\times 3\sqrt{3} = 3$?

5 Express the following as a single square root

(hint: do the steps of simplification backwards!)

a $3\sqrt{2} =$?

b $2\sqrt{5} =$?

c $5\sqrt{7} =$?

d $4\sqrt{3} =$?

6 Express the following as a single square root:

a $a\sqrt{b} =$?

b $2\sqrt{k} =$?

Fluency Practice

A1 Express $4\sqrt{2}$ in the form $\sqrt{a}$	**A2** Express $7\sqrt{2}$ in the form $\sqrt{a}$	**A3** Express $10\sqrt{2}$ in the form $\sqrt{a}$	**A4** Express $11\sqrt{2}$ in the form $\sqrt{a}$
B1 Express $\sqrt{8}$ in the form $a\sqrt{2}$ where a is an integer.	**B2** Express $\sqrt{18}$ in the form $a\sqrt{2}$ where a is an integer.	**B3** Express $\sqrt{50}$ in the form $a\sqrt{2}$ where a is an integer.	**B4** Express $\sqrt{128}$ in the form $a\sqrt{2}$ where a is an integer.
C1 Express $2\sqrt{5}$ in the form $\sqrt{a}$	**C2** Express $3\sqrt{6}$ in the form $\sqrt{a}$	**C3** Express $6\sqrt{3}$ in the form $\sqrt{a}$	**C4** Express $5\sqrt{5}$ in the form $\sqrt{a}$
D1 Express $\sqrt{75}$ in the form $a\sqrt{3}$ where a is an integer.	**D2** Express $\sqrt{54}$ in the form $a\sqrt{6}$ where a is an integer.	**D3** Express $\sqrt{150}$ in the form $a\sqrt{6}$ where a is an integer.	**D4** Express $\sqrt{180}$ in the form $a\sqrt{5}$ where a is an integer.
E1 Express $\sqrt{48}$ in the form $a\sqrt{b}$ where a and b are integers and $a \neq 1$	**E2** Express $\sqrt{45}$ in the form $a\sqrt{b}$ where a and b are integers and $a \neq 1$	**E3** Express $\sqrt{147}$ in the form $a\sqrt{b}$ where a and b are integers and $a \neq 1$	**E4** Express $\sqrt{112}$ in the form $a\sqrt{b}$ where a and b are integers and $a \neq 1$

Problem Solving

How many different ways can you fill the boxes so that the equality is true?

$$\sqrt{\square} = \square\sqrt{3}$$

How many different ways can you fill the boxes so that the equality is true?

$$\sqrt{\square} = 3\sqrt{\square}$$

Problem Solving

$$\sqrt{\square} \times \sqrt{3} = \square$$

Fill in the boxes so that…

a) The 2nd box has an integer inside (there are at least 2 ways of doing this).

b) The 2nd box has a surd inside.

c) The 2nd box has a surd inside with a coefficient greater than 1.

d) The 2nd box has a surd inside with a coefficient greater than 1 AND the surd is not $\sqrt{3}$.

Purposeful Practice

Instructions: Complete the remaining boxes by making the minimum change possible to the centre box. If there are boxes that cannot be filled in, say why.

Value

Difference between the number before the root symbol and inside the root symbol when simplified	Less	Same	More
More			
Same		$\sqrt{63}$	
Less			

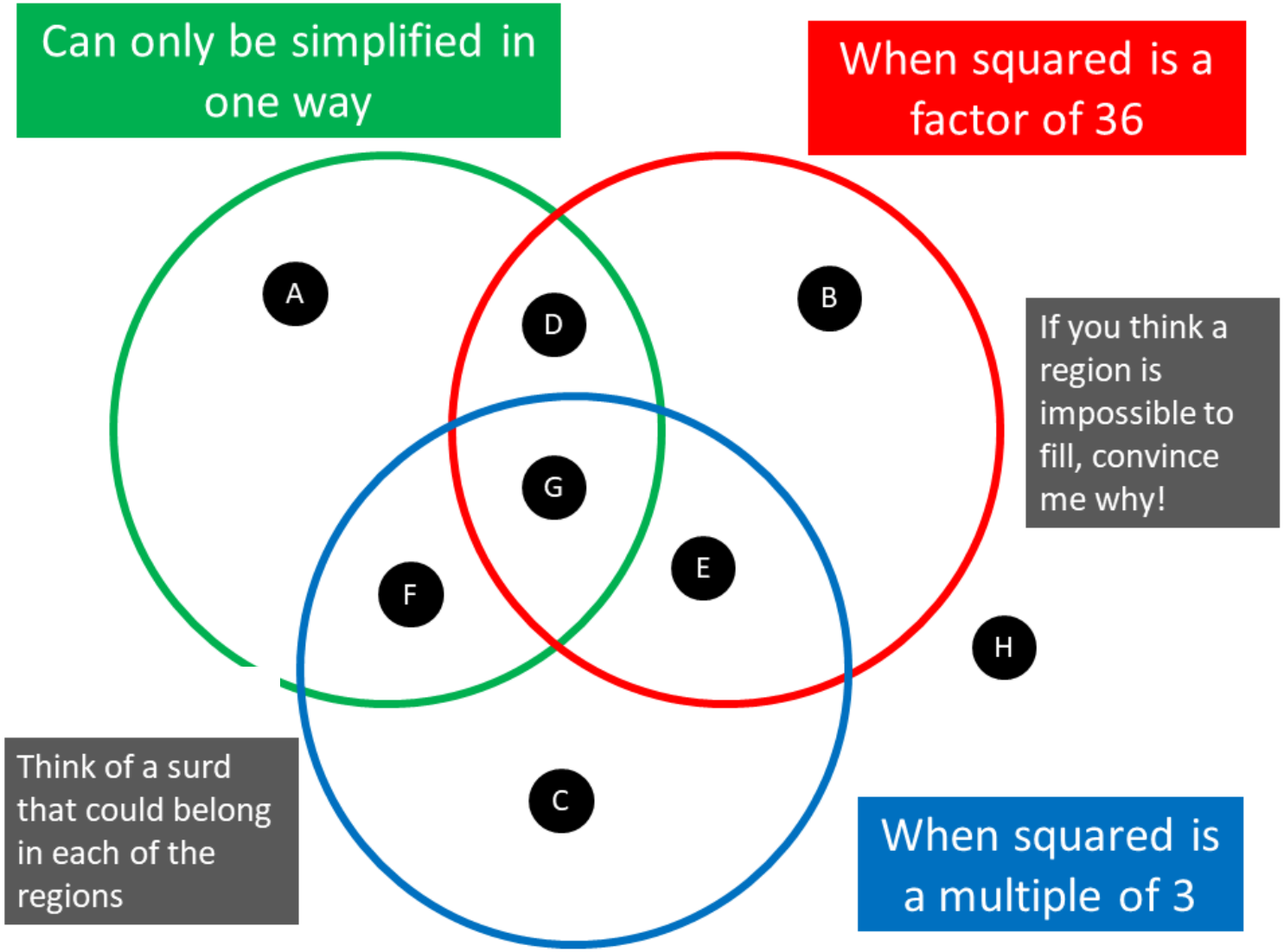
Purposeful Practice

Instructions: Simplify the middle surd. Next choose an un-simplified surd which fits in each box and simplify it.
Try to make your questions and answers as similar as possible to the middle box.

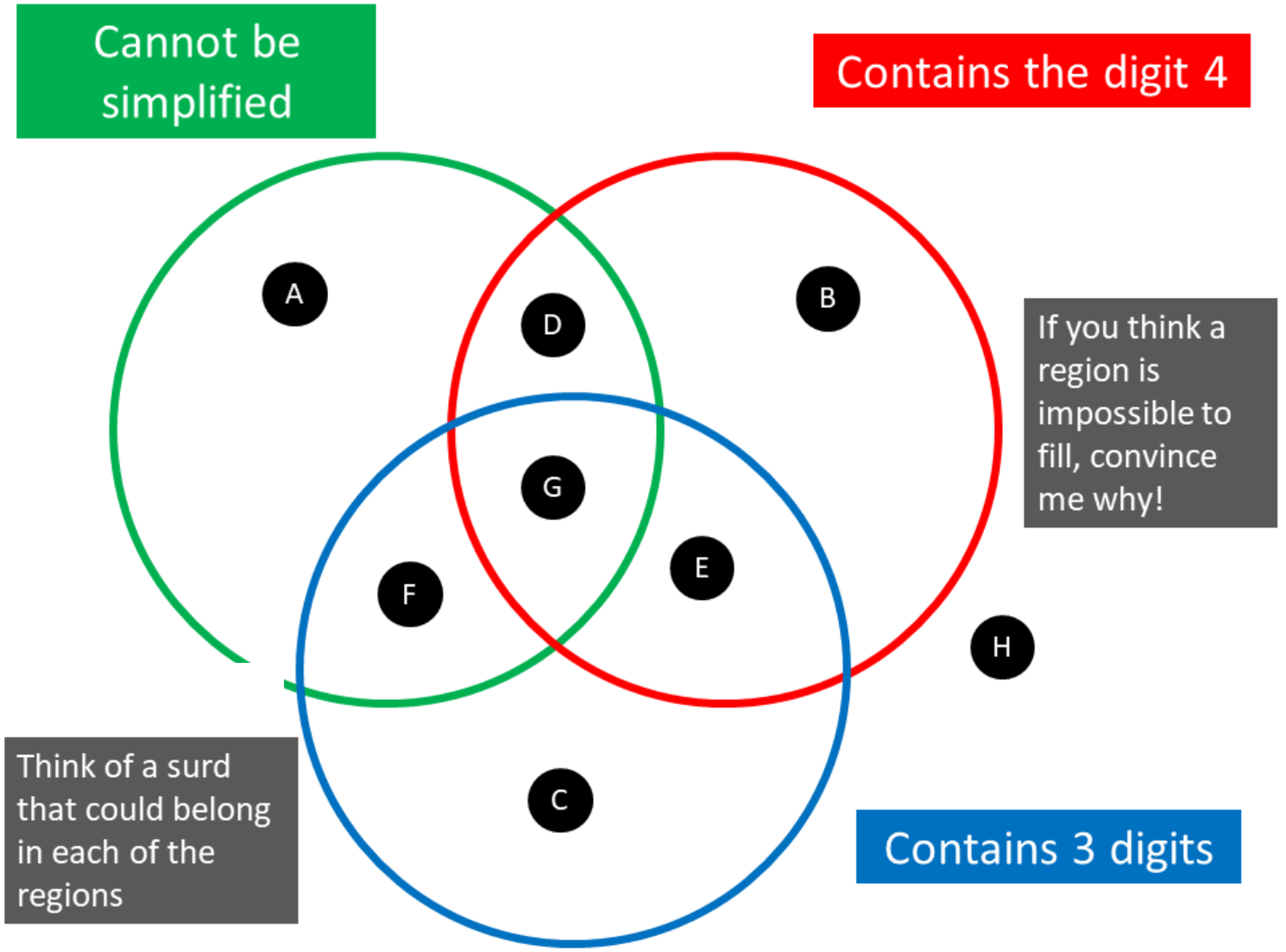
Value of the surd

Value of the irrational part once simplified	Less	Same	More
Less			
Same		$\sqrt{50}$	
More			

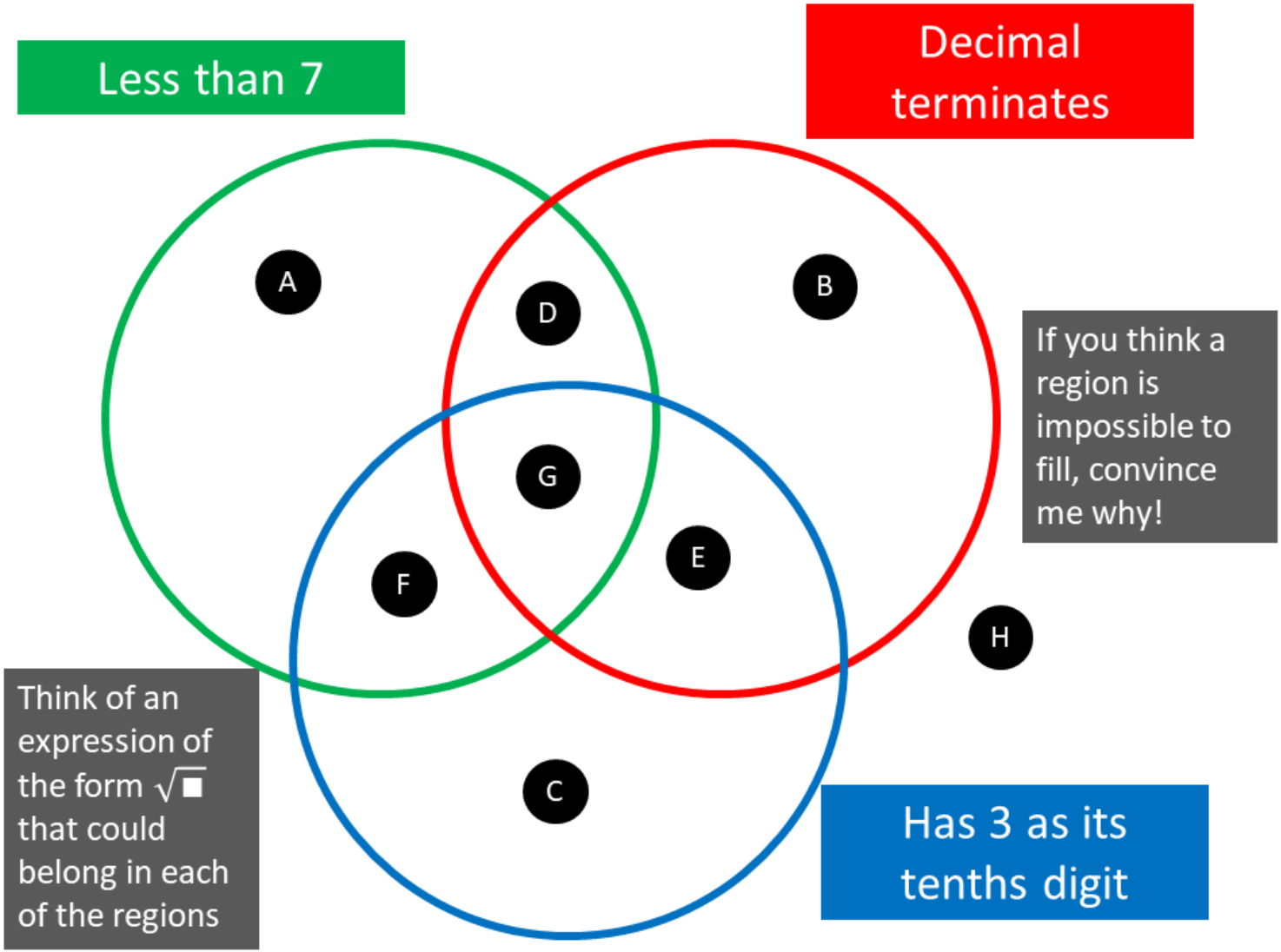
Problem Solving



Problem Solving

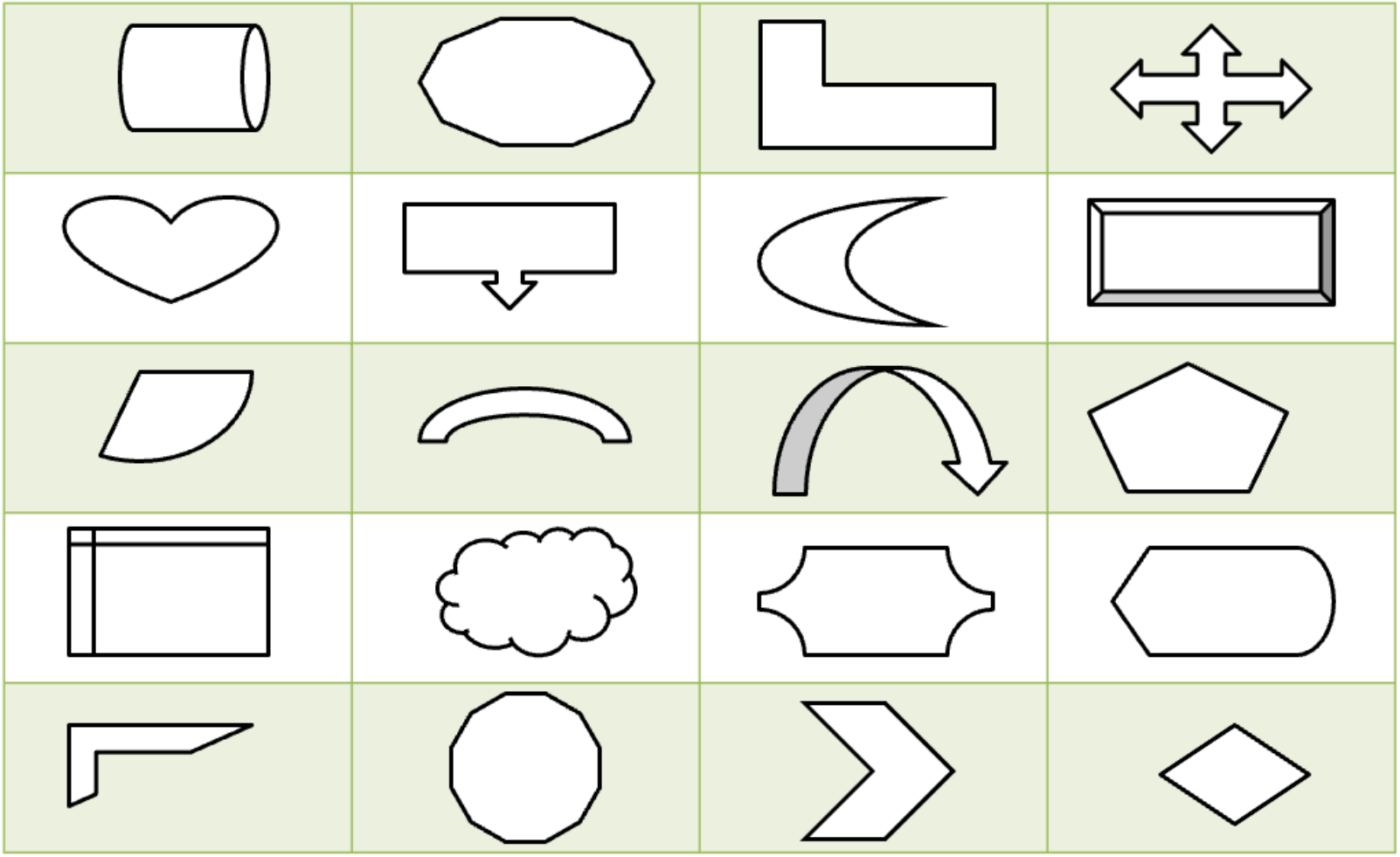


Problem Solving



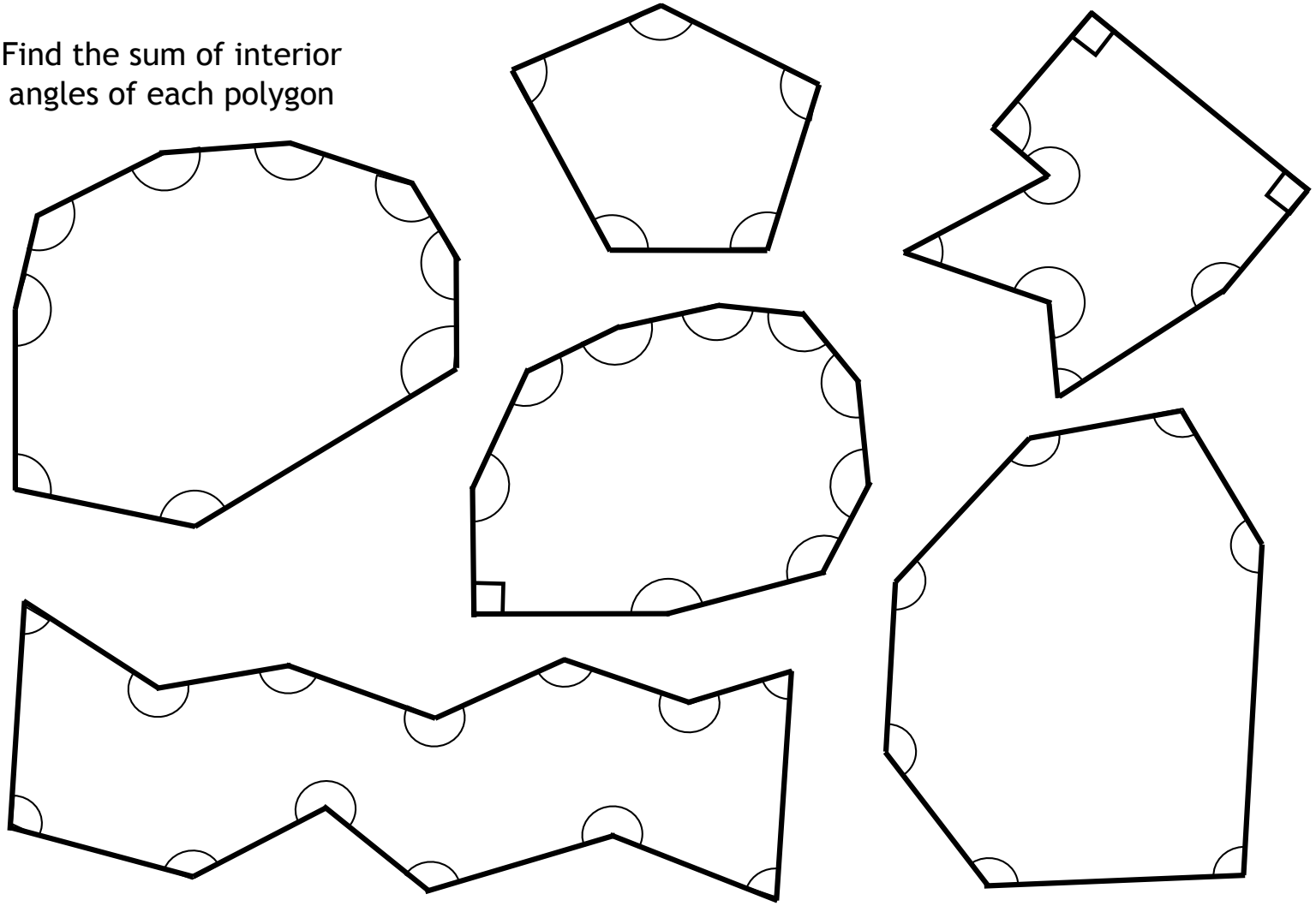
6 Angles in Polygons

Is it a polygon?



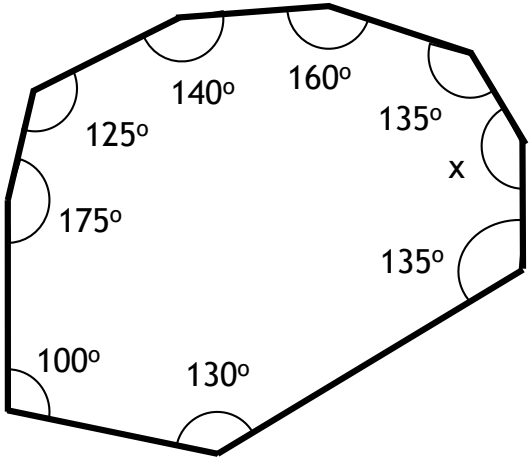
Fluency Practice

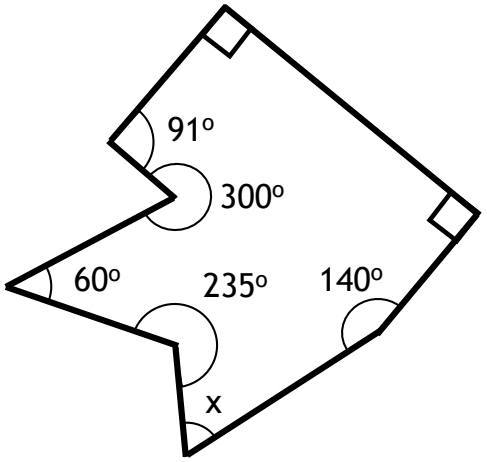
Find the sum of interior angles of each polygon

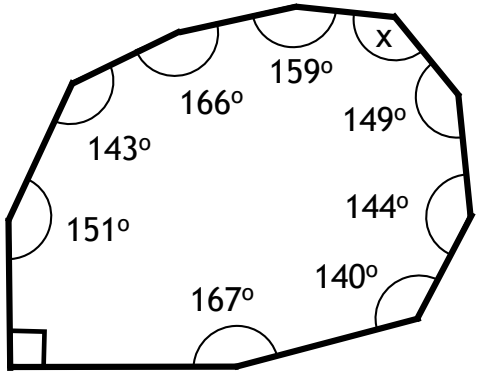


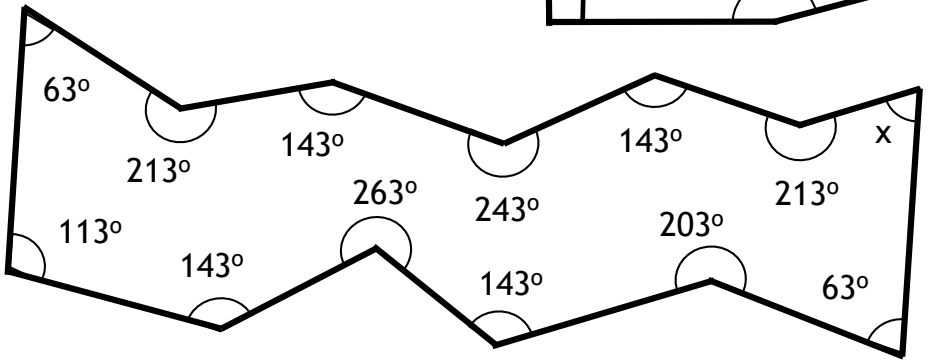
Fluency Practice

Find the angle marked x in each shape









Problem Solving

Here are five angles.

What angle should be added so that:

- 3 of the angles can form a triangle
- 4 of the angles can form a quadrilateral
- 5 of the angles can form a pentagon

(There are two possible answers.)

123°	34°
237°	56°
91°	

Here are six angles.

Five of the angles form a pentagon.

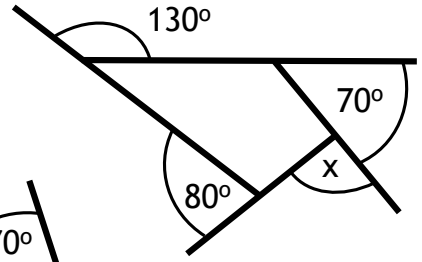
Which angle doesn't belong to the polygon?

43°	48°
91°	109°
146°	151°

Fluency Practice

Find the angle marked x in each question

1)



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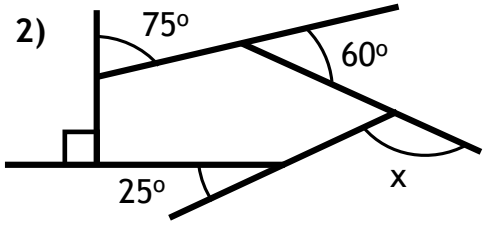

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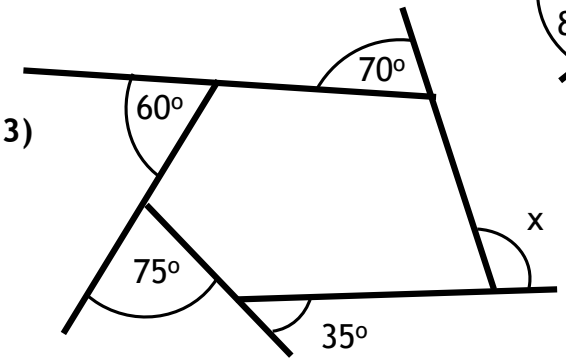

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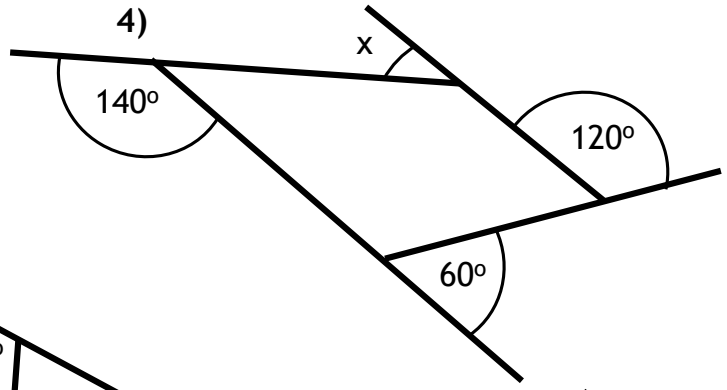

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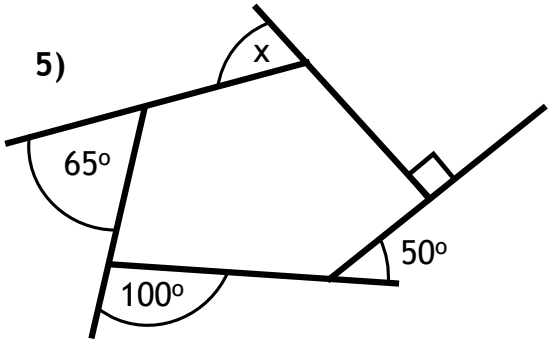

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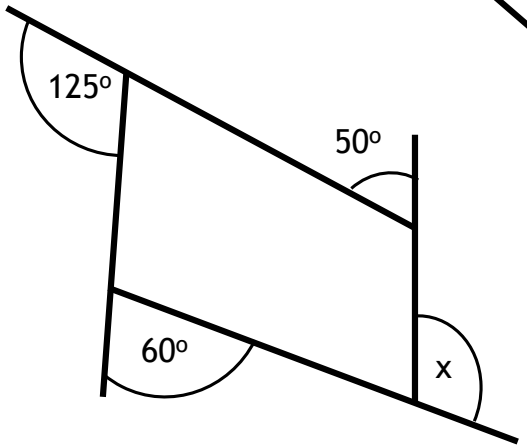

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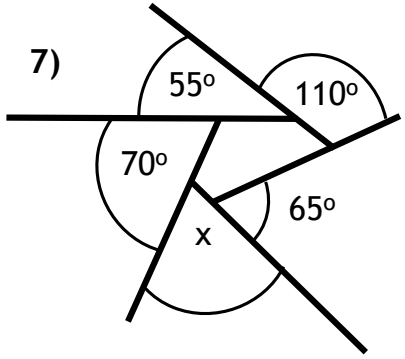
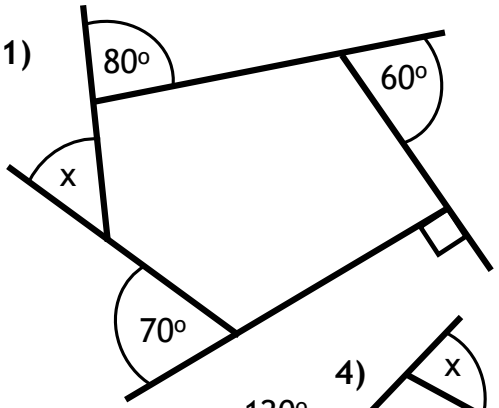


Fluency Practice

Find the angle marked x in each question

1)



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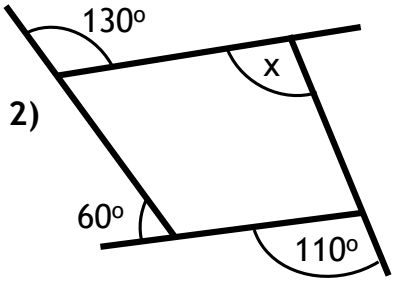
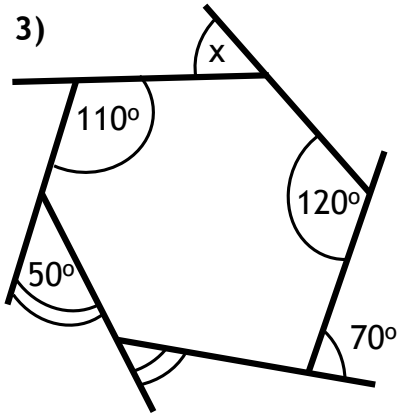


Diagrams not to scale

3)



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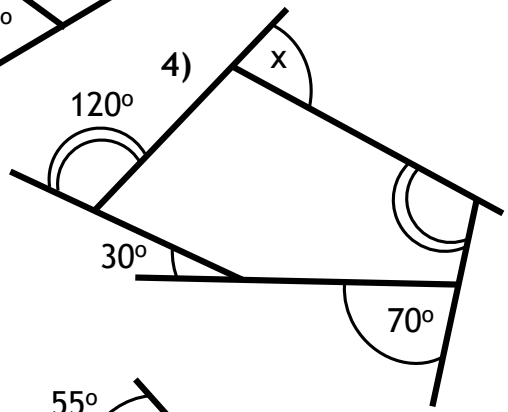

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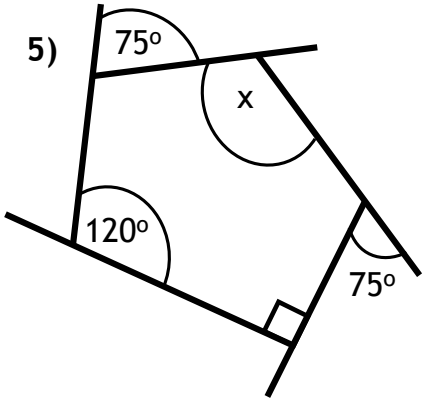

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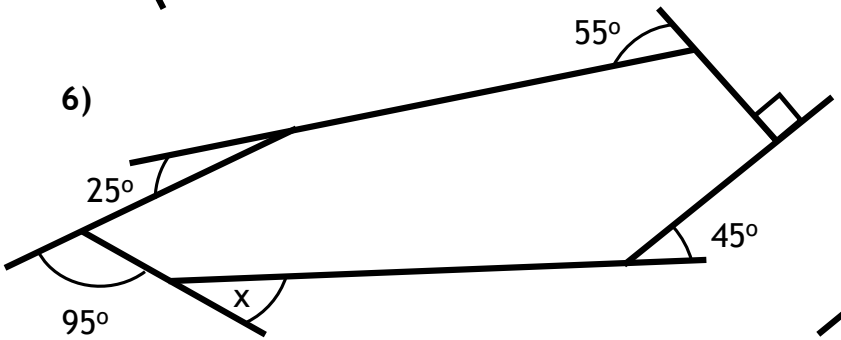

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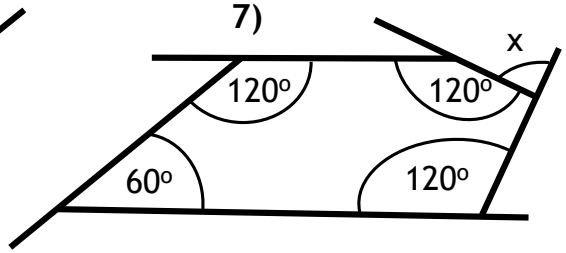
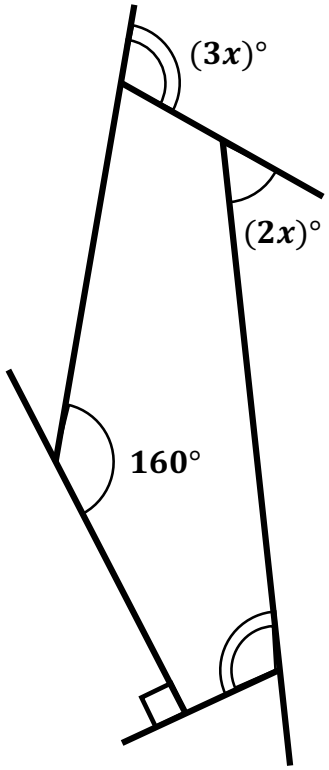
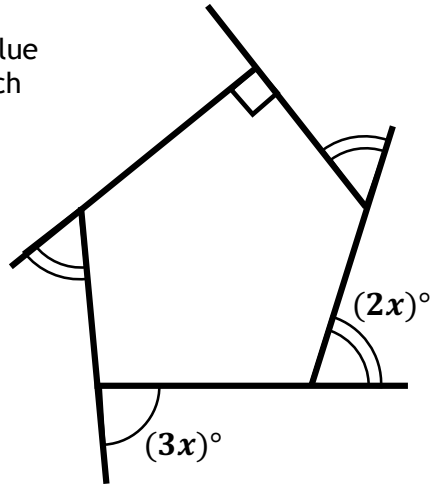
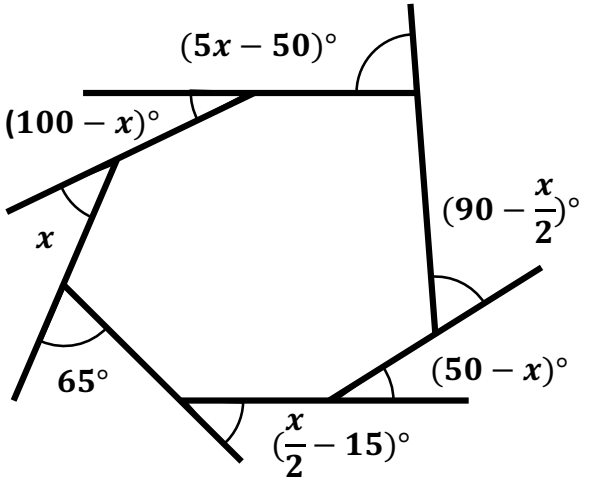


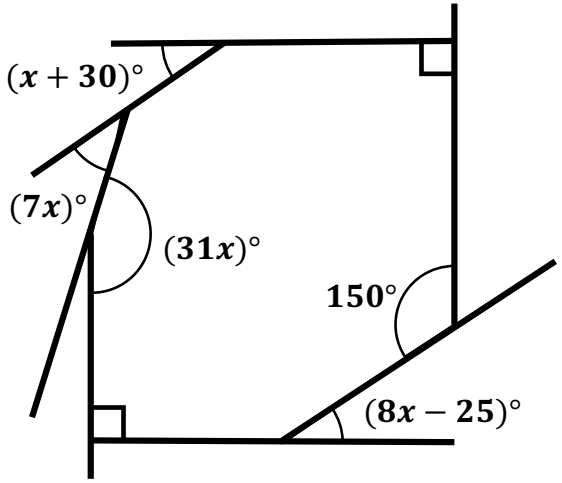
Fluency Practice

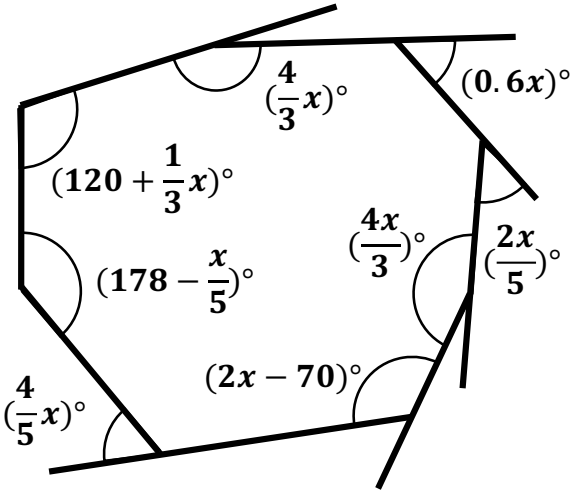
Find the value of x in each question











Purposeful Practice

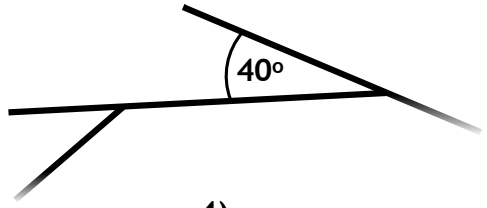
Each question shows part of a regular polygon and an interior or exterior angle.

For questions 1 to 6, find the number of sides. For questions 7 to 10, find the perimeter of the shape in cm.

There is one question that is an ambiguous case. Which question is it and why is it the only possible ambiguous case?

Diagrams not to scale

1)



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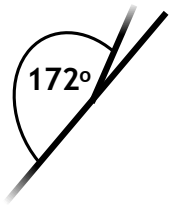

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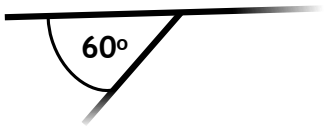

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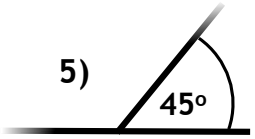

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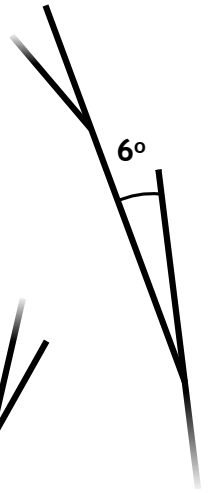

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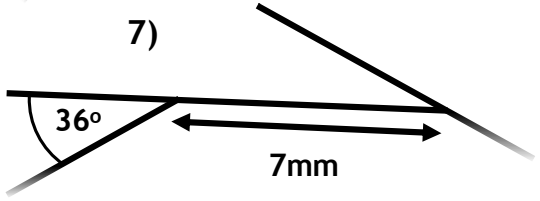

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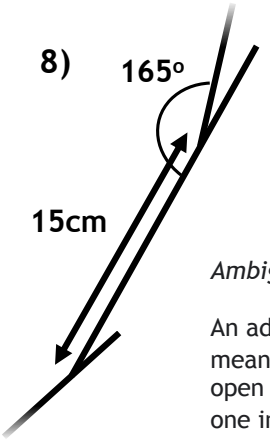

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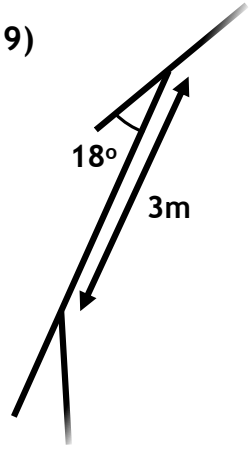


10) A regular polygon that has an edge length of 2mm and an interior angle of 176cm

11) A regular polygon has a perimeter of 180cm and an exterior angle of 10°. How long is each edge in cm?

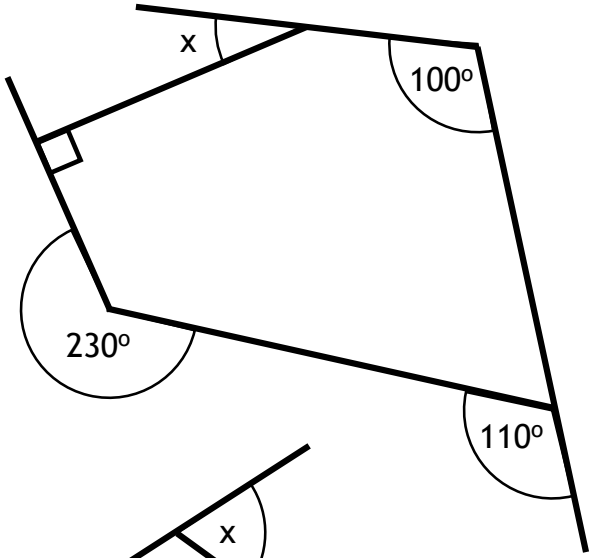
12) A regular polygon has a perimeter of 12m and an interior angle of 171°. How long is each edge in cm?

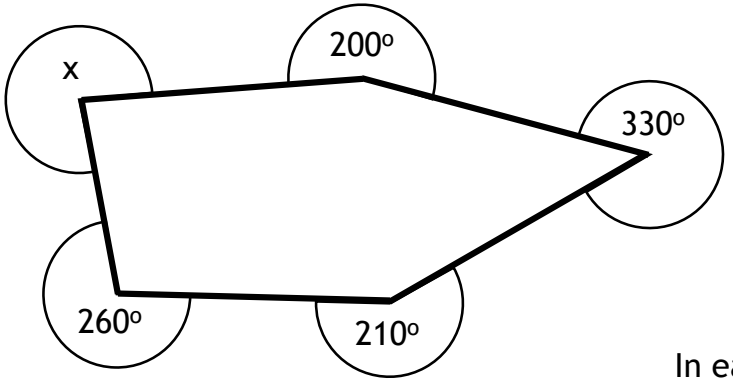
Ambiguous

An adjective that means something is open to more than one interpretation.

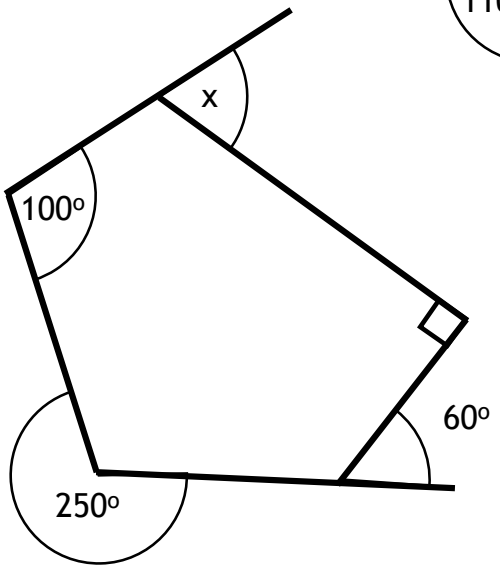
From the Latin: ambi (both ways) and agere (to drive).

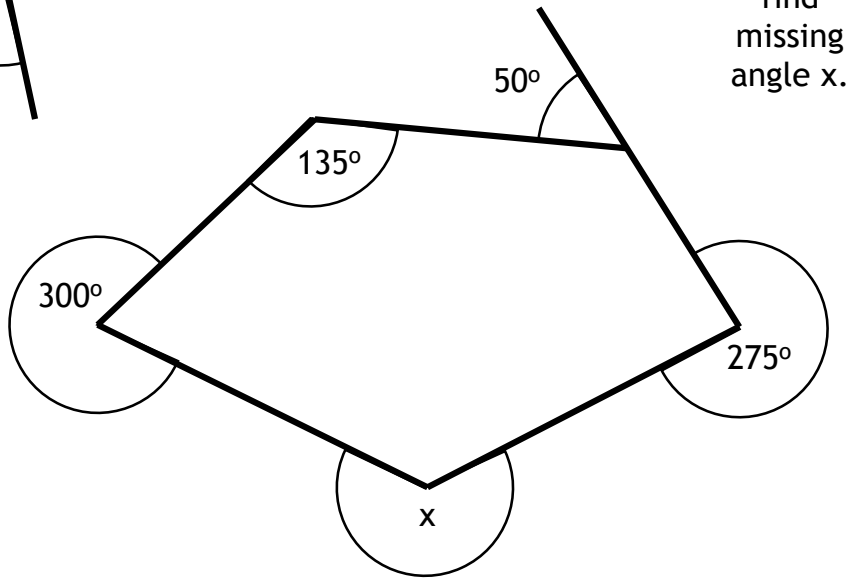
Fluency Practice





In each question, find missing angle x.





Fluency Practice

Q	Simplify:	Answers	Q	Simplify:	Answers
1	Exterior angle of an equilateral triangle		12	Interior angle of an equilateral triangle	
2	Interior angle of a square		13	Exterior angle of a square	
3	Exterior angle of a regular pentagon		14	Interior angle of a regular pentagon	
4	Interior angle of a regular hexagon		15	Exterior angle of a regular hexagon	
5	Exterior angle of a regular octagon		16	Interior angle of a regular octagon	
6	Interior angle of a regular nonagon		17	Exterior angle of a regular nonagon	
7	Exterior angle of a regular decagon		18	Interior angle of a regular decagon	
8	Interior angle of a regular dodecagon		19	Exterior angle of a regular dodecagon	
9	Exterior angle of a regular 15-sided shape		20	Interior angle of a regular 15-sided shape	
10	Interior angle of a regular 20-sided shape		21	Exterior angle of a regular 20-sided shape	
11	Exterior angle of a regular n-sided shape		22	Interior angle of a regular n-sided shape	

Purposeful Practice

5 students look at a regular shape
They each make a statement. Which statement can't be true?

Amelia says:
The shape has an interior angle of 162°

Bilal says:
The sum of all the interior angles In the shape is 3240°

Charlie says:
The sum of all the exterior angles is 360°

Diana says:
The shape has an exterior angle of 18°

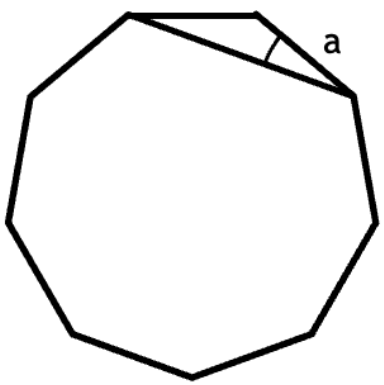
Edward says:
The shape has 18 sides

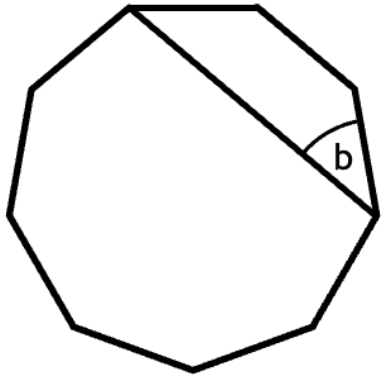
Fluency Practice

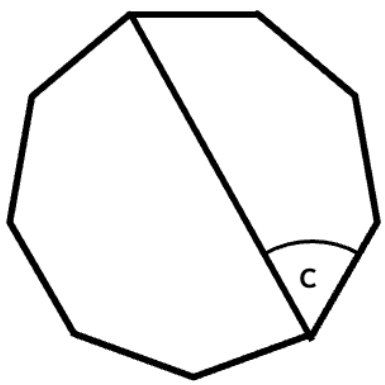
Each diagram shows a regular nonagon

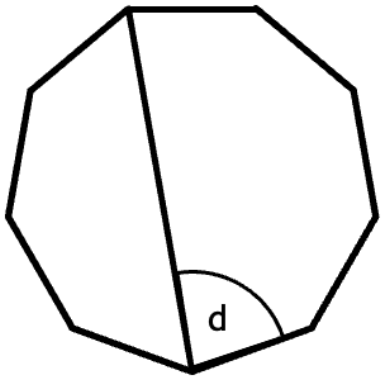
with a line connecting two vertices.

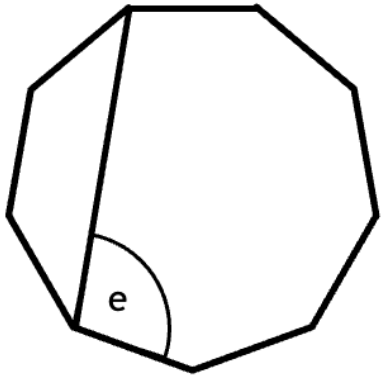
Find the lettered angle in each.

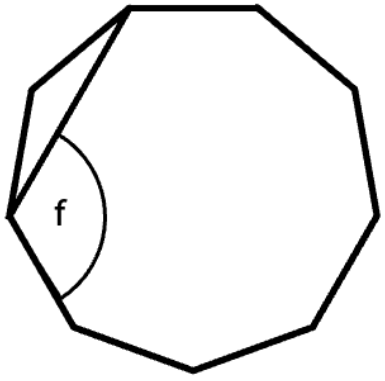










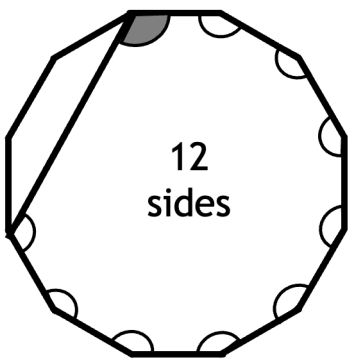


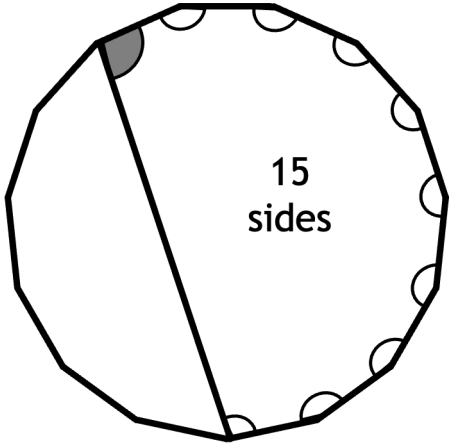
Fluency Practice

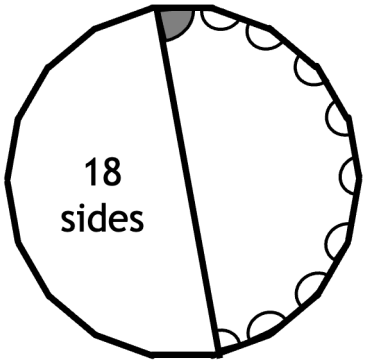
Each diagram shows a regular shape with a line connecting two vertices that forms a decagon.

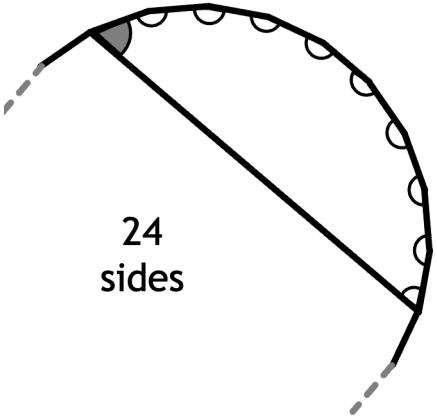
The number of sides is given in each question. Find the angle made between the line and the polygon.

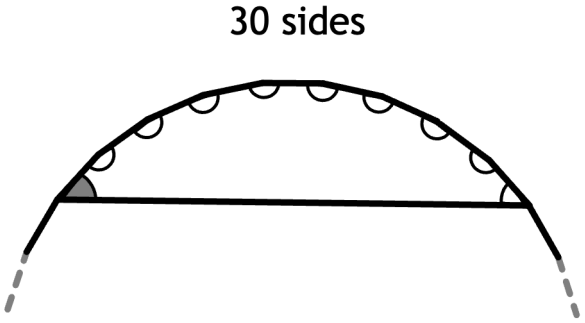
This is shaded in each shape.

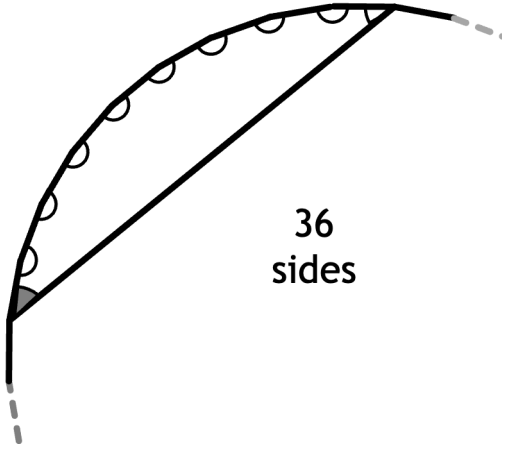






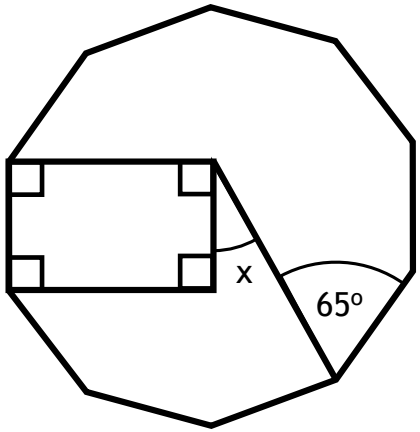


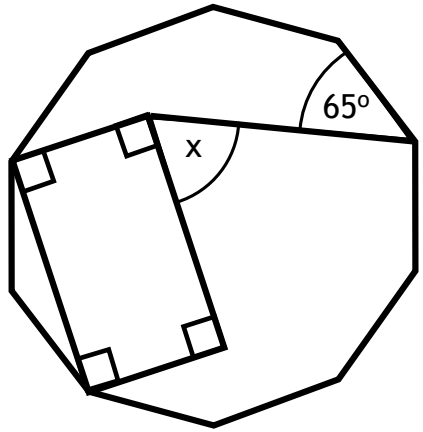


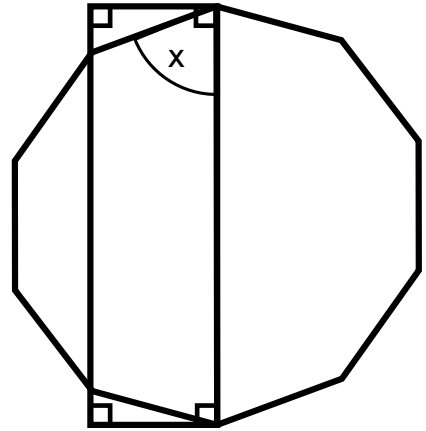


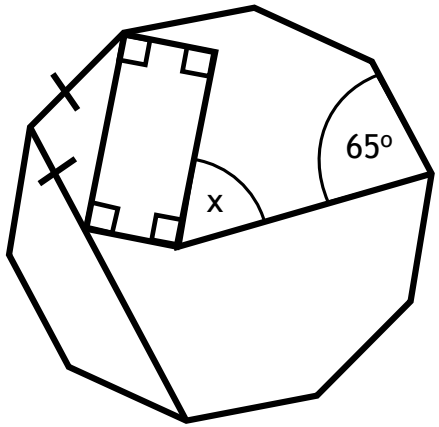
Fluency Practice

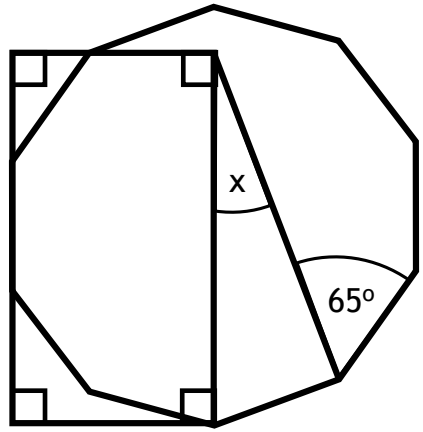
Each shape contains a regular decagon and a rectangle. Find angle x in each diagram.

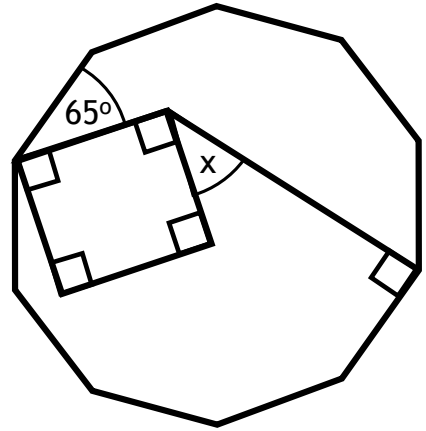






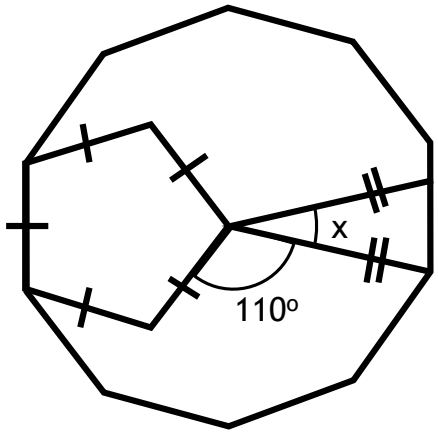


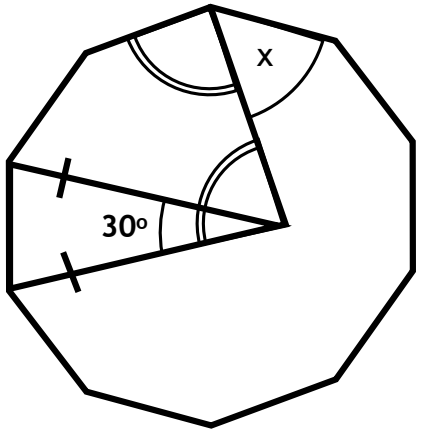


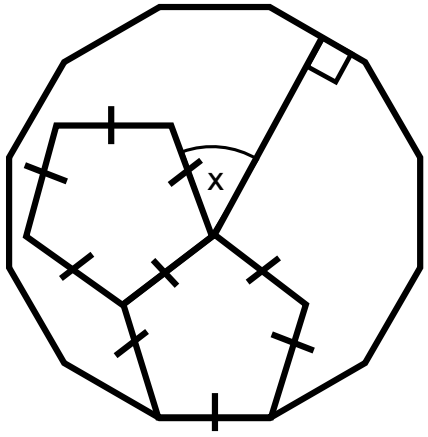


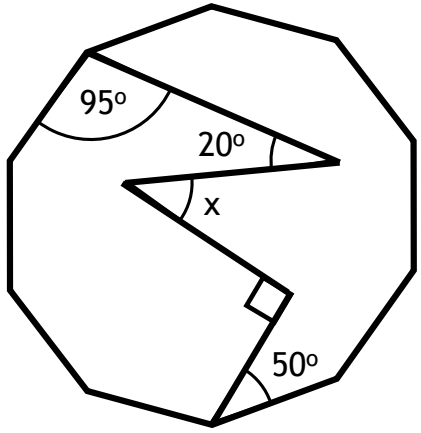
Fluency Practice

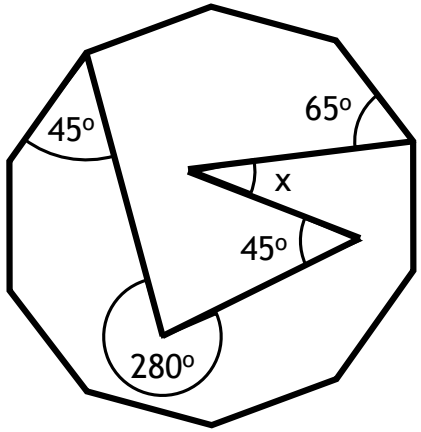
Each shape has an outside boundary of a regular polygon. Find angle x in each diagram.

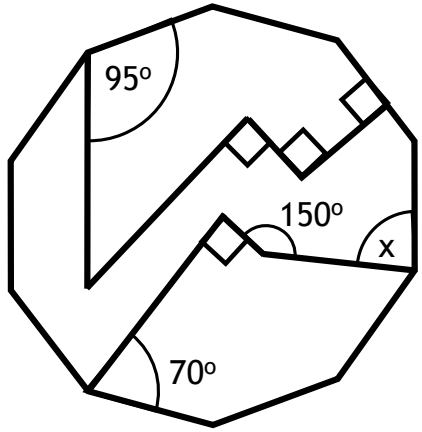




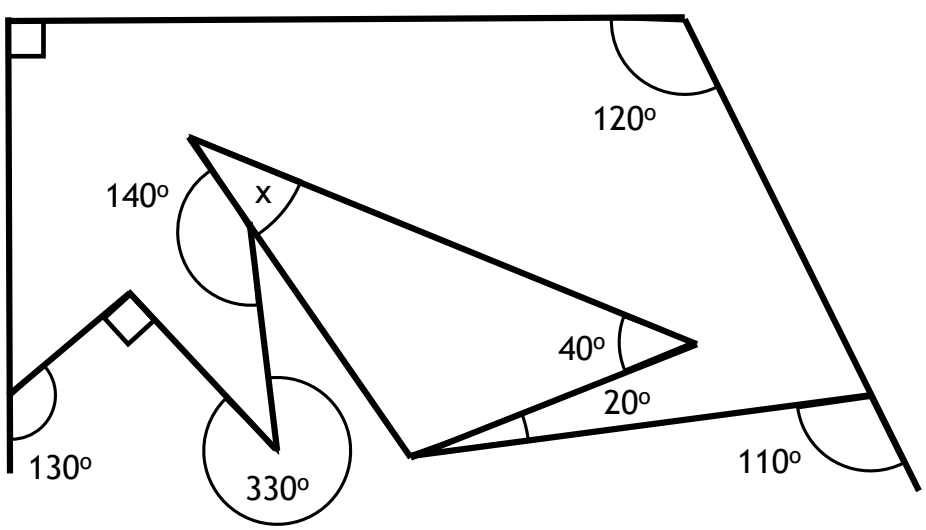


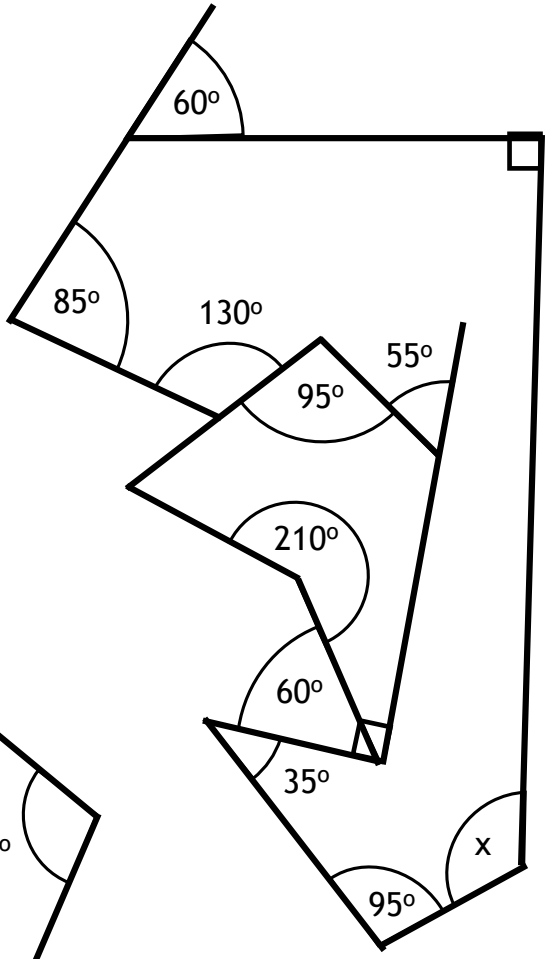


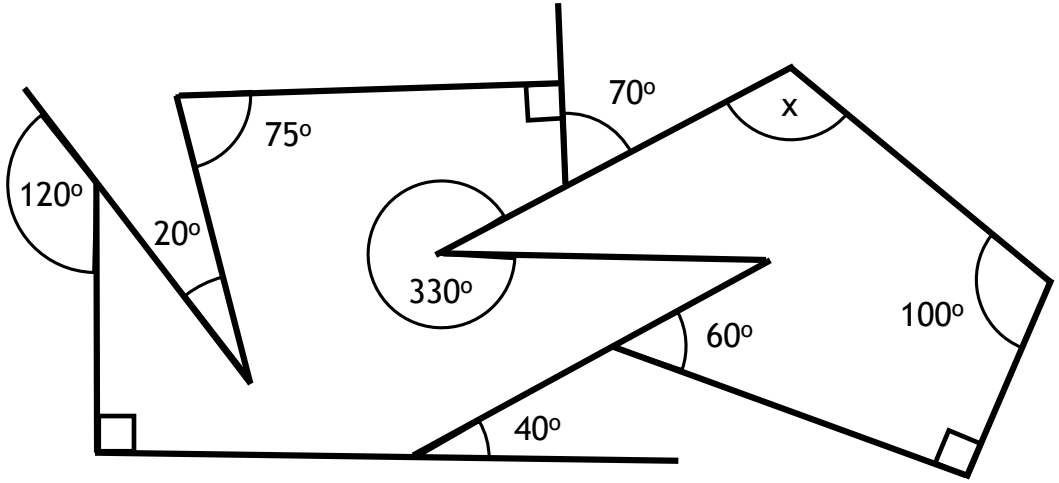




Fluency Practice



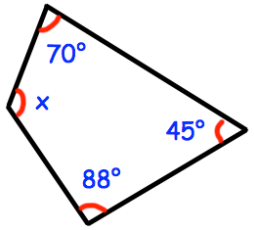




Fluency Practice

Question 1: Find the missing angle in each irregular polygon

(a)



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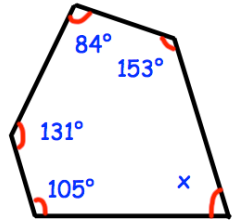

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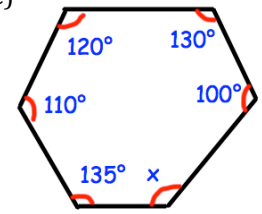

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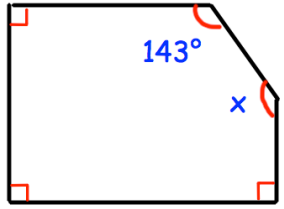

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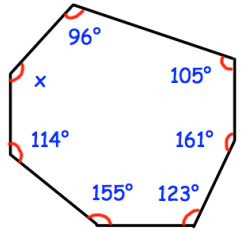

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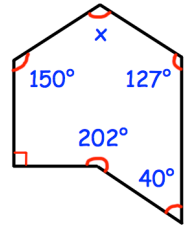

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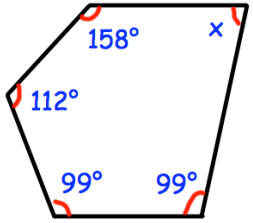

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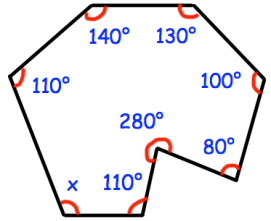
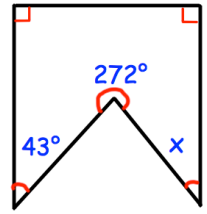


(i)



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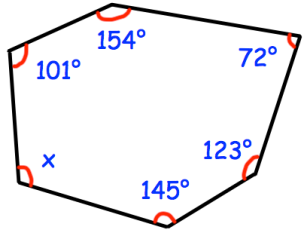

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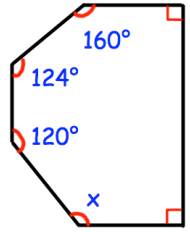

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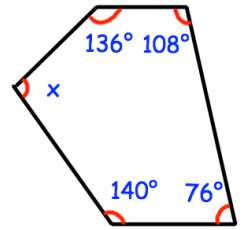

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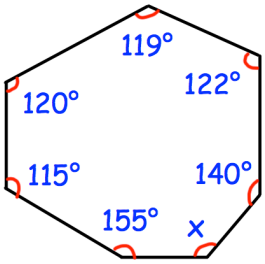

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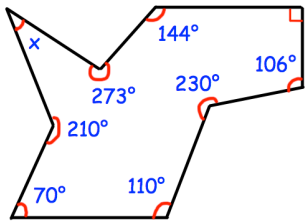


Question 2: Work out the sum of the interior angles for polygons with

(a) 10 sides (b) 14 sides (c) 20 sides (d) 45 sides

(e) 50 sides (f) 80 sides (g) 100 sides (h) 200 sides

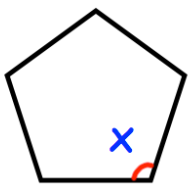
Question 3: Work out the number of sides of polygons with these sum of interior angles

(a) 1260° (b) 2880° (c) 3960° (d) 5040°

(e) 12240° (f) 15840° (g) 2340° (h) 89640°

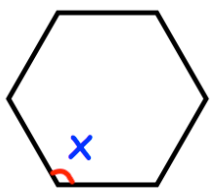
Question 4: Each of the polygons below are regular.
Calculate the size of each interior angle, x.

(a)



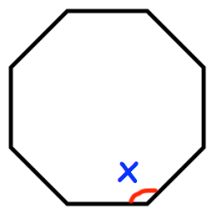
regular pentagon

(b)



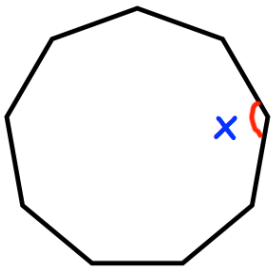
regular hexagon

(c)



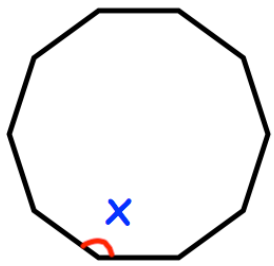
regular octagon

(d)



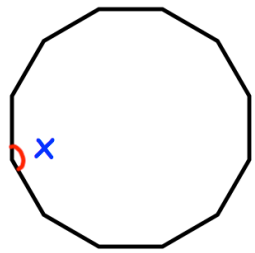
regular nonagon

(e)



regular decagon

(f)



regular dodecagon

Question 5: Calculate the size of each interior angle in regular polygons with

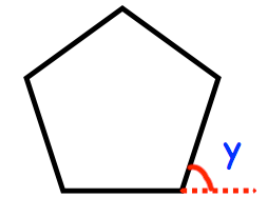
(a) 15 sides (b) 20 sides (c) 24 sides (d) 30 sides

(e) 36 sides (f) 40 sides (g) 50 sides (h) 60 sides

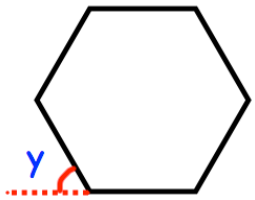
(i) 72 sides (j) 80 sides (k) 90 sides (l) 100 sides

Question 6: Each of the polygons below are regular.
Calculate the size of each exterior angle, y.

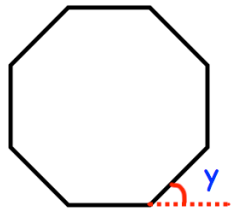
(a)



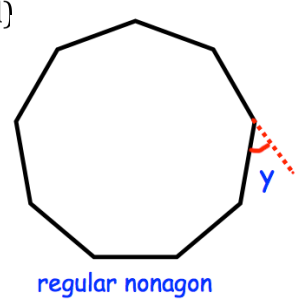
(b)



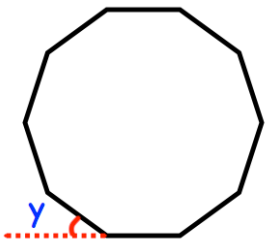
(c)



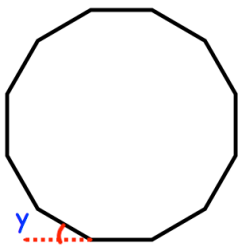
(d)



(e)



(f)



Question 7: Calculate the size of each exterior angle in regular polygons with

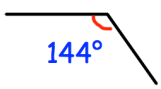
(a) 15 sides (b) 18 sides (c) 20 sides (d) 24 sides

(e) 30 sides (f) 36 sides (g) 40 sides (h) 45 sides

(i) 60 sides (j) 72 sides (k) 90 sides (l) 200 sides

Question 8: Shown below is one interior angle from regular polygons.
Calculate how many sides the polygons have.

(a)

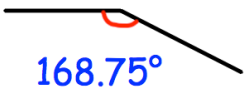


(b)

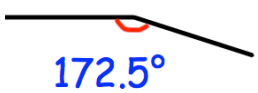
(c)

(d)

(e)



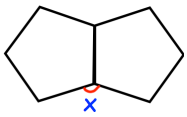
(f)



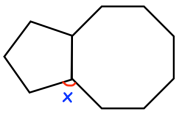
Apply

Question 1: In each diagram below, two regular polygons are shown.
Calculate x.

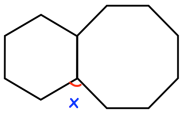
(a)



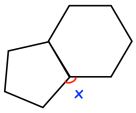
(b)



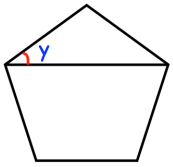
(c)



(d)



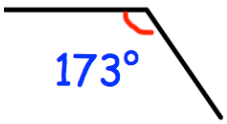
Question 2: Shown is a regular pentagon.
Find y.



Question 3: A regular polygon has 18 sides.
Calculate the size of each interior angle.

Question 4: A regular polygon has 30 sides.
Calculate the size of each interior angle.

Question 5: Explain why this cannot be an interior angle from regular polygons.



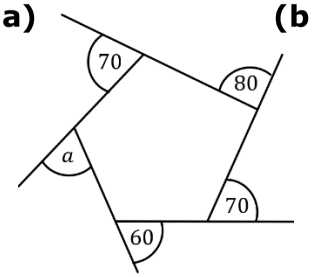
Question 6: A polygon has an interior angle that is five times larger than the exterior angle.
How many sides does it have?

Question 7: Explain why regular hexagons tessellate.

Question 8: Explain why regular pentagons do not tessellate.

Find the missing exterior angles.

(a)



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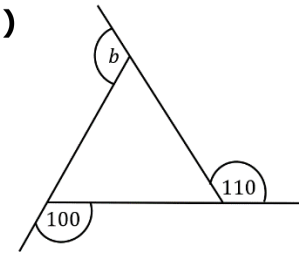

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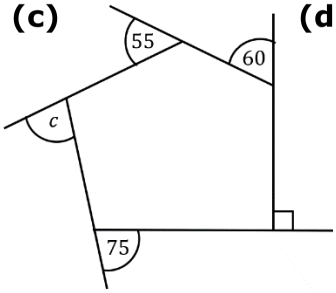
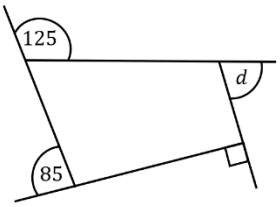


(d)

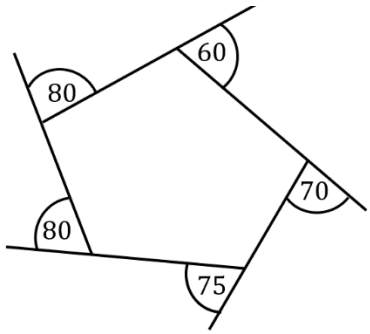


(a) An irregular quadrilateral has interior angles of $90°$, $100°$ and $105°$. What is the size of the fourth angle?

(b) An irregular hexagon has angles of $100°$, $110°$, $115°$, $130°$, and $140°$. What is the size of the sixth angle?

(c) An irregular octagon has six angles of $145°$. If the remaining two angles are equal, what is the size of each?

Jay measured the exterior angles in this polygon. Explain how you know his measurements are wrong.



A decagon has 2 angles of the same size and a further 8 angles of twice the size. What are the sizes of the angles?

Calculate the sum of the interior angles of a polygon with:

(a) 16 sides (b) 11 sides

(c) 20 sides (d) 14 sides

Calculate the size of the exterior and interior angles of a polygon with:

(a) 15 sides (b) 12 sides

(c) 18 sides (d) 36 sides

Calculate the number of sides of a polygon whose exterior angle is:

(a) 12^{o} (b) 20^{o}

(c) 18^{o} (d) 40^{o}

Calculate the number of sides of a polygon whose interior angle is:

(a) $120°$ (b) $162°$

(c) $160°$ (d) $174°$

(a) Explain why it is not possible to have a polygon with an exterior angle of $23°$.

(b) Explain why it is not possible to have a polygon with an interior angle of $143°$.

(a) Find the name of the regular polygon whose interior angle is three times that of its exterior angle.

(b) The interior angle of a regular polygon is 11 times its exterior angle. How many sides does the regular polygon have?

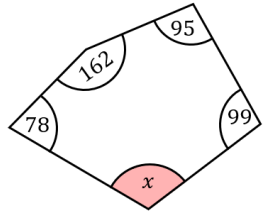
Purposeful Practice

A1 Write down a formula that allows you to calculate the size of an exterior angle (E) of a regular polygon with n sides.	**A2** Write down a formula that relates the size of an exterior angle (E) and the size of an interior angle (I) of a polygon.	**A3** Write down a formula that allows you to calculate the sum (S) of the interior angles in a regular polygon with n sides.	**A4** Work out the size of an exterior angle of a regular polygon with 5 sides
B1 Work out the size of an interior angle of a regular polygon with 9 sides	**B2** Each exterior angle of a regular polygon is 15º. Work out the number of sides the polygon has.	**B3** Each interior angle of a regular polygon is 156º. Work out the number of sides the polygon has.	**B4** Find the **sum** of the interior angles of a polygon with 7 sides
C1 The size of each exterior angle of a regular polygon is 18°. Work out the **sum** of the interior angles of the polygon.	**C2** The sum of the interior angles of a polygon is 2700º. Work out the number of sides the polygon has.	**C3** The size of each interior angle of a regular polygon is 140º bigger than the size of each exterior angle. Work out the number of sides the polygon has.	**C4** The size of each interior angle of a regular polygon is 11 times the size of each exterior angle. Work out the number of sides the polygon has.
D1 The size of each interior angle of a regular polygon with n sides is 144°. Work out the size of each interior angle of a regular polygon with $2n$ sides.	**D2** An exterior angle of regular polygon **A** is 30º bigger than an exterior angle of regular polygon **B**. Polygon **A** has 9 sides. Find the number of sides of polygon **B**.	**D3** An interior angle of regular polygon **C** is 10º smaller than an interior angle of regular polygon **D**. Polygon **C** has 12 sides. Find the number of sides of polygon **D**.	**D4** The sum of the interior angles in polygon **E** is 900º more than the sum of the interior angles in polygon **F**. The total number of sides of the two polygons is 25. How many sides in each polygon?

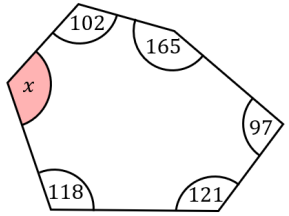
Purposeful Practice

Angles in Irregular Polygons

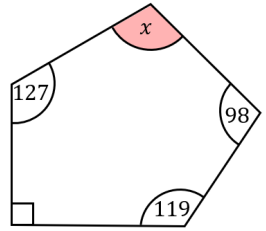
(a)



(b)



(c)



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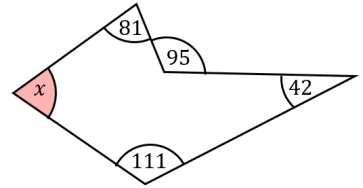

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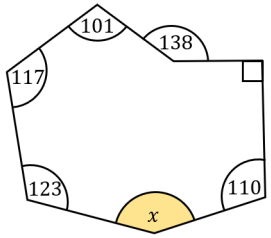

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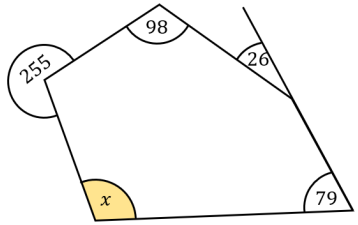

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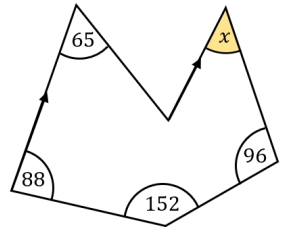

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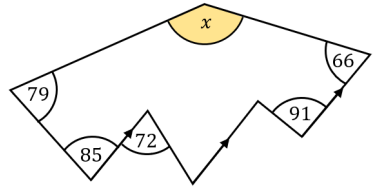
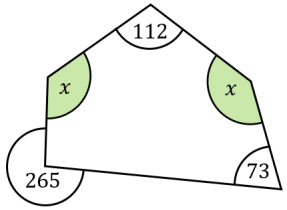


(i)



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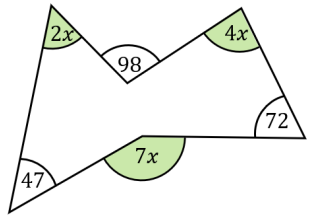


(k)

An irregular pentagon has interior angles of $5x^2, 126°$, $(10x + 72°), 132°$ and a right angle. Find the value of x.

(l)

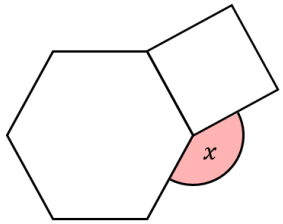
The interior angles in an irregular hexagon make up an arithmetic sequence with common difference of 12. Find the size of the largest angle.

Purposeful Practice

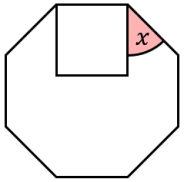
Angles in Regular Polygons

All polygons are regular. Find the missing angles in each of the diagrams.

(a)



(b)



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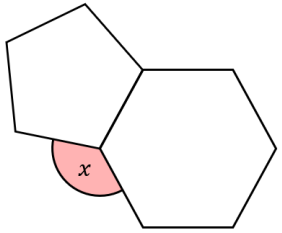

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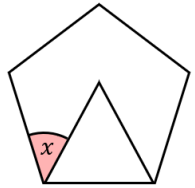

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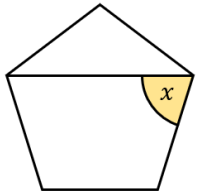

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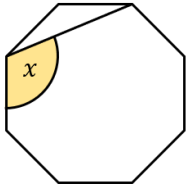

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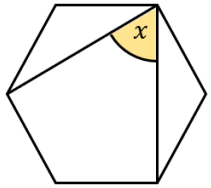

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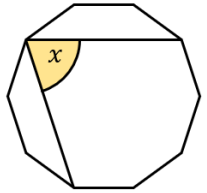
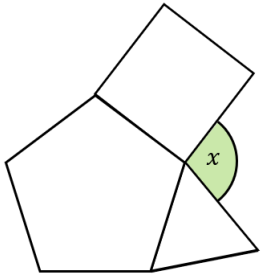


(i)



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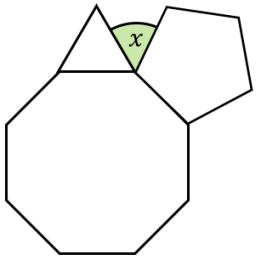

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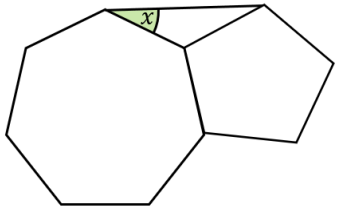
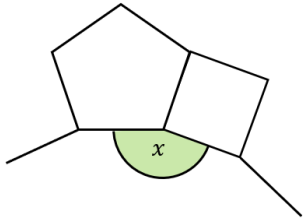


(l)

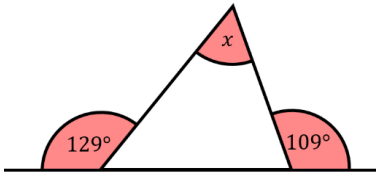
Find the number of sides of the incomplete regular polygon.



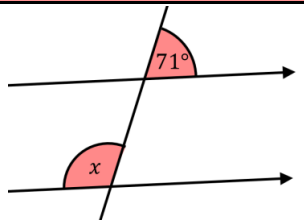
Purposeful Practice

In each question, find the value of x, giving reasons for your answer.

(a)



(b)



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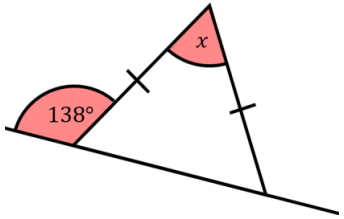
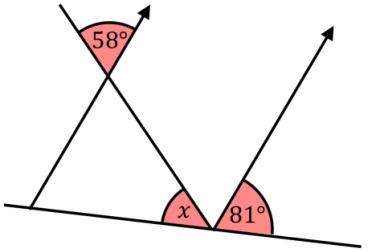


(d)



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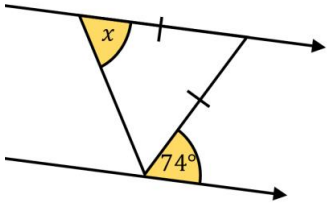

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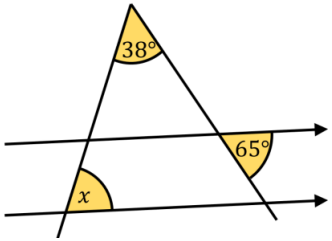
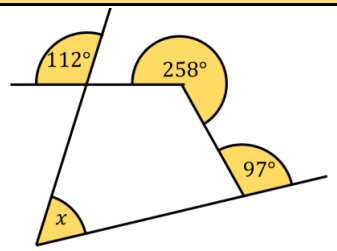


(g)



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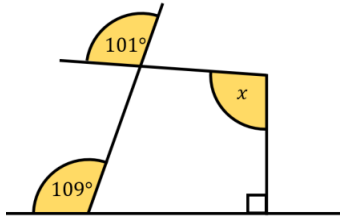
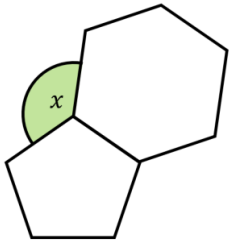
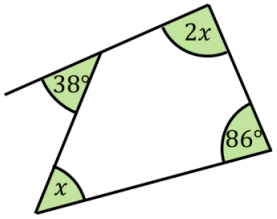


(i)

Both polygons are regular.

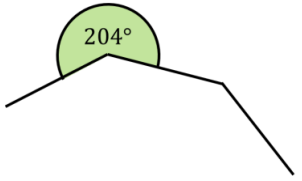


(j)



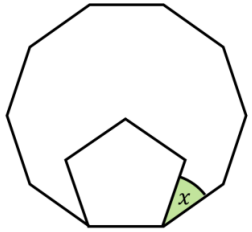
(k)

x is the number of sides in this regular polygon



(l)

Both polygons are regular.



Purposeful Practice

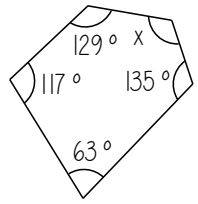
The diagrams are not drawn accurately

1. Find the sum of the interior angles in each polygon

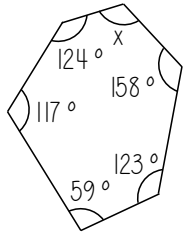
a. 12 sides b. 15 sides c. 18 sides d. 22 sides e. 25 sides f. 30 sides g. 52 sides h. 120 sides

2. Find the value of x

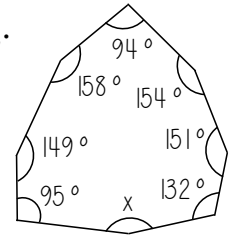
a.



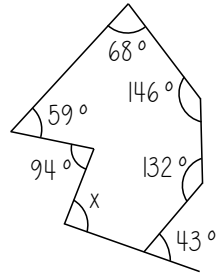
b.



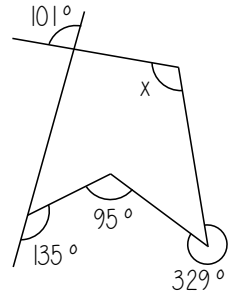
c.



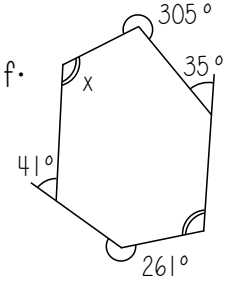
d.



e.



f.

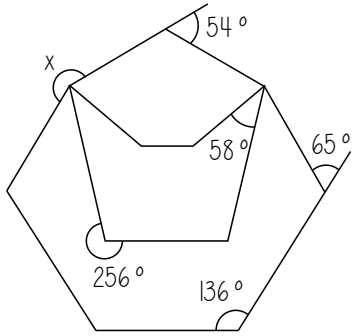


3. Find the number of sides each polygons has, given the sum of the interior angles

a. 1800° b. 1980° c. 3060° d. 3240° e. 3780° f. 5940° g. 9720° h. 14220°

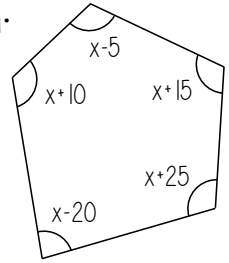
4.

The polygon has one line of symmetry.
Find the value of x.

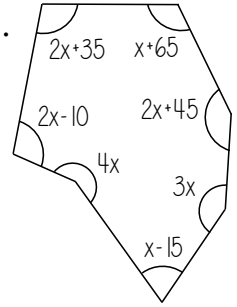


5. Find the value of x (and y)

a.



b.



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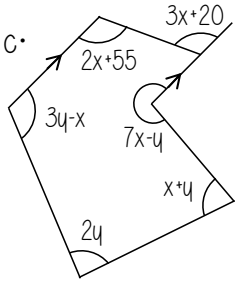
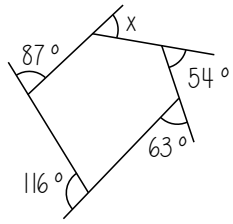
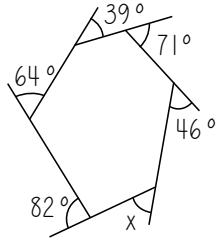


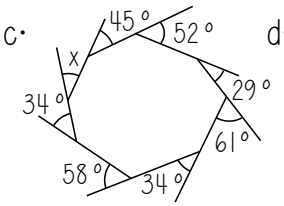
Purposeful Practice

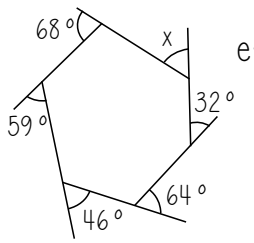
The diagrams are not drawn accurately

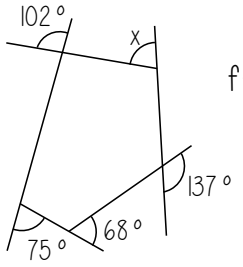
1. Find the value of x

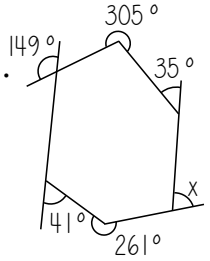
a. 

b. 

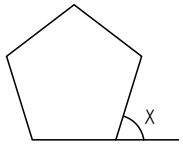
c. 

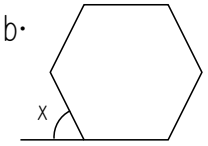
d. 

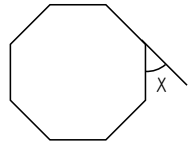
e. 

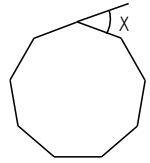
f. 

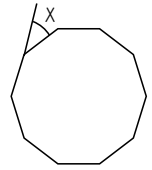
2. Calculate the size of one exterior angle in each regular polygon

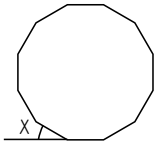
a. 

b. 

c. 

d. 

e. 

f. 

g. 15 sides h. 18 sides i. 20 sides j. 24 sides k. 30 sides l. 60 sides m. 120 sides n. 180 sides

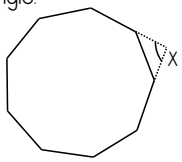
3. Calculate the number of sides in each regular polygon

a. Exterior angle = 15° a. Exterior angle = 60° c. Exterior angle = 5° d. Exterior angle = 12° e. Exterior angle = 4° f. Exterior angle = 45°

g. Exterior angle = 7·5° h. Exterior angle = 11·25° i. Interior angle = 168° j. Interior angle = 156° k. Interior angle = 108° l. Interior angle = 175·5°

4.

The diagram shows a regular nonagon and an isosceles triangle.
Find the value of x.



5.

a. A regular polygon has interior angles 4 times larger than its exterior angles.
Calculate the number of sides.

b. A regular polygon has interior angles 6·5 times larger than its exterior angles.
Calculate the number of sides.

6.

a. Regular polygon A has 12 sides and exterior angles of 6x.
Regular polygon B has exterior angles of 4x.
Find the number of sides polygon B has.

b. Regular polygon C has 20 sides and exterior angles of 2x.
Regular polygon D has exterior angles of 5x.
Find the number of sides polygon D has.

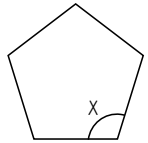
Purposeful Practice

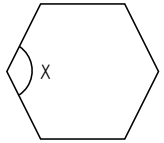
The diagrams are not drawn accurately

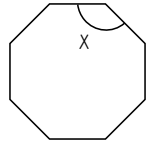
1. Calculate the sum of the interior angles in each polygon

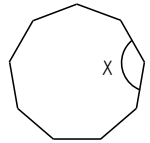
a. 7 sides b. 11 sides c. 17 sides d. 23 sides e. 50 sides f. 95 sides

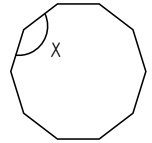
2. Calculate the size of one interior angle in each regular polygon

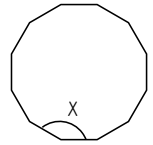
a. 

b. 

c. 

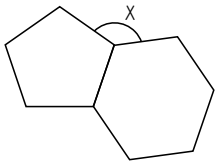
d. 

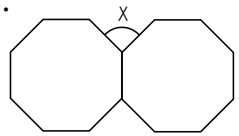
e. 

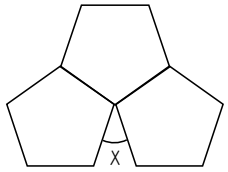
f. 

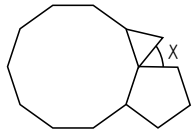
g. 15 sides h. 18 sides i. 20 sides j. 24 sides k. 30 sides l. 60 sides m. 120 sides n. 360 sides

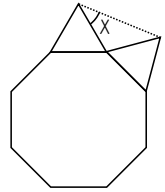
3. All the polygons are regular and meet at a point. Find the value of x

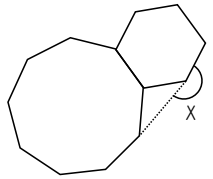
a. 

b. 

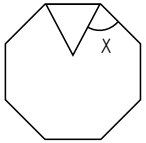
c. 

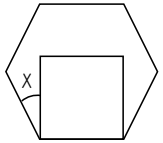
d. 

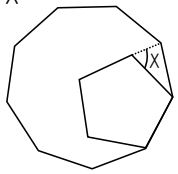
e. 

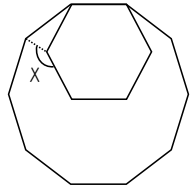
f. 

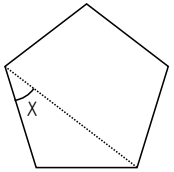
4. All the polygons are regular. Find the value of x

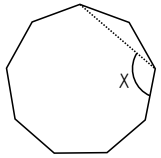
a. 

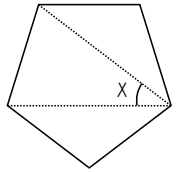
b. 

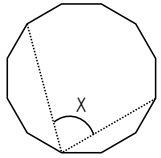
c. 

d. 

e. 

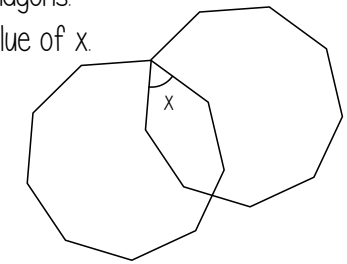
f. 

g. 

h. 

5.

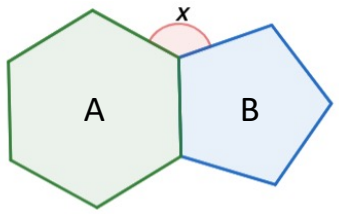
The diagram shows two overlapping, regular nonagons.
Find the value of x.



Purposeful Practice

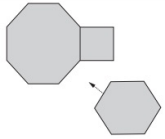
Instructions: Calculate the value of x in the middle box. Then complete the remaining boxes trying to make the minimal change possible.

Value of the angle x

Number of sides of shape A	Less	Same	More
More			
Same			
Less			

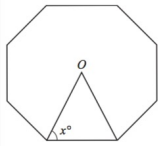
Purposeful Practice

1 [KS3 SATs 2004 L6-L8 Paper 2 Q19 Edited]
A pupil has three tiles. One is a regular octagon, one is a regular hexagon, and one is a square. The side length of each tile is the same. The pupil says the hexagon will fit exactly like this. Is the pupil correct?



?

2



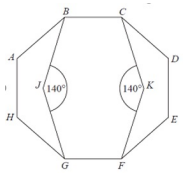
[Edexcel IGCSE Nov2009-3H Q3a]
The diagram shows a regular octagon, with centre O. Work out the value of x.

?

3 *[Edexcel IGCSE Nov-2010-4H Q13]*
The size of each interior angle of a regular polygon is 11 times the size of each exterior angle. Work out the number of sides the polygon has.

?

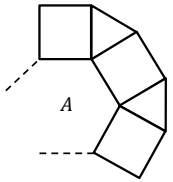
4



[Edexcel GCSE Nov2014-1H Q17] ABCDEFGH is a regular octagon. BCKFGJ is a hexagon. JK is a line of symmetry of the hexagon. Angle BJG = angle $CKF = 140°$. Work out the size of angle KFE.

?

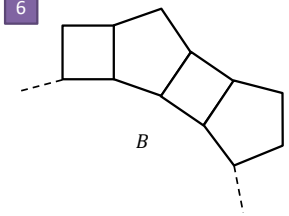
5



A regular polygon A is surrounded by squares and equilateral triangles in an alternating pattern, as shown. Show that A is a hexagon.

?

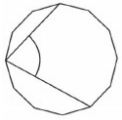
6



A regular polygon B with n sides is surrounded by squares and regular pentagons in an alternating pattern, as shown. Determine the value of n.

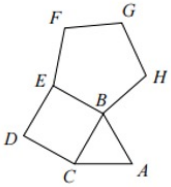
?

7 [IMC 2003 Q22] The diagram shows a regular dodecagon (a polygon with twelve equal sides and equal angles). What is the size of the marked angle?



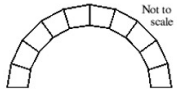
?

8 *[JMO 2014 B1]*
The figure shows an equilateral triangle ABC, a square BCDE, and a regular pentagon BEFGH.
What is the difference between the sizes of ∠ADE and ∠AHE?



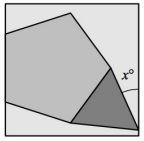
?

9 [IMC 2005 Q14] Ten stones, of identical shape and size, are used to make an arch, as shown in the diagram. Each stone has a cross-section in the shape of a trapezium with three equal sides. What is the size of the smallest angles of the trapezium?



?

10



[IMC 2018 Q18] The diagram shows a regular pentagon and an equilateral triangle placed inside a square. What is the value of x?

?

11 Find all regular polygons which tessellate (when restricted only to one type of polygon).

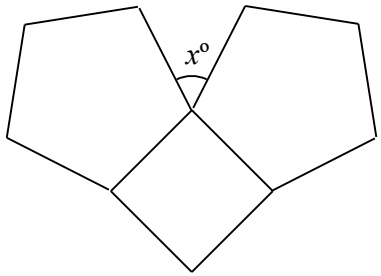
?

☠ By thinking about interior angles, prove that the regular polygons you identified above are the only regular polygons which tessellate.

?

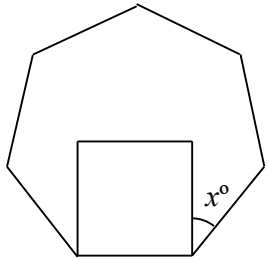
Purposeful Practice

A1 The diagram shows two regular pentagons and a square.



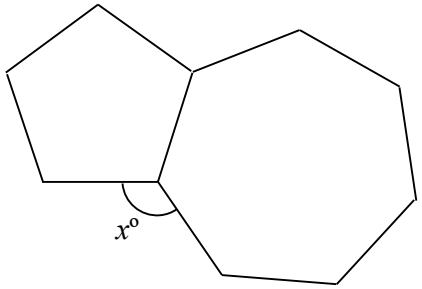
Work out the value of x.

A2 The diagram shows a square inside a regular heptagon.



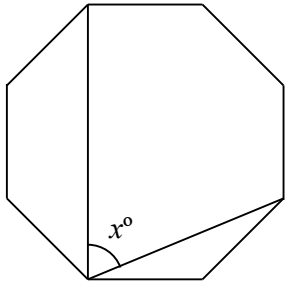
Work out the value of x.

A3 The diagram shows a regular pentagon and a regular heptagon.



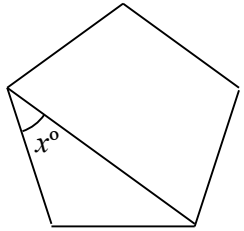
Work out the value of x.

B1 The diagram shows a regular octagon.



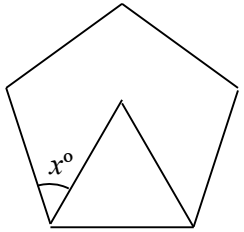
Find the value of x.
Show clear working out.

B2 The diagram shows a regular pentagon.



Find the value of x.
Show clear working out.

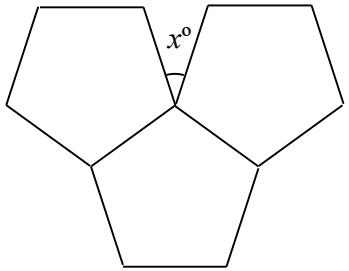
B3 The diagram shows an equilateral triangle inside a regular pentagon.



Work out the value of x.

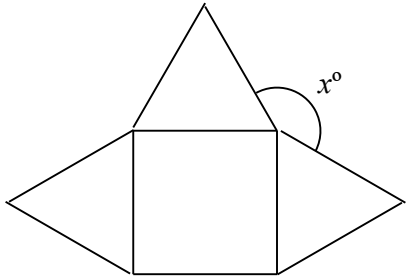
Purposeful Practice

A1 The diagram shows three regular pentagons.



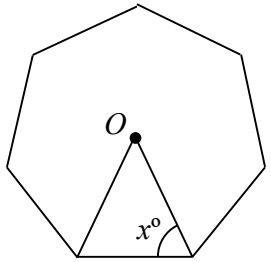
Work out the value of x.

A2 The diagram shows three equilateral triangles and a square.



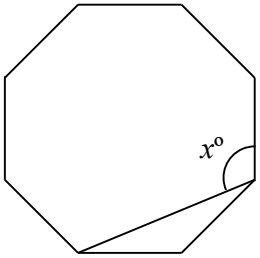
Work out the value of x.

A3 The diagram shows a regular heptagon with centre O.



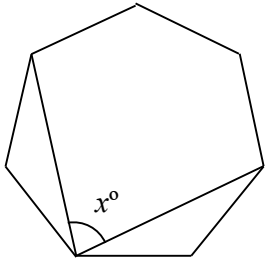
Work out the value of x.

B1 The diagram shows a regular octagon.



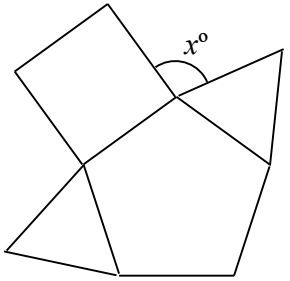
Find the value of x.
Show clear working out.

B2 The diagram shows a regular heptagon.



Find the value of x.
Show clear working out.

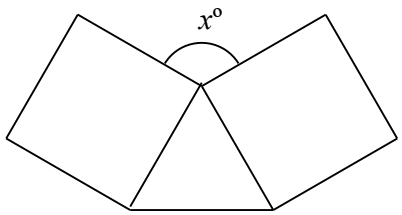
B3 The diagram shows a regular pentagon, a square and two equilateral triangles.



Work out the value of x.

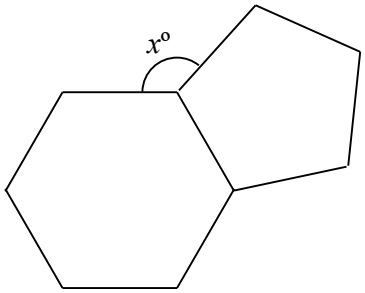
Purposeful Practice

A1 The diagram shows an equilateral triangle and two squares.



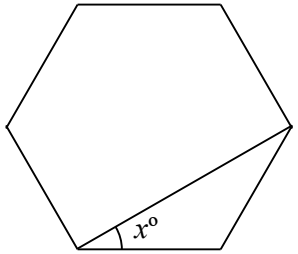
Work out the value of x.

A2 The diagram shows a regular pentagon and a regular hexagon.



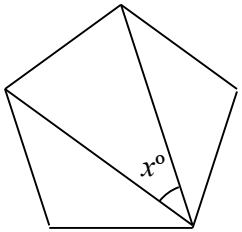
Work out the value of x.

A3 The diagram shows a regular hexagon.



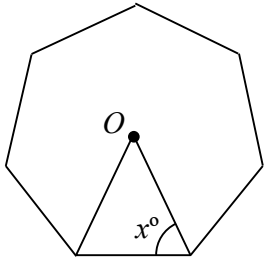
Find the value of x.
Show clear working out.

B1 The diagram shows a regular pentagon.



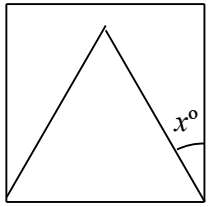
Find the value of x.
Show clear working out.

B2 The diagram shows a regular heptagon with centre O.



Work out the value of x.

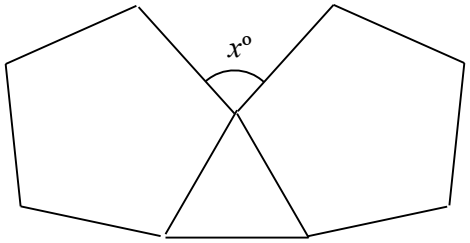
B3 The diagram shows an equilateral triangle inside a square.



Work out the value of x.

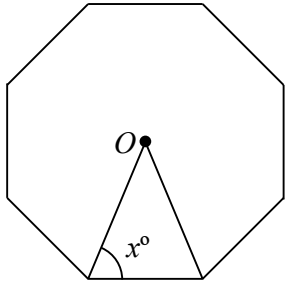
Purposeful Practice

A1 The diagram shows an equilateral triangle and two regular pentagons.



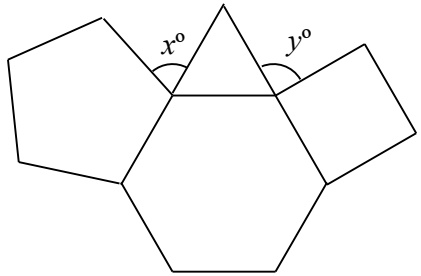
Work out the value of x.

A2 The diagram shows a regular octagon with centre O.



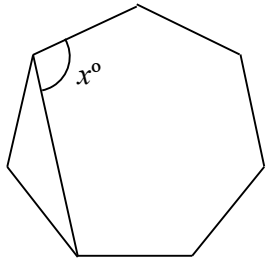
Work out the value of x.

A3 The diagram shows a regular hexagon, a regular pentagon, an equilateral triangle and a square.



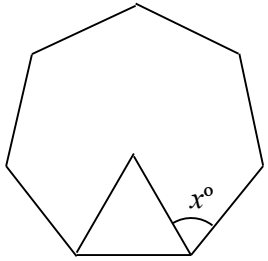
Work out the value of x and the value of y.

B1 The diagram shows a regular heptagon.



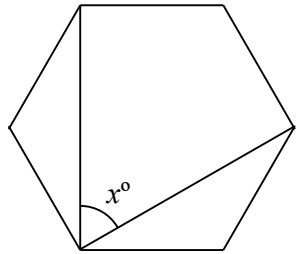
Find the value of x.
Show clear working out.

B2 The diagram shows an equilateral triangle inside a regular heptagon.



Work out the value of x.

B3 The diagram shows a regular hexagon.

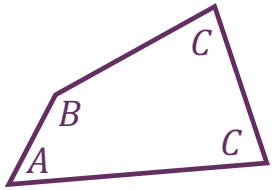


Find the value of x.
Show clear working out.

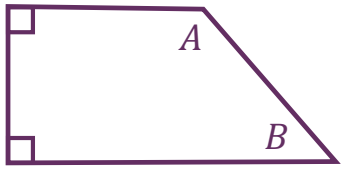
Purposeful Practice

In each question, find the sizes of angles A, B and C.

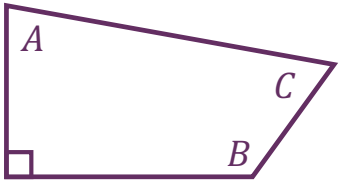
1) $A : B : C = 2 : 5 : 4$



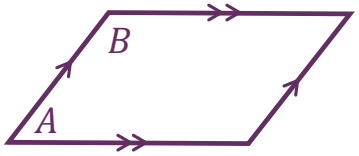
2) $A : B = 7 : 5$



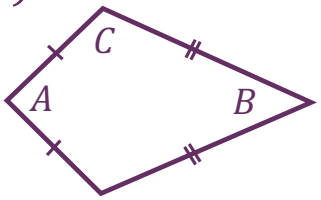
3) $A : B : C = 2 : 9 : 4$



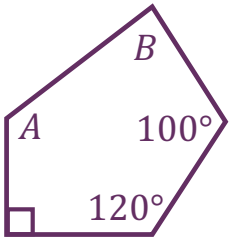
4) $A : B = 1 : 5$



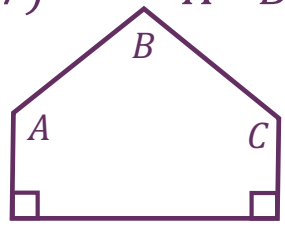
5) $A : B : C = 1 : 2 : 3$



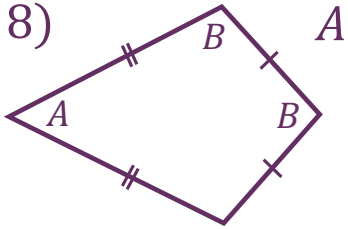
6) $A : B = 3 : 2$



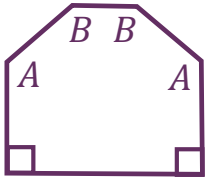
7) $A : B : C = 2 : 5 : 2$



8) $A : B = 1 : 5$



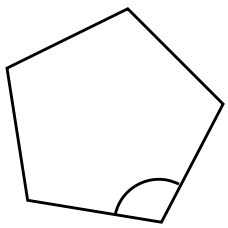
9) $A : B = 4 : 5$



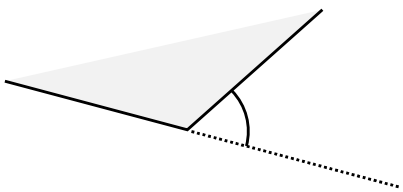
$x°$ Create a Polygon Question

Draw an angle question that needs knowledge of ... to solve.

- regular polygons
- interior angles of a hexagon
- exterior angles of an octagon
- 2 different regular polygons



- angles in a hexagon & a square
- regular & irregular polygons
- exterior angles & the sum of angles around a point
- exterior angles of an n-sided polygon where $n > 10$
- interior angles of a polygon & vertically opposite angles



- interior angles of hexagons & triangles
- isosceles triangles & exterior angles
- interior angles of a polygon & a special quadrilateral

Diagrams don't need to be drawn accurately!