KING EDWARD VI
HANDSWORTH GRAMMAR
SCHOOL FOR BOYS

KING EDWARD VI
ACADEMY TRUST
BIRMINGHAM

Year 8

2025 Mathematics 2026

Unit 6 Tasks – Part 1

DO NOT WRITE INSIDE

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Unit 6 Tasks – Part 2

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Contents

1 Ratio

2 Algebra Recap

3 Index Laws

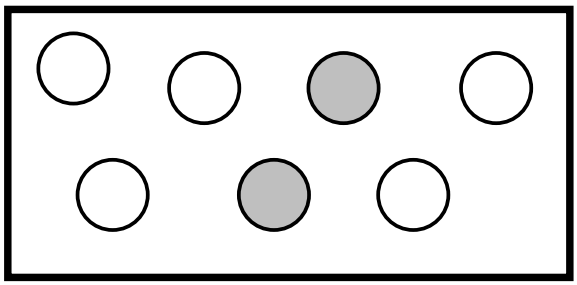
1 Ratio

Intelligent Practice

For each of the diagrams below:

- **i** Write down the ratio of shaded shapes to unshaded shapes
- **ii** Write down the ratio of unshaded shapes to shaded shapes
- **iii** Write down the fraction of shaded shapes
- **iv** Write down the fraction of unshaded shapes

a



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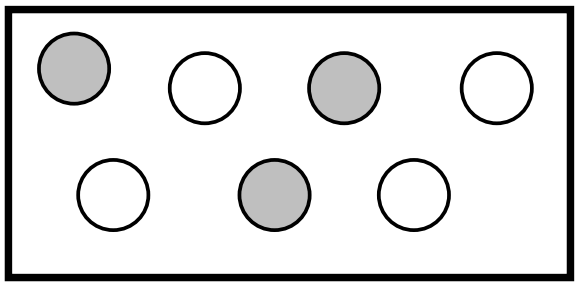

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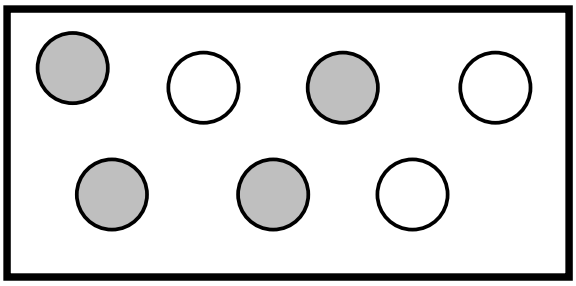

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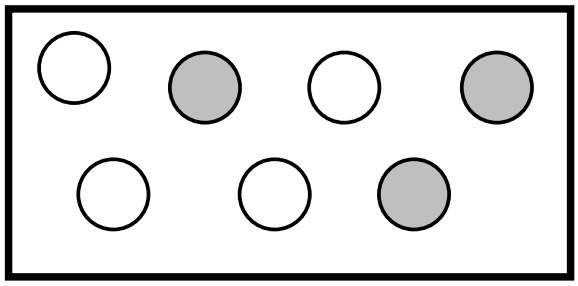

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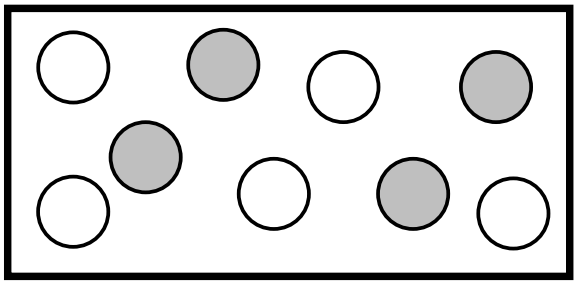

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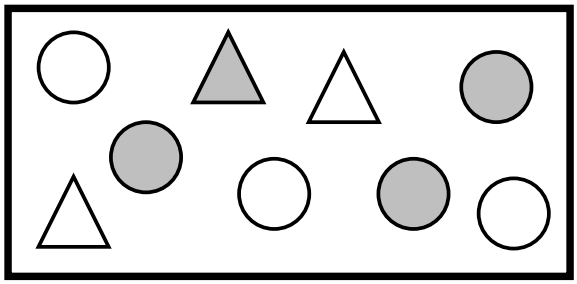

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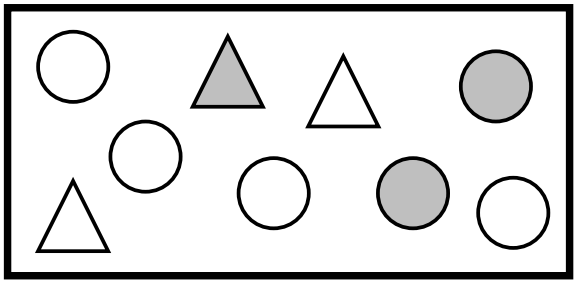

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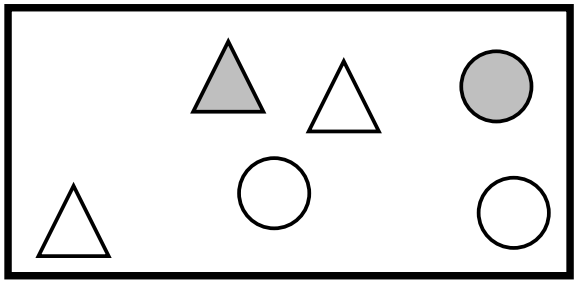
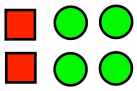
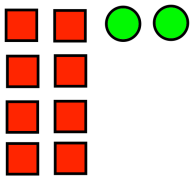
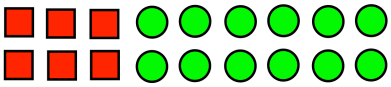


Fluency Practice

Question 1: For each of the following, write down the ratio of red squares to green circles. Give your ratios in their simplest forms.

(a) 

(b) 

(c) 

Question 2: Simplify the following ratios

(a) 4 : 6 (b) 14 : 8 (c) 15 : 10 (d) 6 : 15

(e) 30 : 10 (f) 12 : 16 (g) 6 : 18 (h) 45 : 10

(i) 12 : 28 (j) 24 : 36 (k) 25 : 60 (l) 27 : 63

(m) 48 : 60 (n) 120 : 260 (o) 8000 : 75 (p) 33 : 121

(q) 2.5 : 4.5 (r) 1.5 : 20 (s) 6 : 1.2 (t) 2.25 : 4.95

Question 3: Write the following as ratios in their simplest forms.

(a) £4 to £20 (b) 240cm to 400cm (c) 50 minutes to 20 minutes

(d) 60kg to 72kg (e) 12 miles to 30 miles (f) 15cm to 75cm

(g) 8.5g to 3.5g (h) £0.50 to £20 (i) 1.02 litres to 0.74 litres

Question 4: Write the following as ratios in their simplest forms.

(a) 8 days to 2 weeks (b) 1 hour to 15 minutes (c) 2 hours to 1 day

(d) 95p to £3.00 (e) 400m to 1.5km (f) 15kg to 900g

(g) 4500ml to 2 litres (h) 8km to 50mm (i) 90 minutes to 2 days

Purposeful Practice

Question 5: Express each of the following ratios in the form 1 : n

(a) 2 : 3 (b) 5 : 4 (c) 4 : 10 (d) 10 : 7

(e) 8 : 13 (f) 5 : 81 (g) 100 : 131 (h) 200 : 77

(i) 25 : 29 (j) 21 : 40

Question 6: Express each of the following ratios in the form n : 1

(a) 7 : 2 (b) 9 : 5 (c) 11 : 3 (d) 5 : 8

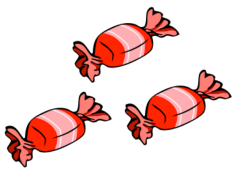
(e) 3 : 10 (f) 19 : 20 (g) 207 : 50 (h) 38 : 55

Apply

Question 1: Daisy mixes 50 ml of orange juice with 200 ml of water.
Write down the ratio of orange juice to water.
Give your answer in its simplest form.

Question 2: At a football match, there are 3000 men and 1800 women.
Write down the ratio of male fans to female fans.
Give your answer in its simplest form.

Question 3: Aidan, Bill and Cara share sweets in the ratio of their ages.
Aidan is 12 years old.
Bill is 9 years old.
Cara is 3 years old.
Write down the ratio of their ages.
Give your answer in its simplest form.



Question 4: In a nursery, there are 5 adults and 14 children.
Write the ratio of adults to children in the form 1 : n

Question 5: Ellie is making a cake.
The instructions say that the ratio of sugar to flour should be 1 : 3
Ellie uses 250g of sugar and 650g of flour.
Has Ellie used the correct ratio of sugar to flour?

Purposeful Practice

Question 6: Shannon is revising for her summer exams.
The table below shows the number of minutes Shannon spends revising on each of 5 evenings.
It also shows the number of minutes Shannon spends relaxing on the 5 evenings.

	Monday	Tuesday	Wednesday	Thursday	Friday
Number of minutes revising	88	198	150	133	160
Number of minutes relaxing	20	40	28	25	34

Shannon wants to spend at least 5 minutes revising for every 1 minute of relaxing.
On which days did Shannon spend enough time revising?

Question 7: Four teachers are planning school trips.
The table shows the number of students and the number of teachers planned to go on the trip.

	Karting	Museum	Theme Park	University
Number of students	140	221	342	159
Number of teachers	8	12	19	9

For every 18 students there must be at least 1 teacher.
Which trips have planned to bring enough teachers?

Intelligent Practice

Simplify:

1) $10 : 16$
2) $16 : 10$
3) $8 : 10$
4) $4 : 5$
5) $4.5 : 5$
6) $32 : 24$
7) $32 : 48$
8) $64 : 96$
9) $64 : 96 : 20$
10) $128 : 96 : 40$
11) $\frac{10}{16}$
12) $50\text{p} : £1.50$
13) $\frac{8}{10}$
14) $\frac{16}{20}$
15) $\frac{32}{20}$
16) $50\text{ cm} : 1.5\text{ m}$
17) $60\text{ minutes} : 1\text{ hour}$
18) $\frac{64}{40}$
19) $600\text{ seconds} : 2.5\text{ minutes}$
20) $28 : 42 : 28$
21) $10a : 16a$
22) $10a : 16b$
23) $10a^2 : 16a$
24) $50\text{p} : £2.70$
25) $32ab : 16bc$
26) $32ba : 16cb$
27) $1.5\text{ km} : 400\text{ m}$
28) $30a^2b : 18b^2a$
29) $18a^3b^2 : 24b^4a^2$
30) $18a^3b^2 : 24b^4a^2 : 21ac$

1. Write each ratio in its simplest form

a. 15 : 40 b. 35 : 50 c. 56 : 24 d. 64 : 96 e. 72 : 45 f. 120 : 45 g. 360 : 216 h. 576 : 1600

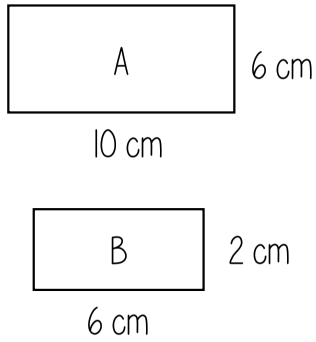
i. 63 : 9 : 27 j. 16 : 24 : 32 k. 35 : 50 : 25 l. 55 : 33 : 121 m. 72 : 96 : 48 n. 128 : 32 : 224

2. Write each ratio in its simplest form

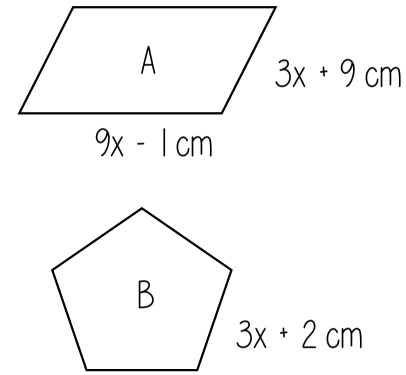
a. 2m : 60cm b. 30mins : 5hrs c. £6·75 : 75p d. 0·4kg : 240g e. 80p : £2·80 f. 5cm : 35mm

5. Write the ratio of... (Give your answer in the simplest form)

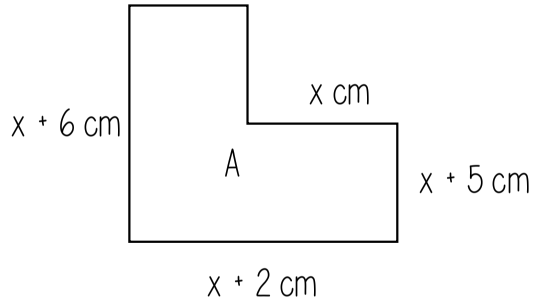
a. area of A : area of B



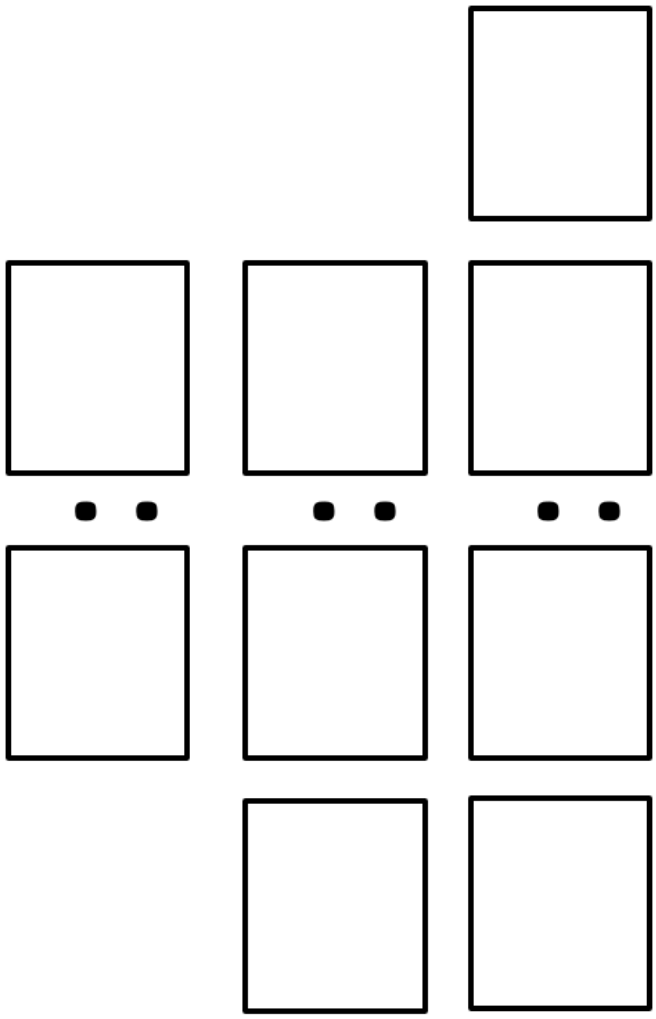
b. perimeter of A : perimeter of B



c. area of A : perimeter of A

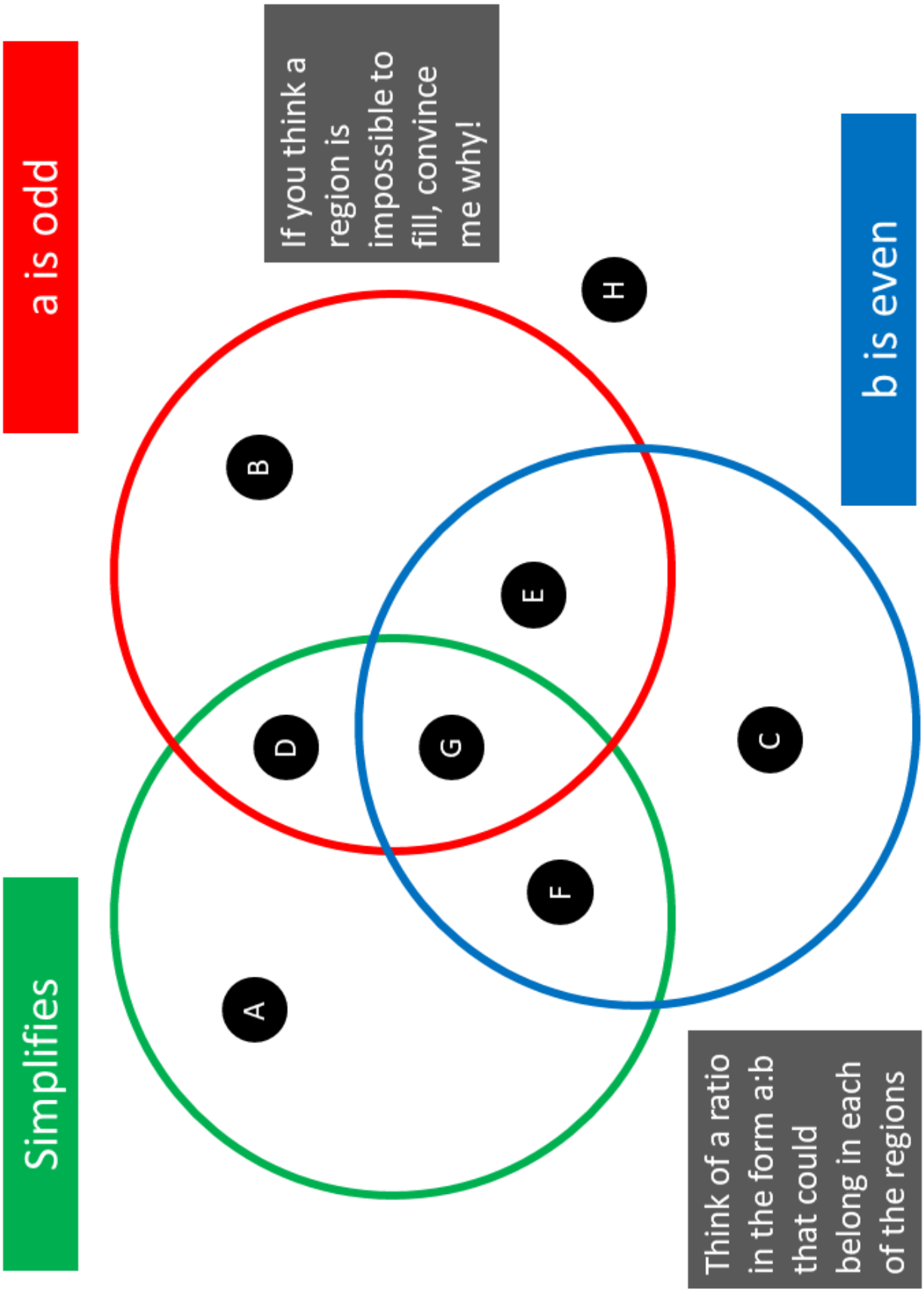


Problem Solving

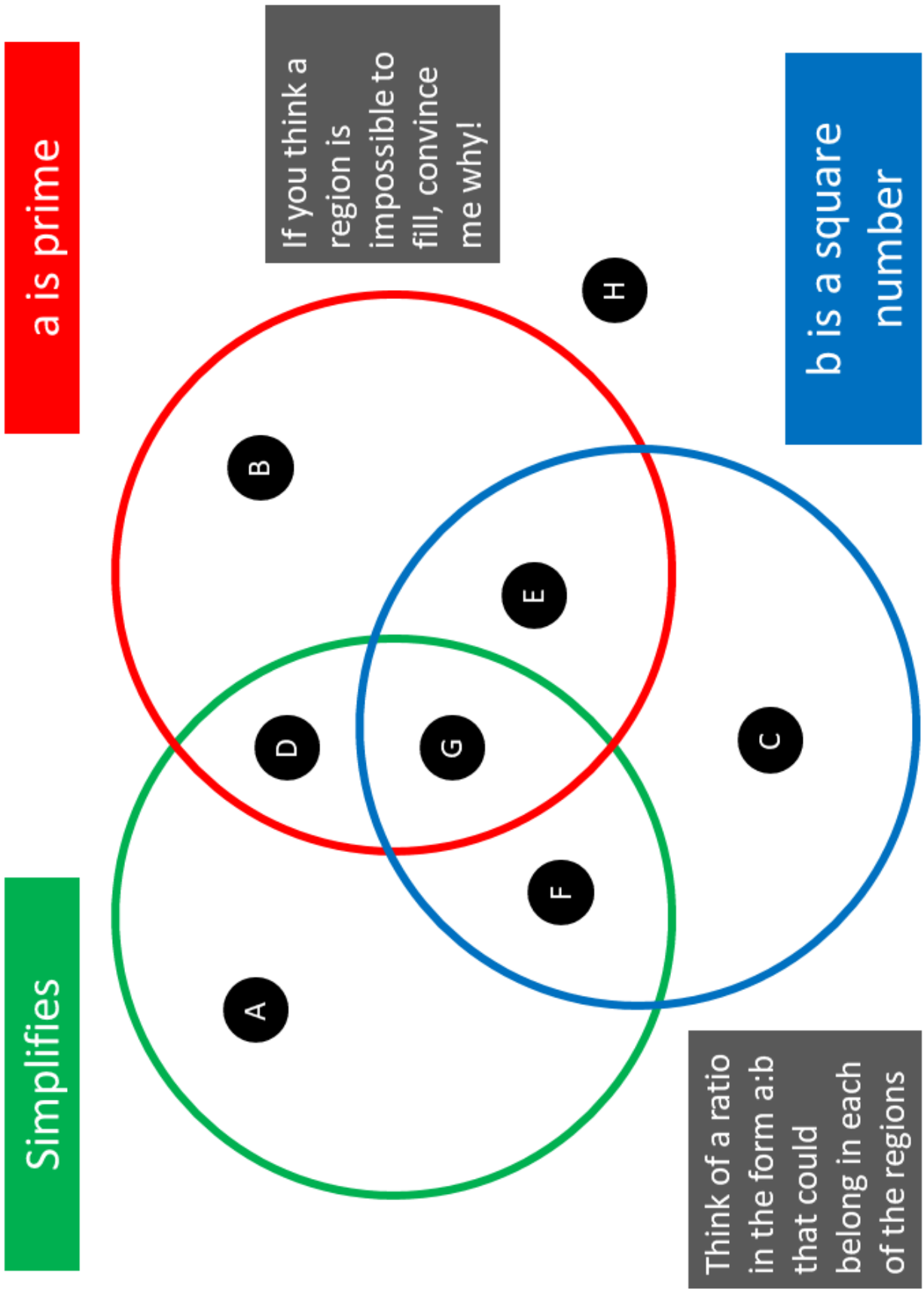


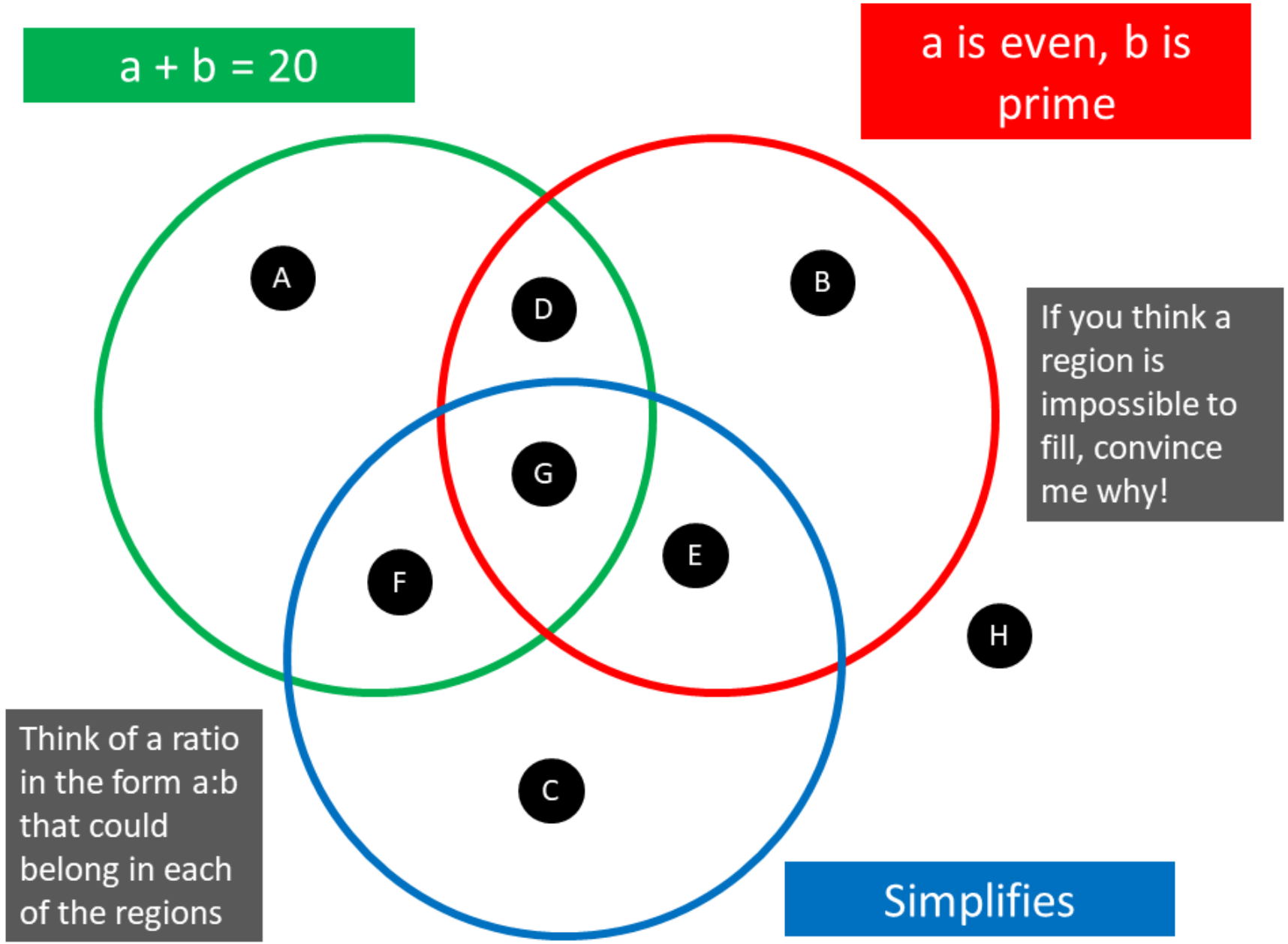
Fill in these boxes with the digits 1-9. You can only use each digit once.
Make three equivalent ratios.

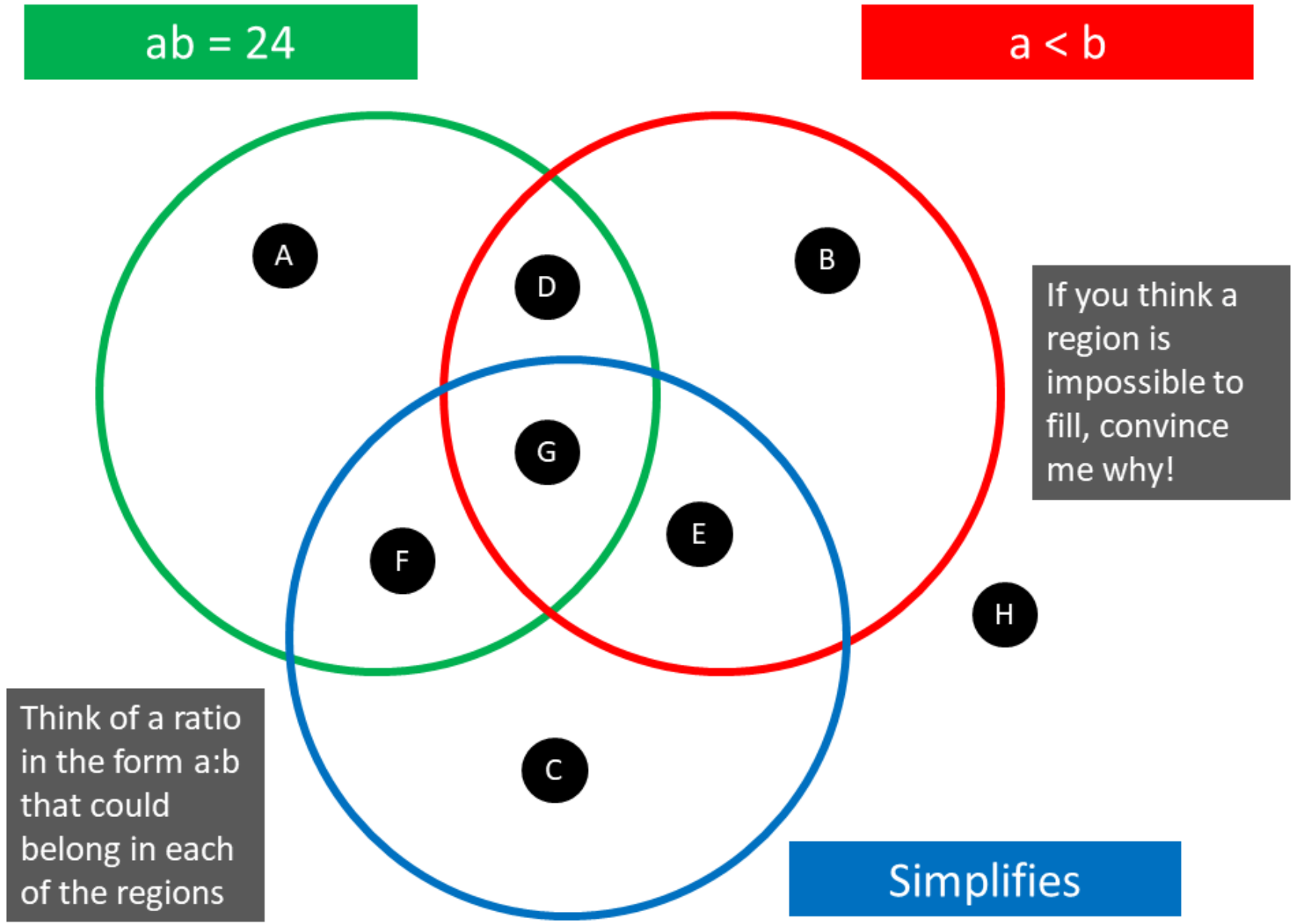
Problem Solving

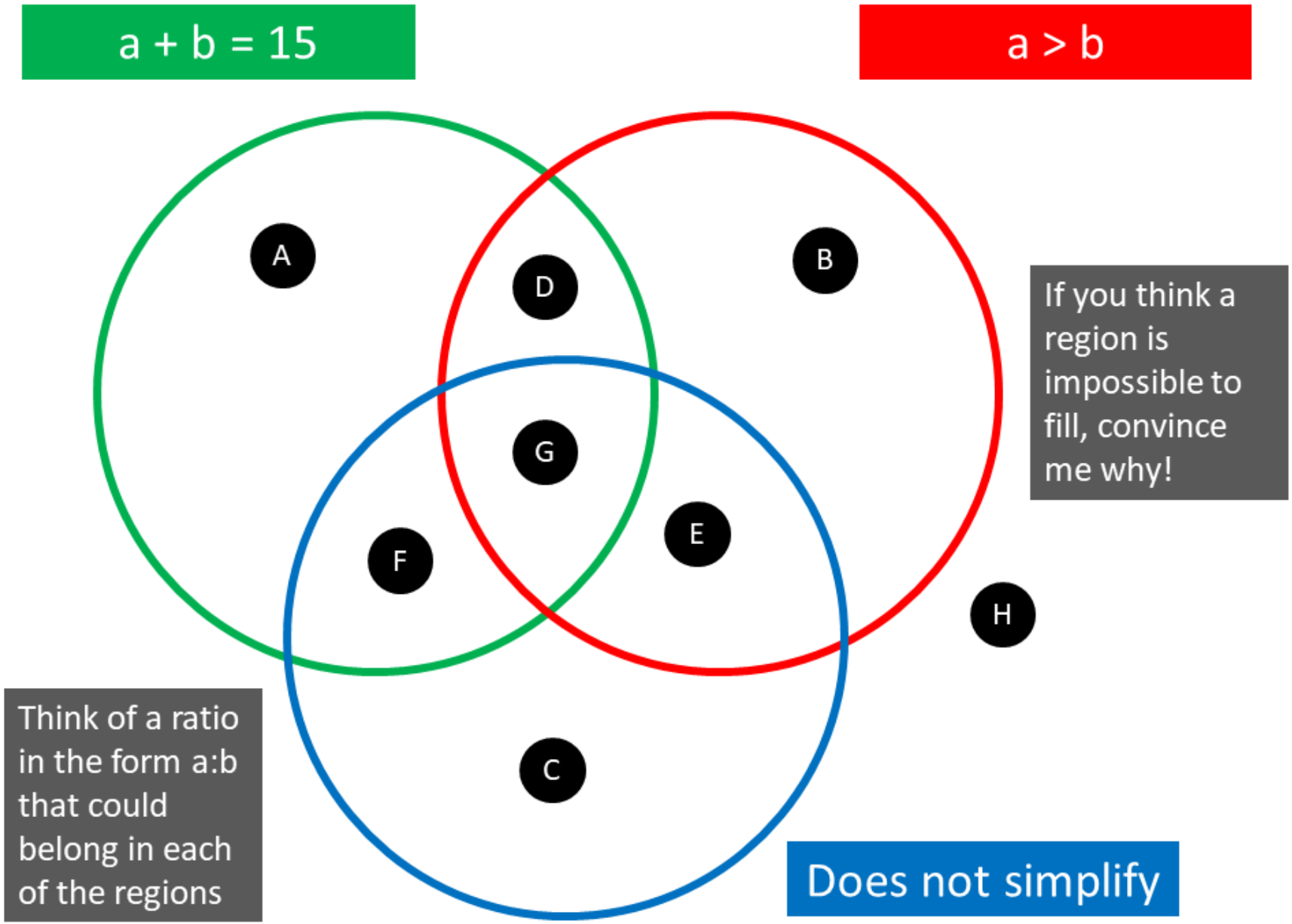


Problem Solving




a + b = 20
a is even, b is prime
A
D
B
G
E
F
H
C
If you think a region is impossible to fill, convince me why!
Think of a ratio in the form a:b that could belong in each of the regions
Simplifies


ab = 24
a < b
A
D
B
G
E
F
H
C
If you think a region is impossible to fill, convince me why!
Think of a ratio in the form a:b that could belong in each of the regions
Simplifies


a + b = 15
a > b
A
D
B
G
E
F
H
C
If you think a region is impossible to fill, convince me why!
Think of a ratio in the form a:b that could belong in each of the regions
Does not simplify

Intelligent Practice

1) The ratio of $a : b$ is $3 : 2$
   a is $\frac{?}{?}$ of the whole

2) The ratio of $a : b$ is $3 : 2$
   b is $\frac{?}{?}$ of the whole

3) The ratio of $a : b$ is $3 : 1$
   b is $\frac{?}{?}$ of the whole

4) The ratio of $a : b$ is $3 : 1$
   b is $\frac{?}{?}$ of a

5) The ratio of $a : b$ is $4 : 1$
   b is $\frac{?}{?}$ of a

6) The ratio of $a : b$ is $4 : 1$
   a is $\frac{?}{?}$ of b

7) The ratio of $a : b$ is $8 : 2$
   a is $\frac{?}{?}$ of b

8) The ratio of $a : b$ is $2 : 8$
   a is $\frac{?}{?}$ of b

9) The ratio of $a : b$ is $3 : 9$
   a is $\frac{?}{?}$ of b

10) The ratio of $a : b$ is $3 : 10$
    a is $\frac{?}{?}$ of b

11) The ratio of $a : b$ is $3 : 10$
    b is $\frac{?}{?}$ of a

12) The ratio of $a : b$ is $3 : 10$
    b is $\frac{?}{?}$ of the whole

13) The ratio of $a : b$ is $10 : 3$
    b is $\frac{?}{?}$ of the whole

14) The ratio of $a : b$ is $10 : 3$
    the whole is $\frac{?}{?}$ of b

15) The ratio of $a : b$ is $? : ?$
    a is $\frac{3}{4}$ of b

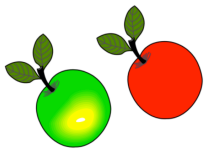
16) The ratio of $a : b$ is $? : ?$
    a is $\frac{3}{4}$ of the whole

17) The ratio of $a : b$ is $p : q$
    a is $\frac{?}{?}$ of the whole

18) The ratio of $a : b$ is $p : q$
    a is $\frac{?}{?}$ of b

Fluency Practice

Question 1: The ratio of red apples to green apples in a basket is 1:2



(a) What fraction of the apples in the basket are red?
(b) What fraction of the apples in the basket are green?

Question 2: The ratio of blue pens to black pens in a box is 3:5

(a) What fraction of the pens are black?
(b) What fraction of the pens are blue?

Question 3: A farmer keeps cows and pigs on his farm.
The ratio of cows to pigs on the farm is 2:3

(a) What percentage of the animals on the farm are cows?
(b) What percentage of the animals on the farm are pigs?

Question 4: Olivia has blue, pink and orange counters in a bag.
The ratio of blue to pink to orange counters is 4:5:2

(a) What fraction of the counters are blue?
(b) What fraction of the counters are orange?

Question 5: Chris makes a drink by mixing lemonade and orange juice in the ratio 13:7

(a) What percentage of the drink is lemonade?
(b) What percentage of the drink is orange juice?

Question 6: There are white, red and yellow counters in a box.
The number of white counters, the number of red counters and the number of yellow counters are in the ratio 2:7:16

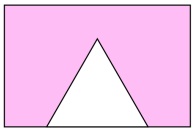
What percentage of the counters in the box are red?

Question 7: Cards in a pack are either orange or purple.
80% of the cards are orange.
Write the ratio of orange cards to purple cards.

Fluency Practice

Question 8: The counters in a bag are red or yellow.
30% of the counters in the bag are red.
Write the ratio of yellow counters to red counters.

Question 9: Chris designs a flag.
20% of the flag is white and the rest is pink.
What is the ratio of white to pink?



Question 10: 14% of the students in a class are left handed.
Write down the ratio of left handed to right handed students.

Question 11: $\frac{1}{3}$ of the beads in a bag are white.

The rest of the beads are grey.

(a) Write down the ratio of white beads to grey beads.
(b) Write down the ratio of grey beads to white beads.

Question 12: An American football team won a sixth of their matches.
They lost the rest.
Work out the ratio matches won : matches lost

Question 13: $\frac{3}{4}$ of the apples in a bag are red.

Write down the ratio of red apples to green apples.

Question 14: $\frac{7}{15}$ of the buses arriving in a town are late.

Write down the ratio of on time buses to late buses.

Apply

Question 1: Bethany and Summer are waitresses.
They share the tips in the ratio of the hours they have worked.
Bethany worked from 11am until 5pm.
Summer worked from 1pm until 9pm

What fraction of the tips does Bethany keep?

Purposeful Practice

Question 2: Oscar and Theo collect coins and stamps.
Altogether they have the same number of coins as stamps.

The ratio of coins Oscar has to coins Theo has is 3:7
The ratio of stamps Oscar has to stamps Theo has is 1:4

Show Theo has more stamps than coins.

Intelligent Practice

1) The ratio of red balls to green balls in a bag is $1:3$. What fraction of the balls are red?

2) The ratio of red balls to green balls in a bag is $1:3$. What fraction of the balls are green?

3) The ratio of red balls to green balls in a bag is $3:1$. What fraction of the balls are green?

4) The ratio of red balls to green balls in a bag is $4:1$. What fraction of the balls are green?

5) The ratio of red balls to green balls in a bag is $4:1$. What fraction of the balls are red?

6) The ratio of red balls to green balls in a bag is $8:1$. What fraction of the balls are red?

7) The ratio of red balls to green balls in a bag is $2:1$. What fraction of the balls are red?

8) The ratio of red balls to green balls in a bag is $4:2$. What fraction of the balls are red?

9) The ratio of red balls to green balls in a bag is $4:4$. What fraction of the balls are red?

10) The ratio of red balls to green balls in a bag is $1:1$. What fraction of the balls are red?

11) The ratio of red balls to green balls in a bag is $1:1$. What fraction of the balls are green?

12) The ratio of red balls to green balls in a bag is $1:5$. What fraction of the balls are green?

13) The ratio of red balls to green balls to blue balls in a bag is $1:5:2$. What fraction of the balls are green?

14) The ratio of red balls to green balls to blue balls in a bag is $1:5:2$. What fraction of the balls are red?

15) The ratio of red balls to green balls to blue balls in a bag is $3:5:2$. What fraction of the balls are red?

16) The ratio of red balls to green balls to blue balls in a bag is $9:15:6$. What fraction of the balls are red?

1. Write in the form n : 1

a. 6 : 2 b. 15 : 5 c. 50 : 10 d. 42 : 6 e. 12 : 8 f. 7 : 2

g. 36 : 10 h. 17 : 5 i. 3 : 10 j. 13 : 20 k. 450 : 75 l. 6400 : 2000

2. Write in the form 1 : n

a. 2 : 12 b. 5 : 15 c. 10 : 35 d. 4 : 10 e. 2 : 15 f. 10 : 27

g. 5 : 2 h. 12 : 9 i. 20 : 33 j. 25 : 40 k. 40 : 100 l. 20 : 84

3. Write in the form 1 : n

a. 4 cm : 5 m b. 15 g : 42 kg c. 2 mm : 65 cm d. 25p : £1·30 e. 20 mins : 1·4 hrs f. 2·5 cm : 450 km

4.

a. Mike mixes water and juice in the ratio 3 : 1
Nate mixes water and juice in the ratio 4 : 1
Who has the strongest drink?

b. Blossom pink paint is mixed using white and red paint in the ratio 4 : 3
Cherry pink paint is mixed using white and red paint in the ratio 10 : 8
Which variety of pink paint is darker in colour?

c. Sally has participated in 36 races and won 5
Betty has participated in 54 races and won 8
Who has been more successful?

4. Here are the goals scored and shots taken by a football team

Player	Goals Scored	Shots Taken
Dennis	4	9
Frank	2	21
Timmy	5	11
Tommy	5	16
Dave	4	15
Richard	5	7
Warren	4	25
Norris	8	34

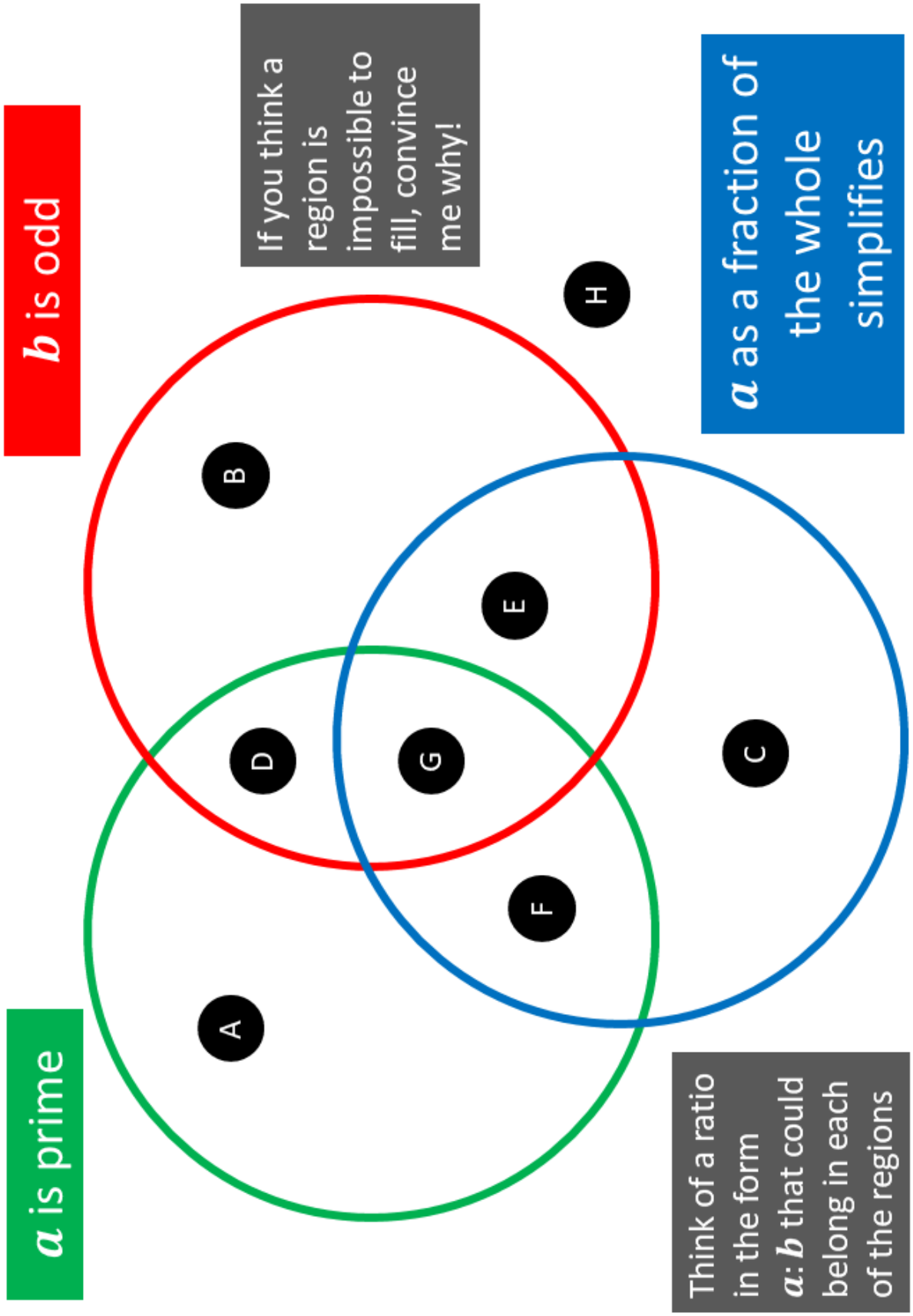
a. Find the ratio of goals : shots for each player.

b. Write the ratios in the form 1 : n (Give to 2·d·p where appropriate)

c. Use the ratios to put the players in order, starting with the most accurate player

d. Another player, Peter, took 35 shots and was the fourth most accurate player.
How many goals could he have scored?

Problem Solving

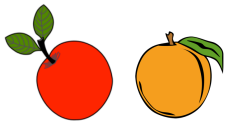


Fluency Practice

Question 1: A drawer contains white socks and black socks only.
The number of white socks to the number of black socks is in the ratio 1:3
There are 12 white socks.

(a) Work out the number of black socks in the drawer.
(b) Work out the total number of socks in the drawer.

Question 2: James has some apples and oranges.
The ratio of apples and oranges is 2:5
He has 15 oranges.
How many apples does James have?



Question 3: The ratio of lemon sweets to strawberry sweets in a tub is 5:3
There are 120 lemon sweets in the tub.
How many strawberry sweets are in the tub?

Question 4: Rachel has some first class and some second class stamps.
The ratio of the number of first class to the number of second class stamps is 3:4
Rachel has 18 first class stamps.

(a) How many second class stamps does Rachel have?
(b) How many stamps does Rachel have in total?

Question 5: Abby, Neil and Dylan share a sum of money in the ratio 2:4:5
Neil receives £60
Work out how much money Dylan receives.

Question 6: The ratio of the number of girls to the number of boys in a school is 9:10
There are 900 boys in the school.

Work out the total number of students in the school.

Question 7: Flour, sugar and butter are mixed in the ratio 6:2:3
How many grams of flour and sugar are needed to mix with 180g of butter?

Purposeful Practice

Apply

Question 1: Four angles are in the ratio 2:3:4:11
The largest angle is 198°
Show the four angles will fit together at a point with no gaps.

Question 2: Matthew makes a drink using lemonade and orange juice.
210ml of his drink was lemonade
140ml of his drink was orange juice
Rosie makes more of the drink for a party using the same ratio of lemonade to orange juice.
Rosie uses 6 litres of lemonade.

How much orange juice does Rosie use?

Question 3: There are red and green apples in a crate.
There are 60 green apples in the crate.
The ratio of the number of red apples to green apples is 1:5

Georgia puts in some more red apples into the crate.
The ratio of the number of red apples to green apples is now 2:3

How many red apples does Georgia put into the crate?

Question 4: Olive has 600 fruit trees.
Some of the trees are apple trees.
The rest of the trees are pears trees and plum trees in the ratio 7:5.

There are 175 plum trees.

Work out what fraction of the trees are apple trees.

Question 5: Two numbers are in the ratio 4:3
One of the numbers is 1.8
What are the two possible values for the other number?

Question 6: Jason, Katie and Leonard share some money.
Jason gets $\frac{1}{5}$ of the money.
Katie and Leonard share the rest of the money in the ratio 17:3

Jason gives 45% of his share of the money to his mother.
He has £198 left.

How much more money does Katie receive than Jason?

Intelligent Practice

1) Claire and John share some money in the ratio $3:2$. Claire receives £18. How much does John receive?
2) Claire and John share some money in the ratio $6:4$. Claire receives £18. How much does John receive?
3) Claire and John share some money in the ratio $3:2$. Claire receives £36. How much does John receive?
4) Sandy and Mark share some sweets in the ratio $1:4$. Mark receives 48 sweets. How many does Sandy receive?
5) Sandy and Mark share some sweets in the ratio $1:9$. Mark receives 18 sweets. How many does Sandy receive?
6) George and Joe share some sweets in the ratio $1:9$. Joe receives 18 sweets. How many sweets are shared in total?
7) George and Joe share some sweets in the ratio $7:9$. Joe receives 18 sweets. How sweets are shared in total?
8) Huda, Nicole and Bethan share some sweets in the ratio $7:8:9$. Huda receives 14 sweets. How many sweets do Nicole and Bethan each receive?
9) A piece of wood is split into three pieces into the ratio $7:8:9$. The smallest piece of wood is 21cm. Work out the length of the other two pieces.
10) A piece of wood is split into three pieces into the ratio $3:6:5$. The smallest piece of wood is 21m. Work out the total length of the wood.
11) Three angles are in the ratio $3:6:5$. The largest angle is $72°$. Could these be the angles of a triangle?
12) Four angles are split in the ratio $3:6:5:2$. The smallest angle is $45°$. Could these four angles meet at a point?

Fluency Practice

Question 1: A bag contains yellow and blue blocks in the ratio 1:3
There are 8 more blue blocks than yellow blocks.

(a) How many yellow blocks are there?
(b) How many blue blocks are there?

Question 2: The ratio of boys to girls in a class is 2:3
There are 6 more girls than boys in the class.
How many girls are in the class?

Question 3: Thomas and Emma share some money in the ratio 3:5
Emma receives £30 more than Thomas.

(a) How much money does Emma receive?
(b) How much money does Thomas receive?

Question 4: In a survey, the ratio of the number of people who preferred tea to those who preferred coffee was 9:5
36 more people preferred tea to coffee.
How many people were in the survey?

Question 5: The ratio of Mollie's age to Heather's age is 4:9
Heather is 40 years older than Mollie
How old is Mollie?

Apply

Question 1: A box contains red, purple and green beads in the ratio 4:6:7
There are 1428 more green beads than red beads.
How many green beads are in the box?

Intelligent Practice

1) Tony and Luke share some money in the ratio $3:7$. Luke receives £20 more than Tony. How much do they each receive?

2) Tony and Luke share some money in the ratio $3:7$. Luke receives £10 more than Tony. How much do they each receive?

3) Katy and Becky share some money in the ratio $2:1$. Katy receives £10 more than Becky. How much do they each receive?

4) The ratio of boys to girls in a class is $2:1$. There are 8 more boys than girls. How many boys and girls in the class?

5) There are blue, red and yellow counters in a bag in the ratio $3:2:1$. There are 6 more blue counters than red counters. How many counters are there in total?

6) There are blue, red and yellow counters in a bag in the ratio $9:6:3$. There are 6 more blue counters than red counters. How many counters are there in total?

7) There are blue, red and yellow counters in a bag in the ratio $9:6:3$. There are 18 more blue counters than red counters. How many counters are there in total?

8) A flapjack is made of oats, butter and syrup in the ratio $7:2:5$. A recipe requires 180g more syrup than butter. How many grams of oats should I use?

9) A flapjack is made of oats, butter and syrup in the ratio $7:1:5$. A recipe requires 180g more syrup than butter. How many grams of oats should I use?

10) A flapjack is made of oats, butter and syrup in the ratio $9:1:5$. A recipe requires 140g more oats than butter. How many grams of flapjack will the recipe make in total?

Purposeful Practice

(a) Yusuf and Zohra have earned £50 in a bake sale. They want to share the money in the ratio $2:3$. How much money does each person receive?

(b) Tina has a bag of 42 sweets. The sweets are either orange or pear flavour and the ratio of orange to pear sweets is $5:2$. Find the number of orange sweets and the number of pear sweets in the bag.

(a) There are 30 students in a class. The ratio of boys to girls is $3:7$. Find the number of boys and the number of girls in the class.

(b) Concrete is made by mixing cement and sand in the ratio $9:4$. How many kilograms of cement and sand are needed to make 65 kg of concrete?

(a) A drawer contains knives, forks and spoons in the ratio $4:2:3$. There are 72 items of cutlery in total. Find the number of knives, forks and spoons in the drawer.

(b) Doggy daycare has 60 dogs. There are small, medium and large dogs in the ratio $5:3:4$. Work out how many of each size of dog there are.

(a) A tennis club has 130 members that are either adults or children. Monthly membership fees are £12 for adults and £5 for children. If the ratio of adults to children is $10:3$, work out the total amount earned in membership fees per month.

(b) Ollie has a jar that contains 5 pence and 10 pence coins. There are 195 coins in the jar. If the ratio of 5 pence coins to 10 pence coins is $6:7$, what is the value of all the money in the jar?

Fluency Practice

Question 1:

(a) Share £20 in the ratio 2:3

(b) Share 15cm in the ratio 1:2

(c) Divide £24 in the ratio 1:3

(d) Share 35 sweets in the ratio 4:3

(e) Divide 55g in the ratio 3:2

(f) Divide 54kg in the ratio 1:5

(g) Share £210 in the ratio 2:5

(h) Share 120 hours in the ratio 5:7

(i) Share 350m in the ratio 3:7

(j) Divide 360° in the ratio 1:4

Question 2:

(a) Share £104 in the ratio 3:5

(b) Divide 161 miles in the ratio 6:1

(c) Divide 315ml in the ratio 2:7

(d) Share $650 in the ratio 4:9

(e) Share £800 in the ratio 11:14

(f) Share 1200kg in the ratio 3:37

(g) Divide €510 in the ratio 13:2

(h) Share 1116mm in the ratio 1:8

Question 3:

(a) Share £40 in the ratio 1:3:4

(b) Divide 63ml in the ratio 2:3:4

(c) Share 88p in the ratio 2:4:5

(d) Share 180° in the ratio 2:2:5

(e) Divide $165 in the ratio 1:2:12

(f) Share 720cm in the ratio 3:4:2:9

Question 4:

(a) Share 1km in the ratio 2:3

(b) Divide 2m in the ratio 9:1

(c) Divide 1 day in the ratio 1:2

(d) Share 4 minutes in the ratio 2:3

(e) Share £6 in the ratio 1:4

(f) Share €12 in the ratio 7:17

Purposeful Practice

Question 5: Work out each of the following. You may use a calculator

(a) Share 10ml in the ratio 1:3

(b) Divide 17g in the ratio 2:3

(c) Divide 345ml in the ratio 3:5

(d) Divide £260 in the ratio 5:11

(e) Share 58° in the ratio 2:7

(f) Share 880 seconds in the ratio 2:5:11

Apply

Question 1: Ed has 30 sweets.
The ratio of red sweets to yellow sweets is 2:3
How many red sweets does Ed have?

Question 2: Liam and Nathan share £60 in the ratio 1:3
How much money does each man receive?

Question 3: The ratio of adults to children at a cricket match is 7:3.
There 150 people at the match.
How many children attended the cricket match?

Question 4: Mark is making concrete.
Concrete is made by mixing cement, sand and gravel in the ratio 1:2:3.
Mark wants to make 300kg of concrete.

(a) How much cement does Mark need?
(b) How much sand does Mark need?
(c) How much gravel does Mark need?

Question 5: The angles in a triangle are in the ratio 1:1:4

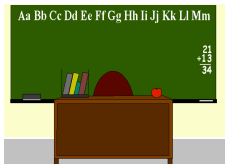
(a) Find the size of each angle
(b) What type of triangle is it?

Question 6: Dorothy has green and blue beads in the ratio 1:4
Dorothy has 80 beads.

(a) How many blue beads does she have?
(b) What fraction of the beads are green?
(c) What percentage of the beads are blue?

Purposeful Practice

Question 7: The ratio of boys to girls in a class is 2:3
Ben says there are 28 students in the class.



(a) Explain why Ben must be wrong
(b) Write down a possible number of students in the class

Question 8: At a football match, the ratio of children to adults is 2:7
There are 2700 people in the crowd.
Each adult ticket is £8
Each child ticket costs £3 less than an adult ticket.

Work out the total money made from ticket sales.

Question 9: In a school, all students study one language, French or Spanish.
The ratio of girls to boys in Year 11 is 4:3
¾ of the boys study French
There are 168 students in Year 11.

How many of the boys study Spanish?

Question 10: In a school election there were four candidates: Tom, Rebecca, Olly and Wendy.
540 students voted in the election.

5% of the votes were for Tom

$\frac{2}{9}$ of the votes were for Rebecca

The ratio of the number of votes for Olly to the number of votes to Wendy was 1:2

How many votes were for Wendy?

Question 11: A drink is made by mixing orange juice and lemonade in the ratio 1:4
Lemonade costs 80p per litre
Orange juice costs £1.20 per litre
Work out the cost of making 3 litres of the drink.

Question 12: Hannah baked some chocolate, strawberry and vanilla cupcakes.
She baked four times as many chocolate as strawberry cupcakes.
She baked three times as many chocolate as vanilla cupcakes.
Altogether Hannah made 152 cupcakes.

How many cupcakes of each flavour did Hannah make?

Purposeful Practice

Question 13: In a car park the ratio of white cars to black cars is 2:7
The ratio of white cars to red cars is 3:11
Altogether there are 343 white, black and red cars.

How many black cars are in the car park?

Question 14: At a holiday park, guests either stay in a caravan or in a tent.
In 2017 there were 460 guests.
In 2017 the number of guests was 15% greater than in 2016.
The ratio, in 2016, of people staying in a caravan to staying in a tent was 5:3.

How many guests stayed in caravans in 2016?

Fluency Practice

Share £60 in the ratio 5:1.	
Divide £48 in the ratio 5:3.	
Share £72 in the ratio 4:5.	
Divide £40 in the ratio 3:5.	
Share £132 in the ratio 8:3.	
Divide £42 in the ratio 3:4.	
Share £33 in the ratio 6:5.	
Divide £56 in the ratio 6:1.	
Share £15 in the ratio 3:7.	
Divide £24 in the ratio 1:3.	
Share £25 in the ratio 1:9.	
Divide £54 in the ratio 2:7.	

sharing in a ratio

match & complete

£48 : £__

£__ : £40

£30 : £__

£__ : £15

£__ : £36

£12 : £__

£_____ : £22.50

£__ : £18

£4.50 : £_____

£__ : £24

£__ : £10

£15 : £__

Intelligent Practice

1) Share 20 in the ratio $2 : 3$

2) Share 20 in the ratio $3 : 2$

3) Share 20 in the ratio $4 : 1$

4) Share 40 in the ratio $4 : 1$

5) Share 40 on the ratio $8 : 2$

6) Share 40 in the ratio $8 : 12$

7) Share 40 in the ratio $10 : 6$

8) Share 40 in the ratio $5 : 3$

9) Share 40 in the ratio $1 : 4 : 3$

10) Share 40 in the ratio $5 : 1 : 2$

11) Jarvis and Damon share sweets in the ratio $2 : 3$. Jarvis gets 4 sweets, how many does Damon get?

12) Share 30 in the ratio $1 : 2$

13) Justine and Brett share sweets in the ratio $7 : 3$. Brett gets 30 sweets, how many does Justine get?

14) Liam and Noel share some money in the ratio $1 : 5$. Noel gets £25, how many does Liam get?

15) Share £9 in the ratio $1 : 5$

16) Mark and Gaz share some money in the ratio $7 : 4$. Gaz gets £30, how many does Mark get?

17) Crispin and Louise share sweets in the ratio $2 : 5$. Louise gets 60 more than Crispin. How many does Crispin get?

18) Tommy and Thom share sweets in the ratio $7 : 9$. Tommy gets 80 less than Thom. How many does Tommy get?

19) Share $180°$ in the ratio $2 : 3 : 5$

20) Richard and Tjinder share money in the ratio $4 : 9$. Tjinder gets £24 more than Richard. How much money did they get altogether?

21) Tim and Mark share some money in the ratio $4 : 5$. Tim gets £25, how many does Mark get?

22) Share $360°$ in the ratio $7 : 5 : 4 : 2$

1.

a. Share 20 in the ratio 2 : 3

b. Divide 36 in the ratio 5 : 4

c. Share 27 in the ratio 2 : 7

d. Divide 45 in the ratio 3 : 4 : 8

e. Share 210 in the ratio 4 : 2 : 1

f. Divide 168 in the ratio 6 : 3 : 5

2.

a. Share 12 in the ratio 5 : 19

b. Divide 34 in the ratio 2 : 5 : 3

c. Divide 42 in the ratio 3 : 4 : 5

3.

A decorator needs 65 litres of pink paint.
Pink paint is made using red and white paint in the ratio 4 : 9
A 3 litre tub of white paint costs £4
A 2 litre tub of red paint costs £5·50
How much will the decorator need to pay to buy enough paint?

4.

At a charity rugby match, the ratio of adults to children is 8 : 3
There are 55,000 people watching in the stadium.
Adult tickets cost £12 and child tickets cost £5.
65 % of ticket sales are going to the charity.
How much money does the charity receive?

5.

Igor won £75 as a prize.
He gave 80 % of the money to Daphne and Harriet.
Daphne and Harriet share their money in the ratio 3 : 7
After receiving her money, Harriet gave Igor £12 from her share.
How much money do they each get?

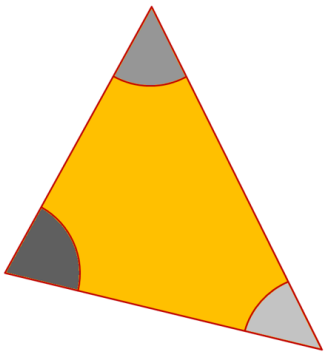
6.

In a school, all students study one humanities subject: Geography, RE or History.
The ratio of students studying Geography, RE and History is 8 : 5 : 3
21 History students and 38 Geography students are female.
There are 176 students in year 7, in a male to female ratio of 5 : 6.
How many male students study RE in year 7?

7. At a school concert, 154 students are taking part. The ratio of boys to girls is 5 : 6 The students can either sing or dance in the concert. The ratio of girls singing to dancing is 2 : 1 The ratio of all students singing to dancing is 4 : 3 How many boys dance in the concert?	8. Raj sells 252 bags of sweets each week. They come in three different flavours: mint, toffee and lemon. The ratio of mint, toffee and lemon sweets 12 : 7 : 9 The price of mint sweets is two times the price of toffee sweets. The price of toffee sweets is three times the price of lemon sweets. His weekly income is £1468·80 Work out the cost of each bag of sweets.
9. 185 counters in a bag are either blue, red or yellow. The ratio of blue counters to red counters is 5 : 3 The ratio of red counters to yellow counters is 2 : 7 How many counters are red?	10. Poppy has £145, Lily has £65 and Daisy has £30 Poppy gives some money to Lily and Daisy. The ratio of the money Poppy, Lily and Daisy now have is 3 : 2 : 1 How much money did Poppy give to each girl?

Purposeful Practice

divide 180° in these ratios:



what are the three angles in the triangle?

(1) 2 : 3 : 4

(2) 5 : 6 : 7

(3) 9 : 10 : 11

(4) 4 : 5 : 6

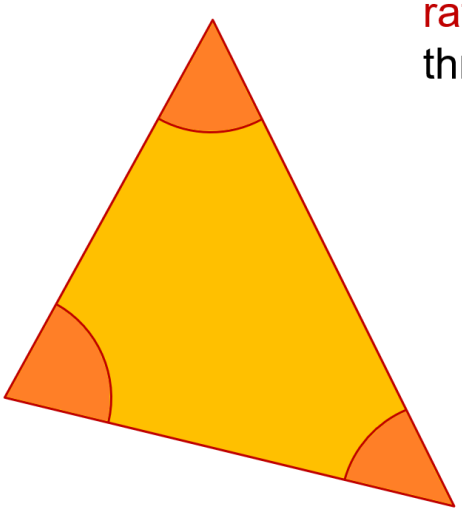
(5) 19 : 20 : 21

(6) 3 : 4 : 5

(7) 11 : 12 : 13

(8) 7 : 8 : 9

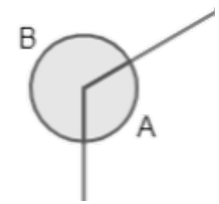
(9) 8 : 9 : 10



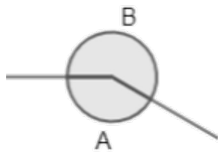
the total of the angles of a triangle is to be split in the ratio of three consecutive numbers

Using ratios to find… **Angles**

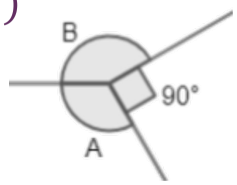
Find the values of A and B, and any missing ratios.

1) 

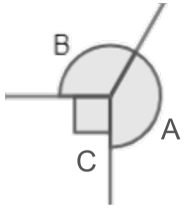
$A : B = 1 : 2$

2) 

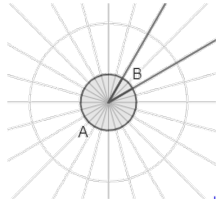
$A : B = 5 : 7$

3) 

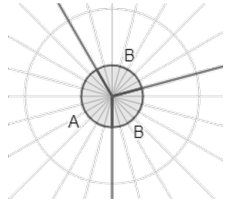
$A : B = 4 : 5$

4) 

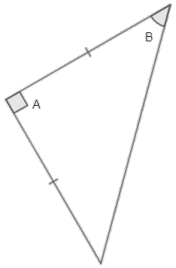
$C : B = 3 : 4$

5) 

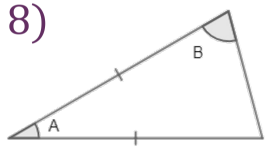
$A : B =$

6) 

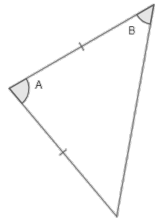
$A : B =$

7) 

$A : B =$

8) 

$A : B = 2 : 5$

9) 

$A : B = 5 : 2$

Purposeful Practice

1. A shade of green paint is made by mixing yellow and blue in the ratio 1:3. How many litres of yellow and blue are required to make 24 litres of the green paint?	2. A bathroom tiling design requires 2 patterned tiles for every 9 plain tiles. Tilly needs 275 tiles to cover her bathroom. How many of each type should she buy?	3. Two sisters share £81 in the ratio 4:1. How much does each sister receive?	4. The angles in a triangle are in the ratio 1:5:6. Work out the angles in degrees.
5. Sally receives an energy bill of £132, including both gas and electricity use. The cost for gas and cost for electricity are in the ratio 5:11. Work out the individual cost for each.	6. The ratio of boys to girls in a class is 3:5. Explain why there could not be 30 pupils in the class.	7. The perimeter of a rectangle is 28cm. The dimensions of the rectangle are in the ratio 3:4. Work out the area of the rectangle.	

Instructions: Calculate how much Tom and sally get in the middle box. Complete the remaining boxes changing as little as possible.

Amount that Sally gets	Number of parts that Tom gets		
	Less	Same	More
More			
Same		**Tom and Sally share £60 In the ratio 4:6 How much do they each get?**	
Less			

Fluency Practice

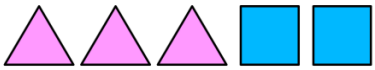
Q	Find the:	Answers
1	A and B share in the ratio 3 : 2. In total they have 40. How much does each have?	
2	A and B share in the ratio 3 : 2. B has 40. How much do they have in total?	
3	A and B share in the ratio 3 : 2. B has 40 less than A. How much do they have in total?	
4	A and B share in the ratio 3 : 5. In total they have 40. How much does each have?	
5	A and B share in the ratio 3 : 5. B has 40. How much do they have in total?	
6	A and B share in the ratio 3 : 5. B has 40 more than A. How much do they have in total?	
7	A and B share in the ratio 2 : 5. In total they have 42. How much does each have?	
8	A and B share in the ratio 2 : 5. A has 42. How much do they have in total?	
9	A and B share in the ratio 2 : 5. B has 42 more than A. How much do they have in total?	
10	A, B and C share in the ratio 2 : 5: 3. In total they have 50. How much does each have?	
11	A, B and C share in the ratio 2 : 5: 3. B has 50. How many does A have?	
12	A, B and C share in the ratio 2 : 5: 3. B has 50 more than C. How many does A have?	

Purposeful Practice

(a) Jamal has 3 toffees and 7 fudges. Write down the ratio of toffees to fudges. What fraction of Jamal's sweets are fudges?

(b) In a football team there are 5 girls and 6 boys. Write down the ratio of boys to girls. What fraction of the team are girls?

(c) Write down the ratio of triangles to squares. What fraction of the shapes are squares?



Write each of these ratios in their simplest form:

(a) $4 : 2$ (b) $2 : 4$

(c) $3 : 6$ (d) $3 : 15$

(e) $35 : 15$ (f) $7.5 : 15$

(g) $4 : 1.5$ (h) $\frac{1}{5} : 2$

(i) $3 : \frac{1}{3}$ (j) $3x : 7x$

Write each of these ratios in their simplest form:

(a) $8 : 2 : 6$ (b) $9 : 6 : 15$

(c) $24 : 12 : 4$ (d) $4 : 0.5 : 3$

(e) $\frac{1}{5} : 2 : 1$ (f) $2y : 4y : 8y$

(a) Rob has red and blue pens in the ratio $3 : 2$. If he has 8 blue pens, how many red pens does he have?

(b) A recipe for a cake uses butter and sugar in the ratio $4 : 7$. If Bo uses 120 g of butter, how much sugar should he use?

(c) Red, green and white paint is mixed in the ratio $5 : 2 : 4$. If Lila uses 50 ml of green paint, how much red and white paint does she need to mix in?

Purposeful Practice

Robbie and Gary share \$675 in the ratio 5 : 4. Gary spends $\frac{5}{6}$ of his money on a new TV. How much does Gary's new TV cost?

Three sisters Delia, Emma and Fajar share £880 in the ratio 2 : 5 : 4. Emma gives $\frac{2}{5}$ of her money to her mother, and Fajar gives $\frac{3}{8}$ of her money to her mother. How much money does their mother get in total?

In a year group there are 120 children. The ratio of boys to girls is 5 : 3. Of the boys, $\frac{2}{5}$ wear glasses. Of the girls, $\frac{2}{9}$ wear glasses. What percentage of the students in the year group wear glasses?

In a cutlery drawer, knives, forks and spoons are in the ratio 6 : 5 : 3. There are 36 spoons in the drawer. Of the knives, 25% are dirty, and of the forks, $\frac{5}{12}$ are dirty. What fraction of all the cutlery is dirty?

There are 90 counters in a bag, either red or green or yellow. $\frac{1}{5}$ of the counters are yellow. The ratio of red counters to green counters is 7 : 5. Ten red counters are removed from the bag. Find the percentage of counters remaining in the bag that are red.

Purposeful Practice

(a) There are 40 flowers in a shop, a mixture of roses and tulips. If there are 12 tulips, write the ratio of roses to tulips in its simplest form.
(b) There are bourbons and digestives in a jar. There are 36 biscuits in total. If 10 of the biscuits are bourbons, find the ratio of bourbons to digestives in its simplest form.
(c) There are 40 socks in a drawer, either black or grey. If $\frac{3}{4}$ of the socks are black, write the ratio of black socks to grey socks in its simplest form.

(a) The ratio of circles to squares is 6 : 1. If there are 5 squares, how many circles are there?
(b) At the gym, the ratio of men to women is 7 : 3. If there are 35 men, how many women are there?
(c) On a washing line there are t-shirts and jumpers in the ratio 2 : 3. If there are 21 jumpers, how many t-shirts are there?

(a) The ratio of dogs to cats is 4 : 1. If there are 5 cats, how many animals are there in total?
(b) A café sells cups of tea and coffee in the ratio 8 : 3. On Tuesday the café sells 72 cups of coffee. How many cups of tea and coffee did they sell in total that day?

(a) Bill has a total of 50 black or white counters. If there are 3 black counters for every 2 white counters, how many black counters are there?
(b) Maryam eats bananas and apples in the ratio 5 : 2. Last week she ate 8 apples. How many bananas did she eat?
(c) A packet contains lime or lemon flavour sweets in the ratio 2 : 7. If there are 36 sweets in total, how many are lemon flavour?

Ratio Worded Problems			
(a)	**(b)**	**(c)**	**(d)**
A pencil case contains 5 blue pencils, 3 red pencils and 7 black pencils. What fraction of the pencils are red? Give your answer in its simplest form.	In a florist shop, the ratio of roses to tulips to gerberas is 7 : 2 : 3. What fraction of the flowers in the shop are roses or tulips? Give your answer in its simplest form.	The ratio of the number of boys to the number of girls in a school is 4 : 7. There are 91 girls in the school. Work out the number of boys in the school.	The books in a library are fiction or non-fiction in the ratio 3 : 2. If there are 573 fiction books, how many books are there in the library in total?
(e)	**(f)**	**(g)**	**(h)**
A map has a scale of 1 : 500. Martha measures a distance of 5 cm on the map. What actual distance in m does this correspond to?	Madeira cake mixes flour, sugar and butter in the ratio 5 : 3 : 2. How much flour and butter is required to mix with 75 g sugar?	In a car park there are twice as many white cars as black cars, and three times as many red cars as white cars. Write the ratio of cars red : white : black in its simplest form.	A recipe to make 8 pancakes needs 200 ml milk and 120 g flour. How much milk and flour is need to make 20 pancakes?
(i)	**(j)**	**(k)**	
The angles in a quadrilateral are in the ratio 5 : 7 : 4 : 2. Find the size of each of the angles.	120 ml of orange drink is made with cordial and water in the ratio 1 : 4. To make the drink stronger 10 ml more of cordial is added. What is the ratio of cordial to water for the new drink?	Ishaq builds a model rocket. The height of the model rocket is 16 cm, and the actual height of the model is 48 m. Find the ratio of the model rocket to the real rocket.	

A1 Share £60 in the ratio 1 : 4	**A2** Share $350 in the ratio 4 : 3	**A3** Share £200 in the ratio 3 : 1 : 4	**A4** Chris and Maddie share $120 in the ratio 3 : 5 How much do they each receive?
B1 Red and yellow paint are mixed to make orange. Sam mixes 600 ml of red with 400 ml of yellow. Write the ratio of red to yellow. Give the ratio in its simplest form.	**B2** A school has a total of 900 pupils. 400 pupils are boys and the rest are girls. Find the ratio of boys to girls. Give the ratio in its simplest form.	**B3** Nial and Alex have played table tennis against each other 30 times. The ratio of the number of times Nial has won to the number of times Alex has won is 3 : 7. How many times has Alex won?	**B4** 1360 people watch a hockey match. The ratio male to female is 3 : 1 How many **more** males than females watch the match?
C1 In a school, there are 75 boys in the tennis squad. The ratio of the number of girls to the number of boys is 4 : 3 How many girls in the tennis squad?	**C2** Flaky pastry can be made using flour and fat in the ratio 4 : 3. Jake makes some flaky pastry using 90 grams of fat. What weight of flour does he use?	**C3** To make grey paint, black paint and white paint are mixed in the ratio 4 : 7. Tom uses 300 ml of black paint. How much white paint does he use?	**C4** The sides of a triangle are in the ratio 2 : 4 : 5 The length of the longest side of the triangle is 15 cm. Work out the perimeter of the triangle.
D1 Jack, Evan and Molly share some money in the ratio 5 : 9 : 6 In total, Jack and Molly receive $77. Work out the amount of money that Evan receives.	**D2** At a school the ratio of the number of boys to number of girls is 9 : 11 There are 96 **more** girls than boys. Work out the total number of students at the school.	**D3** Nathan, Ayesha and Jordan share some money in the ratio 3 : 6 : 4 Ayesha gets £18 more than Nathan. Work out the amount of money that Jordan gets.	**D4** Siyoni, Adam and Ben share some money in the ratio 5 : 3 : 4 In total, Adam and Ben receive $84. Work out how much they each get.

Intelligent Practice

1) The ratio of $a : b$ is $1 : 2$. The ratio of $b : c$ is $2 : 3$. What is the ratio of $a : c$?

2) The ratio of $a : b$ is $1 : 2$. The ratio of $b : c$ is $2 : 4$. What is the ratio of $a : c$?

3) The ratio of $a : b$ is $3 : 2$. The ratio of $b : c$ is $2 : 4$. What is the ratio of $a : c$?

4) The ratio of $a : b$ is $4 : 2$. The ratio of $b : c$ is $2 : 3$. What is the ratio of $a : c$?

5) The ratio of $a : b$ is $4 : 1$. The ratio of $b : c$ is $1 : 3$. What is the ratio of $a : c$?

6) The ratio of $a : b$ is $4 : 6$. The ratio of $b : c$ is $6 : 3$. What is the ratio of $a : c$?

7) The ratio of $a : b$ is $4 : 3$. The ratio of $b : c$ is $6 : 3$. What is the ratio of $a : c$?

8) The ratio of $a : b$ is $4 : 2$. The ratio of $b : c$ is $6 : 3$. What is the ratio of $a : c$?

9) The ratio of $a : b$ is $4 : 1$. The ratio of $b : c$ is $6 : 3$. What is the ratio of $a : c$?

10) The ratio of $a : b$ is $4 : 1$. The ratio of $b : c$ is $5 : 3$. What is the ratio of $a : c$?

11) The ratio of $a : b$ is $4 : 2$. The ratio of $b : c$ is $5 : 3$. What is the ratio of $a : c$?

12) The ratio of $a : b$ is $4 : 3$. The ratio of $b : c$ is $5 : 3$. What is the ratio of $a : c$?

13) The ratio of $a : b$ is $4 : 6$. The ratio of $b : c$ is $10 : 3$. What is the ratio of $a : c$?

14) The ratio of $a : b$ is $4 : 4$. The ratio of $b : c$ is $10 : 3$. What is the ratio of $a : c$?

15) The ratio of $a : b$ is $4 : 2$. The ratio of $b : c$ is $5 : 3$. What is the ratio of $a : c$?

16) The ratio of $a : b$ is $3 : 2$. The ratio of $b : c$ is $5 : 3$. What is the ratio of $a : c$?

17) The ratio of $a : b$ is $3 : 5$. The ratio of $b : c$ is $2 : 3$. What is the ratio of $a : c$?

18) The ratio of $a : b$ is $9 : 5$. The ratio of $b : c$ is $2 : 9$. What is the ratio of $a : c$?

$a:a$ **1 : 1**	$a:b$ **5 : 3**	$a:c$: :	$a:d$: :	$a:e$: :
$b:a$: :	$b:b$ **1 : 1**	$b:c$ **6 : 7**	$b:d$: :	$b:e$: :
$c:a$: :	$c:b$: :	$c:c$ **1 : 1**	$c:d$: :	$c:e$: :
$d:a$ **9 : 4**	$d:b$: :	$d:c$: :	$d:d$ **1 : 1**	$d:e$: :
$e:a$: :	$e:b$: :	$e:c$: :	$e:d$ **11 : 12**	$e:e$ **1 : 1**

Intelligent Practice

1) The ratio of red to blue is $2:3$, the ratio of blue to green is $3:5$, what is the ratio of red to green?

2) The ratio of red to blue is $2:3$, the ratio of blue to green is $6:10$, what is the ratio of red to green?

3) The ratio of red to blue is $4:6$, the ratio of blue to green is $6:10$, what is the ratio of red to green?

4) The ratio of red to blue is $8:12$, the ratio of blue to green is $6:10$, what is the ratio of red to green?

5) The ratio of red to blue is $9:12$, the ratio of blue to green is $6:10$, what is the ratio of red to green?

6) The ratio of red to blue is $12:9$, the ratio of blue to green is $6:10$, what is the ratio of red to green?

7) The ratio of red to blue is $12:10$, the ratio of blue to green is $6:10$, what is the ratio of red to green?

8) The ratio of red to blue is $12:10$, the ratio of blue to green is $15:10$, what is the ratio of red to green?

9) The ratio of red to blue is $120:100$, the ratio of blue to green is $150:100$, what is the ratio of red to green?

10) The ratio of red to blue is $\frac{1}{2}:\frac{1}{3}$, the ratio of blue to green is $\frac{1}{3}:\frac{1}{4}$, what is the ratio of red to green?

11) The ratio of red to blue is $\frac{1}{2}:\frac{1}{3}$, the ratio of blue to green is $\frac{1}{2}:\frac{1}{4}$, what is the ratio of red to green?

12) The ratio of red to blue is $x:y$, the ratio of blue to green is $y:z$, what is the ratio of red to green?

13) The ratio of red to blue is $x:y$, the ratio of blue to green is $3y:4z$, what is the ratio of red to green?

14) The ratio of red to blue is $x:19$, the ratio of blue to green is $17:y$, what is the ratio of red to green?

15) If y and z are prime, what is the ratio of red to blue is $x:y$, the ratio of blue to green is $z:w$, what is the ratio of red to green?

Purposeful Practice

(a) Given that A : B is 4 : 1 and B : C is 2 : 3, find the ratio A : B : C in its simplest form.

(b) Given that D : E is 5 : 2 and E : F is 1 : 3, find the ratio D : E : F in its simplest form.

(c) Given that K : L is 7 : 4 and L : M is 2 : 5, find the ratio K : L : M in its simplest form.

(d) Given that A : B is 7 : 2 and B : C is 6 : 5, find the ratio A : C in its simplest form.

(e) Given that D : E is 7 : 2 and E : F is 3 : 5, find the ratio D : F in its simplest form.

(f) Given that R : S is 9 : 4 and S : T is 5 : 3, find the ratio R : T in its simplest form.

(g) There are three times as many red pens as green pens, and there are twice as many green pens as blue pens. Write down the ratio of red pens to green pens to blue pens.

(h) The ratio of cows to sheep is 9 : 5. The ratio of cows to pigs is 3 : 1. Find the ratio of sheep to pigs.

(i) The ratio of circles to squares is 4 : 3. The ratio of black circles to white circles is 5 : 3. The ratio of black squares to white squares is 5 : 1. Find the ratio of white squares to white circles.

(j) The points A, B, C and D lie in order on a straight line.
AB : BD = 1:5 AC : CD = 7:11
Work out AB : BC : CD

Purposeful Practice

Question 1: In a bag there are blue, green and yellow counters.

The ratio of blue counters to green counters is 3:2
The ratio of green counters to yellow counters is 2:5

(a) Write down the ratio of blue to green to yellow counters in the bag.
(b) What percentage of the beads are green?

Question 2: Archie made some cupcakes for a charity coffee morning.

The ratio of chocolate cupcakes to strawberry cupcakes was 3:1
The ratio of strawberry cupcakes to lemon cupcakes was 2:3

(a) Write down the ratio of chocolate to strawberry to lemon cupcakes.
(b) Work out the smallest possible number of cupcakes that Archie could have made.

Question 3: At a safari park, the ratio of lions to tigers is 7:4.
The ratio of elephants to tigers is 1:2

Write down the ratio of lions to tigers to elephants in the safari park.

Question 4: A bag contains three different shaped pieces of card.

The ratio of circles to triangles is 2:3
The ratio of triangles to rectangles is 2:5

Find the ratio of circles to triangles to rectangles.

Question 5: In a school, all students are taught either French, German or Spanish.

The ratio of the number of students taught French to those taught German is 3:4
The ratio of the number of students taught French to taught Spanish is 12:11

Find the ratio of the number of students taught Spanish to taught German.

Question 6: In a box there are white chocolates, milk chocolates and dark chocolates.

The ratio of white chocolates to milk chocolates is 3:5
The ratio of milk chocolates to dark chocolates is 8:1

What fraction of the chocolates are white chocolate?

Purposeful Practice

Apply

Question 1: In a drawer, there are white, black and grey socks.
The ratio of white socks to black socks is 3:2
The ratio of white socks to grey socks is 9:4

(a) Write down the ratio of white socks to black socks to grey socks.

Elsie says there is an odd white sock.

(b) Explain why Elsie might be wrong.

Question 2: The ratio of red pens to black pens is 2:9
The ratio of black pens to blue pens is 5:4

Show less than 50% of the pens are black.

Question 3: A quadrilateral, ABCD, is drawn.

The ratio of the size of angle A to angle B is 1:3
The ratio of the size of angle B to angle D is 5:3
The ratio of the size of angle C to angle A is 7:5

Find the difference in size between the largest and smallest angles in quadrilateral ABCD.

Question 4: The ratio of Scott's age to Georgia's age to Fiona's age is 11:6:7
The ratio of Oscar's age to Georgia's age is 3:4

Find the ratio of Fiona's age to Oscar's age.

Question 5: Given $4x = 3y$ and $y : z = 1 : 2$

Find x in terms of z

Question 6: w is 15% of x

y is $\frac{3}{5}$ of x

Find the ratio w:x:y

1. Write, in the simplest form, the ratio $p : q : r$

a. $p : q = 3 : 2$ and $q : r = 2 : 5$

b. $p : q = 1 : 4$ and $q : r = 4 : 7$

c. $p : r = 2 : 5$ and $q : r = 3 : 5$

2. Write, in the simplest form, the ratio $f : g : h$

a. $f : g = 1 : 3$ and $g : h = 6 : 5$

b. $f : g = 2 : 5$ and $g : h = 10 : 7$

c. $f : h = 3 : 4$ and $g : h = 1 : 2$

3. Write, in the simplest form, the ratio $w : x : y$

a. $w : x = 2 : 3$ and $x : y = 4 : 1$

b. $w : x = 3 : 5$ and $x : y = 2 : 4$

c. $x : w = 3 : 1$ and $x : y = 4 : 6$

d. $w : y = 3 : 8$ and $y : x = 3 : 5$

e. $w : x = 10 : 5$ and $w : y = 3 : 4$

f. $x : y = 4 : 2$ and $w : y = 3 : 7$

4.

a. The counters in a bag are either blue, red or yellow.
The ratio of blue counters to red counters is 5 : 3
The ratio of red counters to yellow counters is 2 : 7
Show that more than half of the counters are yellow.

b. On a farm, the number of cows to sheep is in the ratio 6 : 5
The number of sheep to pigs in the in the ratio 2 : 3
Show that less than a third of the animals are sheep.

c. The ratio of red pens to black pens is 2 : 9
The ratio of black pens to green pens is 5 : 4
Show that less than 50% of the pens are black.

d. The ratio of men to women at a café is 4 : 3
The ratio of women to children at the café is 8 : 5
Show that less than half of the people are men.

5. Given the ratios, find the values of x, y and z

a. $p : q = x : 7$, $q : r = y : z$ and $p : q : r = 12 : 21 : 14$

b. $p : q = 3 : 8$, $q : r = x : y$ and $p : q : r = 15 : z : 72$

1. Write, in the simplest form, the ratio $w : x : y$

a. $w : x = 2 : 3$ and $x : y = 4 : 1$

b. $w : x = 3 : 5$ and $x : y = 2 : 4$

c. $x : w = 3 : 1$ and $x : y = 4 : 6$

d. $w : y = 3 : 8$ and $y : x = 3 : 5$

e. $w : x = 10 : 5$ and $w : y = 3 : 4$

f. $x : y = 4 : 2$ and $w : y = 3 : 7$

2.

a. The ratio of red pens to black pens is 2 : 9
The ratio of black pens to green pens is 5 : 4
Show that less than 50% of the pens are black.

b. The ratio of men to women at a café is 4 : 3
The ratio of women to children at the café is 8 : 5
Show that less than half of the people are men.

c. The ratio of the ages of Cecily, Elodie and Juno is 10 : 6 : 7
The ratio of Lenny's age to Juno's age is 3 : 4
Show that Lenny is more than half of Cecily's age.

d. Yellow counters to red counters are in the ratio 4 : 3
Blue counters to green counters are in the ratio 8 : 11
Yellow counters to blue counters are in the ratio 2 : 3
Show that no colour accounts for more than 40% of the counters

3.

M divides the line XY in the ratio 1 : 6
N divides the line XY in the ratio 8 : 13

Work out the ratio XM : MN : NY

4.

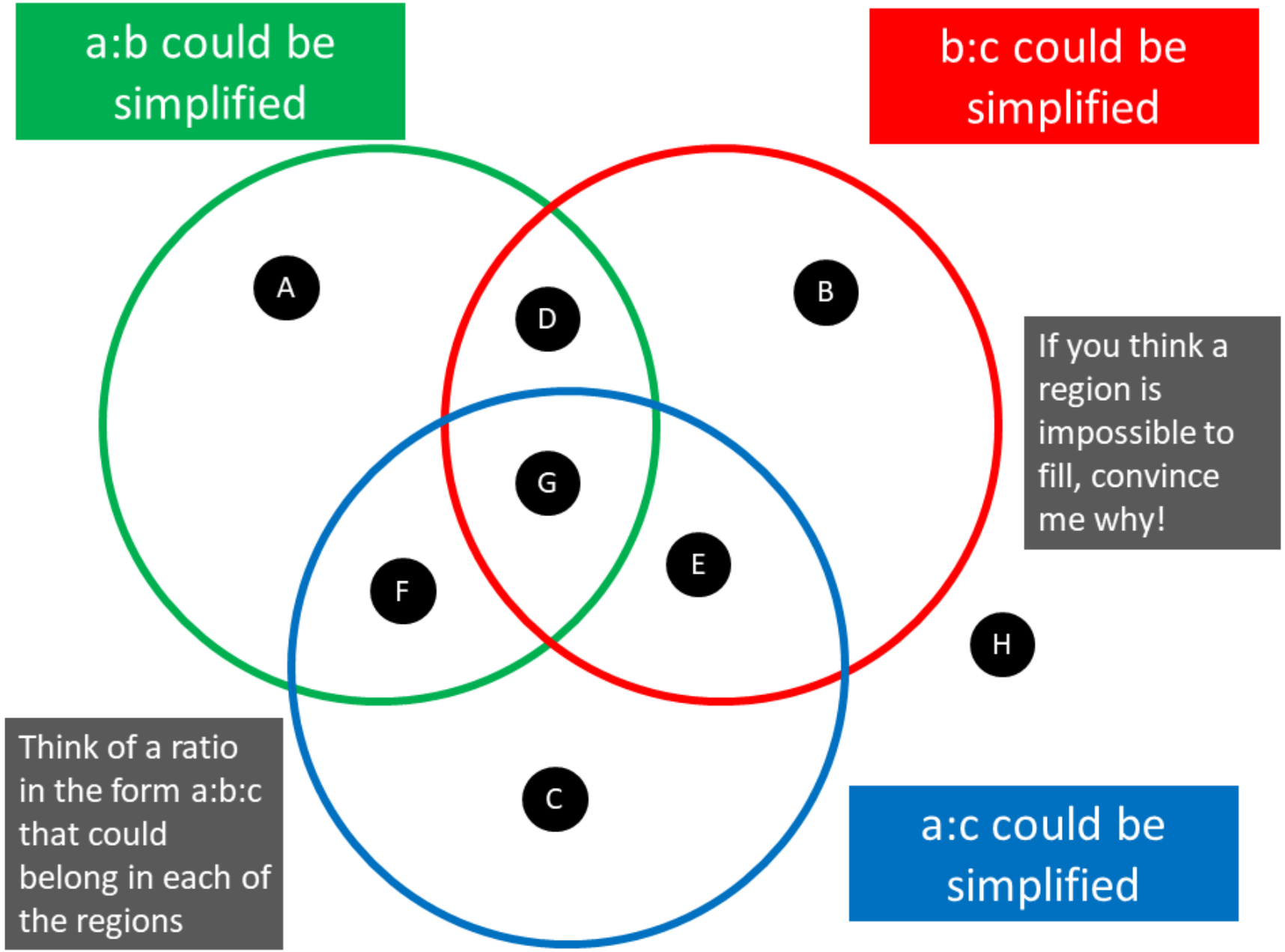
a. The points T, U, V and W lie, in order, on a straight line
TU : UW = 3 : 2
TV : VW = 9 : 1
Work out TU : UV : VW

b. The points E, F, G and H lie, in order, on a straight line
EF : FH = 8 : 2
EG : GH = 49 : 1
Work out EF : FG : GH

5.

a. A, B and C are such that
A : B = 1 : 5
B is 75% of C
Work out the ratio A : C

b. P, Q and R are such that
P : Q = 2 : 3
P is 0·7 of R
Work out the ratio Q : R


a:b could be simplified
b:c could be simplified
A
D
B
If you think a region is impossible to fill, convince me why!
G
E
F
H
Think of a ratio in the form a:b:c that could belong in each of the regions
C
a:c could be simplified

Fluency Practice

Convert each of these statements to a ratio in its simplest form

For every 6 women, the school employs 8 men. women : men ..... :	5cm on the map represents 30cm in real life. map : real life ..... :	28 : 14 ..... :	3 faulty bulbs for every 75 that work perfectly. faulty bulbs : working bulbs ..... : .....
5 adults for every 25 children. adults : children ..... :	Jenny sleeps 15 minutes for every 40 minutes she is awake. time sleeping : time awake ..... :	10ml orange juice for every 300ml of water. orange : water ..... :	6 : 24 ..... : .....
34 red seats for every 12 blue seats. red seats : blue seats ..... :	22 : 44 ..... :	The ratio of girls to boys is 8 : 15 girls : boys ..... :	3cm on the map represents 4m in real life. map : real life ..... : .....
Emma runs 400m for every 5km she cycles. run : cycle ..... :	Kate spends 25p for every £1 she earns. spending : earning ..... :	9 : 27 ..... :	3 adults for every 9 children. adults : children ..... : .....
5cm on the map represents 20m in real life. map : real life ..... :	8 red beads for every 6 blue beads. red beads: blue beads ..... :	8 women for every 8 men. women : men ..... :	100 : 25 ..... : .....

Purposeful Practice

A John and Kate share £180 in the ratio 2 : 3. Work out how much money each person receives.

B A bag contains red, blue and green counters in the ratio 5 : 2 : 3. Given that there are 60 counters in total, work out how many of each counter there are.

C At a bake sale, the ratio of chocolate cakes sold to vanilla cakes sold was 4 : 3.

Given that 24 vanilla cakes were sold, work out the number of chocolate cakes that were sold.

D The prize money for a competition is shared between the winner and the runner-up in the ratio 3 : 1.

The winner received £250 more than the runner-up.

What was the total prize money?

E The ratio of the number of adults to the number of children at a holiday camp is 3 : 2.

There are 72 adults at the holiday camp. Work out how many children there are.

F William has a collection of coins. Each of the coins is either silver or bronze.

The ratio of the number of bronze coins to the number of silver coins is 4 : 1.

William has 12 **more** bronze coins than silver coins. Work out the total number of coins in his collection.

G The angles in a triangle are in the ratio 2 : 3 : 4.

Work out the size of the three angles.

H The angles in a quadrilateral are in the ratio 2 : 3 : 4 : 6.

Work out the size of the largest angle.

I Daisy and Holly share £1200 in the ratio 3 : 5.

Holly gives 30% of the money she receives to a charity, and keeps the rest.

How much money does Holly keep for herself?

J Over the course of a season, a football team won, drew and lost matches in the ratio 2 : 1 : 5.

The team lost 12 **more** matches than they won.

Work out how many matches the team drew in the season.

K Paul and Richard share £9 in the ratio 3 : 7.

Work out how much **more** Richard receives than Paul.

L A jug contains 2 litres of fruit punch. The punch has been made by mixing orange juice, pineapple juice and mango juice in the ratio 5 : 1 : 2.

Work out the amount of each type of juice used. Give your answers in millilitres.

Purposeful Practice

A The following options are available at a car wash.

Standard Wash £8
Deluxe Wash £12

In one day, 60 customers have their cars washed. The ratio of customers choosing the standard wash to those choosing the deluxe wash is 3 : 2.

Work out the total takings at the car wash for the day.

B Entry tickets for a fireworks display were charged at £10 for children and £25 for adults.

800 people attended the fireworks display. The ratio of adults to children in attendance was 7 : 9.

(a) Work out the total amount of money made from ticket sales.

(b) 60% of the cost of each ticket was given to charity. Work out the total amount given to charity.

C Robert is making pink paint by mixing red and white paint in the ratio 1 : 3.

Red paint costs £5 for 500ml.
White paint costs £8 for 3 litres.

Work out how much it will cost Robert to buy enough paint to make 12 litres of pink paint.

D Jill is buying tiles to decorate her bathroom. The design she is following has plain and patterned tiles in the ratio 9 : 2.

Plain tiles
40p each

Patterned
75p each

Jill calculates that she needs 275 tiles in total. Work out how much this will cost.

E A taxi company has a total of 24 cars. Some of the cars can seat 7 passengers and the rest can seat 4 passengers.

The ratio of 7-seat to 4-seat cars is 1 : 5.

Work out the total number of passengers that can be carried in all of the cars at one time.

F A newly built development of 32 houses contains two-bedroom and three-bedroom houses only.

The ratio of two-bedroom houses to three-bedroom houses is 5 : 3.

Work out how many bedrooms there are in total in all of these houses.

G During the summer months, a farm hires 60 workers to pick fruit.

Some of the workers are hired as supervisers. The ratio of supervisers to normal workers is 1 : 9.

Supervisers are paid £10.50 per hour.
Normal workers are paid £8.50 per hour.

Work out the total cost to the farm, per hour, of hiring all the workers.

H Lucy is a florist. She buys roses from her supplier at £1.20 each and carnations at 60p each.

She arranges the flowers into bouquets, using roses and carnations in a ratio of 2 : 3.

She sells the bouquets, each containing a total of 15 flowers for £18 each.

Work out the amount of profit Lucy makes for each bouquet she sells.

Purposeful Practice

A At a restaurant, the ratio of the number of chefs to the number of waiting staff is 2 : 5.

What fraction of the workers at the restaurant are chefs?

B In a class, $\frac{3}{8}$ of the pupils are girls.

Work out the ratio of the number of boys to the number of girls in the class.

Give your answer in the simplest form.

C Harry and Mark share some money in the ratio 2 : 3.

Mark then gives half the amount of money he has received to Harry.

What fraction of the money does Harry end up with?

D Sophie carries out a survey of traffic passing along a road one morning.

64% of the vehicles she counted were cars.
$\frac{2}{25}$ of the vehicles she counted were vans.

Find, in the simplest form, the ratio of *cars : vans : other vehicles* that Sophie counted.

E At a cinema, popcorn is sold in small, medium and large cartons.

One day, the ratio of the number of sales of small, medium and large cartons was 1 : 2 : 2.

What percentage of the cartons sold were large?

F Ellie attends school for 92% of the days in a school year and is absent for the rest.

Work out the ratio of the number of days Ellie attended school to the number of days she was absent.

Give your answer in the form *n : 1*.

G At a school, all pupils study one foreign language, either French, German or Spanish.

There are 720 pupils in total. $\frac{2}{5}$ of the pupils study French. The ratio of the number of pupils who study German to the number who study Spanish is 1 : 3.

Work out how many pupils study each language.

H Anne is making a repeating pattern using three colours of beads: white, red and yellow.

35% of the beads used are white. Red and yellow beads appear in the pattern in the ratio 2 : 1.

Anne has used 180 beads in total.
Work out how many red beads she has used.

I A bag containers black, white and red counters in the ratio 3 : 4 : 2.

A counter is to be picked at random from the bag. Work out the probability the counter is not white.

J George and Harriet shared some money in the ratio 5 : 3. George gave $\frac{2}{3}$ of the money he received to Ivan.

Ivan received £30. How much money was shared?

Purposeful Practice

A A packet contains red, blue and green balloons.

The ratio of red to blue balloons is 2 : 3.
The ratio of blue to green baloons is 2 : 1.

Work out the ratio of:
red balloons : blue balloons : green balloons
Give your answer in the simplest form.

B Lucy, Mary and Nancy each receive a share of £180.

Lucy receives twice as much as Mary.
Nancy receives 50% more than Mary.

Work out how much each person receives.

C At a cafe, a survey is carried out of the sales of different types of coffee over a weekend.

The ratio of cappuccinos sold to lattes sold was 3 : 5.
The ratio of lattes sold to americanos sold was 4 : 3.

Work out the correct number to complete the sentence:
For every 20 cappucinos sold, there were ___ sales of americanos.

D At a holiday camp, the ratio of boys to girls is 2 : 3.

The ratio of girls to adults is 2 : 5.

Work out the ratio of children to adults at the holiday camp. Give your answer in the simplest form.

E A messaging app allows users to send text, picture and video messages.

The ratio of text messages to picture messages sent is 4 : 1.
The ratio of text messages to video messages sent is 11 : 2.

Work out the ratio of picture messages to video messages sent. Give your answer in the simplest form.

F A mosaic is made using black, white and grey tiles.

The ratio of black tiles to white tiles is 3 : 7.
The ratio of black tiles to white and grey tiles combined is 2 : 9.

Given that a total of 24 black tiles were used,
find the total number of grey tiles that were used.

G The ratio of Robert and Steve's ages is 3 : 4.

The ratio of Steve and Tom's ages is 5 : 2.

Given that Robert is aged between 40 and 50, work out Tom's age.

H At an athletics event, gold, silver and bronze medals are awarded.

The ratio of gold to silver medals won by a country is 1 : 3.
The ratio of silver to bronze medals won by the country is 2 : 3.

Find the ratio of gold to bronze medals won by the country in the form 1 : n.

Purposeful Practice

(a) Divide £50 in the ratio 4 : 1

(b) Divide £70 in the ratio 4 : 1

(c) Divide £70 in the ratio 4 : 3

(d) Divide £140 in the ratio 2 : 5

(e) Divide £64 in the ratio 3 : 5

(f) Divide £64 in the ratio 3 : 1 : 4

(g) Divide £72 in the ratio 3 : 2 : 4

(h) Divide £132 in the ratio 5 : 2 : 4

(a) Aisha and Arthur share £150 in the ratio of their ages. Aisha is 14 and Arthur is 11. How much does each of them receive?

(b) There are 33 children in a class. The ratio of boys to girls is 7 : 4. How many girls are there in the class?

(c) The sides of a triangle are in the ratio 3 : 4 : 5. The perimeter of the triangle is 72 cm. What is the length of the longest side?

(a) The ratio of A to B is 3 : 1. The ratio of B to C is 2 : 5. What is the combined ratio A : B : C?

(b) The ratio of red to yellow counters is 7 : 1. The ratio of yellow counters to green counters is 3 : 5. What is the ratio of red to yellow to green counters?

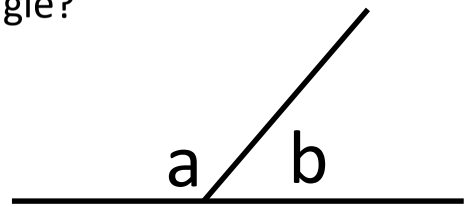
(c) At a zoo, the ratio of monkeys to meerkats is 2 : 7. The ratio of monkeys to penguins is 4 : 3. What is the ratio of meerkats to monkeys to penguins?

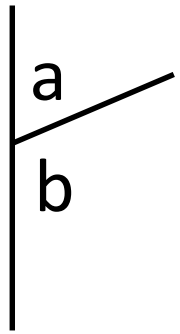
(a) The ratio of C to D is 4 : 3. The ratio of D to E is 2 : 5. What is the ratio C : D : E?

(b) The ratio of squares to circles is 2 : 3. The ratio of circles to triangles is also 2 : 3. What is the ratio of squares to triangles?

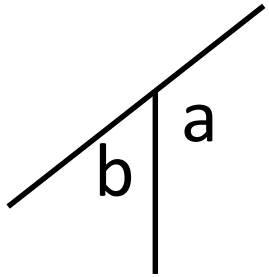
Purposeful Practice

The ratio of a to b is 7:3.
What is the size of the largest angle?

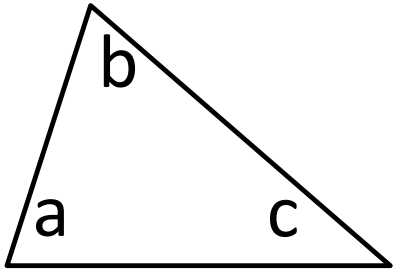




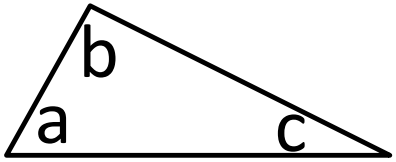
The ratio of a to b is 4:11.
What is the size of the smallest angle?



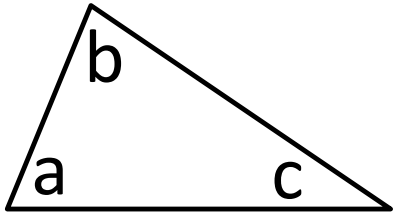
The ratio of a to b is 5:4.
What is the difference in the size of the angles.



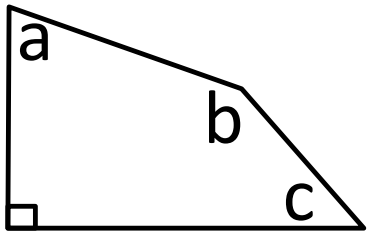
The ratio of a to b to c is 5:3:4.
Calculate the size of each angle



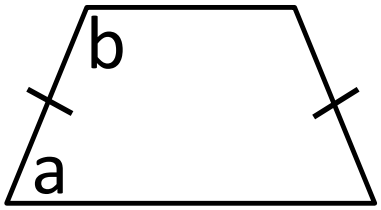
The ratio of a to b is 3:5. If angle $b = 85°$ what is the size of angle C?



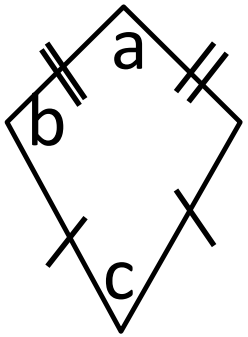
The ratio of a to b is 3:5. The difference between angle a and b is $36°$. What is the size of angle C?



The ratio of a to b to c is 2:5:3.
Calculate the size of each angle



The ratio of a:b is 3:5, what is the difference between the angles.

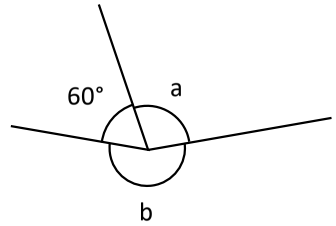


The ratio of a:b:c is 6:5:4.

What is the size of the smallest angle?

Purposeful Practice

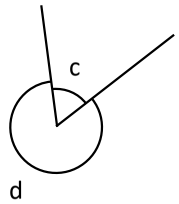
1)



Angles a & b are in the ratio 1:2

a = _____ ° b = _____ °

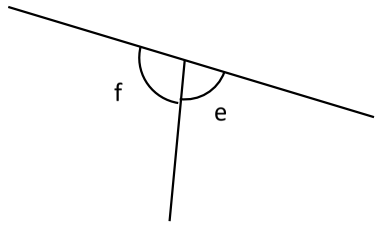
2)



Angles c & d are in the ratio 1:5

c = _____ ° d = _____ °

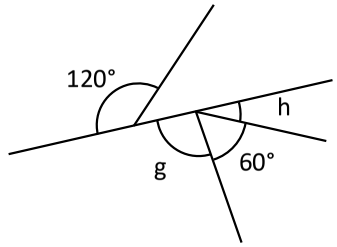
3)



Angles e & f are in the ratio 4:5

e = _____ ° f = _____ °

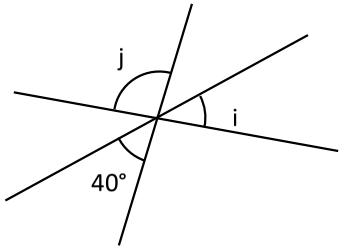
4)



Angles g & h are in the ratio 3:1

g = _____ ° h = _____ °

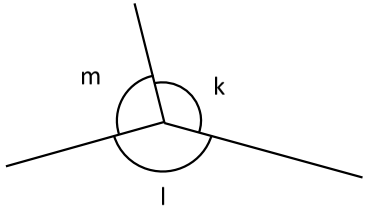
5)



Angles i & j are in the ratio 2:5

i = _____ ° j = _____ °

6)

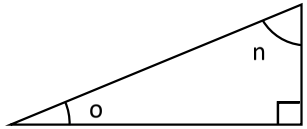


Angles k, l & m are in the ratio 4:5:3

k = _____ ° l = _____ °

m = _____ °

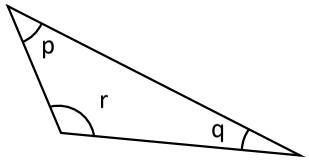
7)



Angle n is 5 times the size of angle o.

n = _____ ° o = _____ °

8)

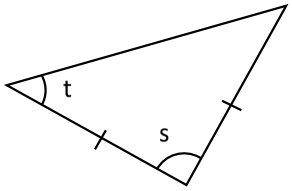


Angle p is 2 times larger than angle q.
Angle r is 3 times larger than angle p.

p = _____ ° q = _____ °

r = _____ °

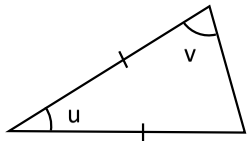
9)



Angles s & t are in the ratio 2:1

s = _____ ° t = _____ °

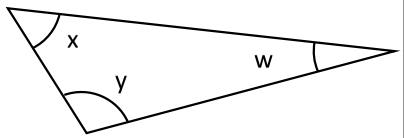
10)



Angles u & v are in the ratio 2:5

u = _____ ° v = _____ °

11)

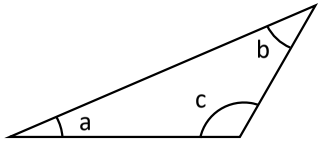


Angle w is 6 times smaller than angle y.
Angles x & y are in the ratio 1:2

w = _____ ° x = _____ °

y = _____ °

12)

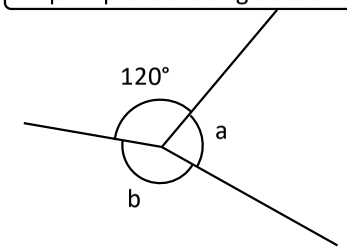


Angles a & b are in the ratio 2:3
Angles c & a are in the ratio 5:1

a = _____ ° b = _____ °

c = _____ °

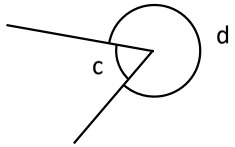
1) Tip! Express the angles as a ratio.



Angle a is half the size of angle b.

a = _____ ° b = _____ °

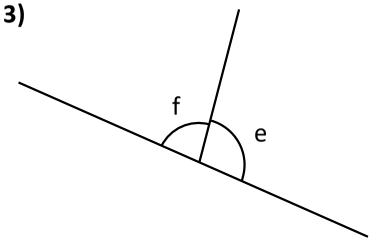
2)



Angle c is $\frac{1}{5}$ the size of angle d.

c = _____ ° d = _____ °

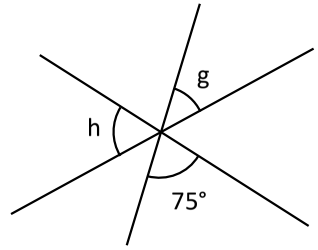
3)



Angle f is $\frac{4}{5}$ the size of angle e.

e = _____ ° f = _____ °

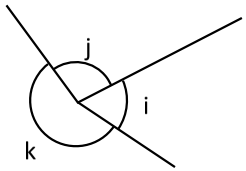
4)



Angle g is $\frac{3}{4}$ the size of angle h.

g = _____ ° h = _____ °

5)



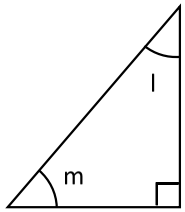
Angle i is $\frac{3}{5}$ the size of angle j.

Angle k is double the size of angle j.

i = _____ ° j = _____ °

k = _____ °

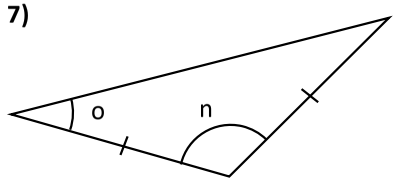
6)



Angle m is $\frac{1}{4}$ larger than angle l.

l = _____ ° m = _____ °

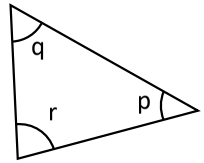
7)



Angle o is $\frac{1}{4}$ the size of angle n.

n = _____ ° o = _____ °

8)



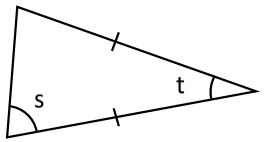
Angle q is $\frac{1}{3}$ larger than angle p.

Angle r is $\frac{1}{4}$ larger than angle q.

p = _____ ° q = _____ °

r = _____ °

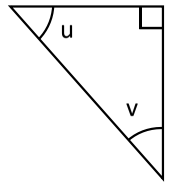
9)



Angle t is $\frac{2}{5}$ the size of angle s.

s = _____ ° t = _____ °

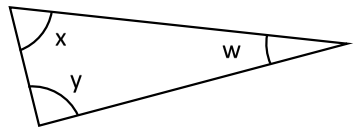
10)



Angle v is $\frac{7}{8}$ the size of angle u.

u = _____ ° v = _____ °

11)



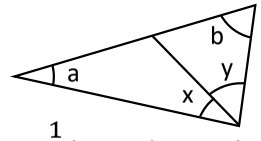
Angle w is $\frac{2}{5}$ the size of angle y.

Angle y is $\frac{2}{3}$ larger than angle x.

w = _____ ° x = _____ °

y = _____ °

12)



Angle x is $\frac{1}{2}$ larger than angle a.

Angle y is $\frac{1}{2}$ smaller than angle x.

Angle b is $2\frac{1}{3}$ larger than angle y.

a = _____ ° b = _____ °

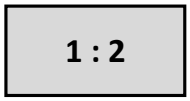
x = _____ ° y = _____ °

Purposeful Practice

Ratio & Shape 1

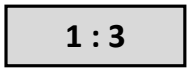
Each rectangle shows its ratio **width : length**
Use this information to find the missing value!

A)



Perimeter = 24 cm
Area =

B)

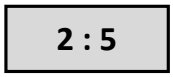


Perimeter = 24 cm
Area =

C)

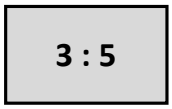
Perimeter = 50 cm
Area =

D)



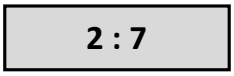
Perimeter = 56 cm
Area =

E)



Perimeter = 32 cm
Area =

F)

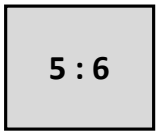


Perimeter = 9 cm
Area =

G)

Perimeter = 27 cm
Area =

H)



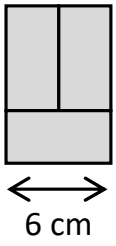
Perimeter = 44 cm
Area =

I)

Perimeter = 44 cm
Area =

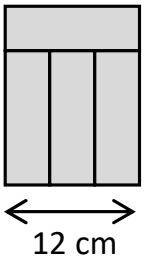
The compound shapes below are made from **congruent** rectangles.
Use the pattern to calculate the **width : length** ratio.
Use the ratio to calculate the missing values.

J)



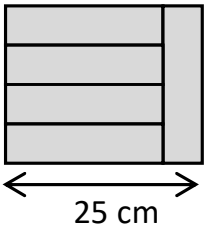
Total Perimeter =

K)



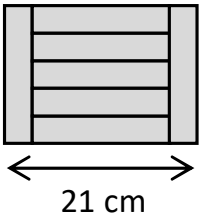
Total Area =

L)



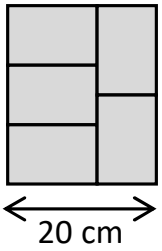
Total Area =

M)



Total Perimeter =

N)



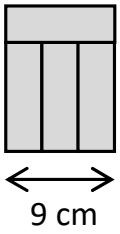
Total Perimeter =

Purposeful Practice

Ratio & Shape 2

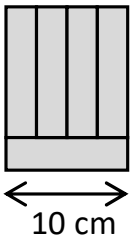
Calculate the **width : length** ratio for each small rectangle.
Use this fact to divide the given length.
Sketch the lengths of a small rectangle to help.

1)



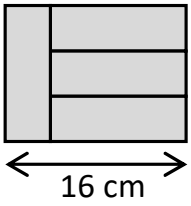
Compound shape perimeter =

2)



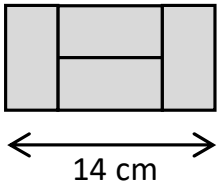
Compound shape perimeter =

3)



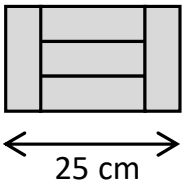
Compound shape perimeter =

4)



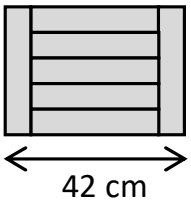
Compound shape perimeter =

5)



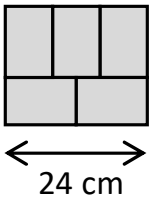
Compound shape perimeter =

6)



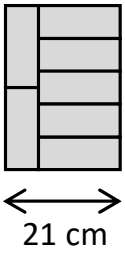
Compound shape perimeter =

7)



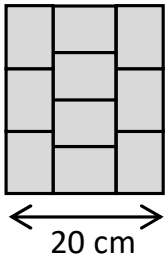
Compound shape perimeter =

8)



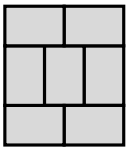
Compound shape perimeter =

9)



Compound shape perimeter =

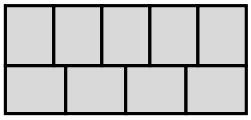
10)



Perimeter = 78 cm

Small rectangle area =

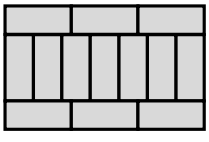
11)



Perimeter = 87 cm

Small rectangle area =

12)

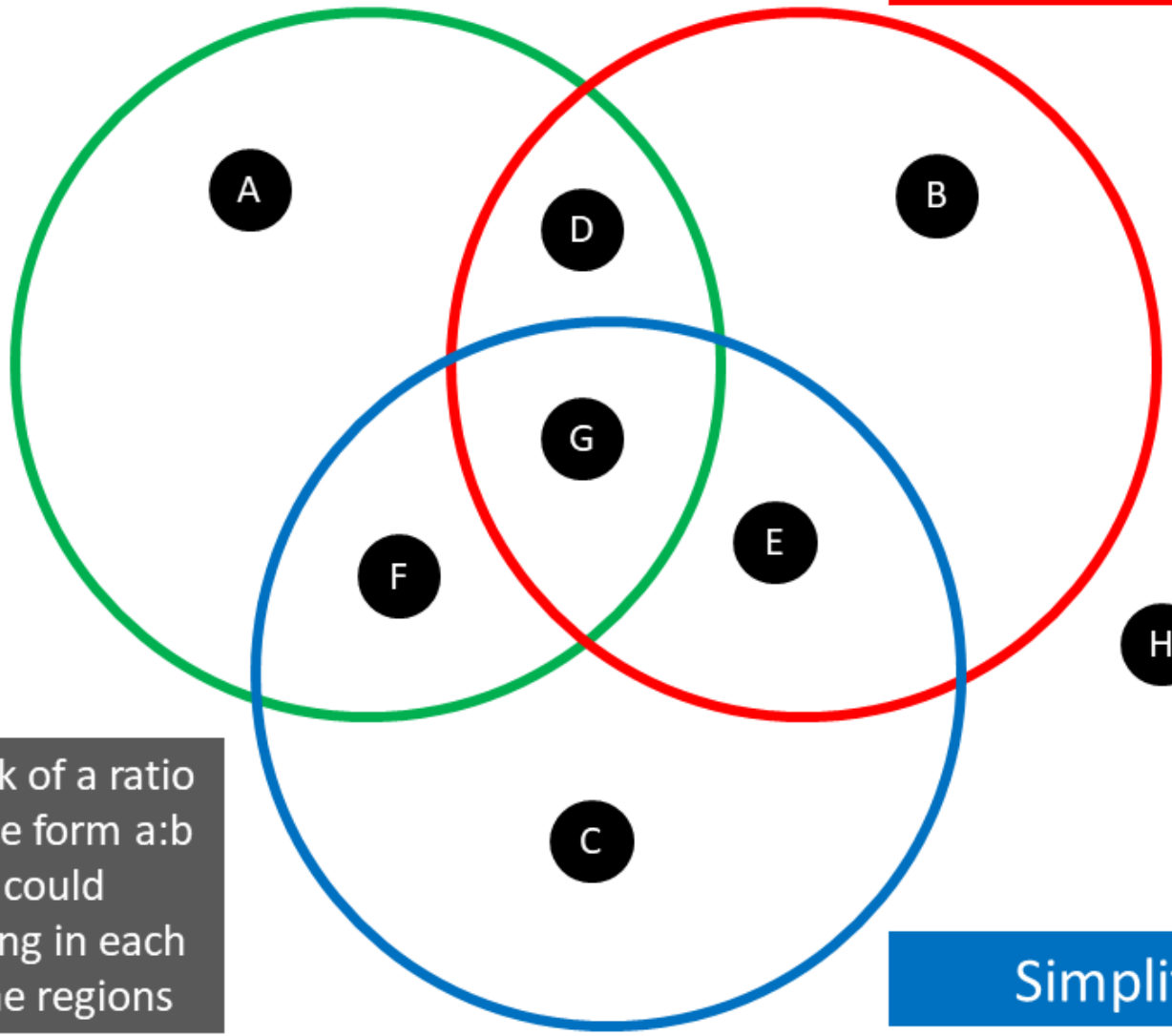


Perimeter = 34 cm

Small rectangle area =

a is 3

24 counters can be shared in this ratio



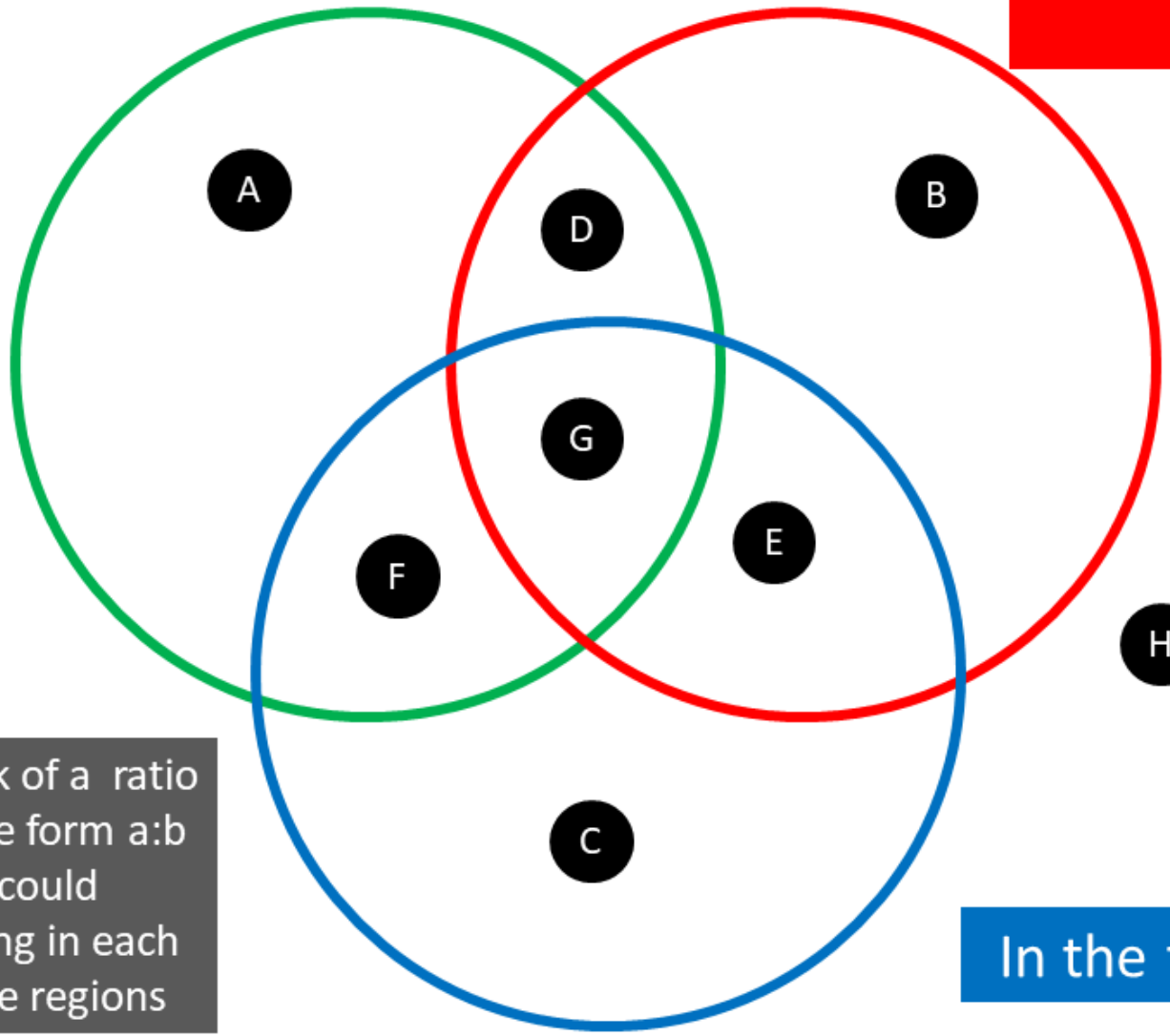
If you think a region is impossible to fill, convince me why!

Think of a ratio in the form a:b that could belong in each of the regions

Simplifies

Equivalent to $\frac{1}{2} : \frac{2}{5}$

18 counters can be shared in this ratio



If you think a region is impossible to fill, convince me why!

Think of a ratio in the form a:b that could belong in each of the regions

In the form 1 : n

Problem Solving

2 Algebra Recap

Fluency Practice

Simplify:

(a) $a + a + a$

(b) $d + d + d + d + d$

(c) $2x + 5x$

(d) $4b + b$

(e) $y + y + 4y$

(f) $m + 2m + 3m$

Simplify:

(a) $x + x + x - x$

(b) $y + y - y - y$

(c) $7a - 2a$

(d) $3b - 2b$

(e) $m + 3m - m$

(f) $5n - n - n$

Simplify:

(a) $x^2 + x^2 + x^2 + x^2$

(b) $xy + xy + xy$

(c) $ab + ab + ab - ab$

(d) $3y^2 + 5y^2$

(e) $12cd - 5cd$

(f) $4x + 4x^2$

Simplify:

(a) $4b + 5b - 2b$

(b) $2x - 5x$

(c) $x^2 + 6x^2 + 2x^2 - 3x^2$

(d) $ab + 3ab - 4ab$

(e) $5y^2 - 2y^2 + 3y^2$

(f) $-a + 5a - 2a$

(g) $abc + bac + cba$

(h) $2a^2 + 3a^2 - 4a^2$

Purposeful Practice

Simplify:

(a) $x + x + y + y$

(b) $a + a + b + a + b$

(c) $2a + 3a + 4b + 2b$

(d) $4x + x + y + 9y$

(e) $6a + 3b + 2a + b$

(f) $a + 2b + 4a + b + 5a$

Simplify:

(a) $a + a + a - a + b + b$

(b) $5x - 2x + 3y + 4y$

(c) $4c + 7c + 6d - 3d$

(d) $8x - 6x + 3y - 2y$

(e) $7a + 2b - 5a + 6b$

(f) $10x + 8y - 3x - 5y$

Simplify

(a) $5p - 3q + 2 - 4p + 5 + 4q$

(b) $4x^2 + 5x - 3x^2 - 2x$

(c) $x^2 + y^3 - 2x^2 + 4y^3$

(d) $x^2y + xy + x^2y$

(a) A rectangle has a width x cm and a length $x + 5$ cm. Write down a simplified expression for its perimeter.

(b) A square has sides of length $2x - 3$ cm. Write down a simplified expression for its perimeter.

A triangle has sides of lengths $ab + 3$, $2ab - 7$ and $4ab + a$ cm. Write a simplified expression for the perimeter of the triangle.

Purposeful Practice

Simplify:

(a) $5 \times a$

(b) $8 \times x$

(c) $-2 \times b$

(d) $6 \times ab$

(e) $3 \times y^2$

(f) $2 \times 3b$

(g) $3 \times 5x$

(h) $-5 \times 3y$

(i) $6 \times 4ab$

(j) $7 \times 4x^2$

Simplify:

(a) $\frac{18a}{6}$

(b) $\frac{16b}{4}$

(c) $\frac{24x}{12}$

(d) $\frac{6y}{2}$

(e) $\frac{15ab}{3}$

(f) $\frac{-8a}{4}$

(g) $\frac{25x^2}{5}$

(h) $\frac{7.5xy}{2.5}$

Simplify:

(a) $6a \times b \times 2c$

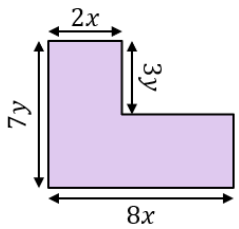
(b) $-3x \times 4 \times 2y$

(c) $-4d \times -7e \times f$

(d) $2.5u \times -2v \times 6w$

(a) A rectangle has a length of $2x$ cm and a width of $5y$ cm. Find a simplified expression for the area of the rectangle.

(b) Find a simplified expression for the area of this compound shape.



Simplifying Expressions					
Simplify $4x + 2x - x$	Simplify $2 \times d$	Simplify $\frac{10a}{5}$	Simplify $a \times 2b$	Simplify $2k - 5k$	Simplify $(xy)^2$
Simplify $\frac{30a^3}{6a}$	Simplify $3x + y - 2x + 4y$	Simplify $4c \times 2d$	Simplify $a \times a \times a$	Simplify $(2a)^3$	Simplify $9x + 7y - 2x - 8y$
Simplify $\frac{40x^5y^2}{5x^2y}$	Simplify $a^2 \times a^3$	Simplify $7a + 5b - 2a - 2b$	Simplify $4x^2y \times 3x^2$	Simplify $3x + x^2 + 4x - x^2$	Simplify $2x \times x^2$
Simplify $7 + x - 3 + 4x$	Simplify $(3b^2)^3$	Simplify $3x^2 \times 4x$	Simplify $6x^2 - 8x^2 + 3x^2$	Simplify $(2xy)^4$	Simplify $5 \times d \times d \times d$
Simplify $5ab \times 3a^4b$	Simplify $2a + 6b - a - b$	Simplify $(2ab^2)^3$	Simplify $3a \times 7b$	Simplify $\frac{8a^2}{16ab}$	Simplify $3a^3b \times 5bc \times 2ac^2$

Fluency Practice

Given that $a = 5$, find the values of:

(a) $a + 6$ (b) $a - 3$

(c) $3a$ (d) $5a - 2$

(e) $\frac{a}{5}$ (f) a^2

(g) $3a - 1$ (h) $a^2 + 10$

(i) $10 - a$ (j) $50 - a^2$

Given that $b = -3$, find the values of:

(a) $b + 8$ (b) $b - 1$

(c) $4b$ (d) $4b - 3$

(e) $\frac{b}{3}$ (f) b^2

(g) $2b + 2$ (h) $b^2 + 1$

(i) $10 - b$ (j) $20 - b^2$

Given that $a = 10, b = 2$ and $c = 7$, find the value of:

(a) $a + b$ (b) $c - b$

(c) $2c + b$ (d) $a + b - c$

(e) $5 + 3b$ (f) $100 - 4a$

(g) $a + b^2$ (h) $a^2 + 2b$

(i) $\frac{a^2}{20}$ (j) $\frac{a+b}{3}$

Given that $a = 8, b = -3$ and $c = 4$, create an expression that will give a value of:

(a) 20 (b) 18

(c) 25 (d) 16

(e) 28 (f) -4

Fluency Practice

Using the formula $A = L \times W$, find the value of A when:

(a) $L = 10$ and $W = 6$

(b) $L = 2.5$ and $W = 8$

(c) $L = 3.5$ and $W = 4$

Using the formula $s = \frac{d}{t}$, find the value of s when:

(a) $d = 10$ and $t = 2$

(b) $d = 450$ and $t = 9$

(c) $d = 20$ and $t = 2.5$

Using the formula $A = \frac{b \times h}{2}$, find the value of A when:

(a) $b = 10$ and $h = 12$

(b) $b = 5$ and $h = 7$

(c) $b = 2.5$ and $h = 10$

Using the formula $V = L \times W \times H$, find the value of V when:

(a) $L = 10, W = 5$ and $H = 2$

(b) $L = 8, W = 6$ and $H = 4$

(c) $L = 3, W = 4$ and $H = 2.5$

Using the formula $F = m \times a$, find the value of V when:

(a) $m = 4$ and $a = -6$

(b) $m = 7.5$, and $a = -10$

Using the formula $E = \frac{m \times v^2}{2}$, find the value of E when:

(a) $m = 5$ and $v = 2$

(b) $m = 20$, and $v = 4$

Substitution into Expressions and Formulae			
In this column: $a = 3, b = 7$ and $c = 2$	In this column: $d = 4, e = -2$ and $f = 9$	In this column: $u = 5, a = -10, t = 2.5$	In this column: $h = 6, w = 3.5$ and $l = 20$
Find $a^2 + b - c$	Find $2d^2 - f$	Find $u^2 - at$	Find A, where $A = l \times w$
Find $ab + 2c$	Find $d(f - e)$	Find $\frac{\sqrt{2a^2 + u^2}}{t}$	Find P, where $P = 2l + 2w$
Find $\frac{ab + bc}{c}$	Find $e^2 + df$	Find v, where $v = u + at$	Find V, where $V = l \times w \times h$
Find $\frac{-b + \sqrt{b^2 - 4ac}}{2a}$	Find $de - \frac{f}{e}$	Find s, where $s = ut + \frac{1}{2}at^2$	Find V, where $V = \frac{1}{3}w^2h$

3 Index Laws

Fluency Practice

Task 1

Rewrite the following with a single exponent in your jotter:

1. $3^4 \times 3^2$
2. 4×4^3
3. $10^3 \times 10^2$
4. $5^3 \times 5^4$
5. $3^5 \times 3^5$
6. $7^4 \times 7^{-2}$
7. $2^7 \times 2^{-3}$
8. $10^{10} \times 10^{-9}$
9. $5^9 \times 5^{-1}$
10. $3^{-4} \times 3^9$
11. $\left(\frac{2}{3}\right)^2 \times \left(\frac{2}{3}\right)^4$
12. $\left(-\frac{1}{2}\right)^2 \times \left(-\frac{1}{2}\right)^3$
13. $\left(\frac{3}{4}\right)^5 \times \left(\frac{3}{4}\right)^{-2}$
14. $\left(\frac{1}{7}\right)^{-7} \times \left(\frac{1}{7}\right)^{20}$
15. $2^{\frac{1}{3}} \times 2^{\frac{2}{3}}$
16. $15^{\frac{4}{3}} \times 15^{\frac{2}{3}}$
17. $10^{\frac{7}{4}} \times 10^{\frac{5}{4}}$
18. $3^{0.4} \times 3^{0.2}$
19. $5^{1.2} \times 5^{0.8}$
20. $5^{1.2} \times 5^{-0.8}$

Task 2

True or False? How do you know? Is there another way you can tell?

1. $2^3 \times 3^2 = 6^5$
2. $3^3 \times 3^3 = 3^6$
3. $2^3 \times 3^2 = 6^6$
4. $2^2 \times 3^2 = 6^2$
5. $2^3 \times 2^2 = 4^5$
6. $2^6 \times 2^3 = 4^9$
7. $6^3 \times 6^4 = 6^{12}$

Task 3

Investigate $2^3 \times 5^3$. Do you notice anything?

Can you generalise?

Rewrite the following and evaluate:

1. $2^3 \times 4^3$
2. $5^2 \times 2^2$
3. $14^2 \times \left(\frac{1}{2}\right)^2$
4. $(-5)^3 \times 2^3$
5. $2^2 \times 3^2 \times 5^3 \times 2^3$

Fluency Practice

Task 2

Simplify the following in your jotter:

1.	$a^2 \times a^4$	2.	$x \times x^3$	3.	$x^2 \times x^6$	4.	$x^6 \times x^{-2}$
5.	$a^{12} \times a^{10}$	6.	$f^{23} \times f^{-10}$	7.	$x^7 \times x^8$	8.	$y^{-6} \times y^7$
9.	$b^7 \times b^5 \times b^9$	10.	$x^2 \times x \times x^7$	11.	$x^4 \times x^5 \times x^6$	12.	$x^2 \times x^4 \times x^6 \times x^8$
13.	$a^2 \times a^4 \times a^{-1}$	14.	$a^3 \times a^{-2} \times a$	15.	$x^{-2} \times x^{-4} \times x^6 \times x^8$		

Task 3

Find as many pairs of values for m and n such that the statement below holds true:

$$c^m \times c^n = c^8$$

Task 4

Simplify the following in your jotter:

1.	$2a^2 \times a^3$	2.	$2a^4 \times 3a$	3.	$2x^6 \times 3x^4$
4.	$5x^4 \times 6x^2$	5.	$\frac{2}{3}x^3 \times 12x^4$	6.	$2a^7 \times 6a^2 \times \frac{1}{4}a$
7.	$4a^3 \times 3a^2 \times 5a$	8.	$-3b^5 \times 8b^4$	9.	$-3c^4 \times -4c^9$
10.	$2a^4 \times 3a^{-1}$	11.	$4a^5 \times 8a^{-3}$	12.	$4r^{-6} \times 5r^7$
13.	$5t^7 \times 2t^{-4} \times 3t$	14.	$3s^2 \times 4s^4 \times -2s^6$	15.	$\frac{2}{3}x^4 \times -12x^3 \times \frac{1}{4}x^{-4}$

Task 5

If $x^2 \times x^y \times x^{-3} = x^{-4} \times x^2 \times x^{2y}$ then:

A $y = 0$ **B** $y = -1$ **C** $y = 1$ **D** $y = \frac{1}{2}$

Intelligent Practice

Simplify

1) $5^5 \times 5^3$

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

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

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

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

6) 4×4^5

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

8) $4^3 \times 4^{-5}$

9) $4^{-3} \times 4^5$

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

Simplify

11) $3^{-3} \times 3^{-5}$

12) $3^3 \times 3^5$

13) $(-3)^3 \times (-3)^5$

14) $3^{0.3} \times 3^{0.5}$

15) $3^{\frac{1}{3}} \times 3^{\frac{1}{5}}$

16) $3^a \times 3^a$

17) $3^a \times 3^b$

18) $a^3 \times b^3$

19) $a^3 \times a^3$

20) $\left(\frac{1}{a}\right)^3 \times \left(\frac{1}{a}\right)^3$

Fluency Practice

Task 1

Rewrite the following using a single exponent in your jotter:

1. $\frac{5^4}{5^2}$
2. $2^5 \div 2^3$
3. $7^4 \div 7^3$
4. $\frac{5^{12}}{5}$
5. $\frac{0.3^7}{0.3^3}$
6. $16^2 \div 16^{-1}$
7. $\frac{13^4}{13^{-2}}$
8. $0.2^8 \div 0.2^{-6}$
9. $9^{-4} \div 9^{-6}$
10. $\frac{6^{-3}}{6^{-12}}$
11. $(\frac{1}{2})^{18} \div (\frac{1}{2})^{13}$
12. $(-\frac{1}{3})^{14} \div (-\frac{1}{3})^{10}$
13. $(\frac{3}{5})^9 \div (\frac{3}{5})^{-3}$
14. $(-\frac{7}{8})^{-2} \div (-\frac{7}{8})^{-7}$
15. $8^{\frac{4}{3}} \div 8^{\frac{1}{3}}$
16. $\frac{19^{\frac{9}{4}}}{19^{\frac{5}{4}}}$
17. $\frac{25^{\frac{9}{4}}}{25^{-\frac{3}{4}}}$
18. $4^{3.1} \div 4^{2.9}$
19. $\frac{15^{1.4}}{15^{-0.6}}$
20. $12^{-0.2} \div 12^{-0.9}$

Task 2

Simplify each quotient and then evaluate the result:

1. $\frac{10^6}{10^2}$
2. $\frac{4^{17}}{4^{14}}$
3. $\frac{9^{210}}{9^{207}}$
4. $\frac{2^{y+1}}{2^y}$
5. $\frac{8^{r+4}}{8^{r+1}}$

Task 3

Spot the mistake(s)

$7^{15} \div 7^5 = 7^3$

Task 4

True or False?

How do you know?

Is there another way you can tell?

1. $10^{-6} \div 10^{-8} = 10^{-14}$
2. $5^3 \div 2^3 = 3^3$

Task 5

Given that $p = 5^m$ and $q = 5^n$, write the following as a single power of 5:

$$\frac{p}{q}$$

Task 6

A formula is given as $H = \frac{2^a}{4}$.

a) Calculate H when $a = 6$, can you express H as a power of 2?
b) Calculate a when $H = 8$.
c) Calculate the minimum value of H given $a \geq 0$.

Fluency Practice

Simplify

1. $\frac{x^6}{x}$
2. $\frac{x^{13}}{x^2}$
3. $c^{12} \div c^4$
4. $x^8 \div x^3$
5. $\frac{x^{10}}{x^3}$
6. $a^{12} \div a^2$
7. $a^{12} \div a^{-2}$
8. $\frac{t^{20}}{t^3}$
9. $\frac{t^{20}}{t^{-3}}$
10. $\frac{t^2}{t^{-5}}$
11. $\frac{t^{-2}}{t^{-5}}$
12. $b^{10} \div b^{-6}$

Simplify

1. $6x^5 \div 3x^2$
2. $3x^5 \div 6x^2$
3. $6x^5 \div 3x^{-2}$
4. $3x^5 \div 6x^{-2}$
5. $\frac{20x^6}{4x^5}$
6. $\frac{4x^6}{20x^5}$
7. $\frac{36x^7}{3x^4}$
8. $\frac{3x^7}{36x^4}$
9. $\frac{36x^7}{3x^{-4}}$
10. $\frac{3x^7}{36x^{-4}}$
11. $\frac{1.3x^7}{1.3x^4}$
12. $\frac{3}{4}x^5 \div \frac{3}{4}x^{-2}$
13. $5.5x^{-1} \div 1.1x^{-5}$
14. $\frac{1.1x^{-1}}{5.5x^{-5}}$
15. $\frac{2}{3}b^{13} \div \frac{1}{3}b^3$

Intelligent Practice

Simplify

1) $6^6 \div 6^3$

2) $6^6 \div 6^2$

3) $6^6 \div 5^2$

4) $5^6 \div 5^2$

5) $5^2 \div 5^6$

6) $5^{-2} \div 5^6$

7) $5^2 \div 5^{-6}$

8) $5^{-2} \div 5^{-6}$

9) $5^{-6} \div 5^{-2}$

10) $(-5)^6 \div (-5)^2$

Simplify

11) $(-4)^6 \div (-5)^2$

12) $(4)^6 \div (5)^2$

13) $(4)^6 \div (4)^2$

14) $\frac{4^6}{4^2}$

15) $\frac{4^{0.6}}{4^{0.2}}$

16) $\frac{4^{\frac{1}{6}}}{4^{\frac{1}{2}}}$

17) $\frac{4^6}{4^6}$

18) $\frac{4^m}{4^m}$

19) $\frac{4^m}{4^p}$

20) $\frac{m^4}{p^4}$

21) $\frac{m^4}{m^6}$

Intelligent Practice

Simplify:

1) 2^0

2) 3^0

3) 4^0

4) 5^0

5) 0^5

6) 0^4

7) 0^0

8) 6^0

9) $(-6)^0$

10) $-(6)^0$

11) $\left(\frac{1}{6}\right)^0$

12) $(0.6)^0$

13) $(6p)^0$

14) $6p^0$

Fluency Practice

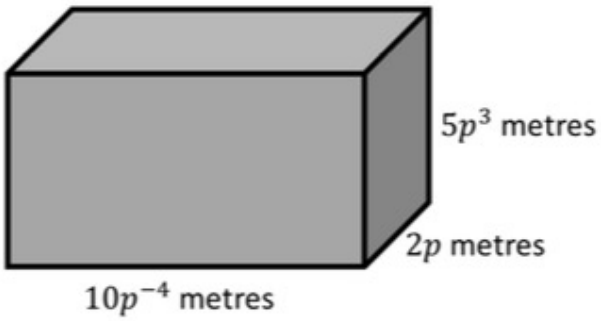
Task 1

1. If $2^3 \times 2^a = 2^0$, what is the value of a?
2. If $4^{-3} \times 4^a = 1$, what is the value of a?
3. If $x^f \times x^g = 1$ and $f < 0$ and $g > 0$, find possible values for f and g.

Task 2

A cuboid has dimensions as shown.

Show that the volume of the cuboid is 100 cubic metres.



Fluency Practice

Evaluate:

(a) x^0 (b) 5^0

(c) $(-3)^0$ (d) $\left(\frac{1}{2}\right)^0$

(e) $\left(\frac{x}{y}\right)^0$ (f) $(-y)^0$

(g) $\left(\sqrt{2}\right)^0$ (h) $(xy)^0$

Evaluate:

(a) $(5y)^0$ (b) $5y^0$

(c) $\frac{y^0}{5}$ (d) $\left(\frac{y}{5}\right)^0$

(e) $5^0 \times y^0$ (f) $\left(\frac{5}{y}\right)^0$

(g) $\frac{5}{y^0}$ (h) $\frac{5^0}{y^0}$

Simplify:

(a) $(2xy^2)^0$ (b) $2^0 \times x^0 \times (y^2)^0$

(c) $2x^0y^2$ (d) $(2x)^0 \times (y^2)^0$

(e) $2x^0(y^2)^0$ (f) $\left(\frac{2x}{y^2}\right)^0$

(g) $\frac{2x^0}{y^2}$ (h) $\frac{(2x)^0}{y^2}$

Solve:

(a) $7^x = 1$ (b) $2^x = 11^0$

(c) $5^x = \frac{1}{8^0}$ (d) $1 = \left(\frac{1}{4}\right)^x$

(e) $3^4 \times 3^x = 1$

(f) $\frac{10^{2/5} \times 10^x}{10^{1/2}} = 1$

Task 1

Simplify the following:

1. $\frac{x^3 \times x^4}{x}$
2. $\frac{x^2 \times x^6}{x^3}$
3. $\frac{x^7}{x^4} \times x$
4. $\frac{a^{-2} \times a^4}{a}$
5. $\frac{3s^2 \times 2s^4}{s^3}$
6. $\frac{5t^4 \times 4t^3}{2t^2}$
7. $\frac{8s^9 \times 4s^0}{2s^4 \times 3s^{-3}}$
8. $\frac{2a^8}{8a^3 \times 3a^4}$
9. $\frac{15x^{-4}}{3x^{-3} \times 2x^{-1}}$
10. $\frac{16s^6 \times 2s^5}{4s^{15} \times 3s^{-4}}$
11. $\frac{4a^{\frac{1}{2}} \times 5a^{\frac{7}{2}}}{10a^0}$
12. $\frac{6s^{\frac{2}{3}} \times 3s^{\frac{4}{3}}}{3s^{-2} \times 3s^4}$

Task 2

Fill in the missing exponents:

$$a^5b \times b^6c \times \frac{ac^7}{b^9} = a^{\square}b^{\square}c^{\square}$$

Task 3

A particle travels $3ab^2$ metres in $12a^2c$ seconds.

Calculate the particles average speed in metres per second.

Fluency Practice

Task 1

Rewrite each expression with a single exponent:

1. $(3^2)^3$
2. $(2^2)^4$
3. $(7^3)^4$
4. $\left(\left(\frac{1}{3}\right)^2\right)^3$
5. $(0.5^6)^3$
6. $(4^9)^2$
7. $(1^9)^9$
8. $(10^6)^3$
9. $(7^3)^4$
10. $\left(\left(\frac{9}{7}\right)^1\right)^2$
11. $(0.9^3)^6$
12. $\left(\left(\frac{2}{5}\right)^3\right)^2$

Task 2

Match the expressions which are equivalent.

Complete the blanks to create 6 matching pairs.

$2^3 \times 2^4$
$2^{15} \div 2^3$
$4^6 \times 4$
$(4^2)^{10}$
4×4^{11}

2^{12}
4^7
4^{12}
48
2^7

Task 3

Look at the statement below:

$$(3^{\square})^2 = 3^5 \times \square^3 = 3^{\square} \div 3^4$$

Three numbers are missing. Write numbers in the boxes to make the statement correct.

Task 4

$$((-4^{-3})^{-2})^{-1}$$

What does this number mean?

Which order of 1, 2, 3 and 4 makes the highest value?

What about the lowest?

Task 5

Given that $q = 5^n$, write q^2 as a single power of 5.

Task 1

Simplify:

1. $(b^5)^3$	2.	$-(b^5)^3$	3.	$(-b^5)^3$	4.	$(k^2)^9$	5.	$-(k^2)^9$
6. $(-k^2)^9$	7.	$(p^7)^{10}$	8.	$-(p^7)^{10}$	9.	$(-p^7)^{10}$	10.	$(h^3)^6$
11. $-(h^3)^6$	12.	$(-h^3)^6$	13.	$(x^2)^5$	14.	$-(x^2)^5$	15.	$(-x^2)^5$
16. $(j^{-4})^{-7}$	17.	$-(j^{-4})^{-7}$	18.	$(-j^{-4})^{-7}$	19.	$(m^{-6})^{-2}$	20.	$-(m^{-6})^{-2}$
21. $(-m^{-6})^{-2}$	22.	$(g^{-9})^{-4}$	23.	$-(g^{-9})^{-4}$	24.	$(-g^{-9})^{-4}$	25.	$(a^{-10})^{-10}$
26. $-(a^{-10})^{-10}$	27.	$(-a^{-10})^{-10}$	28.	$(c^{-15})^{-3}$	29.	$-(c^{-15})^{-3}$	30.	$(-c^{-15})^{-3}$
31. $(f^{-4})^{-9}$	32.	$-(f^{-4})^{-9}$	33.	$(-f^{-4})^{-9}$				

Intelligent Practice

Simplify

1) $(6^2)^5$

2) $(6^3)^5$

3) $(6^4)^5$

4) $(2^4)^5$

5) $(2^5)^4$

6) $(2^5)^0$

7) $(2^5)^{-1}$

8) $(2^{-5})^{-1}$

9) $(3^{-5})^{-1}$

Simplify

10) $\left(3^{\frac{1}{2}}\right)^{-1}$

11) $\left(3^{\frac{1}{2}}\right)^{\frac{1}{2}}$

12) $\left(x^{\frac{1}{2}}\right)^2$

13) $(x^2)^2$

14) $(x^2)^7$

15) $(2^7)^x$

16) $(7^x)^2$

17) $(x^2)^5$

18) $(x^2)^a$

Fluency Practice

Task 1

Simplify:

1. $(2x^3)^2$
2. $(2x^{-3})^2$
3. $(2x^3)^{-2}$
4. $(2x^{-3})^{-2}$
5. $(-2x^3)^2$
6. $(-2x^{-3})^2$
7. $(-2x^3)^{-2}$
8. $(-2x^{-3})^{-2}$
9. $(5b^6)^2$
10. $(5b^{-6})^2$
11. $(5b^6)^{-2}$
12. $(5b^{-6})^{-2}$
13. $(-5b^6)^2$
14. $(-5b^{-6})^2$
15. $(-5b^6)^{-2}$
16. $(-5b^{-6})^{-2}$
17. $(10c^9)^3$
18. $(10c^{-9})^3$
19. $(10c^9)^{-3}$
20. $(10c^{-9})^{-3}$
21. $(-10c^9)^3$
22. $(-10c^{-9})^3$
23. $(-10c^9)^{-3}$
24. $(-10c^{-9})^{-3}$
25. $(5f^6)^2$
26. $(5f^{-6})^2$
27. $(5f^6)^{-2}$
28. $(5f^{-6})^{-2}$
29. $(-5f^6)^2$
30. $(-5f^{-6})^2$
31. $(-5f^6)^{-2}$
32. $(-5f^{-6})^{-2}$
33. $(10k^9)^3$
34. $(10k^{-9})^3$
35. $(10k^9)^{-3}$
36. $(10k^{-9})^{-3}$
37. $(-10k^9)^3$
38. $(-10k^{-9})^3$
39. $(-10k^9)^{-3}$
40. $(-10k^{-9})^{-3}$
41. $(-15h^9k^7)^3$
42. $(3y^6)^2(x^5y^2z)$
43. $(4h^3)^2(-2g^3h)^3$
44. $(14a^4b^6)^2(a^6c^3)^7$

Task 2

Simplify:

1. $(y^4d^6)^8$
2. $(-c^5h^6)^4$
3. $(u^4v^3)^2$
4. $(x^2y^2)^2$
5. $(a^6c^3)^7$
6. $(xy)^2(x^2y^2)^2$
7. $(k^9)^5(k^3)^2$
8. $(3x^2y^3)^2$
9. $(2k)^3(4k^3)^3$
10. $(2y^2c^{-3})^4$
11. $(5dc^5)^3$
12. $(4r^3)^2(r^2)^5$
13. $(2r^{-3})^2(4r)^{-3}(r^3)^4$
14. $(2h^3)^{-3}(3h)^3$
15. $(3z^2)^{-2}(4z^{-2})^{-3}$

Task 3

Simplify:

1. $\left(\frac{x}{y}\right)^6$
2. $\left(\frac{5c}{d^2}\right)^2$
3. $\left(\frac{4d^3}{c^5}\right)^3$
4. $\left(\frac{3w}{g^6}\right)^4$
5. $\left(\frac{-4s^6}{t^3r^5}\right)^3$
6. $\left(\frac{-2d^{11}f^6}{c^{18}}\right)^2$
7. $\left(\frac{2d^4}{4e}\right)^3$
8. $\left(\frac{7y^2}{2x^2}\right)^2$
9. $\left(\frac{2x^{-8}}{3y^{11}}\right)^{-2}$
10. $\left(\frac{4c^{-5}}{8d^0}\right)^3$
11. $\left(\frac{5x^{13}y^5z^2}{3\times5^2}\right)^0$
12. $\left(\frac{3x^2}{2y^2}\right)^5$
13. $\left(\frac{3x}{4x^2}\right)^2$
14. $\left(\frac{bw}{8b^2w^4}\right)^3$
15. $\left(\frac{4n^4b^2}{7n^3b^5}\right)^2$
16. $\left(\frac{6wy^6}{4w^4y^5}\right)^3$
17. $\left(\frac{9x^2}{2u^2}\right)^2$
18. $\left(\frac{6y^2c^3}{8yc^4}\right)^2$
19. $\left(-\frac{3h^3}{5g^5}\right)^3$
20. $\left(\frac{7n^2}{5n^6w^5}\right)^2$

Task 4

Fill in the blanks as many ways as you can: $(\square^{\square})^{\square} = 16y^{12}$

Task 5

Solve for y:

$$(x^3)^y = \frac{(x^y)^y}{x^2}$$

Task 6

1. **The statement** $\left(x^a\right)^b = \left(x^b\right)^a$ **is:**

A Always True

B Sometimes True

C Never True

2. **The statement** $x = \left(x^{-1}\right)^{-1}$ **is:**

A Always True

B Sometimes True

C Never True

3. **If** $\left(x^{\frac{1}{2}}\right)^{\frac{1}{2}} = 2$ **then:**

A $x = 64$ **B** $x = 4$

C $x = 2$ **D** $x = 16$

4. **If** $\left(x^a\right)^b = x^a \div x^b$ **then:**

A $a = -b$ **B** $a = \frac{1-b}{b}$

C $a = \frac{b}{b-1}$ **D** $a = \frac{b}{1-b}$

Fluency Practice

Simplify

(a) $a \times a \times a \times a$

(b) $2 \times b \times b$

(c) $3c \times 4c$

(d) $5d \times d$

(e) $x^2 \times x$

(f) $7y \times 2y^2$

(g) $9a \times 2a^2$

(h) $4b \times 5b \times 2b$

(i) $6c^2 \times c \times 3c$

Simplify

(a) $\frac{a^2}{a}$

(b) $\frac{b^3}{b}$

(c) $\frac{9c^2}{3c}$

(d) $\frac{15d}{3d}$

(e) $\frac{4a^3}{8a^2}$

(f) $\frac{10ab}{5b}$

(g) $\frac{60ab}{10bc}$

(h) $\frac{21x^2y}{3xy}$

Simplify

(a) $a^5 \times a^3$

(b) $b^3 \times b^2$

(c) $3d^3 \times 4d^4$

(d) $6x \times 5x^4$

(e) $\frac{c^7}{c^3}$

(f) $\frac{y^9}{y^2}$

(g) $\frac{9a^6}{3a^2}$

(h) $\frac{27y^{12}}{9y^7}$

Simplify

(a) $(2a)^2$

(b) $(5b)^2$

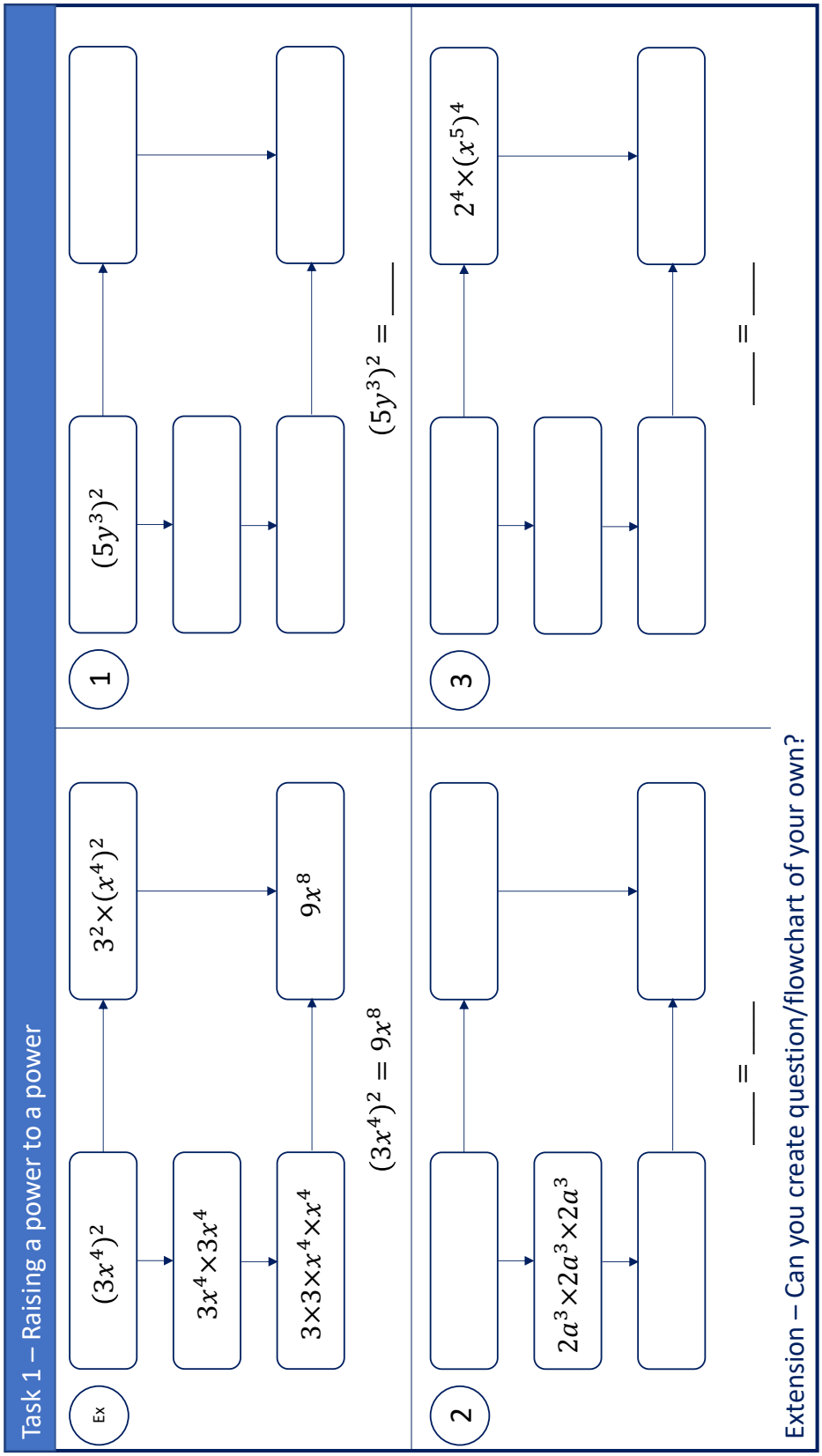
(c) $(xy)^2$

(d) $(3y)^3$

(e) $(2d)^3$

(f) $(4ab)^3$

A rectangle has length $4ab$ and width $6a^2$. Write a simplified expression for the area of the rectangle.


Task 1 – Raising a power to a power
Ex
$(3x^4)^2$
$3x^4 \times 3x^4$
$3 \times 3 \times x^4 \times x^4$
$3^2 \times (x^4)^2$
$9x^8$
$(3x^4)^2 = 9x^8$
1
$(5y^3)^2$
$(5y^3)^2 = ___$
2
$2a^3 \times 2a^3 \times 2a^3$
___ = ___
3
$2^4 \times (x^5)^4$
___ = ___
Extension – Can you create question/flowchart of your own?

Task 2 – Raising a power to a power

Ex

$(7x^3y)^2$ → $7^2\times(x^3)^2\times y^7$

$7x^3y\times7x^3y$

$7\times7\times x^3\times x^3\times y\times y$ → $49x^6y^2$

$(7x^3y)^2 = 49x^6y^2$

4

$(10a^2b^5)^2$ → ____

____

____ → ____

$(10a^2b^5)^2 =$ ____

5

____ → ____

$3pq^2\times3pq^2\times3pq^2$

____ → ____

____ = ____

6

____ → $2^5\times(x^2)^5\times y^5$

____

____ → ____

____ = ____

Extension – Can you create question/flowchart of your own?

Intelligent Practice

Simplify:

1) $y^{13} \times y^4$

2) $6y^{13} \times 5y^4$

3) $y^{13} \div y^4$

4) $40y^{13} \div 8y^4$

5) $(y^{13})^4$

6) $(3y^{13})^4$

7) $7y^4 \div y^2$

8) $7y^4 \times y^2$

9) $(7y^4)^2$

10) $2x^7 \times 5x^4$

11) $12y^5 \times 5x^4$

12) $12y^5 \div 6y^4$

13) $12y^5 \div 12y^{-4}$

14) $(12y^5)^2$

15) $(12y^{-3})^2$

16) $12y^{-3} \div 4y^2$

17) $12y^{-3} \div 4y^{-2}$

18) $12y^{-3} \times 4y^{-2}$

Intelligent Practice

Simplify:

1) $\frac{a^3 \times a^5}{a^6}$

2) $\frac{a^6}{a^3 \times a^5}$

3) $\frac{x^6}{a^3 \times a^5}$

4) $\frac{12x^6}{2a^3 \times 3a^5}$

5) $\frac{12x^6}{2x^3 \times 3x^5}$

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

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

8) $12x^6y^2 \times 3x^5y^2$

9) $12x^6y^2 \div 3x^5y^2$

10) $\frac{12x^6y^2}{3x^5y^2}$

11) $\frac{12x^6y^8}{3x^5y^2}$

Fluency Practice

Q	Simplify:	Answers
1	$x^5 \times x^3$	
2	$\frac{x^5}{x^3}$	
3	$(x^5)^3$	
4	$x^7 \times x^2$	
5	$\frac{x^7}{x^2}$	
6	$(x^7)^2$	
7	$y^4 \times y^4$	
8	$\frac{y^4}{y^4}$	
9	$(y^4)^4$	
10	$a^b \times a^c$	
11	$\frac{a^b}{a^c}$	
12	$(a^b)^c$	

Q	Simplify:	Answers
13	$2x^3 \times 4x^5$	
14	$\frac{2x^3}{4x^5}$	
15	$(2x^3)^5$	
16	$3x^2 \times 5x^4$	
17	$\frac{3x^2}{5x^4}$	
18	$(3x^2)^4$	
19	$5x^{-2} \times -2x^3$	
20	$\frac{5x^{-2}}{-2x^3}$	
21	$(5x^{-2})^3$	
22	$ax^b \times cx^d$	
23	$\frac{ax^b}{cx^d}$	
24	$(ax^b)^c$	

Fluency Practice

Question 1: Write as a single power of m.

(a) $m^2 \times m^3$ (b) $m^3 \times m^3$ (c) $m^6 \times m^2$ (d) $m^7 \times m^3$ (e) $m^6 \times m^8$ (f) $m^2 \times m$ (g) $m \times m^3$

(h) $m^7 \times m^8$ (i) $m^9 \times m^2$ (j) $m \times m^8$ (k) $m^6 \times m^5$ (l) $m^2 \times m^2 \times m^2 \times m^2$

Question 2: Write as a single power of n.

(a) $n^5 \div n^2$ (b) $n^8 \div n^3$ (c) $n^9 \div n^2$ (d) $n^7 \div n^5$ (e) $n^3 \div n$ (f) $n^8 \div n$ (g) $n^7 \div n^4$

(h) $n^9 \div n^3$ (i) $n^4 \div n^8$ (j) $n \div n^3$ (k) $n^{45} \div n^5$ (l) $n^3 \div n^3$

Question 3: Write as a single power of a.

(a) $\frac{a^5}{a^2}$ (b) $\frac{a^9}{a^3}$ (c) $\frac{a^{10}}{a^2}$ (d) $\frac{a^7}{a}$

(e) $\frac{a^{14}}{a^7}$ (f) $\frac{a^4}{a^4}$ (g) $\frac{a^3}{a^4}$ (h) $\frac{a^5}{a^9}$

Question 4: Write as a single power of y.

(a) $(y^5)^2$ (b) $(y^3)^2$ (c) $(y^4)^3$ (d) $(y^5)^4$ (e) $(y^3)^6$ (f) $(y^7)^3$ (g) $(y^6)^6$

(h) $(y^9)^2$ (i) $(y^4)^8$ (j) $(y^3)^{-5}$ (k) $(y^{-5})^2$

Question 5: Write as a single power of y.

(a) $y^7 \times y^3$ (b) $y^9 \div y^7$ (c) $y^6 \div y^2$ (d) $(y^3)^5$ (e) $y^7 \div y$ (f) $y^3 \div y^7$ (g) $(y^9)^5$

(h) $y^6 \times y^7$ (i) $y^6 \times y^5 \times y^2$ (j) $y^8 \times y \times y^3$ (k) $\frac{y^8}{y^5}$

Fluency Practice

Question 6: Write as a single power of x.

(a) $(2x^3)^2$ (b) $(5x^6)^2$ (c) $(5x^5)^3$ (d) $(2x^3)^4$ (e) $(7x^5)^2$ (f) $(4x^7)^3$ (g) $(2x^6)^6$

(h) $(10x^9)^3$ (i) $(3x^4)^4$

Fluency Practice

Simplify:

(a) $4^5 \times 4^2$ (b) $4^5 \times 4^3$

(c) $4^3 \times 4^5$ (d) 4×4^5

(e) $4^5 \times 4^{-2}$ (f) $4^0 \times 4^3$

(g) $4^{2.5} \times 4^{0.5}$ (h) $4^5 \times 5^2$

(i) $5^{-3} \times 5^2$ (j) $5^{-5} \times 5^{-3}$

Simplify:

(a) $4^5 \div 4^2$ (b) $4^5 \div 4^3$

(c) $4^2 \div 4^5$ (d) $4^5 \div 4$

(e) $4^2 \div 4^0$ (f) $4^5 \div 4^{-2}$

(g) $4^5 \div 5^4$ (h) $5^{2.5} \div 5^{0.5}$

(i) $\frac{5^7}{5^2}$ (j) $\frac{(-5)^7}{(-5)^2}$

Simplify:

(a) $(3^4)^5$ (b) $(3^5)^4$

(c) $(3^2)^5$ (d) $(3^{-2})^5$

(e) $(3^4)^1$ (f) $3^3 \times (3^4)^{0.5}$

Simplify:

(a) $\frac{2^3 \times 2^8}{2^5}$ (b) $\frac{2^{-3} \times 2^8}{2^1}$

Find x:

(a) $5^x \times 5^4 = 5^7$

(b) $\frac{3^x \times 3^{-2}}{3^4} = 3^{10}$

(c) $10^2 \times 10^x = 1000000$

Fluency Practice

Simplify:

(a) $b^5 \times b^3$ (b) $d^2 \times d^8$

(c) $y^6 \times y^4$ (d) $x^5 \times x$

(e) $a^0 \times a^7$ (f) $g^2 \times g^8$

(g) $h^{11} \times h^{-2}$ (h) $e^{1.5} \times e^{3.5}$

Simplify:

(a) $\frac{t^8}{t^3}$ (b) $w^{10} \div w^2$

(c) $\frac{a^{11}}{a^5}$ (d) $\frac{y^9}{y}$

(e) $x^2 \div x^7$ (f) $\frac{b^5}{b^{-2}}$

(g) $\frac{c^{4.5}}{c^{1.5}}$ (h) $p^{-4} \div p^0$

Simplify:

(a) $(w^3)^2$ (b) $(t^2)^5$

(c) $(a^6)^4$ (d) $(d^3)^0$

(e) $(x^4)^{-3}$ (f) $(e^{-2})^6$

(g) $(y^{0.5})^7$ (h) $(h^{-3})^{-5}$

Simplify:

(a) $d^5 \times d^4 \times d^2$ (b) $w^3 \times (w^5)^4$

(c) $\frac{b^9 \times b^2}{b^4}$ (d) $\frac{y^{10}}{y^3 \times y^4}$

(e) $\frac{(t^3)^5}{t^4}$ (f) $\frac{e^8 \times e^{-3}}{e^2}$

(g) $\frac{f^{-4} \times f^{12}}{f^3 \times f}$ (h) $a^3 \times a \times (a^{1.5})^{-2}$

(i) $\frac{c^5 \times c^{-8}}{c^0 \times c^{-3}}$ (j) $m^3 \times \frac{m^8 \times m^{-1}}{m^{-4}}$

1. Write as a single power...

a. $m^3 \times m^2$ b. $\left(c^2\right)^4$ c. $n^5 \div n^3$ d. $\left(6^3\right)^3$ e. $4^6 \times 4^2$ f. $q^6 \times q^8$

g. $\frac{b^{10}}{b^5}$ h. $\left(p^5\right)^{-2}$ i. $\left(d^{11}\right)^6$ j. $\frac{2^8}{2}$ k. $\left(f^{-3}\right)^{-2}$ l. $h^4 \times h^{-7}$

m. $e^{-2} \div e^4$ n. $y^5 \times y$ o. $\frac{z^{11}}{z^{-3}}$ p. $\left(i^{-7}\right)^{-3}$ q. $f^{-3} \times f^{-7}$ r. $\left(3^{-4}\right)^2$

2. Write as a single power...

a. $\frac{j^4 \times j^5}{j^2}$ b. $\frac{(73)^2}{76}$ c. $\frac{x^{11}}{x^{-3} \times x^8}$ d. $\frac{y^9 \times y^4}{y^{10}}$ e. $\frac{2^{-5} \times 2^{-2}}{2^3}$ f. $\frac{(k^{-4})^{-5}}{k^{11}}$

3. Find the value of...

a. p^0 b. c^0 c. $(9z)^0$ d. $x^3 \times x^{-3}$ e. $f^5 \times f^3 \times f^{-8}$ f. $r^6 \div r^6$

4. Write as a single power...

a. $2^{6a} \times 2^{3a}$ b. $\frac{8^m}{8^n}$ c. $5^{2x+2} \times 5^{4x+3}$ d. $(49)^3$ e. $6^{3y+7} \div 6^{y+2}$

5. Find the missing values

a. $5^3 \times 5^{\square} = 5^{10}$ b. $7^{\square} \div 7^4 = 7^2$ c. $\left(4^2\right)^{\square} = 4^{-24}$ d. $9^{\square} \times 9^3 = 9^{-8}$ e. $\frac{2^6}{2^{\square}} = 2^{-4}$

f. $\left(10^{\square}\right)^{-3} = 10^{12}$ g. $3^{2a} \times 3^{\square} = 3^{7a}$ h. $\frac{6^{7m+10}}{6^{\square}} = 6^{5m+4}$ i. $\left(4^{3d}\right)^{\square} = 4^{6d}$ j. $7^{4xy} \div 7^{\square} = 7$

Fluency Practice

Set 1

1. Evaluate:

a) 4 + 2 b) 4 – 2 c) 2 – 4 d) 4 x 2 e) 4 ÷ 2 f) 2 ÷ 4

2. Simplify:

a) $2x^2 \times 4x^4$ b) $4x^2 \div 2x^4$ c) $2x^2 \div 4x^4$

d) $4x^2 \times 2x^4$ e) $4x^2 \div 2x^4$ f) $2x^4 \div 4x^2$

Set 2

1. Evaluate:

a) 5 + 3 b) 5 – 3 c) 3 – 5 d) 5 x 3 e) 5 ÷ 3 f) 3 ÷ 5

2. Simplify:

a) $5x^5 \times 3x^3$ b) $5x^5 \div 3x^3$ c) $3x^3 \div 5x^5$

d) $3x^5 \times 5x^3$ e) $3x^5 \div 5x^3$ f) $5x^3 \div 3x^5$

Set 3

1. Evaluate:

a) 5 + (-3) b) 5 – (-3) c) (-3) – 5 d) 5 x (-3) e) 5 ÷ (-3) f) (-3) ÷ 5

2. Simplify:

a) $5x^5 \times (-3x^{-3})$ b) $5x^5 \div (-3x^{-3})$ c) $-3x^{-3} \div 5x^5$

d) $-3x^5 \times 5x^{-3}$ e) $-3x^5 \div 5x^{-3}$ f) $5x^{-3} \div (-3x^5)$

Fluency Practice

1. $(x^3)^4$
2. $(p^2)^7$
3. $(3p^3)^2$
4. $(6t^4)^2$
5. $(5v^5)^2$
6. $(10x^{50})^2$
7. $(abw)^2$
8. $(ab^2)^2$
9. $(c^3d)^2$
10. $(5f^4)^2$
11. $(2v^2w^3)^4$
12. $(3x)^3$
13. $2x^2 + (3x)^2$
14. $13b^3 + (2b)^3$
15. $41x^2 - (6x)^2$
16. $(2x)^3 \times (3x)^2$
17. $x \times (2x)^2 \times 5x^3$
18. $x^3 + (2x)^2 \times 5x$

Purposeful Practice

Simplify the 31 calculations below, crossing out the corresponding squares in the grid. When you have finished, the remaining squares will reveal a message.

y^6	C	y^{13}	Y	y^{100}	A	y^7	0	$3y^{12}$	R	y^{75}	B
$2y^4$	T	y^{20}	Y	1	A	y^{22}	U	y^{29}	H	y^{11}	S
y^{15}	I	y^4	E	y^{18}	A	y^9	P	y^{33}	T	y^{19}	U
y^{21}	R	y^{16}	Q	$2y^2$	C	y^{28}	E	y^5	X	y^{26}	I
y^{64}	N	y^3	R	y^{24}	K	y^2	Y	y^{32}	B	y^{23}	H
y	D	y^8	M	y^{17}	I	$2y^8$	A	y^{30}	G	y^{27}	G
y^{10}	H	y^{12}	J	$4y^3$	W	y^{14}	F	y^{36}	T	y^{31}	S

1. $y^3 \times y^2$
2. $y^5 \times y^6$
3. $y^7 \times y^2$
4. $y^3 \times y^{16}$
5. $(y^2)^2$
6. $(y^3)^5$
7. $(y^4)^5$
8. $(y^7)^2$
9. $(y^5)^{15}$
10. $y^8 \div y^2$
11. $y^{16} \div y^4$
12. $y^7 \div y^6$
13. $y^{16} \div y^8$
14. $y^{15} \times y^9$
15. $(y^{16})^2$
16. $y^8 \times y^9 \times y^{12}$
17. $y^0 \times y^0$
18. $y \times y^{10} \times y^{20}$
19. $y^0 \times y^2$
20. $y \times (y^7)^9$
21. $y^2 + y^2$
22. $y^{28} \div y^2$
23. $y^4(y^{28} \div y^2)$
24. $y^3 + 3y^3$
25. $y^3(y^{25} \div y^5)$
26. $y \times y^{29} \times y^3$
27. $2(y^2)^4$
28. $3(y^4)^3$
29. $y^0 \times (y^{10})^{10}$
30. $y^0(y^{32} \div y^{16})$
31. $y^4 + (y^2)^2$

Fluency Practice

A1 Write as a single power of 5 $5 \times 5 \times 5 \times 5 \times 5 \times 5$	**A2** Write as a single power of 3 $3 \times 3^4 \times 3^7$	**A3** Write as a single power of 4 $4^5 \times 4^2 \times 4$	**A4** Write as a single power of 2 $2^6 \times 2^4 \times 2^{-3}$
B1 Write as a single power of 6 $\frac{6^5}{6^3}$	**B2** Write as a single power of 4 $4^8 \div 4^2$	**B3** Write as a single power of 5 $\frac{5^4}{5^7}$	**B4** Write as a single power of 3 $3^{-2} \div 3^5$
C1 Find the value of n $\frac{4^n \times 4^5}{4^3} = 4^7$	**C2** Find the value of n $\frac{2^5 \times 2^n}{2^2} = 2^8$	**C3** Find the value of n $\frac{5^3 \times 5^6}{5^n} = 5^5$	**C4** Find the value of n $\frac{7^n \times 7^n}{7^9} = 7^{-3}$
D1 Write as a single power of 5 $(5^4)^3$	**D2** Write as a single power of 7 $(7^2)^5$	**D3** Write as a single power of 2 $(2^3)^{-2}$	**D4** Write as a single power of 4 $(4^3)^2 \times (4^2)^5$

Fluency Practice

section a:

Simplify the following, giving your answer in index notation, or as a fraction or integer where possible:

A) $3^4 \times 3^5$

B) $4^4 \times 4^{-2}$

C) $y^0 \times y^{-3}$

D) $(-2)^3 \times (-2)^2$

E) $3^{2a} \times 3^{4a}$

F) $(a^2)^5$

G) $(2^2)^3$

H) $(2c^2)^3$

I) $(a^4b^2)^{-2}$

J) $(2b^2)^3 \times (2b^2)^4$

K) $(5^2)^a \times (5^a)^4$

L) $z^3 \div z^2$

M) $8^3 \div 8^{-3}$

N) $z^3 \div z^{-4}$

O) $6a^3 \div 2a$

P) $15m^3k^3 \div 3m^2k^5$

Q) $(ab^2)^3 \div ab^2$

R) $c^2 \times c^0 \div c$

S) $27c^2 \times c^{-1} \div 9c^4$

T) $3ab^4 \times 6a^{-5}b^2$

U) $-2x^3y^0 \times -2x^2y^{-5}$

section b:

Simplify the following, giving your answer in index notation

A) $12ab^3 \div 6a^2b^2$

B) $\frac{6x^3y}{3x^2}$

C) $\frac{12a^2b}{4ab^2}$

D) $\frac{2a^4b}{(3a^2)^2}$

E) $\frac{1}{a^2} \times \frac{2}{ab^2}$

F) $\frac{2b^3c}{3ab} \times \frac{4ab}{2c}$

G) $\frac{(2xy)^3}{(6x^3y)^2} \times \frac{2xy}{3x^2}$

H) $\left(\frac{2}{x^2}\right)^3$

I) $\left(\frac{ab^2}{8a}\right)^2$

section c (hard):

Determine the value of the letters:

A) $2^a = 4^2$

B) $2^b = 8^2$

C) $2^c \times 4 = 2^5$

D) $2^{3d} = 64$

E) $2^e \times 2 = 32$

F) $3^f \div 3^2 = 3^8$

G) $2^g \div 2^3 = 16$

H) $(3^h)^2 = 3^6$

I) $26^i = 1$

J) $(-4j)^3 = -64$

K) $(2k)^2 = 100$

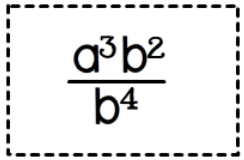
L) $\frac{2^3}{2^{-1}} = 2^l$

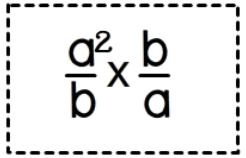
M) $\frac{2^m}{(2^m)^2} = \frac{1}{4}$

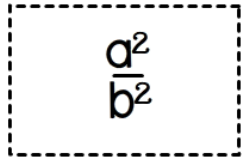
N) $\frac{2 \times 3^{2n}}{2^2 \times 3^n} = \frac{18}{4}$

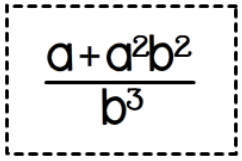
laws of indices

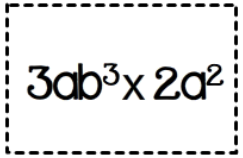
Match the cards into pairs that are equivalent.

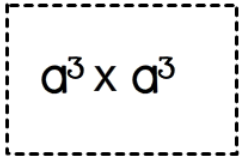


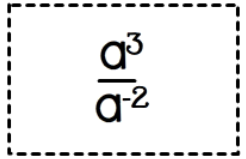


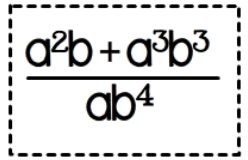


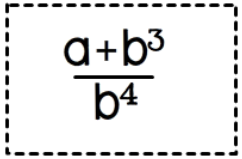


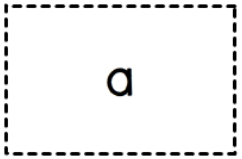


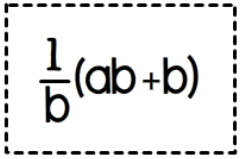


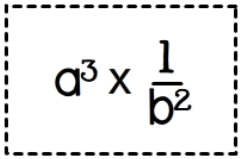


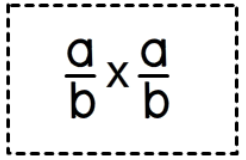


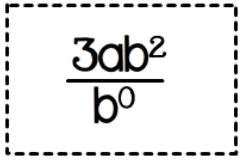


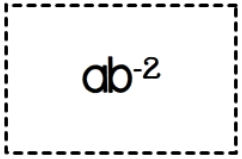


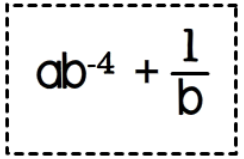


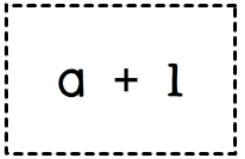


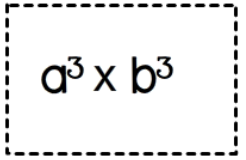


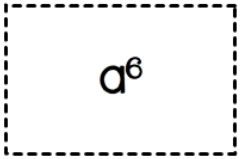


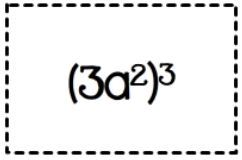


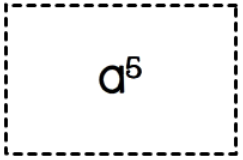


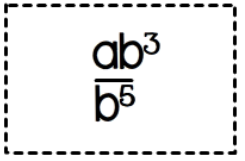


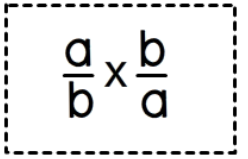


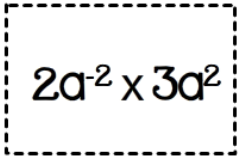












Purposeful Practice

Match the cards at the top to their answers at the bottom. Record your answers in the table.

A $2^3 \times 2^4$

B $3^2 \times 3^3 \div 3$

C $2^3 \times 3^2$

D $(3^6)^0 \div 3^2$

E $(3^3)^2 \times 3^0$

F $2^6 \times 2^1 \div 2^5$

G $(2^8 \div 2^4)^2$

H $3^3 + 3^2$

I $3^3 \times 3^3 \div 3$

J $3^{-1} \times 3^1$

K $(2^3)^2 \times 2^3 \div 2^3$

L $2 \times (2^4 \div 2^2)^4$

M $2^2 \times 2 \div 2^3$

3^{-2} | 4 | 3^4 | 2^7 | 3^5 | 72 | 3^6

2^9 | 36 | 3^0 | 2^6 | 2^8 | 1

A	
B	
C	
D	
E	
F	
G	
H	
I	
J	
K	
L	
M	

Purposeful Practice

A. Work out the value of the letters:

1) $2 \times 2 \times 2 \times 2 \times 2 = 2^a$

2) $3 \times 3 \times 3 \times 3 = 3^b$

3) $2^3 = c$

4) $3^d = 27$

5) $3^4 = e$

6) $10^f = 1000$

7) $\frac{1}{7^2} = \frac{1}{g}$

8) $\frac{1}{9} \times \frac{1}{9} = \frac{1}{9^h}$

B. True or False:

1) $3^3 > 2^5$

2) $1^8 > 2^3$

3) $2^3 < 5^2$

4) $4^3 < 8^2$

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

6) $3^2 \times 3^2 = 3^4$

7) $\left(\frac{1}{2}\right)^3 = \frac{1}{8}$

8) $(-5)^2 = 25$

C. Put these numbers in order of size:

$\frac{1}{3^2}$ $(-3)^2$ $\frac{10^3}{2^2}$ $\left(\frac{1}{2}\right)^3$ 4^2 $\frac{1}{2^4}$

D. If **a** = -5, which of the following are true?

- $\mathbf{a}^2 = -25$
- $\mathbf{a}^2 = 25$
- $\mathbf{a}^3$ is a negative number
- $\mathbf{a}^3 > \mathbf{a}^4$
- $\mathbf{a}^3 < \mathbf{a}^2$

E. If $\mathbf{b}^3$ is an even number, which of the following are true?

- **b** must be an even number
- **b** must be an odd number
- **b** could be odd or even
- $\mathbf{b}^2$ must be an even number

F. Explain how you know that 7^{23} is smaller than 8^{23}

G. Give an example to show that this is not always true: $a \times b^2 = (a \times b)^2$

Algebraic Laws of Indices			
(a)	**(b)**	**(c)**	**(d)**
Simplify $a^4 \times a^3 \times a^{-2}$	Simplify $\frac{b^7 \times b^{-1}}{b^3}$	Simplify $(c^5)^{-2}$	Simplify $d^7 \times \left(d^{1/2}\right)^8$
(e)	**(f)**	**(g)**	**(h)**
$\frac{e^9}{e^n} = e^{11}$ Find the value of n	$\left(f^{\frac{1}{2}}\right)^n = f^7$ Find the value of n	$g^5 \times g^n = g^{15}$ Find the value of n	$\frac{h^7 \times h^n}{h^{-1}} = h^{11}$ Find the value of n
(i)	**(j)**	**(k)**	**(l)**
Simplify $(5a^4)^2$	Simplify $(3a^6b^5)^3$	Simplify $\left(2p^{1/2}q^6\right)^4$	Simplify $(x^{12}y^3)^{1/3}$
(m)	**(n)**	**(o)**	**(p)**
Write $\frac{y^{10} \times y^{-2}}{(y^2)^3}$ as a single power of y	Write $\left(\frac{m^5}{m^{-7}}\right)^{1/2}$ as a single power of m	Simplify fully $\left(\frac{2}{3}x^{-4}y^{1/3}\right)^3$	$(p^{-2})^4 = p \times (p^3)^n$ Find the value of n

Problem Solving

Using the digits 1 to 20, at most one time each, fill in the boxes to create equivalent expressions.

$$(2^{\square})^{\square} = \frac{(2^{\square})^{\square}}{(2^{\square})^{\square}} = 2^{\square} \times 2^{\square} = \frac{2^{\square}}{2^{\square}}$$

Problem Solving

Using the digits 0 1 2 3 4 5 6 7 8 9 at most once each time, fill in the boxes to make the calculation correct.

$$n^{\square} \times n^{\square} = n^{\square} \times n^{\square} = n^{\square} = n^{\square} \times n^{\square} = n^{\square} \times n^{\square}$$

Using the digits 0 1 2 3 4 5 6 7 8 9 at most once each time, fill in the boxes to make as many correct calculations as you can.

$$\square c^{\square} \times \square c^{\square} = \square c^{\square}$$

Fluency Practice

For the following terms,

a) Write with a positive exponent
b) Evaluate:

1.	26^{-1}	2.	2^{-1}	3.	10^{-2}	4.	2^{-2}
5.	-26^{-1}	6.	-2^{-1}	7.	-10^{-2}	8.	-2^{-2}
9.	$(-26)^{-1}$	10.	$(-2)^{-1}$	11.	$(-10)^{-2}$	12.	$(-2)^{-2}$
13.	2^{-5}	12.	-7^{-3}	13.	$(-8)^{-2}$	14.	$(-10)^{-5}$
15.	$(-4)^{-3}$	16.	9^{-4}	17.	-11^{-2}	18.	$(-3)^{-3}$
19.	-3^{-4}	20.	25^{-2}	21.	$(-2)^{-6}$	22.	15^{-2}

Decide if there are mistakes in the following and explain how to fix the answer:

a) $4^{-2} = -16$ b) $10^{-3} = \frac{1}{30}$

Fluency Practice

1. Write in index form:

   a) $\frac{1}{5^2}$ b) $\frac{1}{3^4}$ c) $\frac{1}{8^3}$ d) $\frac{1}{4^5}$ e) $\frac{1}{10^3}$ f) $\frac{1}{2^6}$

2. Write in the form 2^n:

   a) $\frac{1}{2}$ b) $\frac{1}{4}$ c) $\frac{1}{8}$ d) $\frac{1}{32}$ e) $\frac{1}{64}$ f) $\frac{1}{256}$

3. Write in the form 5^n:

   a) $\frac{1}{5}$ b) $\frac{1}{125}$ c) $\frac{1}{625}$ d) $\frac{1}{3125}$ e) $\frac{1}{78{,}125}$ f) $\frac{1}{390{,}625}$

4. Arrange in ascending order:

   $\frac{1}{50}$ 5^{-2} $\frac{3}{10}$ 2^{-3}

Fluency Practice

Simplify the following:

1.	$\left(\frac{1}{5}\right)^{-1}$	2.	$\left(\frac{2}{5}\right)^{-1}$	3.	$\left(\frac{3}{5}\right)^{-1}$	4.	$\left(\frac{4}{5}\right)^{-1}$	5.	$\left(\frac{1}{4}\right)^{-1}$
6.	$\left(\frac{3}{4}\right)^{-1}$	7.	$\left(\frac{1}{3}\right)^{-2}$	8.	$\left(\frac{2}{3}\right)^{-2}$	9.	$\left(\frac{1}{5}\right)^{-2}$	10.	$\left(\frac{2}{5}\right)^{-2}$
11.	$\left(\frac{3}{5}\right)^{-2}$	12.	$\left(\frac{4}{5}\right)^{-2}$	13.	$\left(\frac{2}{3}\right)^{-3}$	14.	$\left(\frac{4}{3}\right)^{-3}$	15.	$\left(\frac{7}{8}\right)^{-2}$
16.	$\left(-\frac{1}{10}\right)^{-4}$	17.	$\left(-\frac{4}{9}\right)^{-3}$	18.	$\left(-\frac{9}{10}\right)^{-2}$	19.	$\left(-\frac{5}{3}\right)^{-3}$	20.	$\left(-\frac{3}{2}\right)^{-4}$
21.	$\left(-\frac{3}{10}\right)^{-3}$	22.	$\left(-\frac{3}{2}\right)^{-3}$	23.	$\left(-\frac{8}{5}\right)^{-3}$	24.	$\left(-\frac{3}{8}\right)^{-2}$	25.	$\left(-\frac{6}{5}\right)^{-2}$

Fluency Practice

Question 1: Evaluate each of the following

(a) 5^{-2} (b) 2^{-1} (c) 2^{-3} (d) 4^{-2} (e) 3^{-3} (f) 6^{-1}

(g) 10^{-2} (h) 2^{-4} (i) 9^{-2} (j) 3^{-4} (k) 10^{-1} (l) 7^{-2}

(m) 2^{-5} (n) 5^{-3} (o) 2^{-6} (p) 10^{-4} (q) 6^{-3} (r) 10^{-6}

Question 2: Write each of the following in index form.

(a) $\frac{1}{5^2}$ (b) $\frac{1}{3^4}$ (c) $\frac{1}{8^3}$ (d) $\frac{1}{4^5}$ (e) $\frac{1}{10^3}$ (f) $\frac{1}{2^6}$

Question 3: Write each of the following in the form 2^n

(a) $\frac{1}{2}$ (b) $\frac{1}{4}$ (c) $\frac{1}{32}$ (d) $\frac{1}{8}$ (e) $\frac{1}{64}$ (f) $\frac{1}{256}$

Question 4: Write each of the following in the form 5^n

(a) $\frac{1}{125}$ (b) $\frac{1}{25}$ (c) $\frac{1}{5}$ (d) $\frac{1}{3125}$ (e) $\frac{1}{625}$ (f) $\frac{1}{15625}$

Purposeful Practice

Apply

Question 1: Arrange in order from smallest to largest.

$$\frac{1}{50} \qquad 5^{-2} \qquad \frac{3}{10} \qquad 2^{-3}$$

Question 2: Work out

(a) $4^{-2} \times 3^{2}$ (b) $10^{-1} \div 5^{-2}$ (c) $2^{-2} + 3^{-2} \times 2^{3}$

Question 3: Sally has completed her homework.
Can you spot any mistakes?

Question 1

Evaluate

4^{-2}

-16

Question 2

Work out

10^{-3}

$\frac{1}{30}$

Question 4: Given that $2^{m} + 2^{n} = \frac{9}{32}$

Work out mn

Question 5:

$$x^{-2} \qquad x^{0} \qquad x \qquad x^{3}$$

Put the expressions above in order, from smallest to largest, when:

(a) x = 2 (b) x = 1 (c) x = 0.5 (d) x = −0.5

(e) x = −1 (f) x = −2

Fluency Practice

Write down the reciprocal of:

(a) 4 (b) 10 (c) 15

(d) -3 (e) 0.4 (f) 1

(g) $\frac{3}{4}$ (h) $\frac{1}{8}$ (i) $\frac{2}{7}$

Evaluate:

(a) 4^{-1} (b) 10^{-1}

(c) 15^{-1} (d) $(-3)^{-1}$

(e) a^{-1} (f) $\left(\frac{2}{3}\right)^{-1}$

(g) $\left(\frac{8}{5}\right)^{-1}$ (h) $\left(1\frac{3}{7}\right)^{-1}$

Evaluate:

(a) 4^{-2} (b) 10^{-3}

(c) 15^{-2} (d) $(-3)^{-2}$

(e) b^{-3} (f) $\left(\frac{1}{3}\right)^{-2}$

(g) $\left(\frac{2}{5}\right)^{-3}$ (h) 0.1^{-2}

Find x.

(a) $\frac{1}{10} = 10^x$ (b) $\frac{1}{1000} = 10^x$

(c) $\frac{1}{2} = 2^x$ (d) $\frac{1}{8} = 2^x$

(e) $\frac{1}{16} = 2^x$ (f) $\frac{1}{256} = 2^x$