

Student Name

Mathematics Stage 4

FRACTIONS DECIMALS PERCENTAGES

Book 9 Represent one quantity as a fraction,
decimal or percentage of another

Version: 260207
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OVERVIEW

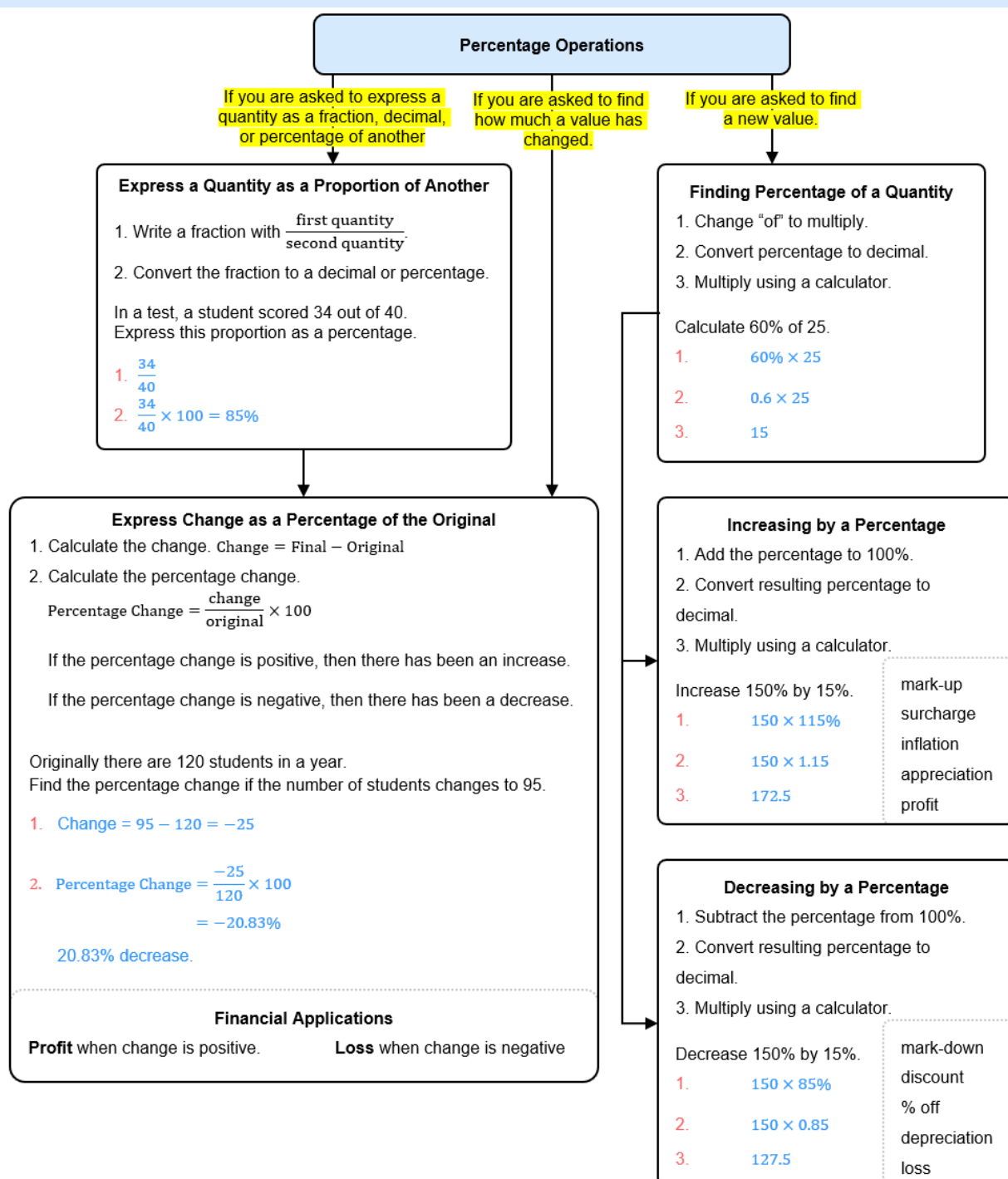
SYLLABUS CONTENT

MA4-FRC-C-01 represents and operates with fractions, decimals and percentages to solve problems

Represent one quantity as a fraction, decimal or percentage of another

- Represent one quantity as a fraction, decimal or percentage of another by considering appropriate units
- Calculate percentage increases and decreases in various contexts
- Examine the financial applications of percentage increase and decrease, including profit and/or loss as a percentage of cost price or selling price

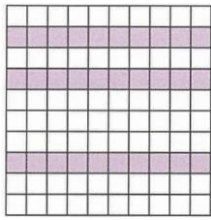
SUMMARY



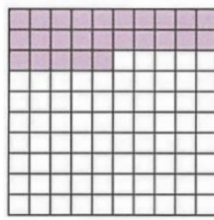
REVIEW OF PRIOR KNOWLEDGE

1 Determine the fraction, decimal, and percentage shaded in each diagram.

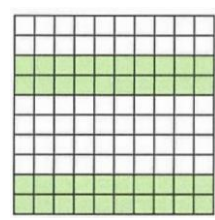
a



b



c



2 Work out:

a $80 \div 2$

b $80 \div 4$

c $80 \div 5$

d $\frac{1}{2}$ of 80

e $\frac{1}{4}$ of 80

f $\frac{1}{5}$ of 80

g 50% of 80

h 25% of 80

i 75% of 80

3 Divide these numbers by 100.

a 100

b 160

c 106

d 126

e 86

f 6

4 Complete these number bonds:

a $20 + \dots = 100$

b $31 + \dots = 100$

c $100 = 15 + \dots$

d $17 + \dots = 100$

e $\dots + 45 = 100$

f $23 = 100 - \dots$

g $100 - \dots = 14$

h $\dots + 39 = 100$

i $27 = 100 - \dots$

5 Complete the table.

Percentage	Decimal
10%	
50%	
80%	
85%	
72%	
21%	
78%	
7.8%	
17.8%	
0.8%	
1.8%	

Percentage	Decimal
1%	
0.1%	
1.5%	
15%	
15.5%	
82.6%	
100%	
110%	
115%	
105%	
250%	

6 Convert to a decimal.

a 110%	b 120%	c 150%
d 156%	e 106%	f 250%

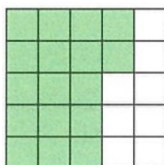
7 Determine the complement percentage (complementary percentages add to 100%).

a 60%	b 18%	c 25%
d 15%	e 0.5%	f 12.5%

EXPRESSING A QUANTITY AS A PROPORTION OF ANOTHER

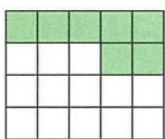
- If you are asked to express a quantity as a proportion of another, then write the quantity as a fraction, decimal or percentage of the other quantity.
 - Write a fraction with $\frac{\text{first quantity}}{\text{second quantity}}$.
 - Convert the fraction to a decimal or percentage.

Example Express a quantity as a proportion of another.



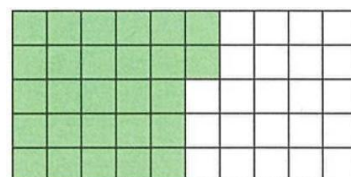
Fraction	Percentage	Decimal
$\frac{\text{Shaded tiles}}{\text{All tiles}}$ $= \frac{17}{25}$	Calculator method: $\frac{17}{25} \times 100 = 68\%$ Non-calculator method: $\frac{17}{25} \times \frac{4}{4} = \frac{68}{100}$	Calculator method: $17 \div 25 = 0.68$ Non-calculator method: $\frac{68}{100} = 0.68$

a Express the proportion shaded as a:



Fraction	Percentage	Decimal
$\frac{7}{20}$	35%	0.35

b Express the proportion shaded as a:



Fraction	Percentage	Decimal
$\frac{27}{50}$	54%	0.54

c In a test, a student scored 34 out of 40.

Fraction	Percentage	Decimal
$\frac{17}{20}$	85%	0.85

d A plane has travelled 4800 km out of 6000 km to its destination.

Fraction	Percentage	Decimal
$\frac{4}{5}$	80%	0.8

Key ideas

- Proportion means part of a; the three ways to express as a proportion are,, and

- 1 Change these test results to equivalent scores out of 100, and hence state the percentage.

	Score	Fraction	Out of 100	Percentage
a	7 out of 10	$\frac{7}{10}$	$\frac{\quad}{100}$	
b	24 out of 50	$\frac{12}{25}$	$\frac{48}{100}$	45%
c	12 out of 20	$\frac{3}{5}$	$\frac{60}{100}$	60%
d	80 out of 200	$\frac{2}{5}$	$\frac{40}{100}$	40%
e	630 out of 1000	$\frac{63}{100}$	$\frac{63}{100}$	63%
f	20 out of 25	$\frac{4}{5}$	$\frac{80}{100}$	80%
g	12 out of 40	$\frac{3}{10}$	$\frac{30}{100}$	30%
h	26 out of 130	$\frac{1}{5}$	$\frac{20}{100}$	20%
i	55 out of 50	$\frac{4}{5}$	$\frac{80}{100}$	80%

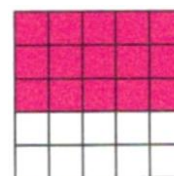
- 2 What fraction, percentage, and decimal of each shape is shaded?

a



Fraction	Percentage	Decimal
$\frac{3}{20}$	15%	0.15

b



Fraction	Percentage	Decimal
$\frac{15}{25}$	60%	0.6

c



Fraction	Percentage	Decimal
$\frac{3}{10}$	30%	0.3

d



Fraction	Percentage	Decimal
$\frac{1}{4}$	25%	0.25

3

a There are 20 counters on a bag. 14 are blue and the rest are red. What fraction of the counters are blue? What is the percentage chance of picking a blue counter? 70%	b At a school, 144 of the 240 year eight students are girls. What fraction of the students are girls? What percentage of the students are girls? 60%
c Abi has written 350 words of a 500-word essay. What percentage does she <i>still need to write</i> ? 30%	d Claire's goal is to raise \$1000 for charity. She managed to raise \$1320. What percentage of her goal did she reach? 132%

4 Express these proportions as a percentage.

a 5 out of 20 25%	f 50 out of 400 12.5%
b 50 out of 200 25%	g 150 out of 400 37.5%
c 150 out of 200 75%	h 15 out of 400 3.75%
d 15 out of 20 75%	i 15 out of 40 37.5%
e 5 out of 40 12.5%	j 150 out of 40 375%

5 Four students completed four different tests. Their results were:

Charlotte: 33 out of 38 marks

Evie: 16 out of 21 marks

Karla: 70 out of 85 marks

Imogen: 92 out of 100 marks

Rank the students in decreasing order of test percentage.

Imogen, Charlotte, Karla, Evie

6 Express these proportions as a percentage. **You will need to convert to the same units.**

a 40 cents out of \$8	b 8 km out of 200 m
5%	4000%
c 50 cents out of \$2	d 1.44 m out of 48 cm
25%	300%
e 3 mm out of 6 cm	f 50 cents out of \$1
5%	50%
g 400 m out of 1.6 km	h \$1 out of 50 cents
25%	200%
i 200 g out of 5 kg	j \$5.10 out of 85 cents
4%	600%

7 Express these quantities as fractions and percentages.

a 12 minutes out of 1 hour	b 42 cm out of 1 m	c 242 g out of 1 kg
20%	42%	24.2%
d 3 seconds out of 2 minutes	e 750 kg out of 1 tonne	f 60 cm out of 2 m
2.5%	75%	30%
g 18 hours out of a day	h 50 mm out of 1.5 m	i 700 mL out of 4.2 L
75%	3.3%	16.6%
j 5 g out of 200 g	k 40c out of \$4	l 10 km out of 200 km
2.5%	10%	5%
m 3 seconds out of 1 minute	n 200 m out of 1 km	o 100 mL out of half a litre
5%	20%	20%
p 200c out of \$1	q 45 marks out of 60 marks	r 40 minutes out of 3 hours.
200%	75%	22.2%

8 Emily does a 2 part test. She scores 19 out of 30 in Section A and 45 out of 55 in Section B.

a What percentage did she score in Section A?

63.3%

b What percentage did she score in Section B?

81.81%

c What percentage was her overall mark?

75.29%

9 In a science experiment, 40g of Chemical A is mixed with 85g of Chemical B.

Jimmy calculated the percentage of Chemical A in the mixture as 47.06%

Explain why he is incorrect.

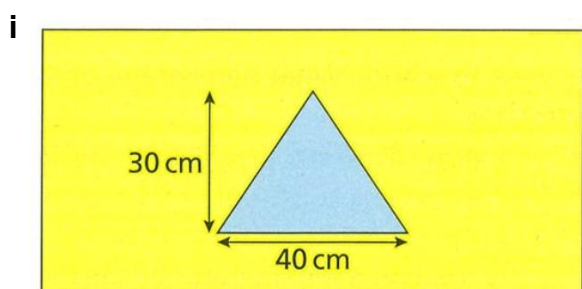
Jimmy did $\frac{40}{85}$ when it should be $\frac{40}{125}$

10 A standard flag is a rectangle 114 cm long by 56 cm wide.

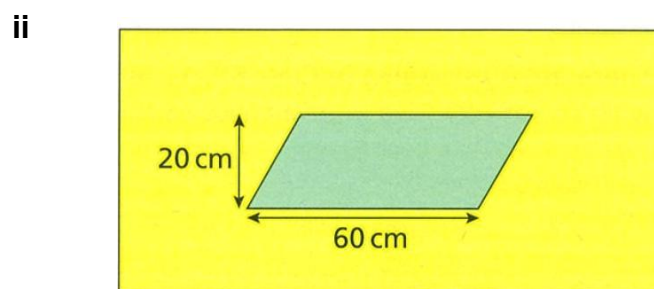
a What is the area of a standard flag?

6384 cm²

b Calculate the percentage of the flag that each of these shapes take up.



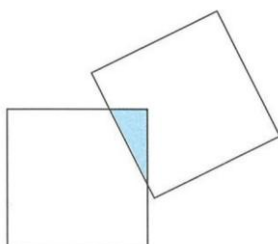
9.4%



18.8%

11 The diagram shows two identical squares overlapping. 15% of each square is shaded.

What percentage of the whole diagram is shaded?



8.108%

PERCENTAGE OF A QUANTITY MENTALLY

Mental Strategies for Percentage of a Quantity			
$50\% = \frac{1}{2}$	divide by 2	$10\% = \frac{1}{10}$	divide by 10
$33.\dot{3}\% = \frac{1}{3}$	divide by 3	$5\% = \frac{1}{20}$	divide by 20
$25\% = \frac{1}{4}$	divide by 4	$1\% = \frac{1}{100}$	divide by 100
$20\% = \frac{1}{5}$	divide by 5		

Find 50% of:

a 60
 $60 \div 2 =$

b 360
 $360 \div 2 =$
30

c 48
 $48 \div 2 =$
24

Find 33.3% of:

a 60
 $60 \div 3 =$

b 360
 $360 \div 3 =$
20

c 48
 $48 \div 3 =$
16

Find 10% of:

a 60
 $60 \div 10 =$

b 360
 $360 \div 10 =$
6

c 48
 $48 \div 10 =$
4.8

Find 20% of:

a 60
 $60 \div 5 =$

b 360
 $360 \div 5 =$
12

c 48
 $48 \div 5 =$
9.6

Find 25% of:

a 60
 $60 \div 4 =$

b 360
 $360 \div 4 =$
15

c 48
 $48 \div 4 =$
12

Find 5% of:

a 60
 $60 \div 20 =$

b 360
 $360 \div 20 =$
3

c 48
 $48 \div 20 =$
2.4

Find 1% of:

a 60
 $60 \div 100 =$

b 360
 $360 \div 100 =$
0.6

c 48
 $48 \div 100 =$
0.48

FINDING A PERCENTAGE FROM A KNOWN PERCENTAGE

Example Calculate percentage of a quantity.

Find 50% of 300	150	Find 10% of 300	30
Find 25% of 300	75	Find 5% of 300	15
Find 75% of 300	225	Find 2.5% of 300	7.5
Find 12.5% of 300	37.5	Find 15% of 300	45
	Find 1% of 300	3	
	Find 0.5% of 300	1.5	
	Find 3% of 300	9	
	Find 3.5% of 300	10.5	

Find 50% of 660	330	Find 10% of 660	66
Find 25% of 660	165	Find 5% of 660	33
Find 75% of 660	495	Find 2.5% of 660	16.5
Find 12.5% of 660	82.5	Find 15% of 660	99
	Find 1% of 660	6.6	
	Find 0.5% of 660	3.3	
	Find 3% of 660	19.8	
	Find 3.5% of 660	23.1	

Key ideas

1. To find a percentage of a quantity, we can use our knowledge of of a quantity and divide.
2. We can derive a new fact from a given fact. For example,
 - a. to find 5% from 10%, we can divide 10% by
 - b. to find 60% from 20%, we can 20% by 3.

1 Find 10% of each amount by finding $\frac{1}{10}$

a 190	b 875	c 37.6	d 9.25
19	87.5	3.76	0.925
e 2700	f 1527.6	g 72.58	h 0.9218
270	152.76	7.258	0.09218

2 Find 20% of these numbers by either finding $\frac{1}{5}$, or by finding $\frac{1}{10}$ then multiplying by 2.

a 50	b 125	c 75	d 10.5
10	25	15	2.1
e 45	f 400	g 390	h 72
9	80	78	14.4

3 Find 5% of these numbers by either finding $\frac{1}{20}$, or by finding $\frac{1}{10}$ then dividing by 2.

a 80	b 60	c 120	d 700
4	3	6	35
e 160	f 150	g 450	h 850
8	7.5	22.5	42.5

4 Complete the table.

Question	Diagram	Strategy	Working										
10% of 400	<table><tr><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td></tr></table>	40	40	40	40	40	40	40	40	40	40	$10\% = \frac{1}{10}$	$400 \div 10 = \dots\dots\dots$ 40
40	40	40	40	40	40	40	40	40	40				
20% of 400	<table><tr><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td></tr></table>	40	40	40	40	40	40	40	40	40	40	$20\% = 10\% \times 2$	$40 \times \dots\dots = \dots\dots\dots$ 80
40	40	40	40	40	40	40	40	40	40				
40% of 400	<table><tr><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td></tr></table>	40	40	40	40	40	40	40	40	40	40		 160
40	40	40	40	40	40	40	40	40	40				
30% of 400	<table><tr><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td></tr></table>	40	40	40	40	40	40	40	40	40	40		 120
40	40	40	40	40	40	40	40	40	40				
5% of 400	<table><tr><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td></tr></table>	40	40	40	40	40	40	40	40	40	40		 20
40	40	40	40	40	40	40	40	40	40				
1% of 400	<table><tr><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td></tr></table>	40	40	40	40	40	40	40	40	40	40		 4
40	40	40	40	40	40	40	40	40	40				
6% of 400	<table><tr><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td><td>40</td></tr></table>	40	40	40	40	40	40	40	40	40	40		 24
40	40	40	40	40	40	40	40	40	40				

5

a 10% of 40 =	4	j 10% of 5 =	0.5
b 10% of 50 =	5	k 5% of 10 =	0.5
c 50% of 10 =	5	l 15% of 10 =	1.5
d 50% of 20 =	10	m 10% of 15 =	1.5
e 20% of 50 =	10	n 10% of 16 =	1.6
f 10% of 80 =	8	o 10% of 120 =	12
g 20% of 80 =	16	p 10% of 100 =	10
h 5% of 80 =	4	q 100% of 10 =	10
i 10% of 10 =	1	r 200% of 10 =	20

6 Find:

a 10% of 800	80	b 5% of 800	40
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Use your answers above to find:

c 20% of 800	160	d 15% of 800	120	e 35% of 800	280
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Bethany says:



To find 95% of 800, multiply 10% of 800 by 9, then add on 5%.

Describe a simpler way of finding 95% of 800. (Hint: how could you use 5%?)

Find 5% of 800, then subtract from 800

7

Find 50% of 120	60	Find 10% of 120	12
Find 25% of 120	30	Find 5% of 120	6
Find 75% of 120	90	Find 2.5% of 120	3
Find 12.5% of 120	15	Find 15% of 120	18
Find 1% of 120		1.2	
Find 0.5% of 120		0.6	
Find 3% of 120		3.6	
Find 3.5% of 120		4.2	

8

Find 20% of 30	6	Find 33. $\dot{3}$ % of 30	10
Find 20% of 15	3	Find 66. $\dot{6}$ % of 30	20
Find 40% of 15	6	Find 66. $\dot{6}$ % of 60	40
Find 10% of 15	1.5	Find 66. $\dot{6}$ % of 180	120
Find 1% of 30		0.3	
Find 0.5% of 30		0.15	
Find 4% of 30		1.2	
Find 8.5% of 30		2.55	

9 Work these out mentally. ($33\frac{1}{3}\%$ is the same as $33.\dot{3}\%$, which is the same as $\frac{1}{3}$)

a 50% of 8	b 25% of 12	c 75% of 24	d 50% of 30
4	3	18	15
e 25% of 30	f 75% of 30	g $33\frac{1}{3}\%$ of 12	h $66\frac{2}{3}\%$ of 12
7.5	22.5	4	8
i $33\frac{1}{3}\%$ of 27	j $66\frac{2}{3}\%$ of 30	k $33\frac{1}{3}\%$ of 90	l $66\frac{2}{3}\%$ of 180
9	20	30	120

10 Work these out mentally.

a 50% of 36	b 20% of 45	c 25% of 68
18	9	17
d 25% of 48	e 75% of 48	f 10% of 180
12	36	18
g 5% of 80	h 65% of 180	i 45% of 90
4	117	40.5
j 10% of 6000	k 1% of 6000	l 3% of 6000
600	60	180
m 5% of 60	n 2% of 150	o 30% of 250
3	3	75

11 Find these amounts mentally:

a 75% of 4.4	b 49% of 180	c 110% of 6
3.3	88.2	6.6
d 150% of 50	e 200% of 30	f 120% of 90
75	60	108
g $166\frac{2}{3}\%$ of 120	h 350% of 12	
200	42	

12 In a survey, 35% of respondents said they felt a penalty was too lenient and 20% felt it was too harsh. If there were 1200 respondents, how many felt the penalty was appropriate?

540

13 Eric scored 60% on his most recent Mathematics test. He is determined to improve his score on the next topic test, which will be out of 30 marks. What is the least number of marks Eric can score to improve on his previous test score?

19

14 Work out these percentages of 180.

a 75%	b 175%	c 200%	d 250%
135	315	360	450
e 220%	f $133\frac{1}{3}\%$	g $266\frac{2}{3}\%$	
396	240	480	

15

a Find the difference between 30% of 600 and $33\frac{1}{3}\%$ of 600

20

b Write down $3\frac{1}{3}\%$ of 600

20

c Work out $3\frac{1}{3}\%$ of 90

3

d Work out $6\frac{2}{3}\%$ of 450

0

16 Work out:

a 30% of 80

24

b 80% of 30

24

What do you notice about your answers?

They are equal.

Without using a calculator, find:

a 32% of 50

16

b 16% of 25

4

c 36% of 25

9

d 17% of 50

8.5

e 64% of 12.5

8

f 90% of $66\frac{2}{3}$

60

17 Complete these mentally. Complete the questions going down the columns.

a 50% of 24

12

b 50% of 72

36

c 25% of 120

30

d 25% of 480

120

e 75% of 120

90

f 10% of 90

9

g 10% of 9

0.9

h 10% of 19

1.9

i 20% of 55

11

j 20% of 110

22

k 20% of 165

33

l 40% of 5

2

m 40% of 55

22

n 40% of 155

62

a 80% of 50

40

b 80% of 250

200

c 80% of 3000

2400

d 50% of 28

14

e 28% of 50

14

f 35% of 40

14

g 25% of 56

14

h 56% of 25

14

i 75% of 48

36

j 75% of 240

180

k 90% of 60

54

l 90% of 15

13.5

m 70% of 70

49

n 70% of 7

4.9

a 16% of 25

4

b 18% of 50

9

c 45% of 20

9

d 20% of 45

9

e 5% of 64

3.2

f 15% of 64

9.6

g 8% of 125

10

h 16% of 125

20

i 116% of 125

145

j 3% of 120

3.6

k 103% of 120

123.6

l 10% of 320

32

m 1% of 320

3.2

n 99% of 320

316.8

18 Fill in the missing numbers in at least 5 ways.

- a
- % of = 30
- % of = 30
- % of = 30
- % of = 30
- % of = 30

- b
- % of = 27
- % of = 27
- % of = 27
- % of = 27
- % of = 27

19 Work out the following:

a 10% of 40 4	b 10% of 42 4.2	c 30% of 40 12	d 30% of 42 12.6
e 10% of 60 6	f 5% of 60 3	g 15% of 60 9	h 15% of 80 12
i 60% of 80 48	j 20% of 31 6.2	k 25% of 50 12.5	l 80% of 300 240
m 1% of 900 9	n 11% of 900 99	o 23% of 60 13.8	p 41% of 130 53.3

20 Find the number if:
(hint: convert to fractions)

a $33\frac{1}{3}\%$ of the number is 60 180	b 80% of the number is 60 75
c 75% of the number is 60 80	d 12.5% of the number is 60 480
e 12% of the number is 60 500	f $66\frac{2}{3}\%$ of the number is 60 90

- 21** In real life, percentages won't be "nice" numbers that can be easily converted to a common fraction. Instead, you can **estimate** the whole by rounding.

Worked Solution	Explanation
If 21% is 410, estimate the value of the whole. $21\% \approx 20\%$ $\frac{1}{5}$ of a number is 410 $410 \times 5 = 2050$ So, the whole is around 2050.	What does the $\approx$ symbol mean? Why did we choose to round 21% to 20%? Where did $\frac{1}{5}$ come from? Why did we multiply by 5?

Without using a calculator, draw a line to match each percentage on the left to the estimate of the whole on the right.

Percentage	Estimate of Whole
51% = 72 •	• 10 000
97% = 686 •	• 180
3% = 298 •	• 1500
24% = 103 •	• 700
9% = 53 •	• 6000
19% = 300 •	• 540
33% = 89 •	• 140
11% = 612 •	• 80
67% = 121 •	• 270
74% = 60 •	• 400

INCREASE AND DECREASE BY A PERCENTAGE MENTALLY

INCREASING BY A PERCENTAGE

1. Find percentage of the quantity.
2. Add the result to the original amount.

Example Increase by a percentage.

Increase 150 by 10%.

1. Find percentage $10\% \text{ of } 150 = 15$

2. Add to original $150 + 15 = 165$

a 80 increased by 50%

50% of 80 =

80 + =

120

b 200 increased by 25%

..... of =

..... + =

250

c Increase 125 by 20%

150

d 40 increased by 80%

72

DECREASING BY A PERCENTAGE

1. Find percentage of the quantity.
2. Subtract the result from the original amount.

Example Decrease by a percentage.

Decrease 150 by 20%.

1. Find percentage $20\% \text{ of } 150 = 30$

2. Subtract from original $150 - 30 = 120$

a Decrease 12 by 25%

25% of 12 =

12 - =

9

b 90 decreased by 30%

..... of =

..... - =

63

c Decrease 250 by 70%

75

d 140 decreased by 15%

119

Key ideas

1. To increase by a percentage, find that percentage, then it to the original.
2. To decrease by a percentage, find that percentage, then it from the original.

1 Complete the find the increased amounts.

a Increase 400 by 10%

10% of 400:

New amount: $400 + \dots = \dots$

440

b Decrease 200 by 40%

40% of 200:

New amount: $200 - \dots = \dots$

120

2 Calculate these percentage **increases**:

a Increase 300 by 10%

330

b Increase 100 by 40%

140

c Increase 100 by 25%

125

d Increase 90 by 33.3%

120

e Increase 68 by 20%

81.6

f Increase 380 by 50%

570

3 Calculate these percentage **decreases**:

a Decrease 24 by 50%

12

b Decrease 60 by 10%

54

c Decrease 50 by 40%

30

d Decrease 90 by 30%

63

e Decrease 150 by 10%

135

f Decrease 80 by 25%

60

4 Calculate the following:

a Increase 80 by 10%

88

b Decrease 50 by 60%

20

c Increase 120 by 20%

144

d Decrease 80 by 20%

64

e Increase 240 by 15%

276

f Decrease 15 by 10%

13.5

5 Amina thinks that increasing a number by 100% is the same as multiplying the number by 2.

a Explain why Amina is right.

Increasing by 100% means adding the entire original amount to itself, which is the same as multiplying by 2.

b What percentage increase would be the same as multiplying by 3?

FINDING PERCENTAGES USING MULTIPLIERS

- To find a percentage of a quantity using a decimal multiplier:
 1. Change “of” to multiply.
 2. Convert percentage to decimal.
 3. Multiply using a calculator.

Example Calculate percentage of a quantity using multipliers.

Calculate 60% of 25.	What does “of” mean?
1. “of” → × $60\% \times 25$	
2. Convert 0.6×25	Where did we get 0.6 from?
3. Multiply 15	

a 40% of 60

$$= 40\% \times 60$$

$$= 0.4 \times 60$$

$$= \dots\dots\dots$$

24

b 25% of 36

$$= 25\% \times 36$$

$$= \dots\dots\dots \times \dots\dots\dots$$

$$= \dots\dots\dots$$

9

c 55% of 15

$$= \dots\dots\dots \times \dots\dots\dots$$

$$= \dots\dots\dots \times \dots\dots\dots$$

$$= \dots\dots\dots$$

8.25

d 120% of 50

$$= \dots\dots\dots \times \dots\dots\dots$$

$$= \dots\dots\dots \times \dots\dots\dots$$

$$= \dots\dots\dots$$

60

Key ideas

1. To find percentage of a quantity, the quantity by the percentage.

1 Use a calculator to work out the following:

a 37% of 150 $0.37 \times 150 = \dots\dots\dots$ 55.5	b 68% of 350 238	c 9% of 140 12.6
d 12% of 324 38.88	e 25% of 6.7 1.675	f 61% of 5 3.05
g 3% of 52 1.56	h 89% of 137 121.93	i 8.9% of 137 12.193
j 37% of 820 303.4	k 29% of 800 232	l 4% of 650 26
m 16% of 204 32.64	n 74% of 1800 1332	o 4.2% of 310 13.02

2 Jasmine thinks that 2.7% is the same as 0.27. Explain why she is wrong.

2.7% is 0.027

a Find 2.7% of 300 8.1	b Find 1.8% of 40 0.72
--------------------------------------	--------------------------------------

3 Which is larger, 90% of 56 or 9% of 560?

They are equal.

4 The human body is around 70% water. A year 10 student weighs around 61 kg.
How much of that is water, in kilograms?

42.7 kg

5 Calculate each of the following using a calculator.

a 74% of 765	b 47% of 765	c 94% of 765
566.1	359.55	719.1
d 9.4% of 765	e 0.94% of 765	f 9.04% of 765
71.91	7.191	69.156
g 904% of 765	h 904.904% of 765	i $\frac{9}{4}\%$ of 865
6915.6	6922.5156	19.4625

6 Find the missing number:

$$25\% \text{ of } 40 = 33\frac{1}{3}\% \text{ of } \square$$

30

7 Work out the missing numbers.

a $\square\%$ of 80 = 100	b $\square\%$ of 150 = 250	c 250% of $\square$ = 35
125%	166.6%	14

8 Find the missing number.

a 40% of $\square$ = 24	b 60% of $\square$ = 24	c 3% of $\square$ = 24
60	40	800
d 12% of $\square$ = 24	e 120% of $\square$ = 24	f 150% of $\square$ = 24
200	20	16

9 Sven's height is 120% of Huda's height.

Emily's height is 110% of Sven's height.

Huda is 115 cm tall. How tall is Emily?

151.8 cm

PERCENTAGE INCREASE AND DECREASE USING MULTIPLIERS

INCREASING BY A PERCENTAGE USING MULTIPLIERS

- To increase by a percentage using a decimal multiplier:
 - Add the percentage to 100%.
 - Convert resulting percentage to decimal.
 - Multiply using a calculator.

Example Increase by a percentage using multipliers.

Increase 150 by 15%. 1. Add to 100% $150 \times 115\%$ 2. Convert 150×1.15 3. Multiply 172.5	Where did 115% come from? <i>To increase by 15%, we 15% to%, which is 115%.</i>
--	--

a Increase 125 by 20%

$$= 125 \times 120\%$$

$$= \dots \times \dots$$

$$= \dots$$

150

b 200 increased by 45%

$$= \dots \times \dots$$

$$= \dots \times \dots$$

$$= \dots$$

290

c 40 increased by 17%

$$= \dots \times \dots$$

$$= \dots \times \dots$$

$$= \dots$$

46.8

d 15 increased by 30%

$$= \dots \times \dots$$

$$= \dots \times \dots$$

$$= \dots$$

19.5

DECREASING BY A PERCENTAGE USING MULTIPLIERS

- To decrease by a percentage using a decimal multiplier:
 - Subtract the percentage from 100%.
 - Convert resulting percentage to decimal.
 - Multiply using a calculator.

Example Decrease by a percentage using multipliers.

Decrease 150 by 15%.	Where did 85% come from?
1. Subtract from 100% $150 \times 85\%$	To decrease by 15%, we 15%
2. Convert 150×0.85	from%, which is 85%
3. Multiply 127.5	

a Decrease 12 by 25%

$$= 12 \times 75\%$$

$$= \dots \times \dots$$

$$= \dots$$

9

b 170 decreased by 35%

$$= \dots \times \dots$$

$$= \dots \times \dots$$

$$= \dots$$

110.5

c 450 decreased by 85%

$$= \dots \times \dots$$

$$= \dots \times \dots$$

$$= \dots$$

67.5

d 550 decreased by 12.5%

$$= \dots \times \dots$$

$$= \dots \times \dots$$

$$= \dots$$

481.25

Key ideas

- To increase by a percentage, add the percentage to the original and
- To decrease by a percentage, the percentage from the original and multiply.
- 145% of a quantity is the same as by 45%.
- 80% of a quantity is the same as decreasing by%

1 Find the percentage after these percentage increases, and the decimal you would multiply by.

a 10% increase 110%, $\times 1.1$	b 15% increase%, $\times$ 115%, $\times 1.15$	c 35% increase 115%, $\times 1.15$
d 52% increase 152%, $\times 1.52$	e 60% increase 160%, $\times 1.6$	f 6% increase 106%, $\times 1.06$
g 75% increase 175%, $\times 1.75$	h 90% increase 190%, $\times 1.9$	i 17% increase 117%, $\times 1.17$

2 Find the percentage after these percentage decreases, and the decimal you would multiply by.

a 10% decrease 90%, $\times 0.9$	b 15% decrease%, $\times$ 85%, $\times 0.85$	c 35% decrease 65%, $\times 0.65$
d 52% decrease 48%, $\times 0.48$	e 60% decrease 40%, $\times 0.4$	f 6% decrease 94%, $\times 0.94$
g 75% decrease 25%, $\times 0.25$	h 90% decrease 10%, $\times 0.1$	i 17% decrease 83%, $\times 0.83$

3 Write down the decimal multiplier you would use to

a Increase by 20% $\times 1.2$	b Decrease by 20% $\times 0.8$	c Increase by 30% $\times 1.3$
d Decrease by 30% $\times 0.7$	e Decrease by 90% $\times 0.1$	f Increase by 2% $\times 1.02$
g Decrease by 2% $\times 0.98$	h Increase by 17% $\times 1.17$	i Decrease by 17% $\times 0.83$
j Increase by 65% $\times 1.65$	k Decrease by 65% $\times 0.35$	l Increase by 100% $\times 2$
m Increase by 25% $\times 1.25$	n Decrease by 35% $\times 0.65$	o Decrease by 42% $\times 0.58$
p Increase by 4.5% $\times 1.045$	q Increase by 123% $\times 2.23$	r Decrease by 4.5% $\times 0.955$

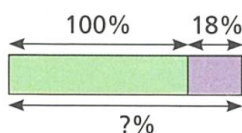
4 Calculate these percentage increases and decreases.

a Increase 200 by 18%

$$= 200 \times 118\%$$

$$= 200 \times 1.18$$

$$= \dots\dots\dots$$



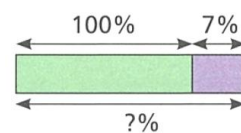
236

b Increase 80 by 7%

$$= \dots\dots\dots \times \dots\dots\dots$$

$$= \dots\dots\dots \times \dots\dots\dots$$

$$= \dots\dots\dots$$



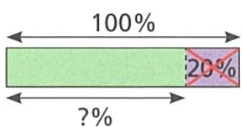
85.6

c Decrease 150 by 20%

$$= \dots\dots\dots \times \dots\dots\dots$$

$$= \dots\dots\dots \times \dots\dots\dots$$

$$= \dots\dots\dots$$



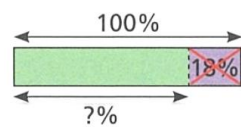
120

d Decrease 75 by 18%

$$= \dots\dots\dots \times \dots\dots\dots$$

$$= \dots\dots\dots \times \dots\dots\dots$$

$$= \dots\dots\dots$$



61.5

e Increase 160 by 40%

224

f Decrease 63 by 20%

50.4

g Increase 25 by 100%

50

h Increase 14 by 150%

21

5 What is the effect of each of these decimal multipliers?

a 1.04

4% increase

b 0.94

6% decrease

c 1.2

20% increase

d 1.23

23% increase

e 1.08

8% increase

f 0.85

15% decrease

g 1.92

92% increase

h 0.62

38% decrease

i 0.18

82% decrease

j 1.09

9% increase

k 1.67

67% increase

l 2

100% increase

m 2.5

150% increase

n 3.5

250% increase

o 0.1

90% decrease

p 0.05

95% decrease

q 0.02

98% decrease

r 2.02

102% increase

6 Calculate these percentage increases.

a Increase 30 by 10%

$$30 \times 1.1 =$$

b Increase 30 by 20%

c Increase 60 by 20%

d Increase 60 by 10%

e Increase 74 by 10%

f Increase 74 by 15%

g Increase 84 by 10%

h Increase 84 by 5%

i Increase 84 by 2.5%

7 Calculate these percentage decreases.

a Decrease 30 by 10%

$$30 \times 0.9 =$$

b Decrease 30 by 20%

c Decrease 60 by 20%

d Decrease 60 by 10%

e Decrease 74 by 10%

f Decrease 74 by 15%

g Decrease 104 by 10%

h Decrease 104 by 5%

i Decrease 104 by 2.5%

j Increase 44 by 2.5%

k Increase 44 by 5.2%

l Increase 44 by 0.5%

m Increase 44 by 50%

n Increase 44 by 100%

o Increase 44 by 150%

p Increase 44 by 175%

q Increase 88 by 175%

r Increase 88 by 275%

j Decrease 68 by 2.5%

k Decrease 68 by 5.2%

l Decrease 68 by 0.5%

m Decrease 48 by 50%

n Decrease 48 by 100%

o Decrease 96 by 60%

p Decrease 96 by 30%

q Decrease 96 by 15%

r Decrease 96 by 10%

33

45.1

36

46.288

72

44.022

66

66

81.4

88

85.1

110

92.4

121

88.2

242

86.1

330

27

66.3

24

64.464

48

67.66

54

24

66.6

0

62.9

38.4

93.6

67.2

98.8

81.6

101.4

86.4

8 Perform these percentage operations.

a Find 35% of 60

b Find 60% of 35

c Increase 60 by 35%

d Increase 35 by 60%

e What is 100% of 35?

f Increase 35 by 100%

g Find 160% of 35

h Find 160% of 35

i Increase 35 by 160%

j Decrease 60 by 35%

k Decrease 35 by 60%

l Decrease 35 by 100%

m 35 as a percentage of 60

n 60 as a percentage of 35

21

21

81

56

35

70

56

56

91

39

14

0

58.3%

171.43%

9 Which of these calculations represents increasing 55 by 12%?

A

$$55 \times 0.12$$

B

$$55 \times 1.12$$

C

$$0.12 \times 55 + 55$$

D

$$\frac{55}{100} \times 112$$

E

$$55 \div 0.88$$

B and C and D

10 In 1980, the population of a village was 1200. By 2020, the population had fallen by 45%. Calculate the population of the village in 2020.

660

11 An arena has a capacity of 2800. An extension increases the capacity of the arena by 35%. Find the new capacity of the arena.

3780

12 Zach works 4 days a week. Each working day, he works from 9 a.m. to 4 p.m. He is paid \$20 per hour. At the end of the week, he is given a 20% bonus on his earnings. Work out how much Zach earns each week.

\$672

- 13 Joey used 0.27 as his multiplier when working out a percentage problem.



He must have been working out 27% of an amount.

He must have been working out a 73% decrease.



Explain why they are both correct.

27% of an amount is the same as a 73% decrease.

- 14 “To increase 170 by 20% I work out 20% of 170 and add it to 170”.

“To increase 170 by 20%, I multiply 170 by 1.2 “

“To increase 170 by 20%, I multiply by $\frac{6}{5}$ ”

Explain why the three methods are equivalent.

All three methods find 120% of the original amount.

- 15 The height of a plant increases by 150%.

a Calculate the new height if the original height was 70 cm.

175 cm

b Explain why multiplying by 1.5 is incorrect.

To increase, we add 150% to 100%, which is 250%. Therefore we should multiply by 2.5.

- 16 Filipo is thinking of two numbers, x and y .

He decreases x by a quarter and increases y by 20%. The new numbers are equal.

Write this information as an equation of the form: $\square x = \square y$

If $y = 60$, find the value of x .

PERCENTAGE INCREASE & DECREASE IN FINANCE

Prior knowledge check

- 1 A shopkeeper **discounts** an item in a sale. The price changes from \$10 to \$8.
 - a Explain what is meant when someone “discounts” (verb) something.
.....
 - b The discount is \$2. Describe what a discount (noun) is.
.....
 - c The discounted price is \$8. Describe what the discounted price is.
.....
- 2 A supermarket discounts a bag of chocolates from \$5.50 to \$3.50.
 - a Identify the original price.
 - b Identify the discounted price.
 - c Identify the discount amount.
- 3 A shopkeeper **marks up** an item in a sale. The price changes from \$10 to \$13.
 - a Explain what is meant when someone “marks up” (verb) something.
.....
 - b The mark-up is \$3. Describe what a mark-up (noun) is.
.....
 - c The mark-ed up price is \$13. Describe what the marked-up price is
.....
- 4 A supermarket marks up a bag of chocolates from \$5.50 to \$7.30.
 - a Identify the original price.
 - b Identify the marked-up price.
 - c Identify the mark-up amount.
- 5 The original price of an item is \$60. Determine the final price after a:
 - a Discount of 50% off
 - b Discount of 25% off
 - c Discount of 10% off
 - d Discount of 75% off

MARKUPS AND DISCOUNTS

- Percentages have many applications in the business world.
- Mark-up, surcharge, inflation, appreciation: **percentage increase**.
- Mark-down, discount, % off, depreciation: **percentage decrease**.

Example Identify percentage increase or decrease.

Determine whether these represent a percentage increase or decrease.		
a Discount	b Mark-up	c Reduce
d Appreciate	e Depreciate	f Inflation
g Surcharge	h % off	i Mark-down

Example Calculate markups and discounts.

A \$860 television is discounted by 25%. Find the discount amount and the discounted price. Discount amount = $25\% \times \\$860$ $= \\$215$ Discounted price = Original price – Discount $= \\$860 - \\215 $= \\$645$	Calculate 75% of 860. Why is a 25% discount is the same as 75% of the original? 25% discount means to 25% from%, which makes 75%.
---	---

Complete the table.

Scenario	Change, as a percentage	Final price, as a percentage
\$860 television is discounted by 25%.	–25%	75%
\$80 poster has been marked up by 30%	+30%	130%
\$600 television has been discounted by 20%	–20%	80%
\$150 scooter has been reduced by 15%.	–15%	85%
\$52 jumper has depreciated by 25%.	–25%	75%
\$14 meal has a surcharge of 10%.	+10%	110%
\$420 stereo has been marked up by 50%	+50%	150%
\$50 boogie board is 70% off.	–70%	30%

a Find the discount and the discounted price if a supermarket is offering 30% off a \$5.50 bar of chocolate. Discount amount = $30\% \times \\$5.50$ = Discounted price = $70\% \times \\$5.50$ = \$1.65 \$3.85	b Find the mark-up and the marked-up price if a \$250 microwave oven has been marked up by 12%. Mark-up amount = $12\% \times \\$250$ = Marked-up price = $112\% \times \\$250$ = \$30 \$280
c A shop is offering 60% off storewide. How much of a discount would you get for a \$70 jacket? \$42	d A shop is offering 60% off storewide. What would be the discounted price of a \$70 jacket? \$28
e A bottle of drink used to cost \$8. Its price inflated by 7%. How much would it cost now? \$8.56	f A bottle of water used to cost \$8. Its price inflated by 7%. How much did the price increase by? \$0.56
g A café has a 15% holiday surcharge. If a meal cost \$17 on a normal day, how much would it cost on a public holiday? \$19.55	h A car originally cost \$60 000 and depreciated by 12%. How much is it worth now? \$52800

Key ideas

1. Mark-up, surcharge, inflation, and appreciation are all words associated with percentage
2. Discount, % off, depreciation, mark-down are all words associated with percentage
3. You need to read the question carefully to determine whether you are finding the change, or the final amount.

1 Fill in the blanks.

a  Cost price = \$12
Mark-up = \$33
Retail price = \$

\$45

b  Cost price = \$7 per kg
Mark-up = \$2 per bag
Retail price = \$ per bag

\$9

c  Cost price = \$15
Mark-up = \$
Retail price = \$50

\$35

d  Cost price = \$
Mark-up = \$22
Retail price = \$34

\$12

2 Fill in the blanks.

a  Retail price = \$50
Discount = \$10
Discounted price = \$

\$40

b  Retail price = \$20
Discount = \$4
Discounted price = \$

\$16

c  Retail price = \$15
Discount = \$
Discounted price = \$12.50

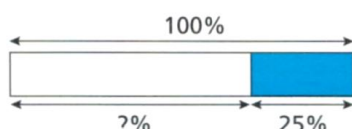
\$2.50

d  Retail price = \$
Discount = \$75
Discounted price = \$225

\$300

3

- a** A pair of shoes normally costs \$60. In a sale, the price is reduced by 25%.



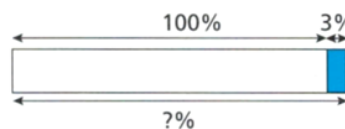
What percentage of the original price is the sale price?

Find the sale price of the shoes.

75%

\$45

- b** A train company increases fares by 3%. Lydia used to spend \$7 per ticket.



What percentage of the original price is the new price?

Find the new cost of travel.

103%

\$7.21

4 A toy store is having a sale in which everything is discounted by 10% of the recommended retail price (RRP). A remote-control car has a RRP of \$120.

- a** Calculate the discount on the car. **b** Calculate the selling price of the car.

\$12

\$108

5 A grocery store is increasing all prices by 8%. A tub of ice-cream used to cost \$8.50

- a** Calculate the mark-up. **b** Calculate the selling price.

\$0.68

\$9.18

6 Calculate the new price if:

- a** \$80 is discounted by 50% **b** \$30 is marked up by 20% **c** \$45 is reduced by 10%

\$40

\$36

\$40.50

- d** \$50 is 65% off

- e** \$75 has a surcharge of 20%

- f** \$85 appreciates by 120%.

\$17.50

\$90

\$187

- g** \$450 Blu-ray player reduced by 12%

- h** \$12 990 second-hand car depreciates by 15%

- i** \$1 725 000 home with an additional 3% selling fee

\$504

\$11041.50

\$1 776 750

7 A box of cereal has a mass of 375g. A promotional box contains an extra 20% for free. What is the mass of the promotional box?

450g

8 A dress costs \$42. It is reduced by 15% in a sale. What is the sale price of the dress?

\$35.70

- 9 A restaurant has a 1.5% surcharge on all credit card payments.
How much would a \$32.50 meal cost if paying by card?

\$32.99

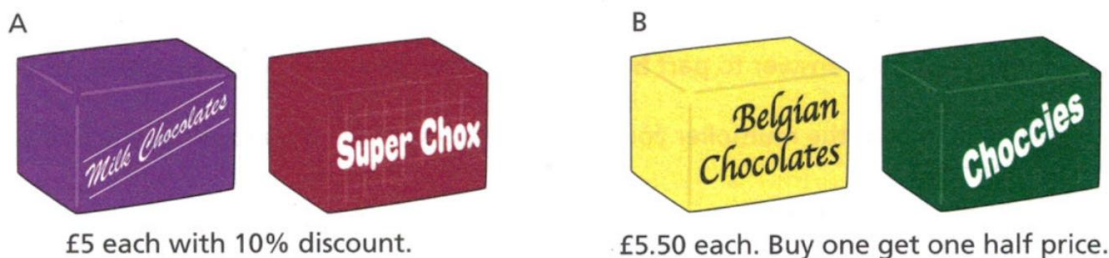
- 10 An online clothes store is offering 17.5% off all purchases.
How much would a skirt that originally costs \$85 be?

\$70.13

- 11 EB Games and Target buy PlayStations at a cost-price of \$480 and resell them at a markup.
EB Games has a mark-up of \$150 while Target has a mark-up of 25% of the cost-price.
At which store is the PlayStation cheaper, and by how much?

Target cheaper by \$30

- 12 Emily wants to buy two boxes of chocolate. Which is the better deal, and by how much?



Option B is the better deal by \$0.75

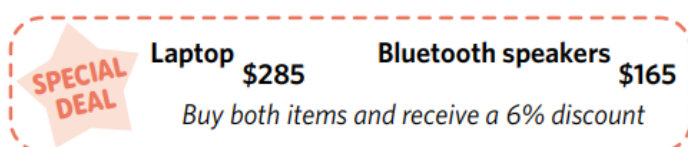
- 13 The online retailer Amazon provides three choices for the same TV:
Seller A prices the TV at \$2400 but doesn't offer a discount.
Seller B prices the TV at \$2900 but will offer a 20% discount.
Seller C prices the TV at \$2750 but will offer a 15% discount.
Which seller offers the TV at the lowest price?

Seller B

- 14 Tevita desperately wants to buy a new mountain bike that has a RRP of \$350. He has only \$220. The local bike store regularly has sales with discounts of multiples of 5%. What is the smallest discount that will allow him to purchase the bike?

40% off

- 15 Ruby buys the laptop and the Bluetooth speakers. The bill is \$425. Is this the correct amount to pay? Explain your answer.



No, she should only have to pay \$423

- 16 An electronics store is selling a sound system for \$1000. The manager wanted to make more money, so he increased the price by 100%. However, the manager realised no one was buying at the new price, so he decreased the price by 100%.

He notices that now everyone is buying a sound system.

- a How much is each customer paying?

\$0

- b Explain why this is not the original price.

By decreasing by 100% of the new price, he is making it free.

Calculate the results of these repeated percentage changes:

- c Increase \$280 by 10% and then decrease the result by 10%.

\$277.20

- d Decrease \$1400 by 5% and then increase the result by 5%.

\$1396.50

- 17 Show that an increase of 10% followed by a decrease of 10% on the new price gives a result that is less than the original amount.

$$x \times 1.1 \times 0.9 = 0.99x$$

CHANGE AS A PERCENTAGE OF THE ORIGINAL

Prior knowledge check

- 1 Calculate the change by using the formula $\text{Change} = \text{Final} - \text{Original}$

a 120 to 150	b 120 to 90	c 80 to 70
d 88 to 29	e 72 to 200	f 97 to 24
- 2 If you have 25 red marbles out of a total of 100 marbles, what percentage of the marbles are red?
- 3 A company sold 400 of its 1,000 products. What is the percentage of products sold?
- 4 If you have 4 green balls out of 5 balls, what percentage of the balls are green?
- 5 Out of a class of 30 students, 15 are girls. What percentage of the class are girls?
- 6 If you have \$200 saved, and you want to know what percentage of your \$600 savings goal you've reached, what is the percentage?

EXPRESSING CHANGE AS A PERCENTAGE OF THE ORIGINAL

Percentage Change Formula
$\text{Change} = \text{Final} - \text{Original}$ $\text{Percentage Change} = \frac{\text{change}}{\text{original}} \times 100$

- Percentage change expresses a difference as a **percentage** of the **original** value.
 - Calculate the change.
 - Calculate the percentage change.
 - If the percentage change is positive, then there has been an increase.
 - If the percentage change is negative, then there has been a decrease.

Example Express change as a percentage of the original.

Originally there are 120 students in a year. Find the percentage change if the number of students changes to 150. 1. $\text{Change} = 150 - 120 = 30$ 2. $\text{Percentage Change} = \frac{\text{change}}{\text{original}} \times 100$ $= \frac{30}{120} \times 100$ $= 25\%$ 25% increase.	How do we calculate the change? <i>Change is -</i> What does the formula $\frac{\text{Change}}{\text{Original}} \times 100$ calculate? <i>This finds the change as a of the original.</i>
Originally there are 120 students in a year. Find the percentage change if the number of students changes to 95. 1. $\text{Change} = 95 - 120 = -25$ 2. $\text{Percentage Change} = \frac{-25}{120} \times 100$ $= -20.83\%$ 20.83% decrease.	How do we know whether it's an increase or decrease? A answer means increase. A answer means decrease.

Calculate the percentage change. Answer to 2 d.p where appropriate.

a 80 to 120 Change: % change: $\frac{\quad}{90} \times 100$ 50% increase	b 80 to 70 Change: % change: 12.5% decrease	c 88 to 29 67.05% decrease
d 72 to 200 177.78% increase	e 97 to 24 72.16% decrease	f 50 to 76 52% increase

- 1 Complete the table, showing percentage change.

Original Amount	New Amount	Change	Percentage Change
90	125	$125 - 90 = 35$	$\frac{35}{90} \times 100 =$ 87.5% increase
12	20		66.66% increase
140	70		50% decrease
80	15		81.25% decrease
120	270		125% increase

- 2 Last year, a tennis club had 150 members. This year, the tennis club has only 126 members.

a How many fewer members does the club have than last year?

24

b Work out the percentage reduction in the number of members.

16% decrease

- 3 Last year, a book club had 60 members. This year, the book club has 96 members,

a How many more members does the club have this year than last year?

36

b Work out the percentage increase in the number of members.

60% increase

- 4 A plant is 1.6 m tall. One month later, the plant is 2 m tall.

Find the percentage increase in the height of the plant.

25% increase

- 5 Find the percentage change (increase or decrease) when:

a 15 g becomes 18 g

b 18 g becomes 15 g

20% increase

16.6% decrease

c 4 m becomes 24 m

d 24 m becomes 4 m

500% increase

83.33% decrease

6 Find the percentage change, to two decimal places, when:

a A ticket was \$60 but changed to \$29.

b A ticket of \$60 originally cost \$29.

51.66% decrease

106.90% increase

c A 12 cm tall hedge grows to 18 cm.

d A hedge that got cut down to 12 cm was originally 18 cm.

50% increase

33.33% decrease

7 Find the percentage change when:

a \$12 is increased **to** \$15.

b \$12 is increased **by** \$15.

25% increase

125% increase

c What is the difference between “increased to” and “increased by”.

“increased to” tells you the final value;

“increased by” tells you the change.

8 Find the percentage change when:

a \$60 is decreased by \$15.

b \$60 is decreased to \$15.

25% decrease

75% decrease

c \$25 is increased to \$37.

d \$25 is increased by \$37.

48% increase

148% increase

e \$55 is decreased to \$18.

f \$37 is increased to \$58.

67.27% decrease

56.76% increase

9 A rugby player has mass 105 kg. His doctor advises him to lose 15% of his mass.

a Work out the mass of the rugby player if he succeeds in losing 15% of his mass.

89.25 kg

b The rugby player actually loses 12 kg. What percentage of his mass has he lost?

11.43% decrease

PROFIT AND LOSS

- If you sell something for more than you paid for it, then you have made a profit.
- If you sell something for less than you paid for it, then you have made a loss.

$$\text{Profit/Loss} = \text{Selling Price} - \text{Cost Price}$$

- **Profit** is when the difference is positive, **loss** is when the difference is negative.

Example Determine the profit or loss.

Phillip buys a table for \$386. He sells it for \$400. Is this profit or loss, and by how much? $\begin{aligned}\text{Profit/Loss} &= \text{Selling Price} - \text{Cost Price} \\ &= \$400 - \$386 \\ &= \$14\end{aligned}$ \$14 profit. Diana buys a phone for \$1200 and sells it for \$800. Is this profit or loss, and by how much? $\begin{aligned}\text{Profit/Loss} &= \text{Selling Price} - \text{Cost Price} \\ &= \$800 - \$1200 \\ &= -\$400\end{aligned}$ \$400 loss.	What does “cost price” mean? <i>Cost price is how much a seller for an item.</i> How do we know whether the difference between two numbers is profit or loss? <i>By using Selling Price – Cost Price, if the answer is positive, it is, if the answer is negative, it is</i>
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a Determine profit or loss:
Cost price: \$12
Selling price: \$18

b Determine profit or loss:
Cost price: \$20
Selling price: \$15

c Shirley buys a bike for \$525 and sells it for \$418. Is this a profit or a loss, and by how much?

d Kathy buys some lollies for \$3.15. She sells them at a charity stall for \$4.50. Is this a profit or a loss, and by how much?

\$6 profit

\$5 loss

\$107 loss

\$1.35 profit

Key ideas

1. If selling price > cost price, then we call the difference
2. If selling price cost price, then we call the difference loss.

Percentage Change Formula
$\text{Percentage Change} = \frac{\text{change}}{\text{original value}} \times 100$

Example Express profit or loss as a percentage of the original.

An investor bought a share for \$12 and sold it for \$4. What is the percentage profit/loss? 1. Profit/Loss = Selling price – Cost price $= 4 - 12$ $= -8 \quad \therefore \$8 \text{ loss}$ 2. Percentage loss = $\frac{\text{change}}{\text{original}} \times 100$ $= \frac{-8}{12} \times 100$ $= -66.\dot{6}\%$ Loss of 66.6%.	How do we calculate the change? Change is – How do we know whether it is a profit or a loss? A answer means profit. A answer means loss.
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Calculate the percentage change in these scenarios.

a A collector buys an antique for \$250 and sells it for \$300. Change = Percentage change = $\frac{\text{change}}{\text{original}} \times 100$ 50% profit	b A trader invests \$8000. After a year their investment has a value to \$6300. Change = Percentage change = 21.25% loss
c Ross buys a ticket to a concert for \$125, but later is unable to go. He sells it to his friend for \$75. Change = Percentage change = 40% loss	d The population of Australia increased from 22.03 million to 26.64 million. Change = Percentage change = 20.93% increase

Key ideas

1. Percentage profit or loss is calculated by writing the change as a fraction of the then multiplying by 100.

1 Calculate the percentage change and state whether it is a profit or loss.

a \$20 becomes \$36

b \$10 becomes \$13

80% profit

30% profit

c \$40 becomes \$30

d \$25 becomes \$21

25% loss

12.5% loss

2 Sven buys a tablet computer for \$650. How much does he sell the tablet for if:

a he makes a profit of 20%.

b he makes a loss of 30%.

\$780

\$455

3 Abdullah buys a scooter for \$75. He later sells it for \$60

a What loss does Abdullah make on the scooter?

b What percentage loss does he make?

\$15

20% loss

4 A shop buys printers for \$80 and sells them for \$95.

a How much profit does the shop make for each printer?

b What percentage profit does the shop make for each printer?

\$15

18.75% profit

5 Complete the table.

Cost Price \$	Selling Price \$	Profit/Loss	% Profit/Loss
4	5	\$1 profit	$\frac{1}{4} \times 100 = 25\%$ profit
10	12		20% profit
10	7		30% loss
16	12		25% loss
24	30		25% profit
100	127		27% profit
50	47		6% loss
25	15		40% loss

6

a Gari buys a ticket to a concert for \$90. She sells it to her friend for \$72. Calculate the percentage loss she made.

20% loss

b Mr Ding buys trading cards for \$120. 10 years later he sells them for \$500. Calculate the percentage profit made.

316.6% profit

c Ava buys scarves for \$15 and sells them for \$21. What is her percentage profit?

40% profit

d Beth buys a car for \$8000. Two years later, she sells it for \$5500. Work out her percentage loss.

31.25% loss

7 Which of the following stores is offering a larger percentage discount?

Store A: Jeans originally selling for \$60, now on sale for \$51

Store B: Jeans originally selling for \$84, now on sale for \$73.50

Store B

8 Chloe is running a tuck shop. She buys a pack of 12 chocolate bars for \$3.50

a Chloe sells all the chocolate bars for 60c each. Work out her percentage profit.

105.71% profit

b Work out Chloe's percentage profit if she sells one third of the chocolate bars for 60c each and the rest for 30c each.

37.14% profit

9

a A new car costs \$15000. After 3 years, the car has lost 35% of its value. How much is the car worth after 3 years?

\$9750

b A different car costs \$18000 when new and is worth \$14000 after 3 years. What is the percentage decrease in the value of the car?

22.2% decrease

10 Complete the table. Round your answer to 2 decimal points.

Price Paid	Selling Price	Percentage Profit or Loss
\$16	\$20	$\frac{\text{Change}}{\text{Original}} \times 100 =$ 25% profit
\$20	\$16	20% loss
\$5.99	\$7.49	25.04% profit
\$30	$30 \times 1.45 =$ \$43.50	45% profit
\$30	\$34.50	15% profit
\$80	\$68	15% loss
\$85	\$17	80% loss
\$90	\$166.50	85% profit

11 Decide whether you are finding the selling price or calculating the percentage change.

a Xavier purchased materials for \$48 and made a dog kennel. Later, he sold the kennel for \$84. Calculate the percentage profit or loss.	b Jemma purchased a \$400 foal. How much should she sell it for if she wants to make a 30% profit?
c Lee purchased a \$5000 car, which she later sold for \$2800. Calculate the percentage profit or loss.	d Estelle purchased a piece of sporting equipment for \$120. She sold it for a loss of 35%. How much did she sell it for?
e Helen creates bracelets using materials costing \$0.80 and sell them for \$10 each. Calculate the percentage profit or loss.	f Charlotte wants to sell her knitted squares for a 250% profit. If the squares cost her \$1.30 to make in materials, how much should she sell them for?

- 12** Seb buys a book for \$12 and sells it for \$15. He works out his percentage profit:

$$\text{Profit} = 15 - 12 = 3$$

$$\text{Percentage profit} = \frac{3}{15} \times 100\% = 20\%$$

Explain Seb's mistake.

He divided by the new value instead of the original value.

- 13** Jason and Cheryl's test marks both go up by 20 percentage *points*.

Jason: "My test mark went up from 55% to 75%"

Cheryl: "My test mark went up from 42% to 62%"

Who has made the most improvement? Explain your answer.

Cheryl, as she made a 47.6% improvement while Jason made a 36.4% improvement.

- 14** Flo buys 12 cupcakes for \$5.64. She sells the cupcakes for 60 cents each.
Work out Flo's percentage profit.

27.66% profit

- 15** Emily buys 6 mugs for \$17.10. She sells each mug for \$3.55. Work out her percentage profit.

24.56% profit

- 16** An elephant calf weighed 115 kg when born. The calf grew to an adult weighing 5.93 tonnes.
Calculate the percentage change in mass, to the nearest percentage.

5057% increase

- 17** Emma completed a worksheet in 2:18 (minutes:seconds).
A week later, she completed the same worksheet in 1:45.
Work out the percentage change, to 1 d.p.

23.9% decrease

- 18** Chloe buys 200 bracelets for \$120.
At the summer fete, she sells one-quarter of the bracelets for \$2.
She then reduces the price of the remaining bracelets by 25%.
At the end of the day, she has 20 bracelets left. Work out:

a the number of bracelets that she sold at the reduced price.

130

b Chloe's total income.

\$295

c the percentage profit that she made.

45.83% profit

- 19** A professor earns \$58 000 a year.
She pays no tax on the first \$12 500 of her earnings,
she pays 20% tax on earnings from \$12 500 to \$37 500 and
40% tax on earnings over \$37 500.
Express the total amount of tax she pays as a percentage of her earnings, rounded to 2 d.p.

22.76%

CHECK YOUR UNDERSTANDING

Express a quantity as a percentage

1	What is 100 as a percentage of 500?						
a	25%	b	100%	c	$\frac{1}{5}\%$	d	20%
2	In a quiz, Karl scored 14 out of 20. What is this as a percentage?						
a	14%	b	70%	c	60%	d	36%
3	In a quiz, Tricia scored 26 out of 40. What is this as a percentage?						
a	86%	b	26%	c	52%	d	65%
4	What is 140 as a percentage of 70?						
a	2%	b	50%	c	70%	d	200%
5	A drink is 270 mL. It contains 28 mL of cordial. What percentage is cordial?						
a	9.6%	b	11%	c	10.4%	d	75.6%
6	What percentage of a 1 kg bag is 0.7 kg?						
a	7%	b	700%	c	0.7%	d	70%
7	What is 50 m as a percentage of 5 km?						
a	100%	b	1%	c	50%	d	10%

Find percentage of a quantity

1	25% of 12	a	3	b	4	c	2	d	3.3
2	20% of 80	a	20	b	15	c	16	d	80
3	90% of 50	a	90	b	45	c	40	d	50
4	40% of 80	a	40	b	35	c	30	d	32
5	75% of 50	a	37.5	b	35	c	30	d	40
6	15% of 200	a	10	b	30	c	15	d	75
7	95% of 200	a	195	b	190	c	180	d	200
8	25% of 3	a	0.75	b	1.5	c	0.25	d	2.25
9	65% of 20	a	30	b	65	c	13	d	15

Increase and decrease by a percentage

1	Increase 80 by 20%			
a	88	b	16	c 96 d 100
2	Decrease 30 by 20%			
a	6	b	24	c 36 d 27
3	Decrease 40 by 40%			
a	0	b	16	c 56 d 24
4	Increase 160 by 30%			
a	208	b	190	c 48 d 4800
5	Increase 600 by 20%			
a	660	b	120	c 720 d 620
6	Increase 700 by 20%			
a	140	b	770	c 720 d 840
7	Decrease 220 by 15%			
a	187	b	$14\frac{2}{3}$	c 33 d 205

Percentage change using multipliers

1	What is the multiplier for increasing by 26%?	a	$\times 0.26$	b	$\times 1.26$	c	$\times 26$	d	$\times 126$
2	What is the multiplier for decreasing by 53%?	a	$\times 0.47$	b	$\times 0.67$	c	$\times 67$	d	$\times 47$
3	What does the multiplier 0.92 calculate?	a	8% decrease	b	92% decrease	c	8% increase	d	92% increase
4	What does multiplier 1.03 calculate?	a	3% increase	b	3% decrease	c	1.03% increase	d	30% increase
5	What is the multiplier for decreasing by 2.3%?	a	$\times 1.023$	b	$\times 1.23$	c	$\times 0.977$	d	$\times 0.97$
6	Increase 650 by 17%	a	667	b	747.5	c	760.5	d	776
7	Increase \$9.50 by 20%	a	\$0.70	b	\$1.90	c	\$11.40	d	\$19
8	Reduce 400 by 6%	a	240	b	424	c	376	d	425.53

Percentage change in finance

1	The cost of a train ticket was \$25. It experiences inflation of 10%. What is the new price?						
a	\$2.50	b	\$35	c	\$250	d	\$27.50
2	\$220 marked up by 20%						
a	\$26400	b	\$240	c	\$44	d	\$264
3	15% of \$360						
a	\$54	b	\$345	c	\$306	d	\$24
4	15% off \$360						
e	\$54	f	\$345	g	\$306	h	\$24
5	An artwork originally valued at \$500 appreciates by 25%. What is the new value?						
a	\$550	b	\$525	c	\$125	d	\$625
6	Jake buys a shirt marked at \$80 and has a 10% discount coupon. How much should he expect to pay?						
a	\$54	b	\$70	c	\$72	d	\$74
7	Rosie buys a coat marked at \$120 and uses a 20% off coupon code. How much will she save?						
a	\$96	b	\$24	c	\$100	d	\$20
8	Meena receives a 20% pay increase. Her pay was \$9.50, how much <i>extra</i> does she now get paid?						
a	\$0.70	b	\$1.90	c	\$11.40	d	\$19

Percentage change

1	What is the percentage increase from 40 to 50?						
a	25%	b	10%	c	20%	d	0.1%
2	What is the percentage increase from 80 to 280?						
a	250%	b	200%	c	71.42%	d	2.5%
3	In a storm 200 fruit trees were left standing out of an original 250. What is the percentage change in trees?						
a	20%	b	−20%	c	25%	d	−25%
4	The price of a watch was \$620. The price increased to \$708. What was the percentage change in price?						
a	14.2%	b	87.6%	c	12.4%	d	85.8%
5	A phone that originally costs \$800 has a sale price of \$600. What is the percentage discount?						
a	33.3%	b	$\frac{1}{4}\%$	c	200%	d	25%
6	Ash buys a car for \$3150 and sells it for \$4095. What is the percentage profit?						
a	30%	b	945%	c	23.08%	d	49.95%
7	The price of a TV decreases by \$400 to \$1200. What was the percentage decrease?						
a	$66\frac{2}{3}\%$	b	33.3%	c	25%	d	75%