TOPIC 6

Application of percentages

6.1 Overview

Why learn this?

Percentages are used to describe many different kinds of information. They are so common that they have their own symbol, %. A *per cent* is a hundredth, so using percentages is an alternative to using decimals and fractions. Percentages are a convenient way to describe how much of something you have and how meaningful information is. For example, you might see an item advertised for sale at 10% discount.

What do you know?

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1 **THINK** List what you know about percentages. Use a thinking tool such as a concept map to show your list.
2 **PAIR** Share what you know with a partner and then with a small group.
3 **SHARE** As a class, create a thinking tool such as a large concept map that shows your class's knowledge of percentages.

Learning sequence

6.2 Percentages, fractions and decimals

- The term **per cent** means 'per hundred'.
- The symbol for percentage is %. For example, 60% means 60 parts out of 100 parts.
- Percentages, fractions and decimals are different ways of expressing the same quantity.
- Percentage is another way of writing a fraction with a denominator of 100, or of writing the number of hundredths in a decimal.

$$60\% = \frac{60}{100} = 0.60$$

- There are a number of common percentages, and their fraction and decimal equivalents, with which you should be familiar.

Percentage	Fraction	Decimal
50%	$\frac{1}{2}$	0.5
25%	$\frac{1}{4}$	0.25
75%	$\frac{3}{4}$	0.75
$33\frac{1}{3}\%$	$\frac{1}{3}$	$0.\dot{3}$
100%	1	1

WORKED EXAMPLE 1

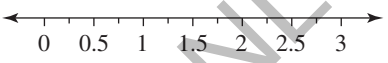
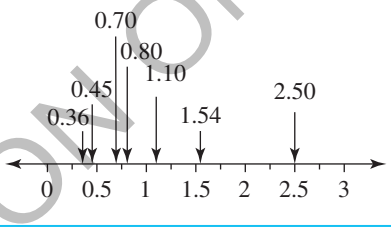
Convert the following percentages to fractions and then decimals.
a 67% **b** 55%

THINK	WRITE
a 1 To convert to a fraction, write the percentage, then change it to a fraction with a denominator of 100.	**a** $67\% = \frac{67}{100}$
2 To convert 67% to a decimal, think of it as 67.0%, then divide it by 100 by moving the decimal point two places to the left.	$67\% = 0.67$
b 1 To convert 55% to a fraction, write the percentage, then change it to a fraction by adding a denominator of 100.	**b** $55\% = \frac{55}{100}$
2 This is not in simplest form, so cancel by dividing the numerator and the denominator by 5.	$55\% = \frac{\cancel{55}}{\cancel{100}} = \frac{11}{20}$
3 To convert 55% to a decimal, think of it as 55.0%, then divide it by 100 by moving the decimal point two places to the left.	$55\% = 0.55$

- The easiest method of comparing percentages, fractions and decimals is to convert all of them to their decimal form and use place values to compare them.

WORKED EXAMPLE 2

Place the following quantities in ascending order, and then place them on a number line.
45%, $\frac{7}{10}$, 0.36, 80%, $2\frac{1}{2}$, 110%, 1.54

THINK	WRITE/DRAW
1 Convert all of the quantities into their decimal equivalents.	0.45, 0.7, 0.36, 0.80, 2.5, 1.10, 1.54
2 Place them in ascending order.	0.36, 0.45, 0.7, 0.80, 1.10, 1.54, 2.5
3 Place them in ascending order in their original form.	0.36, 45%, $\frac{7}{10}$, 80%, 110%, 1.54, $2\frac{1}{2}$
4 Draw a number line from 0 to 3, with increments of 0.25.	
5 Place the numbers on the number line.	

Percentage increases and decreases

- Percentage increases and decreases can be used to calculate and compare prices, mark ups, discounts, population changes, company profits and many other quantities.

WORKED EXAMPLE 3

Calculate the percentage increase when 52 increases to 72.

THINK	WRITE
1 The difference between 52 and 72 is 20.	$72 - 52 = 20$
2 The percentage increase can be calculated by creating the fraction 20 out of 52 and then multiplying by 100.	$\frac{20}{52} \times 100 = 38.46$
3 Write the answer.	The percentage increase is 38.46%.

WORKED EXAMPLE 4

Calculate the percentage decrease when the population of a town falls from 62 000 people to 48 000 people.

THINK	WRITE
1 The difference between 62 000 and 48 000 is 14 000.	$62\,000 - 48\,000 = 14\,000$
2 The percentage decrease can be calculated by creating the fraction 14 000 out of 62 000 and then multiplying by 100.	$\frac{14\,000}{62\,000} \times 100 = 22.58$
3 Write the answer.	The percentage decrease is 22.58%.

Percentage error

- Percentage error is used to compare the difference between an estimate of a quantity and the actual value. For example, manufacturers and scientists use percentage error to determine the reliability of their equipment and processes, and the validity of their experiments. The closer the percentage error is to zero, the better the estimate.

Calculating percentage error

- If the approximate value is greater than the exact value:

$$\text{Percentage error} = \frac{\text{approximate value} - \text{exact value}}{\text{exact value}} \times 100$$

- If the approximate value is less than the exact value:

$$\text{Percentage error} = \frac{\text{exact value} - \text{approximate value}}{\text{exact value}} \times 100$$

WORKED EXAMPLE 5

a The estimated weight of a newborn baby was 3500 grams, but the baby's actual weight was 4860 grams. Calculate the percentage error.
b The estimated distance between two towns was 70 km, but the actual distance was 65.4 km. Calculate the percentage error.

THINK	WRITE
a 1 The estimated weight was less than the actual weight.	a $\text{Percentage error} = \frac{\text{exact value} - \text{approximate value}}{\text{exact value}} \times 100$
2 Calculate the percentage error.	$\text{Percentage error} = \frac{4860 - 3500}{4860} \times 100$ $= 27.98\%$
3 Write the answer.	The percentage error is 27.98%.
b 1 The estimated distance was greater than the actual distance.	b $\text{Percentage error} = \frac{\text{approximate value} - \text{exact value}}{\text{exact value}} \times 100$
2 Calculate the percentage error.	$\text{Percentage error} = \frac{70 - 65.4}{65.4} \times 100$ $= 7.03\%$
3 Write the answer.	The percentage error is 7.03%.

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Exercise 6.2 Percentages, fractions and decimals

INDIVIDUAL PATHWAYS

REFLECTION
Where might it be necessary in daily life to convert between percentages and fractions or decimals?

PRACTISE	CONSOLIDATE	MASTER
Questions: 1–11, 14, 16	Questions: 1–16	Questions: 1–17

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FLUENCY

1 Express each of the following fractions as a percentage.
a $\frac{7}{8}$ **b** $\frac{3}{5}$ **c** $\frac{5}{6}$ **d** $2\frac{1}{3}$

2 Express each of the following decimals as a percentage.
a 0.15 **b** 0.85 **c** 3.10 **d** 0.024

3 WE1 Express the following percentages as fractions in simplest form.
a 20% **b** 35% **c** 61% **d** 105%

4 WE1 Express the following percentages as decimals.
a 24% **b** 13% **c** 1.5% **d** 250%

UNDERSTANDING

5 WE2 For the following sets of numbers, write them in ascending order and then place them on a number line.
a 1.6, 25%, $\frac{7}{8}$, 75%, 10%, $3\frac{1}{2}$, 2.4 **b** $3\frac{4}{5}$, 330%, 4.5, 150%, 3, $2\frac{1}{3}$, 2.8

6 WE3 Calculate the percentage increase when 250 increases to 325.

7 WE4 Calculate the percentage decrease, correct to 2 decimal places, when the population of fish in a pond decreases from 1500 to 650.

8 Express \$120 as a percentage of \$400.

9 In a library, there are 24 children, 36 women and 42 men. What is the percentage of women visiting the library? Give your answer to 2 decimal places.

10 During a sale, a jacket originally priced at \$79.99 is decreased in price to \$55.99. What is the percentage decrease?

11 WE5 **a** The estimated grocery bill budgeted for the week was \$250, but the actual bill was \$262.20. Calculate the percentage error.
b A long-distance runner estimated her run took 120 minutes, but the official time recorded was 118.3 minutes. Calculate the percentage error.

REASONING

12 A group of students was practising their basketball free throws. Each student had four shots and the results are displayed in the table.

Free throw results	Number of students	Percentage of students
No shots in	3	
One shot in, three misses	11	
Two shots in, two misses	10	
Three shots in, one miss	4	
All shots in	2	

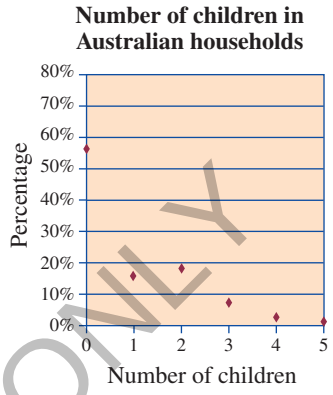
a How many students participated in the game?
b Complete the table to show the percentage of students for each result.
c How many students made exactly 25% of their shots?
d What percentage of students made less than 50% of their shots?

13 WE5 In supermarkets, potatoes are frequently sold in 2 kg bags. As potatoes are discrete objects, the bags rarely weigh exactly 2 kg. For reasons relating to both customer satisfaction and profit, the warehouse supervisor knows that a percentage error of more than 10% is unacceptable.

Two bags of potatoes are chosen at random and weighed. Bag A weighs 2.21 kg and Bag B weighs 1.88 kg. Calculate the percentage error for each of these bags and determine if either or both will pass the inspection.

PROBLEM SOLVING

14 The graph at right shows the percentage of households with 0 to 5 children.



- **a** What percentage of these households have six or more children?
- **b** What percentage of these households have fewer than two children?
- **c** What fraction of these households have no children?
- **d** What fraction of these households have between one and three children?

15 Use the bunch of flowers shown to answer these questions.

- **a** What percentage of the flowers are yellow?
- **b** What fraction of the flowers are pink?
- **c** Write two of your own questions and swap with a classmate.

16 Survey your classmates on the brand of mobile phone that they have. Present your results in a table showing the percentage, fraction and decimal amount of each brand.

17 The Australian government capped the level of ethanol in petrol at 10%, because petrol with 20% or more ethanol may cause engine problems in some older vehicles.

- **a** Explain what is meant by the expression 'capped at 10%'.
- **b** What is the highest fraction of ethanol allowed in Australian petrol?
- **c** Above what fraction of ethanol can car engines experience problems?

CHALLENGE 6.1

The price of entry into a theme park has increased by 10% every year since the theme park opened. If the latest price rise increased the tickets to $8.80, what was the price of a ticket 2 years ago?

6.3 Finding percentages of an amount

- Sally wants to buy a book but is not sure whether she has enough money. The original price was $35 but the sale notice says that all books have been reduced by 20%.
- If you were the sales assistant, could you help her solve the problem?

To find a percentage of an amount (for example 20% of $35):

1. write the percentage as a fraction with a denominator of 100
2. change the 'of' to a ×
3. write the amount over one if it is not already a fraction
4. cancel
5. multiply the numerators and multiply the denominators
6. divide the numerator by the denominator.

WORKED EXAMPLE 6

Find 20% of 35.

THINK	WRITE
1 Write the question.	20% of 35
2 Write the percentage as a fraction with a denominator of 100, change the 'of' to a '×', write the amount as a faction over 1 and cancel.	$= \frac{20}{\cancel{100}^{20}} \times \frac{\cancel{35}^{7}}{1}$
3 Cancel again.	$= \frac{\cancel{20}^{1}}{\cancel{20}^{1}} \times \frac{7}{1}$
4 Multiply numerators and multiply denominators.	$= \frac{7}{1}$
5 Simplify by dividing the numerator by the denominator.	$= 7$

- If Sally has $30, does she have enough money to buy the book? The price has been reduced by $7. The sale price is $28 so she will have enough.

WORKED EXAMPLE 7

Find 46% of 75 and write the answer as a mixed numeral.

THINK	WRITE
1 Write the question.	46% of 75
2 Write the percentage as a fraction, change the 'of' to a '×', write the number as a faction over 1. Cancel.	$= \frac{46}{\cancel{100}^{4}} \times \frac{\cancel{75}^{3}}{1}$
3 Cancel again.	$= \frac{\cancel{46}^{23}}{\cancel{4}^{2}} \times \frac{3}{1}$
4 Multiply numerators and multiply denominators.	$= \frac{69}{2}$
5 Write the answer as a mixed numeral by dividing the denominator into the numerator.	$= 34\frac{1}{2}$

- To find a percentage of an amount using decimals:
  1. write the percentage as a decimal
  2. change the 'of' to × (multiplication)
  3. multiply.

WORKED EXAMPLE 8

Of the 250 students selected at random to complete a survey, 16% were in Year 11. How many students were in Year 11?

THINK	WRITE
1 Decide what percentage of the total is required and write an expression to find the percentage of the total.	16% of 250
2 Write the percentage as a decimal. Change the 'of' to a '×.'	$= 0.16 \times 250$
3 Multiply.	$= 40$
4 Answer the question by writing a sentence.	40 of the 250 students were in Year 11.

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Exercise 6.3 Finding percentages of an amount

REFLECTION
In what situations would it be useful to use the shortcut methods for common percentages?

INDIVIDUAL PATHWAYS

PRACTISE	CONSOLIDATE	MASTER
Questions: 1–10, 14, 18, 24	Questions: 1a–e, 2a–l, 3a–i, 4, 5a–g, 6a–l, 7–18, 24–26	Questions: 1e–j, 2j–u, 3g–o, 4, 5i–l, 6i–r, 7–26

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FLUENCY

1 Copy each of the following problems, then find the answers by completing the working.

a $90\% \text{ of } 200 = \frac{90}{100} \times \frac{200}{1} =$

b $8\% \text{ of } 50 = \frac{8}{100} \times \frac{50}{1} =$

c $50\% \text{ of } 120 = \frac{50}{100} \times \frac{120}{1} =$

d $20\% \text{ of } 90 = \frac{20}{100} \times \frac{90}{1} =$

e $30\% \text{ of } 150 = \frac{30}{100} \times \frac{150}{1} =$

f $75\% \text{ of } 16 = \frac{75}{100} \times \frac{16}{1} =$

g $5\% \text{ of } 30 = \frac{5}{100} \times \frac{30}{1} =$

h $80\% \text{ of } 55 = \frac{80}{100} \times \frac{55}{1} =$

i $15\% \text{ of } 70 = \frac{15}{100} \times \frac{70}{1} =$

j $65\% \text{ of } 120 = \frac{65}{100} \times \frac{120}{1} =$

2 WE6 Find the following.

a 50% of 20	**b** 20% of 80	**c** 5% of 60	**d** 10% of 30
e 9% of 200	**f** 31% of 300	**g** 40% of 15	**h** 12% of 50
i 35% of 80	**j** 70% of 110	**k** 52% of 75	**l** 90% of 70
m 80% of 5000	**n** 44% of 150	**o** 68% of 25	**p** 24% of 175
q 38% of 250	**r** 95% of 200	**s** 110% of 50	**t** 150% of 8
u 125% of 20			

3 WE7 Find the following and write the answer as a mixed numeral.

a 18% of 20	**b** 16% of 30	**c** 11% of 70	**d** 8% of 120
e 74% of 25	**f** 66% of 20	**g** 2% of 95	**h** 55% of 45
i 15% of 74	**j** 32% of 220	**k** 95% of 62	**l** 32% of 65
m 18% of 80	**n** 82% of 120	**o** 27% of 60	

4 MC **a** 45% written as a fraction is:

A $\frac{45}{100}$ **B** $\frac{45}{1}$ **C** $\frac{450}{1}$ **D** $\frac{1}{45}$

b When finding 17% of 22, the 'of' will be changed to:

A ÷ **B** from **C** + **D** ×

c Which of the following would find 15% of 33?

A 15 of 33 **B** $\frac{15}{1} \times 33$ **C** $\frac{15}{100} \times \frac{33}{100}$ **D** $\frac{15}{100} \times \frac{33}{1}$

d 60% of 30 is:

A $19\frac{4}{5}$ **B** $\frac{31}{5}$ **C** 186 **D** 18

5 For each of the following, express the percentage as a decimal first and then solve, remembering to round your answer to the nearest 5c.

a 15% of $12.00	**b** 15% of $8.00	**c** 15% of $20.00
d 15% of $60.00	**e** 25% of $30.00	**f** 25% of $45.00
g 25% of $90.00	**h** 25% of $220.00	**i** 30% of $15.00
j 30% of $25.00	**k** 30% of $47.50	**l** 30% of $102.20

6 Find 1% of the following. Round the answers to the nearest 5c.

a $268	**b** $713	**c** $573	**d** $604
e $5.60	**f** $12	**g** $13	**h** $14.80
i $21.70	**j** $81.75	**k** $19.89	**l** $429.50
m $4.25	**n** $6.49	**o** $9.99	**p** $0.24
q $0.77	**r** $1264.37		

7 Find the following. Round the answers to the nearest 5c.

a 12% of $11	**b** 21% of $50	**c** 11% of $30
d 3% of $22	**e** 6% of $40	**f** 22% of $10
g 13% of $14	**h** 35% of $210	**i** 12% of $150
j 9% of $17	**k** 2% of $53	**l** 7% of $29
m 45% of $71.50	**n** 33% of $14.50	**o** 42% of $3.80
p 31% of $1.45	**q** 64% of $22.50	**r** 41% of $1200

8 MC **a** 10% of $7.25 equals:

A $725 **B** $7.30 **C** $72.50
D $0.73 **E** $7250

b 1% of $31.48 equals:

A $3.14 **B** $0.31 **C** $0.32
D $31.50 **E** $0.03

c 15% of $124 equals:

A $18.60 **B** $1.24 **C** $6.20
D $13.64 **E** $15.24

d 22% of $5050 equals:

A $60.60 **B** $50.50 **C** $1111
D $43.56 **E** $1010

UNDERSTANDING

9 Maria is buying a new set of golf clubs. The clubs are marked at $950, but if Maria pays cash, the shop will take 10% off the marked price. How much will the clubs cost if Maria pays cash?

10 WE8 Thirty per cent of residents in the shire of Booroondara are over the age of 65. If there are 180 000 residents, how many are over the age of 65?

11 Jay is buying a new lounge suite worth $2150. Jay has to leave a 15% deposit and then pay the balance in monthly instalments. How much deposit does Jay have to pay?

12 Ninety per cent of students at a school were present for school photographs. If the school has 1100 students, how many were absent on the day the photographs were taken?

13 Jim can swim 50 m in 31 seconds. If he improves his time by 10%, what will Jim's time for 50 m be?

14 In a survey, 40 people were asked if they liked or disliked Vegemite. Of the people surveyed, 5% said they disliked Vegemite. How many people:

a disliked Vegemite? **b** liked Vegemite?

15 Thirty-two thousand four hundred people went to the Gabba to watch a Brisbane versus Collingwood football match. Of the crowd, 42% went to the game by car and 55% caught public transport. How many people:

a arrived by car? **b** caught public transport?

16 Explain how to use the shortcut method (that is, without using a calculator) to leave a $17\frac{1}{2}$% tip for a bill of $76.

17 If a train fare of $12 was increased by 10%, how much will you pay for the return trip? (Assume that the fare is the same each way.)

REASONING

18 When I am 5% older than I am now, I will be 21 years old. How old am I now?

19 The price of bread has increased to 250% of its price 20 years ago. If a loaf of bread costs $2.00 now, how much would it have cost 20 years ago? Show your working.

20 I am six months old. If I gain 10% of my current mass I will be three times my birth mass. If my birth mass was 3 kg, what is my mass now? Round your answer to one decimal place. Show your working.

21 I am 33 years old. I have lived in England for 8 years. If I stay in England, how old will I be when the number of years I have lived there is 50% of my age? Show your working.

22 My mother is four times older than I am. My sister is 75% of my age, and 10% of my grandfather's age. My father is 50, 2 years older than my mother. How old are my sister and grandfather? Justify your answer.

PROBLEM SOLVING

23 Broadcasting regulations specify that 55% of television programs shown between 6 pm and midnight must be Australian and that, between 6 pm and midnight, there should be no more than 13 minutes per hour of advertising.

- **a** How many minutes of advertising are allowed between 6 pm and midnight?
- **b** For how many minutes are programs screened between 6 pm and midnight?
- **c** What is the maximum percentage time spent screening advertising?
- **d** How many minutes of Australian content must be screened between 6 pm and midnight?

24 In a Maths competition, the top 8% of students across the state achieve a score of 40 or more out of a possible 50.

- **a** In a school where 175 students are entered in the Maths competition, how many scores of more than 40 would you expect?
- **b** In one school, there were 17 scores of 40 or more, and 204 scores that were less than 40. Did the students perform better than state average?

25 My mother is four times older than I am. My sister is 75% of my age and 10% of my grandmother's age. My father is 50, which is two years older than my mother. How old are my sister and grandmother?

26 I am 27 years old and have lived in Australia for 12 years. If I continue to live in Australia, how old will I be when the number of years I have lived here is 75% of my age?

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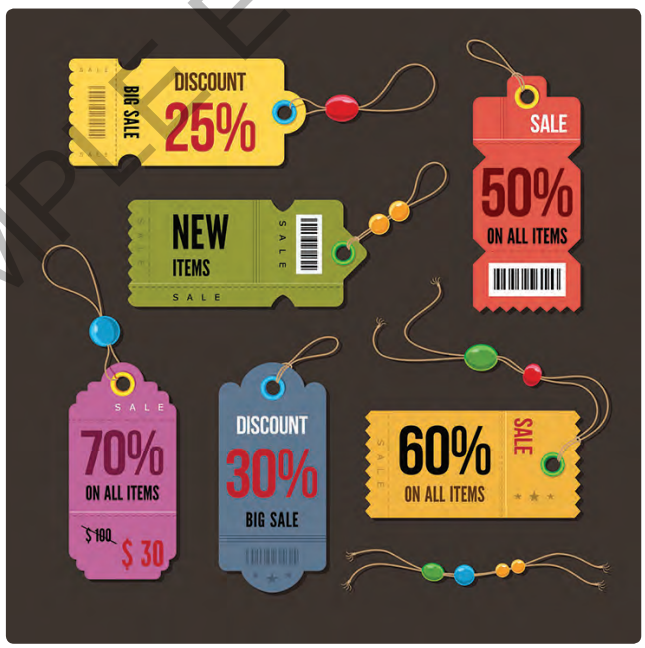
6.4 Discount

- To get rid of old stock (for example out-of-date fashions at the end of a season), store managers often reduce prices by giving discounts.
- A discount is a reduction in price.
- A discount can be shown as an amount in dollars.



- A discount can be shown as a percentage of the marked price (that is, the price marked on the article).

- If the discount is expressed as a percentage, to find the actual amount of a discount, we calculate the percentage of the marked price by multiplying the marked price by the percentage. For example, a 10% discount on an item marked at $120 gives a discount amount of $12.

Calculating selling price of a discounted item

- Method 1
  - Use the percentage remaining after the percentage discounted has been subtracted from 100%; that is, if an item for sale has a 10% discount then the price must be 90% of the marked price.

WORKED EXAMPLE 9

Find the sale price on a hat marked $72 if a 10% discount is given.

THINK	WRITE
1 Find the percentage of the marked price that is paid, by subtracting the percentage discount.	100% − 10% = 90%
2 Find the sale price of the hat.	90% of $72 = 0.9 × $72 = $64.80
3 Write the answer in a sentence.	The sale price of the hat is $64.80.

- Method 2
  - The new sale price of the item can be solved by calculating the amount of the discount, then subtracting the discount from the marked price.
  - Alternative solution:

Discount = 10% of $72.00
= $7.20

Sale price = marked price − discount
= \$72.00 − \$7.20
= \$64.80

WORKED EXAMPLE 10

Peddles is a bicycle store that has offered a discount of 15% on all goods.
Find:
a the cash discount allowed on a bicycle costing \$260
b the sale price of the bicycle.

THINK	WRITE
a Find the discount, which is 15% of the marked price.	a Discount = 15% of \$260 = 0.15 × \$260 = \$39 The cash discount allowed is \$39.
b 1 To find the sale price, subtract the discount from the marked price.	b Sale price = marked price − discount = \$260 − \$39 = \$221
2 Answer the question in a sentence.	The sale price of the bicycle is \$221.

- To calculate the percentage discount, write the monetary amount as a percentage of the original price.

$$\text{Percentage discount} = \frac{\text{cash discount}}{\text{original price}} \times \frac{100}{1}\%$$

WORKED EXAMPLE 11

At Peddles, the price of a bicycle is reduced from \$260 to \$200. Calculate the percentage discount.

THINK	WRITE
1 Calculate the amount of the discount.	Discount = \$260 − \$200 = \$60
2 Write the discount as a percentage of the original price.	Percentage discount = $\frac{60}{260} \times 100\%$ = 23%
3 Answer the question in a sentence.	The percentage discount is about 23%.

Exercise 6.4 Discount

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INDIVIDUAL PATHWAYS

PRACTISE	CONSOLIDATE	MASTER
Questions: 1–7, 12, 13, 20, 27	Questions: 1–20, 25, 27	Questions: 1–27

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REFLECTION
How are discounts used to encourage people to purchase?

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Digital docs
SkillSHEET
Decreasing a quantity by a percentage
doc-6899
SkillSHEET
Finding a percentage of a quantity (money)
doc-6900

FLUENCY

1 Calculate the discount on each of the items in the table, using the percentage shown.

	Item	Marked price	Discount
a	MP3 player	$210	20%
b	Skateboard	$185	25%
c	Rollerblades	$330	15%
d	Mobile phone	$190	40%

2 Without the use of a calculator, calculate the percentage discount for each of the following.

	Marked price	Discount
a	$100	$10
b	$250	$125
c	$90	$30
d	$80	$20

3 WE9 Find the sale price of each article when the marked price and discount are shown as in this table.

	Marked price (RRP)	Discount
a	$1000	15%
b	$250	20%
c	$95	12%
d	$156	$33\frac{1}{3}\%$
e	$69.95	$7\frac{1}{2}\%$

4 Decrease the amount by the percentages.

a $50 by 10% **b** $90 by 50% **c** $45 by 20%

5 Find the percentage discount given on the items shown in the table. Round to the nearest per cent.

	Original price	Selling price
a	$25	$15
b	$100	$72
c	$69	$50
d	$89.95	$70

UNDERSTANDING

6 A tablet computer was advertised with a saving of $148. Estimate the percentage discount being offered.

A$599
SAVE $148.00

7 The following items are all discounted.


$380
25% discount


$450
20% discount


$260
$33\frac{1}{3}$% discount


$600
15% discount

a Which has the largest dollar discount?

b Which have the same dollar discount?

c What is the difference between the largest and the smallest dollar discount?

d If the surfboard has a discount of 20%, would $470 be enough to buy it?

8 **WE10** A sale discount of 20% was offered by the music store Solid Sound. Find:

a the cash discount allowed on a $350 sound system

b the sale price of the system.

9 A wristwatch is advertised at $69.95, less 10% discount. Find the sale price.

10 A store-wide clearance sale advertised 15% off everything.

a What would be the selling price of a pair of jeans marked at $49?

b If a camera marked at $189 was sold for $160.65, was the correct percentage deducted?

11 T-shirts are advertised at $15.95 less 5% discount. How much would Jim pay for five T-shirts?

12 **WE11** Calculators were advertised at $20, discounted from $25. What percentage discount was given?

13 A tennis racquet marked at $79.95 sells for $60. What percentage discount is this, to the nearest whole number?

14 CDs normally selling for $28.95 were cleared for $23.95. What percentage discount was given (correct to 1 decimal place)?

15 A shirt was reduced from $90 to $63. Express the reduction as a percentage of the original price.

16 At a sale, Ann bought a $120 jacket for $48. What percentage of the original price did she save?

17 You bought a mobile phone priced $199.95 and signed up for a 1-year plan. You received a 10% discount on the telephone and 15% discount on the $75 connection fee. How much did you pay altogether (correct to the nearest 5 cents)?

18 Aanh bought two hairdryers for $128 each. She sold one at a loss of 5% and the other for a profit of 10%.

a Find the selling price of each.

b Will she have made a profit or a loss?

19 **MC** Kristen's car insurance was $670, but she had a 'No claim bonus' discount of 12%. Which of the following will not give the amount she must pay?

A First find 12% of $670 and add your answer to $670.

B Calculate $88 \div 100 \times 670$.

C Find 88% of $670.

D First find 12% of $670, and subtract your answer from $670.
E Calculate $0.12 \times \$670$ and subtract your answer from $670.

REASONING

20 Movie tickets sell for $12.00 each, but if you buy 4 or more you get $1.00 off each ticket. What percentage discount is this (correct to 2 decimal places)? Show your working. *Hint*: Find $1 as a percentage of $12.

21 MC I am allowed a discount of 10% off the total price of 6 articles that cost $\$x$ each. The price finally paid is:

A $\$60x$ **B** $\$5.4x$ **C** $\$0.06x$ **D** $\$0.6x$ **E** $\$6x$

Justify your answer.

22 You are in a surf shop and you hear 'For today only: take fifty per cent off the original price and then a further forty per cent off that.' You hear a customer say 'This is fantastic! You get ninety per cent off the original price!' Is this statement correct? Explain why.

23 Is there a difference between 75% off $200 and 75% of $200? Explain.

24 Henry buys a computer priced at $1060, but with a 10% discount. Sancha finds the same computer selling at $840 plus a tax of 18%. Who has the better buy? Explain.

PROBLEM SOLVING

25 A classmate was completing a discount problem where she needed to calculate a 25% discount on $79. She misread the question and calculated a 20% discount to get $63.20. She then realised her mistake and took a further 5% from $63.20. Is this the same as taking 25% on $79? Use calculations to support your answer.

26 A store had to increase its prices by 10% to cover increasing expenses. A particular DVD player was originally priced at $220. Use the questions below to help you calculate the new price of the DVD player using two different methods.

a i Calculate the cost increase and add it to the original price.
ii Add the percentage amount to 100% and multiply your answer by the original price.
b What do you notice about the answers to part **a**?
c Describe this alternative method in your own words.

27 What would you multiply the original prices of items by to get their new prices with:

a a 20% discount? **b** a 15% discount?
c a 25% increase? **d** a 5% increase?
e a 35% discount? **f** an 11% increase?
g a 6% discount? **h** a 100% increase?

eBookplus
Digital doc
Investigation
Successive discounts
doc-2228

6.5 Profit and loss

- When a manufacturer produces a product, it is usually sold to a wholesaler who subsequently sells the product on to retail outlets. At each stage the product is marked up by a certain percentage.

- When a retailer calculates the price to be marked on an article (the *selling price*, SP), many overhead costs must be taken into account (staff wages, rent, store improvements, electricity, advertising and so on).
- The total price the retail shop owner pays for the product including overhead costs is the *cost price*, CP.
- The *profit* is the difference between the total of the retailer's costs (cost price) and the price for which the goods actually sell (selling price).
  – If SP > CP, then a profit is made.

$$\text{Profit} = \text{selling price} - \text{cost price}$$

  – If SP < CP, then a loss is made.

$$\text{Loss} = \text{cost price} - \text{selling price}$$

Selling price

- To calculate the selling price of an item given the cost price and the percentage profit, increase the cost price by the given percentage.

$$\text{Selling price} = (100\% + \text{percentage profit}) \text{ of cost price}$$

- To calculate the selling price of an item given the cost price and the percentage loss, decrease the cost price by the given percentage.

$$\text{Selling price} = (100\% - \text{percentage loss}) \text{ of cost price}$$

WORKED EXAMPLE 12

Ronan operates a sports store at a fixed profit margin of 65%. For how much would he sell a pair of running shoes that cost him $40?

THINK	WRITE
1 Find the selling price by first adding the percentage profit to 100% then finding this percentage of the cost price.	Selling price = 165% of $40 = 1.65 × $40 = $66
2 Write the answer in a sentence.	The running shoes would sell for $66.

WORKED EXAMPLE 13

David bought a surfboard for $300 and sold it at a 20% loss a year later. What was the selling price?

THINK	WRITE
1 Find the selling price by first subtracting the percentage loss from 100% then finding this percentage of the cost price.	Selling price = 80% of $300 = 0.80 × $300 = $240
2 Write the answer in a sentence.	David sold the surfboard for $240.

- Profit or loss is usually calculated as a percentage of the cost price.

$$\text{Percentage profit} = \frac{\text{profit}}{\text{cost}} \times 100\%$$

$$\text{Percentage loss} = \frac{\text{loss}}{\text{cost}} \times 100\%$$

WORKED EXAMPLE 14

A music store buys CDs at $15 each and sells them for $28.95 each. What is the percentage profit made on the sale of a CD?

THINK	WRITE
1 Calculate the profit on each CD: selling price − cost.	Profit = $28.95 − $15 = $13.95
2 Calculate the percentage profit: $\frac{\text{profit}}{\text{cost}} \times 100\%$.	Percentage profit = $\frac{13.95}{15} \times 100\%$ = 93%
3 Write the answer in a sentence, rounding to the nearest per cent if applicable.	The profit is 93% of the cost price.

- Modern accounting practice favours calculating profit or loss as a percentage of the selling price. This is because commissions, discounts, taxes and other items of expense are commonly based on the selling price.

$$\text{Percentage profit} = \frac{\text{profit}}{\text{selling price}} \times 100\%$$

$$\text{Percentage loss} = \frac{\text{loss}}{\text{selling price}} \times 100\%$$

assessON

Exercise 6.5 Profit and loss

REFLECTION
How can you tell if an item is being sold for a profit or a loss?

INDIVIDUAL PATHWAYS

PRACTISE	CONSOLIDATE	MASTER
Questions: 1–8, 11, 19	Questions: 1–15, 18, 19	Questions: 1–20

Individual pathway interactivity int-4422 eBookplus

eBookplus

Digital docs
SkillSHEET Expressing one quantity as a percentage of another doc-6901
SkillSHEET Increasing a quantity by a percentage doc-6902

Assume percentage profit or loss is calculated on the cost price unless otherwise stated.

FLUENCY

1 WE12,13 Find the selling price for each of the following:

	Cost price	%	Profit/loss
a	$18	40%	profit
b	$116	25%	loss

	Cost price	%	Profit/loss
c	$1300	30%	profit
d	$213	75%	loss
e	$699	$33\frac{1}{3}\%$	profit

2 **WE14** For each of the following items, find the percentage profit or loss.

	Cost price	Selling price
a	$15	$20
b	$40	$50
c	$40	$30
d	$75	$85
e	$38.50	$29.95

UNDERSTANDING

3 A supermarket buys frozen chickens for $3.50 each and sells them for $5.60. What is the percentage profit made on the sale of each chicken?

4 A restored motorbike was bought for $350 and later sold for $895.

a How much profit was made?

b What percentage was profit? Give your answer correct to the nearest whole number.

5 James' Second Hand Bookshop buys second hand books for $4.80 and sells them for $6.00.

a What is the ratio of the profit to the cost price?

b What is the percentage profit on the cost price?

c What is ratio of the profit to the selling price?

d What is the percentage profit on the selling price?

e Discuss how **a** and **b** are related.

6 A retailer bought a laptop for $1200 and advertised it for $1525.

a How much profit was made?

b What is the percentage profit (to the nearest whole number) on the cost price?

c What is the percentage profit (to the nearest whole number) on the selling price?

d Compare the differences between the answers to **b** and **c**.

7 Rollerblades bought for $139.95 were sold after six months for $60.

a How much was the loss?

b What was the percentage loss? Give your answer to the nearest whole number.

8 A sports card collection costing $80 was sold for $65. What was the percentage loss?

9 Running shoes bought by a sports store for $30 per pair were sold at $79.95. What percentage profit was made?

10 Kyle runs a jewellery business that uses a fixed profit margin of 98%. For how much would he sell a necklace that cost him $830?

11 Find the selling price for each item.

- **a** Jeans costing $20 are sold with a profit margin of 95%.
- **b** A soccer ball costing $15 is sold with a profit margin of 80%.
- **c** A sound system costing $499 is sold at a loss of 45%.
- **d** A skateboard costing $30 is sold with a profit margin of 120%.

12 A fruit-and-veg shop bought 500 kg of tomatoes for $900 and sold them for $2.80 per kg.

- **a** What is the profit per kilogram?
- **b** Calculate the profit as a percentage of the cost price (round to 1 decimal place).
- **c** Calculate the profit as a percentage of the selling price (round to 1 decimal place).
- **d** Compare the answers to parts **b** and **c**.

13 Sonja bought an old bike for $20. She spent $47 on parts and paint and renovated it. She then sold it for $115 through her local newspaper. The advertisement cost $10.

- **a** What were her total costs?
- **b** What percentage profit (to the nearest whole number) did she make on costs?
- **c** What percentage profit (to the nearest whole number) did she make on the selling price?

14 MC A clothing store operates on a profit margin of 150%. The selling price of an article bought for $\$p$ is:

A $\$151p$ **B** $\$150p$ **C** $\$2.5p$ **D** $\$1.5p$ **E** $\$0.15p$

REASONING

15 A fruit and vegetable retailer buys potatoes by the tonne for $180 and sells them in 5-kg bags for $2.45. What percentage profit does he make (to the nearest whole number)? Show your working.

16 Two business partners bought a business for $158 000 and sold it for $213 000. The profit was to be shared between the two business partners in the ratio of 3 : 2. What percentage share (to the nearest whole number) does each person receive? How much does each receive?

17 What is the maximum discount a retailer can offer on her marked price of $100 so that she ends up selling at no profit and no loss, if she had initially marked her goods up by $50? Justify your answer.

PROBLEM SOLVING

18 To produce a set of crockery consisting of a dinner plate, soup bowl, bread plate and coffee mug, the costs per item are $0.98, $0.89, $0.72 and $0.69 respectively. These items are packaged in boxes of 4 sets and sell for $39. If the company sells 4000 boxes in a month, what is their total profit?

19 Copy and complete the table below.

Cost per item	Items sold	Sale price	Total profit
$4.55	504	$7.99	
$20.00		$40.00	$8040.00
$6.06	64 321		$225 123.50
	672	$89.95	$28 425.60

20 The method used to calculate profits can make a difference when comparing different profits.

Cost = $20.00
Price = $120.00

Cost = $26 500.00
Price = $32 000.00

Cost: $1.00 (Homemade)
Price: $3.50

a **i** Describe the profits on each of the items above as a raw amount.
ii List the items from largest profit to smallest profit.
iii Discuss whether this is a fair method of comparing the profits.

b **i** Express the profit on each of the items as a percentage of its cost.
ii List the items from largest profit to smallest profit.
iii Discuss whether this is a fair method of comparing the profits.

c **i** Express the profit on each of the items as a percentage of its price.
ii List the items from largest profit to smallest profit.
iii Discuss whether this is a fair method of comparing the profits.

eBook*plus*
Digital doc
WorkSHEET 6.2
doc-6913

CHALLENGE 6.2
Max bought a car for $6000.00. He sold it to Janine for 80% of the price he paid for it. Janine sold it to Jennifer at a 10% loss. Jennifer then sold it to James for 75% of the price she paid. What did James pay for the car? What was the total percentage loss on the car from Max to James?

6.6 Goods and Services Tax (GST)

- **GST**: This is a tax levied by the Australian federal government on goods and services. (As with all taxes, there are exemptions, but these will not be considered here.)

- **Goods**: A tax of 10% is added to new items that are purchased, such as some foods, petrol and lollies.
- **Services**: A tax of 10% is added to work (services) that is paid for, such as work performed by plumbers, painters and accountants.

WORKED EXAMPLE 15

A packet of potato chips costs $1.84 before GST. Find:
a the GST charged on the packet of chips
b the total price the customer has to pay.

THINK	WRITE
a GST is 10%.	10% of $1.84 = $0.18 cents (rounded)
b Total equals GST plus pre-GST price.	$1.84 + $0.18 = $2.02 (rounded up by the seller to $2.05)

- To find the pre-GST amount when the total you are given includes GST, divide the GST-inclusive amount by 110 and multiply by 100.

WORKED EXAMPLE 16

A plumber's hourly charge includes GST. If she worked for 5 hours and the total bill including GST was $580, what was her hourly price before GST?

THINK	WRITE
1 Find the hourly price including GST.	$\frac{\$580}{5} = \$116$
	110% of pre-GST hourly rate = $116
2 Find the hourly price excluding GST.	100% of pre-GST hourly rate = $\frac{\$116}{110} \times \frac{100}{1}$
	The plumber's hourly rate is $105.45 before GST.

assess on

Exercise 6.6 Goods and Services Tax (GST)

REFLECTION
What do the terms *inclusive* and *exclusive of GST* mean?

INDIVIDUAL PATHWAYS

PRACTISE	CONSOLIDATE	MASTER
Questions: 1–13, 15	Questions: 1–15	Questions: 1–16

Individual pathway interactivity int-4423 eBookplus

FLUENCY

1 Explain the GST in your own words.
2 Does GST apply below? Answer yes or no for each example.

a Petrol
b A lawyer's fee
c Hotel accommodation
d Lounge room carpet
e Floor tiling
f Wages at a fast-food restaurant

3 **WE15** With or without a calculator:
i calculate the GST payable on each of the following pre-GST prices
ii calculate the total price including GST.
a 500 g laundry powder at $4.50
b 400-g tin of canned peaches at $2.12

4 **WE16** The prices below are inclusive of GST. What is the pre-GST price of each?
a 1 kg apples at $3.85
b 500 g laundry powder at $4.50
c 400-g tin of canned peaches at $2.20
d 5 kg potatoes at $6.50

5 The telephone company Ringtel charges home customers $42.50 per month plus $0.24 per local call. Find the monthly phone bill, including GST, if a customer makes 51 local calls in a month.

6 All car rental agencies use similar charging plans. Drivo charges $44 per day plus $0.47 per kilometre travelled. A customer wishes to rent a car for four days and travels 1600 km. What is her total bill, including GST?

7 Expresso is a company that operates in the 'we-visit-you' car repair business. It charges $85 per hour plus a flat $40 visiting fee.
a Set up an expression, which includes GST, for the cost of a repair that takes t hours.
b If the repair takes 3 hours and 30 minutes, what is the final cost?

8 A company that installs floor tiles charges $35 per square metre for the actual tiles, and a fee of $100 plus $10 per square metre to install the tiles in a home. Let the area of the floor to be tiled be x m^2.
a Find an expression, including GST, that represents the total cost of tiling in terms of x.
b What would be the total cost for a 20 m^2 floor?

9 A new bicycle costs $450, including GST. How much is the GST?

10 To buy my new super-dooper mobile phone outright I must pay $30 per month, including GST, for 3 years. How much GST will I pay?

11 I buy a pack of batteries and pay 25 cents GST. How much did I pay in total for the batteries?

UNDERSTANDING

12 In the United Kingdom a similar tax, called the Value Added Tax or VAT, is levied at 20%. If I paid A$67 for a jumper purchased in a shop in Bond Street, London:
a how much VAT did I pay?
b what was the pre-VAT price of the jumper?

13 In New Zealand GST is levied at 15% of the purchase price of goods. If I buy a pair of jeans and pay NZ$12 in GST, what total price did I pay for the jeans in NZ dollars?

REASONING

14 The Goods and Services Tax or GST rate is 10%. This means that when a business sells something or provides a service it must charge an extra $\frac{1}{10}$ of the price/cost. That extra money then must be sent to the tax office. For example, an item that would

otherwise be worth $100 now has GST of $10 added. So the price tag will show $110. The business will then send to the tax office that $10 with all the other GST it has collected on behalf of the government.

a Suppose a shopkeeper made sales totalling $15 400. How much GST must he put aside?

b Is there a number he can quickly divide by to figure out the GST?

PROBLEM SOLVING

15 In the country Snowdonia, GST is 12.5%. Igor's girlfriend Karla has purchased a new hair drier that cost her in total, including GST, 111 Kopeks. There are 100 Plens in 1 Kopek.

a How much GST did Karla pay?

b If 1 Australian dollar = 2 Kopeks, how much GST would Karla have paid if she had purchased the hair drier in Melbourne, where GST is currently 10%?

16 Taking GST to be 10%:

a what is the GST payable on an item whose pre-GST price is $\$P$, and what is the price payable?

b What is the pre-GST price of an item for which I paid $\$A$, and how much GST did I pay?

6.7 Review

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The Maths Quest Review is available in a customisable format for students to demonstrate their knowledge of this topic.

The Review contains:

- **Fluency** questions — allowing students to demonstrate the skills they have developed to efficiently answer questions using the most appropriate methods
- **Problem Solving** questions — allowing students to demonstrate their ability to make smart choices, to model and investigate problems, and to communicate solutions effectively.

A summary of the key points covered and a concept map summary of this topic are available as digital documents.

Review questions

Download the Review questions document from the links found in your eBookPLUS.

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Interactivities

Word search
int-2625

Crossword
int-2626

Sudoku
int-3186

Language

It is important to learn and be able to use correct mathematical language in order to communicate effectively. Create a summary of the topic using the key terms below. You can present your summary in writing or using a concept map, a poster or technology.

cost price
discount
GST
loss
marked price
overhead costs
percentage discount
percentage loss
percentage profit
profit
sale price
selling price

Link to assessON for questions to test your readiness **FOR** learning, your progress **AS** you learn and your levels **OF** achievement.

assessON

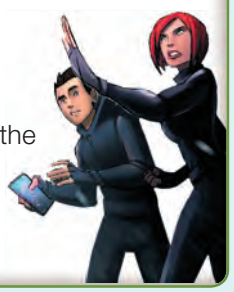
assessON provides sets of questions for every topic in your course, as well as giving instant feedback and worked solutions to help improve your mathematical skills.

www.assesson.com.au

Link to SpyClass, an exciting online game combining a comic book–style story with problem-based learning in an immersive environment.

SPY CLASS

Join Jesse, Toby and Dan and help them to tackle some of the world's most dangerous criminals by using the knowledge you've gained through your study of mathematics.



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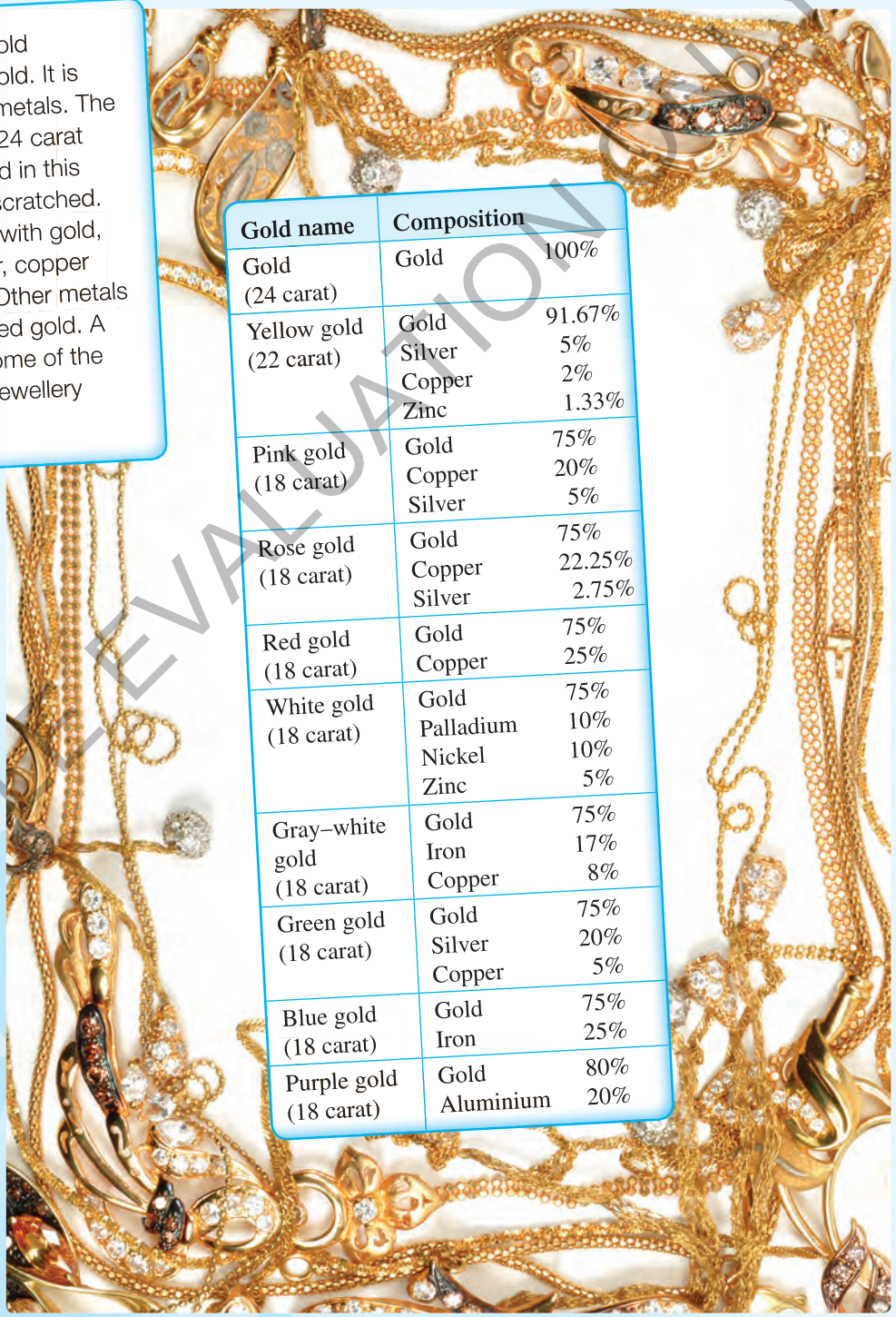
RICH TASK

The composition of gold in jewellery

You may be aware that most gold jewellery is not made of pure gold. It is actually an alloy, or mixture of metals. The finest gold used in jewellery is 24 carat and is known as fine gold. Gold in this form is very soft and is easily scratched. Most metals will form an alloy with gold, the most common being silver, copper and zinc in jewellery making. Other metals may be used to create coloured gold. A table of the composition of some of the common gold alloys used in jewellery pieces is shown at right.



Gold name	Composition	
Gold (24 carat)	Gold	100%
Yellow gold (22 carat)	Gold Silver Copper Zinc	91.67% 5% 2% 1.33%
Pink gold (18 carat)	Gold Copper Silver	75% 20% 5%
Rose gold (18 carat)	Gold Copper Silver	75% 22.25% 2.75%
Red gold (18 carat)	Gold Copper	75% 25%
White gold (18 carat)	Gold Palladium Nickel Zinc	75% 10% 10% 5%
Gray–white gold (18 carat)	Gold Iron Copper	75% 17% 8%
Green gold (18 carat)	Gold Silver Copper	75% 20% 5%
Blue gold (18 carat)	Gold Iron	75% 25%
Purple gold (18 carat)	Gold Aluminium	80% 20%

Use the table to answer the following questions.

1. Study the table and list the metals used to create the alloys of gold mentioned.
2. A particular rose-gold bracelet weighs 36 grams. Calculate the masses of the various components in the bracelet.
3. How much more gold would be in a yellow-gold bracelet of the same mass? What fraction is this of the mass of the bracelet?
4. Pink, rose and red gold all contain 75% gold. In addition, they each contain copper, and pink and rose gold also contain silver. Describe the effect you feel the composition of the alloy has on the colour of the gold.

5. Why does white gold not contain any copper?
6. Compare the composition of the alloys in red gold and blue gold.
7. 24-carat gold is classed as 100% gold. On this basis, an alloy of gold containing 75% gold has a carat value of 18 carat. Note this fact in the table above. The purple gold is 80% gold. What would its carat value be?
8. Just as there are various qualities of gold used in jewellery making, the same is true of silver jewellery. Sterling silver, which is commonly used, is actually not pure silver. Find out about the composition of silver used in jewellery making. Write a short report on your findings on a separate sheet of paper.

CODE PUZZLE

What did the grass say to the dirt?

The answer to each percentage question below, and the letter beside it, give the puzzle's solution code.

A 35% of $200	**B** 80% of 70kg	**C** $33\frac{1}{3}$% of 2h	**D** 62% of 1.5m
E 75% of 60min	**F** 20% of $250	**H** 150% of 28cm	**L** 5% of 380kg
M 90% of 50kg	**N** $12\frac{1}{2}$% of 96cm	**O** 8% of 10h	**Q** $6\frac{1}{2}$% of $1000	**R** 15% of 2m
S $66\frac{2}{3}$% of 45min	**T** 25% of $360	**U** 7% of 600kg	**X** 18% of $350

$70	93cm	93cm	$70	19kg	45min	$90	$90	45min	30cm	$90	48min

40min	12cm	45kg	,	30min	19kg	12cm	42kg	93cm	.	42cm	,	42kg	93cm

$50	12cm	30min	$63	12cm	$90	56kg	12cm	42kg	93cm	$65	93cm	40min	.

eBookplus Activities

6.2 Percentages, fractions and decimals

Digital docs

- SkillSHEET (doc-6897) Rounding money to the nearest 5 cents
- SkillSHEET (doc-6898) Converting a percentage to a decimal fraction

Interactivity

- IP interactivity 6.2 (int-4419) Percentages, fractions and decimals

6.3 Finding percentages of an amount

Digital doc

- WorkSHEET 6.1 (doc-6912)

Interactivity

- IP interactivity 6.3 (int-4420) Finding percentages of an amount

6.4 Discount

Digital docs

- SkillSHEET (doc-6899) Decreasing a quantity by a percentage
- SkillSHEET (doc-6900) Finding a percentage of a quantity (money)
- Investigation (doc-2228) Successive discounts

Interactivity

- IP interactivity 6.4 (int-4421) Discount

6.5 Profit and loss

Digital docs

- SkillSHEET (doc-6901) Expressing one quantity as a percentage of another
- SkillSHEET (doc-6902) Increasing a quantity by a percentage
- WorkSHEET 6.2 (doc-6913)

Interactivity

- IP interactivity 6.5 (int-4422) Profit and loss

6.6 Goods and Services Tax (GST)

Interactivity

- IP interactivity 6.6 (int-4423) Goods and Services Tax (GST)

6.7 Review

Interactivities

- Word search (int-2625)
- Crossword (int-2626)
- Sudoku (int-3186)

Digital docs

- Topic summary (doc-10758)
- Concept map (doc-10771)
- Topic review (Word doc-14934, PDF doc-14935)

To access eBookPLUS activities, log on to www.jacplus.com.au

Answers

TOPIC 6 Application of percentages

6.2 Percentages, fractions and decimals

1 **a** 87.5%
b 60%
c 83.33% (correct to 2 decimal places)
d 233.33% (correct to 2 decimal places)

2 **a** 15% **b** 85% **c** 310% **d** 2.4%

3 **a** $\frac{1}{5}$ **b** $\frac{7}{20}$ **c** $\frac{61}{100}$ **d** $\frac{21}{20}$

4 **a** 0.24 **b** 0.13 **c** 0.015 **d** 2.50

5 **a** 10%, 25%, 75%, $\frac{7}{8}$, 1.6, 2.4, $3\frac{1}{2}$
b 150%, $2\frac{1}{3}$, 2.8, 3, 330%, $3\frac{4}{5}$, 4.5

6 30%

7 56.67%

8 30%

9 35.29%

10 30%

11 **a** 4.65% **b** 1.44%

12 **a** 30
b

Free throw results	Number of students	Percentage of students
No shots in	3	10%
One shot in, three misses	11	36.$\dot{6}$%
Two shots in, two misses	10	33.$\dot{3}$%
Three shots in, one miss	4	13.$\dot{3}$%
All shots in	2	6.$\dot{6}$%

c 11 **d** 46.$\dot{6}$%

13 Bag B will pass but Bag A will not pass.

14 **a** 0% **b** 72% **c** $\frac{14}{25}$ **d** $\frac{41}{100}$

15 **a** 38% **b** $\frac{8}{21}$ **c** Answers will vary.

16 Answers will vary.

17 **a** The expression 'capped at 10%' means that petrol can contain a maximum of 10% ethanol.
b $\frac{1}{10}$ **c** $\frac{1}{5}$

Challenge 6.1

$7.27

6.3 Finding percentages of an amount

1 **a** 180 **b** 4 **c** 60 **d** 18 **e** 45
f 12 **g** $1\frac{1}{2}$ **h** 44 **i** $10\frac{1}{2}$ **j** 78

2 **a** 10 **b** 16 **c** 3 **d** 3 **e** 18
f 93 **g** 6 **h** 6 **i** 28 **j** 77
k 39 **l** 63 **m** 4000 **n** 66 **o** 17
p 42 **q** 95 **r** 190 **s** 55 **t** 12
u 25

3 **a** $3\frac{3}{5}$ **b** $4\frac{4}{5}$ **c** $7\frac{7}{10}$ **d** $9\frac{3}{5}$ **e** $18\frac{1}{2}$
f $13\frac{1}{5}$ **g** $1\frac{9}{10}$ **h** $24\frac{3}{4}$ **i** $11\frac{1}{10}$ **j** $70\frac{2}{5}$
k $58\frac{9}{10}$ **l** $20\frac{4}{5}$ **m** $14\frac{2}{5}$ **n** $98\frac{2}{5}$ **o** $16\frac{1}{5}$

4 **a** A **b** D **c** D **d** D

5 **a** $1.80 **b** $1.20 **c** $3.00 **d** $9.00 **e** $7.50
f $11.25 **g** $22.50 **h** $55.00 **i** $4.50 **j** $7.50
k $14.25 **l** $30.65

6 **a** $2.70 **b** $7.15 **c** $5.75 **d** $6.05 **e** $0.05
f $0.10 **g** $0.15 **h** $0.15 **i** $0.20 **j** $0.80
k $0.20 **l** $4.30 **m** $0.05 **n** $0.05 **o** $0.10
p $0.00 **q** $0.00 **r** $12.65

7 **a** $1.30 **b** $10.50 **c** $3.30 **d** $0.65 **e** $2.40
f $2.20 **g** $1.80 **h** $73.50 **i** $18.00 **j** $1.55
k $1.05 **l** $2.05 **m** $32.20 **n** $4.80 **o** $1.60
p $0.45 **q** $14.40 **r** $492.00

8 **a** D **b** B **c** A **d** C

9 $855

10 54 000 residents

11 $322.50

12 110 students

13 27.9 seconds

14 **a** 2 people **b** 38 people

15 **a** 13 608 people **b** 17 820 people

16 10% + 5% + $2\frac{1}{2}$% = $7.60 + $3.80 + $1.90 = $13.30

17 $26.40

18 20 years old

19 $0.80

20 8.2 kg

21 50 years old

22 9 years old, 90 years old

23 **a** 78 minutes
b 282 minutes or 4 hours 42 minutes
c $21\frac{2}{3}$%
d 155.1 minutes or 155 minutes 6 seconds

24 **a** 14
b 7.69% of students achieved a score of 40 or more, which is just below the state average.

25 Sister: 9; grandmother: 90

26 60

6.4 Discount

1 **a** $42 **b** $46.25 **c** $49.50 **d** $76

2 **a** 10% **b** 50% **c** $33\frac{1}{3}$% **d** 25%

3 **a** $850 **b** $200 **c** $83.60 **d** $104 **e** $64.70

4 **a** $45 **b** $45 **c** $36

5 **a** 40% **b** 28% **c** 28% **d** 22%

6 Estimate 25%

7 **a** Mobile phone $95
b Surfboard and bike
c $8.35 **d** No

8 **a** $70 **b** $280

9 $62.96

10 **a** $41.65 **b** Yes

11 $75.76

12 20%

13 25%

14 17.3%

15 30%

16 60%

17 $243.70

18 **a** $121.60 $140.80 **b** Gain

19 A

20 $1.00/$12.00 × 100% = 8.33%, so this is a 8.33% discount.

21 B

22 No, the statement is not correct. For example, if you have a cost of $100, a 50% discount = $50 and a 40% discount = $20. Total discount = $70; this represents a 70% discount, not 90%.

23 Yes (difference in the meanings) 75% off $200 = $150 off the price so would pay only $50.
75% of $200 = $150, i.e. $\frac{3}{4}$ of $200.

24 Henry pays $954; Sancha pays $991.20. Henry has the best buy.

25 95% of \$63.20 = \$60.05; 75% of \$79 = \$59.25. The two methods calculate percentages of different amounts so result in different answers.

26 **a** **i** 10% of \$220 = \$22
\$220 + \$22 = \$242
ii 110% of \$220 = \$242
b The answers are the same.
c The price increase is 10%. Add this to 100% to get 110% and then multiply 110% by the original price to give the new price.

27 **a** 80% **b** 85% **c** 125% **d** 105%
e 65% **f** 111% **g** 94% **h** 200%

6.5 Profit and loss

1 **a** \$25.20 **b** \$87 **c** \$1690 **d** \$53.25 **e** \$932

2 **a** $33\frac{1}{3}$% profit **b** 25% profit
c 25% loss **d** $13\frac{1}{3}$% profit
e 22.2% loss

3 60%

4 **a** \$545 **b** 156%

5 **a** 1 : 4 **b** 25% **c** 1 : 5 **d** 20%
e The ratio of the profit to the cost price as a fraction is the same as the percentage profit on the cost price.

6 **a** \$325 **b** 27% **c** 21%
d The percentage profit is greater on the cost price.

7 **a** \$79.95 **b** 57%

8 18.75%

9 166.5%

10 \$1643.40

11 **a** \$39 **b** \$27 **c** \$274.45 **d** \$66

12 **a** \$1.00 profit per kg
b 55.6%
c 35.7%
d The percentage profit is greater on the cost price.

13 **a** \$77 **b** 49% **c** 33%

14 C

15 172%

16 60%, 40%; \$33 000, \$22 000

17 50%

18 \$103 520

19

Cost per item	Items sold	Sale price	Total profit
\$4.55	504	\$7.99	\$1733.76
\$20.00	402	\$40.00	\$8040.00
\$6.06	64 321	\$9.56	\$225 123.50
\$47.65	672	\$89.95	\$28 425.60

20 **a** **i** \$100, \$5500, \$2.50
ii Car, shoes, cake
iii Not fair; profit should be compared as a proportion of cost.
b **i** 500%, 20.75%, 250%
ii Shoes, cake, car
iii Fairer than in questions in 1 and 3
c **i** $83.\dot{3}$%, 17%, 71.4%
ii Shoes, cake, car
iii Not fair; the profit should be calculated on the cost.

Challenge 6.2

James paid \$3240. The total percentage loss was 46%.

6.6 Goods and Services Tax (GST)

1 GST is a tax levied by the Australian federal government on goods and services.

2 **a–e** Yes **f** No

3 **a** **i** 45 cents **ii** \$4.94
b **i** 21 cents **ii** \$2.33

4 **a** \$3.50 **b** \$4.09 **c** \$2.00 **d** \$5.91

5 \$60.21

6 \$1020.80

7 **a** $1.1(85t + 40)$ **b** \$371.25

8 **a** $1.1(45x + 100)$ **b** \$1100

9 \$40.91

10 \$98.18

11 \$2.75

12 **a** \$11.17 **b** \$55.83

13 NZ\$92

14 **a** \$1400 **b** 11

15 **a** 12 Kopeks, 33 Plens
b \$4.94 GST, total price ≈ \$54.27

16 **a** $\$\frac{P}{10}, \$\frac{11P}{10}$ **b** $\frac{10A}{11}, \frac{A}{11}$

Investigation — Rich task

1 Metals used as alloying elements with gold are silver, copper, zinc, palladium, nickel, iron and aluminium.

2 27 g gold, 8.01 g copper, 0.99 g silver

3 6 g, $\frac{1}{6}$

4 From pink to rose to red gold the percentage of silver decreases, causing the gold alloy to darken in colour. At the same time, the percentage of copper increases, also contributing to the darker colour.

5 The copper would colour the gold with its familiar reddish colour so that it would not be white.

6 Red gold and blue gold each have 75% gold and 25% of another metal. In the case of red gold the contributing metal is copper; blue gold contains iron.

7 19 K

8 Answers will vary but should include that sterling silver is 92.5% silver and 7.5% copper. Silver from Mexico is of a lower quality. Teacher to check student answers.

Code puzzle

Don't move. I've got you covered.