

Student Name

Mathematics Stage 4

FRACTIONS DECIMALS PERCENTAGES

Book 10 Solve problems that involve
the use of percentages

Version: 260207
Report mistakes & suggest improvements:
<https://MrDingMaths.com>

CONTENTS

Overview	2
Repeated Percentage Change.....	5
Unitary Method For Finding a Percentage	16
Unitary Method for Financial Problems	23
The Goods and Services Tax	29
Mixed Practice.....	40
Check Your Understanding	44

OVERVIEW

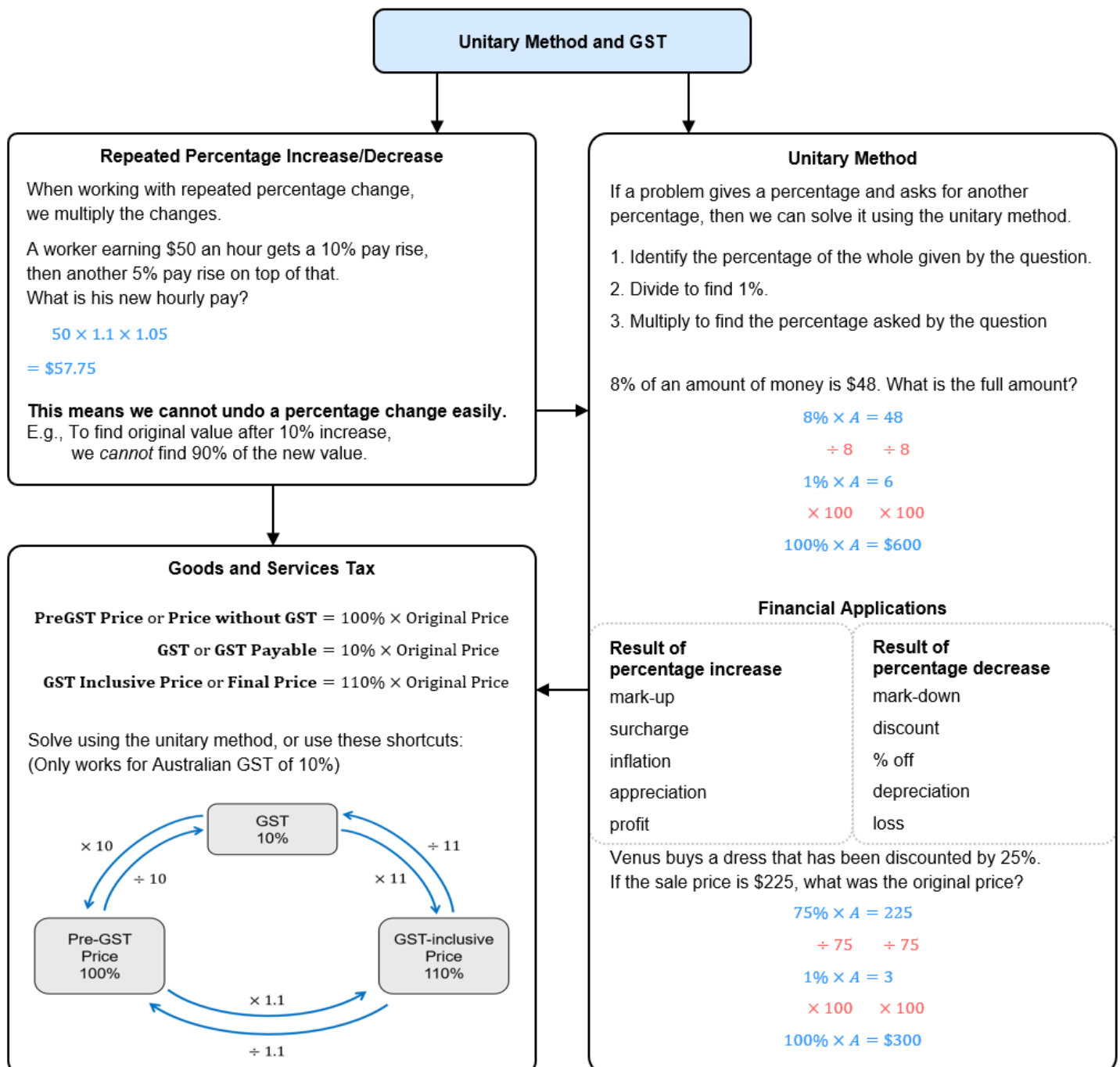
SYLLABUS CONTENT

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

Solve problems that involve the use of percentages

- Apply knowledge of percentages to calculate quantities in various contexts
- Apply knowledge of percentage increases and decreases to solve problems in various contexts
- Solve real-life problems involving percentages using the unitary method or other techniques
- Solve financial problems involving percentages, specifically considering GST, profit and loss

SUMMARY



REVIEW OF PRIOR KNOWLEDGE

1 Write these percentages as decimals.

a 45%

b 145%

c 109%

2 Write the decimal multiplier for these percentage problems:

a Increase by 35%

b Decrease by 35%

c Decrease by 65%

d Increase by 65%

e Find 35% of a quantity

f Find 65% of a quantity.

3 **Increase** 60 by:

a 10%

b 20%

c 50%

d 5%

e 40%

f 500%

4 **Decrease** 60 by:

a 10%

b 20%

c 50%

d 5%

e 40%

f 4%

5 Determine the percentage change:

$$\frac{\text{change}}{\text{original}} \times 100$$

a Original: 8
Final: 15

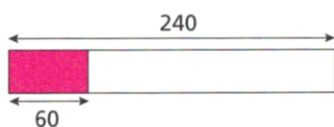
b Original: 50
Final: 90

c Original: 15
Final: 12

d Original: 500
Final: 360

6

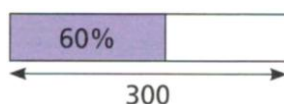
a Express 60 as a percentage of 240



b Work out 60% of 240



c Find 60% of 300



d Express 60 as a percentage of 300



7 Solve these equations.

a $\frac{x}{5} = 30$

b $\frac{3}{2}x = 16$

c $\frac{1}{4}x = 19$

d $1.5x = 45$

e $0.75x = 100$

f $0.25x = 50$

g 110% of $x = 38.5$

h 85% of $x = 102$

i 7% of $x = 80$

8

a If 50% of a quantity is 100,
what is 10%?

b If 75% of a quantity is 80,
what is 25%?

c If 110% of a quantity is 99,
what is 10%?

d If 160% of a quantity is 30,
what is 80%?

9 What is the new amount, as a percentage of the original?

a 18% markup

b 14% discount

c 70% off

118%

d 6.6% inflation

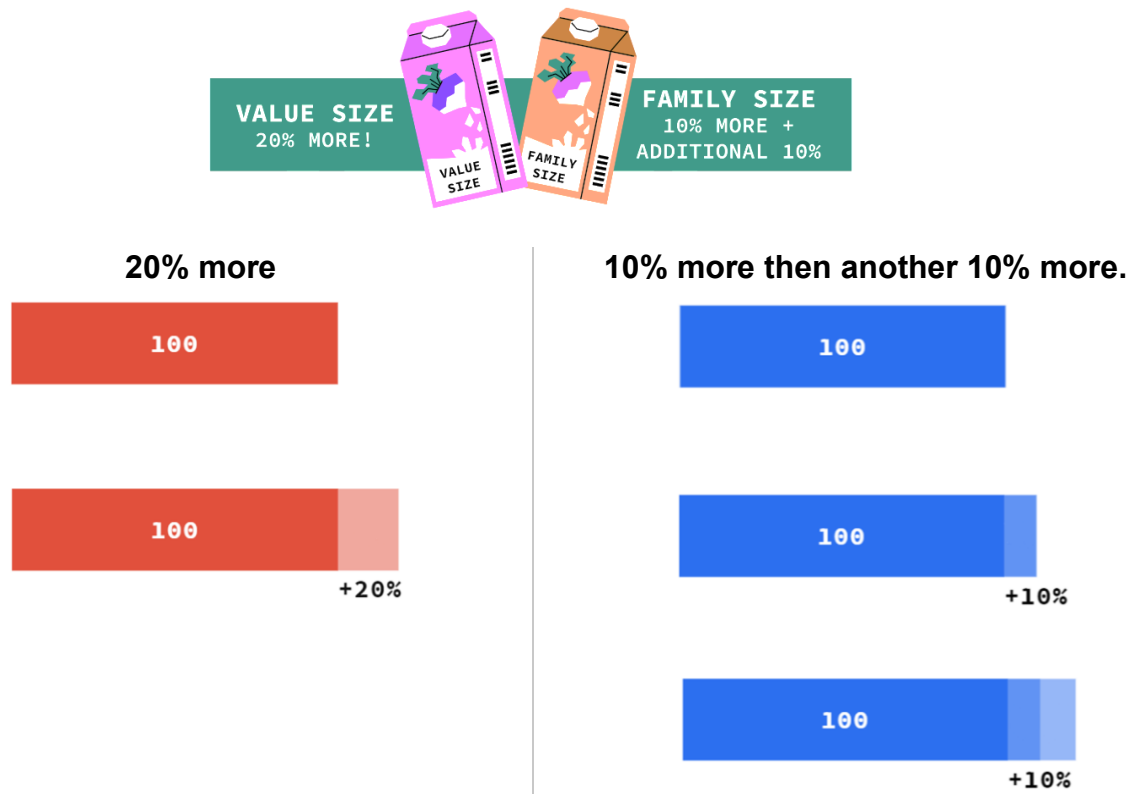
e 24% markup

f 17.5% discount

REPEATED PERCENTAGE CHANGE

Investigation Repeated percentage increase.

There are two different sizes of milk for the same price.
One contains 20% more than the original,
while the other has 10% more than the original then another 10% of the increased amount.
Which is the better deal?



When a percentage increase is applied repeatedly, the changes become larger because each increase is calculated based on a value.

This means that each subsequent increase is than the previous one, as it is applied to a amount.

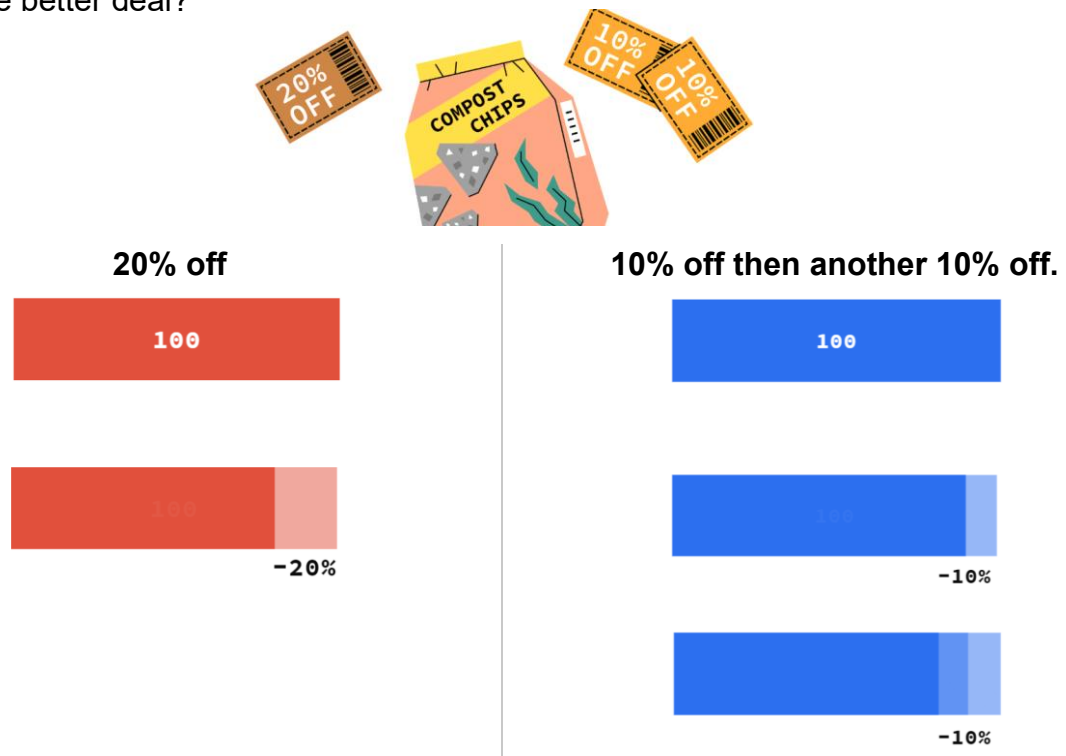
Investigation Repeated percentage decrease.

A chip packet can be bought in two ways.

You can either use a single 20% off coupon or

a 10% coupon and then another coupon that takes a further 10% off the discounted price.

Which is the better deal?



When a percentage decrease is applied repeatedly, the changes become smaller because each decrease is calculated based on a value.

This means that each subsequent decrease is than the previous one, as it is applied to a amount.

REPEATED PERCENTAGE CHANGE

- When working with repeated percentage change, we **multiply** the changes.

Example Determine overall percentage change.

A worker is earning \$50 an hour. She gets a 10% pay rise, then another 5% pay rise on top of that.

What is her new hourly pay?

$$50 \times 1.1 \times 1.05$$

$$= \$57.75$$

Determine the overall percentage change.

$$\% \text{ Change} = \frac{\text{Final} - \text{Original}}{\text{Original}} \times 100$$

$$= \frac{57.75 - 50}{50} \times 100$$

$$= 15.5\%$$

Why did we multiply by 1.1 and 1.05.

The multiplier for% increase is $\times 1.1$

The multiplier for% increase is $\times 1.05$

The order in which we apply the pay increases is not important. Why?

Since we are, we can in any order.

How come the overall percentage increase is 15.5%, not 15%?

With repeated percentage increases, the changes get

- a** A chicken burger at the canteen cost \$5 when Mr Ding was in year 7.
In year 9 the price increased 20% and in year 11 the price increased by a further 20%.

What is the price after the two increases?

What is the overall percentage change?

\$7.20

44% increase

- b** A set of \$500 tools is on sale for 20% off and then has a further 15% discount applied.

What is the discounted price?

What is the overall discount percentage?

\$340

32% discount

- c** A shopkeeper increased the price of a \$1000 item by 50%.
Seeing that nobody was buying at the higher price, he reduced the price by 50%.

What is the final price?

What is the overall percentage change?

\$750

25% discount

Key ideas

- To calculate repeated percentage increases or decreases, we the percentages.

1

a Increase \$120 by 15%, then increase the result by 15% $\\$120 \times 1.15 \times 1.15 =$ \$158.70	b Decrease \$120 by 15%, then decrease the result by 15% \$86.70
a Decrease \$120 by 15%, then increase the result by 15% \$117.30	b Increase \$150 by 10%, then increase the result by 10% \$181.50
c Decrease \$150 by 10%, then decrease the result by 10% \$121.50	d Increase \$150 by 10%, then decrease the result by 10% \$148.50
e Decrease \$150 by 10%, then increase the result by 10% \$148.50	f Decrease \$150 by 10%, then increase the result by 15% \$155.25

2 A television costs \$500. Its price is **increased** by 10%.

- a** What is its new price?
- \$550
- b** After a year its price is increased by another 10%. What is its price now?
- \$605
- c** Find 120% of 500
- \$600
- d** Is increasing by 10% then 10% again the same as increasing by 20%?
- no

3 A television costs \$500. Its price is **decreased** by 10%.

- a** What is its new price?
- \$450
- b** After a year its price is decreased by another 10%. What is its price now?
- \$405
- c** Find 80% of 500
- \$400
- d** Is decreasing by 10% then 10% again the same as decreasing by 20%?
- no

4 A television costs \$500. Its price is increased by 5%.

a What is its new price?

\$525

b After a year its price is decreased by 5%. What is its price now?

\$498.75

c Does increasing by 5% then decreasing by 5% keep the price the same?

no

5 In a sale, the prices of all items in a shop are reduced by 10%.

For a promotion, the shop is offering an extra 20% off sale prices.

Work out the price of a handbag that cost \$60 before the sale.

\$43.20

Is this the same as 30% off?

30% off is \$42. No.

6 Ali buys a car for \$18000.

The value of the car depreciates by 16% in the first year and 12% each year after the first.

Work out the value of the car at the end of 3 years.

\$11708.93

7 Abdullah invested \$2000 in shares. In March, the value of his shares increased by 4%.

In April, the value of his shares decreased by 6%.

Work out the value of Abdullah's shares at the start of May.

\$1955.20

8 Identify what is incorrect about this statement:

"\$400 to \$800 is an increase of 100%, so \$800 to \$400 is a decrease of 100%."

\$800 to \$400 is a decrease of 40%.

- 9** If an amount is increased by the same percentage each time, powers can be used. For example: 50 increased by 12% three times would be:

$$\begin{aligned} & 50 \times 1.12 \times 1.12 \times 1.12 \\ & = 50 \times (1.12)^3 \\ & = 70.25 \text{ (2 d.p.)} \end{aligned}$$

Use a similar technique to find the final value in these situations. Round to 2 decimal places.

- a** The mass of a rat initially at 60 grams grows at a rate of 10% every month for 3 months.

79.86 g

- b** The cost of a new car initially at \$80 000 increases by 5% every year for 4 years.

\$97240.5

- c** The value of a house initially at \$380 000 decreases by 4% per year for 7 years.

\$285 550.04

- d** The length of a pencil initially at 16 cm decreases through being sharpened by 15% every week for 5 weeks.

7.10 cm

- 10** Which of these calculations would give the result of a 15% decrease, repeated 4 times?

A

$$\times 1.5^4$$

B

$$\times 0.15^4$$

C

$$\times 0.85^4$$

- 11** There are 300 cells in a Petri dish. The number of cells increases by 6% every hour. Work out the number of cells in the dish after these times, answer to the nearest whole.

- a** 1 hour

318 cells

- b** 6 hours

426 cells

- c** 72 hours

19913 cells

- 12** The value of a car depreciates by 12% per year. Faith's car cost \$55 000 when new. Work out the value of the car after.

- a** 1 year

\$48 400

- b** 5 years

\$29 025.26

- c** 10 years

\$15317.55

Worked Solution	Explanation
A shopkeeper increases prices in his store by 30%. A year later, he increases the prices by a further 10%. What is the overall percentage increase? $1.3 \times 1.1 = 1.43$ Overall percentage increase of 43%.	Why did we do 1.3×1.1? <i>The multiplier for% increase is $\times 1.3$</i> <i>The multiplier for% increase is $\times 1.1$</i> The result of 1.43 means the new price is 143% of the price. Where did we get 43% increase from? $143\% - \text{.....}\% = 43\%$

13 Calculate the overall percentage change if:

a 10% increase is followed by another 10% increase.

b 20% increase is followed by another 5% increase.

21% increase

26% increase

c 35% increase is followed by another 10% increase.

d 33% increase is followed by another 15% increase.

48.5% increase

52.95% increase

Worked Solution	Explanation
In a sale, all items are reduced by 30%. Shirley has a membership card that takes a further 10% off the sale price. What is the overall percentage discount? $0.7 \times 0.9 = 0.63$ Overall percentage discount of 37%.	Why did we do 0.7×0.9? <i>The multiplier for% decrease is $\times 0.7$</i> <i>The multiplier for% decrease is $\times 0.9$</i> The result of 0.63 means the new price is 63% of the price. Where did we get 37% discount from? $100\% - \text{.....}\% = 37\%$

14 Calculate the overall percentage change if:

a 10% decrease is followed by another 10% decrease.

b 20% decrease is followed by another 5% decrease.

19% decrease

24% decrease

c 35% decrease is followed by another 10% decrease.

d 33% decrease is followed by another 15% decrease.

41.5% decrease

43.05% decrease

- 15** In a sale, all items are reduced by 20%.
As a special promotion, sale items are reduced by a further 25%.
- a** Work out the sale price of a cooker that cost \$350 before the sale.

\$210

- b** What is the overall percentage reduction in cost of the combined offers?

40% reduction

- 16** Calculate the overall percentage change if:

- a** 20% decrease is followed by a 30% increase.

4% increase

- b** 30% increase is followed by a 40% decrease.

22% decrease

- c** 10% increase a total of three times.

33.1% increase

- d** 10% discount a total of three times.

27.1% decrease

- 17** A quantity is increased by 20% twice.

- a** Work out the single multiplier that can be used to increase a quantity by 20% twice.

$\times 1.44$

- b** Explain why this results in an overall increase of more than 40%.

Repeated percentage increases get larger.

- 18** Zach's rent increased by 10% in 2019 and by 15% in 2020.
Zach says that his rent has increased by 25% in these two years. Explain why he is incorrect.

Repeated percentage changes are multiplied, not added.

- 19** A ball is dropped. After each bounce, it reaches a height that is 80% of its previous maximum.
After how many bounces would it reach a height that is less than 10% of its original?

11 bounces

20 A number is increased by 10% and then the answer is decreased 10%.

- a** Will the final answer be greater than, less than, or the same as the original number?
Justify your answer.

Smaller, since $1.1 \times 0.9 = 0.99$

- b** How would your answer to part **a** change if the decrease happens before the increase?
Why?

No change, we can multiply in any order.

21 Cars are known to depreciate (fall in value year on year).

The average depreciation of a car's value is 10% every year.

Every year the car depreciates, it is only worth 90% of the price of the previous year:

$$\text{Value of car over time} = \text{original price} \times 0.9 \times 0.9 \times 0.9 \times \dots \times 0.9$$

Number of 0.9 = number of years after purchase

- a** Determine the value of a \$54000 car after three years using $\$54000 \times (0.9)^3$.

\$39366

- b** Rounded to the nearest dollar, determine the value of the car when it is 10 years old.

\$18829

- c** Will the value of the car ever reach zero?

No. (You will get very small fractions of a dollar but it will never become zero).

22 A cube has sides of length 6 cm.

- a** Calculate the volume of the cube.

216 cm³

- b** Each side of the cube is increased by 10%. Find the new volume of the cube.

287.496 cm³

- c** Work out the percentage increase in the volume of the cube.

33.1% increase

- d** Would your answer to part **c** change if the original side lengths were different?

No

23 2023 HSC Standard 2 Band 5

An item is discounted by 30% and then a further discount of 20% is applied to the reduced price. What is the total percentage discount?

44%

24 HSC Standard 2 Sample Question Band 5

A dress was on sale with 25% discount.

As a regular customer, Kate received a further 10% on the already discounted price.

What was the overall percentage discount Kate received?

32.5%

25 \$100 is increased by 25%. What percentage decrease must be used to get back to \$100?

An equation has been set up for you, where y represents the multiplier.

$$100 \times 1.25 \times y = 100$$

20% decrease

26

- a** During a sale in a bookstore all travel guides are reduced from \$30 by 20%.
What percentage increase is required to take the price back to \$30?

25% increase

- b** The cost of an item is reduced by 50%.
What percentage increase is required to return to its original price?

100% increase

- c** The cost of an item is increased by 75%.
What percentage decrease is required to return to its original price?
Round to 2 decimal places.

42.86% decrease

- d** The cost of an item is changed by $a\%$, what do you need to multiply to return to the original cost?

 $\frac{1}{a}\%$

27

- a** The length of a rectangle is increased by 60% but its area remains the same.
By what percentage is the width decreased?

37.5%

- b** The length of another rectangle is decreased by 25% and its area remains the same.
By what percentage is the width increased?

33.33%

UNITARY METHOD FOR FINDING A PERCENTAGE

- If a problem gives a percentage, and asks for another percentage, then we can solve it using the **unitary method**:
 - Identify the given percentage of the whole.
 - Divide to find 1%.
 - Multiply to find the required percentage.

Example Solve percentage problems using the unitary method.

8% of an amount of money is \$48. What is the full amount? $ \begin{array}{rcl} 8\% & = & 48 \\ \div 8 & & \div 8 \\ 1\% & = & 6 \\ \times 100 & & \times 100 \\ 100\% & = & \$600 \end{array} $	What did we do to find 1%? <i>We 8% by to get 1%.</i> How did we find the full amount? <i>We 1% by to get 100%.</i>
---	---

Find these amounts using the unitary method.

a 12% is \$60. What is the full amount?

12%	=	
1%	=	
	=	

\$500

b 11% is \$77. What is the full amount?

11%	=	
	=	
	=	

\$700

c 17% is \$51. How much is 25%?

	=	
	=	
25%	=	

\$75

d 78% is \$312. How much is 120%?

	=	
	=	
	=	

\$480

Key ideas

- The unitary method involves:
 - Determining the of the whole given by the question.
 - Dividing to find
 - to find the percentage that the question wants.

1 Complete the table.

a 90% of a number is 180. What is the number? 90% = 180 10% = 20 100% = 200	b 90% of a number is 450. What is the number? 90% = 450 10% = 100% = 500	c 90% of a number is 72. What is the number? 80
d 80% of a number is 720. What is the number? 900	e 80% of a number is 120. What is the number? 150	f 60% of a number is 120. What is the number? 200
g 20% of a number is 120. What is the number? 600	h 70% of a number is 490. What is the number? 700	i 70% of a number is 245. What is the number? 350
j 50% of a number is 160. What is the number? 320	k 25% of a number is 160. What is the number? 640	l 85% of a number is 170. What is the number? 200

2 Find the amount required for each of the following.

a 3% is 27. Find the full amount.

3%	=	
1%	=	
100%	=	

c 12% is \$132. Find the full amount.

e 6% is \$36. Find 20%.

6%	=	
1%	=	
20%	=	

g 40% is \$200. Find 3%.

b 5% is 40. Find the full amount.

.....%	=	
1%	=	
.....%	=	

d 60% is 300. Find the full amount.

f 15% is \$45. Find 80%.

.....%	=	
1%	=	
.....%	=	

h 25% is 75. Find 7%.

3 A cup of milk contains 124 mg of calcium. This is roughly 15% of an adult's recommended daily intake of calcium.

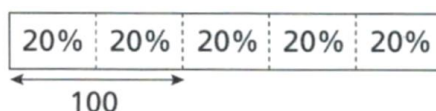


Using the above information, what is the recommended daily intake of calcium for an adult?

4 A bottle is 13% full and currently holds 143 mL. What is the capacity of the bottle?

These questions don't require finding 1% first. Try to do them mentally.

- 5 40% of a number is 100.



Work out:

a 10% of the number

25

b 5% of the number

12.5

c 60% of the number

75

d 100% of the number

250

- 6 10% of an amount of money is \$60, how much is:

a 100% of that amount?

\$600

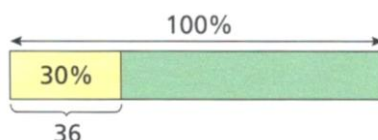
b 150% of that amount?

\$900

c 15% of that amount?

\$90

- 7 30% of a number is 36.



Work out:

a 10% of the number

12

b 5% of the number

6

c 40% of the number

48

d 60% of the number

72

e 100% of the number

120

f 140% of the number

168

- 8 120% of a number is 96. Work out:

a 10% of the number

8

b 20% of the number

16

c 35% of the number

28

d 100% of the number

80

- 9 If 40% of a number is 32, find:

a 10% of the number

8

b 5% of the number

4

c 15% of the number

12

d 120% of the number

96

e 200% of the number

160

f 75% of the number

60

10 Fill in the table. You may use a calculator. The method for finding each unknown is given.

Original Amount Unitary method/ Equations method	Percentage Change $\frac{\text{Change}}{\text{Original}} \times 100$	New Amount $\times$ Decimal	Change Final – original
50	+20%	$50 \times 1.2 =$ 60	10
60	+20%	72	12
72	+20%	86.4	14.4
72	–20%	57.6	–14.4
72	–25%	54	–18
72	+35.416%	97.5	25.5
45	+20%	54	9
67.5	–20%	54	–13.5
54	0%	54	0
54	100%	108	+54
135	–20%	108	–27
81	+33.3%	108	+27
96	+12.5%	108	–12
78.72	+25%	98.40	19.68
98.4	–20%	78.72	–19.68
85.6	+20%	102.72	+17.12

- 11 Instead of the unitary method, we can use equations to quickly solve for the unknown.

Worked Example	Explanation
90% of a number is 74.25. Find the number. $x \times 0.9 = 74.25$ $\div 0.9 \quad \div 0.9$ $x = 82.5$	Why did we multiply by 0.9? <i>To find%, we multiply by 0.9.</i> What does x represent? <i>x represents the amount.</i> Why did we divide both sides by 0.9 to find x? <i>The operation of multiplication is division.</i>

Find the number if:

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

- 12 Read the example carefully and answer the questions.

Worked Example	Explanation
43% of a number is 11.18. Find the value of 79%. $0.43x = 11.18$ $\div 0.43 \quad \div 0.43$ $x = 26$ $0.79x = 20.54$	Why did we multiply by 0.43? <i>To find%, we multiply by 0.43.</i> What does x represent? <i>x represents the amount.</i> Why did we multiply x by 0.79? <i>The question asked us to find%</i>

a 6% of the total is \$36. Find 20%.	b 15% of the total is \$45. Find 80%
120	240
c 40% of the total is \$200. Find 35%.	d 25% of the total is \$75. Find 7%.
175	21

13

a What is the mass if
120% of the mass is 720 kg?

600 kg

b What is the volume if
175% of the volume is 120 L?

68.57 L

14 2023 HSC Standard 1

The nutrition label for a food item is shown. Based on the information on this label, what is the daily recommended intake of carbohydrates, to the nearest gram?

Nutrition information		
	Quantity per serving	% daily recommended intake per serving
Energy	420 kJ	5%
Protein	2.2 g	4%
Carbohydrates	19.1 g	6%
Fat, total	1.9 g	3%

318 g

15 Forty per cent of workers for a large construction company prefer to have an early lunch and 25% of workers prefer to work through lunch and leave an hour earlier at the end of the day. All other workers prefer a late lunch. If 70 workers prefer a late lunch, how many workers are employed by the construction company?

200

UNITARY METHOD FOR FINANCIAL PROBLEMS

- If a question gives us the amount *after* a discount or markup and asks for the original price, we can solve it using the **unitary method**.
 - Identify the percentage of the whole given by the question.
 - Divide to find 1%.
Do not round your answer.
 - Multiply to find the percentage asked by the question.

Example Solve percentage problems using the unitary method.

A restaurant meal cost \$47.10 after a public holiday surcharge of 15%. What is the original cost of the meal? $115\% = 47.10$ $\div 115 \quad \div 115$ $1\% = 0.4095652174 \dots$ $\times 100 \quad \times 100$ $100\% = \$40.96$	How did we know that \$47.10 represents 115%? <i>Surcharge means , so \$47.10 represents 100% + 15%</i> How did we find the original cost? <i>First we divided by to find 1%, Then we multiplied by to find 100%/</i> Why did we write out all the decimals? <i>We do not our answer until the vert last step.</i>
--	--

- a** A pair of shoes was **20% off**. The discounted price is \$120. What was the original price?

80%	=	
	=	
	=	

\$150

- b** A can of tuna was **marked up** by 35%, costing \$2.70. What was the original price?

	=	
	=	
	=	

\$2

- c** Venus buys a dress that has been discounted by 25%. If the sale price is \$225, what was the original price?

\$300

- d** Pip makes an 18% profit on a cake she decorated. If she sells the cake for \$330.40, what was the original cost of the cake?

\$280

1 Determine the percentage of the original.

- a A book is marked up by 20%.
Retail price is% of the cost price

120%

- b A bag of apples was marked up by 30%.
Retail price is% of the cost price

130%

- c A yoga mat is discounted by 40%.
Discounted price is% of the original.

60%

- d A hairdresser discounts services by 10%.
Discounted price is% of the original.

90%

- e A yoga mat is 65% off.
New price is% of the original.

35%

- f A meal includes a 15% surcharge.
New price is% of the original.

115%

2

- a The price of an item has **increased** by 10% to \$55. What was the original price?

	=	
	=	
	=	

\$50

- b The price after a 12% markup is \$720. What was the original price?

	=	
	=	
	=	

\$642.86

- c A necklace in a jewellery store has been **discounted** by 20% to \$240. What was the original price?

\$300

- d A restaurant bill comes to \$38.50. This includes a 10% public holiday surcharge. What is the cost on a normal day?

\$35

- e Brian drinks 40% of the water from his drink bottle and there is 300 mL left. How much water was in the drink bottle to begin with?

\$500

- f A travel agency reduces the prices of their holidays by 30%. Calculate the original price of a holiday which has a discounted price of \$2800.

\$4000

3 Calculate the cost price, rounding to the nearest cent where relevant.

a Find the original price of a pack of batteries that is discounted by 30%, if the discounted price is \$14.

\$20

b Find the original price of a herbal tea pack after a discount of 20%, if the discounted price is \$2.40.

\$3

c Find the cost price of a shampoo bottle that is marked up by 40%, if the retail price is \$5.

\$3.57

d Find the cost price of a bag of dog food that is marked up by 30%, if the retail price is \$19.23.

\$14.79

e Find the original price of a pair of jeans that is discounted by 20%, if the discounted price is \$31.96.

\$39.95

f Find the cost price of a roll of tape that is marked up by 60%, if the retail price is \$2.80.

\$1.75

4 Rhys is solving this problem:

After a 12% pay rise, a worker earns \$168 a day. What did the worker earn before the pay rise?

a Work out the worker's original pay.

\$150

b Rhys tried to solve the problem by finding 88% of \$168. Is he correct?

No.

5 Gary and Beca both get a pay rise of the same percentage.

Zach's salary increases from \$22 500 to \$23 400.

a Work out the percentage increase in Gary's salary.

4%

b Beca's salary increases to \$23 920. Use your answer to part **a** to work out Beca's salary before her pay increase.

\$23 000

6 Complete the table. Round your answer to 2 decimal places.

Cost Price Unitary method Equations method	Selling Price $\times$ Decimal	Percentage Change $\frac{\text{Final} - \text{Original}}{\text{Original}} \times 100$
\$30	$30 \times 0.8 = 24$	20% loss
\$85	\$69.70	18% discount
\$65	\$75	$\frac{75 - 65}{65} \times 100 = 15.38\%$
\$700	\$665	5% decrease
$120\% = 30$ $1\% = 0.25$ $100\% = 25$	\$30	20% profit
\$80	\$100	25% mark-up
\$60	\$75	25% inflation
\$40	\$50	25% increase
\$166.67	\$100	40% off
\$550	\$649	18% surcharge
\$50	\$40	20% decrease
\$64	\$80	25% profit
\$100	\$80	20% reduction
\$200	\$10	95% decrease
\$75	\$97.50	30% profit
\$500	\$350	30% loss

7

a Calculate 15% of 60	b Express 15 as a percentage of 60	c 15% of a number is 60. What is the number?
9	25%	400
d Increase 60 by 15%	e Decrease 60 by 15%	f A number is increased by 15% to 60. What is the number?
69	51	52.17
g A number is decreased by 15% to 60. What is the number?	h A number is increased from 15 to 60. What is the percentage change?	i A number is decreased from 60 to 15. What is the percentage change?
70.59	300% increase	75% decrease

8

a A loaf of bread costs 89c. The price increases by 22% due to inflation. What is the new price? Answer in dollars.	b The price of a loaf of bread increases from 89c to \$1.20. What is the change as a percentage? Round to 1 d.p.
\$1.09	34.8%
c A loaf of bread cost 89c five years ago. This price increases by 6% every year. How much does it cost now, to the nearest cent?	d A shop marks down a loaf of bread to 89c in a 30% off sale. What did it cost originally?
\$1.26	\$1.27

9 NAPLAN A+

Lucia is saving her money to buy a jet ski.

After 3 months, she had saved 40% of the cost of the jet ski.

After 5 months, she had saved another \$1200 and now had 60% of the cost of the jet ski.

How much does the jet ski cost?

\$6000

10 NAPLAN A+

Harrison was saving his money to buy a cricket bat.

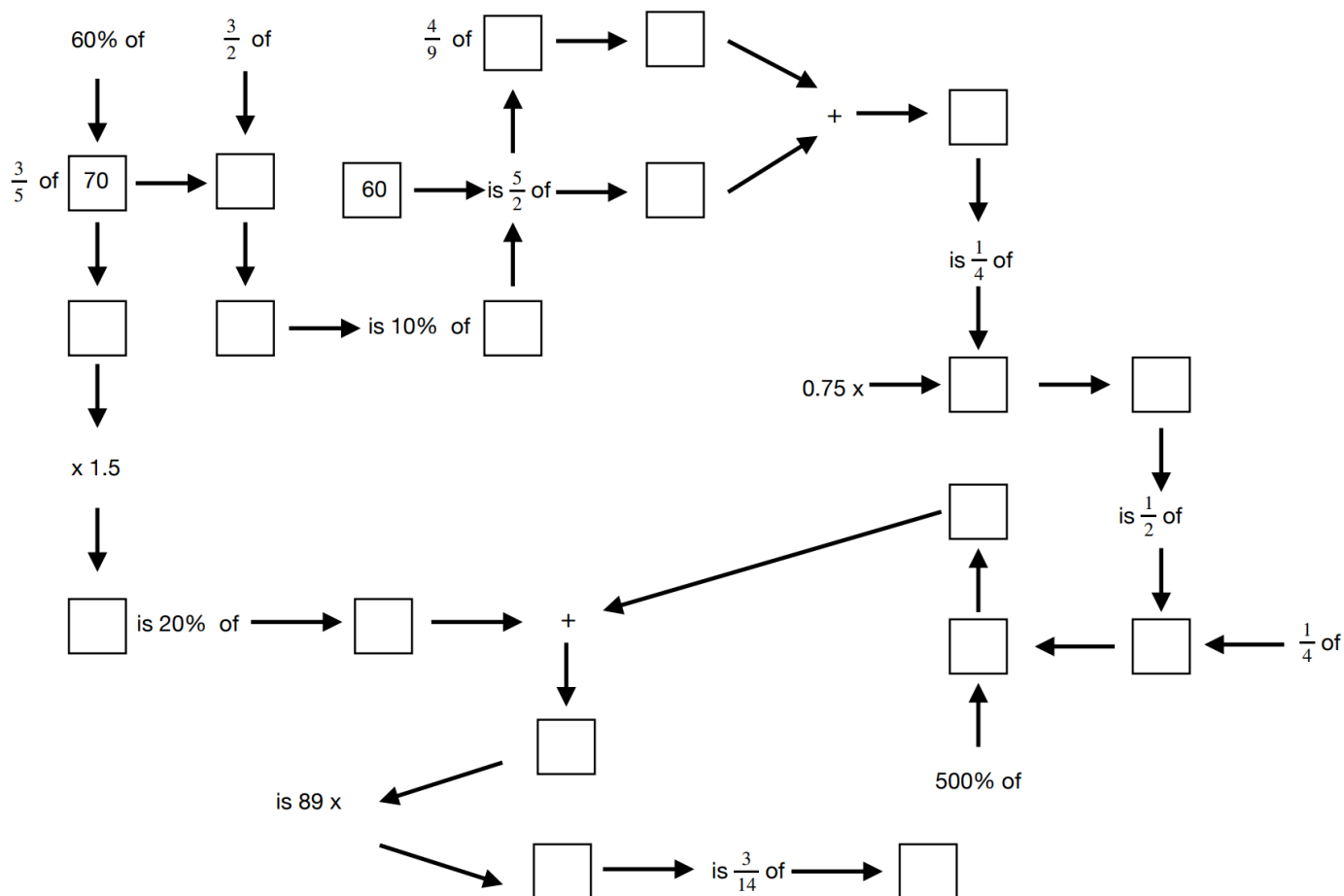
After 1 month, he had saved 45% of the bat's cost.

After 2 months, he had saved another \$90 and now had 75% of the bat's cost.

How much does the bat cost?

\$300

11 Fill in the boxes.



THE GOODS AND SERVICES TAX

- The Australian Government collects a tax called the **Goods and Services Tax (GST)**.
- There are exceptions for basic food items and some medical expenses.

GST not charged (essential goods)	GST charged (non-essential goods)
• Fruits, vegetables, rice, flour, eggs, milk. • Basic healthcare and medicine. • Housing • Water, gas, electricity	• Clothing • Electronics • Processed food • Restaurants • Entertainment

Example Calculate price including GST.

A manufacturer values a table at \$289. Calculate the GST payable and the final price. GST payable = $\\$289 \times 0.1$ = \$28.9 GST-included price = $\\$289 \times 1.1$ = \$317.90	What is the difference between “GST-Payable” and “GST-included price”? <i>GST payable is%</i> <i>GST-included price is%</i>
--	--

Calculate the GST payable and the final GST-included price for items priced at:

a \$700 GST payable = \$70 GST-included price = \$770	b \$680 GST payable = \$68 GST-included price = \$748
c \$28 GST payable = \$2.80 GST-included price = \$30.80	d \$34 GST payable = \$3.40 GST-included price = \$37.40

Key ideas

1. In Australia the goods and services tax is% of the original price of the item.
2. Essential items such as basic groceries, housing, and utilities are charged GST.

- 1 Complete the table without using a calculator.

Original Price (no GST)	10% GST Payable	GST-Inclusive Price
\$100	$100 \times 0.1 =$ \$10	$100 \times 1.1 =$ \$110
\$50	\$5	\$55
\$150	\$15	\$165
\$5	\$0.50	\$5.50
\$120	\$12	\$132
\$75	\$7.50	\$82.50

PROBLEMS INVOLVING GST

GST and Percentages

PreGST Price or Price without GST = $100\% \times \text{Original Price}$

GST or GST Payable = $10\% \times \text{Original Price}$

GST Inclusive Price or Final Price = $110\% \times \text{Original Price}$

Example Determine percentage given and percentage to find.

The pre-GST price is \$300. Calculate the GST payable. Percentage given: Percentage to find:	The final price is \$300. Calculate the GST payable. Percentage given: Percentage to find:
The GST is \$300. Calculate the pre-GST price. Percentage given: Percentage to find:	The GST is \$300. Calculate the final price. Percentage given: Percentage to find:
The GST-inclusive price is \$300. Calculate the pre-GST price. Percentage given: Percentage to find:	The GST-inclusive price is \$300. Calculate the GST. Percentage given: Percentage to find:
The pre-GST price is \$300. Calculate the final price. Percentage given: Percentage to find:	The GST-inclusive price is \$300. Calculate the GST payable. Percentage given: Percentage to find:

- In Australia, GST is **always** included in the price tag, so **you are always paying 110%** of the original price. This is not the case for other countries.
- **Unitary method** for solving GST problems:
 1. Identify the given percentage of the whole.
 2. Divide to find 1%.
 3. Multiply to find the required percentage.

Example Problems involving GST.

A bike has GST of \$38 added to its price. What is the price of the bike before GST? $10\% = \$38$ $\times 10 \quad \times 10$ $100\% = \$380$ The pre-GST price was \$380.	What percentage of the original does \$38 represent? <i>GST of \$38 means \$38 represents%</i> What percentage of the original are you trying to find? <i>Price before GST is%</i>
Mr Ding went to KFC and bought lunch for \$7.95. What was the price without GST? $110\% = \$7.95$ $\div 11 \quad \div 11$ $10\% = \$0.7227 \dots$ $\times 10 \quad \times 10$ $100\% = \$7.227 \dots$ The original price was \$7.23	What percentage of the original does \$7.95 represent, how do you know? <i>If \$7.95 is the price paid, it must represent%, since all prices in Australia GST.</i> What percentage of the original are you trying to find? <i>Price without GST is%</i> Why didn't we find 1% in this example? <i>When working with GST, we can use% as the smallest "unit" we work with.</i>

- a** The **final price** of a pair of shoes is \$99.
How much **GST** was paid?

.....%	=	99
	=	

\$9

- b** The **final price** is \$220.
Calculate the **pre-GST price**.

.....%	=	220
	=	
	=	

\$200

- c** A laptop has **GST payable** of \$105.
What is the **GST-inclusive** price?

.....%	=	105
	=	
	=	

\$1155

- d** A haircut costs \$70 **including GST**.
What is the price **without GST**?

.....%	=	70
	=	
	=	

\$63.64

- e** A movie ticket costs \$25 **without GST**.
What is **GST payable**?

\$2.50

- f** A restaurant meal is **advertised** for \$23.
What is the **non-GST price**?

\$20.91

Key ideas

1. In stores, the GST is always in the shown price.
2. "GST" or "GST payable" is% of the original price.
3. "GST-inclusive price" or "final price" is% of the original price.
4. "Pre-GST price" or "price without GST" or "original price" is% of the original price.
5. We can solve GST problems using the method.

1 If the **GST payable** is \$8:

a Find the **original price** without GST.

10%	=	\$8
100%	=	

\$80

b Find the price **including GST**.

10%	=	\$8
110%	=	

\$88

2 If the **GST included** price is \$99:

a Calculate the **GST payable**.

.....%	=	\$99
.....%	=	

\$9

b Calculate the **original price**.

	=	
	=	

\$90

3 The cost of a lounge suite is \$990 including GST.

a Calculate the GST payable.

\$90

b Calculate the pre-GST price

\$900

4 For each of the following items, the cost including GST is given.

Calculate the cost before GST was added.

a A plane ticket costing \$715

\$650

b A lawnmower costing \$495

\$450

c A meal costing \$18

\$16.36

d A phone costing \$2400

\$2181.82

- 5 A plumber's quote for installing a dishwasher is \$264, including the GST.
- a Use the unitary method to calculate the GST payable.
- b Divide \$264 by 11; does this give the same answer as part a?

\$24

yes

- c Calculate the pre-GST price for installing the dishwasher.
- d Divide \$264 by 1.1; does this give the same answer as part c?

\$240

yes

GST-included price: $\frac{11}{10}$ of original price

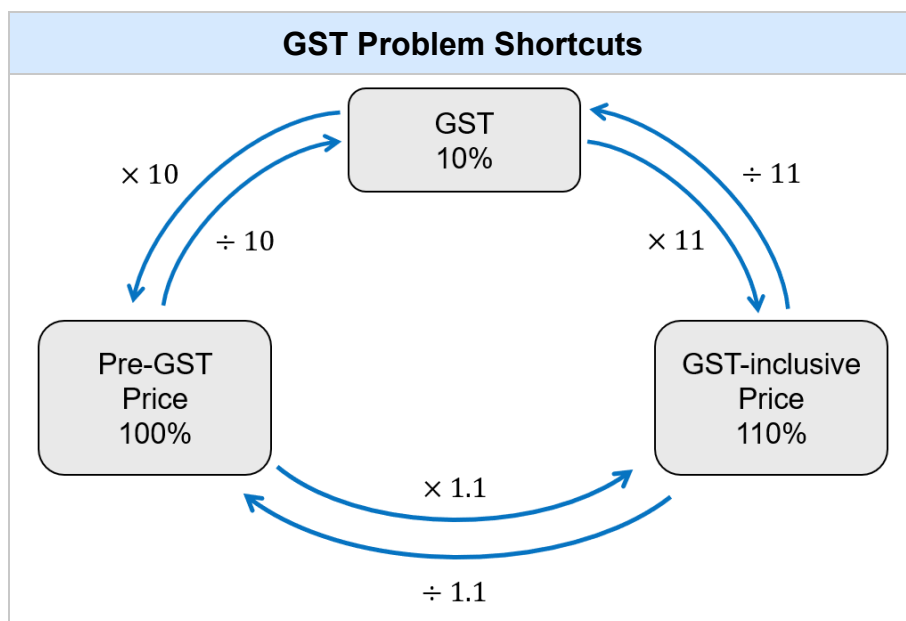


Original Price:

$\frac{10}{11}$ of GST-included price

GST:

$\frac{1}{11}$ of new price



- 6 These are GST-inclusive prices. Find GST payable and pre-GST price.

a \$616

GST payable:

$$616 \div 11 =$$

Pre-GST price:

$$616 \div 1.1 =$$

\$56

\$560

b \$1067

GST payable:

Pre-GST price:

\$97

\$970

c \$8679

GST payable:

Pre-GST price:

\$789

\$7890

d \$108.57

GST payable:

Pre-GST price:

\$9.87

\$98.70

7 Complete this table.

Original Price (no GST)	10% GST Payable	Price (110% of original)
\$599	\$59.90	\$658.90
\$125	\$12.50	
\$680	\$68	\$748
\$700	\$70	\$770
\$850	\$85	\$935
\$600	\$60	\$660
\$650	\$65	\$715
\$789	\$78.90	\$867.90
\$270	\$27	\$297
\$892	\$89.20	\$981.20
\$661.50	\$66.15	\$727.65
\$645	\$64.50	\$709.50
\$518.18	\$51.82	\$570
\$27.74	\$2.77	\$30.51

- 8 Aimee has two quotes for repairs on her car. The first is a pre-GST price of \$2450. The second is \$2680 including GST. Which quote is cheaper and by how much?

Second quote cheaper by \$15

- 9 The GST is also called a “value-added tax” (VAT).
Since a tax is only meant for citizens of a country, if you go travelling in another country you can get the tax you pay refunded at the airport.
Unless the VAT is 10%, you cannot use the shortcuts used for Australian GST.
Use the unitary method to answer these questions:

- a The GST in Australia is 10%.
If a tourist paid \$1200 for an iPhone, how much GST would they get refunded?

\$109.09

- b The VAT in Thailand is 7%. Mr Ding bought his mum a scarf for ฿4800.
How much VAT would he get refunded?

฿314.02

- c The VAT in Japan is 10%. Mr Ding bought some anime figurines for ¥24 000.
How much VAT would he get refunded?

¥2181.82

- d The VAT in New Zealand is 15%. A tourist was refunded \$90.
What was the VAT-inclusive value of the merchandise they bought?

\$690

- e The VAT in the UK is 20%. A tourist got refunded £144 for a laptop they bought.
What was the VAT-inclusive value of the laptop?

\$864

10 2004 HSC Standard 2 Band 4

Rita purchased a camera for \$880 while on holidays in Australia. This price included 10% GST. When she left Australia she received a refund of the GST.

What was Rita's refund?

\$80

11 2010 HSC Standard 2 Band 5

A new phone was purchase for \$725 which included 10% GST.

What was the price of the phone without GST, correct to the nearest cent?

\$659.09

12 Not all items in a supermarket attract GST.

Read the receipt carefully and answer the questions.

- a** Highlight the prices that include GST.
- b** Complete the calculation to find the GST included in the price of biscuits:

$$\begin{aligned} \text{GST (biscuits)} &= \$4.95 \div 11 \\ &= \dots\dots\dots \end{aligned}$$

- c** Therefore, calculate the total cost and the GST included.

Deli Delights	
Shellrock 50245	
Tax Invoice: 45F-9415G2	
12/08/14	

*Cream biscuits	4.95
Tasty cheese	8.45
Apples	
1.4 kg @ \$4.95/kg	6.93
Potatos	
1.94 kg @ \$2.99/kg	5.80
*Kinto orange soft drink	1.92
*Potato chips	2.45
*Hummus dip 250 g	3.98
TOTAL	
GST included:	
*Taxable item	

Total = \$34.48; GST = \$1.21

13 2019 HSC Standard 2 Band 5

Part of a supermarket receipt is shown.
Determine the missing values, A and B .

SUPERMARKET	
RECEIPT	
Date: 22/09/2019	
Description	\$
*Chocolates 300 g	A
Tomatoes 1 kg	5.00
Natural almonds 400 g	B
Cheese slices 500 g	8.50
Milk 2 L	3.20
Bananas 570 g	2.85
Total for 6 items	36.25
GST included in total	0.70
*GST of 10% is included in the price of item.	

$A = \$7.70$; $B = \$9$

14 2023 HSC Standard 2 Band 5

A receipt from a supermarket shows a total of \$124.87. The GST shown on the receipt is \$3.86.
GST, at a rate of 10%, is only charged on some items.
What was the value of the items which did NOT have GST charged?

\$82.41

MIXED PRACTICE

1 Find the amount required for each of the following.

a A bottle of shampoo is labelled "25% extra free". The bottle contains 250 mL of shampoo. Work out how much shampoo a normal-sized bottle contains.

200 mL

b Abdullah's restaurant bill comes to \$38.50. This includes a 10% service charge. Calculate the cost of the meal before the service charge was added.

\$35

c A sunflower is 180 cm tall. This is an increase of 5% on its height a week earlier. What was the height last week? Answer to 1 decimal place.

171.4 cm

d Emily sells her car for \$3500. She makes a 12% profit on the price she paid. How much did Emily pay for the car?

\$3125

e After an 8% pay rise, Faith earns \$91.80 a week. How much was Faith paid before the pay rise?

\$85

f The cost of a theatre ticket is reduced by 5% to \$42.75. What was the cost before the decrease?

\$45

g Because of a 10% increase, the price of Chloe's train ticket increases by \$2.30. Work out the price before the increase.

\$23

h In a sale, the price of a fridge is reduced by 40%. The fridge now costs \$279. Work out the original price of the fridge.

\$465

i A pair of jeans cost \$59.50 in a "15% off everything" sale. How much did the jeans cost before the sale?

\$70

j A car dealer makes a 25% profit when she sells a car for \$4000. How much did she pay for the car?

\$3200

2 Solve these percentage problems.

a A computer costs \$800 before GST of 10% is added. Work out the price of the computer after GST is added.

\$880

b A washing machine costs \$450. Work out the price of the washing machine after a 20% discount.

\$562.50

c Beca scores 68 out of 80 in a Science test. Express her score as a percentage.

85%

d Marta scored 84 marks in a test. As a percentage, Marta scored 70%. Work out the total number of marks in the test.

120

e In a school, 15% of the students wear glasses. If 63 students wear glasses, how many students are in the school?

433 students

f Jackson buys a scooter. He pays \$300 including GST at 10%. Work out the price of the scooter before GST is added.

\$272.73

g A necklace costs \$23. In a sale, the price is reduced by 12%. What is the sale price of the necklace?

\$20.24

h In a survey, the population of a village was 4752. One year later, the population has increased by 3%. Find the new population to the nearest integer.

4895

i Flo scored 56 out of 80 in a Maths test. Ed scored 64 out of 92 in a different test. Who did better?

Flo

j Seb buys a bike for \$245 and sells it for \$380. Work out the percentage profit.

55.1%

k	In a sale, the price of a dress is reduced from \$26 to \$20.80. Work out the percentage discount.	l	A ball is dropped from a height of 150cm. After each bounce, it reaches a height 20% lower than previously. What height does it reach after the fourth bounce?
	20% discount		61.44 cm
m	In a sale, all prices in a shop are reduced by 10%. Later, the shop is offering an extra 25% off sale prices. Work out the price of a pair of shoes that cost \$90 before the sale.	n	Ms Harris sold a house for \$462 000, making a 65% profit on the amount she paid for the house. How much profit did she make?
	\$60.75		\$182 000
o	A shopkeeper wants to sell an item for \$500, including GST. How much GST is he charging his customers?	p	Samantha went shopping and bought a new bike for \$750. How much GST did she pay?
	\$45.45		\$68.18
q	In a sale, the price of a laptop is reduced by 25%. A week later, the price is reduced by a further 15%. The final price is \$586.50. Work out the original price of the before the sale.	r	The value of an investor's shares dropped by 18% to \$30 750 in a financial crash. What was the value of the shares before the crash?
	\$920		\$42708.33
s	Bev rolls a die and it lands on six 35% of the time. The dice lands on six 147 times. How many times did Bev roll the dice?	t	Darius has been saving to buy a laptop. The laptop originally cost \$800 but has increased in price by 25%. Darius has saved \$900. How much more does he need to save?
	420		\$100

3 A shoe store is running a 20% off storewide sale.

a How much would you pay for a pair of sneakers originally priced at \$56.50?

\$45.20

b Mr Ding pays \$48.80 for a pair of shoes. What was the original price?

\$61

c Another shop is offering one quarter off the price storewide. Which is the better deal, and why?

one-quarter as that's 25%

d You have \$500 to spend. How many pairs of shoes, costing \$96 before the price reduction, can you buy?

6 pairs

4 HSC Standard 2 Sample Question Band 4

A golf shop is having a Boxing Day sale.

What is the percentage discount on a putter which is reduced from \$120.00 to \$102.00?

15%

The same discount applies storewide.

What discount amount is applicable to a box of golf balls whose original price was \$25.00?

\$3.75

What is the sale price of a golf bag which originally cost \$160.00?

\$136

5 2018 HSC Standard 2 Band 5

To determine the retail price of an item, a shop owner increases its cost price by 30%. In a sale, the retail price is reduced by 30% to give the sale price.

How does the sale price compare to the cost price?

- A. The sale price is less than the cost price.
- B. The sale price is the same as the cost price.
- C. The sale price is more than the cost price.
- D. It is impossible to compare without knowing the cost price.

A

CHECK YOUR UNDERSTANDING

Unitary method

1	25% of a number is 8. What is the original number?						
a	2	b	32	c	33	d	40
2	25% of a number is 7500. What is the original number?						
a	2250	b	9750	c	25 000	d	30 000
3	A carpenter sells a chair for \$20, making a 60% profit. What was the cost of making the chair?						
a	\$32	b	\$12	c	\$12.50	d	\$8
4	A jacket is advertised for \$245 after a 30% reduction. What was the original price?						
a	\$275	b	\$171.50	c	\$318.50	d	\$350
5	A fancy restaurant meal cost \$400 including a 20% surcharge. What was the original price?						
a	\$66.67	b	\$333.33	c	\$320	d	\$333.34