GCSE Maths – Ratio, Proportion and Rates of Change

Percentage Change

Worksheet

WORKED SOLUTIONS

This worksheet will show you how to work out different types of percentage change questions. Each section contains a worked example, a question with hints and then questions for you to work through on your own.

Section A

Worked Example

Increase 75 by 24%.

Step 1: Interpret an increase of 24% as a decimal multiplier.

An increase of 24% is 124% of the original value. So, the decimal multiplier is:

$$124 \div 100 = 1.24$$

Step 2: Multiply the decimal multiplier by the original value.

$$1.24 \times 75 = \mathbf{93}$$

Guided Example

Decrease the number 140 by 46%.

Step 1: Interpret a decrease of 46% as a decimal multiplier.

A decrease of 46% means : $100\% - 46\% = 54\%$

$54\% = \dfrac{54}{100} = 0.54$

Step 2: Multiply the starting value by the decimal multiplier.

$140 \times 0.54 = \boxed{75.6}$

Now it's your turn!
If you get stuck, look back at the worked and guided examples.

1. Increase 56 by 13%.

Increase by 13% = 100% + 13% = 113%

113% = $\frac{113}{100}$ = 1.13

56 × 1.13 = **63.28**

2. Decrease £136 by 30%.

Decrease by 30% = 100% − 30% = 70%

70% = $\frac{70}{100}$ = 0.7

£136 × 0.7 = **£95.2**

3. A water bottle is normally sold for £12. In a sale, shop A decreases the price by 40% whilst shop B knocks £2 off every item. Which shop should I go to for the water bottle, and why?

Shop A :

Decrease by 40% = 100% − 40% = 60%

60% = $\frac{60}{100}$ = 0.6

Price of bottle : 0.6 × £12 = £7.2

Shop B :

£12 − £2 = £10

I should go to shop A because the price of bottle is cheaper which is £7.20

4. A house increases in value by 17%. A month later, it decreased in value by 8%. What is the overall percentage change in price of the house?

Original price of house = 100%

Increase in value = 100% + 17% = 117%

Decrease in value a month later = 117% − 8% = 109%

Percentage change = 100% − 109% = **9%**

Section B

Worked Example

Ingredients for one batch of cakes costs £2.56. Katy makes 4 batches and sells each batch for £5. Work out how much profit Katy makes as a percentage change.

Step 1: Calculate how much Katy spent on ingredients.

Multiply the cost per batch by the number of batches she bought ingredients for.

$$4 \times £2.56 = £10.24$$

Step 2: Calculate how much money she made from selling the cakes and find the difference between this and the money spent.

$$4 \times £5 = £20$$
$$£20 - £10.24 = £9.76$$

Step 3: Substitute the difference and money spent into the formula for percentage change and solve.

$$Percentage\ Change = \frac{Change}{Original} \times 100$$

$$Percentage\ Change = \frac{£9.76}{£10.24} \times 100$$

$$Percentage\ Change = \mathbf{95}\% \text{ (to the nearest percent)}$$

Alternatively, you could solve this problem by basing the calculation off the prices of one batch only. Since the answer is a percentage, and not the actual profit, the percentage change will be the same.

$$Percentage\ Change = \frac{Change}{Original} \times 100$$

$$Percentage\ Change = \frac{£5 - £2.56}{£2.56} \times 100 = \frac{£2.44}{£2.56} \times 100$$

$$= \mathbf{95}\% \text{ (to the nearest percent)}$$

Guided Example

An art gallery contains 45 paintings. After an exhibition, paintings are bought and sold, and it now contains 38 items. Calculate the percentage change in the number of paintings in the gallery, giving your answer to the nearest percent.

Step 1: Find the difference between the number of paintings in the gallery after and before the exhibition.
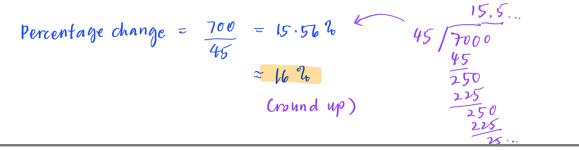
$$\text{Difference in number of paintings} = 45 - 38 = 7$$

$$\begin{array}{r} {}^3\cancel{4}{}^1 5 \\ -\ 38 \\ \hline 7 \end{array}$$

Step 2: Substitute the change in number of paintings, and the original number of paintings, into the formula for percentage change.

$$\text{Percentage change} = \frac{\text{change in number of paintings}}{\text{original number}} \times 100$$

$$= \frac{7}{45} \times 100$$

$$= \frac{700}{45}$$

Step 3: Solve the equation, and round the percentage change to the nearest whole number.

$$\text{Percentage change} = \frac{700}{45} = 15.56\%$$

$$\approx 16\%$$

(round up)

$$45 \overline{)7000} \quad \begin{array}{l} 15.5... \\ \end{array}$$

$$\begin{array}{r} 45 \\ \hline 250 \\ 225 \\ \hline 250 \\ 225 \\ \hline 25... \end{array}$$

Now it's your turn!
If you get stuck, look back at the worked and guided examples.

5. The population of koalas in a forest one year ago was 48. In the same forest, one year ago there were 114 snakes. Now there are 40 koalas and 150 snakes. Which species has experienced the greatest percentage change in population?

Change in koalas population $= 48 - 40$
$= 8$

Change in snake population $= 150 - 114$
$= 36$

Percentage change of koalas $= \frac{8}{48} \times 100$
$= 16.67\%$

Percentage change of snake $= \frac{36}{114} \times 100$
$= 31.6\%$

The snakes has experienced the greatest percentage change.

6. Angela buys a house for £160000 and renovates it. After three years, the house is worth £213500. What is the percentage increase in price?

Difference in price $= 213500 - 160000$
$= 53500$

Percentage change $= \frac{53500}{160000} \times 100$
$= 33.4\%$

```
      33.43...
16 ) 535 0
     48
     ‾‾
     55
     48
     ‾‾
      70
      64
      ‾‾
       60
       48
```

7. A museum received 140 within the first week of opening. In the second week, 480 people visited the museum. What is the percentage change in the number of visitors over the two weeks?

difference in visitors $= 480 - 140 = 340$

Percentage change $= \frac{340}{140} \times 100 = 242.9\%$

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  480
- 140
‾‾‾‾‾
  340
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Section C

Worked Example

The population in a small village is depleting. Over the last year, it has experienced a 15% decrease and now has 340 residents. How many people lived in the town one year ago?

Step 1: Substitute the values given into the equation for percentage decrease to form an equation.

Let the population of the town one year ago be x.

$$Percentage\ Decrease = \frac{Old - New}{Original} \times 100$$

$$15 = \frac{x - 340}{x} \times 100$$

Step 2: Solve the equation, by collecting the x terms on one side.

$$0.15 = \frac{x - 340}{x}$$
$$0.15x = x - 340$$
$$0.85x = 340$$
$$x = 400$$

The population of the town one year ago was 400.

Guided Example

A farmer is monitoring his population of chickens and calculates that every year, the number of chickens increases by approximately 30%. At the start of 2008, he forgot to count the number of chickens but in 2009 he found that there were 156. Estimate the number of chickens at the start of 2008.

Step 1: Substitute the values we have for the percentage increase and the number of chickens into the formula for percentage increase.

$$30 = \frac{156 - x}{x} \times 100$$

Step 2: Solve the equation by collecting the coefficients of x onto one side.

$$\div 100 \begin{cases} 30 = \frac{156 - x}{x} \times 100 \\ 0.3 = \frac{156 - x}{x} \end{cases}$$

$$+x \begin{cases} 0.3x = 156 - x \\ 1.3x = 156 \end{cases}$$

$$\div 1.3 \begin{cases} x = 120 \end{cases}$$

The number of chickens at the start of 2008 is **120**

Now it's your turn!
If you get stuck, look back at the worked and guided examples.

8. A pair of headphones are in a sale where everything is 40% off. The sale price of the headphones is £54. What was the original full price of the headphones?

Percentage change $= \dfrac{old - new}{old} \times 100$

$0.4 = \dfrac{x - 54}{x}$

$54 = 0.6x$

$x = 90$ $\Big) \div 0.6$

$40 = \dfrac{x - 54}{x} \times 100$

$0.4x = x - 54$

$54 = 0.6x$ $\quad +54 \quad -0.4x$

The original price is £90

9. A carrot patch starts with 200 carrots. A farmer discovers that every week, pests consume 5% of his produce. How many carrots does the farmer have after two weeks, and what is the percentage change compared to the original amount?

original carrot = 200
first week = 100% - 5% = 95%
carrot after first week = 200 × 0.95 = 190
carrot after second week = 190 × 0.95 = 180.5
$\qquad$ decrease by 5% ✓

Difference in carrot to the original = 200 - 180.5 = 19.5

Percentage change $= \dfrac{19.5}{200} \times 100$
$= 9.75\%$

10. Pamela buys an old car for £1000. After fixing the engine and exhaust, the car increases in value by 110%. Once she has painted the exterior and fitted new seats, it appreciates in value by a further 60%. How much can she sell the car for now?

Original price = £1000 $\quad$ (110% + 100% = 210%)
After fixing engine and exhaust = 1000 × 2.1 = £2100

After painting exterior and new seats = £2100 × 1.6 = £3360

$(100\% + 60\% = 160\% = 1.6)$

She can sell her car for £3360 now.

11. A brand of orange juice develops a special edition of its best-selling juice bottle. Is buying the new bottle more cost-effective? Explain your answer.

Classic
£1.99

special edition
40% extra juice!
£2.99

Classic = 100% juice = £1.99

Increase in juice = 100% + 40%
$= 140\%$

$140\% = \dfrac{140}{100} = 1.4$

New price = £1.99 × 1.4 = £2.786
$= £2.79$
nearest pence ←

Buying the new bottle is not cost-effective because the price for an extra 40% juice should only cost £2.79