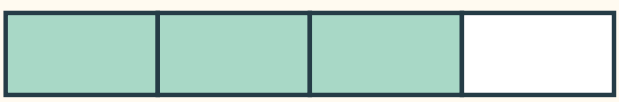
MATHS FIELD GUIDE · GRADE 9

Percentage multipliers and reverse percentages

OPENING PROBLEM

A sale price of ₹450 is 75% of the tag price. What was the tag price?



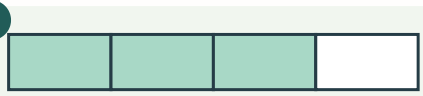
02 Find the whole that the percent refers to
03 Rules and worked cases
04 Successive changes multiply
05 From the givens to the answer
06 Keep corresponding parts together
07 Check your reasoning
08 Check your reasoning

ILLUSTRATED PROBLEM SHEET

Find the whole that the percent refers to

One hundred percent means the chosen starting whole.

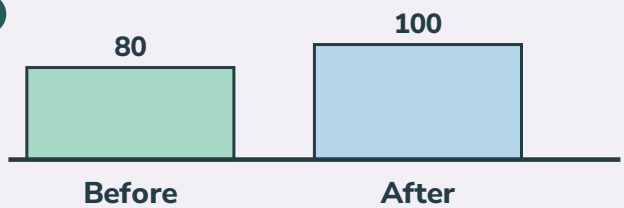
1



A sale price of ₹450 is 75% of the tag price. What was the tag price?

Three parts total ₹450. One is ₹150, so four parts give ₹600.

2



How large is the increase as a percent of the starting value?

The increase is 20 out of 80. That is 25%.

3

₹200 × 1.10
↓
₹220 × 0.90
↓
₹198

Why do a 10% rise and a 10% fall fail to cancel?

The fall is 10% of ₹220. It removes ₹22 after a rise of ₹20.

4

Fraction	Decimal	Percent
1/8	0.125	12.5%
3/8	0.375	37.5%

How do you get the second row from the first?

Triple each representation. Each column still names the same share.

20% of ₹150
₹30.

₹30 is 20%
whole ₹150.

CHAPTER PROBLEM

A ₹640 ticket rises in price by 12.5%. Find the new price in rupees.

720. 640 × 1.125 = 720.

MATHS REFERENCE · GRADE 9

Percentage multipliers and reverse percentages

Rules, conditions and worked cases

Recognise the case	Mathematical reasoning
Successive changes	₹1,000 × 1.20 × 0.90 = ₹1,080. Overall rise 8%.
Reverse discount	Sale price ₹720 after 20% off means original = 720/0.8 = ₹900.
Percent versus percentage points	A rate rising from 20% to 25% gains five points, or 5/20 = 25% relative to its old value.

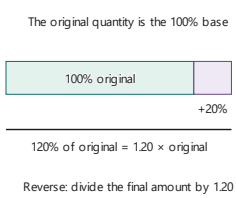
Read the representations

A percentage compares a part with a stated whole

Percent means per hundred. A percentage is a ratio: part ÷ whole × 100. The whole must be named before the ratio can be interpreted.

An increase of p% adds p/100 of the original amount. The final amount is original × (1 + p/100). A decrease uses (1 − p/100).

The extra strip is measured against the original 100% bar. It is not a percentage of the enlarged bar.

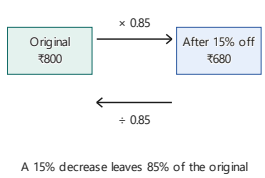


Reverse the multiplier, not the percentage sign

After a decrease, the final amount is only a fraction of the original. To recover the original, divide the final amount by the forward multiplier.

The pictured discount leaves 85%: final = original × 0.85. Therefore original = final ÷ 0.85.

A 100% decrease leaves zero. The original cannot be recovered from that final zero alone because every positive original would give it.



Time (h)	Distance (km)
1	18
2	36
2.5	45

At steady speed, how far in 2½ hours?

Two hours give 36 km and half an hour adds 9 km. Total 45 km.

THEOREMS AND REPRESENTATIONS

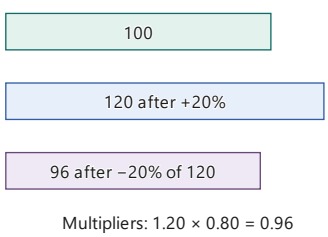
Successive changes multiply

Successive changes multiply

Each new percentage change uses the amount at that stage as its base. Multiply the stage multipliers in order.

Equal percentage increases and decreases do not cancel. The decrease acts on a different amount, as the bars show.

For any p% increase followed by a p% decrease, the combined multiplier is $(1 + p/100)(1 - p/100) = 1 - (p/100)^2$.



Profit, loss and discount have different named bases

Profit = selling price − cost price; profit percent = profit ÷ cost price × 100. Loss percent also uses cost price.

A discount is measured against the marked price: sale price = marked price × (1 − discount rate/100).

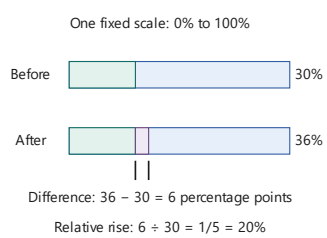
State the base explicitly. A profit as a percentage of selling price is a different ratio from profit as a percentage of cost.

Percent change and percentage points answer different questions

A rate rising from 30% to 36% rises by 6 percentage points. That subtraction compares the two rates directly.

Relative to the original rate, the increase is $(36 - 30)/30 \times 100 = 20\%$.

The diagram uses the same 100-unit scale for both rates. The extra strip is 6 units out of the original 30, not 6% of 30. Group counts still require their group totals.



600 m in 5 min
↓
120 m per min
↓
7.2 km per hour

Why divide before multiplying?

Find distance in one minute, then scale to sixty minutes and convert metres to kilometres.

WORKED EXAMPLES

From the givens to the answer

Work backwards from a profit

1. A bicycle sells for ₹2,760 at a profit of 15% on cost. The sale is 115% of the cost.
2. 2,760 = cost × 1.15, so cost = 2,760 ÷ 1.15 = ₹2,400.
3. The profit is ₹360. Checking 360 ÷ 2,400 × 100 = 15 verifies the stated base.

Is adding 25% the inverse of taking off 25%?

A learner says a discounted price can always be restored by adding the discount percentage.

1. Taking off 25% multiplies the original by 0.75.
2. The inverse multiplier is 1/0.75 = 4/3, not 1.25.
3. For a fresh check, ₹900 after 25% off came from ₹1,200; adding 25% to ₹900 gives only ₹1,125.

Check another case

Example 1

A ₹500 amount rises 30% and then falls 20%. Find the final amount in rupees.

520

500 × 1.30 × 0.80 = 520.

Example 2

Give a reliable method for any reverse-percentage question.

Name the original quantity that is the 100% base.

Write final = original × forward multiplier.

Divide final by that multiplier, checking that it is nonzero and that substitution restores the final amount.

Pack	Price
250 g	₹40
400 g	₹60

Which pack costs less per 100 g?

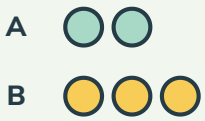
₹16 versus ₹15. The 400 g pack costs less per 100 g.

ILLUSTRATED PROBLEM SHEET

Keep corresponding parts together

Multiply or divide both counts by the same factor to preserve a ratio.

1



The mix is two parts A to three parts B. How many parts in all?

Five. A is two fifths of the whole mixture.

2

A	B
2	3
4	6
6	9

What changes across batches?

The totals change, while the amount of B for each unit of A stays at 3/2.

3

Total 35 g
↓
35 ÷ 5 = 7 g
↓
A = 14 g

How much A is in 35 g of this mix?

One part is 7 g. Two parts give 14 g and the remaining 21 g is B.

4

A	B
2	3
3	4

Does adding one to both counts preserve this recipe?

No. Cross-products 2 × 4 and 3 × 3 differ.

1:4 by parts
first share is 1/5 of the total.

1:4 by parts
first amount is 1/4 of the second.

CHAPTER PROBLEM

After a 30% discount, a bag costs ₹1,470. Find its marked price in rupees.

2100. 1470 ÷ 0.70 = 2100.

QUESTION BANK · FOLD OR COVER THE RIGHT COLUMN

Check your reasoning

Try the problem	Solution and reasoning
01 A total falls from 100 to 80. By what percent must 80 rise to return to 100?	25%. The gain of 20 is measured against 80.
02 In the same mix B weighs 18 g. How much does A weigh?	Three parts weigh 18 g, so one weighs 6 g and A weighs 12 g.
03 A ₹750 price decreases by 16%. Find the new price in rupees.	630 750 × 0.84 = 630.
04 A salary becomes ₹27,000 after an 8% rise. Find the original salary in rupees.	25000 27000 ÷ 1.08 = 25000.
05 An item sells for ₹1,020 at a 15% loss on cost. Find its cost price in rupees.	1200 1020 ÷ 0.85 = 1200.
06 A ₹1,600 marked price has successive discounts of 10% and 5%. Find the final price in rupees.	1368 1600 × 0.90 × 0.95 = 1368.

Time (min)	Water (L)
0	3
1	5
2	7

Is water volume proportional to time?

It grows by 2 L each minute but starts at 3 L. Doubling time need not double the amount.

QUESTION BANK · FOLD OR COVER THE RIGHT COLUMN

Check your reasoning

Try the problem	Solution and reasoning
07 A shop buys an item for ₹480 and sells it for ₹600. Find profit percent on cost; enter the number only.	25 Profit 120 divided by cost 480 gives 25%.
08 A success rate rises from 40% to 50%. Find the increase in percentage points.	10 50 – 40 = 10 percentage points.
09 Explain why a 10% rise followed by a 10% fall leaves less than the starting amount.	The rise multiplies the starting amount by 1.10. The fall multiplies that new amount by 0.90. The product is 0.99, so the final amount is 99% of the start.
10 A report gives a profit of ₹200 but no cost price. Can its profit percentage on cost be determined?	Profit percentage on cost requires profit divided by cost. The same ₹200 profit can arise from different costs. Without the cost or equivalent information, the percentage is undetermined.
11 After 20% off, a coat costs ₹1,840. Find its marked price in rupees.	2300 1840 ÷ 0.80 = 2300.

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