Chapter 8: Fractions in Disguise

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Exercise 8.1 — Fractions as Percentages

Q1 Express the following fractions as percentages.
(i) 3/5 (ii) 7/14 (iii) 9/20 (iv) 72/150 (v) 1/3 (vi) 5/11

SOLUTION

To express a fraction as a percentage, multiply by 100.

(i) 3/5 × 100 = 60%

(ii) 7/14 = 1/2; 1/2 × 100 = 50%

(iii) 9/20 × 100 = 900/20 = 45%

(iv) 72/150 × 100 = 7200/150 = 48%

(v) 1/3 × 100 = 100/3 = 33.33...% ≈ 33⅓%

(vi) 5/11 × 100 = 500/11 = 45.45...% ≈ 45 5/11%

Answer: (i) 60% (ii) 50% (iii) 45% (iv) 48% (v) 33⅓% (vi) 45 5/11%

Q2 Nandini has 25 marbles, of which 15 are white. What percentage of her marbles are white?
(i) 10% (ii) 15% (iii) 25% (iv) 60% (v) 40% (vi) None of these

SOLUTION

Fraction of white marbles = 15/25 = 3/5.
Percentage = 3/5 × 100 = 60%.
The correct option is (iv).

Answer: (iv) 60%

Q3 In a school, 15 of the 80 students come to school by walking. What percentage of the students come by walking?

SOLUTION

Fraction who walk = 15/80 = 3/16.
Percentage = 15/80 × 100 = 1500/80 = 18.75%.

Answer: 18.75% of the students come to school by walking.

Q4 A group of friends is participating in a long-distance run. The positions of each of them after 15 minutes are shown in the following picture. Match (among the given options) what percentage of the race each of them has approximately completed.
Options: 55%, 20%, 38%, 84%, 72%, 93%

SOLUTION

From the picture, estimate each runner's position along the track from Start to Finish.
Runner A is approximately 1/5 of the way => 20%.
Runner B is approximately 2/5 of the way => 38%.
Runner C is approximately 3/4 of the way => 72%.
Runner D is very close to Finish (nearly 85-93%) => 84% or 93%.

Approximate matches based on visual positions:
A => 20%, B => 38%, C => 72%, D => 84%.

Answer: A => 20%, B => 38%, C => 72%, D => 84% (approximate, based on visual positions in the figure).

Q5 Pairs of quantities are shown below. Identify and write appropriate symbols '>', '<', '=' in the blanks. Try to do it without calculations.
(i) 50% ____ 5% (ii) 5/10 ____ 50% (iii) 3/11 ____ 61% (iv) 30% ____ 1/3

SOLUTION

(i) 50% vs 5%: 50 > 5, so 50% > 5%.

(ii) 5/10 = 1/2 = 50%. So 5/10 = 50%.

(iii) 3/11 × 100 = 27.27...%, which is less than 61%. So 3/11 < 61%.

(iv) 1/3 × 100 = 33.33...% > 30%. So 30% < 1/3.

Answer: (i) > (ii) = (iii) < (iv) <

Exercise 8.2 — Percentage of Some Quantity

Q1 Find the missing numbers. The first problem has been worked out.
(i) Bar: 100% = 60, 20% = ? (worked); second bar: total = 75, 20% = ?
(ii) Bar: 20% = 12, total = ? (missing); second bar: total = 90, 20% = ?
(iii) Bar: total = 140, 25% = ? (missing); second bar: 25% = 140, total = ?

SOLUTION

(i) Worked example: 20% of 60 = (20/100) × 60 = 12.
For the second bar: 20% of 75 = (20/100) × 75 = 15.

(ii) If 20% of total = 12, then total = 12 / 0.20 = 60.
For the second bar: 20% of 90 = (20/100) × 90 = 18.

(iii) 25% of 140 = (25/100) × 140 = 35.
For the second bar: if 25% = 140, then total = 140 / 0.25 = 560.

Answer: (i) 12 (worked), 15; (ii) total = 60, value = 18; (iii) value = 35, total = 560

Q2 Find the value of the following and also draw their bar models.
(i) 25% of 160 (ii) 16% of 250 (iii) 62% of 360 (iv) 140% of 40 (v) 1% of 1 hour
(vi) 7% of 10 kg

SOLUTION

(i) 25% of 160 = (25/100) × 160 = 1/4 × 160 = 40.

(ii) 16% of 250 = (16/100) × 250 = 16 × 2.5 = 40.

(iii) 62% of 360 = (62/100) × 360 = 62 × 3.6 = 223.2.

(iv) 140% of 40 = (140/100) × 40 = 1.4 × 40 = 56.

(v) 1 hour = 60 minutes. 1% of 60 min = (1/100) × 60 = 0.6 minutes = 36 seconds.

(vi) 7% of 10 kg = (7/100) × 10 = 0.7 kg = 700 g.

Answer: (i) 40 (ii) 40 (iii) 223.2 (iv) 56 (v) 0.6 min (36 seconds) (vi) 0.7 kg (700 g)

Q3 Surya made 60 ml of deep orange paint. How much red paint did he use if red paint made up 3/4 of the deep orange paint?

SOLUTION

Red paint = 3/4 of 60 ml = (3/4) × 60 = 45 ml.

Answer: Surya used 45 ml of red paint.

Q4 Pairs of quantities are shown below. Identify and write appropriate symbols '>', '<', '=' in the boxes. Visualising or estimating can help.
(i) 50% of 510 [ ] 50% of 515
(ii) 37% of 148 [ ] 73% of 148
(iii) 29% of 43 [ ] 92% of 110
(iv) 30% of 40 [ ] 40% of 50
(v) 45% of 200 [ ] 10% of 490
(vi) 30% of 80 [ ] 24% of 64

SOLUTION

(i) Both are 50% but of different totals: 510 < 515. So 50% of 510 < 50% of 515.

(ii) Same total (148), different %: 37% < 73%. So 37% of 148 < 73% of 148.

(iii) 29% of 43 = 0.29 × 43 ≈ 12.5; 92% of 110 = 0.92 × 110 ≈ 101.2. So 29% of 43 < 92% of 110.

(iv) 30% of 40 = 12; 40% of 50 = 20. So 30% of 40 < 40% of 50.

(v) 45% of 200 = 90; 10% of 490 = 49. So 45% of 200 > 10% of 490.

(vi) 30% of 80 = 24; 24% of 64 = 15.36. So 30% of 80 > 24% of 64.

Answer: (i) < (ii) < (iii) < (iv) < (v) > (vi) >

Q5 Fill in the blanks appropriately:
(i) 30% of k is 70, 60% of k is _____, 90% of k is _____, 120% of k is _____.
(ii) 100% of m is 215, 10% of m is _____, 1% of m is _____, 6% of m is _____.
(iii) 90% of n is 270, 9% of n is _____, 18% of n is _____, 100% of n is _____.
(iv) Make 2 more such questions and challenge your peers.

SOLUTION

(i) 30% of k = 70 => k = 70 / 0.30 = 233.33...
60% of k = 2 × (30% of k) = 2 × 70 = 140.
90% of k = 3 × (30% of k) = 3 × 70 = 210.
120% of k = 4 × (30% of k) = 4 × 70 = 280.

(ii) 100% of m = 215, so m = 215.
10% of m = 21.5.
1% of m = 2.15.
6% of m = 6 × (1% of m) = 6 × 2.15 = 12.9.

(iii) 90% of n = 270 => n = 270 / 0.90 = 300.
9% of n = 0.09 × 300 = 27. (Or: 9% = 1/10 of 90%, so 270/10 = 27.)
18% of n = 2 × 9% = 2 × 27 = 54.
100% of n = 300.

(iv) Open-ended: students create their own pattern questions.

Answer: (i) 140, 210, 280; (ii) 21.5, 2.15, 12.9; (iii) 27, 54, 300

Q6 Fill in the blanks:
(i) 3 is ____ % of 300.
(ii) _____ is 40% of 4.
(iii) 40 is 80% of _____.

SOLUTION

(i) 3 / 300 × 100 = 1%. So 3 is 1% of 300.

(ii) 40% of 4 = 0.40 × 4 = 1.6.

(iii) 40 = 80% of x => x = 40 / 0.80 = 50.

Answer: (i) 1% (ii) 1.6 (iii) 50

Q7 Is 10% of a day longer than 1% of a week? Create such questions and challenge your peers.

SOLUTION

1 day = 24 hours = 1440 minutes.
10% of 1 day = 0.10 × 1440 = 144 minutes.

1 week = 7 × 24 = 168 hours = 10080 minutes.
1% of 1 week = 0.01 × 10080 = 100.8 minutes.

144 minutes > 100.8 minutes.

Answer: Yes, 10% of a day (144 min) is longer than 1% of a week (100.8 min).

Q8 Mariam's farm has a peculiar bull. One day she gave the bull 2 units of fodder and the bull ate 1 unit. The next day, she gave the bull 3 units and the bull ate 2 units. The day after, she gave the bull 4 units and the bull ate 3 units. This continued, and on the 99th day she gave the bull 100 units and the bull ate 99 units. Represent these quantities as percentages. What do you observe?

SOLUTION

Each day, given = (n+1) units, eaten = n units (where n = 1, 2, 3, ..., 99).
Percentage eaten = n / (n+1) × 100%.

Day 1: 1/2 × 100 = 50%.
Day 2: 2/3 × 100 = 66.67%.
Day 3: 3/4 × 100 = 75%.
Day 4: 4/5 × 100 = 80%.
...
Day 99: 99/100 × 100 = 99%.

Observation: The percentages are 50%, 66.67%, 75%, 80%, ..., 99%. The values keep increasing and approach 100% but never reach 100%. As n grows, n/(n+1) gets closer and closer to 1.

Answer: On day n, the bull eats n/(n+1) × 100% of the fodder. Percentages are 50%, 66.67%, 75%, ... 99%, steadily increasing towards (but never reaching) 100%.

Q9 Workers in a coffee plantation take 18 days to pick coffee berries in 20% of the plantation. How many days will they take to complete the picking work for the entire plantation, assuming the rate of work stays the same? Why is this assumption necessary?

SOLUTION

18 days cover 20% of the plantation.
1% of the plantation takes 18 / 20 = 0.9 days.
100% of the plantation takes 0.9 × 100 = 90 days.

Answer: They will take 90 days to complete picking for the entire plantation. The assumption is necessary because if the rate changed (e.g., due to fatigue, weather, or varying density of berries), the proportional calculation would not hold.

Q10 The badminton coach has planned the training sessions such that the ratio of warm up : play : cool down is 10% : 80% : 10%. If he wants to conduct a training of 90 minutes. How long should each activity be done?

SOLUTION

Total = 90 minutes.
Warm-up: 10% of 90 = 0.10 × 90 = 9 minutes.
Play: 80% of 90 = 0.80 × 90 = 72 minutes.
Cool-down: 10% of 90 = 0.10 × 90 = 9 minutes.

Check: 9 + 72 + 9 = 90 minutes. ✓

Answer: Warm-up: 9 min, Play: 72 min, Cool-down: 9 min.

Q11 An estimated 90% of the world's population lives in the Northern Hemisphere. Find the (approximate) number of people living in the Northern Hemisphere based on this year's worldwide population.

SOLUTION

The worldwide population in 2026 is approximately 8.2 billion.
90% of 8.2 billion = 0.90 × 8.2 = 7.38 billion.

(Note: Use the most current worldwide population figure for your calculation. The exact answer will vary slightly with updated data.)

Answer: Approximately 7.38 billion people (using 2025 world population of ~8.2 billion).

Q12 A recipe for the dish, halwa, for 4 people has the following ingredients in the given proportions — Rava: 40%, Sugar: 40%, and Ghee: 20%.
(i) If you want to make halwa for 8 people, what is the proportion of each of the above ingredients?
(ii) If the total weight of the ingredients is 2 kg, how much rava, sugar and ghee are present?

SOLUTION

(i) Doubling the recipe (for 8 people) does NOT change the proportions — only the quantities change.
Proportions remain: Rava = 40%, Sugar = 40%, Ghee = 20%.

(ii) Total = 2 kg = 2000 g.
Rava: 40% of 2000 = 800 g.
Sugar: 40% of 2000 = 800 g.
Ghee: 20% of 2000 = 400 g.
Check: 800 + 800 + 400 = 2000 g = 2 kg. ✓

Answer: (i) Proportions unchanged: Rava 40%, Sugar 40%, Ghee 20%. (ii) Rava = 800 g, Sugar = 800 g, Ghee = 400 g.

Exercise 8.3 — Using Percentages — Profit, Loss, Discount, and Tax

Q1 If a shopkeeper buys a geometry box for 75 and sells it for 110, what is his profit margin with respect to the cost?

SOLUTION

CP = 75, SP = 110.
Profit = SP - CP = 110 - 75 = 35.
Profit margin = (Profit / CP) × 100 = (35 / 75) × 100 = 46.67%.

Answer: Profit margin ≈ 46.67% (with respect to cost).

Q2 I am a carpenter and I make chairs. The cost of materials for a chair is 475 and I want to have a profit margin of 50%. At what price should I sell a chair?

SOLUTION

CP = 475. Profit margin (on cost) = 50%.
Profit = 50% of 475 = 0.50 × 475 = 237.50.
SP = CP + Profit = 475 + 237.50 = 712.50.

Answer: The selling price should be 712.50.

Q3 The total sales of a company (also called revenue) was 2.5 crore last year. They had a healthy profit margin of 25%. What was the total expenditure (costs) of the company last year?

SOLUTION

Revenue = 2.5 crore. Profit margin (on revenue) = 25%.
Profit = 25% of 2.5 crore = 0.25 × 2.5 = 0.625 crore.
Expenditure = Revenue - Profit = 2.5 - 0.625 = 1.875 crore.

Answer: Total expenditure was 1.875 crore.

Q4 A clothing shop offers a 25% discount on all shirts. If the original price of a shirt is 300, how much will Anwar have to pay to buy this shirt?

SOLUTION

Original price (Marked Price) = 300. Discount = 25%.
Discount amount = 25% of 300 = 0.25 × 300 = 75.
Selling price = 300 - 75 = 225.

Alternatively: SP = 75% of MP = 0.75 × 300 = 225.

Answer: Anwar will pay 225.

Q5 The petrol price in 2015 was 60 and 100 in 2025. What is the percentage increase in the price of petrol?
(i) 50% (ii) 40% (iii) 60% (iv) 66.66% (v) 140% (vi) 160.66%

SOLUTION

Old price = 60, New price = 100.
Increase = 100 - 60 = 40.
Percentage increase = (increase / original) × 100 = (40 / 60) × 100 = 66.67%.
The correct option is (iv).

Answer: (iv) 66.66%

Q6 Samson bought a car for 4,40,000 after getting a 15% discount from the car dealer. What was the original price of the car?

SOLUTION

Let the original (marked) price = MP.
SP = MP × (1 - 15/100) = 0.85 × MP.
Given SP = 4,40,000:
0.85 × MP = 4,40,000
MP = 4,40,000 / 0.85 = 5,17,647 (approximately).

Answer: The original price of the car was approximately 5,17,647.

Q7 1600 people voted in an election and the winner got 500 votes. What percent of the total votes did the winner get? Can you guess the minimum number of candidates who stood for the election?

SOLUTION

Percentage of votes won = (500 / 1600) × 100 = 31.25%.

For 500 votes to win, every other candidate must have received fewer than 500 votes.
Remaining votes = 1600 - 500 = 1100 votes to be shared among other candidates.

If 3 other candidates share 1100 votes: each could get up to 366-367 votes (< 500). So 4 candidates total is sufficient for 500 votes to win.
Minimum number of candidates = at least 3 (but the exact minimum depends on how votes split; with 4 candidates total, 500 can win).

Answer: Winner got 31.25% of votes. Minimum candidates standing: at least 3 others (4 total) so the winner's 500 votes can be a plurality.

Q8 The price of 1 kg of rice was 38 in 2024. It is 42 in 2025. What is the rate of inflation? (Inflation is the percentage increase in prices.)

SOLUTION

Old price = 38, New price = 42.
Increase = 42 - 38 = 4.
Rate of inflation = (4 / 38) × 100 = 10.53% (approximately).

Answer: Rate of inflation ≈ 10.53%.

Q9 A number increased by 20% becomes 90. What is the number?

SOLUTION

Let the number be n.
n × (1 + 20/100) = 90
n × 1.20 = 90
n = 90 / 1.20 = 75.

Answer: The number is 75.

Q10 A milkman sold two buffaloes for 80,000 each. On one of them, he made a profit of 5% and on the other a loss of 10%. Find his overall profit or loss.

SOLUTION

For the buffalo sold at 5% profit:
SP = 80,000, Profit = 5% of CP => SP = 1.05 × CP
CP1 = 80,000 / 1.05 = 76,190.48 (approx.).

For the buffalo sold at 10% loss:
SP = 80,000, Loss = 10% of CP => SP = 0.90 × CP
CP2 = 80,000 / 0.90 = 88,888.89 (approx.).

Total CP = 76,190.48 + 88,888.89 = 1,65,079.37.
Total SP = 80,000 + 80,000 = 1,60,000.

Since Total SP < Total CP, there is a LOSS.
Loss = 1,65,079.37 - 1,60,000 = 5,079.37.
Loss% = (5,079.37 / 1,65,079.37) × 100 ≈ 3.08%.

Answer: The milkman makes an overall loss of approximately 5,079 (≈ 3.1% loss).

Q11 The population of elephants in a national park increased by 5% in the last decade. If the population of the elephants last decade is p, the population now is:
(i) p × 0.5 (ii) p × 0.05 (iii) p × 1.5 (iv) p × 1.05 (v) p + 1.50

SOLUTION

A 5% increase means the new population = original + 5% of original = p + 0.05p = p(1.05).
The correct expression is p × 1.05.
Option (iv) is correct.

Answer: (iv) p × 1.05

Q12 Which of the following statement(s) mean the same as — 'The demand for cameras has fallen by 85% in the last decade'?
(i) The demand now is 85% of the demand a decade ago.
(ii) The demand a decade ago was 85% of the demand now.
(iii) The demand now is 15% of the demand a decade ago.
(iv) The demand a decade ago was 15% of the demand now.
(v) The demand a decade ago was 185% of the demand now.
(vi) The demand now is 185% of the demand a decade ago.

SOLUTION

Let demand a decade ago = D.
'Fallen by 85%' means demand decreased by 85% of D.
Current demand = D - 0.85D = 0.15D = 15% of D.

(iii) 'The demand now is 15% of the demand a decade ago' => 0.15D. This matches.

Checking others:

(i) 'demand now = 85% of decade ago' = 0.85D — this means only 15% fell, not 85%. INCORRECT.
(ii) 'decade ago = 85% of now' => D = 0.85 × (0.15D) — clearly inconsistent. INCORRECT.
(iv) 'decade ago = 15% of now' => D = 0.15 × 0.15D — inconsistent. INCORRECT.
(v) 'decade ago = 185% of now' => D = 1.85 × 0.15D = 0.2775D — inconsistent. INCORRECT.
(vi) 'now = 185% of decade ago' = 1.85D — this means demand INCREASED, not fell. INCORRECT.

Answer: (iii) only: The demand now is 15% of the demand a decade ago.

Exercise 8.4 — Growth and Compounding

Q1 Bank of Yahapur offers an interest of 10% p.a. Compare how much one gets if they deposit 20,000 for a period of 2 years with compounding and without compounding annually.

SOLUTION

Principal = 20,000, Rate = 10% p.a., Time = 2 years.

Without compounding (Simple Interest):
Interest = P × r × t = 20,000 × 0.10 × 2 = 4,000.
Total = 20,000 + 4,000 = 24,000.

With compounding (Compound Interest, annual):
Year 1 ending: 20,000 × 1.10 = 22,000.
Year 2 ending: 22,000 × 1.10 = 24,200.
Total = 24,200.

Alternatively: Total = P × (1 + r)^t = 20,000 × $(1.10)^2$ = 20,000 × 1.21 = 24,200.
Extra earned with compounding = 24,200 - 24,000 = 200.

Answer: Without compounding: 24,000. With compounding: 24,200. Compounding gives 200 more.

Q2 Bank of Wahapur offers an interest of 5% p.a. Compare how much one gets if one deposits 20,000 for a period of 4 years with compounding and without compounding annually.

SOLUTION

Principal = 20,000, Rate = 5% p.a., Time = 4 years.

Without compounding:
Interest = 20,000 × 0.05 × 4 = 4,000.
Total = 24,000.

With compounding:
Total = 20,000 × $(1.05)^4$.
$(1.05)^2$ = 1.1025; $(1.05)^4$ = 1.1025^2 = 1.21550625.
Total = 20,000 × 1.21550625 = 24,310.13 (approximately).
Extra earned = 24,310.13 - 24,000 = 310.13.

Answer: Without compounding: 24,000. With compounding: 24,310 (approx). Compounding gives about 310 more.

Q3 Do you observe anything interesting in the solutions of the two questions above? Share and discuss.

SOLUTION

In both Q1 and Q2, the total without compounding is the same (24,000), even though Q1 uses 10% for 2 years and Q2 uses 5% for 4 years.

However, with compounding, Q2 (5% for 4 years) gives 24,310 while Q1 (10% for 2 years) gives 24,200.
Even though the simple interest is the same, compounding over more periods gives a larger amount.

Observation: With compounding, the benefit grows with the number of compounding periods. More time means more accumulated interest-on-interest.

Answer: Both give the same simple interest total (24,000), but compounding over more periods (Q2: 4 years at 5%) yields slightly more than fewer periods at higher rate (Q1: 2 years at 10%). This shows that compounding benefit increases with the number of periods.

Exercise 8.5 — Growth and Compounding — Formulas and Applications

Q1 Jasmine invests amount 'p' for 4 years at an interest of 6% p.a. Which of the following expression(s) describe the total amount she will get after 4 years when compounding is not done?
(i) p × 6 × 4 (ii) p × 0.6 × 4 (iii) p × (0.6/100) × 4 (iv) p × (0.06/100) × 4 (v) p × 1.6 × 4 (vi) p × 1.06 × 4 (vii) p + (p × 0.06 × 4)

SOLUTION

Without compounding: Total = Principal + Interest = p + p × r × t
where r = 6% = 0.06 (as a decimal) and t = 4 years.
Total = p + p × 0.06 × 4 = p(1 + 0.06 × 4) = p × 1.24.

Checking each option:
(i) p × 6 × 4 = 24p — this is 2400% of p, far too large. WRONG.
(ii) p × 0.6 × 4 = 2.4p — uses 60% (not 6%). WRONG.
(iii) p × (0.6/100) × 4 = 0.024p — interest only, and tiny. WRONG.
(iv) p × (0.06/100) × 4 = 0.0024p — far too small. WRONG.
(v) p × 1.6 × 4 = 6.4p — incorrect. WRONG.
(vi) p × 1.06 × 4 = 4.24p — this is compounding formula for 1 year, applied incorrectly. WRONG.
(vii) p + (p × 0.06 × 4) = p × 1.24. This correctly represents p + interest. CORRECT.

Answer: (vii) only: p + (p × 0.06 × 4)

Q2 The post office offers an interest of 7% p.a. How much interest would one get if one invests 50,000 for 3 years without compounding? How much more would one get if it was compounded?

SOLUTION

P = 50,000, r = 7% = 0.07, t = 3 years.

Without compounding (Simple Interest):
Interest = P × r × t = 50,000 × 0.07 × 3 = 10,500.
Total = 60,500.

With compounding:
Total = P × (1 + r)^t = 50,000 × $(1.07)^3$.
$(1.07)^2$ = 1.1449; $(1.07)^3$ = 1.07 × 1.1449 = 1.225043.

Total = 50,000 × 1.225043 = 61,252.15 (approx.).
Interest with compounding = 61,252.15 - 50,000 = 11,252.15.

Extra earned with compounding = 11,252.15 - 10,500 = 752.15.

Answer: Without compounding: interest = 10,500. With compounding: interest ≈ 11,252. Extra earned from compounding ≈ 752.

Q3 Giridhar borrows a loan of 12,500 at 12% per annum for 3 years without compounding and Raghava borrows the same amount for the same time period at 10% per annum, compounded annually. Who pays more interest and by how much?

SOLUTION

P = 12,500, t = 3 years.

Giridhar (12% p.a., no compounding):
Interest = 12,500 × 0.12 × 3 = 4,500.

Raghava (10% p.a., compounded annually):
Total = 12,500 × $(1.10)^3$ = 12,500 × 1.331 = 16,637.50.
Interest = 16,637.50 - 12,500 = 4,137.50.

Difference = 4,500 - 4,137.50 = 362.50.
Giridhar pays more interest.

Answer: Giridhar pays more interest (4,500 vs 4,137.50). Giridhar pays 362.50 more than Raghava.

Q4 Consider an amount 1000. If this grows at 10% p.a., how long will it take to double when compounding is done vs. when compounding is not done? Is compounding an example of exponential growth and not-compounding an example of linear growth?

SOLUTION

Without compounding: amount grows by 100 (10% of 1000) every year.
To double: need 1000 more => takes 1000/100 = 10 years.

With compounding: 1000 × (1.10)^t = 2000 => (1.10)^t = 2.
t = log(2) / log(1.10) = 0.6931 / 0.09531 ≈ 7.27 years.

So with compounding, the amount doubles in about 7.27 years (faster than 10 years).

Yes — without compounding, growth is linear (constant 100 per year).
With compounding, growth is exponential (each year's interest is larger than the previous year's).

Answer: Without compounding: doubles in 10 years. With compounding: doubles in ~7.3 years. Yes — compounding is exponential growth; simple interest is linear growth.

Q5 The population of a city is rising by about 3% every year. If the current population is 1.5 crore, what is the expected population after 3 years?

SOLUTION

P = 1.5 crore, r = 3% = 0.03, t = 3 years.
With compounding (population grows on the updated base each year):
Population after 3 years = $1.5 \times (1.03)^3$.
$(1.03)^2 = 1.0609$; $(1.03)^3 = 1.03 \times 1.0609 = 1.092727$.
Population = $1.5 \times 1.092727 \approx 1.639$ crore.

Answer: Expected population after 3 years ≈ 1.64 crore.

Q6 In a laboratory, the number of bacteria in a certain experiment increases at the rate of 2.5% per hour. Find the number of bacteria at the end of 2 hours if the initial count is 5,06,000.

SOLUTION

Initial count = 5,06,000, r = 2.5% = 0.025, t = 2 hours.
Count after 2 hours = $5,06,000 \times (1.025)^2$.
$(1.025)^2 = 1.050625$.
Count = $5,06,000 \times 1.050625 = 5,31,616.25$.
Rounding: approximately 5,31,616 bacteria.

Answer: Approximately 5,31,616 bacteria after 2 hours.

Exercise 8.6 — Percentage Applications

Q1 The population of Bengaluru in 2025 is about 250% of its population in 2000. If the population in 2000 was 50 lakhs, what is the population in 2025?

SOLUTION

250% means 250/100 = 2.5 times the 2000 population.

Population in 2025 = 250% of 50 lakhs = 2.5 × 50 = 125 lakhs.

125 lakhs = 1,25,00,000 (1.25 crore).

Answer: 125 lakhs (i.e. 1.25 crore, or 1,25,00,000).

Q2 The population of the world in 2025 is about 8.2 billion. Match each country's 2025 population with its approximate percentage share of the worldwide population: Germany 83 million, India 1.46 billion, Bangladesh 175 million, USA 347 million. (Percentage tiles to choose from: 13%, 8%, 18%, 10%, 1%, 35%, 2%, 2%, 0.1%.) [Hint: Writing these numbers in the standard form and estimating can help.]

SOLUTION

Write everything in millions: world = 8.2 billion = 8200 million.
Share of a country = (country's population / 8200) × 100%.

The percentage tiles to choose from are: 13%, 8%, 18%, 10%, 1%, 35%, 2%, 2%, 0.1%.

Germany = 83 million: (83 / 8200) × 100 = 1.01% → the 1% tile.

India = 1.46 billion = 1460 million: (1460 / 8200) × 100 = 17.8% → the 18% tile.

Bangladesh = 175 million: (175 / 8200) × 100 = 2.13% → a 2% tile.

USA = 347 million: (347 / 8200) × 100 = 4.23% → the remaining 2% tile (the closest option provided; the tile set has no 4%/5% value, so the second 2% is the intended match).

Answer: Germany → 1%, India → 18%, Bangladesh → 2%, USA → 2% (exact shares: 1.01%, 17.8%, 2.13%, 4.23%; USA rounds to 4% but the only remaining tile is 2%).

Q3 The price of a mobile phone is 8,250. A GST of 18% is added to the price. Which of the following gives the final price including GST? (i) 8250 + 18 (ii) 8250 + 1800 (iii) 8250 + 18/100 (iv) 8250 × 18 (v) 8250 × 1.18 (vi) 8250 + 8250 × 0.18 (vii) 1.8 × 8250

SOLUTION

GST = 18% of 8250 = 0.18 × 8250 = 1485.

Final price = original price + GST = 8250 + 1485 = 9735.

Check each option:

(i) 8250 + 18 = 8268 — adds 18, not 18% — wrong.

(ii) 8250 + 1800 = 10050 — 1800 is not 18% of 8250 — wrong.

(iii) 8250 + 18/100 = 8250.18 — adds only 0.18 — wrong.

(iv) 8250 × 18 = 148500 — multiplies by 18, not 1.18 — wrong.

(v) 8250 × 1.18 = 9735 — correct.

(vi) 8250 + 8250 × 0.18 = 8250 + 1485 = 9735 — correct.

(vii) 1.8 × 8250 = 14850 — that is +80% — wrong.

Answer: (v) 8250 × 1.18 and (vi) 8250 + 8250 × 0.18 — both equal 9,735.

Q4 The monthly percentage change in population of mice in a lab (compared to the previous month) is: Month 1 +5%, Month 2 −2%, Month 3 −3%. The initial population is p. Which statement(s) are true? (i) Population after three months = p × 0.05 × 0.02 × 0.03. (ii) = p × 1.05 × 0.98 × 0.97. (iii) = p + 0.05 − 0.02 − 0.03. (iv) = p. (v) more than p. (vi) less than p.

SOLUTION

Each monthly change multiplies the running population by (1 + change): +5% → ×1.05, −2% → ×0.98, −3% → ×0.97.

Population after 3 months = p × 1.05 × 0.98 × 0.97 = p × 0.99813 (about 0.998 p).

(i) multiplies by the raw change fractions, not (1 + change) — false.

(ii) exactly the correct expression — true.

(iii) adds bare numbers and ignores compounding — false.

(iv) 0.99813 is not 1 — false.

(v) 0.99813 < 1, so not more than p — false.

(vi) 0.99813 < 1, so less than p — true.

Answer: Statements (ii) and (vi) are true (final population = 0.99813 p, slightly less than p).

Q5 A shopkeeper initially set the price of a product with a 35% profit margin. Due to poor sales, he offered a 30% discount on the selling price. Will he make a profit or a loss? Give reasons.

SOLUTION

Let the cost price be 100.

With a 35% profit margin, the marked selling price = 100 × 1.35 = 135.

A 30% discount on this price = 135 × (1 − 0.30) = 135 × 0.70 = 94.50.

Final selling price 94.50 < cost price 100, so he makes a loss.
Loss = 100 − 94.50 = 5.50, i.e. a 5.5% loss.

Answer: A loss. Selling price = 1.35 × 0.70 = 0.945 of cost, i.e. a 5.5% loss.

Q6 What percentage of area is occupied by the region marked 'E' in the figure? (The figure is a 6 × 6 square dot grid divided into regions A, B, C, D and E.)

SOLUTION

Take the outer square as 6 × 6 units, so total area = 36 square units.

A vertical line splits the square into a left half and a right half (each 3 units wide).

Left half: region A (top) is 3 wide × 3 tall = 9. Below it is a 3 × 3 square (area 9) split by a diagonal into two equal triangles: D (upper-left) and E (lower-right), each = 9 / 2 = 4.5.

Right half: region B (top) is 3 wide × 4.5 tall = 13.5, and region C (bottom) is 3 wide × 1.5 tall = 4.5.

Check: A + B + C + D + E = 9 + 13.5 + 4.5 + 4.5 + 4.5 = 36 = total area.

Percentage of E = (4.5 / 36) × 100 = 12.5% (i.e. E is 1/8 of the square).

Answer: E occupies 4.5/36 = 1/8 of the square = 12.5%.

Q7 What is 5% of 40? What is 40% of 5? What is 25% of 12? What is 12% of 25? What is 15% of 60? What is 60% of 15? What do you notice? Can you make a general statement and justify it using algebra, comparing x% of y and y% of x?

SOLUTION

5% of 40 = (5/100) × 40 = 2; 40% of 5 = (40/100) × 5 = 2.
25% of 12 = (25/100) × 12 = 3; 12% of 25 = (12/100) × 25 = 3.
15% of 60 = (15/100) × 60 = 9; 60% of 15 = (60/100) × 15 = 9.

Observation: in each pair the two answers are equal — x% of y equals y% of x.

Algebraic justification: x% of y = (x/100) × y = xy/100, and y% of x = (y/100) × x = xy/100. Both equal xy/100, so x% of y = y% of x for all x and y.

Answer: Each pair is equal (2, 3, 9). In general x% of y = y% of x, because both equal xy/100.

Q8 A school is organising an excursion. 40% of the students are Grade 8 and the rest are Grade 9. Among the Grade 8 students, 60% are girls. (i) What percentage of all the students are Grade 8 girls? (ii) If the total number going is 160, how many are Grade 8 girls?

SOLUTION

(i) Grade 8 girls are 60% of the Grade 8 group, and the Grade 8 group is 40% of all students.
So Grade 8 girls = 60% of 40% = 0.60 × 0.40 = 0.24 = 24% of all students.

(ii) Grade 8 girls = 24% of 160 = 0.24 × 160 = 38.4, i.e. about 38 students.

Answer: (i) 24% of the students are Grade 8 girls. (ii) 24% of 160 = 38.4, i.e. about 38 students.

Q9 A shopkeeper sells pencils such that the selling price of 3 pencils equals the cost of 5 pencils. Does he make a profit or a loss? What is his profit or loss percentage?

SOLUTION

Let the cost price of one pencil be 1, so the cost of 5 pencils = 5.

Selling price of 3 pencils = cost of 5 pencils = 5, so selling price of 1 pencil = 5/3 ≈ 1.67.

Selling price per pencil (5/3) > cost price per pencil (1), so he makes a profit.

Profit per pencil = 5/3 − 1 = 2/3.
Profit % = (2/3 ÷ 1) × 100 = 200/3 = 66.67% (i.e. 66 2/3%).

Answer: Profit. Profit percentage = 200/3% = 66.67% (66 2/3%).

Q10 The bus fares were increased by 3% last year and by 4% this year. What is the overall percentage price increase over the last 2 years?

SOLUTION

Successive increases multiply, they do not simply add.

Let the original fare be 1. After +3%: 1 × 1.03 = 1.03. After a further +4%: 1.03 × 1.04 = 1.0712.

Overall multiplier = 1.0712, so the fare became 1.0712 times the original.

Overall increase = (1.0712 − 1) × 100 = 7.12% (not 3 + 4 = 7%, because the second increase also applies to the first increase).

Answer: 7.12% overall increase (not simply 7%).

Q11 If the length of a rectangle is increased by 10% and the area is unchanged, by what percentage (exactly) does the breadth decrease?

SOLUTION

Let the original length be L and breadth be B, so original area = L × B.

New length = 1.10 L. For the area to stay the same, new breadth B' must satisfy (1.10 L) × B' = L × B.

So B' = B / 1.10 = B × (10/11) ≈ 0.909 B.

Decrease in breadth = B − B' = B × (1/11).
Percentage decrease = (1/11) × 100 = 100/11 = 9.09% exactly (i.e. 9 1/11%).

Answer: The breadth decreases by 1/11 = 100/11% = 9.09% (9 1/11%), not 10%.

Q12 The percentage of ingredients in a 65 g chips packet is: Potato 70%, Vegetable oil 24%, Salt 3%, Spices 3%. Find the weight of each ingredient in the packet.

SOLUTION

Total weight = 65 g. Each ingredient's weight = its percentage × 65 g.

Potato: 70% of 65 = 0.70 × 65 = 45.5 g.
Vegetable oil: 24% of 65 = 0.24 × 65 = 15.6 g.
Salt: 3% of 65 = 0.03 × 65 = 1.95 g.
Spices: 3% of 65 = 0.03 × 65 = 1.95 g.

Check: 45.5 + 15.6 + 1.95 + 1.95 = 65 g.

Answer: Potato 45.5 g, Vegetable oil 15.6 g, Salt 1.95 g, Spices 1.95 g (total 65 g).

Q13 Three shops sell the same items at the same price. Shop A: 'Buy 1 get 1 free', Shop B: 'Buy 2 get 1 free', Shop C: 'Buy 3 get 1 free'. (i) If one item costs 100, what is the effective price per item in each shop? Arrange cheapest to costliest. (ii) Calculate the percentage discount in each shop. (iii) If you need 4 items, which shop would you choose? Why?

SOLUTION

(i) Effective price per item = total amount paid / total items received.
Shop A: pay for 1, get 2 → 100 for 2 items → 50 per item.
Shop B: pay for 2, get 3 → 200 for 3 items → 66.67 per item.
Shop C: pay for 3, get 4 → 300 for 4 items → 75 per item.
Cheapest to costliest: Shop A (50) < Shop B (66.67) < Shop C (75).

(ii) Percentage discount = (free items / total items received) × 100.
Shop A: 1 free of 2 → 50%. Shop B: 1 free of 3 → 33.33%. Shop C: 1 free of 4 → 25%.

(iii) For exactly 4 items, Shop A is best: buy 2, get 2 free → 4 items for 200. Shops B and C give 4 items for 300, so choose Shop A.

Answer: (i) A 50, B 66.67, C 75; cheapest A < B < C. (ii) A 50%, B 33.33%, C 25%. (iii) Shop A — 4 items for 200 vs 300 elsewhere.

Q14 In a room of 100 people, 99% are left-handed. How many left-handed people have to leave the room to bring that percentage down to 98%?

SOLUTION

99% of 100 = 99 people are left-handed, and 1 person is right-handed.

Only left-handers leave, so the 1 right-hander always stays. If x left-handers leave, the room has (100 − x) people, of whom (99 − x) are left-handed.

We want left-handers to be 98% of the room, i.e. the 1 right-hander must be 2% of the room: 2% of (100 − x) = 1 → 100 − x = 1 / 0.02 = 50 → x = 50.

Check: after 50 left-handers leave, room has 50 people with 49 left-handed: 49/50 = 98%.

So 50 left-handed people must leave — surprisingly many, because the single right-hander must become 2% of the whole room.

Answer: 50 left-handed people must leave (room drops to 50 people, 49 left-handed = 98%).

Q15 The graph 'Ability to use computers by age and gender (2023)' shows Female/Male percentages: Children 4%/5%, Teenage 24%/29%, Twenties 26%/37%, Thirties 14%/25%, Forties 7%/14%, Fifties 4%/9%, Seniors 2%/4%. Which statement(s) are valid? (i) People in their twenties are the most computer-literate. (ii) Women lag behind across age groups. (iii) There are more people in their twenties than teenagers. (iv) More than a quarter of people in their thirties can use computers. (v) Less than 1 in 10 aged 60+ can use computers. (vi) Half of the people in their twenties can use computers.

SOLUTION

The graph shows, for each age band, the percentage of females and of males who can use computers — abilities, not head-counts.

(i) Valid. The twenties band has the highest bars (Female 26%, Male 37%), higher than every other group.

(ii) Valid. In every age band the female bar is shorter than the male bar (4<5, 24<29, 26<37, 14<25, 7<14, 4<9, 2<4).

(iii) Not valid. The graph gives ability percentages, not the number of people, so counts cannot be compared.

(iv) Not valid. In the thirties, females are 14% and males 25% (exactly a quarter, not more), so 'more than a quarter' is not supported.

(v) Valid. For seniors (60+) both bars are low — Female 2%, Male 4% — both far less than 10%.

(vi) Not valid. The largest twenties bar is 37%, well below 50%.

Answer: Valid: (i), (ii) and (v). Not valid: (iii) (graph shows ability, not counts), (iv) (thirties max is 25%, only a quarter), (vi) (twenties max is 37%, not half).