NA02 — Percentage, Ratio & Proportion

📈 Numerical Ability – NA02 | AFCAT Level | ★ High Priority

📌 **AFCAT Focus:** NA02 is the **highest-weightage chapter** in Numerical Ability (3–5 questions). Master **percentage conversions** (fraction↔%↔decimal), **successive % change formula**, and **ratio shortcuts**. Also feeds Profit/Loss and SI/CI. Average students who memorise the % fraction table can solve most AFCAT questions in under 30 seconds.

1. Percentage

FIG. 1.1 — PERCENTAGE ↔ FRACTION ↔ DECIMAL: MASTER CONVERSION TABLE

PERCENTAGE ↔ FRACTION ↔ DECIMAL CONVERSIONS		
PERCENTAGE	FRACTION	DECIMAL
10%	1/10	0.1
20%	1/5	0.2
25%	1/4	0.25
33.33%	1/3	$0.3\overline{3}$
50%	1/2	0.5
66.67%	2/3	0.667
75%	3/4	0.75
Memorise these! AFCAT uses these fractions directly in questions.		

Key Percentage Formulas:

- x% of y = **x × y / 100**
- % increase = **(Increase / Original) × 100**
- % decrease = **(Decrease / Original) × 100**

- If A is x% more than B, then B is **x/(100+x) × 100 %** less than A
- Successive change: x% then y% → Net % = **x + y + xy/100**

✎ Worked Example — Successive Percentage Change

A salary is increased by 20% and then decreased by 10%. What is the net % change?

Use: Net = x + y + xy/100 (here x = +20, y = −10)

Net = 20 + (−10) + (20×−10)/100 = 20 − 10 − 2 = **+8%** (net increase)

✓ Net increase = 8%

RATIO & PROPORTION

2. Ratio & Proportion

FIG. 2.1 — RATIO & PROPORTION: CONCEPTS & PROPERTIES

RATIO (a : b)

a : b = a/b (a = antecedent, b = consequent)

Properties:
- Multiply/divide both terms by same number
- a:b = ka:kb (equivalent ratios)

Comparison: a/b vs c/d

Cross multiply: ad vs bc

Types:

Compounded ratio: (a:b)×(c:d) = ac:bd

Duplicate ratio: $a^2:b^2$ Sub-duplicate: √a:√b

PROPORTION (a:b = c:d)

a, b, c, d in proportion: **ad = bc**

(Product of extremes = Product of means)

Key Rules:

Componendo: (a+b)/b = (c+d)/d

Dividendo: (a−b)/b = (c−d)/d

Componendo-Dividendo: (a+b)/(a−b) = (c+d)/(c−d)

Types:

Continued: a:b:c = a/b = b/c (b = √ac)

Direct: y↑ when x↑ Inverse: y↓ when x↑

Topic C

Partnership (Profit Sharing)

AFCAT Direct

Simple **Equal time:** Profit divided in ratio of investments. If A invests Rs 3,000 and B invests Rs 5,000, ratio = 3:5. A gets 3/8 of profit, B gets 5/8.

Compound **Different time:** Profit ratio = Capital×Time. If A invests Rs 3,000 for 6 months and B invests Rs 5,000 for 8 months, A:B = (3,000×6):(5,000×8) = 18,000:40,000 = 9:20.

Working Partner A working partner may receive a salary/commission from profits *before* the remaining profit is split in the investment ratio.

✎ Worked Example — Ratio & Partnership

A, B and C invest Rs 20,000; Rs 25,000 and Rs 15,000 respectively. Total profit = Rs 9,600. Find each person's share.

Ratio: 20,000 : 25,000 : 15,000 = **4 : 5 : 3** (divide by 5,000)
Total parts = 4+5+3 = 12
A = (4/12)×9,600 = **Rs 3,200**
B = (5/12)×9,600 = **Rs 4,000**
C = (3/12)×9,600 = **Rs 2,400**

✓ A: Rs 3,200 B: Rs 4,000 C: Rs 2,400

✎ Worked Example — Election Results (% Application)

In an election between two candidates, the winner gets 65% of total votes and wins by 900 votes. Find total votes and votes for each candidate.

Winner: 65% Loser: 35% Difference: 30%
30% of total = 900 → Total votes = 900 × 100/30 = **3,000**
Winner: 65% of 3,000 = **1,950 votes**
Loser: 35% of 3,000 = **1,050 votes**

✓ Total = 3,000 | Winner = 1,950 | Loser = 1,050

Topic B — Componendo, Dividendo, Alternendo & Invertendo

AFCAT Theory

Setup If **a/b = c/d** (i.e., a:b = c:d), then the following transformations all hold true:

Invertendo **b/a = d/c** — flip both fractions. (Invert both sides simultaneously.) E.g. if 3/4 = 6/8 → 4/3 = 8/6 ✓

Alternendo **a/c = b/d** — swap the means (b and c swap positions). E.g. if 3/4=6/8 → 3/6=4/8 → 1/2=1/2 ✓

Componendo — $(a+b)/b = (c+d)/d$ — add denominator to numerator on both sides. E.g. $a/b=c/d \rightarrow (a+b)/b=(c+d)/d$

Dividendo — $(a-b)/b = (c-d)/d$ — subtract denominator from numerator on both sides.

Componendo-Dividendo — $(a+b)/(a-b) = (c+d)/(c-d)$ — the most used rule in AFCAT. Apply when given a ratio and asked to find $(x+y)/(x-y)$ type expressions.

Example: If $x/y = 3/2$, find $(x+y)/(x-y)$.

Apply C-D: $(3+2)/(3-2) = 5/1 = 5$

📐 Formula Sheet — NA02

Core % Formulas

$x\%$ of $y = xy/100$

% increase = $(\text{increase}/\text{original})\times 100$

Successive: $x+y+xy/100$

A more than B by x%: B less than A by $x/(100+x)\%$

Ratio Key Facts

$a:b::c:d \rightarrow ad = bc$

Compounded: $ac:bd$

Duplicate: $a^2:b^2$

Componendo-Dividendo: $(a+b)/(a-b) = (c+d)/(c-d)$

Proportion Types

Mean proportion of a,b: $\sqrt{(ab)}$

Third proportion to a,b: b^2/a

Fourth proportion to a,b,c: bc/a

Direct: $y = kx$ Inverse: $y = k/x$

% Fraction Table (Key)

1/8 = 12.5% 1/6 = 16.67%

2/5 = 40% 3/8 = 37.5%

5/8 = 62.5% 7/8 = 87.5%

1/9 = 11.11% 1/11 = 9.09%

Partnership

Simple: Profit $\propto$ Capital

Compound: Profit $\propto$ Capital × Time

Working partner gets salary first, then split

Population / Growth

After n years: $P\times(1 + r/100)^n$

% change on original: use net formula

If population falls: $P\times(1 - r/100)^n$

📝 Topic-Wise PYQs — NA02

Q1. 35% of 280 is: AFCAT PYQ

(a) 91 (b) 96 (c) 98 (d) 105

✓ Answer: (c) 98

35% of 280 = (35/100)×280 = 35×2.8 = 98. Shortcut: 35% = 25%+10% = 70+28 = 98.

Q2. A number is increased by 20% and then decreased by 20%. The net change is: AFCAT PYQ

(a) 0% change (b) 4% decrease (c) 4% increase (d) 2% decrease

✓ Answer: (b) 4% decrease

Net = x+y+xy/100 = 20+(−20)+(20×−20)/100 = 0−4 = −4%. A 4% decrease. This is a classic AFCAT trap — students assume 0% change.

Q3. If A:B = 2:3 and B:C = 4:5, then A:B:C = ? AFCAT PYQ

(a) 8:12:15 (b) 2:3:5 (c) 6:8:10 (d) 4:6:10

✓ Answer: (a) 8:12:15

Make B common: A:B = 2:3 = 8:12; B:C = 4:5 = 12:15. So A:B:C = 8:12:15.

Q4. In an election, candidate A gets 55% of total votes. If he wins by 2,400 votes, find total votes: Tricky

(a) 20,000 (b) 24,000 (c) 30,000 (d) 12,000

✓ Answer: (b) 24,000

A gets 55%, B gets 45%. Difference = 10%. 10% of total = 2,400 → Total = 24,000.

Q5. A and B invest Rs 4,000 and Rs 6,000. If total profit = Rs 5,500, B's share is: AFCAT PYQ

(a) Rs 2,000 (b) Rs 3,000 (c) Rs 3,300 (d) Rs 2,500

✓ Answer: (c) Rs 3,300

Ratio = 4:6 = 2:3. B's share = (3/5)×5,500 = Rs 3,300.

🧠 Quick Memory Chart — NA02

📈 % Conversions

- 10% = **1/10**
- 25% = **1/4**
- 33.33% = **1/3**
- 50% = **1/2**
- 12.5% = **1/8**
- 16.67% = **1/6**

📈 % Formulas

- Successive: **x+y+xy/100**
- Both same sign: **net increases**
- Opposite signs: may decrease
- +r% then −r% = $-r^2/100$ %
- A 20% more than B → B is **16.67% less**

📈 Ratio & Partnership

- ad = bc (proportion)
- C-D: (a+b)/(a−b) = (c+d)/(c−d)
- Mean proportion: **√(ab)**
- Simple partnership: **Capital ratio**
- Compound: **Capital × Time**

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