

QUARKS PHYSICS INSTITUTE

Trusted Guidance for Government Jobs

STGT PURE SCIENCE

MATHEMATICS

UNIT-WISE COMPLETE STUDY MATERIAL

Theory • Derivations • Diagrams • Solved Examples • PYQs (2016–2026) with Solutions • Trend Analysis • Practice Sets • Revision Capsule

UNIT 1

ARITHMETIC

Ratio & Proportion • Partnership • Percentage • Profit & Loss • SI & CI • Instalments • Banking

SUDIP LASKAR

CSIR NET 2020 (AIR 145) • GATE Physics 2021 (AIR 52)
CSIR NET JRF 2022 (AIR 162) • CSIR NET JRF 2023 (AIR 93)
STPGT Physics 2025 (Rank 2)

Mapped to the official TRBT Syllabus (2016), Group-C Mathematics • Built from an analysis of 298 PYQs across 2016, 2017, 2018, 2019, 2022 and 2026

First Edition • June 2026 • For Tripura STGT (Classes IX–X) Aspirants

Copyright © 2026 Sudip Laskar / Quarks Physics Institute. All rights reserved.

ARITHMETIC

SYLLABUS

(a) Ratio and Proportion – Application to Simple Problems, Partnership. (b) Percentage and Its Application Including Profit and Loss. (c) Simple Interest and Compound Interest. (d) Instalments. (e) Banking; Saving Bank Accounts, Computation of Interest for a Series of Months.

PYQ RADAR

40 questions across six papers (2016: 7, 2017: 8, 2018: 7, 2019: 7, 2022: 6, 2026: 5) – about 13% of the Mathematics section. The workhorses: **CP:SP ratio conversions** (five questions), the **fraction-percentage family** ($16\frac{2}{3}\%$, $12\frac{1}{2}\%$, $6\frac{1}{4}\%$...), and **every variant of the CI formula** (find A , P , r , n , doubling). **Warning that wins marks:** in this unit “None of the above” is the *correct* answer in about one question in six – compute first, then look at the options, never the reverse.

1. INTRODUCTION

Arithmetic is the mathematics of daily commerce: comparing quantities (ratio), scaling them (percentage), trading them (profit and loss), and lending them (interest, instalments, banking). Every question in this unit reduces to a one- or two-line formula – the skill STGT actually tests is **translation**: turning a word problem into the right fraction in under a minute.

2. RATIO AND PROPORTION

Ratio $a : b$ compares two like quantities ($b \neq 0$); it is unitless and unchanged on multiplying both terms by $k \neq 0$. **Proportion**: $a : b :: c : d$ means $ad = bc$ (product of extremes = product of means).

Vocabulary. Duplicate ratio of $a : b$ is $a^2 : b^2$; sub-duplicate is $\sqrt{a} : \sqrt{b}$; **mean proportional** between a and c is $b = \sqrt{ac}$ (from $a : b :: b : c$); third proportional to a , b is b^2/a . Continued proportion: $a : b :: b : c$.

2.1 THE K-METHOD (SOLVES HALF THE PYQS)

If $\frac{a}{b} = \frac{c}{d} = k$, put $a = bk$, $c = dk$ and substitute.

EXAMPLE 1

MODERATE

If $a : b = c : d$, find $\frac{a^2 + b^2}{c^2 + d^2}$.

STGT 2026

Solution: With $a = bk$, $c = dk$: $\frac{b^2(k^2 + 1)}{d^2(k^2 + 1)} = \frac{b^2}{d^2}$. And $\frac{ab}{cd} = \frac{kb^2}{kd^2} = \frac{b^2}{d^2}$ too – so the value equals ab/cd .

2.2 COMPONENDO–DIVIDENDO

If $\frac{a}{b} = \frac{c}{d}$, then $\frac{a+b}{a-b} = \frac{c+d}{c-d}$ (and componendo, dividendo, alternendo, invertendo separately)

EXAMPLE 2

EASY

If $\frac{4x+7y}{4x-7y} = \frac{7}{3}$, find $x : y$.

STGT 2017

Solution: Cross-multiply: $12x + 21y = 28x - 49y \Rightarrow 70y = 16x \Rightarrow x : y = 35 : 8$. (Componendo–dividendo gives the same in one step: $\frac{4x}{7y} = \frac{7+3}{7-3} = \frac{10}{4}$.)

2.3 COMBINING RATIOS (THE BRIDGE TRICK)

Given $A : B$ and $B : C$, scale both so the **common term matches**:

EXAMPLE 3

MODERATE

$A : B = 5 : 2$ and $B : C = 3 : 2$. Find $A : B : C$.

STGT 2022

Solution: LCM of B's values (2, 3) is 6: $A : B = 15 : 6$, $B : C = 6 : 4 \Rightarrow A : B : C = 15 : 6 : 4$.

2.4 RATIO IN DISGUISE (PYQ PATTERNS)

- **Equal percentages:** $30\%A = 40\%B = 50\%C \Rightarrow A : B : C = \frac{1}{30} : \frac{1}{40} : \frac{1}{50} = 20 : 15 : 12$ (2016) – invert the multipliers.
- **Coins:** value ratio = count ratio $\times$ denomination: counts $2 : 3 : 5$ of ₹1/50p/25p $\Rightarrow$ values $200 : 150 : 125 = 8 : 6 : 5$ (2022).
- **Expenditure** = price $\times$ quantity: prices $2 : 3$, quantities $5 : 4 \Rightarrow 10 : 12 = 5 : 6$ (2019).
- **Speeds with units:** $550 \text{ m/min} = 33 \text{ km/h}$ vs $33 \text{ km in } \frac{3}{4} \text{ h} = 44 \text{ km/h} \Rightarrow 3 : 4$ (2018).
- **Unknown addend:** “add x to 6, 15, 20, 43 to make them proportional”: $(6+x)(43+x) = (15+x)(20+x) \Rightarrow 14x = 42 \Rightarrow x = 3$. The released 2017 key printed 5 – the worked algebra says 3; trust the working.

3. PARTNERSHIP

Profit shares $\propto$ capital $\times$ time. Equal time $\Rightarrow$ shares $\propto$ capitals.

EXAMPLE 4

MODERATE

A, B, C invest in the ratio $15 : 6 : 4$ (combined from $A : B = 5 : 2$, $B : C = 3 : 2$) and the profit is ₹3,500. Find B's share. STGT 2022

Solution: Total parts = 25; B's share = $\frac{6}{25} \times 3500 = ₹840$. The released key said “None of the above” although 840 sat in option (A) – the working is unambiguous. Compute, then choose.

EXAMPLE 5

MODERATE

A invests ₹5,000 for 12 months, B ₹6,000 for 8 months. Divide a profit of ₹5,400.

Solution: Shares $\propto 5000 \times 12 : 6000 \times 8 = 60000 : 48000 = 5 : 4$. A gets 3000, B gets 2400.

4. PERCENTAGE

$x\% = \frac{x}{100}$. The exam's favourite percentages are *fractions wearing disguises*:

Table: The fraction-percentage family (memorise cold)

%	FRACTION	%	FRACTION	%	FRACTION
50	$\frac{1}{2}$	$33\frac{1}{3}$	$\frac{1}{3}$	25	$\frac{1}{4}$
20	$\frac{1}{5}$	$16\frac{2}{3}$	$\frac{1}{6}$	$12\frac{1}{2}$	$\frac{1}{8}$
10	$\frac{1}{10}$	$8\frac{1}{3}$	$\frac{1}{12}$	$6\frac{1}{4}$	$\frac{1}{16}$

EXAMPLE 6

EASY

If $6\frac{1}{4}\%$ of a number is 15, find the number.

STGT 2016

Solution: $6\frac{1}{4}\% = \frac{1}{16}$, so $N = 15 \times 16 = 240$.

4.1 REVERSE AND SUCCESSIVE CHANGES

$x\%$ up needs $\frac{100x}{100+x}\%$ down to undo; $x\%$ more $\Leftrightarrow$
 $\frac{100x}{100+x}\%$ less

successive $a\%$ then $b\%$: net $= a + b + \frac{ab}{100}$ (signs included)

EXAMPLE 7

EASY

A price rises 20%. By what percent must the new price fall to restore the old price?

STGT 2016

Solution: $\frac{100 \times 20}{120} = 16\frac{2}{3}\%$. (Same skeleton, 2019: Raju earns 50% more than Ramu $\Rightarrow$ Ramu earns $\frac{50}{150} \times 100 = 33\frac{1}{3}\%$ less.)

EXAMPLE 8

MODERATE

The sum of two numbers is 1500 and 30% of one equals 45% of the other. Find them.

STGT 2026

Solution: $0.3x = 0.45y \Rightarrow x : y = 3 : 2 \Rightarrow x = 900, y = 600$. The options offered 800/700, 1200/300, 1000/500 – so the keyed answer was **None of the above**. Compute first!

5. PROFIT AND LOSS

$$\text{Profit}\% = \frac{SP - CP}{CP} \times 100; \quad SP = CP \left(1 \pm \frac{x}{100}\right);$$

(% always on CP unless stated)

6. SIMPLE INTEREST

$$SI = \frac{PRT}{100}; \quad \text{Amount } A = P + SI = P \left(1 + \frac{RT}{100}\right)$$

P in rupees, R in % per annum, T in years – convert months ($\div 12$) and days ($\div 365$) first; that conversion is the question half the time.

EXAMPLE 12

EASY

Simple interest on ₹1 for 1 month is 1 paisa. Find the annual rate.

STGT 2017

Solution: 12 months $\Rightarrow$ ₹0.12 on ₹1 $\Rightarrow R = 12\%$ p.a.

5.1 THE CP:SP RATIO DICTIONARY (FIVE PYQS)

Table: Percentage profit/loss as a pure ratio

GIVEN	CP : SP	YEAR
Profit $12\frac{1}{2}\% = \frac{1}{8}$	8 : 9	2016
Loss $16\frac{2}{3}\% = \frac{1}{6}$	6 : 5	2017
CP:SP = 6 : 5	loss $16\frac{2}{3}\%$	2018
Profit $20\% = \frac{1}{5}$	5 : 6 (NOTA in 2019!)	2019
Profit $25\% = \frac{1}{4}$	4 : 5	—

Rule: profit $\frac{p}{q}$ of CP $\Rightarrow$ CP:SP = $q : (q + p)$; loss $\Rightarrow q : (q - p)$.

5.2 "CP OF M ARTICLES = SP OF N ARTICLES"

$$\text{profit}\% = \frac{m - n}{n} \times 100 \quad (m > n: \text{profit}; m < n: \text{loss})$$

EXAMPLE 9

EASY

The cost price of 30 pens equals the selling price of 20 pens. Find the profit percent.

STGT 2016

Solution: $\frac{30-20}{20} \times 100 = 50\%$. (2017's lemons: CP 5 per rupee, SP 4 per rupee $\Rightarrow \frac{5-4}{4} \times 100 = 25\%$.)

EXAMPLE 10

MODERATE

Pens cost ₹1 for 4. At a profit of $33\frac{1}{3}\%$, how many pens sell for ₹1?

STGT 2018

Solution: CP per pen = $\frac{1}{4}$; SP = $\frac{1}{4} \times \frac{4}{3} = \frac{1}{3} \Rightarrow$ 3 pens per rupee.

5.3 PROFIT ON SP, AND CHANGING THE TARGET PROFIT

- Profit reckoned on SP: 20% on CP $\Rightarrow \frac{20}{120} \times 100 = 16\frac{2}{3}\%$ on SP (2022).
- Re-targeting: SP ₹84 at 5% profit $\Rightarrow$ CP = $84/1.05 = 80$; for 10% profit SP = 88 (2019).

5.4 THE DISHONEST DEALER (2026'S HARD QUESTION)

Cheating $x\%$ while buying and $y\%$ while selling multiplies the goods-flow by $\frac{1}{1-x/100} \cdot \frac{1}{1-y/100}$:

EXAMPLE 11

ADVANCED

A trader defrauds 10% in buying and 10% in selling. Find his actual gain percent.

STGT 2026

Solution: Gain factor = $\frac{1}{0.9} \times \frac{1}{0.9} = \frac{1}{0.81} = 1.2346 \Rightarrow$ gain $\approx 23.46\%$. Options offered 20/27/26 $\Rightarrow$ keyed **None of the above**. (One-sided cheating with a 900 g weight: $\frac{100}{90} - 1 = 11\frac{1}{9}\%$.)

EXAMPLE 13

MODERATE

At $4\frac{1}{2}\%$ p.a., what is the SI on ₹1 for 1 day?

STGT 2016

Solution: $SI = \frac{1 \times \frac{9}{2} \times \frac{1}{365}}{100} = \frac{9}{73000} \approx ₹0.000123$ – none of the printed options (0.1/1/0.01) $\Rightarrow$ **None of the above**. The unit conversion is the whole question.

EXAMPLE 14

EASY

In 4 years the SI on a sum is $\frac{9}{25}$ of the principal. Find the rate.

STGT 2019

Solution: $\frac{9}{25}P = \frac{P \cdot R \cdot 4}{100} \Rightarrow R = \frac{900}{100} = 9\%$.

EXAMPLE 15 **EASY**

At what rate does 1 year's SI equal the SI at 5% for 2 years (same principal)? **STGT 2022**

Solution: $R \times 1 = 5 \times 2 \Rightarrow R = 10\%$ – rate-time products match.

7. COMPOUND INTEREST, GROWTH AND DEPRECIATION

$$A = P \left(1 + \frac{r}{100}\right)^n; \quad CI = A - P; \quad \text{half-yearly: rate} \\ \rightarrow r/2, \text{ periods} \rightarrow 2n$$

$$\text{Growth: } V = P \left(1 + \frac{r}{100}\right)^n; \quad \text{Depreciation:} \\ V = P \left(1 - \frac{r}{100}\right)^n$$

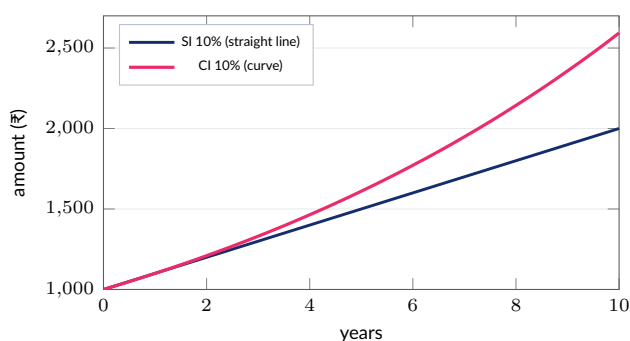


Fig. 1: ₹1000 at 10%: SI climbs linearly, CI compounds – equal in year 1, apart forever after.

CI – SI for 2 years (same P, r): difference = $P \left(\frac{r}{100}\right)^2$ – the interest on year-1 interest.

7.1 THE FOUR PYQ VARIANTS**EXAMPLE 16** **MODERATE**

(Find P) At 12% p.a. CI, a sum amounts to ₹3,136 in 2 years. Find it. **STGT 2017**

Solution: $P = \frac{3136}{(1.12)^2} = \frac{3136}{1.2544} = ₹2,500$.

EXAMPLE 17 **EASY**

(Find n) In how many years does ₹1,000 become ₹1,331 at 10% CI? **STGT 2026**

Solution: $(1.1)^n = 1.331 = (1.1)^3 \Rightarrow n = 3$ years. Memorise the ladder $1.1^2 = 1.21, 1.1^3 = 1.331, 1.2^2 = 1.44, 1.05^2 = 1.1025$.

EXAMPLE 18 **MODERATE**

(Find r) ₹4,000 amounts to ₹5,324 in 3 years at CI. Find the rate. **STGT 2022**

Solution: $\left(1 + \frac{r}{100}\right)^3 = \frac{5324}{4000} = 1.331 = (1.1)^3 \Rightarrow r = 10\%$. The options were 8/11/12 $\Rightarrow$ keyed **None of the above** – the third NOTA earned by honest computation.

EXAMPLE 19 **MODERATE**

(Half-yearly) CI on ₹8,000 for 1 year at 12% p.a. compounded half-yearly. **STGT 2018**

Solution: Rate 6% per half-year, 2 periods: $A = 8000(1.06)^2 = 8000 \times 1.1236 = 8988.80 \Rightarrow CI = ₹988.80$.

7.2 DOUBLING AND BEYOND

If money doubles in n years at CI, it becomes $4 \times$ in $2n$,
 $8 \times$ in $3n$ years (2^k needs kn)

EXAMPLE 20 **MODERATE**

A sum doubles in 9 years at CI. When is it $4 \times$? **STGT 2019**

Solution: $(1 + r)^9 = 2 \Rightarrow 4 = 2^2 = (1 + r)^{18}$: **18 years**. Options gave 13.5/27/9 $\Rightarrow$ **None of the above**. (At *simple* interest the answer would differ – doubling means $+P$, quadrupling $+3P$, i.e. 27 years: the 13.5/27 options bait the SI confusion.)

EXAMPLE 21 **EASY**

(Depreciation) A machine loses 10% value yearly; today it is worth ₹9,72,000 after 2 years. Original price? **STGT 2018**

Solution: $P(0.9)^2 = 972000 \Rightarrow P = \frac{972000}{0.81} = ₹12,00,000$. (Salary growth is the mirror: ₹18,750 $\times 1.08 = ₹20,250$ – 2017.)

8. INSTALMENTS

The cash-down pattern (the only one STGT has asked): pay part now; the **outstanding balance** earns simple interest until cleared.

EXAMPLE 22 **EASY**

A watch costs ₹2,000 cash, or ₹1,000 down and the balance after 2 months at 12% p.a. How much clears the loan? **STGT 2022**

Solution: Balance ₹1,000; $SI = 1000 \times \frac{12}{100} \times \frac{2}{12} = 20 \Rightarrow$ pay **₹1,020**.

EXAMPLE 23 **MODERATE**

A radio costs ₹220 cash, or ₹100 down and ₹125 after 1 month. Find the implied annual rate. **STGT 2026**

Solution: Outstanding = $220 - 100 = 120$; it grows to 125 in one month, so monthly interest = 5: $r = \frac{5}{120} \times 12 \times 100 = 50\%$ p.a. – instalment plans hide steep rates; that is the lesson *and* the formula.

9. BANKING: SAVINGS ACCOUNTS AND RECURRING DEPOSITS**9.1 THE SAVINGS PASSBOOK**

Columns: date, particulars, **withdrawal**, **deposit**, **balance**. Each line: new balance = old balance – withdrawal + deposit.

EXAMPLE 24 **EASY**

A balance line reads ₹70; the next balance is ₹400. What sits in the deposit column? **STGT 2016**

Solution: Deposit = $400 - 70 = ₹330$.

9.2 INTEREST FOR A SERIES OF MONTHS (MINIMUM-BALANCE METHOD)

Traditional savings-bank rule: for each calendar month take the **minimum balance between the 10th and the last day**; interest for the month = that minimum $\times \frac{r}{100} \times \frac{1}{12}$; sum over the months and credit.

EXAMPLE 25**MODERATE**

Minimum balances (10th-last day) in four months are ₹4,000, ₹6,000, ₹5,000, ₹5,000 at 6% p.a. Find the interest credited.

Solution: Sum = 20,000; interest = $20000 \times \frac{6}{100} \times \frac{1}{12} = ₹100$. (Equivalently ₹20, 30, 25, 25 month by month.)

9.3 RECURRING DEPOSIT (THE 2018 QUESTION)

Deposit ₹ P monthly for n months at $r\%$ p.a.: the first instalment earns for n months, the last for 1 — an AP totalling $\frac{n(n+1)}{2}$ month-units:

$$I = P \cdot \frac{n(n+1)}{2} \cdot \frac{r}{12 \times 100}; \quad \text{maturity} = nP + I$$

EXAMPLE 26**MODERATE**

₹1,500 per month for 8 months at 12% p.a. Find the maturity value.

STGT 2018

Solution: $I = 1500 \times \frac{8 \times 9}{2} \times \frac{12}{1200} = 1500 \times 36 \times 0.01 = 540$. Maturity = $12000 + 540 = ₹12,540$.

10. EXAM CAPSULE — FACTS, TRAPS, HABITS**EXAM POINT****Banked one-liners:**

- CP:SP dictionary: $+12\frac{1}{2}\% \rightarrow 8 : 9$; $-16\frac{2}{3}\% \rightarrow 6 : 5$; $+20\% \rightarrow 5 : 6$; $+25\% \rightarrow 4 : 5$. (2016–2019)
- CP of $m =$ SP of $n \Rightarrow$ profit = $\frac{m-n}{n} \times 100$ ($30/20 \rightarrow 50\%$; $5/4$ lemons $\rightarrow 25\%$). (2016, 2017)
- Undo $+x\%$ with $\frac{100x}{100+x}\%$; 50% more = $33\frac{1}{3}\%$ less. (2016, 2019)
- Profit on SP: 20% on CP = $16\frac{2}{3}\%$ on SP. (2022)
- $1.1^2 = 1.21$, $1.1^3 = 1.331$, $1.12^2 = 1.2544$, $0.9^2 = 0.81$, $1.06^2 = 1.1236$ — five squares/cubes that solved five CI questions.
- CI doubling in n yr $\Rightarrow 4\times$ in $2n$ (18, not 13.5 or 27). (2019)
- RD interest = $P \frac{n(n+1)}{2} \cdot \frac{r}{1200}$; passbook deposit = balance jump. (2016, 2018)
- Instalment rate: monthly interest on *outstanding balance*, $\times 12$ for p.a. (radio: 50%). (2022, 2026)
- Dishonest both ways at 10%: gain = $\frac{1}{0.81} - 1 \approx 23.46\%$. (2026)

COMMON MISTAKES

- **NOTA is real here:** six of the forty answers are “None of the above”, and at least two printed keys contradict their own arithmetic (the 2017 proportion question — correct $x = 3$; the 2022 partnership — correct ₹840). *Compute fully, then match.*
- Profit % is on **CP** by default — switching to SP is a stated, separate question.
- Convert time first: days $\div 365$, months $\div 12$ — the 2016 one-day-interest question lives entirely in this step.
- Doubling logic differs: SI doubling in $n \Rightarrow 4\times$ in $3n$; CI $\Rightarrow 2n$.
- In “equal percentages” ratios, *invert*: $30\%A = 40\%B \Rightarrow A : B = 4 : 3$, not $3 : 4$.

All 40 Mathematics MCQs from this unit asked in STGT 2016, 2017, 2018, 2019, 2022 and 2026, grouped by sub-topic with worked solutions.

Table: Year-wise distribution of Unit-1 questions

2016	2017	2018	2019	2022	2026	TOTAL
7	8	7	7	6	5	40

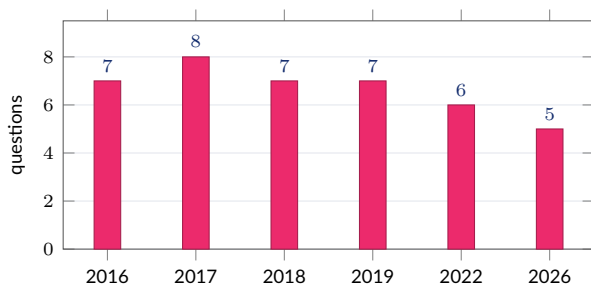


Fig. 2: A steady 5–8 questions every paper.

Table: Sub-topic frequency across the six papers

SUB-TOPIC	QS	REPEAT CHANCE
Ratio, proportion & partnership	10	VERY HIGH
Profit and loss	10	VERY HIGH
Compound interest & depreciation	6	VERY HIGH
Percentage	6	HIGH
Simple interest	4	HIGH
Installments & banking	4	HIGH

A. RATIO, PROPORTION AND PARTNERSHIP

Q1.

STGT 2016 EASY

If 30% of A = 40% of B = 50% of C, then A : B : C is

- (A) 3 : 4 : 5 (B) 20 : 15 : 12
(C) 5 : 4 : 3 (D) None of the above

Answer: (B). $A : B : C = \frac{1}{30} : \frac{1}{40} : \frac{1}{50} = \frac{1}{3} : \frac{1}{4} : \frac{1}{5} = 20 : 15 : 12$. Equal products $\Rightarrow$ inverted ratio.

Q2.

STGT 2017 EASY

If $\frac{4x+7y}{4x-7y} = \frac{7}{3}$, then $x : y$ is

- (A) 7 : 3 (B) 3 : 7
(C) 35 : 8 (D) 8 : 35

Answer: (C). $12x + 21y = 28x - 49y \Rightarrow 70y = 16x \Rightarrow x : y = 70 : 16 = 35 : 8$.

Q3.

STGT 2017 MODERATE

What number must be added to each of 6, 15, 20 and 43 to make them proportional?

- (A) 2 (B) 3
(C) 4 (D) 5

Answer: (B) by the working – the released key printed (D).
 $(6+x)(43+x) = (15+x)(20+x) \Rightarrow 258 + 49x = 300 + 35x \Rightarrow 14x = 42 \Rightarrow x = 3$. Check: $9 : 18 = 23 : 46 \checkmark$. A documented key/working conflict – trust the algebra.

Q4.

STGT 2018 EASY

If $x : y = 4 : 3$, then $(5x + 8y) : (6x - 7y)$ is

- (A) 43 : 3 (B) 44 : 3
(C) 46 : 3 (D) 47 : 3

Answer: (B). Put $x = 4k, y = 3k$: $(20 + 24)k : (24 - 21)k = 44 : 3$.

Q5.

STGT 2018 EASY

A truck covers 550 m in one minute; a bus covers 33 km in $\frac{3}{4}$ hour. The ratio of their speeds is

- (A) 4 : 3 (B) 2 : 3
(C) 3 : 4 (D) 3 : 2

Answer: (C). Truck: $550 \times 60 = 33$ km/h. Bus: $33 \div \frac{3}{4} = 44$ km/h. $33 : 44 = 3 : 4$.

Q6.

STGT 2019 EASY

Sameer's and Rabi's marks are in the ratio 4 : 3. If Sameer gets 64, Rabi gets

- (A) 46 (B) 48
(C) 42 (D) None of the above

Answer: (B). One part = $64/4 = 16$; Rabi = $3 \times 16 = 48$.

Q7.

STGT 2019 EASY

Prices of wheat and sugar are in the ratio 2 : 3; quantities consumed in 5 : 4. The ratio of expenditures is

- (A) 6 : 5 (B) 5 : 6
(C) 8 : 15 (D) None of the above

Answer: (B). Expenditure = price $\times$ quantity = $(2 \times 5) : (3 \times 4) = 10 : 12 = 5 : 6$.

Q8.

STGT 2022 EASY

Coins of ₹1, 50 p and 25 p are in the count ratio 2 : 3 : 5. The ratio of their values is

- (A) 6 : 6 : 5 (B) 8 : 6 : 5
(C) 8 : 5 : 6 (D) None of the above

Answer: (B). Values $\propto (2 \times 100) : (3 \times 50) : (5 \times 25) = 200 : 150 : 125 = 8 : 6 : 5$.

Q9.

STGT 2022 MODERATE

A, B, C start a business with ₹3,500. If $A : B = 5 : 2$ and $B : C = 3 : 2$, B's profit share is

- (A) ₹840 (B) ₹900
(C) ₹940 (D) None of the above

Answer: (A) by the working – the released key printed (D). Bridge on B: $A : B : C = 15 : 6 : 4$ (25 parts); $B = \frac{6}{25} \times 3500 = ₹840$, which is option (A). Second documented key conflict – compute and commit.

Q10.

STGT 2026 MODERATE

If $a : b = c : d$, then $\frac{a^2 + b^2}{c^2 + d^2}$ equals

- (A) $\frac{1}{2}$ (B) $\frac{a+b}{c+d}$
(C) $\frac{ab}{cd}$ (D) None of the above

Answer: (C). k-method: both sides reduce to b^2/d^2 .

B. PERCENTAGE

Q11.

STGT 2016 EASY

A price is increased by 20%. To restore the previous price, the present price must be reduced by

- (A) 20% (B) $16\frac{2}{3}\%$
(C) 25% (D) 10%

Answer: (B). $\frac{20}{120} \times 100 = 16\frac{2}{3}\%$ – undo-percentage formula $\frac{100x}{100+x}$.

Q12.

STGT 2016 EASY

If $6\frac{1}{4}\%$ of a number is 15, the number is

- (A) 420 (B) 200
(C) 340 (D) 240

Answer: (D). $6\frac{1}{4}\% = \frac{1}{16} \Rightarrow N = 15 \times 16 = 240$.

Q13.

STGT 2017 EASY

A salary grows 8% yearly. One year ago it was ₹18,750; now it is

- (A) ₹20,250 (B) ₹20,000
(C) ₹25,000 (D) None of the above

Answer: (A). $18750 \times 1.08 = 20,250$.

Q14.

STGT 2017 EASY

Reducing a number by 10% gives 90. The number is

- (A) 90 (B) 80
(C) 100 (D) 120

Answer: (C). $0.9N = 90 \Rightarrow N = 100$.

Q15.

STGT 2019 EASY

Raju's salary is 50% more than Ramu's. Ramu's salary is less than Raju's by

- (A) $33\frac{1}{3}\%$ (B) $33\frac{1}{2}\%$
(C) $33\frac{1}{4}\%$ (D) None of the above

Answer: (A). $\frac{50}{150} \times 100 = 33\frac{1}{3}\%$ – "more" and "less" use different bases.

Q16.

STGT 2026 MODERATE

Two numbers add to 1500 and 30% of one = 45% of the other. The numbers are

- (A) 800, 700 (B) 1200, 300
(C) 1000, 500 (D) None of the above

Answer: (D). $x : y = 45 : 30 = 3 : 2 \Rightarrow 900$ and 600 – absent from the options, so NOTA. Compute first.

C. PROFIT AND LOSS

Q17.

STGT 2016 EASY

If the profit on selling is $12\frac{1}{2}\%$, the ratio of cost price to selling price is

- (A) 9 : 8 (B) 8 : 9
(C) 5 : 4 (D) 4 : 5

Answer: (B). Profit $\frac{1}{8}$ of CP $\Rightarrow$ CP:SP = 8 : 9.

Q18.

STGT 2016 EASY

The cost price of 30 pens equals the selling price of 20 pens. The profit is

- (A) 50% (B) $33\frac{1}{3}\%$
(C) 20% (D) 25%

Answer: (A). $\frac{30-20}{20} \times 100 = 50\%$.

Q19.

STGT 2017 EASY

If the loss is $16\frac{2}{3}\%$, the ratio of cost price to selling price is

- (A) 5 : 6 (B) 6 : 5
(C) 10 : 9 (D) 9 : 10

Answer: (B). Loss $\frac{1}{6} \Rightarrow$ SP = $\frac{5}{6}$ CP $\Rightarrow$ CP:SP = 6 : 5.

Q20.**STGT 2017 EASY**

CP of 5 lemons is ₹1; SP of 4 lemons is ₹1. The profit percent is

- (A) 25% (B) 20%
(C) 15% (D) 10%

Answer: (A). Per lemon: CP ₹0.20, SP ₹0.25 $\Rightarrow \frac{0.05}{0.20} \times 100 = 25\%$.

Q21.**STGT 2018 EASY**

If CP : SP = 6 : 5, the loss percent is

- (A) $15\frac{2}{3}\%$ (B) $16\frac{2}{3}\%$
(C) 15% (D) 16%

Answer: (B). Loss = 1 on CP 6: $\frac{1}{6} \times 100 = 16\frac{2}{3}\%$ – the 2017 question read backwards.

Q22.**STGT 2018 MODERATE**

The cost price of 4 pens is ₹1. To gain $33\frac{1}{3}\%$,

- (A) the selling price of 3 pens should be ₹1
(B) the selling price of 5 pens should be ₹1
(C) the selling price of 6 pens should be ₹1
(D) the selling price of 7 pens should be ₹1

Answer: (A). SP per pen = $\frac{1}{4} \times \frac{4}{3} = \frac{1}{3} \Rightarrow 3$ pens per rupee.

Q23.**STGT 2019 EASY**

An item sells at ₹84 with 5% profit. The selling price for 10% profit is

- (A) ₹92.40 (B) ₹90
(C) ₹88 (D) None of the above

Answer: (C). CP = $84/1.05 = 80$; new SP = $80 \times 1.10 = 88$.

Q24.**STGT 2019 EASY**

If the profit on selling is 20%, the ratio of cost price to selling price is

- (A) 6 : 5 (B) 2 : 3
(C) 4 : 5 (D) None of the above

Answer: (D). CP:SP = 5 : 6 – not offered, so NOTA. (The 2016/2017 ratio questions *did* list the answer; this one tested composure.)

Q25.**STGT 2022 EASY**

A profit of 20% reckoned on cost price equals what percent reckoned on selling price?

- (A) 15% (B) 20%
(C) $16\frac{2}{3}\%$ (D) None of the above

Answer: (C). $\frac{20}{120} \times 100 = 16\frac{2}{3}\%$.

Q26.**STGT 2026 DIFFICULT**

A businessman defrauds 10% in buying and 10% in selling. His actual gain percent is

- (A) 20% (B) 27%
(C) 26% (D) None of the above

Answer: (D). Gain factor = $\frac{1}{0.9} \cdot \frac{1}{0.9} = \frac{1}{0.81} \approx 1.2346 \Rightarrow \approx 23.46\%$ – not listed.

D. SIMPLE INTEREST**Q27.****STGT 2016 MODERATE**

At $4\frac{1}{2}\%$ per annum, the simple interest on ₹1 for 1 day is

- (A) ₹0.1 (B) ₹1
(C) ₹0.01 (D) None of the above

Answer: (D). $\frac{1 \times 4.5 \times \frac{1}{365}}{100} \approx ₹0.000123$ – three orders below every option.

Q28.**STGT 2017 EASY**

If the SI on ₹1 for one month is 1 paisa, the annual rate is

- (A) 10% (B) 12%
(C) 15% (D) 5%

Answer: (B). ₹0.01 monthly $\Rightarrow$ ₹0.12 yearly on ₹1 = 12%.

Q29.**STGT 2019 EASY**

In 4 years the SI on a sum is $\frac{9}{25}$ of the principal. The annual rate is

- (A) 4% (B) 5%
(C) 9% (D) None of the above

Answer: (C). $\frac{9}{25} = \frac{4R}{100} \Rightarrow R = 9\%$.

Q30.**STGT 2022 EASY**

At what annual rate does 1 year's SI equal the SI at 5% for 2 years?

- (A) 10% (B) 8%
(C) 12% (D) None of the above

Answer: (A). $R \times 1 = 5 \times 2 \Rightarrow R = 10\%$.

E. COMPOUND INTEREST AND DEPRECIATION**Q31.****STGT 2017 MODERATE**

At 12% p.a. CI, a principal amounts to ₹3,136 in 2 years. The principal is

- (A) ₹2,000 (B) ₹2,500
(C) ₹1,200 (D) None of the above

Answer: (B). $P = 3136/(1.12)^2 = 3136/1.2544 = 2500$.

Q32.

STGT 2018 MODERATE

The CI on ₹8,000 for 1 year at 12% p.a. compounded half-yearly is

- (A) ₹988.80 (B) ₹480
(C) ₹508.80 (D) ₹888.80

Answer: (A). $8000(1.06)^2 = 8988.80 \Rightarrow CI = 988.80$.

Q33.

STGT 2018 EASY

A machine depreciates 10% yearly; after 2 years it is worth ₹9,72,000. It was bought for

- (A) ₹12,00,000 (B) ₹11,00,000
(C) ₹10,00,000 (D) ₹9,00,000

Answer: (A). $P(0.9)^2 = 972000 \Rightarrow P = 972000/0.81 = 12,00,000$.

Q34.

STGT 2019 MODERATE

At CI a sum doubles in 9 years. In how many years does it become four times?

- (A) 13.5 years (B) 27 years
(C) 9 years (D) None of the above

Answer: (D). $4 = 2^2 \Rightarrow 2 \times 9 = 18$ years — not offered. (13.5 and 27 are the SI-style decoys.)

Q35.

STGT 2022 MODERATE

₹4,000 amounts to ₹5,324 in 3 years at CI. The annual rate is

- (A) 8% (B) 11%
(C) 12% (D) None of the above

Answer: (D). $(1 + r/100)^3 = 1.331 = (1.1)^3 \Rightarrow r = 10\%$ — not among 8/11/12.

Q36.

STGT 2026 EASY

In how many years will ₹1,000 amount to ₹1,331 at 10% p.a. CI?

- (A) 3 years (B) 4 years
(C) 5 years (D) None of the above

Answer: (A). $(1.1)^n = 1.331 \Rightarrow n = 3$.

F. INSTALMENTS AND BANKING

Q37.

STGT 2016 EASY

A passbook balance reads ₹70; the next balance is ₹400. The deposit-column entry is

- (A) ₹300 (B) ₹470
(C) ₹330 (D) None of the above

Answer: (C). Deposit = $400 - 70 = 330$.

Q38.

STGT 2018 MODERATE

₹1,500 per month for 8 months in a recurring deposit at 12% p.a. (monthly reckoning). The maturity value is

- (A) ₹10,540 (B) ₹12,000
(C) ₹12,540 (D) ₹11,540

Answer: (C). $I = 1500 \cdot \frac{8 \cdot 9}{2} \cdot \frac{12}{1200} = 540$; maturity = $12000 + 540 = 12,540$.

Q39.

STGT 2022 EASY

A watch costs ₹2,000 cash, or ₹1,000 down with the balance after 2 months at 12% p.a. SI. The closing payment is

- (A) ₹1,010 (B) ₹1,020
(C) ₹1,050 (D) None of the above

Answer: (B). $1000 + 1000 \times \frac{12}{100} \times \frac{2}{12} = 1020$.

Q40.

STGT 2026 MODERATE

A radio costs ₹220 cash, or ₹100 down and ₹125 after one month. The annual simple-interest rate charged is

- (A) 10% (B) 20%
(C) 50% (D) None of the above

Answer: (C). Outstanding 120 grows by 5 in a month: $r = \frac{5}{120} \times 1200 = 50\%$ p.a.

TREND ANALYSIS AND EXAM STRATEGY

WHAT THE SIX PAPERS REVEAL

- **“None of the above” is a first-class citizen:** it is the keyed answer in 6 of 40 questions (15%) — always after honest arithmetic produced a value missing from the options (5:6, 18 years, 10%, 900/600, 23.46%, ₹0.000123). Never force-fit.
- **Two released keys contradict their own arithmetic** (2017 proportion: $x = 3$; 2022 partnership: ₹840). The exam's own solution culture says: *trust the working*.
- **The CP:SP dictionary is the most recycled object:** five questions in six papers are one-line conversions between

a percentage and a ratio.

- **Every CI variant has now been asked:** find A , find P (2017), find r (2022), find n (2026), doubling (2019), half-yearly (2018), depreciation (2018) — one formula, seven costumes.
- **Instalments arrived in 2022 and repeated in 2026** — the outstanding-balance method is the new fixture.
- **Fraction-percentage fluency** ($\frac{1}{6}$, $\frac{1}{8}$, $\frac{1}{16}$) is assumed everywhere.

MOST IMPORTANT AREAS (IN ORDER)

1. CP:SP ratio conversions and CP-of- m = SP-of- n .
2. The CI formula in all directions + the powers ladder (1.1^2 , 1.1^3 , 1.12^2 , 0.9^2 , 1.06^2).
3. Ratio bridging ($A : B, B : C \rightarrow A : B : C$) and the k-method.
4. Undo-percentage and more/less conversions.
5. Instalment rate on outstanding balance; RD maturity formula.
6. Time-unit conversion in SI (days/months $\rightarrow$ years).

LAST-MINUTE REVISION POINTS

- $+x\%$ undone by $\frac{100x}{100+x}\%$; 50% more = $33\frac{1}{3}\%$ less.
- Profit $\frac{p}{q} \Rightarrow$ CP:SP = $q : q+p$; loss $\Rightarrow q : q-p$.

- Profit on SP = $\frac{x}{100+x} \times 100$ of the CP-profit $x\%$.
- CI doubling $n \Rightarrow 4\times$ in $2n$; SI doubling $n \Rightarrow 4\times$ in $3n$.
- RD: $I = P \frac{n(n+1)}{2} \cdot \frac{r}{1200}$. Instalment: interest accrues on the *unpaid balance* only.
- Both-ways fraud $x\%$: gain = $\left(\frac{1}{(1-x/100)^2} - 1\right) \times 100$.

EXAM POINT

Probability outlook for the next paper: one CP:SP/profit conversion ($p \approx 0.9$), one CI numerical ($p \approx 0.9$), one ratio-bridge or k-method item ($p \approx 0.85$), one percentage reverse/successive item ($p \approx 0.8$), one instalment/banking question ($p \approx 0.7$) – and at least one keyed “None of the above”. Compute first; option-match last.

PREDICTED HIGH-PROBABILITY QUESTIONS

QP1.

STGT TARGET**CP:SP**

If the profit on selling an article is 25%, the ratio of cost price to selling price is

- (A) 5 : 4 (B) 4 : 5
(C) 3 : 4 (D) 5 : 6

Answer: (B). Profit $\frac{1}{4} \Rightarrow$ CP:SP = 4 : 5 – the only dictionary row not yet asked.

QP2.

STGT TARGET**RATIO**

If $A : B = 3 : 4$ and $B : C = 2 : 5$, then $A : B : C$ is

- (A) 3 : 4 : 10 (B) 6 : 8 : 5
(C) 3 : 8 : 10 (D) 6 : 4 : 10

Answer: (A). Bridge on B (LCM 4): $6 : 8 : 20 = 3 : 4 : 10$.

QP3.

STGT TARGET**SUCCESSIVE**

Two successive increases of 10% are equivalent to a single increase of

- (A) 20% (B) 21%
(C) 19% (D) 22%

Answer: (B). $10 + 10 + \frac{10 \times 10}{100} = 21\%$.

QP4.

STGT TARGET**SI**

A sum doubles at simple interest in 10 years. The annual rate is

- (A) 5% (B) 8%
(C) 10% (D) 20%

Answer: (C). SI = P in 10 yr $\Rightarrow \frac{10R}{100} = 1 \Rightarrow R = 10\%$.

QP5.

STGT TARGET**CI**

The compound interest on ₹5,000 for 2 years at 10% p.a. is

- (A) ₹1,000 (B) ₹1,025
(C) ₹1,050 (D) ₹1,100

Answer: (C). $5000(1.21 - 1) = 1050$.

QP6.

STGT TARGET**CI-SI**

The difference between CI and SI on ₹10,000 for 2 years at 10% p.a. is

- (A) ₹50 (B) ₹100
(C) ₹200 (D) nil

Answer: (B). $P(r/100)^2 = 10000 \times 0.01 = 100$.

QP7.

STGT TARGET**PARTNERSHIP**

A invests ₹4,000 and B ₹5,000 for the same period; the profit is ₹1,800. B's share is

- (A) ₹800 (B) ₹1,000
(C) ₹900 (D) ₹1,125

Answer: (B). 4 : 5 of 1800 $\Rightarrow B = 1000$.

QP8.

STGT TARGET**RD**

₹1,000 per month for 6 months at 12% p.a. in a recurring deposit matures to

- (A) ₹6,210 (B) ₹6,120
(C) ₹6,060 (D) ₹6,360

Answer: (A). $I = 1000 \cdot \frac{6 \cdot 7}{2} \cdot \frac{12}{1200} = 210$; maturity = 6210.

QP9.

STGT TARGET

DEPRECIATION

A scooter worth ₹40,000 depreciates 10% yearly. Its value after 2 years is

- (A) ₹32,000 (B) ₹32,400
(C) ₹34,000 (D) ₹36,000

Answer: (B). $40000 \times 0.81 = 32,400$.

QP10.

STGT TARGET

DISHONEST

A shopkeeper sells at cost price but uses an 800 g weight for 1 kg. His gain percent is

- (A) 20% (B) 25%
(C) 8% (D) $12\frac{1}{2}\%$

Answer: (B). Gain = $\frac{1000-800}{800} \times 100 = 25\%$ – the one-sided version of 2026's fraud question.

PRACTICE QUESTIONS — LEVEL 1 (FOUNDATION)

- If $2 : 3 = 8 : x$, then x is
(A) 10 (B) 12
(C) 16 (D) 24
- 25% of 360 is
(A) 80 (B) 85
(C) 90 (D) 95
- The simple interest on ₹1,000 at 5% p.a. for 2 years is
(A) ₹50 (B) ₹100
(C) ₹150 (D) ₹200
- If $CP = ₹80$ and $SP = ₹100$, the profit percent is
(A) 20% (B) 25%
(C) 30% (D) $12\frac{1}{2}\%$
- $\frac{1}{8}$ expressed as a percentage is
(A) 8% (B) $12\frac{1}{2}\%$
(C) 16% (D) $6\frac{1}{4}\%$
- The duplicate ratio of $2 : 3$ is
(A) $4 : 9$ (B) $2 : 3$
(C) $\sqrt{2} : \sqrt{3}$ (D) $8 : 27$
- The mean proportional between 4 and 9 is
(A) 6.5 (B) 36
(C) 6 (D) 13
- If $3 : 4 = x : 20$, then x is
(A) 12 (B) 15
(C) 16 (D) 18
- A transaction earns a profit when
(A) $SP > CP$
(B) $CP > SP$
(C) $SP = CP$
(D) $MP = CP$
- The amount under compound interest is given by
(A) $A = P \left(1 + \frac{r}{100}\right)^n$
(B) $A = P \left(1 + \frac{rn}{100}\right)$
(C) $A = P + \frac{rn}{100}$
(D) $A = P \left(\frac{r}{100}\right)^n$
- 10% of 10% of 100 is
(A) 10 (B) 1
(C) 0.1 (D) 100
- For equal investment periods, partnership profits are shared in the ratio of
(A) capitals (B) ages
(C) withdrawals (D) equal parts
- In a passbook, a withdrawal entry makes the balance
(A) rise (B) fall
(C) stay equal (D) double
- The value of six 50-paise coins is
(A) ₹3 (B) ₹6
(C) ₹2.50 (D) ₹12
- 120 increased by 25% becomes
(A) 145 (B) 150
(C) 144 (D) 155

PRACTICE QUESTIONS — LEVEL 2 (STGT STANDARD)

- If $A : B = 2 : 3$ and $B : C = 4 : 5$, then $A : B : C$ is
(A) $2 : 3 : 5$ (B) $8 : 12 : 15$
(C) $6 : 8 : 10$ (D) $4 : 6 : 5$
- If $x : y = 3 : 5$, then $(2x + y) : (x + 2y)$ is
(A) $11 : 13$ (B) $13 : 11$
(C) $6 : 10$ (D) $5 : 8$
- Successive increases of 10% and 20% equal a single increase of
(A) 30% (B) 32%
(C) 28% (D) 34%
- A loss of 20% means $CP : SP$ equals
(A) $4 : 5$ (B) $5 : 4$
(C) $6 : 5$ (D) $5 : 6$
- The cost price of 25 articles equals the selling price of 20. The profit percent is
(A) 20% (B) 25%
(C) 30% (D) $33\frac{1}{3}\%$
- At simple interest a sum doubles in 10 years. The rate is
(A) 5% (B) 8%
(C) 10% (D) 20%
- The compound interest on ₹5,000 for 2 years at 10% p.a. is
(A) ₹1,000 (B) ₹1,050
(C) ₹1,100 (D) ₹1,500
- The difference between CI and SI on ₹10,000 for 2 years at 10% is
(A) ₹50 (B) ₹100
(C) ₹150 (D) ₹200
- The number which is 20% more than 250 is
(A) 270 (B) 290
(C) 300 (D) 310
- Partners invest in the ratio $3 : 5$ for equal periods; the profit is ₹1,600. The larger share is
(A) ₹600 (B) ₹960
(C) ₹1,000 (D) ₹1,200
- ₹4,500 at 10% p.a. simple interest amounts in 2 years to
(A) ₹5,200 (B) ₹5,400
(C) ₹5,500 (D) ₹4,950
- A machine worth ₹20,000 depreciates 10% in a year. Its value becomes
(A) ₹19,000 (B) ₹18,000
(C) ₹17,500 (D) ₹16,000

13. A recurring deposit of ₹500/month for 12 months at 10% p.a. earns interest
 (A) ₹300 (B) ₹325 (C) ₹350 (D) ₹600
14. An outstanding balance of ₹500 kept 3 months at 12% p.a. SI is cleared by paying
 (A) ₹512 (B) ₹515 (C) ₹518 (D) ₹520
15. $33\frac{1}{3}\%$ of 240 is
 (A) 60 (B) 70 (C) 80 (D) 90

PRACTICE QUESTIONS — LEVEL 3 (ADVANCED / COMPETITIVE EDGE)

1. If $a : b = 2 : 3$, $b : c = 4 : 5$ and $c : d = 6 : 7$, then $a : b : c : d$ is
 (A) 16 : 24 : 30 : 35
 (B) 8 : 12 : 15 : 35
 (C) 16 : 24 : 35 : 30
 (D) 2 : 3 : 5 : 7
2. A shopkeeper sells at cost price but uses a 900 g weight per kg. His gain percent is
 (A) 10% (B) $11\frac{1}{9}\%$
 (C) $9\frac{1}{11}\%$ (D) 12%
3. ₹10,000 at 20% p.a. compounded half-yearly for 1 year yields a compound interest of
 (A) ₹2,000 (B) ₹2,100
 (C) ₹2,200 (D) ₹1,100
4. A sum doubles at simple interest in 8 years. The rate is
 (A) $12\frac{1}{2}\%$ (B) 10%
 (C) 8% (D) 16%
5. A number is increased by 25% and then decreased by 20%. The net change is
 (A) +5% (B) -5%
 (C) 0% (D) +45%
6. A invests ₹5,000 for 12 months and B ₹6,000 for 8 months. Profit ₹5,400 is split as
 (A) A: ₹3,000; B: ₹2,400
 (B) A: ₹2,400; B: ₹3,000
 (C) A: ₹2,700; B: ₹2,700
 (D) A: ₹3,600; B: ₹1,800
7. At simple interest a sum triples in 15 years. The annual rate is
 (A) $13\frac{1}{3}\%$ (B) 15%
 (C) 20% (D) $16\frac{2}{3}\%$
8. A cycle costs ₹6,200. A buyer pays ₹1,200 down and the rest after 6 months at 8% p.a. SI. The final payment is
 (A) ₹5,000 (B) ₹5,100
 (C) ₹5,200 (D) ₹5,400
9. A savings account's minimum balance (10th-last day) in a month is ₹4,000; the rate is 6% p.a. That month's interest is
 (A) ₹40 (B) ₹24
 (C) ₹20 (D) ₹10
10. Successive discounts of 20% and 10% equal a single discount of
 (A) 30% (B) 28%
 (C) 29% (D) 32%

ASSERTION-REASON QUESTIONS

Code: (A) Both A and R are true and R is the correct explanation of A. (B) Both A and R are true but R is *not* the correct explanation of A. (C) A is true but R is false. (D) A is false but R is true.

- AR1. A:** For the same profitable sale, profit percent on CP exceeds profit percent on SP.
R: In a profit, SP is larger than CP, so the same profit is divided by a larger base.
- AR2. A:** For annual compounding, the first year's CI equals the first year's SI.
R: Interest-on-interest begins only from the second year.
- AR3. A:** A 20% rise followed by a 20% fall restores the original value.
R: The net change is $20 - 20 - \frac{20 \times 20}{100} = -4\%$.
- AR4. A:** The mean proportional between 4 and 16 is 8.
R: The mean proportional between a and c is $\sqrt{ac}$.
- AR5. A:** If money doubles at CI in 9 years, it triples in 13.5 years.
R: Under CI, growth multiplies as $(1 + r/100)^n$.
- AR6. A:** In partnership, profits are shared in proportion to capital $\times$ time.
R: A rupee invested longer contributes more to the business.
- AR7. A:** The recurring-deposit interest formula contains the factor $\frac{n(n+1)}{2}$.
R: The monthly instalments remain invested for $n, n-1, \dots, 1$ months, an AP summing to $\frac{n(n+1)}{2}$.
- AR8. A:** If $a : b = c : d$, then $\frac{a+b}{a-b} = \frac{c+d}{c-d}$.
R: Equal ratios survive componendo-dividendo.

HOTS — HIGHER ORDER THINKING

- H1. Petrol becomes 25% costlier. To keep the fuel budget unchanged, consumption must fall by
 (A) 25% (B) 20%
 (C) $33\frac{1}{3}\%$ (D) 15%
- H2. A town of 8,000 grows 5% yearly. It reaches 9,261 in
 (A) 2 years (B) 3 years
 (C) 4 years (D) 5 years
- H3. For the same principal, rate and a period beyond one year, which earns more?
 (A) simple interest (B) compound interest
 (C) both equal (D) cannot say
- H4. Coins of 50 p and 25 p are in the count ratio 4 : 5 and total ₹6.50. The number of 25 p coins is
 (A) 8 (B) 10
 (C) 12 (D) 15
- H5. A loan of ₹200 is settled by ₹206 after 2 months. The annual simple-interest rate is
 (A) 12% (B) 15%
 (C) 18% (D) 24%
- H6. $x\%$ of y is always equal to
 (A) $y\%$ of x (B) $\frac{x}{y}\%$
 (C) $xy\%$ (D) $\frac{y}{x}\%$ of 100

ANSWER KEYS AND HINTS

Table: Level 1

1	2	3	4	5	6	7	8
B	C	B	B	B	A	C	B
9	10	11	12	13	14	15	
A	A	B	A	B	A	B	

Table: Level 2

1	2	3	4	5	6	7	8
B	A	B	B	B	C	B	B
9	10	11	12	13	14	15	
C	C	B	B	B	B	C	

Table: Level 3

1	2	3	4	5	6	7	8	9	10
A	B	B	A	C	A	A	C	C	B

Table: Assertion-Reason and HOTS

AR1	AR2	AR3	AR4	AR5	AR6	AR7	AR8
A	A	D	A	D	A	A	A
H1	H2	H3	H4	H5	H6		
B	B	B	B	C	A		

HINTS TO SELECTED PROBLEMS

- L2-2: $x = 3k, y = 5k$: $(6 + 5) : (3 + 10) = 11 : 13$.
- L2-13: $I = 500 \cdot \frac{12 \cdot 13}{2} \cdot \frac{10}{1200} = 500 \times 78 \times \frac{1}{120} = 325$.
- L3-1: Chain-scale: $a : b = 16 : 24, b : c = 24 : 30, c : d = 30 : 35$.
- L3-2: Gain = $\frac{1000-900}{900} \times 100 = \frac{100}{9} = 11\frac{1}{9}\%$.
- L3-3: $10000(1.1)^2 - 10000 = 2100$ (10% per half-year, 2 periods).
- L3-7: Tripling adds $2P$: $\frac{15R}{100} = 2 \Rightarrow R = 13\frac{1}{3}\%$.
- L3-8: $5000 + 5000 \times \frac{8}{100} \times \frac{1}{2} = 5200$.
- L3-9: $4000 \times \frac{6}{100} \times \frac{1}{12} = 20$.
- L3-10: $20 + 10 - \frac{200}{100} = 28\%$.
- AR5: Tripling needs $(1 + r)^n = 3 = 2^{\log_2 3} \Rightarrow n = 9 \log_2 3 \approx 14.3$ yr, not 13.5 – A false.
- H1: $\frac{25}{125} \times 100 = 20\%$.
- H4: $4k(50) + 5k(25) = 325k$ paise = 650 $\Rightarrow k = 2 \Rightarrow 25$ p coins = 10.
- H5: $\frac{6}{200} \times \frac{12}{2} \times 100 = 18\%$.

RATIO, PROPORTION, PARTNERSHIP

- $a : b :: c : d \Leftrightarrow ad = bc$; mean proportional = $\sqrt{ac}$; duplicate ratio $a^2 : b^2$.
- k-method: $\frac{a}{b} = \frac{c}{d} = k \Rightarrow a = bk, c = dk$ — substitute and simplify.
- Componendo-dividendo: $\frac{a}{b} = \frac{c}{d} \Rightarrow \frac{a+b}{a-b} = \frac{c+d}{c-d}$.
- Bridge ratios on the common term: $A : B = 5 : 2, B : C = 3 : 2 \Rightarrow 15 : 6 : 4$.
- Equal percentages invert: $30\%A = 40\%B = 50\%C \Rightarrow \frac{1}{30} : \frac{1}{40} : \frac{1}{50}$.
- Coins: value $\propto$ count $\times$ denomination. Expenditure = price $\times$ quantity.
- Partnership: shares $\propto$ capital $\times$ time.

PERCENTAGE

- Fraction family: $\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5}, \frac{1}{6}, \frac{1}{8}, \frac{1}{12}, \frac{1}{16} = 50, 33\frac{1}{3}, 25, 20, 16\frac{2}{3}, 12\frac{1}{2}, 8\frac{1}{3}, 6\frac{1}{4} \%$.
- Undo $+x\%$: reduce by $\frac{100x}{100+x} \%$; $x\%$ more $\Leftrightarrow \frac{100x}{100+x} \%$ less.
- Successive a, b : net = $a+b+\frac{ab}{100}$ (signs included; $+25, -20 \Rightarrow 0$).

PROFIT AND LOSS

- Profit% = $\frac{SP-CP}{CP} \times 100$ (base CP); on SP base: $\frac{x}{100+x} \times 100$.
- Dictionary: $+12\frac{1}{2} \rightarrow 8 : 9$; $+20\% \rightarrow 5 : 6$; $+25\% \rightarrow 4 : 5$; $-16\frac{2}{3} \rightarrow 6 : 5$; $-20\% \rightarrow 5 : 4$.
- CP of m = SP of n : profit% = $\frac{m-n}{n} \times 100$.
- False weight (sell side): gain = $\frac{\text{true} - \text{false}}{\text{false}} \times 100$; both-ways $x\%$: $\frac{1}{(1-x/100)^2} - 1$.

INTEREST, INSTALMENTS, BANKING

- $SI = \frac{PRT}{100}$ (T in years!); equal SIs $\Rightarrow$ equal $R \times T$ products.
- $A = P(1 + \frac{r}{100})^n$; half-yearly: $r/2, 2n$. CI – SI (2 yr) = $P(\frac{r}{100})^2$.
- Powers ladder: $1.1^2 = 1.21$; $1.1^3 = 1.331$; $1.12^2 = 1.2544$; $1.06^2 = 1.1236$; $0.9^2 = 0.81$.
- Doubling at CI in n yr $\Rightarrow 4\times$ in $2n$; at SI doubling in $n \Rightarrow R = \frac{100}{n} \%$, $4\times$ in $3n$.
- Depreciation/growth: $V = P(1 \mp \frac{r}{100})^n$.
- Instalment: interest accrues on the *outstanding balance*; annualise monthly interest $\times 12$.
- Passbook: balance = old – withdrawal + deposit; monthly interest on the minimum balance (10th–last day) at $\frac{r}{1200}$.
- RD: $I = P \cdot \frac{n(n+1)}{2} \cdot \frac{r}{1200}$; maturity = $nP + I$.

FORMULA SHEET

$$a : b :: c : d \Rightarrow ad = bc; \text{ mean prop.} = \sqrt{ac}$$

$$\text{Net of } a\%, b\%: a + b + \frac{ab}{100}$$

$$\text{Profit\%} = \frac{SP - CP}{CP} \times 100; \text{ on SP: } \frac{x}{100+x} \times 100$$

$$SI = \frac{PRT}{100}; A = P\left(1 + \frac{RT}{100}\right)$$

$$\text{Depreciation: } V = P\left(1 - \frac{r}{100}\right)^n$$

$$\text{RD: } I = P \cdot \frac{n(n+1)}{2} \cdot \frac{r}{1200}; \text{ maturity} = nP + I$$

$$\text{Partnership: share} \propto \text{capital} \times \text{time}$$

$$\frac{a}{b} = \frac{c}{d} \Rightarrow \frac{a+b}{a-b} = \frac{c+d}{c-d}$$

$$\text{Undo } +x\%: \frac{100x}{100+x} \% \text{ down}$$

$$\text{CP of } m = \text{SP of } n: \frac{m-n}{n} \times 100$$

$$A = P\left(1 + \frac{r}{100}\right)^n; \text{ CI-SI (2y)} = P\left(\frac{r}{100}\right)^2$$

$$\text{CI doubling in } n \Rightarrow 2^k \times \text{ in } kn \text{ years}$$

$$\text{Savings interest/month} = \text{min. balance} \times \frac{r}{1200}$$

$$\text{False weight: gain} = \frac{\text{true} - \text{false}}{\text{false}} \times 100$$

QUICK NOTES

Memory tricks.

- Fraction wheel: “half-third-quarter-fifth-sixth-eighth” = $50-33\frac{1}{3}-25-20-16\frac{2}{3}-12\frac{1}{2}$.
- CP:SP: “profit $\frac{p}{q} \Rightarrow q : q+p$ ” — denominator first.
- Powers ladder chant: “21, 331, 2544, 1236, 81” (the five decimals that solve every CI PYQ).
- NOTA discipline: *solve, then scan* — one answer in six isn’t on the list.
- RD factor: “months stand in a staircase” $\Rightarrow \frac{n(n+1)}{2}$.

Table: Frequently confused pairs — settle them now

PAIR	DISTINCTION
% on CP vs % on SP	default base is CP; SP base shrinks the figure ($20 \rightarrow 16\frac{2}{3}$)
More% vs less%	different bases: $+50\%$ pairs with $-33\frac{1}{3}\%$
SI vs CI doubling	$4\times$ in $3n$ (SI) vs $2n$ (CI)
Rate per annum vs per month	always convert time to years first
Successive % vs sum of %	$10 + 10 = 21$, not 20 (the $\frac{ab}{100}$ term)
Count ratio vs value ratio (coins)	multiply counts by denominations
Depreciation vs growth	$(1-r)^n$ vs $(1+r)^n$ — sign of the bracket
Instalment price vs cash price	the difference is interest on the <i>balance</i> , not on the full price

EXAM POINT

Final 60-second drill: $6\frac{1}{4}\% = \frac{1}{16}$ • undo +20% by $16\frac{2}{3}\%$ • +50% more = $33\frac{1}{3}\%$ less • CP:SP: $+12\frac{1}{2}\% \rightarrow 8:9$, $-16\frac{2}{3}\% \rightarrow 6:5$, +20% $\rightarrow 5:6$ • 30/20 pens $\rightarrow 50\%$ • profit on SP $16\frac{2}{3}\%$ • $1.1^3 = 1.331$ • $1.12^2 = 1.2544$ • $0.9^2 = 0.81$ • double in 9 $\Rightarrow 4\times$ in 18 • RD $\frac{n(n+1)}{2}$ • radio instalment 50% p.a. • both-ways 10% fraud $\approx 23.5\%$ • passbook deposit = balance jump • NOTA ≈ 1 in 6 – compute first.

END OF UNIT 1 – ARITHMETIC

Next in this series: Unit 2 – Algebra • Quarks Physics Institute • STGT Pure Science (Mathematics)