CAT QUANTITATIVE APTITUDE | TIME & WORK

TIPS, TRICKS, SHORTCUTS, FORMULAS, MISTAKES TO AVOID

DOCUMENT MATRIX

Exam / Section Name	CAT | Quantitative Aptitude (Arithmetic Section)
Historical Weightage	1 to 3 direct questions per paper, forming a consistent part of the Arithmetic section.
Core Influence	Basis for multi-variable rate problems, pipe/cistern systems, and work-allocation questions.
Guide Length / Best Used As	8 Sections | Formula Sheet and Work Unit Constant Reference.

Historical Trends (Last 4 CAT Cycles)

CAT Year	Individual Efficiency	Alternating Workflows	Pipes & Cisterns (Leakages)	Group Wage Splits
CAT 2022	2-variable efficiency questions using direct ratios	Rare	Single-pipe fill/empty, constant leak rate	Basic efficiency-ratio wage splits
CAT 2023	3-variable efficiency with ratio constraints	Simple A/B alternate-day cycles	Leak rates stated as variable (pressure-based)	Wages tied to man-days rather than efficiency ratio alone
CAT 2024	Efficiency changed mid-project (fatigue or productivity factors)	3-worker alternating cycles with early exit	Multi-pipe systems with simultaneous inlet, outlet, and leak	Wage splits requiring skill-weighted multipliers
CAT 2025	Efficiency stated as percentage change instead of ratio	Cyclic patterns with a partial final cycle	Leak rate as a function of height or volume (non-linear)	Wage splits across sub-teams with different daily rates
CAT 2026 (Forecast)	Efficiency framed through combined percentage and ratio statements	Alternating schedules with non-integer cycle endpoints	Compound leak scenarios that activate after a stated threshold	Wage allocation requiring the man-day-hour chain formula

1 | INTRODUCTION & PURPOSE

CAT does not reward direct reciprocal addition of the form 1/A + 1/B. Questions are built around changing efficiencies, non-uniform work schedules such as alternating days or staggered joining, and pipe or cistern systems where leaks behave non-linearly rather than as a fixed drain. The consistent requirement is converting each scenario into integer work units through LCM initialization before applying any arithmetic.

2 | CORE CONCEPTS

Term & Definition Matrix

	Definition	Applied Behaviour
Inverse Variation Law	For fixed Work, Time and Efficiency are inversely proportional: $T \propto 1/E$	If efficiency doubles, time halves. Times of workers with different rates are never added directly.
Work Unit Constant	Total Work is fixed at the LCM of all individual times, converting the problem into whole-number units	Removes fractions; daily efficiency becomes an integer (units/day)
Net Efficiency Rate	The sum of all positive (workers/inlets) and negative (leaks/outlets) rates acting on the same work body	$E_{net} = \Sigma E_{positive} - \Sigma E_{negative}$
Negative Work (Leaks)	A rate that depletes completed work, modeled as a negative efficiency term	A leak of capacity L subtracts L units per hour from the fill rate; net progress can reverse if L exceeds the fill rate
Proportional Wage Allocation	Total payment is split by work actually contributed (efficiency × time engaged), not by days present	Wage share equals the ratio of work units completed, not the ratio of days present

KEY INSIGHT

Work is the invariant quantity. Set Total Work equal to the LCM of all given times. This converts fractional rate equations into integer daily efficiencies. Once Total Work and each individual's daily unit efficiency are known, most Time & Work questions reduce to addition, subtraction, or ratio division of integers.

THE GOLDEN QUESTION

What is the total constant work-units value, and what is the daily unit efficiency of each component? Answering this first simplifies alternating schedules, leakages, and wage splits into arithmetic on integers.

3 | FORMULA SHEET

3A | Basic Formulas

	Statement
Work = Efficiency × Time	Fundamental work equation. Work is fixed, so E × T is invariant for a single worker's own completion.
E_A = Total Work / T_A	Efficiency derived from LCM-based total work divided by individual completion time
$E_{combined} = E_A + E_B + \ldots$	Combined workers: rates, not times, are additive
	Combined time is Total Work divided by summed efficiency, never the sum or average of individual times

$T_{combined}$ = Total Work / ($E_A + E_B$ + ...)	
$T_A / T_B = E_B / E_A$	A ratio of times is the inverted ratio of efficiencies

3B | Advanced Formulas

	Statement
$M_1D_1H_1 / W_1 = M_2D_2H_2 / W_2$	Chain rule: Men × Days × Hours per unit Work is conserved across two scenarios of the same project type
$W_{cycle} = (E_A + E_B) \times$ 2 days	Alternating days workflow: compute work done per full cycle, then handle the remaining fractional day separately
$E_{new} = E_{old} \times (1 \pm r)$	Structural fractional efficiency shift, where r is the stated percentage change
$W_{remaining} = W_{total} - \Sigma(E_i \times t_i)$	Residual work after a group departs or efficiency changes mid-project. The new combined rate applies only to this residual.

3C | Special / Boundary Cases

	Handling Rule
Variable filling rate pipes	If a pipe's rate changes after a stated volume or time, split the tank into phases and solve each phase's time separately using its own rate, then sum durations
Dynamic leakage (height/pressure-based)	Leak rate is not constant. Model it as a function of water level and recalculate net efficiency each time the leak-rate threshold is crossed.
Exponential efficiency scaling	Where efficiency compounds across periods, use geometric progression sums rather than linear addition of a constant daily rate

> **DERIVE-ON-THE-SPOT METHOD**
>
> When multiple variable groups exit or enter mid-project, freeze the calculation at the exact moment of change: (1) compute work completed up to that instant using the old combined rate, (2) subtract it from Total Work to get the residual, (3) form a fresh combined-rate equation using only the currently active workers, applied to the residual work alone.

---

4 | TOPIC-WISE CONCEPT SUMMARIES & SOLVED EXAMPLES

4A | LCM Methods & Variable Worker Efficiencies

Core Concepts

- Set Total Work equal to the LCM of all stated individual completion times, so every worker's daily efficiency is an integer.
- Convert percentage or ratio efficiency comparisons directly into a ratio of daily units, not a ratio of times, before combining.
- When efficiency changes mid-project, scale the unit efficiency only for the affected time window; do not apply the change retroactively.

> **CAT TIP**
>
> A statement such as "20% more efficient" should not be read as a 20% reduction in time. Efficiency and time are inversely related: a 20% efficiency increase reduces time by 20/120 (approximately 16.67%), not by 20%.

Solved Example

Q: A can complete a task in 12 days. B is 50% more efficient than A. Working together, in how many days will they finish the job?

```
Total Work = LCM(12), scaled to 24 units for clean integer handling → 24 units
E_A = 24 / 12 → 2 units/day
B is 50% more efficient → E_B = 2 × 1.5 = 3 units/day
E_combined = 2 + 3 → 5 units/day
T_combined = 24 / 5 → 4.8 days
```

Answer: 4.8 days

4B | Alternating Schedules, Destruction Workers & System Leaks

Core Concepts

- Compute work completed in one full cycle (for example, 2 days for an alternating A-B pattern) as a single integer before addressing the tail end.
- A destruction worker or leak is a negative efficiency term; subtract it from the net positive rate, never divide by it.
- Near project completion, check whether the final partial day or cycle needs only a fraction of a worker's full-day output.

> **CAT TIP**
>
> Do not assume the last cycle is always a full cycle. Once cumulative work approaches Total Work minus one worker's daily unit, switch to hour-by-hour or fractional-day tracking instead of counting whole cycles.

Solved Example

Q: Pipe A fills a tank in 10 hours, Pipe B fills it in 15 hours, and a leak L can empty the full tank in 30 hours. If A and B are opened together with the leak active, how long will the tank take to fill?

```
Total Work = LCM(10, 15, 30) → 30 units
E_A = 30/10 = 3 units/hr, E_B = 30/15 = 2 units/hr, E_L = -30/30 = -1 unit/hr
E_net = 3 + 2 - 1 → 4 units/hr
T = 30 / 4 → 7.5 hours
```

Answer: 7.5 hours

4C | Group Efforts, Wage Distributions & Constraints

Core Concepts

- Wages are split by work-units contributed (efficiency × engaged time), not by headcount or number of days present.
- Convert every group's contribution to the same Total-Work-unit scale before forming the wage ratio; mixing man-days and man-hours is a common setup error.

- When sub-teams have different daily rates, apply the chain rule $M_1D_1H_1/W_1 = M_2D_2H_2/W_2$ to normalize contributions to a common baseline.

> **CAT TIP**
>
> A worker who leaves early still earns wages for the units actually completed up to the point of exit. Prorate by the fraction of total work contributed, not by the fraction of total time elapsed in the project.

Solved Example

Q: A, B, and C undertake a project for ₹5,400. A can do the work alone in 6 days, B in 8 days, and C in 12 days. If all three work together, how should the wage be split?

```
Total Work = LCM(6, 8, 12) → 24 units
E_A = 24/6 = 4, E_B = 24/8 = 3, E_C = 24/12 = 2 units/day
Wage Ratio = E_A : E_B : E_C = 4 : 3 : 2, sum = 9
A's share = (4/9) × 5400 → ₹2400
B's share = (3/9) × 5400 → ₹1800
C's share = (2/9) × 5400 → ₹1200
```

Answer: A ₹2,400 | B ₹1,800 | C ₹1,200

---

5 | CAT TRAP IDENTIFIER

The Trap Matrix

	Mechanism of Error	Correct Counter-Approach
The Reciprocal Mistake	Adding raw time values (for example, 10 + 15 = 25 days) instead of adding rates	Convert to efficiency (units/day) first, add efficiencies, then convert back to time
The Changing Base Efficiency Trap	A stated efficiency change is applied to elapsed time instead of the future output rate	Apply the percentage adjustment to the efficiency figure going forward; past completed work is unaffected
The Negative Work Boundary Trap	Ignoring that a leak or outlet can make net efficiency negative, meaning the system never fills	Check the sign of E_{net} before computing time; a negative net rate means the system regresses, not merely slows down

> **PRE-ATTEMPT MENTAL CHECKLIST**
>
> 1. What is the LCM to set as Total Work?
> 2. Are there any leaks, outlets, or destruction agents acting as negative efficiency?
> 3. Does anyone's efficiency change mid-project, and from what point exactly?
> 4. Is the schedule alternating, staggered, or does someone exit early?
> 5. Is the final day or cycle a full unit of work, or a partial fraction?
> 6. Is the wage question based on a work-ratio split, not a time-ratio or headcount split?

---

6 | SPEED TECHNIQUES & SHORTCUTS

Table A — Time-to-Efficiency Conversion by Common LCM Base

	Time (days) → Efficiency (units/day)
10	10→1, 5→2, 2→5, 1→10
12	12→1, 6→2, 4→3, 3→4, 2→6, 1→12
15	15→1, 5→3, 3→5, 1→15
20	20→1, 10→2, 5→4, 4→5, 2→10, 1→20
30	30→1, 15→2, 10→3, 6→5, 5→6, 3→10, 2→15, 1→30
60	60→1, 30→2, 20→3, 15→4, 12→5, 10→6, 6→10, 5→12, 4→15, 3→20, 2→30, 1→60

Table B — Multiplier Shifts for Percentage Efficiency Increases

	Multiplier on Efficiency	Resulting Time Multiplier
+10%	×1.10	×(10/11) ≈ 0.909
+20%	×1.20	×(10/12) ≈ 0.833
+25%	×1.25	×(4/5) = 0.80
+50%	×1.50	×(2/3) ≈ 0.667
+100%	×2.00	×0.50

Strategic Directives

Use LCM-Based Integer Models When	Use Fractional / Algebraic Chain Equations When
All given times are clean, finite integers	Times or rates involve unknowns requiring symbolic solving
The question is a direct combined-time or combined-work query	The question spans multiple scenarios with differing men, days, or hours (chain rule)
Leak or pipe rates are constant throughout	Leak or pipe rates change with height, pressure, or time
Wage-split or ratio questions with fixed daily rates	Efficiency scales exponentially or compounds over multiple periods

APPROXIMATION & BOUNDARY CHECKING

To eliminate impossible answer options, test both extremes: assume everyone works at the fastest given rate to set the minimum possible time, and assume everyone works at the slowest given rate to set the maximum possible time. The correct answer lies between these two bounds; any option outside this range can be eliminated without full calculation.

7 | COMMON MISTAKES TO AVOID

Mistake 1: Adding Times Directly

WRONG: A takes 10 days, B takes 15 days, so together they take 10 + 15 = 25 days.

CORRECT: Convert to efficiency: $E_A = 3$, $E_B = 2$ (LCM = 30) → $E_{combined} = 5$ → T = 30/5 = 6 days.

Mistake 2: Averaging Efficiencies Instead of Summing

WRONG: Treating combined daily output as the average of individual efficiencies.

CORRECT: Combined efficiency is the sum, $E_A + E_B$, since both act simultaneously on the same work body.

Mistake 3: Applying Percentage Change to Time Instead of Efficiency

WRONG: B is 25% more efficient than A, so B takes 25% less time.

CORRECT: $E_B = 1.25 \times E_A$ → $T_B = T_A / 1.25 = 0.8 \times T_A$, a 20% time reduction, not 25%.

Mistake 4: Ignoring the Sign of a Leak in Net Rate

WRONG: Treating a leak as simply slowing down the fill time by adding its time value.

CORRECT: Leak efficiency is subtracted from the net rate: $E_{net} = E_{fill} - E_{leak}$. If this is negative, the tank never fills.

Mistake 5: Prorating Wages by Days Present Instead of Work Done

WRONG: Splitting payment by the ratio of number of days each person was present.

CORRECT: Split payment by the ratio of work-units contributed (efficiency × days actually engaged).

---

8 | QUICK REVISION CARD

Master Formula Checklist

- Work = Efficiency × Time
- $T_{combined}$ = Total Work / (sum of efficiencies)
- $T_A / T_B = E_B / E_A$ (inverse ratio)
- $M_1D_1H_1 / W_1 = M_2D_2H_2 / W_2$ (chain rule)
- E_{net} = (sum of fill rates) − (sum of leak rates)

Standard LCM Base Configurations

	Recommended LCM Base
4, 6, 12	12
5, 10, 15	30
6, 8, 12	24
10, 15, 30	30
12, 15, 20	60

Top 5 Time & Work Traps

- The Reciprocal Mistake (adding times instead of rates)
- The Changing Base Efficiency Trap (adjusting time instead of rate)
- The Negative Work Boundary Trap (missing negative net efficiency)
- Assuming the final alternating cycle is always a full cycle
- Prorating wages by days present instead of work contributed

PRE-SOLVE WORKFLOW CHECK

LCM set? Efficiencies converted to integers? Leaks or negatives identified? Mid-project changes isolated by phase? Final partial cycle checked? Wage or ratio basis confirmed as work-units?

Timing & Target Metrics

	Target Time	
Direct LCM-based questions	Under 45 seconds	**90%+**
Complex / alternating workflow questions	Under 75 seconds	**90%+**