Pipe and Cistern

~ Quantitative Aptitude · SSC Exams ~

← circled = key info!

A Pipe & Cistern sum is just a Time & Work sum — **filling = +ve work**, **emptying = −ve work**. Track the **net rate** per hour.

① Core Idea – Fill (+) & Empty (−)

The sign rule

- **Inlet** fills the tank in **a** hrs → rate = **+1/a** tank per hour.
- **Outlet / leak** empties it in **b** hrs → rate = **−1/b** tank per hour.
- **Net rate** = add all the signed rates → **Time = 1 ÷ (net rate)**.

Example – one inlet

A pipe fills a tank in **5** hours. In 1 hour it fills **1/5** of the tank.
∴ in **2** hours it fills 2 × 1/5 = **2/5** of the tank. ✅

Example – one outlet (drain)

A drain empties a **full** tank in **4** hours → rate = **−1/4** per hour.
∴ in 3 hours it drains 3/4 → only **1/4** of the water is left. ✅

Golden habit ⟶ write every pipe as a + or – fraction of the tank per hour, then just **add**. The whole chapter is that one idea.

✓ "Fills in a hours" and "does 1/a per hour" mean the **same thing**. Faster pipe ⟶ smaller time ⟶ bigger fraction per hour.

② Two Inlets Together

*Inlet A fills in **a** hrs, inlet B fills in **b** hrs. Open both → add their rates.*

Formula

Combined rate = $1/a + 1/b = (a+b)/ab$ per hour.

∴ Time to fill together = $ab/(a+b)$ hours.

Worked example — a = 12, b = 8

Step 1 — rates 1/12 and 1/8; together = 1/12 + 1/8 = 2/24 + 3/24 = **5/24**.

Step 2 — Time = 24/5 = **4.8 hrs = 4 hrs 48 min**.

Check — ab/(a+b) = (12×8)/(12+8) = 96/20 = **4.8 hrs**. ✅

Worked example — a = 15, b = 10

Time = ab/(a+b) = (15×10)/(15+10) = 150/25 = **6 hrs**.

Check → 1/15 + 1/10 = 2/30 + 3/30 = 5/30 = 1/6 → 6 hrs. ✅

Try these (fill together)

a=20, b=30 → 600/50 = **12 hrs**

a=10, b=40 → 400/50 = **8 hrs**

a=5, b=20 → 100/25 = **4 hrs**

a=6, b=4 → 24/10 = **2.4 hrs**

a=9, b=18 → 162/27 = **6 hrs**

a=16, b=16 → 256/32 = **8 hrs**

Reverse type — find the second pipe

A fills in **10** hrs; A + B together fill in **6** hrs. Find B alone.

1/B = 1/6 − 1/10 = 5/30 − 3/30 = 2/30 = 1/15 ∴ B = **15 hrs**. ✅

*Together-time is **always less** than either pipe alone — a good sanity check on your answer.*

③ Inlet + Outlet

*Inlet fills in **a** hrs, outlet empties in **b** hrs. They pull opposite ways → **subtract**.*

Formula (when $b > a$, i.e. inlet is faster)

Net rate = $\mathbf{1/a - 1/b = (b-a)/ab}$ per hour.

∴ Time to fill = $\mathbf{ab/(b-a)}$ hours.

*If the **outlet is faster** ($b < a$) the net rate is negative → tank **never fills**.*

Worked example — inlet 6 hrs, outlet 8 hrs

Step 1 — net = $1/6 - 1/8 = 4/24 - 3/24 = \mathbf{1/24}$ per hour.

Step 2 — Time = $24 \div 1 =$ **24 hrs**.

Check — $ab/(b-a) = (6\times8)/(8-6) = 48/2 =$ **24 hrs**. ✅

Worked example — inlet 10 hrs, outlet 15 hrs

Net = $1/10 - 1/15 = 3/30 - 2/30 = \mathbf{1/30}$ → Time = **30 hrs**.

Via formula → $(10\times15)/(15-10) = 150/5 =$ **30 hrs**. ✅

Trap — outlet faster (inlet 8, outlet 6)

Net = $1/8 - 1/6 = 3/24 - 4/24 = \mathbf{-1/24}$ per hour.

Rate is negative ∴ a full tank would **empty in 24 hrs**; an empty one **never fills**. ✅

*Rule of thumb → **fill time > inlet's own time** when an outlet is fighting it. If your answer is smaller, you added instead of subtracting.*

③ Inlet + Outlet — more practice

Worked example — inlet 4 hrs, outlet 12 hrs

Net = 1/4 − 1/12 = 3/12 − 1/12 = **2/12 = 1/6** → Time = **6 hrs**.

Formula → (4×12)/(12−4) = 48/8 = **6 hrs**. ✅

Worked example — inlet 8 hrs, outlet 24 hrs

Net = 1/8 − 1/24 = 3/24 − 1/24 = **2/24 = 1/12** → Time = **12 hrs**.

Formula → (8×24)/(24−8) = 192/16 = **12 hrs.** ✅

Net-rate ready-reckoner (inlet a, outlet b)

Inlet a	Outlet b	Net rate 1/a−1/b	Fill time
6	8	1/24	**24 hrs**
12	16	1/48	**48 hrs**
20	25	1/100	**100 hrs**
9	18	1/18	**18 hrs**
8	6	−1/24	**never fills**

Reverse type — find the outlet

Inlet fills in **9** hrs; with the outlet open it takes **18** hrs. Find outlet time.

1/outlet = 1/9 − 1/18 = 2/18 − 1/18 = 1/18 ∴ outlet empties in **18 hrs**. ✅

✓ "With the leak/outlet it takes longer" ⟶ the extra time hides the outlet's rate. Subtract to expose it.

④ Three or More Signed Pipes

Any number of pipes — some filling (+), some draining (−). Just **add all the signed rates**.

Formula

Net rate = $(\pm 1/a) + (\pm 1/b) + (\pm 1/c) + \ldots$

Time = **1 ÷ (net rate)**. Positive → fills; negative → empties.

Worked example — A 10, B 15 fill; C 30 drains

Step 1 — net = $1/10 + 1/15 - 1/30$.

Step 2 — LCM 30 → $3/30 + 2/30 - 1/30 =$ **$4/30 = 2/15$**.

Answer → Time = $15/2$ = **7.5 hrs = 7 hrs 30 min**. ✅

Worked example — three inlets A 20, B 30, C 60

Net = $1/20 + 1/30 + 1/60 = 3/60 + 2/60 + 1/60 =$ **$6/60 = 1/10$**.

∴ Time = **10 hrs**. ✅

Worked example — A 6, B 12 fill; C 8 drains

Net = $1/6 + 1/12 - 1/8$. LCM 24 → $4/24 + 2/24 - 3/24 =$ **$3/24 = 1/8$**.

∴ Time = **8 hrs**. ✅

Try these

A 12, B 15 fill & C 20 drains → $1/12+1/15-1/20 = 1/10$ → **10 hrs**

A 4, B 6 fill & C 12 drains → $3/12+2/12-1/12 = 4/12 = 1/3$ → **3 hrs**

A 10, B 12, C 15 all fill → $6/60+5/60+4/60 = 15/60 = 1/4$ → **4 hrs**

Take the **LCM of all timings** as the common denominator first — the addition then becomes whole numbers over one denominator.

⑤ The LCM Method

The fastest exam method — work with **whole units** instead of fractions.

Steps

① Let capacity = **LCM of all the pipe timings** (call these "units").

② Each pipe's rate = **capacity ÷ its own time** — **+** for inlet, **−** for outlet.

③ Net rate = **add the signed unit-rates**.

④ Time = **capacity ÷ net rate**.

Worked example — A 12, B 15 fill; C 20 drains

Capacity = LCM(12,15,20) = **60 units**.

Rates → A = 60/12 = **+5**, B = 60/15 = **+4**, C = 60/20 = **−3**.

Net = 5 + 4 − 3 = **+6 units/hr**.

Time = 60 ÷ 6 = **10 hrs**. ✅

Worked example — A 12, B 18 fill; C 36 drains

Capacity = LCM(12,18,36) = **36 units**.

Rates → A = 36/12 = +3, B = 36/18 = +2, C = 36/36 = −1.

Net = 3 + 2 − 1 = **+4** → Time = 36 ÷ 4 = **9 hrs**. ✅

✓ Units let you also answer **"how much is filled in t hours?"** instantly → net rate × t = units filled, out of the capacity.

No decimals, no fractions to add — the LCM method is why toppers finish these sums in seconds.

⑤ LCM Method — more examples

Worked example — A 15, B 20 fill; C 12 drains

Capacity = LCM(15,20,12) = **60 units**.

Rates → A = 60/15 = +4, B = 60/20 = +3, C = 60/12 = −5.

Net = 4 + 3 − 5 = **+2** → Time = 60 ÷ 2 = **30 hrs**. ✅

Worked example — how much filled in a fixed time?

A 6, B 8 (both inlets). Capacity = LCM = **24**; A = +4, B = +3, net = **+7/hr**.

In **2** hrs → 7 × 2 = 14 units of 24 = **7/12 filled**.

Full time = 24 ÷ 7 = **3 3/7 hrs ≈ 3 hrs 26 min**. ✅

Worked example — find the drained-only time

A 10, B 15 fill; C drains. All open → full in **12** hrs. Find C alone.

Capacity = LCM(10,15) = 30. A = +3, B = +2. Net for 12 hrs = 30/12 = **+2.5**.

C-rate = (3 + 2) − 2.5 = **−2.5** ∴ C alone = 30 ÷ 2.5 = **12 hrs**. ✅

Try these (LCM units)

A 8, B 12 fill → cap 24, +3+2 = 5 → 24/5 = **4.8 hrs**

A 9, B 12 fill; C 18 drains → cap 36, +4+3−2 = 5 → 36/5 = **7.2 hrs**

A 20, B 30 fill; C 60 drains → cap 60, +3+2−1 = 4 → 60/4 = **15 hrs**

When a "capacity in litres" is given, **1 unit = capacity ÷ total units**. That converts unit-answers into litres per minute.

✓ Fraction method and LCM method give the **same answer** — use whichever the numbers suit. LCM wins when 3+ pipes appear.

⑥ Leak Problems

A pipe fills in **a** hrs, but a leak slows it to **a'** hrs (a' > a). The leak is a hidden outlet.

Formula

Leak rate = $1/a - 1/a'$ = $\mathbf{(a'-a)/(a \cdot a')}$ per hour.

∴ Leak alone empties the full tank in $\mathbf{(a \times a')/(a' - a)}$ hrs.

Worked example — fills in 6, with leak 8

Step 1 — leak rate = $1/6 - 1/8 = 4/24 - 3/24 = \mathbf{1/24}$.

Step 2 — leak empties full tank in **24 hrs**.

Check — $(6\times8)/(8-6) = 48/2 =$ **24 hrs**. ✅

Worked example — fills in 9, with leak 12

Leak alone = $(9\times12)/(12-9) = 108/3 =$ **36 hrs**.

Check → $1/9 - 1/12 = 4/36 - 3/36 = 1/36$ → 36 hrs. ✅

Try these (leak-alone time)

fills 4, leak 5 → $20/1$ = **20 hrs**

fills 3, leak 4 → $12/1$ = **12 hrs**

fills 10, leak 12 → $120/2$ = **60 hrs**

fills 12, leak 15 → $180/3$ = **60 hrs**

Reverse leak type — find the new fill time

Pipe fills in **12** min; a leak empties the full tank in **30** min. Fill time with leak?

Net = $1/12 - 1/30 = 5/60 - 2/60 = 3/60 = 1/20$ ∴ **20 min.** ✅

💡 A leak is just an outlet you weren't told about — treat it as **−1/(leak time)** and the same signed-rate rules apply.

⑦ Pipe Open for Part of the Time

A pipe is closed after some hours. Method → **filled fraction so far**, then time for the **rest**.

Worked example — A 10, B 15; A shut after 3 hrs

Step 1 — both 3 hrs: $3(1/10 + 1/15) = 3(3/30 + 2/30) = 3 \times 1/6 = \mathbf{1/2}$ filled.

Step 2 — remaining 1/2 by B alone: $(1/2) \div (1/15) = \mathbf{7.5}$ **hrs**.

Answer → total $= 3 + 7.5 =$ **10.5 hrs**. ✅

Worked example — A 15, B 10; B shut after 4 hrs

Step 1 — both 4 hrs: $4(1/15 + 1/10) = 4(2/30 + 3/30) = 4 \times 1/6 = \mathbf{2/3}$.

Step 2 — remaining 1/3 by A alone: $(1/3) \div (1/15) = \mathbf{5}$ **hrs**.

Answer → total $= 4 + 5 =$ **9 hrs**. ✅

Worked example — "when should A be closed?"

A 15, B 20 (min). Both open; A closed early so the tank is full in exactly **12** min. When shut A?

A runs **t** min, B runs the full 12 min: $t/15 + 12/20 = 1 \rightarrow t/15 = 1 - 3/5 = 2/5$.

$\therefore t = 15 \times 2/5 =$ **6 min** (close A after 6 min). ✅

✓ *Master equation →* ***(A's on-time)/a + (B's on-time)/b + … = 1 whole tank****. Plug in what you know, solve for the unknown.*

Count each pipe's ***own*** *running time separately — a pipe that is shut for part of the job contributes only for the hours it was open.*

⑦ Part-Time Opening — more

Worked example — simple part-open

Tap A fills in **6** hrs. It is opened for **2** hrs, then closed.

Filled = $2/6$ = **$1/3$**; remaining = **$2/3$** of the tank. ✅

Worked example — inlet + outlet, outlet shut midway

Inlet A 8 hrs, outlet B 12 hrs. Both open; B closed after **4** hrs. Total fill time?

Step 1 — 4 hrs both: $4(1/8 - 1/12) = 4(3/24 - 2/24) = 4 \times 1/24 =$ **$1/6$**.

Step 2 — remaining $5/6$ by A alone: $(5/6) \div (1/8) = 40/6 =$ **$6\ 2/3$ hrs**.

Answer → $4 + 6\ 2/3 =$ **$10\ 2/3$ hrs ≈ 10 hrs 40 min**. ✅

Worked example — capacity in litres

Tank = 2400 L. Pipe A fills in 20 min, B in 30 min. Both opened, A shut after 6 min. Fill time?

Cap = LCM(20,30) = 60 units → 1 unit = 40 L. A = +3, B = +2 units/min.

6 min both: $6(3+2) = 30$ units. Remaining 30 units by B: $30 \div 2 = 15$ min.

∴ total = $6 + 15$ = **21 min**. ✅

Try these

A 12, B 6; A shut after 4 → $4/12+4/6 = 1/3+2/3 = 1$ → full in **4 hrs**

A 20, B 30; B shut after 10 → $10/20+10/30 = 1/2+1/3 = 5/6$; rest $1/6$ by A = $10/3$ → total **$13\ 1/3$ hrs**

A fills 5, opened 3 hrs then shut → filled $3/5$, left **$2/5$**

Split the job into **phases** (all pipes open → some shut). Find the fraction each phase does, then chain them to reach 1 whole tank.

⑧ Part-Full Tank / Pipe Opened Later

Worked example — tank already half-full

A fills in 8 hrs, B (outlet) empties in 12 hrs. Tank is **half-full**; both opened. When full?

Step 1 — net = 1/8 − 1/12 = 3/24 − 2/24 = **1/24** per hour.

Step 2 — only 1/2 left: (1/2) ÷ (1/24) = **12 hrs**. ✅

Worked example — one pipe joins later

A fills in 20 hrs, B in 30 hrs. A opened first; B joins after **5** hrs. Total time?

Step 1 — A alone 5 hrs: 5/20 = **1/4** filled.

Step 2 — remaining 3/4 with both: rate 1/20 + 1/30 = 3/60 + 2/60 = **1/12**.

Step 3 — (3/4) ÷ (1/12) = 9 hrs. Total = 5 + 9 = **14 hrs**. ✅

Worked example — part-full, single pipe

Tank is **1/4** full; pipe A fills the whole tank in 12 hrs. Time to top it up?

Remaining = 3/4; time = (3/4) × 12 = **9 hrs**. ✅

Worked example — outlet joins to empty a full tank

Tank **full**. Outlet A empties in 10 hrs; a second outlet B (empties in 15 hrs) joins after 2 hrs.

A alone 2 hrs: 2/10 = 1/5 drained; left 4/5. Both: 1/10 + 1/15 = 1/6 per hr.

(4/5) ÷ (1/6) = 24/5 = 4.8 hrs. Total empty = 2 + 4.8 = **6.8 hrs**. ✅

💡 *Always ask **"how much of the tank is left to do?"** — it may be 1/2, 3/4, or a full 1. Time = (work left) ÷ (net rate).*

⑨ Pipes Opened Alternately

Pipes take turns (1 hr each). Use the **cycle method** with LCM units.

Cycle method

① Capacity = LCM. ② Work done in **one full cycle** (all turns). ③ See how many whole cycles fit, then finish the leftover in the next turn.

Worked example — A 4, B 6 alternately, A first

Units — cap = LCM(4,6) = 24; A = +6/hr, B = +4/hr.

Cycle — 2 hrs (A then B) = 6 + 4 = **10 units**.

Whole cycles — 2 cycles = 4 hrs → 20 units; remaining = 4 units.

5th hr — A's turn, fills 4 of the 4 units needed in exactly 1 hr.

Answer → 4 + 1 = **5 hrs**. ✅

Worked example — A 6, B 8 alternately, A first

Cap = 24; A = +4, B = +3. Cycle (2 hrs) = 7 units.

3 cycles = 6 hrs → 21 units; remaining 3 units. 7th hr = A's turn (+4/hr): 3 units in 3/4 hr.

∴ total = 6 + 3/4 = **6.75 hrs = 6 hrs 45 min**. ✅

Fill & drain alternately — A 5 fills, B 4 drains

Cap = LCM(5,4) = 20; A = +4, B = −5. Cycle (2 hrs) = 4 − 5 = **−1 unit**.

Net loss each cycle ∴ if it starts empty it **never fills** — the drain wins over a cycle. ✅

💡 Don't just divide capacity by cycle-work — the **last partial turn** is often filled by one pipe alone. Track it hour by hour near the end.

More Solved Examples – I

Q1. A 20 min, B 30 min fill; waste pipe empties 3 L/min; all open → full in 18 min. Capacity?

$V/20 + V/30 - 3 = V/18 \rightarrow V(1/20 + 1/30 - 1/18) = 3$. Inside $= 9/180 + 6/180 - 10/180 = 5/180 = 1/36$.

$\therefore V/36 = 3 \rightarrow V =$ **108 litres**. ✅

Q2. A is twice as fast as B; together they fill in 20 min. B alone?

Let B's rate $= r$, A's rate $= 2r$. Together $3r$ fills in $20 \rightarrow 3r = 1/20 \rightarrow r = 1/60$.

$\therefore$ B alone $=$ **60 min**, A alone $= 30$ min. ✅

Q3. A 10 hrs, B 12 hrs, C (outlet) 15 hrs. All open, tank empty. Fill time?

Cap $= \text{LCM}(10,12,15) = 60$; $A = +6$, $B = +5$, $C = -4$. Net $= 6 + 5 - 4 = +7$.

Time $= 60 \div 7 =$ **$8\ 4/7$ hrs ≈ 8 hrs 34 min**. ✅

Q4. Cistern fills in 9 hrs; a leak makes it 10 hrs. Leak empties full tank in?

Leak $= (9 \times 10)/(10 - 9) = 90/1 =$ **90 hrs**.

Check $\rightarrow 1/9 - 1/10 = 10/90 - 9/90 = 1/90$. ✅

Q5. A 30 min, B 45 min fill. A opened; B joins after 5 min. Total time?

Cap $= \text{LCM}(30,45) = 90$; $A = +3$, $B = +2$. A alone 5 min $= 15$ units; left 75 units.

Both: $3 + 2 = 5$/min $\rightarrow 75 \div 5 = 15$ min. Total $= 5 + 15 =$ **20 min**. ✅

✓ In "capacity" sums, keep rates in **litres/min** and set combined rate = capacity ÷ given time. One equation cracks it.

More Solved Examples – II

Q6. Three inlets A 6, B 8, C 12 hrs. All open. Fill time?

Cap = LCM(6,8,12) = 24; A = +4, B = +3, C = +2. Net = 9/hr.

Time = 24 ÷ 9 = **8/3 hrs = 2 hrs 40 min**. ✅

Q7. A 12 hrs, B 16 hrs fill together; after 4 hrs A is shut. B finishes in?

Cap = LCM(12,16) = 48; A = +4, B = +3. 4 hrs both = 4(7) = 28 units; left 20.

B alone: 20 ÷ 3 = 20/3 = **6 2/3 hrs** more (total 10 2/3 hrs). ✅

Q8. Tank full. Outlet empties in 8 hrs; an inlet (fills in 12 hrs) is left open by mistake. Empty time?

Net = −1/8 + 1/12 = −3/24 + 2/24 = −1/24 → drains at 1/24 per hr.

∴ empties in **24 hrs**. ✅

Q9. A 15 min, B 20 min. Opened alternately, A first. Fill time?

Cap = LCM(15,20) = 60; A = +4, B = +3. Cycle (2 min) = 7 units.

8 cycles = 16 min → 56 units; left 4. 17th min = A (+4): fills 4 in 1 min. Total = **17 min**. ✅

Q10. A 24, B 32 min fill; both open, A closed some time before full. Full in 18 min. A ran for?

Cap = LCM(24,32) = 96; A = +4, B = +3. B runs full 18 min = 54 units; A supplies 96 − 54 = 42.

A ran 42 ÷ 4 = **10.5 min**. ✅

"For how long did a pipe run?" → total units − (the always-on pipe's units) = the part-time pipe's units; divide by its unit-rate.

Higher-Level Mixed Examples Σ

Q11. A + B fill in 12 hrs, B + C in 15 hrs, A + C in 20 hrs. All three together?
Add: $2(A+B+C) = 1/12 + 1/15 + 1/20 = 5/60 + 4/60 + 3/60 = 12/60 = 1/5$.
$\therefore$ $A+B+C = 1/10 \rightarrow$ all three fill in **10 hrs**. ✅

Q12. From Q11, find C alone.
$C = (A+B+C) - (A+B) = 1/10 - 1/12 = 6/60 - 5/60 = 1/60 \rightarrow$ C alone = **60 hrs**. ✅

Q13. Two pipes 20 & 24 min fill; waste pipe empties in x. All open → full in 30 min. Find x.
Cap = LCM(20,24,30) = 120; inlets +6, +5; net for 30 min = $120/30 = 4$.
Waste $= (6 + 5) - 4 = -7$ units/min $\rightarrow$ empties 120 in $120/7$ = **17 1/7 min**. ✅

Q14. A fills 16 min, B fills 24 min. Both open; leak wastes 1/3 of A's water. Fill time?
Effective $A = (2/3)(1/16) = 1/24$. Net $= 1/24 + 1/24 = 2/24 = 1/12$.
$\therefore$ fill time = **12 min**. ✅

Q15. Tank fills in 6 hrs by A & B together. A alone takes 5 hrs more than B. Find B alone.
Let $B = t$, $A = t + 5$. $1/t + 1/(t+5) = 1/6 \rightarrow 6(2t + 5) = t(t + 5) \rightarrow t^2 - 7t - 30 = 0$.
$(t - 10)(t + 3) = 0 \rightarrow t =$ **10 hrs** (B), A = 15 hrs. ✅

Q16. Pipe fills 12 min; after 3 min a leak starts, doubling the remaining time. Leak-alone time?
First 3 min: $3/12 = 1/4$ filled. Left $3/4$ would take 9 min normally, but takes 18 min now.
Net rate after leak $= (3/4)/18 = 1/24$; leak $= 1/12 - 1/24 = 1/24 \rightarrow$ leak alone = **24 min**.
✅

Practice Set

1. A 12, B 6 fill together = ?
2. Inlet 8, outlet 12; fill time?
3. A 10, B 15, C(drain) 30; fill?
4. Fills 6, leak 8; leak-alone?
5. A 15, B 20, C(drain)12; fill?
6. Inlet 6, outlet 9; fill time?
7. Fills 12, leak makes 15; leak?
8. A 20, B 30; A shut after 6, rest by B?
9. A twice B; together 12 min; B alone?
10. Three inlets 4, 6, 12; fill?
11. A 4, B 6 alternately (A first); fill?
12. Half-full; A 8 fill, B 12 drain; fill?
13. Inlet 10, outlet 5; result?
14. A+B 10, A alone 15; B alone?

Answer Key — with working

1→ 4 hrs (72/18) · **2→ 24 hrs** (8×12/4) · **3→ 7.5 hrs** (net 4/30) · **4→ 24 hrs** (48/2) · **5→ 30 hrs** (cap60, +4+3−5=2) · **6→ 18 hrs** (54/3) · **7→ 60 min** (12×15/3) · **8→ 21 hrs more** (6/20+t/30=1 → t/30=7/10 → t=21) · **9→ 36 min** (3r=1/12 → r=1/36) · **10→ 2 hrs** (cap12, +3+2+1=6) · **11→ 5 hrs** (cap24, 2 cycles=20 units, 5th hr A fills last 4) · **12→ 12 hrs** ((1/2)÷(1/24)) · **13→ never fills** (outlet faster, net −1/10) · **14→ 30 hrs** (1/10−1/15=1/30).

Quick Revision

- ✓ Inlet = **+1/a**, outlet/leak = **−1/b**. Add signed rates; time = 1 ÷ net rate.
- ✓ Two inlets → **ab/(a+b)**; inlet+outlet → **ab/(b−a)**; leak alone → **a·a'/(a'−a)**.
- ✓ 3+ pipes → **LCM units**. Part-time/alternate → work in phases or cycles.

✓ *If the net rate comes out **negative**, an empty tank never fills — the drains are winning.*

☆ Fill or drain — track the net rate! ☆