Interview Logic Puzzle Cheat Sheet

A compact cheat-sheet of **commonly asked logic & reasoning puzzles** for interview prep. Each puzzle has a short statement, the key idea, and a concise solution path you can memorize or practice.

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1. Coin & Balance Puzzles

A. 8 coins, 1 lighter (balance scale) - **Idea:** Ternary split. Each weighing gives 3 outcomes → $3^2 = 9 \geq 8$ → 2 weighings. - **Procedure:** Split 3-3-2. Weigh 3 vs 3. Pick lighter group (or the 2 if balanced). Resolve in second weighing.

B. 12 coins, 1 counterfeit (unknown lighter/heavier) - **Idea:** 3 weighings suffice because $3^3 = 27 > 24$ possibilities (12×2). - **Procedure (summary):** 4 vs 4 first, then use outcomes to narrow to 4 or fewer candidates, then design second/third weighings to identify both coin and sign.

C. Digital scale trick (weights known) - **Idea:** Use unique counts (1×coin1, 2×coin2, …) to get a unique shortfall indicating the counterfeit. - **When possible:** 1 weighing if genuine coin weight known or if you can measure expected total.

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2. River Crossing & Transport

A. Wolf, Goat, Cabbage (boat hold 1) - **Key move:** Take goat first, shuttle predator/cargo while avoiding leaving wolf+goat or goat+cabbage alone. - **Sequence:** Goat → (return) → Wolf → (bring goat back) → Cabbage → (return) → Goat. - **Trips:** 7 times across.

B. 3 Missionaries / 3 Cannibals (boat holds 2) - **Goal:** Avoid cannibals outnumbering missionaries on either bank. - **Strategy:** Use intermediate ferrying patterns with safe returns. Classic solution exists with 11 crossings.

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3. Time / Rope / Hourglass

A. Two uneven ropes (each 1 hour). Measure 45 minutes. - Light Rope1 at both ends (burns in 30 min), Rope2 at one end. When Rope1 finishes, light the other end of Rope2 → additional 15 min.

B. Hourglasses (3-hour and 5-hour) measure 8 hours - Flip both; track which empties and flip accordingly. Use combined cycles to sum to 8.

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4. Hat Logic

A. 3 people in line (A sees B & C, B sees C, C sees none) - **Key inference:** A's inability to answer gives information. If A says "I don't know", it implies B and C have the same color. B then uses that plus seeing C to deduce his own. - **Chain:** A's ignorance → B deduces if B sees X, then his must be X.

B. 4 people variant (more challenging) - Additional rounds of silence/answers transmit parity information. The general approach: determine what each silence implies, propagate constraints, then deduce.

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5. Bridge & Flashlight (1 flashlight)

Example: 1,2,7,10 minutes. - **Optimal strategy:** Send fastest shuttlers as the torch carriers. - **Min time:** 17 minutes. - **Pattern:** 1&2 cross, 1 returns, 7&10 cross, 2 returns, 1&2 cross.

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6. Egg Drop (2 eggs, 100 floors)

Idea: Choose floors with decreasing intervals to minimize worst-case drops. - **Formula:** Solve $n + (n-1) + ... + 1 \geq 100 \rightarrow n \approx 14$. - **Worst-case drops:** 14.

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7. Jug / Water Measurement

3L & 5L jugs → measure 4L - **Steps:** Fill 5 → pour to 3 (left 2) → empty 3 → pour 2 into 3 → fill 5 → pour into 3 until full (leaves 4). - **General approach:** Use gcd-based reasoning (can measure multiples of gcd(3,5) = 1).

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8. Truth / Lie / Knights & Knaves

One-question path-finding (two guards) - **Standard question:** "If I asked the other guard which road leads to the city, what would he say?" Then take the opposite. - **Reasoning:** The liar inverts; asking about the other inverts again → gives the wrong road; invert to get correct.

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9. Ball / Weights / Scales (numeric vs balance)

A. 8 balls one heavier (balance) - 2 weighings: 3-3-2 split; weigh 3 vs 3; then weigh one vs one in the identified group.

B. Using a digital scale with unknown genuine weight - If genuine weight unknown, you can still design multi-step weighings to deduce counterfeit in ⌈log_2(n)⌉ weighings by binary splitting and subtraction, but constraints vary.

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10. Misc Quickies and Common Tricks

- **Snail climb (5 up, 3 down, 15 high):** Net 2 per hour, but final climb reaches top at hour 6 (last climb doesn’t slide back).
- **100 doors toggling:** Perfect squares remain open (1,4,9,...).
- **Clock angle at 3:15:** 7.5 degrees.
- **Two questions to identify heavier coin among three using balance:** 1 weighing suffices if you compare two; else deduce.

Practice Tips

- **Information counting:** Each balance weighing has 3 outcomes → use base-3 reasoning.
- **Always consider the last step separately:** Many puzzles have a final move that breaks the repeating pattern (e.g., last climb, last crossing).
- **Silence is information:** In logic-chain puzzles, "I don’t know" often conveys as much as an answer.
- **GCD for water/jug problems:** Reachable volumes are multiples of gcd(jug1, jug2).

Want this as a printable PDF?

I can export this cheat-sheet to PDF, add illustrative diagrams (small state graphs or simple ASCII), or expand any section with step-by-step diagrams. Tell me which format you prefer: *PDF*, *PNG cheat card*, or *expanded walk-throughs* for specific puzzles.

Expanded Walkthroughs (Added)

A. 12-Coin Problem (Counterfeit could be lighter or heavier) — 3 Weighings

Goal: Identify which one of 12 coins is counterfeit and whether it is lighter or heavier using a balance scale in 3 weighings.

Why 3 weighings suffice: Each weighing has 3 outcomes → $3^3 = 27$ distinct outcome patterns. There are 12 coins × 2 possibilities (lighter/heavier) = 24 possibilities. $27 \geq 24$, so 3 weighings can encode enough information.

Standard strategy (high level): 1. Label coins 1..12. First weigh 1,2,3,4 vs 5,6,7,8. - If balanced → counterfeit is among 9..12. - If left lighter → counterfeit is one of 1..4 (lighter) or 5..8 (heavier). Keep track of which side was lighter/heavier. - If right lighter → symmetric case. 2. Use the second weighing to craft a mix of coins that, combined with the first outcome, reduces candidates to at most 3 possibilities with known sign patterns. 3. Third weighing isolates the single coin and its sign.

Notes: The explicit full decision tree is long; interviewers expect you to explain the information-counting idea and start the first weighing (4 vs 4). If pressed, demonstrate one branch fully — e.g., first weighing balances → weigh 1,2,9 vs 3,4,10, and show branch analysis.

B. 4-Person Hat Variant (Silence as information)

Setup: 4 people in a line: A (back) sees B,C,D; B sees C,D; C sees D; D sees none. Each hat is red or blue. They hear questions in order: "Do you know your hat color?" and can reply Yes/No (or remain silent). At least one red and one blue exist.

Key idea: Each "No" communicates that the speaker's visible configuration is ambiguous — i.e., there exist multiple color assignments consistent with earlier No's and public knowledge. This allows later people to eliminate possibilities.

Typical deduction chain: 1. If A saw three hats the same color (all B,C,D are blue), A could immediately deduce his is red (since at least one of each color exists). So A's silence implies not all three ahead are identical. 2. B uses A's silence plus what B sees (C & D) to infer whether B has unique information. Continued silences shrink the set of possible configurations exponentially.

Worked short example: Suppose actual hats are [Red, Blue, Blue, Blue] for [A,B,C,D]. - A sees B,C,D = BBB. If A were rational, A would say "My hat is Red" immediately (since both colors must appear). If A stays silent, others deduce A did not see BBB; thus at least one of B,C,D differs. B sees C,D = BB; combining with A's silence, B deduces: A did not see BBB, so A must have seen at least one non-blue — but B sees two blues, so B infers his own must be blue? (Process continues.)

Practice tip: Work through small concrete assignments and pretend you are each person, one step at a time. Keeping a table of consistent worlds (all possible assignments) and eliminating those inconsistent with observed No/Yes answers is helpful.

C. Egg Drop (2 eggs, 100 floors) — Minimize worst-case drops

Goal: Minimize worst-case number of drops to find the highest safe floor.

Strategy idea: Use decreasing step sizes so the number of remaining attempts after the first break equals the number of remaining steps to test.

Math: Choose n such that:

$n + (n-1) + (n-2) + \ldots + 1 \geq 100$

This sum is $n(n+1)/2 \geq 100$. Solve $n^2 + n - 200 \geq 0 \rightarrow n \approx 13.65 \rightarrow n = 14$.

Algorithm: - First drop from floor 14. If egg breaks, test floors 1..13 sequentially (up to 13 more drops → worst-case 14). - If it doesn't break, go up by 13 floors (14 + 13 = 27), then 12, 11, ... - Worst-case total drops = 14.

Why decreasing steps matter: If you dropped equal intervals, you might end up with too many remaining floors to test sequentially after the first break. Decreasing the interval keeps the worst-case bounded.

Small ASCII Diagrams

12-coin first weighing branches (simplified):

Weighing1: (1 2 3 4) vs (5 6 7 8)

- Balance → candidate set {9,10,11,12}
- Left lighter → candidates: {1..4 lighter} ∪ {5..8 heavier}
- Right lighter → symmetric

Represent each branch as a subtree and design Weighing2 to split the branch into three outcomes mapping uniquely to ≤3 possibilities.

Egg-drop decreasing steps example (14): 14 -> 27 -> 39 -> 50 -> 60 -> 69 -> 77 -> 84 -> 90 -> 95 -> 99 -> 100 (sequence of floors tested until reaching or exceeding)

If you'd like, I can now: - **Export the updated cheat-sheet to PDF**, or - **Add visual state-trees** (graph images) for the 12-coin and egg-drop problems, or - **Create a printable 1-page PNG cheat card** with the top 12 puzzles and one-line solutions.

Tell me which one you want and I'll produce it.