Align Chronotype Quiz

(MCQ, 5 items — deterministic, MCTQ-style)

Instructions to users

Pick the closest option. Use your **natural behavior**, not what your job forces.
If you use an alarm on free days, say so.

Q1. On workdays, when do you usually wake up?

A. ≤ 06:00
B. 06:01–07:00
C. 07:01–08:00
D. 08:01–09:00
E. ≥ 09:01

Q2. On free days with no alarm, when do you naturally wake up?

A. ≤ 06:30
B. 06:31–07:30
C. 07:31–08:30
D. 08:31–09:30
E. ≥ 09:31

(If you do use an alarm on free days, still choose a band; we'll ask in Q3.)

Q3. How much longer do you sleep on free days than on workdays?

A. Same or ≤ 30 min
B. 30–60 min
C. 60–90 min
D. > 90 min
E. I use an alarm on free days

Q4. On long or demanding days (6+ hours of cognitively demanding work), what tends to happen first?

A. I stay sharp most of the day
B. I slow down, but accuracy holds
C. It depends on the type of work
D. Small mistakes start appearing
E. I feel mentally spent early

Q5. When you're interrupted during focused work (messages, meetings, context switches), what usually happens?

A. I resume at the same depth
B. I need a short ramp-up
C. It depends on the interruption
D. Depth drops noticeably
E. I can't recover full focus

Scoring Rubric

(Deterministic; no learned weights)

Notation: hours in 24h decimal (07:30 → 7.5).
`wrap24(x)` keeps values in [0, 24).

Map answers to numeric anchors

Q1 — workday wake midpoint (`wakeW_mid`)

- A 6.0
- B 6.5
- C 7.5
- D 8.5
- E 9.5

Q2 — free-day wake midpoint (`wakeF_mid`)

- A 6.5
- B 7.0
- C 8.0
- D 9.0
- E 10.0

Q3 — extra sleep on free days (`extra_h`)

- A 0.25
- B 0.75
- C 1.25
- D 1.75
- E 0.0 *(flag lower confidence)*

Q4 — fatigue sensitivity (`fatigue_h`)

- A −0.25
- B −0.10
- C 0.00
- D +0.10
- E +0.25

Q5 — interruption sensitivity (`interrupt_h`)

- A −0.25
- B −0.10
- C 0.00
- D +0.10
- E +0.25

Compute phase proxies

```
SDw = 7.0                    // assumed workday sleep (population
mean)

SDf = SDw + extra_h          // free-day sleep reflects debt


MSW = wrap24(wakeW_mid - SDw/2)

MSF = wrap24(wakeF_mid - SDf/2)


// Sleep-debt correction (MCTQ convention)

Debt  = SDf - SDw
```

```
MSFsc = wrap24(Debt > 0 ? (MSF - 0.5*Debt) : MSF)
```

Focus fragility (separate from chronotype typing)

```
Fragility = clamp((fatigue_h + interrupt_h)/2, -0.25, +0.25)
```

This is **not** used to shift circadian phase.
It is stored as a bounded reliability prior.

Social jetlag (feedback only)

```
Δ = abs(MSF - MSW)
```

```
SJL_hours = (Δ > 12) ? (24 - Δ) : Δ
```

Confidence flag

```
confidence = (Q3 == 'E') ? 'Lower' : 'Normal'
```

Chronotype Mapping

(Based on MSFsc only)

- `< 2.5` → **Aurora** (early)

- `2.5–<3.5` → **Daybreak** (slightly early)
- `3.5–<4.5` → **Meridian** (midday)
- `4.5–<5.5` → **Twilight** (slightly late)
- `≥ 5.5` → **Nocturne** (late)

Output Fields

- Chronotype label (plain English)
- Phase anchor: *“Your estimated baseline mid-sleep is around HH:MM.”*
- Social jetlag: *“Work vs free days differ by ~H hours.”*
- Focus fragility: *Low / Medium / High*
- Confidence chip if applicable

Why These 5 Questions

(Neuroscience Justification)

Q1–Q3: Sleep timing and sleep debt

What they capture
Habitual sleep timing and accumulated sleep debt. Free-day timing without an alarm is the best behavioral proxy for intrinsic circadian phase; workdays reflect social constraint. Extra sleep on free days indicates debt that biases free-day timing later.

Why this is valid
Mid-sleep on free days, sleep-debt corrected (MSFsc), shows strong convergence with laboratory circadian phase markers such as dim-light melatonin onset (DLMO), without requiring

diaries or biological sampling. Discrepancies between work and free days quantify social jetlag and predict mood, metabolic, and performance outcomes.

Key literature

- Roenneberg et al., *Current Biology* (2003, 2007)
- Wittmann et al., *Chronobiology International* (2006)
- Juda et al., *Chronobiology International* (2013)

Q4: Fatigue sensitivity under sustained cognitive load

What it captures
A coarse, experience-based proxy for how prolonged cognitive demand manifests (slowing, errors, exhaustion), without requiring users to introspect about “thinking quality.”

Why this is valid
Homeostatic sleep pressure and fatigue impair executive control, error monitoring, and decision stability. Individuals differ reliably in vulnerability and slope of decline.

Key literature

- Schmidt et al., *NeuroImage* (2007)
- Duffy & Czeisler, *Sleep* (2009)

Q5: Interruption recovery cost

What it captures
Sensitivity to fragmentation and task switching, expressed as recovery depth and time.

Why this is valid
Interruptions reliably tax working memory and inhibitory control. Recovery costs vary across individuals and meaningfully predict downstream performance degradation.

Key literature

- May & Hasher, *Psychological Science* (1998)

- Valdez et al., *Biological Rhythm Research* (2012)

Why Five Questions (Not More)

- **Construct coverage:**
  Q1–Q3 anchor circadian phase and correct for sleep debt.
  Q4–Q5 add bounded reliability priors without contaminating phase estimation.
- **User burden:**
  Five MCQs preserve completion and reliability in consumer onboarding.
- **Determinism:**
  Transparent math, reproducible outcomes, no opaque inference.

Guardrails and Bias Handling

- **Alarms on free days:** lower confidence; suppress debt correction
- **Jet lag, shift work, illness:** prompt retake after 1–2 typical weeks
- **Light, caffeine, meals:** addressed post-result, not inside the quiz

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References (Selected)

- Roenneberg T. et al. *Current Biology*; *Journal of Biological Rhythms*
- Wittmann M. et al. *Chronobiology International*
- Juda M. et al. *Chronobiology International*

- Horne JA, Östberg O. *International Journal of Chronobiology*
- Duffy JF, Czeisler CA. *Sleep*
- May CP, Hasher L. *Psychological Science*
- Schmidt C. et al. *NeuroImage*
- Valdez P. et al. *Biological Rhythm Research*

Bottom line:

This quiz estimates circadian phase cleanly, corrects for sleep debt using validated methods, and adds explicitly bounded reliability priors without polluting chronotype typing.

It does not claim to measure thinking quality. It establishes the biological structure required for downstream mode–condition matching.

Appendix A

Deterministic Derivation of Mode-Specific Reliability Windows

(Architecture-integrated, neuroscience-grounded, confidence-gated)

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0. Why this appendix exists

The baseline quiz establishes a **stable biological reference frame**. This appendix defines the **deterministic transformation** from that reference frame into **mode-specific reliability windows**—the minimal structure Align needs to allocate “Framing / Synthesis / Evaluation / Execution / Reflection” to conditions where they are most likely to hold up.

This appendix is deliberately constrained by Align’s architecture: **structural truth > psychological inference**, **local-first**, **deterministic baseline + probabilistic refinement**, and **silence as a valid output**.

(refer to Tech brief)

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1. Inputs and where they live in the system

1.1 Inputs (from baseline quiz only)

These are the only inputs used for the derivation:

- **MSFsc** (sleep-debt corrected mid-sleep on free days): continuous phase anchor
  This is the core behavior-based proxy for circadian phase used in the MCTQ framework, and has been validated against physiological markers (including DLMO) in shortened and standard forms. [opus.bibliothek.uni-augsburg.de+2leixulab.net+2]
- **Chronotype class** (Aurora/Daybreak/Meridian/Twilight/Nocturne): discretized from MSFsc
  Align's five-type system and "best focus window" anchors.
  CHRONOTYPES
- **Fragility index** (Low/Medium/High): bounded prior computed from Q4 (fatigue sensitivity) + Q5 (interruption recovery)
- **Social jetlag** (SJL_hours): absolute difference between work and free day midsleep markers; descriptor of misalignment between biological and social time. [PubMed+1]

These are stored in the backend `UserState` as `chronotype`, `baseline_windows`, and `confidence_score` inputs, never as raw events. (refer to Tech brief)

1.2 Non-inputs (explicit exclusions)

This derivation does **not** use:

- behavioral metadata aggregates (switch_rate, fragmentation_index, etc.)
- calendar load
- wearables
- any AI pattern detection

Those can only influence **confidence gating**, never the baseline structure. (refer to Tech brief)

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2. Scientific premise

Two well-supported effects are enough to justify deterministic windows:

1. **Circadian phase modulates cognitive control and related executive functions** ("synchrony effects"): people show better inhibitory control and related executive performance at their circadian-optimal times, relative to non-optimal times. Hasher Aging & Cognition Lab+1
2. **Fatigue and sleep loss selectively degrade executive control, error monitoring, and decision-relevant processes**, with measurable impairment in error detection/remediation and executive functioning under sleep deprivation / high sleep pressure. PubMed+2Fatigue Managers Network+2

Separately, **task switching / interruptions impose reliable "switch costs"**—slower, more error-prone responses after a switch—and this cost persists even with preparation. PubMed+1 In applied settings, interruptions increase stress and perceived time pressure even when people compensate by speeding up. UC Irvine ICS

Align's move is to treat these as **structural constraints** and refuse to infer hidden mental states. (refer to Tech brief)

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3. Output contract (what this appendix produces)

The Biological Baseline Engine produces a deterministic object:

BaselineModeWindows

- `phase_anchor_msfsc` (continuous)
- `chronotype` (enum)
- For each mode ∈ {Framing, Synthesis, Evaluation, Execution, Reflection}:
  - `reliable_windows[]` (clock-time intervals)
  - `fragile_windows[]` (clock-time intervals)
  - `window_sharpness` (wide/standard/narrow)
- `sjl_hours` (continuous)
- `fragility_level` (Low/Medium/High)

This object is **user-visible** in principle but **not necessarily user-shown** until permitted by the Confidence Engine. (refer to Tech brief)

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4. Deterministic derivation algorithm

Step 1 — Build the chronotype reliability envelope (population prior)

Each chronotype maps to a base “best focus window” envelope (Align’s v1 anchors).

CHRONOTYPES

This is a deterministic, non-learning prior and is treated as **the stable reference frame**. (refer to Tech brief)

Example anchors (from Chronotype System v1):

- Aurora: 05:30–09:30
- Daybreak: 07:00–11:00
- Meridian: 10:00–14:00
- Twilight: 13:00–17:00
- Nocturne: 18:00–22:30
  CHRONOTYPES

Step 2 — Translate modes into reliability requirements (fixed mapping)

Define mode requirements as **executive control vs sustained attention vs error monitoring vs slack**:

- **Framing** → highest dependence on executive control / inhibitory gating (fragile to interruptions)
  Synchrony effects in inhibitory control support circadian modulation of inhibition and “frontal” style control. Hasher Aging & Cognition Lab+1
- **Synthesis** → highest dependence on sustained attention and resistance to fragmentation
  Task switching literature supports persistent costs after switches and incomplete “reconfiguration.” PubMed+1
- **Evaluation** → highest dependence on error monitoring, inhibition, and fatigue resistance
  Sleep loss impairs error monitoring and remediation; decision-relevant executive functions degrade. PubMed+2Fatigue Managers Network+2
- **Execution** → comparatively tolerant (procedural/throughput) but still sensitive to severe fatigue
  (We do not claim execution is “immune,” only less fragile than framing/evaluation under mild degradation.) Fatigue Managers Network+1
- **Reflection** → requires low time pressure / slack; less about peak inhibition, more about protected downtime
  (Evidence here is less direct; Align treats this as a conservative design assumption, not a physiological claim.)

This mapping is deterministic and identical for all users.

Step 3 — Position mode windows relative to the envelope (ordering → timing)

Within each chronotype envelope, place modes in a fixed relative arrangement:

- **Framing / Evaluation** cluster near the top of the envelope (highest executive reliability)
- **Synthesis** slightly inside the envelope, avoiding edges (more sensitive to fragmentation)
- **Execution** extends into shoulders around the envelope (more tolerant)
- **Reflection** sits after the envelope (protected lower-pressure window)

This is not "personality." It's a conservative arrangement consistent with:

- synchrony effects for inhibition/executive control Hasher Aging & Cognition Lab+1
- fatigue-related impairment of executive / error monitoring PubMed+1
- switch costs and reconfiguration limits under interruptions PubMed+1

Step 4 — Calibrate window sharpness using Fragility (width only, never position)

PHASE CONSTRAINT (CRITICAL)

Window sharpness modulation is part of the Biological Baseline Engine but is PHASE-GATED.

In Phase 1 (Deterministic Governance MVP), Align MUST emit canonical chronotype reliability windows verbatim, without widening or narrowing.

Fragility is computed and stored, but it does NOT alter window geometry until Phase 2 (Physiological Calibration), where confidence modulation and window contraction are enabled.

This constraint is non-negotiable for Phase 1 and exists to preserve determinism, auditability, and reproducibility of baseline geometry.

Fragility (Low/Medium/High) changes **window width**, not the phase anchor.

Deterministic rule:

- Low fragility → widen all reliable windows by +30 min; allow execution to extend further into shoulders
- Medium fragility → default widths
- High fragility → narrow all reliable windows by −30 min; additionally:
    - narrow **Evaluation** by an extra −15 min (fatigue vulnerability) PubMed+1
    - narrow **Framing/Synthesis** by an extra −15 min (interruption vulnerability) PubMed+1

Why this is defensible: sleep loss/fatigue disproportionately impacts executive systems and error monitoring, while fragmentation imposes persistent switch costs and impaired reconfiguration. Wiley Online Library+2PubMed+2

Step 5 — Apply Social Jetlag as an asymmetry penalty (confidence modifier, not structure change)

CANONICAL WINDOW DEFINITION

The window templates defined in this section are CANONICAL for all system outputs.

Other documents may present narrative, illustrative, or simplified variants of these windows for explanatory purposes. Such variants MUST NOT be emitted by the system.

All Align outputs that surface mode-specific reliability windows MUST conform exactly to the definitions in this section.

SJL_hours does not alter biological windows. It reduces the system's willingness to speak and increases the probability of silence.

This is aligned with the core principle: **silence is a valid output** when conditions are unstable or misaligned.

(refer to Tech brief)

Social jetlag as a construct and its association with wellbeing/sleep outcomes is well-established. PubMed+1

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5. Concrete deterministic window templates (what's actually emitted)

These templates use Align's Chronotype System v1 anchors as the **execution/focus envelope** and derive mode windows around it.

CHRONOTYPES

(Exact minutes are deterministic and can be tuned once; tuning is a product choice, not per-user learning.)

Aurora (focus envelope 05:30–09:30)

CHRONOTYPES

- Framing: 06:00–08:00
- Evaluation: 07:00–09:00
- Synthesis: 06:30–09:00
- Execution: 09:00–12:30
- Reflection: 18:00–20:00 (low-pressure)

Daybreak (07:00–11:00)

- Framing: 08:00–10:00
- Evaluation: 09:00–11:00
- Synthesis: 08:30–11:00
- Execution: 11:00–15:00
- Reflection: 20:00–21:30

Meridian (10:00–14:00)

- Framing: 10:00–12:00
- Evaluation: 11:00–13:30
- Synthesis: 10:30–13:30
- Execution: 14:00–17:00
- Reflection: 18:00–20:00

Twilight (13:00–17:00)

- Framing: 13:00–15:00
- Evaluation: 15:00–17:00
- Synthesis: 14:00–17:00
- Execution: 17:00–20:00
- Reflection: 21:00–22:30

Nocturne (18:00–22:30)

- Framing: 18:30–20:30
- Evaluation: 20:00–22:00
- Synthesis: 19:00–22:00
- Execution: 14:00–18:00
- Reflection: 22:00–23:00

Fragility modulation then expands/contracts these windows per Step 4.

Important: these are **baseline priors**, not guarantees. Align must still obey confidence gating before surfacing anything.

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6. Where the Confidence Engine gates this (architecture integration)

The Confidence Engine decides whether Align is allowed to surface mode-window guidance at all. It uses:

- baseline stability (days of consistent data)
- pattern consistency across aggregates
- outcome asymmetry
- override behavior
- wearable drift (optional)

If confidence < threshold → **silence**, even if baseline windows exist. (refer to Tech brief)

This is the "foolproofing" move: it prevents the system from speaking when:

- the user is new
- schedule is unstable
- data is sparse
- misalignment is extreme

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7. Why this is hard to break (explicit failure-mode handling)

This appendix is designed to be robust under known failure modes listed in the technical brief (sparse usage, irregular schedules, missing days, high overrides). The response is always:

- fall back to baseline structure
- widen silence zone
- never hallucinate certainty

  This is the correct safety posture for a system whose output is "when to speak and when to stay silent."

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8. Summary

- The quiz yields a validated behavioral circadian phase proxy (MSFsc) and a bounded fragility prior; social jetlag quantifies misalignment. opus.bibliothek.uni-augsburg.de+1
- Mode windows are derived deterministically by intersecting a chronotype reliability envelope with fixed mode requirements grounded in circadian synchrony effects, fatigue-related executive impairment, and task-switching costs. Hasher Aging & Cognition Lab+2Wiley Online Library+2
- The baseline structure never adapts; only the Confidence Engine governs whether advice is surfaced, preserving agency and preventing overclaiming.