

Solutions

2.1

- 6 H⁺ (enters at complex II, skipping I: 4+2).

2.2

- $3 \times 2.5 + 1 \times 1.5 + 1 \times 1 = 10$ ATP-equivalents ✓.

2.3

- Complex II (succinate dehydrogenase / FADH₂ entry).

3.1

- Sources: glycolysis 2 ATP + 2 NADH; PDH 2 NADH; TCA 6 NADH + 2 FADH₂ + 2 GTP.
- Malate shuttle: $2 + 5 + 5 + 15 + 3 + 2 = \mathbf{32 \text{ ATP}}$ ✓; glycerol-P shuttle: $2 + 3 + 5 + 15 + 3 + 2 = \mathbf{30}$ ✓.
- The older 36–38 used P/O 3 and 2 – the ratio convention, not the bookkeeping, differs.

3.2

- Complex IV blocked: electrons stop, pumping stops, gradient collapses, ATP synthase stalls.
- Tissues cannot consume O₂ (venous blood red); ATP falls → glycolysis alone → lactate rises.
- Antidote rationale: hydroxocobalamin binds cyanide / nitrites shift Hb to a form that competes – mechanism-first.