Solutions

2.1

- Insulin; drives hepatic glycogen synthesis (and lipogenesis).

2.2

- Ketones supply ~2/3 of brain energy (glucose need falls to ~30–40 g/day).

2.3

- Non-enzymatic glycation of haemoglobin, integrated over the ~120-day red-cell lifetime.

3.1

- Hour 6: liver on glycogenolysis, fat basal release, muscle glucose/ fatty acids. Hour 18: glycogen near-empty – gluconeogenesis from amino acids/glycerol/lactate; fat lipolysis high. Day 4: liver exports ketones; muscle largely fatty acids; brain ~2/3 ketones.
- Switch justified: 100 g bank ÷ ~120 g/day brain demand ≈ one day.
- Protein sparing: each gram of brain glucose replaced by ketones spares ~2 g muscle protein (amino-acid carbon for glucose).

3.2

- No insulin ⇒ glucagon programme runs: lipolysis (free fatty acids → ketones → acidosis), proteolysis (weight loss), glycogenolysis + gluconeogenesis despite high glucose; glucose above renal threshold → osmotic diuresis (polyuria, thirst); acidosis drives Kussmaul (deep) breathing.
- Type 2: insulin present but resisted – same ledger, milder arrows, years not hours.