Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

Each answer shows the steps, then the **result**.

2.1

2 N = 28 g per 60 g

28/60 ≈ **0.47**

2.2

90 × 0.16 = **14.4** g N

urea = 14.4/0.47

≈ **31** g

2.3

alanine + α-ketoglutarate ⇌ pyruvate + glutamate

vitamin B6 (pyridoxal phosphate)

2.4

the brain removes ammonia by making glutamine

glutamine draws water into astrocytes, which swell

glutamate and α-ketoglutarate are used up, so brain energy and signalling suffer

3.1

(a) 450/35 ≈ **13** times

(b) before birth, the mother's liver cleared the baby's ammonia through the placenta; after birth, protein feeds start and ammonia builds up

(c) less protein means less nitrogen to clear; glucose stops the body breaking down its own protein for energy

(d) dialysis to remove ammonia quickly; drugs that carry nitrogen out by other routes (nitrogen scavengers)

3.2

(a) phenylalanine builds up to very high levels and harms the developing brain, causing learning disability

(b) phenylalanine is an essential amino acid needed for growth, so a little is needed; tyrosine cannot be made from it, so it becomes essential and must be eaten

(c) the baby looks normal at first, and brain damage can be prevented only if the diet starts in the first weeks

3.3

(a) 150/35 ≈ **4.3** times

(b) fewer working liver cells means less urea made; bypass blood from the gut reaches the brain without passing through the liver

(c) the acid turns ammonia (NH_3) into ammonium (NH_4^+), which is trapped in the gut; lactulose also speeds the gut, so more is passed out

(d) blood in the gut is a large protein meal, which bacteria turn into ammonia

(e) regular lactulose aiming at 2–3 soft stools a day, and quick treatment of triggers such as bleeding and infection; enough protein and energy in the diet, and review for a liver transplant

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