

2.6 Lipid metabolism

Name: _____ Class: _____ Date: _____ **Total: 24 marks**

KEY WORDS lipoprotein

Objective

Count β -oxidation ATP yields and route the lipoprotein freight.

1 Key knowledge and worked examples

■ The palmitate count

C16: 7 cycles $\rightarrow$ 8 acetyl-CoA + 7 FADH₂ + 7 NADH = 80 + 10.5 + 17.5 – 2 activation = **106 ATP** ✓.

■ The freight classes

Chylomicrons (gut $\rightarrow$), VLDL (liver $\rightarrow$), LDL (deliver cholesterol), HDL (return).
Fasting $\rightarrow$ ketogenesis: brain ~2/3 ketones by day 3.

2 Practice

2.1 How many β -oxidation cycles for a C12 fatty acid, and how many acetyl-CoA result? [3]

2.2 Which lipoprotein returns cholesterol to the liver? [3]

2.3 Why can the brain not burn long-chain fatty acids? [3]

3 Exam-style questions

3.1 Compute the complete ATP yield of stearate (C18).

Count cycles, acetyl units, reducing equivalents. Sum ATP equivalents with 2.5/1.5 and subtract activation. Compare per-carbon efficiency with glucose (30–32 ATP / 6 C). [8]

3.2 (Fictional infant) fasting hypoketotic hypoglycaemia.

Explain the double failure (no ketones AND hypoglycaemia) from one β -oxidation defect. State the diagnostic signature on the blood spot. Explain why feeding frequency is the core management. [7]

Solutions

2.1

- C12: $12/2 - 1 = 5$ cycles; 6 acetyl-CoA.

2.2

- HDL (reverse transport).

2.3

- They do not cross the blood–brain barrier; ketones are the water-soluble substitute.

3.1

- C18: 8 cycles $\rightarrow$ 9 acetyl-CoA + 8 FADH₂ + 8 NADH.
- Yield: $9 \times 10 + 8 \times 1.5 + 8 \times 2.5 - 2 = 90 + 12 + 20 - 2 = \mathbf{120 \text{ ATP}}$ ✓.
- Per carbon: $120/18 \approx 6.7$ vs glucose $32/6 \approx 5.3 \text{ ATP/C}$ ✓ fat wins on reduced carbons.

3.2

- β -oxidation block: no acetyl-CoA $\rightarrow$ no ketones; no ATP from fat $\rightarrow$ gluconeogenesis unfunded $\rightarrow$ hypoglycaemia.
- Signature: low glucose WITH low ketones (plus acyl-carnitine profile on the newborn spot).
- Frequent feeds keep the body out of fasting – prevention is the therapy.