1. Haemoglobin has a quaternary structure but myoglobin does not. Why?

   ☐ Haemoglobin has no α-helices

   ☐ Haemoglobin has four chains; myoglobin has one

   ☐ Myoglobin has no haem group

   ☐ Myoglobin is not a protein

2. An enzyme makes a reaction go further towards products at equilibrium.

   ☐ True ☐ False

3. A reaction has $\Delta G^{\circ\prime} = +14.2$ kJ per mol. It is coupled to ATP hydrolysis (-30.5 kJ per mol). What is the overall $\Delta G^{\circ\prime}$, in kJ per mol?

   _____ kJ per mol

4. One glucose gives two acetyl-CoA. How many NADH do the two TCA turns make?

   _____ NADH

5. Which glycogen store keeps blood glucose up between meals?

   ☐ Both equally

   ☐ Liver glycogen

   ☐ Brain glycogen

   ☐ Muscle glycogen

6. How many β-oxidation cycles does stearate (C18) need?

   _____ cycles

7. Alanine transaminates with α-ketoglutarate. What are the products?

   ☐ Aspartate and oxaloacetate

   ☐ Urea and water

   ☐ Glucose and ammonia

   ☐ Pyruvate and glutamate

8. How does glucagon turn on glycogen breakdown in the liver?

   ☐ It breaks glycogen down directly

   ☐ It removes phosphates from the enzymes

   ☐ It enters the nucleus and switches on genes within seconds

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9. Myoglobin binds O_2 cooperatively, giving a sigmoid curve.

   ☐ True ☐ False

10. What is K_m?

    ☐ The substrate concentration at half of V_{max}

    ☐ The rate when [S] = 1 mM

    ☐ The maximum rate of the enzyme

    ☐ The amount of enzyme in the cell

1. **Haemoglobin has four chains; myoglobin has one**

   Quaternary structure is the assembly of several chains. One chain (myoglobin) cannot have it; Hb's $\alpha_2\beta_2$ tetramer does.

2. **False**

   An enzyme speeds both directions equally; it reaches the same equilibrium sooner but does not move it.

3. **-16.3 kJ per mol**

   $+14.2 + (-30.5) = -16.3$ kJ per mol: negative, so the coupled pair runs.

4. **6 NADH**

   3 NADH per turn $\times$ 2 turns = 6, plus 2 $FADH_2$ and 2 GTP.

5. **Liver glycogen**

   The liver's ~100 g is exported as glucose; muscle's larger ~400 g is used only by the muscle itself.

6. **8 cycles**

   $18/2 - 1 = 8$ cycles, giving 9 acetyl-CoA: the last cycle splits a 4-carbon piece into two acetyl-CoA.

7. **Pyruvate and glutamate**

   The amino group moves to α-ketoglutarate, making glutamate; alanine's carbon skeleton is left as pyruvate.

8. **It raises cAMP, and PKA phosphorylates the enzymes**

   Glucagon $\rightarrow$ cAMP $\rightarrow$ PKA $\rightarrow$ phosphorylase on, glycogen synthase off. Insulin does the opposite, by removing those phosphates.

9. **False**

   Myoglobin has one site, so its curve is a hyperbola. Cooperativity needs several sites that influence each other, as in Hb.

10. **The substrate concentration at half of V_{max}**

    Put $[S] = K_m$ into the equation: $v = V_{max}K_m/2K_m = V_{max}/2$.

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