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 used, 4 made: net **2** ATP

2 NADH

2.2

$\Delta G = 5 + 2.58 \ln 0.01$

$\approx -\mathbf{6.9}$ kJ/mol

negative, so yes

2.3

hexokinase (glucose → glucose 6-phosphate)

PFK-1 (fructose 6-phosphate → fructose 1,6-bisphosphate)

pyruvate kinase (PEP → pyruvate)

2.4

without enough O_2, NADH cannot be reoxidised in the mitochondria

turning pyruvate into lactate regenerates NAD^+, so glycolysis can keep making ATP

3.1

(a) ATP and citrate slow it: the cell has energy; AMP speeds it: energy is low; fructose 2,6-bisphosphate speeds it: the liver is told glucose is plentiful

(b) it is the first step used only by glycolysis, the committed step, so controlling it does not block the other uses of glucose 6-phosphate

(c) after a meal, more F2,6BP: glycolysis speeds up and glucose is used and stored; in a fast, less: glycolysis slows and gluconeogenesis can run

3.2

(a) $32/2 = \mathbf{16}$ times

(b) muscle gains 2 ATP, the liver spends 6: net cost **4** ATP per glucose

(c) it lets muscle make ATP fast without oxygen, and recycles the lactate instead of letting the blood become acidic

3.3

(a) red cells have no mitochondria, so glycolysis is their only ATP source

(b) less ATP is made; the Na^+/K^+ pump fails, so the cells cannot keep their shape and water balance; stiff, damaged cells are removed by the spleen

(c) more 2,3-BPG shifts the oxygen curve to the right, so each red cell gives more O_2 to the tissues

(d) regular blood counts, and transfusion when Hb is very low; folic acid for new red cells, and checks for gallstones and iron overload

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