Solutions

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

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

2.1

NADH: $4 + 4 + 2 = 10$ H^+, $10/4 = 2.5$

$FADH_2$ enters at II: $4 + 2 = 6$ H^+, $6/4 = 1.5$

2.2

2 CO_2, 3 NADH, 1 $FADH_2$, 1 GTP

$3 \times 2.5 + 1.5 + 1$

$=$ **10** ATP

2.3

glycolysis: $2 + 2 \times 2.5 = 7$

pyruvate dehydrogenase: $2 \times 2.5 = 5$; TCA: $2 \times 10 = 20$

total **32** ATP

2.4

O_2 takes the electrons at the end of the chain

without it the carriers stay reduced, electrons cannot move on, and no H^+ are pumped

3.1

(a) electrons cannot pass to O_2, so complexes upstream stay full of electrons; no electron flow means no H^+ pumping anywhere

(b) ATP per glucose falls from 32 to 2; NADH is reoxidised by making lactate, so lactate rises and the blood becomes acidic

(c) the tissues cannot use O_2, so it stays in the blood

(d) give an antidote that binds cyanide (such as hydroxocobalamin), with 100% oxygen and support

3.2

(a) H^+ leak back without making ATP, so less ATP is made per fuel; the body burns more fat and sugar to keep its ATP up

(b) the energy of the H^+ gradient is released as heat instead of being stored in ATP

(c) to make heat, keeping the baby warm without shivering

3.3

(a) every NADH gives nothing; left: 2 ATP from glycolysis, 2 GTP, and $2 \times 1.5 = 3$ from $FADH_2$; total **7** ATP

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(b) NADH cannot be reoxidised by complex I, so pyruvate is turned to lactate to regenerate NAD^+

(c) they use the most ATP and depend most on mitochondria

(d) mitochondrial DNA is passed on through the mother; offer genetic testing of the mitochondrial and nuclear genes, and testing of the mother and her children