Mark each point independently. Accept alternative correct responses. Underlined words are required. [1] per bullet point unless stated. ★ = Higher Tier only.

Question 1 [0 marks]

Context: The student performed 3 minutes of stepping exercise, then rested and recorded recovery. Heart rate ...

Q: A student measures their heart rate before, during and after exercise. The table shows the results.

[0 marks]

Question 2 [3 marks]

Q: Describe the effect of exercise on heart rate, using data from the table to support your answer.

• Heart rate increased from 68 bpm at rest to 142 bpm at the end of exercise [1]

• After exercise ended, heart rate decreased during recovery [1]

• Heart rate returned to resting rate (68 bpm) after 10 minutes [1]

[3 marks]

Question 3 [3 marks]

Q: Explain why heart rate increases during exercise.

• During exercise muscles respire more rapidly and need more oxygen and glucose [1]

• Heart rate increases to pump more oxygenated blood to the muscles per minute [1]

• This also removes carbon dioxide and lactic acid from the muscles more quickly [1]

[3 marks]

Question 4 [3 marks]

Q: The student's breathing rate remained elevated for several minutes after exercise stopped. Explain why.

• During intense exercise, anaerobic respiration occurred in the muscles, producing lactic acid [1]

• After exercise, extra oxygen is needed to break down (oxidise) the lactic acid in the liver [1]

• This extra oxygen requirement is the oxygen debt — elevated breathing rate continues until it is repaid [1]

[3 marks]

Question 5 [1 mark]

Q: The student repeats the experiment the following day but their recovery time is much shorter. Suggest ONE reason why.

• The student may be fitter / better adapted to exercise / their cardiovascular system is more efficient at removing lactic acid [1]

• Accept: the student was warmed up from the previous day / less intense exercise

Note: Accept any valid physiological explanation.

[1 mark]

Question 6 [2 marks]

Q: Suggest TWO improvements the student could make to this investigation to make the results more reliable.

• Repeat the investigation multiple times and calculate a mean [1]

• Use the same intensity of exercise (e.g. standardised stepping rate / step height) each time [1]

• Accept: control time of day / food intake / caffeine intake before investigation [1] — any two

[2 marks]

Question 7 ★ Higher Tier [3 marks]

Q: Explain why a trained athlete would be expected to have a lower resting heart rate and faster recovery time than an untr...

• A trained athlete has a larger and stronger heart muscle (cardiac hypertrophy) [1]

• Each heartbeat pumps more blood (greater stroke volume) so fewer beats are needed per minute — lower resting rate [1]

• Faster recovery because their cardiovascular system delivers O■ and removes lactic acid more efficiently [1]

[3 marks]

END OF QUESTIONS — Total: 15 marks