Exercise and respiration 1

Name: _____

Class: _____

Date: _____

Time: **60 minutes**

Marks: **57 marks**

Comments:

1. Being overweight can affect the health and life expectancy of a person.

(a) What is **one** lifestyle change a person could make to help them lose body mass?

Tick (✓) **one** box.

Drink more alcohol ☐

Eat less fatty food ☐

Stop smoking ☐

(1)

(b) Exercise has many health benefits.

Give **two** health benefits of regular exercise.

Do **not** refer to losing body mass in your answer.

1. _____

_____

2. _____

_____

(2)

During exercise, breathing rate increases to provide more oxygen for aerobic respiration.

(c) What is the equation for aerobic respiration?

Tick (✓) **one** box.

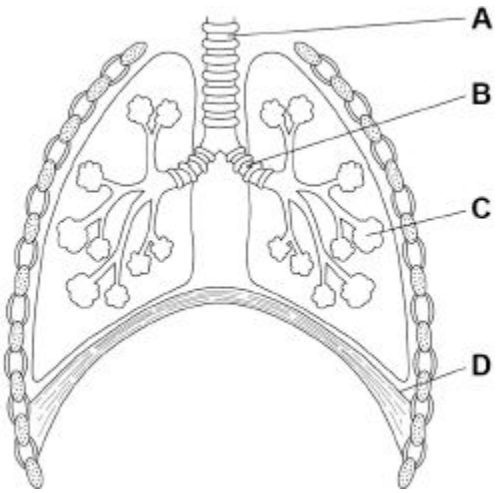
carbon dioxide + water → glucose + oxygen ☐

glucose + oxygen → carbon dioxide + water ☐

oxygen + water → glucose + carbon dioxide ☐

(1)

(d) The diagram below shows the human breathing system.



Where does gas exchange take place?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

A scientist investigated the effect of exercise on the breathing rate of four people.

This is the method used.

1. Measure the resting breathing rate.
2. Exercise for 10 minutes.
3. Measure the breathing rate as soon as exercise stops.
4. Record the time taken for the breathing rate to return to the resting rate.

The table below shows the results.

Person	Resting breathing rate in breaths per minute	Breathing rate after exercise in breaths per minute	Increase in breathing rate in breaths per minute	Time for breathing rate to return to resting rate in minutes
A	12	45	33	5.5
B	10	28	18	4.0
C	11	35	24	6.5
D	13	52	39	10.0

(e) The scientist concluded that person **B** was the fittest.

Give **two** reasons that support the scientist's conclusion.

Use the table above.

1. _____

_____

2. _____

_____

(2)

(f) Suggest **two** reasons why the scientist's conclusion may **not** be valid.

1. _____

_____

2. _____

_____

(2)

(g) Give **two** changes that happen in the body during aerobic exercise.

Do **not** refer to increased breathing rate in your answer.

1. _____

_____

2. _____

_____

(2)

(h) Muscles respire anaerobically during vigorous exercise.

Complete the sentences.

Choose answers from the box.

amino acids	**carbon dioxide**	**glucose**
lactic acid	**oxygen**	

Muscles respire anaerobically if they do not have enough _____.

Anaerobic respiration of glucose produces _____.

(2)

(Total 13 marks)

2. Being overweight can affect the health and life expectancy of a person.

(a) Give **one** disease related to being overweight.

_____

(1)

(b) Body mass index (BMI) helps to show if a person has a healthy body mass for their height.

BMI is calculated using the equation:

$$\text{BMI} = \frac{\text{body mass in kg}}{(\text{height in m})^2}$$

A woman has a BMI of 27 and a body mass of 68.1 kg

Calculate the woman's height in metres.

_____

_____

_____

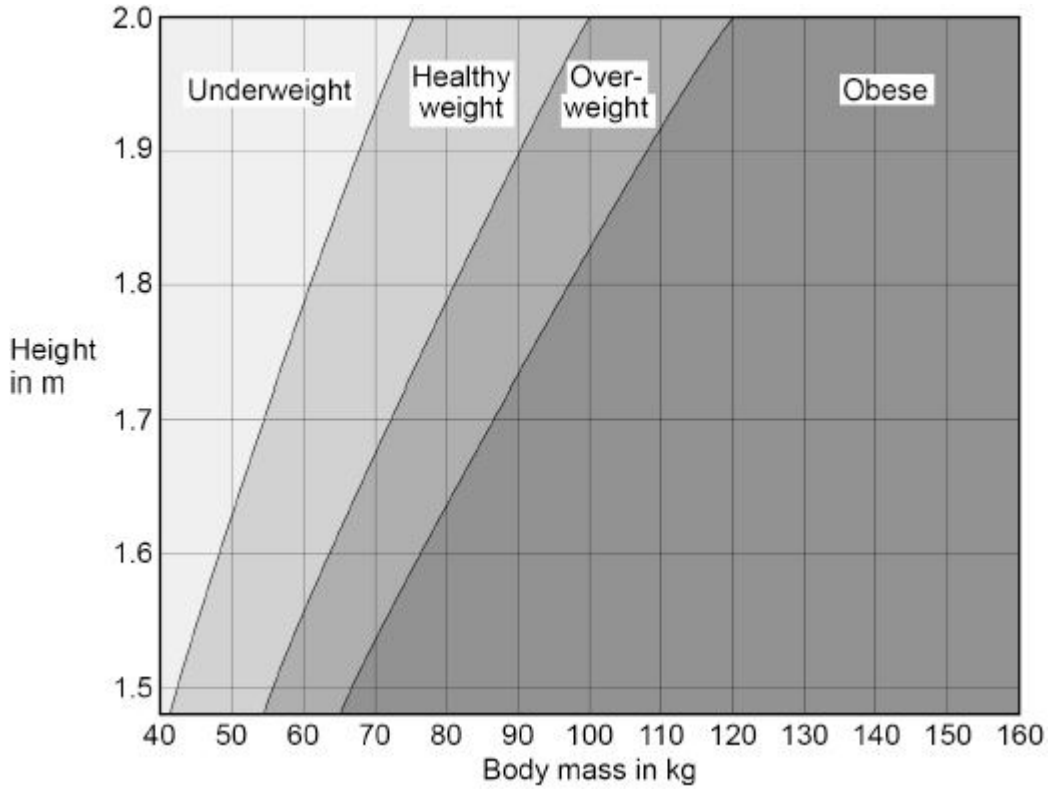
_____

_____

Height = _____ m

(3)

(c) The graph below shows a height-body mass chart for adults.



Which weight category describes the woman in part (b)?

Tick (✓) **one** box.

Underweight ☐

Healthy weight ☐

Overweight ☐

Obese ☐

(1)

(d) People are encouraged to control their body mass with diet and exercise.

Describe how the balance between the mass of food eaten and the amount of exercise a person does controls body mass.

(3)

(e) During long periods of vigorous exercise the body respires anaerobically.

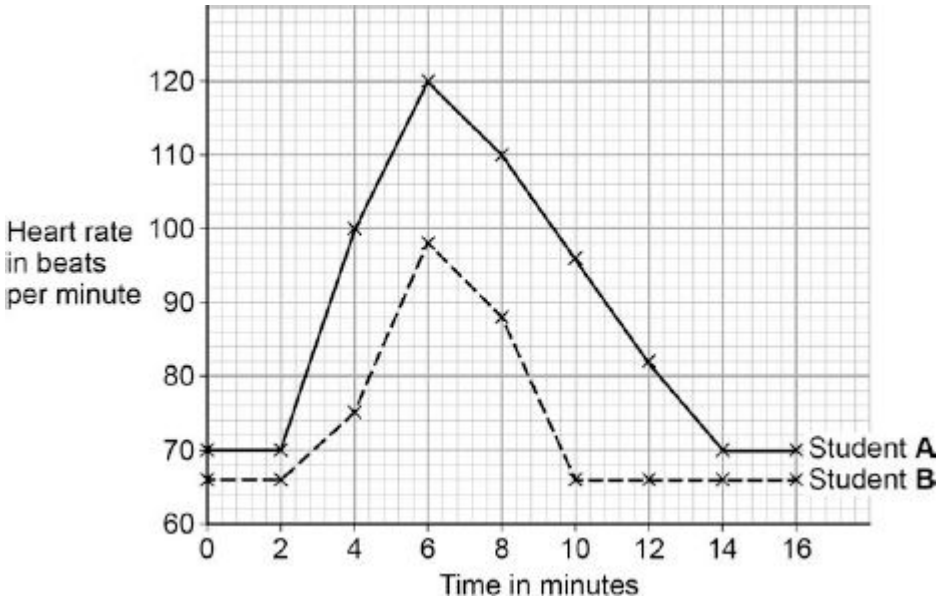
Explain the changes that happen in the body during **and** after vigorous exercise.

(6)

(Total 14 marks)

3. Some students investigated how exercise affects heart rate.

The figure below shows their results.



(a) What was Student **B**'s resting heart rate?

Resting heart rate = _____ beats per minute

(1)

(b) The students started running at 2 minutes.

What evidence for this is in the figure above?

_____

_____

(1)

(c) For how many minutes did the students run?

Tick **one** box.

2 ☐

4 ☐

6 ☐

14 ☐

(1)

(d) Student **B** is fitter than Student **A**.

Use the figure above to give **two** pieces of evidence that support this statement.

1. _____

_____

2. _____

_____

(2)

(e) There are other changes in the body during exercise.

Explain why these changes occur.

_____

_____

_____

_____

_____

_____

_____

_____

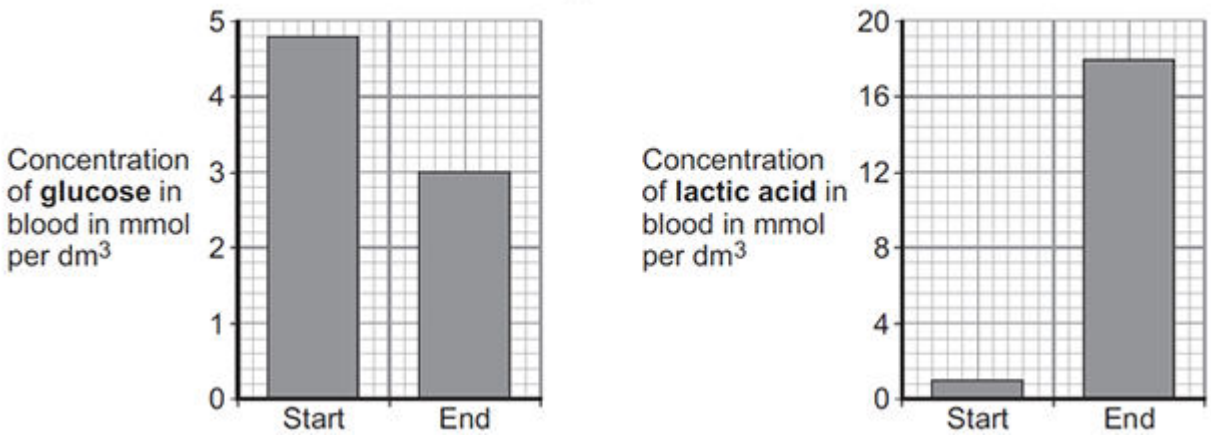
(4)

(Total 9 marks)

4. An athlete ran as fast as he could until he was exhausted.

(a) **Figure 1** shows the concentrations of glucose and of lactic acid in the athlete's blood at the start and at the end of the run.

Figure 1



(i) Lactic acid is made during anaerobic respiration.

What does anaerobic mean?

_____

_____

(1)

(ii) Give evidence from **Figure 1** that the athlete respired anaerobically during the run.

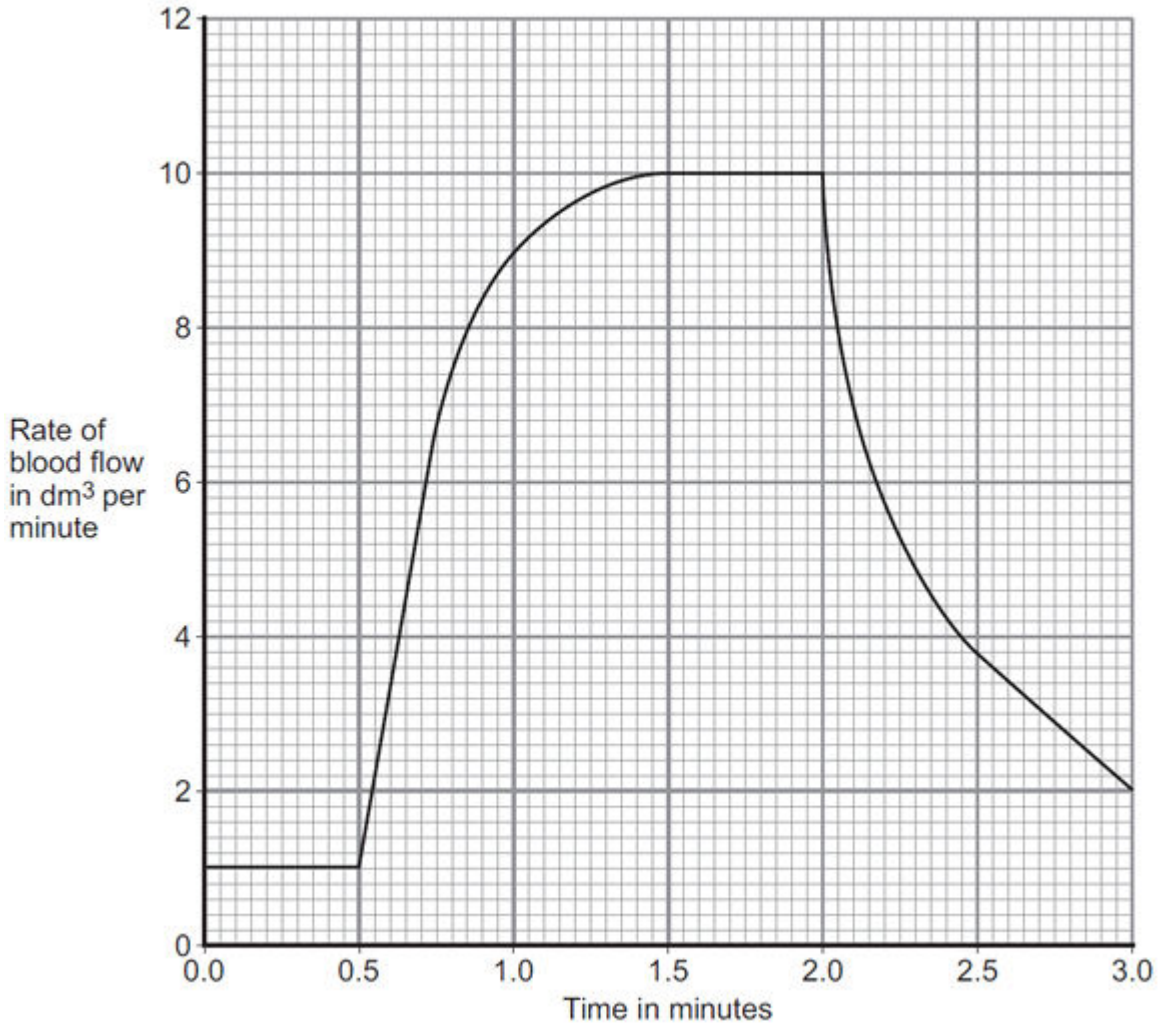
_____

_____

(1)

(b) **Figure 2** shows the effect of running on the rate of blood flow through the athlete's muscles.

Figure 2



(i) For how many minutes did the athlete run?

Time = _____ minutes

(1)

(ii) Describe what happens to the rate of blood flow through the athlete's muscles during the run.

Use data from **Figure 2** in your answer.

_____

_____

_____

_____

(2)

(iii) Explain how the change in blood flow to the athlete's muscles helps him to run.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

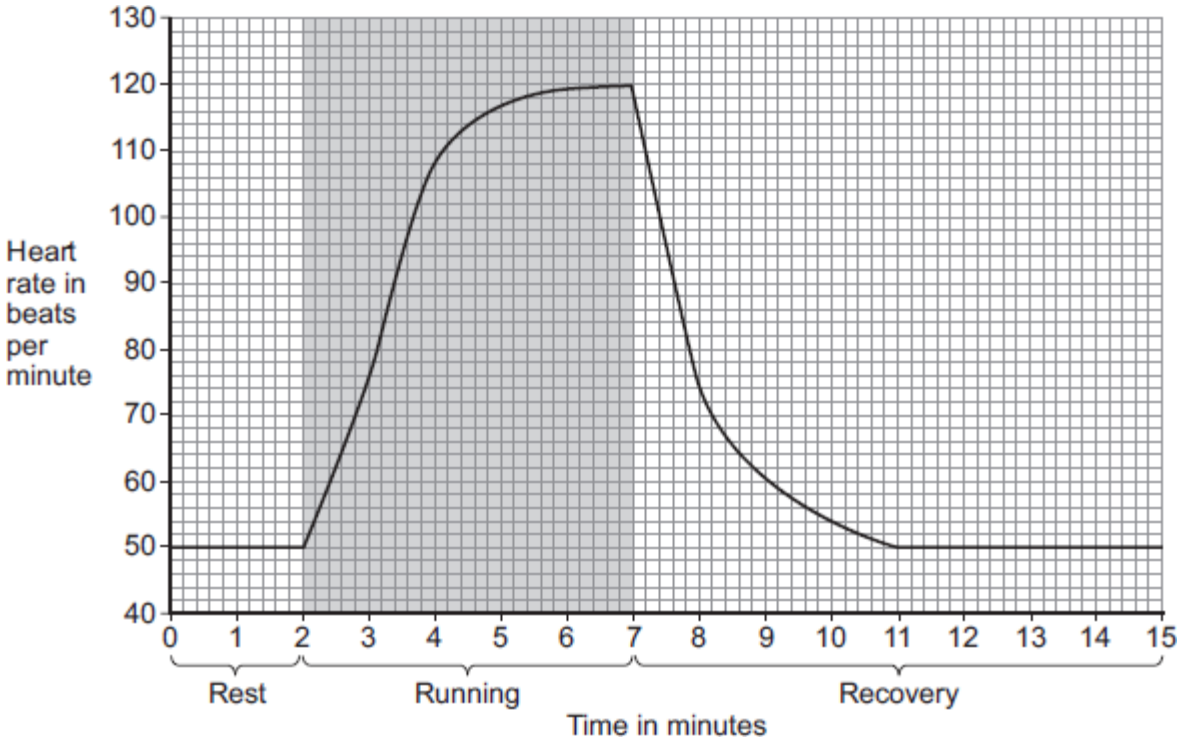
(4)

(Total 9 marks)

5. A student ran on a treadmill for 5 minutes.

The speed of the treadmill was set at 12 km per hour.

The graph below shows the effect of the run on the student's heart rate.



(a) (i) What was the student's heart rate at rest?

_____ beats per minute

(1)

(ii) After the end of the run, how long did it take for the student's heart rate to return to the resting heart rate?

_____ minutes

(1)

(b) During the run, the student's muscles needed larger amounts of some substances than they needed at rest.

(i) Which **two** of the following substances were needed in larger amounts during the run?

Tick (✓) **two** boxes.

carbon dioxide ☐

glucose ☐

lactic acid ☐

oxygen ☐

protein ☐

(2)

(ii) Why are the two substances you chose in part **(b)(i)** needed in larger amounts during the run?

Tick (✓) **one** box.

To help make more muscle fibres ☐

To release more energy ☐

To help the muscles to cool down ☐

(1)

(c) After exercise, a fit person recovers faster than an unfit person.

Let the student's heart rate at the end of exercise = **a**.

Let the student's heart rate after 2 minutes of recovery = **b**.

The table below shows how the difference between **a** and **b**, (**a** − **b**), is related to a person's level of fitness.

(a − b)	**Level of fitness**
< 22	Unfit
22 to 52	Normal fitness
53 to 58	Fit
59 to 65	Very fit
> 65	Top athlete

What is the student's level of fitness?

Use information from the graph and the table.

a = _____ beats per minute

b = _____ beats per minute

(**a − b**) = _____ beats per minute

Level of fitness = _____

(3)

(d) The student repeated the run with the treadmill set at 16 km per hour.

The student's heart rate took 3 minutes longer to return to the normal resting rate than when running at 12 km per hour.

Give reasons why it took longer to recover after running faster.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 12 marks)

Mark schemes

1. (a) eat less fatty food

1

(b) any **two** from:

- strengthens muscles

  ignore references to losing weight / mass

  ignore references to immediate effects of exercise on body eg increases heart rate

  ignore makes you healthier

  allow makes you stronger
  allow improves stamina

- strengthens heart (muscle)

  allow keeps your heart healthy

- reduces risk of (coronary) heart disease / CHD / cardiovascular disease

  allow reduces (blood) cholesterol

  allow improves circulation

- reduces blood pressure

- reduces risk of (Type 2) diabetes

- improves mental health / mood

- improves mobility

  allow strengthens bones

  allow boosts immunity

  allow reduces risk of (some) cancers

  allow makes you fitter

  ignore improves a person's appearance

2

(c) glucose + oxygen → carbon dioxide + water

1

(d) C

1

(e) any **two** from:

- lowest / lower resting breathing rate

  statements must be comparative

- lowest / lower breathing rate after exercise

- lowest / lower increase in breathing rate

- least amount of time for breathing rate to return to resting rate

  allow less time for breathing rate to return to resting rate

  allow shortest recovery time

2

(f) any **two** from:

- only based on one measurement

- person B may have done less intense exercise

  allow person B may have done a different type of exercise

- other factors (besides breathing rate) indicate fitness

  eg stamina / strength / speed

  allow age / sex / body mass may not have been controlled

  ignore references to medical conditions

2

(g) deeper breathing

allow heavier breathing
ignore breathing rate increases

1

increased heart rate

allow blood flows faster
ignore more blood flows around body
allow increased (body) temperature
allow (increased) sweating
allow increased blood flow to skin
*do **not** accept lactic acid is produced 1*

1

(h) oxygen

word takes precedence
allow O_2
ignore O / O^2

1

lactic acid

1

[13]

2. (a) any **one** from:

- (Type 2) diabetes

  ignore obesity

  *do **not** accept Type 1 diabetes allow cardiovascular disease ignore heart attack / failure*
- (coronary / ischaemic) heart disease / CHD
- high blood pressure
- cancer
- depression

  allow (osteo)arthritis

1

(b) $27 = \frac{68.1}{\text{height}^2}$

1

$\text{height}^2 = 68.1 \div 27$

or

$\text{height}^2 = 2.522(\text{r}) / 2.52 / 2.5$

allow height = $\sqrt{\frac{68.1}{27}}$

or

allow height = $\sqrt{2.522(\text{r})}$

1

height = 1.59 (m) allow height =

allow a correctly rounded value

if 2.5 is given in step 2 allow an answer of 1.58 (m)

1

(c) overweight

*answer must be consistent with height calculated in **(b)***

1

(d) any **three** from:

*max **2** marks if refer to energy being made / used / produced / created*
allow reference to calories / joules for energy

- increased energy intake if more food eaten

  allow increased energy intake if more fat / carbohydrate eaten
  allow converse
  allow energy taken in when you eat

- if exercise more, more energy is transferred / released

  *allow if exercise more, respiration / metabolism increases **or** is faster*
  allow converse
  allow energy is transferred during exercise
  *do **not** accept energy is burnt during exercise*

- if more energy is taken in than is transferred body mass increases
  or
  if less energy is taken in than is transferred body mass decreases

  allow if less energy is transferred than is taken in body mass increases
  or
  if more energy is transferred than is taken in body mass decreases

- if energy intake = energy transferred body mass stays the same

  *if no marks are awarded allow **1** mark for food eaten can increase body mass **and** exercise can decrease body mass*
  or
  *allow **1** mark for if a lot of food is eaten **and** little exercise is done body mass increases*
  allow converse

3

(e) **Level 3:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.

5–6

Level 2: Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.

3–4

Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

1–2

No relevant content

0

Indicative content
During exercise:

- increased breathing rate
- increased breath volume
- (to) take in more oxygen for (aerobic) respiration
- (and) exhale more carbon dioxide
- increased heart rate
- (so) increased blood flow (to muscles)
- (to) transport oxygen / glucose to respiring cells faster
- (and) increase rate of carbon dioxide removal
- glycogen converted to glucose

- insufficient oxygen supplied (during prolonged vigorous exercise)
- (so) lactic acid is formed (during anaerobic respiration)
- (and) an oxygen debt is created
- (lactic acid causes) muscles become fatigued / tired **or** (causes) muscles to stop contracting efficiently
- allow reference to sweating **or** increased body temperature **or** vasodilation (during or after exercise)

After exercise:

- heart rate remains high **or** heart rate slowly decreases
- continue to breathe rapidly **or** breathing rate slowly decreases
- (to) pay back oxygen debt
- oxygen debt is the amount of oxygen needed to break down lactic acid
- (and to) provide more oxygen to react with the lactic acid and remove it from cells
- (some) lactic acid transported to liver
- (lactic acid) is converted back into glucose

For Level 3 need reference to:

- changes during **and** after exercise
- lactic acid **and** its removal.

[14]

3. (a) 66 (beats per minute)

1

(b) heart rate increased

1

(c) 4

1

(d) any **two** from:

- resting heart rate was lower
- heart rate did not increase as much
- heart rate did not increase as fast
- heart rate returned to normal sooner

2

(e) **Level 2 (3–4 marks):**
A detailed and coherent explanation is given, which logically links changes in the body during exercise to reasons for these changes.

Level 1 (1–2 marks):
Discrete relevant points made. Links may not be made.

0 marks:
No relevant content

Indicative content

Changes:
- breathing rate increases
- deeper breathing
- (body) temperature increases
- sweating occurs
- muscle fatigue
- vasodilation

Explanations linked to correct change:
- to provide more oxygen
- to remove carbon dioxide faster
- (as) more energy required
- (so) increased respiration
- (so) more energy transferred
- for movement or contraction of muscles
- some energy warms the body
- (sweating) cools the body down
- (by) evaporation of sweat

4

[9]

4. (a) (i) without <u>oxygen</u>

allow not enough oxygen

ignore air

ignore production of CO_2

ignore energy

1

(ii) more / high / increased lactic acid (at end)

allow approximate figures (to show increase)

ignore reference to glucose

1

(b) (i) 1.5

allow only 1.5 / 1½ / one and a half

1

(ii) increases at first **and** levels off

ignore subsequent decrease

1

suitable use of numbers eg
rises to 10 / by 9 (dm^3 per min)
or
increases up to 1.5 (min) / levels off after 1.5 (min) (of x axis timescale)

allow answer in range 1.4 to 1.5

or
after the first minute (of the run)

1

(iii) supplies (more) oxygen

1

supplies (more) glucose

1

need 'more/faster' once only for full marks

*allow removes (more) CO_2 / lactic acid / heat as an alternative for either marking point one **or** two, **once** only*

for (more) respiration

1

releases (more) energy (for muscle contraction)

*do **not** allow energy production or for respiration*

1

[9]

5. (a) (i) 50

1

(ii) 4

accept 3.9 − 4.0

1

(b) (i) glucose

1

oxygen

1

(ii) to release more energy

1

(c) correct readings from graph:

a = 120

b = 60

allow 60 - 61

1

calculation correct for candidate's figures:

e.g. a − b = 60

1

level of fitness correct for candidate's figures:

e.g. very fit

1

(d) any **four** from:

- higher heart rate (at 16 km / h) (so takes longer to slow to normal)
- more energy needed
- not enough O_2 supplied / more O_2 needed / reference to O_2-debt
- (more) anaerobic respiration
- (more) lactic acid made / to be broken down / to remove / to oxidise
- higher blood flow needed to deliver (the required amount of) oxygen.

'more' must be given at least once for full marks

do not allow more energy produced

allow higher blood flow to remove lactic acid / remove (additional) CO_2

4

[12]