# Bioenergetics part 1 AQA Triple Biology

Name: _____

Class: _____

Date: _____

Time: **73 minutes**

Marks: **69 marks**

Comments:

**1.** Plants and animals have adaptations that help them survive.

A stingray is an animal that lives in the sea.

Seagrass is a plant that grows on the sea floor.

The figure below shows a stingray swimming above seagrass.

(a) Draw **one** line from each adaptation of **seagrass** to how the adaptation helps the seagrass survive.

| **Adaptation of seagrass** | **How the adaptation helps the seagrass to survive** |
|---|---|
| Flexible leaves | Keep seagrass in one place on the sea floor |
| Long, deep roots | Poison animals that try to eat the seagrass |
| | Stop seagrass breaking in strong water currents |

**(2)**

In the stingray, gas exchange takes place in the gills.

(b) Name the organs where gas exchange takes place in humans.

_____

**(1)**

(c) Gills are adapted to maximise gas exchange.

Which **two** features of gills help to maximise gas exchange?

Tick (✓) **two** boxes.

Gills are not open at night. ☐

Gills have a large surface area. ☐

Gills have a low temperature. ☐

Gills have thin walls. ☐

Gills have very few capillaries. ☐

**(2)**

(d) Stingrays rest on the sea floor.

The table below shows information about the metabolic rate of a stingray.

| **Activity of stingray** | **Metabolic rate in arbitrary units** |
|---|---|
| Resting | 484 |
| Swimming | 944 |

Calculate how many times greater the metabolic rate of the stingray is when swimming compared with when resting.

Give your answer to the nearest whole number.

**(3)**

(e) When the metabolic rate of the stingray increases, the rate of aerobic respiration in the stingray increases.

Complete the word equation for aerobic respiration.

Choose answers from the box.

| | | | | |
|---|---|---|---|---|
| **carbon dioxide** | **magnesium** | **nitrogen** | **oxygen** | **water** |

glucose + _____ → _____ + _____

**(3)**

(f) Explain why the rate of respiration in the stingray increases when the stingray starts to swim.

**(3)**

(g) Some plants can use anaerobic respiration.

Which **two** substances are produced during anaerobic respiration in plants?

Tick (✓) **two** boxes.

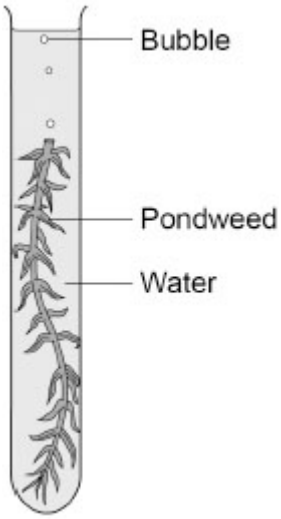
| | |
|---|---|
| Carbon dioxide | ☐ |
| Ethanol | ☐ |
| Hydrochloric acid | ☐ |
| Oil | ☐ |
| Protein | ☐ |

**(2)**

**(Total 16 marks)**

**2.** A student investigated the effect of temperature on the rate of photosynthesis in pondweed.

The figure below shows how the student set up the apparatus.



This is the method used.

1. Prepare five tubes of pondweed as shown in the figure above.
2. Place one tube into each of five water baths set at different temperatures.
3. Wait two minutes.
4. Measure the time taken for each piece of pondweed to release 10 bubbles.

(a) What is the independent variable in the investigation?

_____

**(1)**

The table below shows the results.

| **Temperature in °C** | **Time taken for pondweed to release 10 bubbles in seconds** |
|---|---|
| 10 | 84 |
| 20 | 43 |
| 30 | 27 |
| 40 | 25 |
| 50 | 33 |

(b) Calculate the rate of photosynthesis at **20 °C**.

Give your answer to 3 significant figures.

Give the unit.

Rate (3 significant figures) = _____

Unit = _____

**(4)**

(c) Explain the difference in the rate of photosynthesis at 40 °C compared with the rate of photosynthesis at 10 °C.

**(3)**

(d) Give **two** other factors that affect the rate of photosynthesis.

Do **not** refer to temperature in your answer.

1 _____

2 _____

**(2)**

(e) Describe **one** way the method could be changed to obtain more accurate results for the rate of photosynthesis.

_____

_____

_____

**(1)**

A gardener noticed that some plants were not growing as well as usual.

(f) Describe **two** ways the gardener could identify a plant disease.

1 _____

_____

2 _____

_____

**(2)**

(g) One of the plants had purple spots on its leaves and the leaves fell off.

What disease is the plant most likely to have?

_____

**(1)**

(h) A different plant had yellow leaves, but no spots.

Explain why plants may develop yellow leaves.

_____

_____

_____

_____

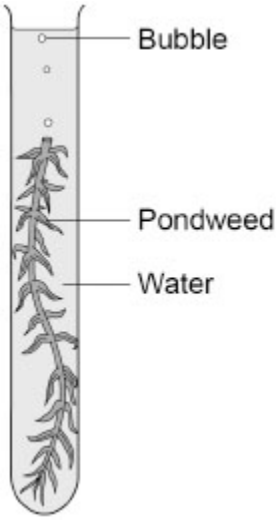
_____

**(2)**

**(Total 16 marks)**

**3.** A student investigated the effect of temperature on the rate of photosynthesis in pondweed.

The figure below shows how the student set up the apparatus.




This is the method used.

1. Prepare six tubes of pondweed as shown in the figure above.
2. Place one tube into each of six water baths set at different temperatures.
3. Wait two minutes.
4. Measure the time taken for each piece of pondweed to release 10 bubbles.

(a) What is the independent variable in the investigation?

Tick (✓) **one** box.

Length of pondweed ☐

Temperature of pondweed ☐

Volume of water ☐

**(1)**

The table below shows the results.

| Temperature in °C | Time taken for pondweed to release 10 bubbles in seconds |
|---|---|
| 10 | 84 |
| 20 | 43 |
| 30 | 27 |
| 40 | 25 |
| 50 | 33 |
| 60 | 77 |

(b) Complete the sentences.

Choose answers from the box.

| cellulose | chlorophyll | nitrogen | oxygen | water |
|---|---|---|---|---|

Photosynthesis by the pondweed releases bubbles of

_____.

The green substance needed for photosynthesis is called

_____.

**(2)**

(c) Describe the effect of increasing temperature on the time taken for the pondweed to release 10 bubbles.

_____

_____

_____

_____

**(2)**

(d) Calculate the rate of photosynthesis at **50 °C**.

Use the equation:

$$\text{rate of photosynthesis in bubbles per second} = \frac{10}{\text{time taken to release 10 bubbles in seconds}}$$

Use the table above.

Give your answer to 1 decimal place.

Rate of photosynthesis (1 decimal place) = _____ bubbles per second

**(3)**

(e) Which temperature had the fastest rate of photosynthesis?

Tick (✓) **one** box.

20 °C ☐

30 °C ☐

40 °C ☐

50 °C ☐

**(1)**

The table is repeated below.

| **Temperature in °C** | **Time taken for pondweed to release 10 bubbles in seconds** |
|---|---|
| 10 | 84 |
| 20 | 43 |
| 30 | 27 |
| 40 | 25 |
| 50 | 33 |
| 60 | 77 |

(f) The student repeated the investigation at 80 °C.

What would be the time taken for the pondweed to release 10 bubbles at 80 °C?

Tick (✓) **one** box.

Less than 77 seconds ☐

Exactly 77 seconds ☐

More than 77 seconds ☐

**(1)**

(g) Which **two** factors could affect the rate of photosynthesis in this investigation?

Tick (✓) **two** boxes.

- Concentration of carbon dioxide ☐
- Light intensity ☐
- Size of boiling tube ☐
- Size of bubbles ☐
- Type of stopwatch ☐

**(2)**

**(Total 12 marks)**

**4.** This question is about the human circulatory system.

(a) Blood plasma transports blood cells around the body.

Give **one** other function of blood plasma.

Do **not** refer to oxygen in your answer.

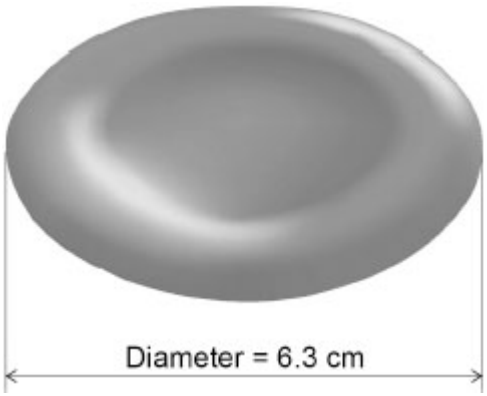
_____

_____

**(1)**

(b) **Figure 1** shows a red blood cell.

**Figure 1**



The image of the red blood cell in **Figure 1** is magnified 7200 times.

Calculate the real diameter of the red blood cell.

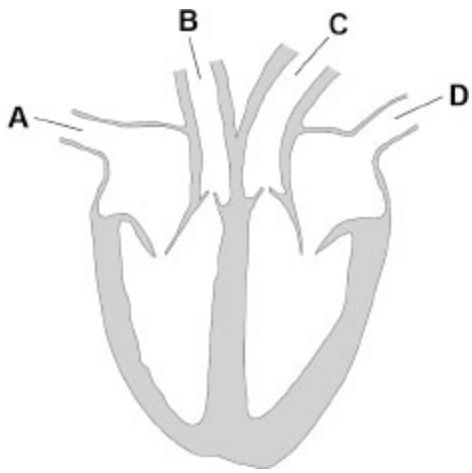
Give your answer in micrometres (µm).

Real diameter = _____ µm

**(5)**

**Figure 2** shows the heart.

**Figure 2**



(c) Blood pressure is a measure of the force of the blood against the walls of the blood vessels.

The table below shows information about the different types of blood vessel shown in **Figure 2**.

| **Pressure of blood travelling through blood vessel in arbitrary units** | **Blood vessel in Figure 2** |
|---|---|
| 4 | **D** |
| 5 | |
| 18 | |
| 120 | |

Complete the table above using the correct letters from **Figure 2**.

One row has been completed for you.

**(2)**

(d) Name blood vessel **D** in **Figure 2**.

_____

**(1)**

(e) Describe the structure of the walls of an artery.

_____

_____

**(1)**

An athlete ran on a running machine.

The athlete:

- reached their maximum intensity of exercise and then stopped exercising
- had their use of oxygen recorded
- had the lactic acid concentration in their blood recorded.

(f) During the exercise the athlete respired aerobically **and** anaerobically.

Explain why anaerobic respiration is less efficient than aerobic respiration.

_____

_____

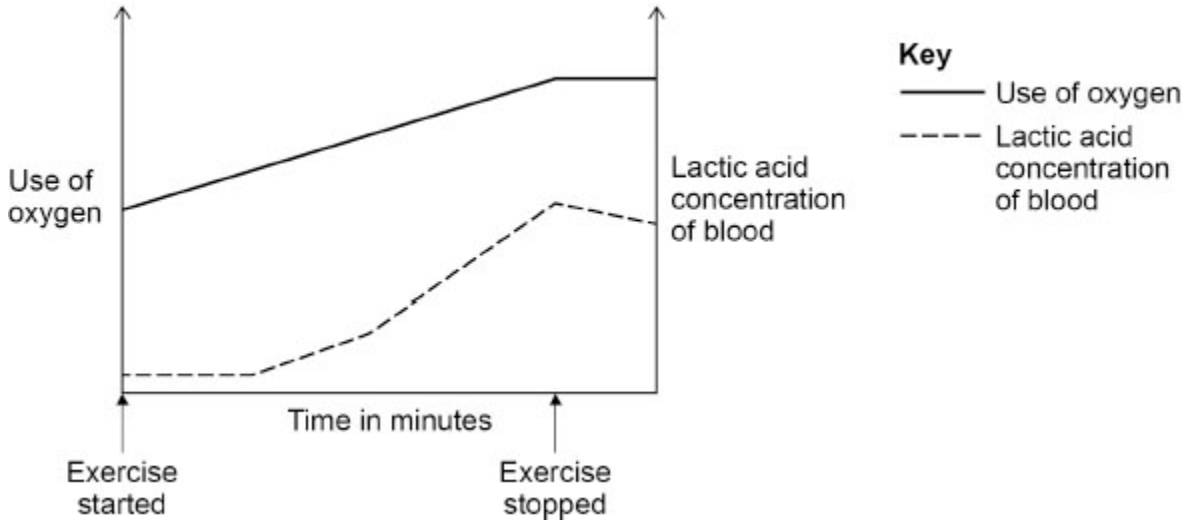
_____

_____

**(2)**

**Figure 3** shows the athlete's use of oxygen and the lactic acid concentration of blood during exercise and after exercise.

**Figure 3**




(g) Explain why the use of oxygen remained high **after** the athlete stopped exercising.

_____

_____

_____

_____

**(2)**

(h) Some athletes regularly exercise in conditions that increase the number of red blood cells.

Explain why having an increased number of red blood cells is an advantage to an athlete.

_____

_____

_____

_____

**(2)**

**(Total 16 marks)**

**5.** Diffusion is important for gas exchange.

(a) Define the term 'diffusion'.

_____

_____

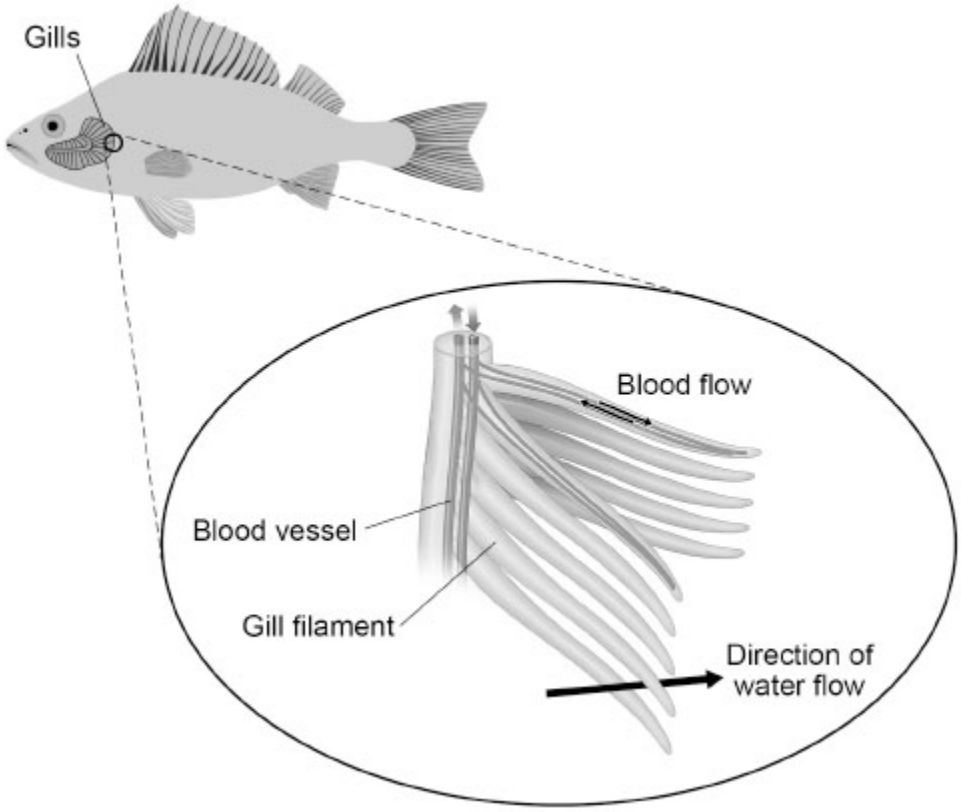
_____

**(1)**

(b) Fish exchange gases through gills.

Oxygen from the water enters the blood of a fish through the gills.

The figure below shows part of a gill.



Explain how gills are adapted to maximise the exchange of oxygen between the water and the blood.

**(4)**

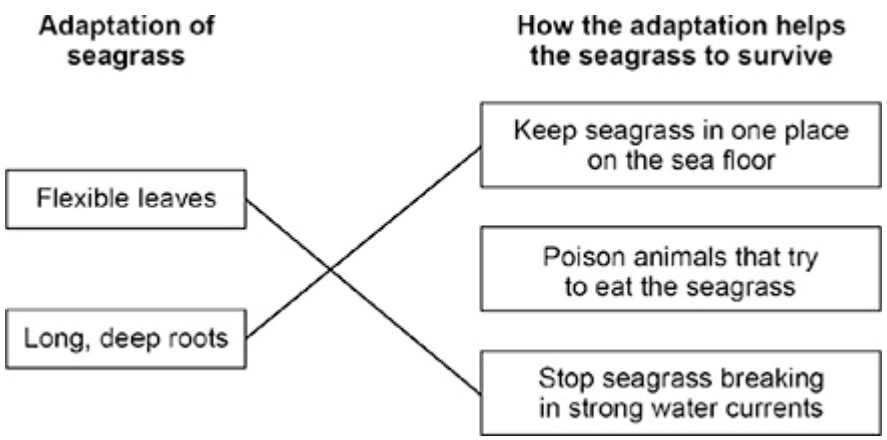
(c) Some fish rest on the sea floor.

Explain why the metabolic rate of a fish is higher when swimming compared with when resting.

**(4)**

**(Total 9 marks)**

**1.** (a)




**2**

do **not** accept more than one line from a box on the left

(b) lungs

*ignore alveoli*

**1**

(c) gills have a large surface area

**1**

gills have thin walls

**1**

(d)

$$\frac{944}{484}$$

**1**

1.9(50413…)

**1**

2

*allow correct rounding from incorrect division*

**1**

(e) *LHS*
oxygen

**1**

*RHS*
carbon dioxide

**1**

water

**1**

*in either order*

*allow formulae*

(f) (stingray is) moving

*ignore swimming*

1

(so) muscles (contract)

1

(which) needs energy (from respiration)

*do **not** accept energy produced / made / created*

*do **not** accept energy released for respiration*

**OR**

(when swimming) muscles (1)

(muscles) contract (1)

(which) needs energy (from respiration) (1)

*do **not** accept energy produced / made / created*

*do **not** accept energy released for respiration*

1

(g) carbon dioxide

1

ethanol

1

**[16]**

**2.** (a) temperature

1

(b) $\frac{10}{43}$ **or** $\frac{1}{43} \times 10$

*allow correct calculation in other units eg bubbles per minute / hour*

1

0.23255…

1

0.233

(unit) bubbles per second

*allow student's incorrectly calculated value to 3 significant figures*

*allow use of other values for time from the table*

1

*unit must be consistent with student's answer for MP3*

1

(c) rate / photosynthesis is faster / higher (at 40°C)

*allow converse for 10°C if clearly stated*

*allow as the temperature increases, the rate (of photosynthesis) increases*

**1**

reactants / particles / molecules / enzymes have greater (kinetic) energy

*allow reactants / particles / molecules / enzymes move faster*

**1**

(so) collide more frequently

*allow (so) more collisions in a given time allow more <u>successful</u> collisions*

**1**

(d) any **two** from:

- light intensity / level
- colour / wavelength of light

*if neither point awarded allow **1** mark for light unqualified*

- carbon dioxide (concentration)
- (mass of) chlorophyll

*allow number of chloroplasts*

*ignore water / humidity*

*do **not** accept wind*

**2**

(e) collect gas / oxygen in a (gas) syringe

**or**

collect gas / oxygen in an inverted measuring cylinder

*allow bubbles for gas / oxygen do **not** accept incorrect gas*

*allow measure the <u>volume</u> of gas / oxygen in a (gas) syringe ignore use a gas syringe*

*allow measure the <u>volume</u> of gas / oxygen in an inverted measuring cylinder*

*ignore collect gas / oxygen in a measuring cylinder*

*ignore use an inverted*

*measuring cylinder*

*allow other correct methods*

**1**

(f) any **two** from:

- reference to a gardening manual / website / app
- take (infected plants) to a laboratory / scientist / expert
- use testing kits that contain monoclonal antibodies

*ignore use / search the internet unqualified*

**2**

(g) (rose) black spot

*allow other correct diseases such as rust*

*do **not** accept nitrate / magnesium deficiency*

*do **not** accept tobacco mosaic virus **or** TMV*

**1**

(h) a shortage of magnesium (ions)

*allow a shortage of nitrate / iron (ions)*

**1**

which causes chlorosis
**or**
(so) less chlorophyll
**or**
(magnesium is needed) to make chlorophyll

**OR**

lack of light (1)

causes chlorosis **or** causes chlorophyll to break down (1)

*ignore chlorosis unqualified*

*ignore fewer chloroplasts*

*allow (nitrate / iron is needed) to make chlorophyll*

**1**

**[16]**

**3.** (a) temperature of pondweed

**1**

(b) oxygen

**1**

chlorophyll

*in this order only*

**1**

(c) (time) decreases

*ignore use of data*

*allow rate / speed increases*

**1**

then (time) increases

*allow then rate / speed decreases*

**1**

(d)

$\frac{10}{33}$

1

0.3030…

1

0.3

*do **not** accept 0.30*

*allow correct rounding to 1 dp from a calculation using an incorrect value for time from the table.*

1

(e) 40 °C

1

(f) more than 77 seconds

1

(g) concentration of carbon dioxide

1

light intensity

1

**[12]**

**4.** (a) (to) transport / carry hormones / antibodies / proteins / ions / enzymes / urea / glucose / carbon dioxide

*allow (to) transport / carry other correctly named substances*

*allow (to) transport / carry platelets*

*ignore nutrients / waste / oxygen*

1

(b) *recall of equation*

$$\text{magnification} = \frac{\text{size of image}}{\text{size of real object}}$$

*allow*

$$\text{magnification} = \frac{\text{diameter of image}}{\text{diameter of real object}}$$

*ignore use of equation triangle*

**1**

*rearrangement of equation*

$$\text{size of real object} = \frac{\text{size of image}}{\text{magnification}}$$

*allow*

$$\text{diameter of real object} = \frac{\text{diameter of image}}{\text{magnification}}$$

**1**

*substitution*

$$\frac{6.3}{7200}$$

*allow substitution of incorrectly converted value*

**1**

0.000875 (cm)

*allow answer using incorrectly converted value*

**1**

*conversion*

8.75 (µm)

*allow 8.8 (µm)*

*allow conversion to µm at any stage*

*ignore further rounding*

**1**

(b)

| Pressure of blood travelling through vessel in arbitrary units | Blood vessel in Figure X |
|---|---|
| | |
| 5 | A |
| 18 | B |
| 120 | C |

allow **1** mark for 1 or 2 correct answers

ignore names of blood vessels

**2**

(d) pulmonary vein

**1**

(e) thick elastic / muscle (layer)

*ignore thick wall unqualified*

*do **not** accept reference to cell walls*

*ignore has no valves*

**1**

(f) less energy released / transferred (per molecule of glucose)

*allow more molecules of glucose need to be broken down to release / transfer equivalent energy*

*do **not** accept less energy produced / made / created*

*do **not** accept no energy released*

*do **not** accept less energy released for respiration*

**1**

(due to) incomplete breakdown / oxidation of glucose

*allow glucose **only** broken down to lactic acid*

**1**

(g) (the athlete has an) <u>oxygen debt</u>

*allow the lactic acid concentration is high*

**1**

(so more) oxygen is required to oxidise lactic acid

*allow (so more) oxygen is required to remove lactic acid*

*allow (so more) oxygen is required to break down lactic acid*

*ignore reference to oxygen being used to convert lactic acid back to glucose (in the liver)*

*ignore reference to liver as the site of lactic acid oxidation*

**1**

(h) (there is) more haemoglobin so more oxygen (carried **/** bound)

*allow more oxyhaemoglobin (is formed)*

**1**

(athlete can do) more aerobic respiration to transfer / release (more) energy
**or**
(athlete can do) more aerobic respiration so less muscle fatigue / cramp

*allow (athlete will do) less anaerobic respiration which transfers / releases less energy*

*allow (athlete will do) less anaerobic respiration which would (otherwise) result in muscle fatigue / cramp*

*do **not** accept (athlete can do) more anaerobic respiration*

*do **not** accept energy produced / made / created*

*do **not** accept energy released for respiration*

**1**

**[16]**

**5.** (a) movement / spreading of particles from (an area of) high(er) concentration to low(er) concentration

*allow movement / spreading of substances / chemicals / gases / liquids from (an area of) high(er) concentration to low(er) concentration*

*allow movement / spreading of substances / chemicals / gases / liquids down a concentration gradient*

*ignore reference to membrane*

*do **not** accept reference to against the concentration gradient*

**1**

(b) (gills / filaments) provide a large surface area for (maximum) diffusion / absorption

*allow blood vessels for capillaries*

*do **not** accept arteries / veins for capillaries*

**1**

good blood supply to maintain concentration gradient
**or**
has a capillary network to maintain concentration gradient

**1**

filaments / capillaries have thin walls for a short diffusion distance / time
**or**
filaments / capillaries have walls that are one cell thick for a short diffusion distance / time

*ignore membranes / filaments / capillaries are one cell thick*

*do **not** accept reference to cell walls*

**1**

water in close proximity to blood supply for a short diffusion distance / time

*allow blood supply is close to gill surface for a short diffusion distance / time*

*allow a counter-current flow to maintain a concentration gradient*

**1**

(c) (increased) movement

*allow converse if clearly describing resting fish*

*ignore swimming*

**1**

(which) needs (more) energy

**or**

(more) energy provided (by respiration)

*do **not** accept energy produced / made / created*

*do **not** accept energy for respiration*

**1**

(so) more respiration needs to take place

**1**

(for increased) muscle <u>contract</u>ion

**1**

**[9]**