Exampro GCSE Biology

B2.4 Respiration

Higher tier

Name:

Class:

Author:

Date:

Time: 84

Marks: 80

Comments:

Q1. In an investigation four groups of athletes were studied. The maximum rate of oxygen consumption for each athlete was measured and the mean for each group was calculated. The athletes then ran 10 mile races and the mean of the best times was calculated for each group. The results are shown in the table below.

GROUP OF ATHLETES	MAXIMUM RATE OF OXYGEN CONSUMPTION (cm^3 per kg per min)	BEST TIME IN 10 MILE RACE (minutes)
A	78.6	48.9
B	67.5	55.1
C	63.0	58.7
D	57.4	64.6

(i) What is the relationship between maximum rate of oxygen consumption and time for a 10 mile race?

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(1)

(ii) Suggest an explanation for this relationship.

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(3)
(Total 4 marks)

Q2. Marathon runners are recommended to have a high carbohydrate diet prior to a race. Three athletes tried out three dietary regimes prior to a marathon race.

These three dietry regimes were as follows.

Athlete A Up to 7 days before the race - Normal mixed diet

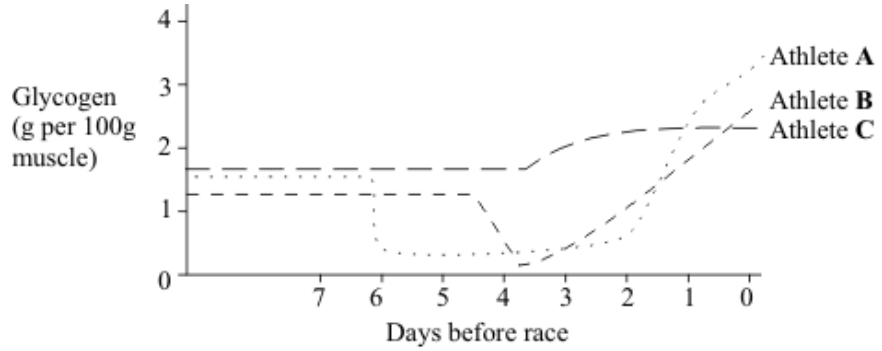
7 days before the race - Prolonged extreme physical activity

6-3 days before the race - Protein and fat diet; no carbohydrate

2 and 1 days before the race - Large carbohydrate intake

Athlete B	Up to 5 days before race	-	Normal mixed diet
	5 days before the race	-	Prolonged extreme physical activity
	4-1 days before the race	-	Large carbohydrate intake
Athlete C	Up to 4 days before the race	-	Normal mixed diet
	4-1 days before the race	-	Large carbohydrate intake

The graph below shows the effect of each of these dietary regimes on glycogen levels in the athletes' muscles



(a) (i) What is the immediate effect of extreme physical activity on the glycogen content of muscles?

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(1)

(ii) Describe how this effect occurs.

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(3)

(b) (i) Evaluate the three regimes as preparation for a marathon race.

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(3)

(ii) Suggest a possible explanation for the different effects of the three regimes.

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(2)

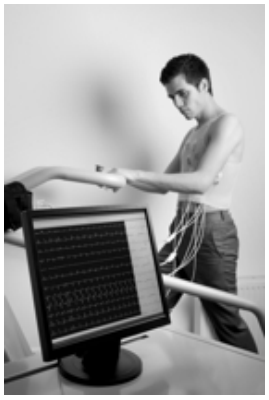
(Total 9 marks)

Q3. (a) During respiration, sugar is oxidised to release energy. Complete the equation for respiration.

Sugar + ... = ... + ... + energy

(3)

(b) The photograph below shows an athlete using an exercise machine. The machine can be adjusted to vary the rate at which the athlete is required to work.

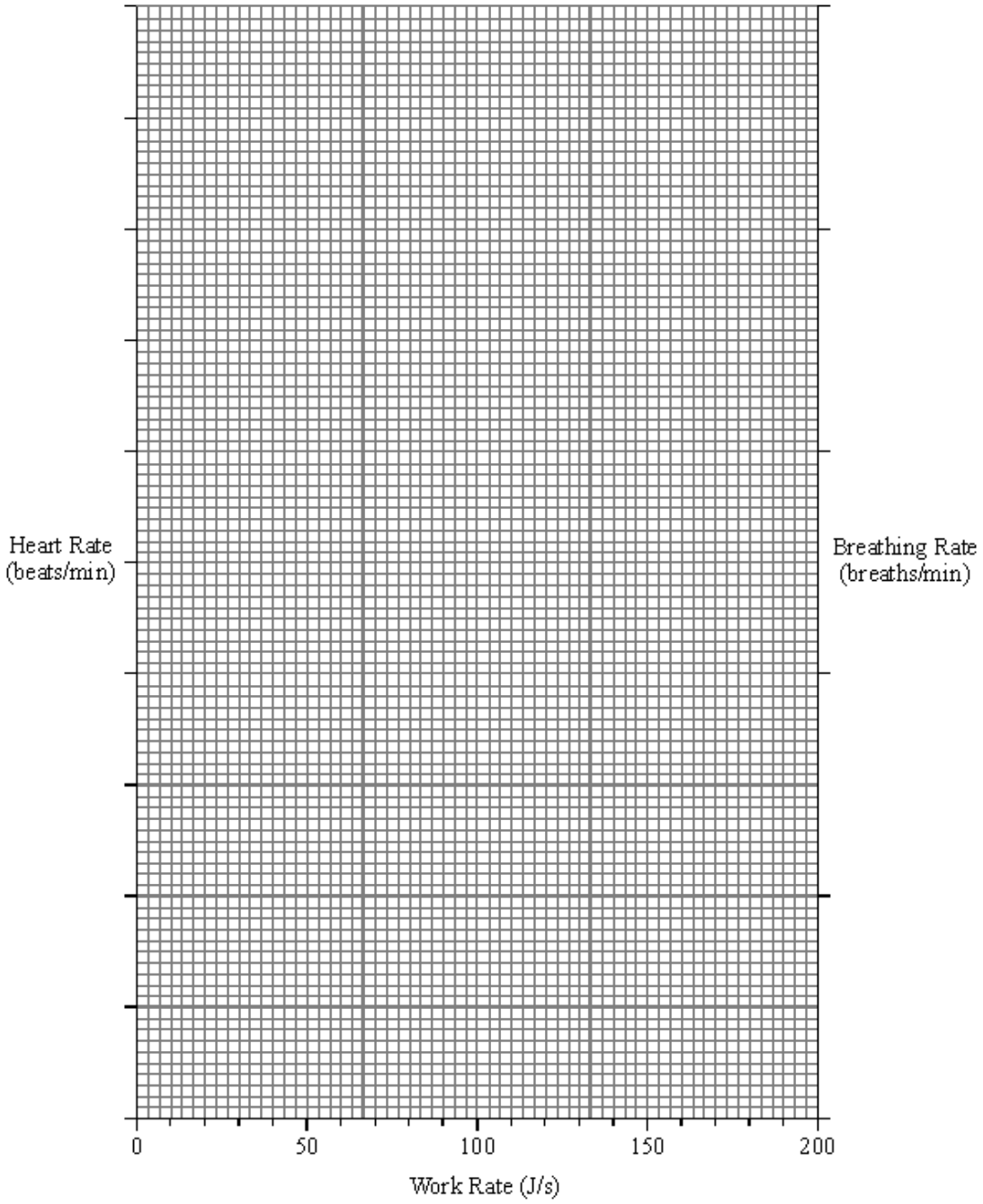


The athlete's heart rate and breathing rate were measured at different work rates.

The table below shows the results which were obtained.

WORK RATE (J/s)	HEART RATE (beats/min.)	BREATHING RATE (breaths/min.)
0	86	9.6
60	106	10.0
80	112	10.4
100	122	10.4
120	135	11.4
140	143	14.5
160	156	15.8
200	174	30.5

Plot the data on the graph paper below.



(3)

(c) Explain, as fully as you can, the advantages to the body in the change in breathing and heart rates.

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(6)

(d) This increase in the rate of heart-beat is a response to a stimulus. For this response suggest:

(i) the stimulus; .....

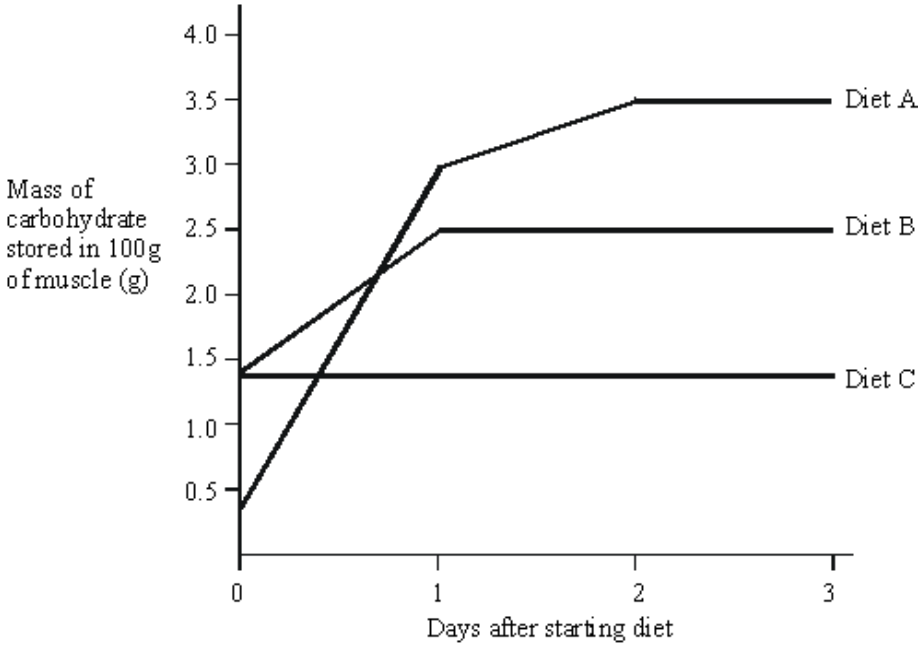
(ii) the co-ordinator; .....

(iii) the effector. .....

(3)

(Total 15 marks)

Q4. The graph below shows the effect of a high carbohydrate diet on the stored carbohydrate in the muscles.



Diet A – High carbohydrate diet, started after several days of eating a diet without carbohydrate.
Diet B – High carbohydrate diet, started after normal mixed diet.
Diet C – Normal mixed diet.

What advice would you give the athlete about the best diet preparation for a long race? Explain why you would give this advice.

Diet .....

Explanation

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(Total 2 marks)

Q5. Regular exercise is important, as it helps to maintain an efficient supply of blood to the muscles, the heart and the lungs. This is helped by an increase in the heart rate during exercise.

Explain why it is necessary for the heart rate to increase during exercise.

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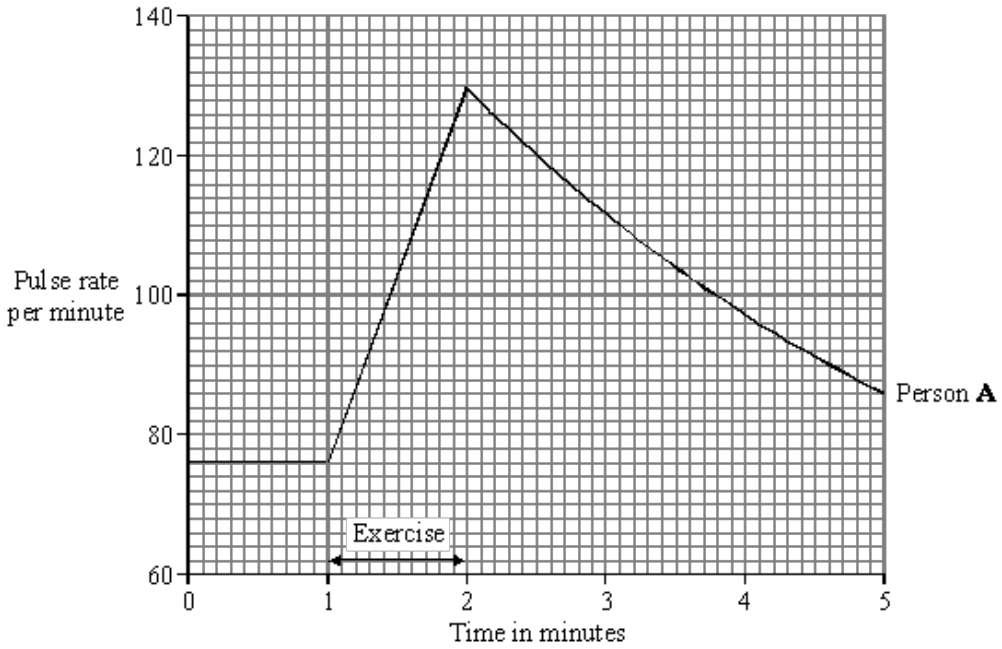
(Total 4 marks)

Q6. **Person A** and **Person B** measured their pulse rates over a period of five minutes. For one minute of this time they exercised by stepping on and off a box. At other times they sat still. The graph shows the results for **Person A**.



(i) What does the graph tell you about the changes in the pulse rate of **Person A** within the five minute period?

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(3)

(ii) What was the pulse rate of **Person A** at the end of the five minute period?

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(1)

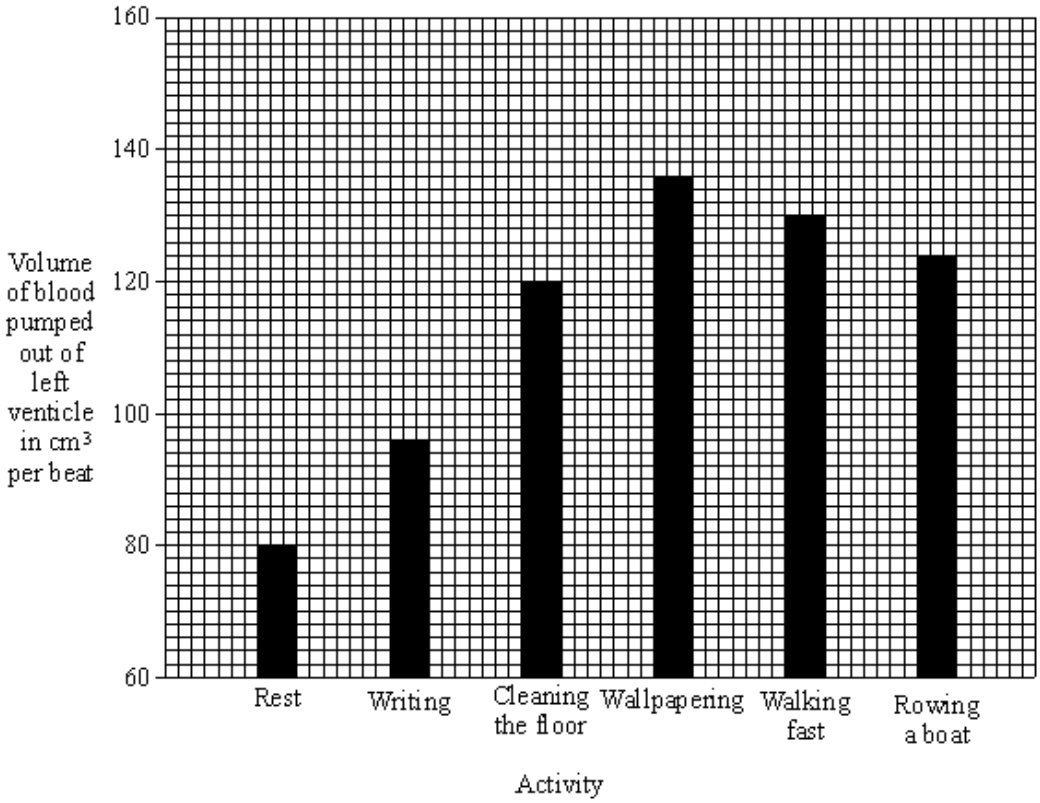
(iii) The table shows the results obtained for **Person B**.

Time in minutes	**Pulse rate per minute**
0	68
1	68
2	110
3	96
4	80
5	68

Plot these results on the graph.

(2)
(Total 6 marks)

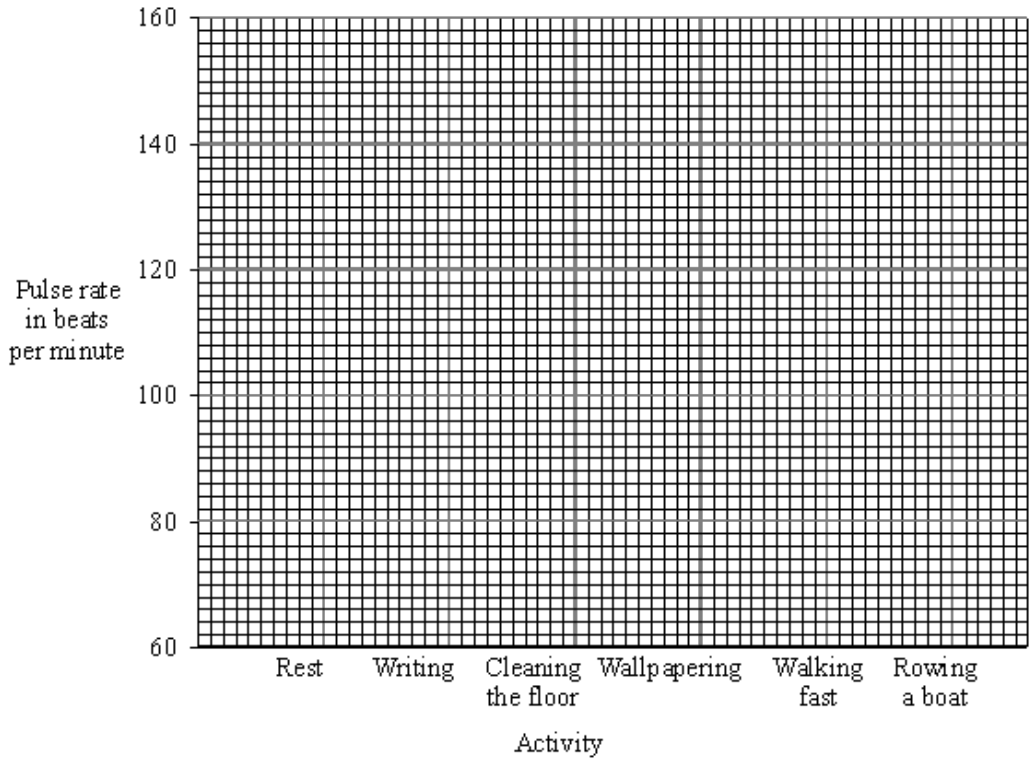
Q7. (a) The volume of blood pumped out of the left ventricle at each beat was measured for a person during six different activities. These activities showed an increasing energy demand, with rest requiring the least energy and rowing a boat the most. The results of these measurements are shown on the bar chart.



(i) The pulse rate was also measured for the person during the same activities. The table shows the results that were obtained.

Activity	Pulse rate in beats per minute
Rest	70
Writing	85
Cleaning the floor	100
Wallpapering	120
Walking fast	132
Rowing a boat	153

On the graph paper below draw a bar chart of the results obtained for the measurements of the pulse rate.



(2)

(ii) Undertaking activities with increasing energy demand has an effect on the volume of blood pumped from the left ventricle (per beat) and on the pulse rate. What do the bar charts show these effects to be? Use only information shown in the bar charts in your answer.

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(2)

(b) The pulse rate changed when the activity changed. Explain the reason for this.

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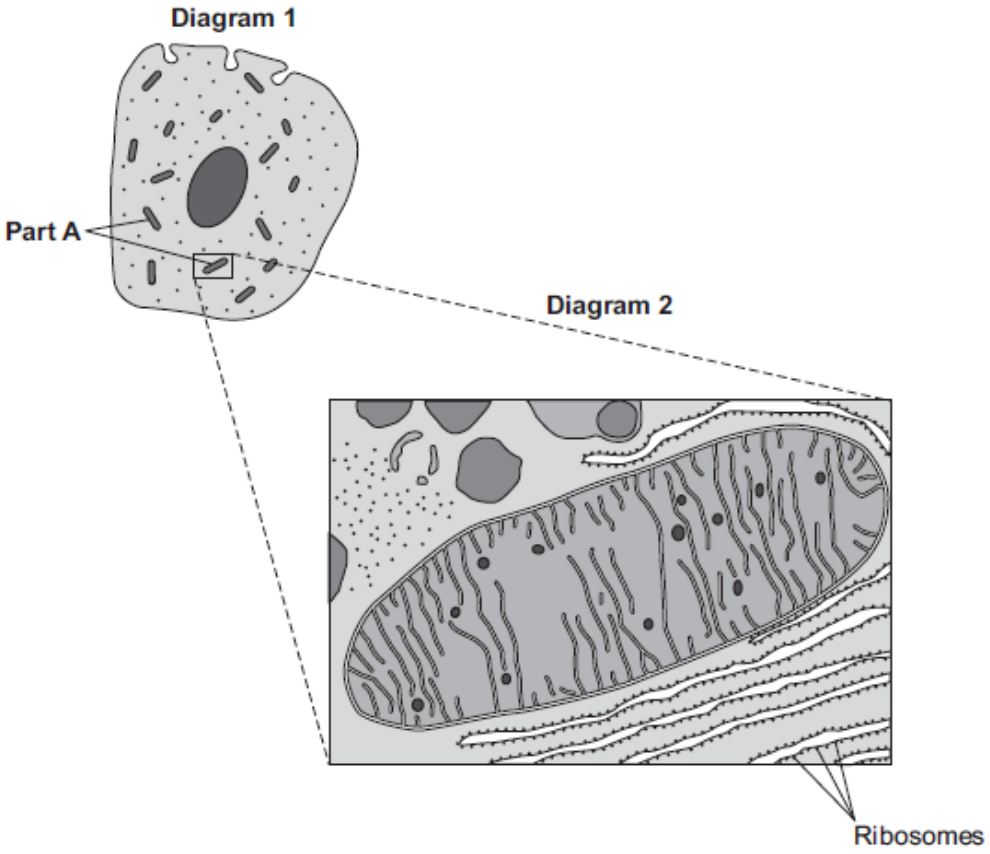
(2)

(Total 6 marks)

Q8. **Diagram 1** shows a cell from the pancreas.

Diagram 2 shows part of the cell seen under an electron microscope.



Part **A** is where most of the reactions of aerobic respiration happen.

(a) (i) Name part **A**.

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(1)

(ii) Complete the equation for aerobic respiration.

glucose + oxygen ⟶ ..... + ... (+ energy)

(2)

(iii) Part **A** uses oxygen.

Explain how oxygen passes from the blood to part **A**.

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(3)

(b) The pancreas cell makes enzymes.

Enzymes are proteins.

Describe how the ribosomes and part **A** help the cell to make enzymes.

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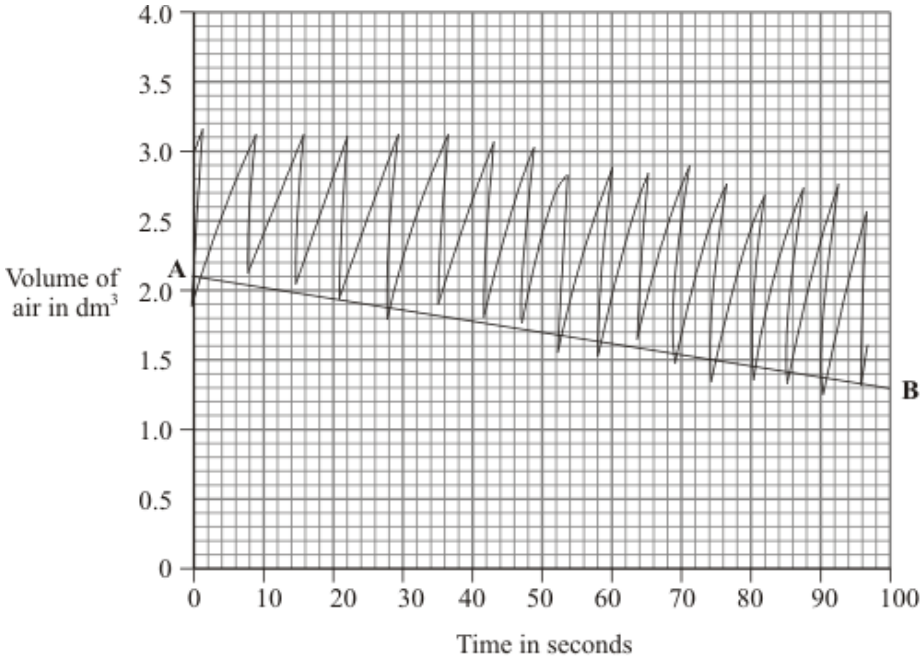
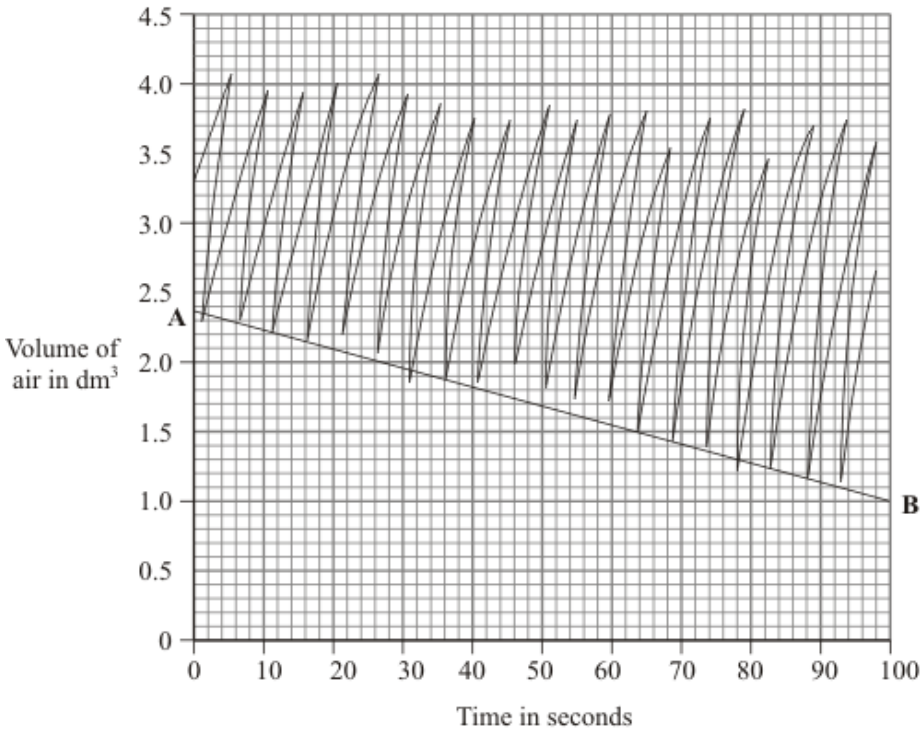
(3)
(Total 9 marks)

Q9. A student's breathing was monitored before and after vigorous exercise. The student breathed in and out through a special apparatus. The graphs show the changes in the volume of air inside the apparatus. Each time the student breathed in, the line on the graph dropped. Each time the student breathed out, the line went up.



Before exercise



After exercise

(a) How many times did the student breathe in per minute:

before exercise; .....

after exercise? .....

(1)

(b) On each graph, the line **A** – **B** shows how much oxygen was used. The rate of oxygen use before exercise was 0.5 dm^3 per minute. Calculate the rate of oxygen use after exercise.

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Rate of oxygen use after exercise = ... dm^3 per minute

(2)

(c) The breathing rate and the amount of oxygen used were still higher after exercise, even though the student sat down to rest. Why were they still higher?

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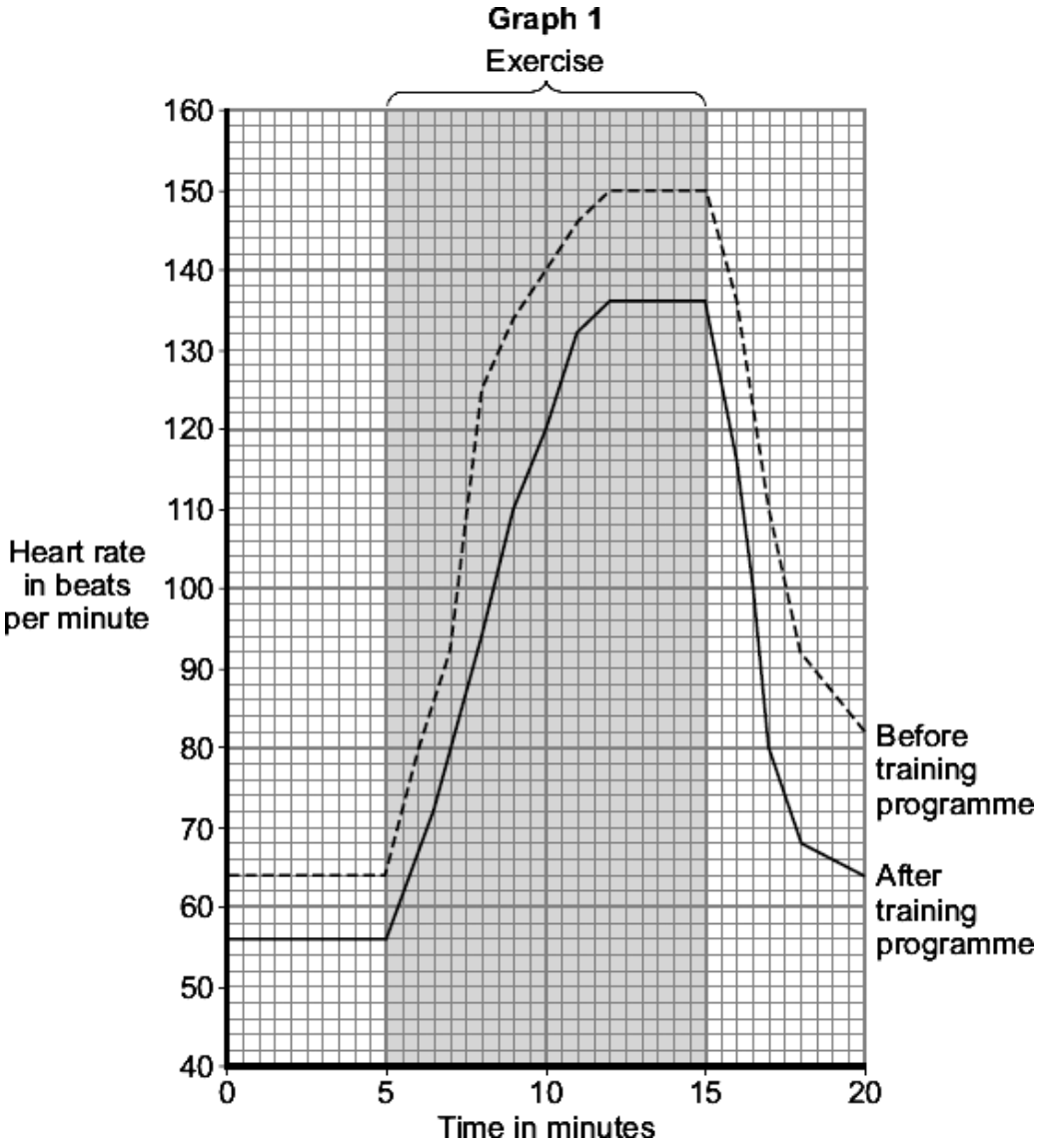
(4)

(Total 7 marks)

Q10. An athlete carried out a 6-month training programme.

Graph 1 shows the effect of the same amount of exercise on his heart rate before and after the training programme.



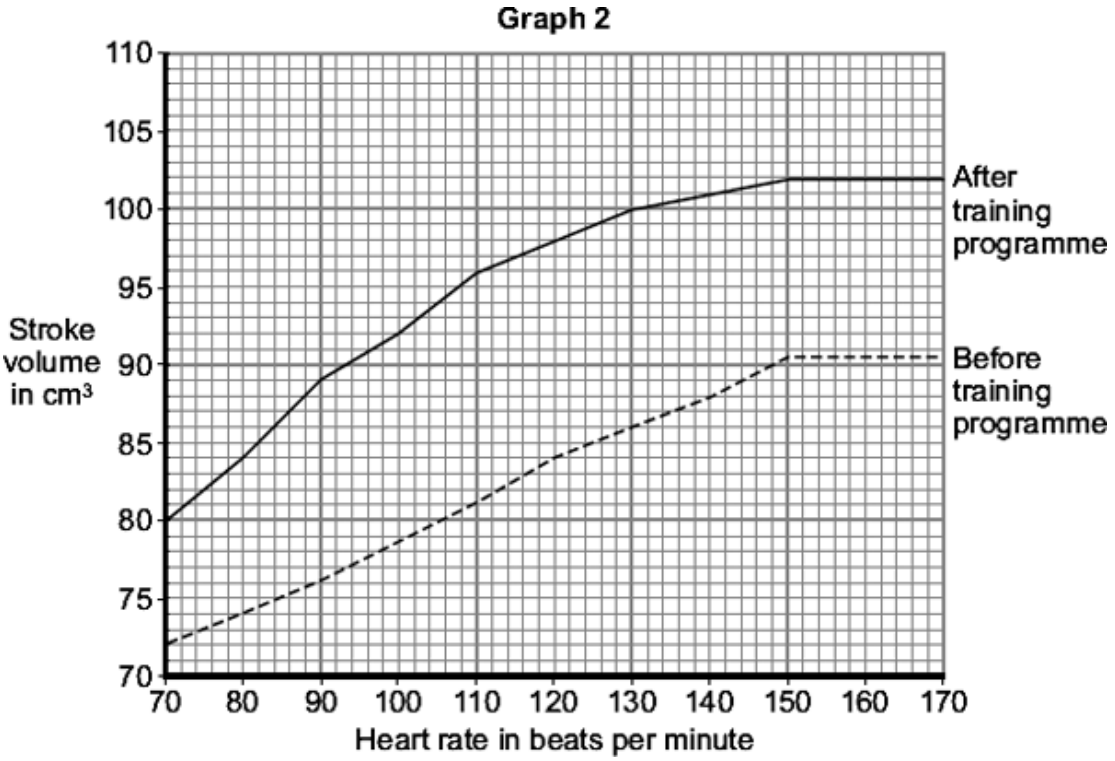
(a) (i) Use **Graph 1** to find the heart rate of the **trained** athlete 5 minutes after the start of the exercise.

Heart rate = ... beats per minute

(1)

The stroke volume of the heart is the volume of blood pumped out of the left side of the heart in one heart beat.

Graph 2 shows the relationship between the stroke volume and the heart rate before and after the athlete did the training programme.



(ii) The *cardiac output* is defined as

cardiac output = heart rate × stroke volume

Calculate the cardiac output of the **trained** athlete 5 minutes after the start of the exercise. Use your answer to part (a)(i), and information from **Graph 2**.

Show clearly how you work out your answer.

.....

.....

Cardiac output = ... cm^3 blood per minute

(2)

(b) **Graph 1** shows that, for the same amount of exercise, the heart of the trained athlete was beating more slowly than it did before the training programme.

Use information from **Graph 2** to explain why.

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(2)

(c) An increased cardiac output will provide more oxygen and more glucose to the working muscles.

Explain how this helps the athlete during exercise.

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(4)

(Total 9 marks)

Q11. Lactic acid production during exercise affects an athlete's performance.

Explain why lactic acid is produced during exercise.

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(2)

(Total 2 marks)

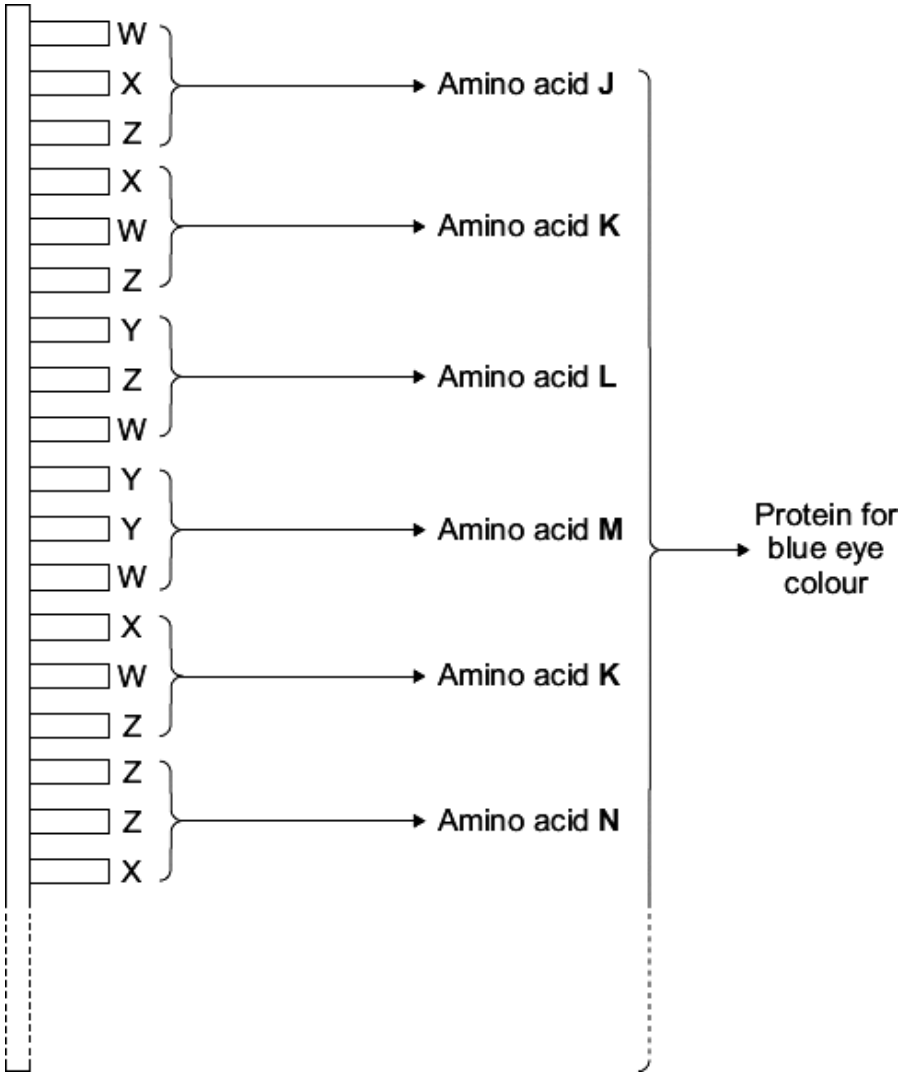
Q12. A molecule of DNA contains four different bases, **W**, **X**, **Y** and **Z**.

The four bases are arranged in a long chain.

The chain of bases controls the synthesis of a protein.

The diagram shows a small section of a DNA molecule.

This section is responsible for synthesising the protein for blue eye colour.



(a) What word is used to describe '*a small section of a DNA molecule that controls the synthesis of a protein*'?

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(1)

(b) In the cell, where are proteins synthesised?

.....

(1)

(c) Describe how the protein for blue eye colour is synthesised.

To gain full marks you must use information from the diagram.

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(3)

(d) Mistakes sometimes occur when DNA molecules are copied during cell division.

Suppose that one of the **W** bases shown in the diagram was substituted by an **X** base.

(i) What would happen to the structure of the protein synthesised by this part of the DNA molecule?

.....

.....

(1)

(ii) What might be the effect of this change in structure of the protein?

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(1)

(Total 7 marks)

M1. (i) the higher the rate of oxygen consumption, the shorter the time taken to complete

for 1 mark

1

(ii) the faster oxygen is taken into the blood,
the faster energy can be released in the muscles,
and the faster the athlete can run

for 1 mark each

3

[4]

M2. (a) (i) reduced sharply

for 1 mark

1

(ii) converted to glucose which is respired to produce energy

(allow answers in terms of glucagon)

gains 3 marks

3

(b) (i) athlete A's was most effective
since resulted in highest muscle glycogen level on day of race
for energy release during race

for 1 mark each

3

(ii) e.g. excess carbohydrate stored as glycogen rather than fat in short term
particularly if glycogen stores depleted

for 1 mark each

2

[9]

M3. (a) oxygen;)
carbon dioxide;) *allow symbols*
water)

each for 1 mark

3

(b) graph with reasonable vertical scales;
accurate plotting of all points (ignore lines) and labelling lines
histogram – must be coded

gains 3 marks

3

(c) 6 of:
during exercise the level of CO_2 (in the blood) rises;

increased breathing to remove excess CO_2;

increased oxygen supply to muscles;
or increased breathing takes in more O_2

or increased heart rate takes more O_2 to muscles;

increased supply of sugar to muscles;
increased respiration rate;
enable faster rate of energy release;
reference to lactic acid (allow even though not on syllabus)/O_2 debt;

to avoid cramp;
anaerobic reference;
reference to removal of 'heat';

6

(d) high carbon dioxide concentration;
brain/central nervous system;
heart muscles (both)

3

[15]

M4. follow diet A because it gives the highest proportion of stored sugar in the muscles
for 1 mark each

[2]

M5. any **four** from:

more energy / respiration required

*accept it prevents / reduces anaerobic respiration **or** less / no lactic acid*

reference to increase must be made, but only needed once, provided inference is clear for remainder of points.

accept 'delivered more quickly' for 'increase'

increase oxygen uptake into blood (in lungs)

increase oxygen delivery to muscles

increase glucose delivery to muscles

increase removal of heat from muscles **or** increase delivery of heat to skin

increase removal of carbon dioxide from muscles

increase removal of carbon dioxide from blood (in lungs)

[4]

M6. (i) <u>with exercise</u> rate rises;

accept between 1 – 2 minutes rate rises

1

(when exercise stops) rate falls slowly;

*accept gentle fall **or** steady fall*

for answers which <u>just describe a rise then a fall allow one mark only</u> as an alternative to the first two points

1

rate does not return to normal **or** to starting **or** to resting rate

*accept rate returns to normal after five minutes **or** three minutes of rest **or** after recording ended*

1

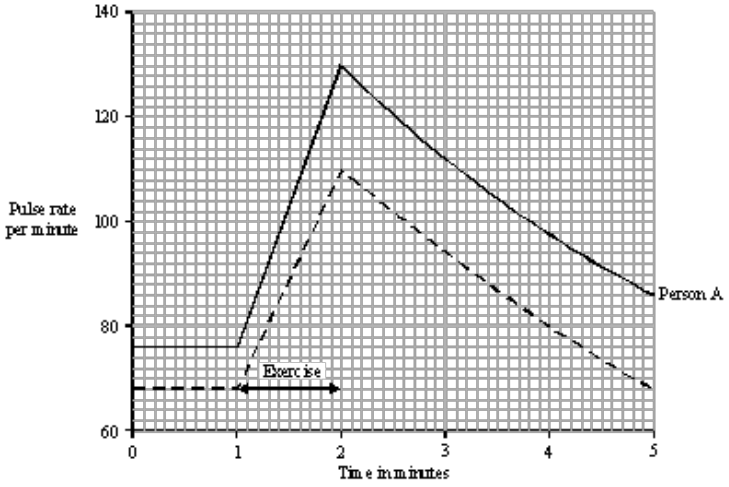
(ii) 86 (per minute);

1

(iii) plotting points;

deduct one mark for each error to max of two

if 68 wrongly plotted count as one error (ignore the quality of the line)



2

[6]

M7. (a) (i) plotting values for pulse rates;

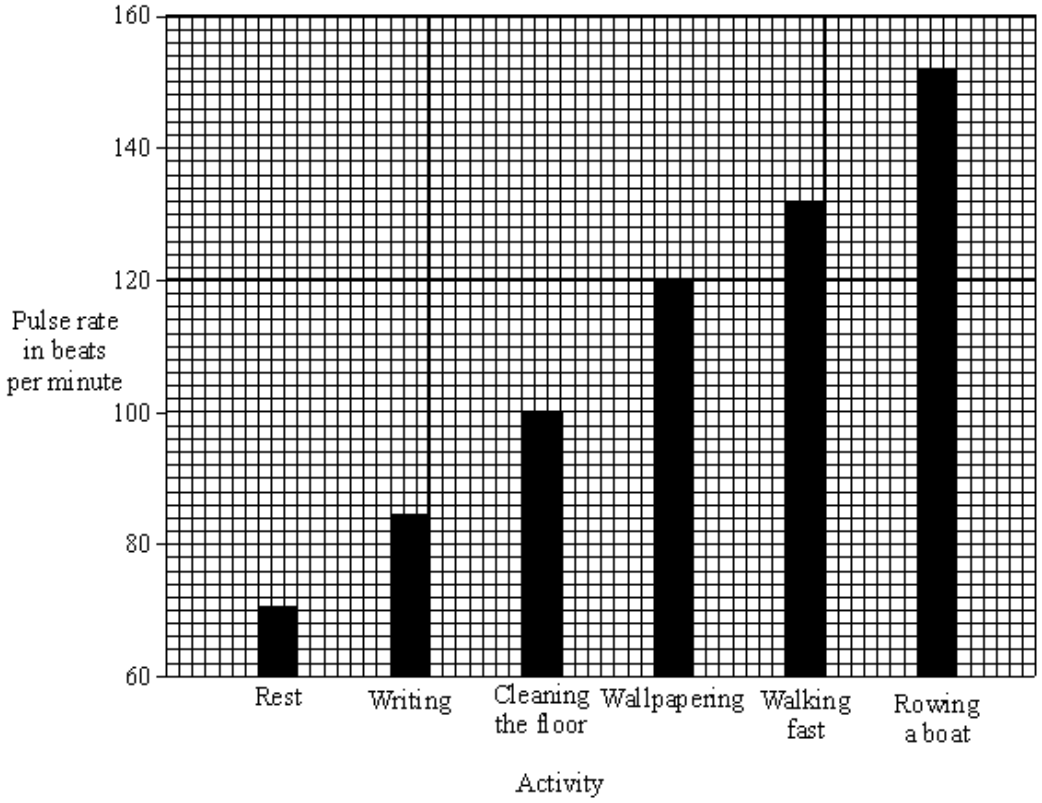
2 marks- minus 1 mark for each error to a maximum of 2

Accept values if plotted on blood volume bar chart

Non-horizontal tops to bars producing variable values = 1 error

If drawn as a line graph =1 mark maximum

2



(ii) **Either**

volume of blood went up then fell;

Accept went to a maximum then fell

pulse rate increased (steadily);

*Accept went up steadily **or** kept going up*

2

Or

at first **or** with low activity **or** with moderate activity both pulse and volume increased;

Accept activity up to wall- papering

with more activity pulse continued to increase but volume fell;

(b) Any **two** of

with increased activity greater muscle use **or** greater respiration;

need more glucose **or** oxygen;

Accept more sugar

heart beat faster;

Do not accept more air

*Accept more blood needed **or** blood flows faster*

*If 'more' **or** equivalent stated once it can be accepted elsewhere by implication*

2

[6]

M8. (a) (i) mitochondrion / mitochondria

must be phonetically correct

1

(ii) carbon dioxide / CO_2

1

water / H_2O

1

in either order

*accept CO2 but **not** CO^2*

*accept H2O **or** HOH but not H^2O*

(iii) diffusion

1

high to low concentration

allow down a concentration gradient

1

through (cell) membrane **or** through cytoplasm

*do **not** accept cell wall*

1

(b) ribosomes make proteins / enzymes

1

using amino acids

1

part A / mitochondria provide the energy for the process

allow ATP

*do **not** accept produce or make energy*

1

[9]

M9. (a) (before exercise) – 9 to 11 **and** (after exercise) – 12 **or** 13

both *correct*

1

(b) 0.75 to 0.90

ignore working or lack of working

eg. 2.35 – 1.55 ***or*** $\frac{(2.35-1.0)\times 60}{100}$ ***or*** *other suitable figures for* ***1*** *mark*

2

(c) any **four** from:

still need to remove extra carbon dioxide

still need to remove heat / to cool

(some) anaerobic respiration (in exercise)

lactic acid made (in exercise)

oxygen needed to break down lactic acid **or** suitable reference to oxygen debt

lactic acid broken down to CO_2 and water **or** lactic acid changed into glucose

4

[7]

M10. (a) (i) 120

1

(ii) 11 760 **or**
correct answer from candidate's answer to (a)(i)

correct answer with or without working

if answer incorrect

120 × 98 ***or***
candidate's answer to (a)(i) × corresponding SV gains ***1*** *mark*

if candidate uses dotted line / might have used dotted line(bod) in (a)(i) ***and*** *(a)(ii) no marks for (a)(i) but allow full ecf in (a)(ii) eg 140 x 88 = 12320 gains* ***2*** *marks*

2

(b) trained athlete has higher stroke volume / more blood per beat

1

same volume blood expelled with fewer beats

or for same heart rate more blood is expelled

1

(c) increased aerobic respiration

or

decreased anaerobic respiration

allow correct equation for aerobic respiration

accept don't have to respire anaerobically

1

increased energy supply / need

1

less lactic acid formed

or to breakdown lactic acid **or** less O_2-debt

1

can do more work **or** can work harder / faster / longer

accept muscle contraction for work

or less fatigue / cramp / pain

1

[9]

M11. insufficient / no oxygen available

1

for (just) aerobic respiration

or

respires anaerobically

1

[2]

M12. (a) gene / allele

1

(b) (in / on) ribosome(s)

1

(c) any **three** from:

- amino acids make up a protein
- (protein is) particular combination / sequence (of amino acids)
- bases form a code
- the bases work in threes or description
  accept bases work in triplet
- (code / three bases) for one amino acid
  *accept eg (bases) WXZ for amino acid J for **2** marks*

3

(d) (i) different / wrong amino acid (coded for) **or** different / wrong shape
ignore reference to amino acid 'made'
ignore change unqualified
ignore different protein

1

(ii) different / example of different eye colour
allow protein may / would not be made / function (normally)

1

[7]