1 Read the passage.

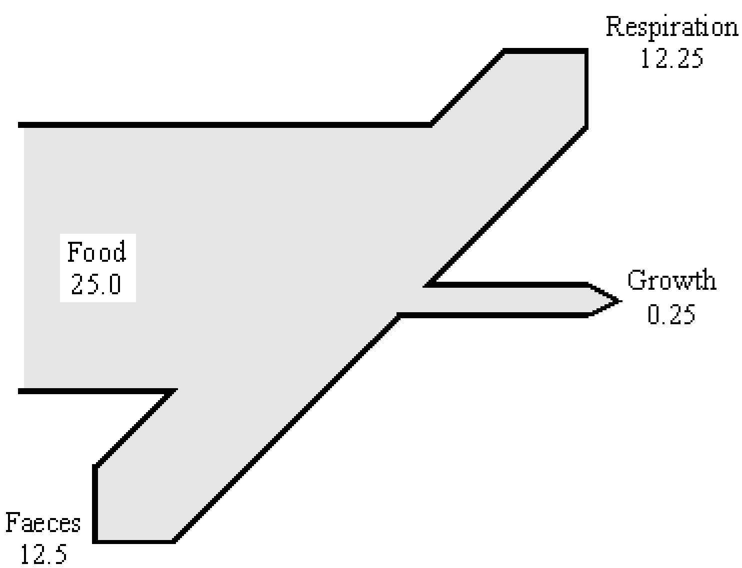
Glutton up a gum tree

Along the banks of the Cygnet River on Kangaroo Island, the branches of the dying gum trees stretch out like accusing fingers. They have no leaves. Birds search in vain for nectar-bearing flowers.

The scene, repeated mile upon mile, is an ecological nightmare. But, for once, the culprit is not human. Instead, it is one of the most appealing mammals on the planet – the koala. If the trees are to survive and provide a food source for the wildlife such as koalas that depend on them, more than 2000 koalas must die. If they are not removed the island's entire koala population will vanish.

Illegal killing has already started. Worried about soil erosion on the island, some farmers have gone for their guns. Why not catch 2000 koalas and take them to the mainland? "Almost impossible," says farmer Andrew Kelly. "Four rangers tried to catch some and in two days they got just six, and these fought, bit and scratched like fury."

The diagram shows the flow of energy through a koala.
The numbers show units of energy.



(i) Calculate the percentage of the food intake which is converted into new tissues for growth. Show your working.

______________ %

(2)

(ii) Give **three** different ways in which the koala uses the energy released in respiration.

1. ____

____

2. ____

____

3. ____

____

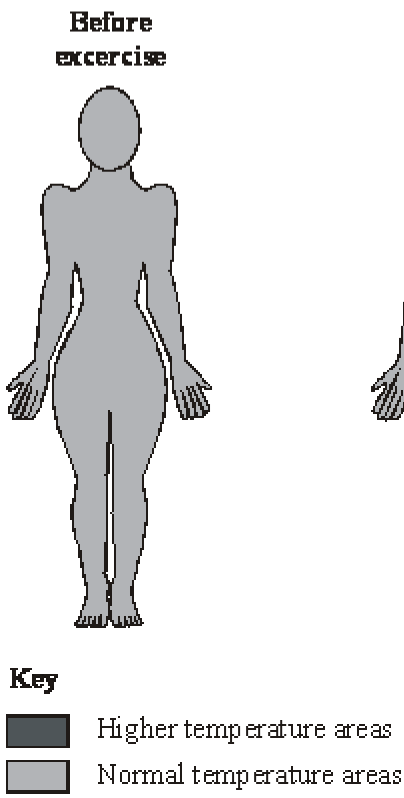
(3)

(Total 5 marks)

2 The temperature at the surface of the skin can be measured by using a technique called thermography.

In this technique, areas with higher temperature appear as a different colour on the thermographs.

The drawings below show the results of an investigation in which thermographs were taken from a person before and after exercise.



Describe and explain, as fully as you can, the effects of exercise on skin temperature.

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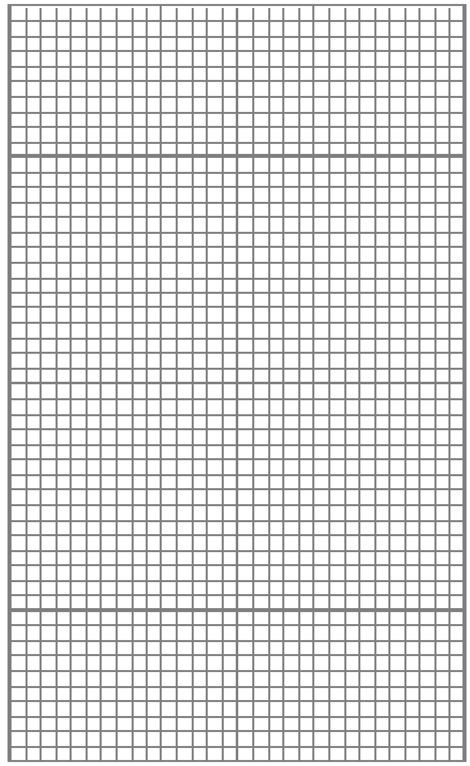
(Total 3 marks)

3 (a) The table shows an athlete's breathing rate after the end of a race.

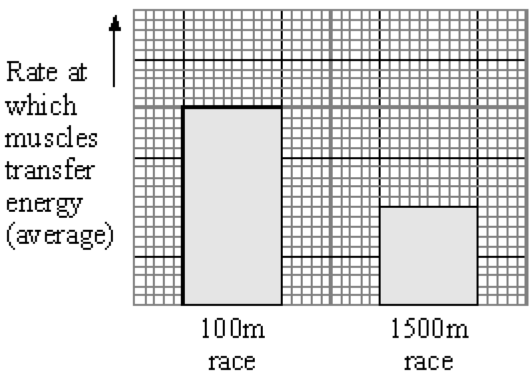
Use the information shown in the table to draw a line graph.

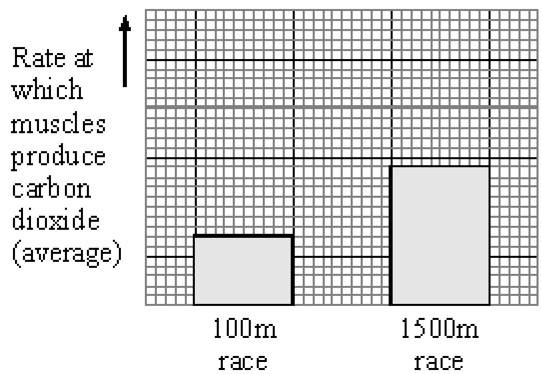
Time after end of race (minutes)	Breathing rate (litres per second)
0	4
1	2
2	1
3	1
4	1
5	1



(3)

(b) The bar charts show what happens in an athlete's muscles when running in two races of different distances.





(i) Compare what happens in the athlete's muscles when running in the two races.

____

____

(3)

(ii) Use the information in the box to explain your answer to (i).

aerobic respiration	glucose + oxygen	$\rightarrow$	carbon dioxide + water
anaerobic respiration	glucose	$\rightarrow$	lactic acid

____

____

(2)

(c) Explain why the athlete breathes at a faster rate than normal for two minutes after finishing a 100 metres race.

____

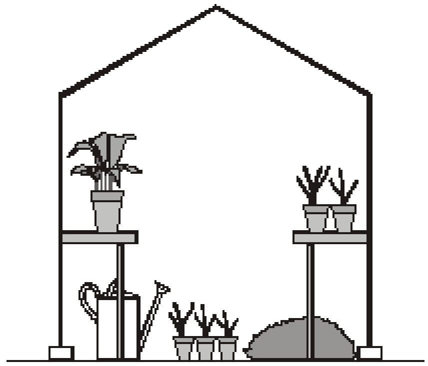
____

____

(2)

(Total 10 marks)

4 The diagram shows some plants growing in a greenhouse on a hot summer's day.



Which **one** of the following factors is most likely to limit the rate of photosynthesis at this time?

- carbon dioxide concentration
- light intensity
- temperature

Factor ____

Explain the reason for your answer.

____

____

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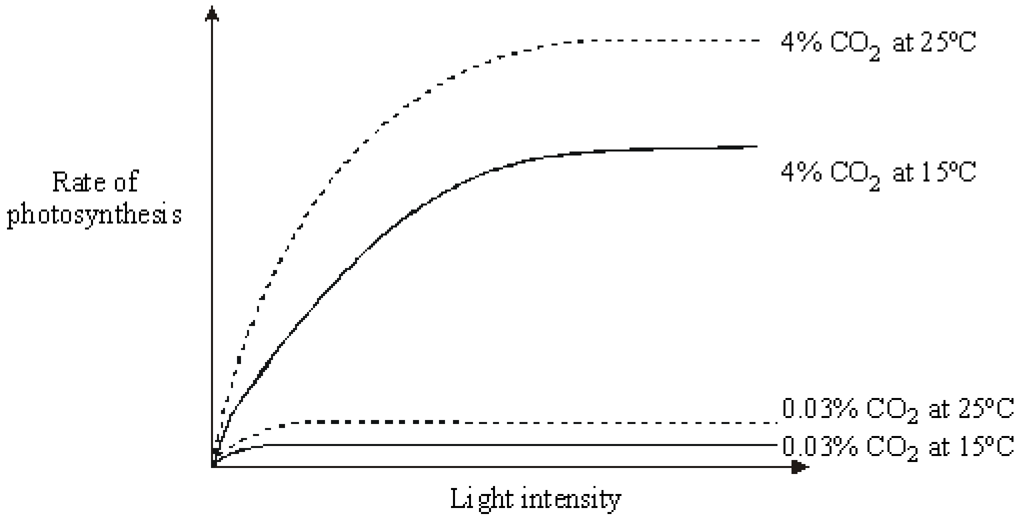
____

____

(Total 4 marks)

5 The graph shows how the rate of photosynthesis is affected by different conditions.



(a) What patterns can you find from this graph?

____

____

____

____

____

(5)

(b) How useful could this information be to a grower using glasshouses? Give reasons for your answer.

____

____

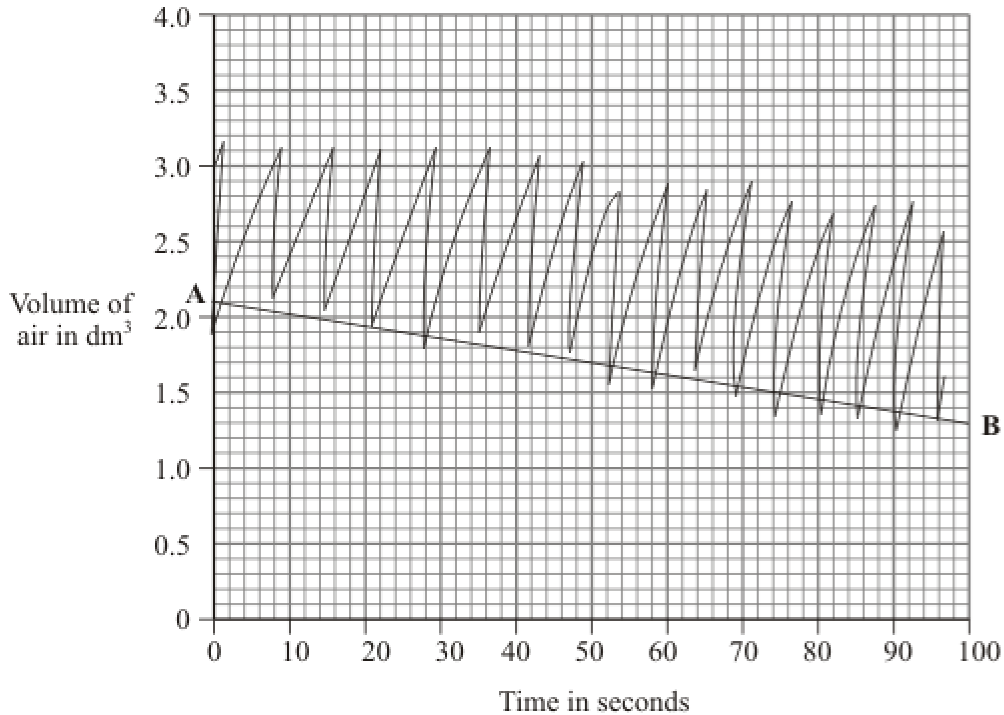
____

(2)

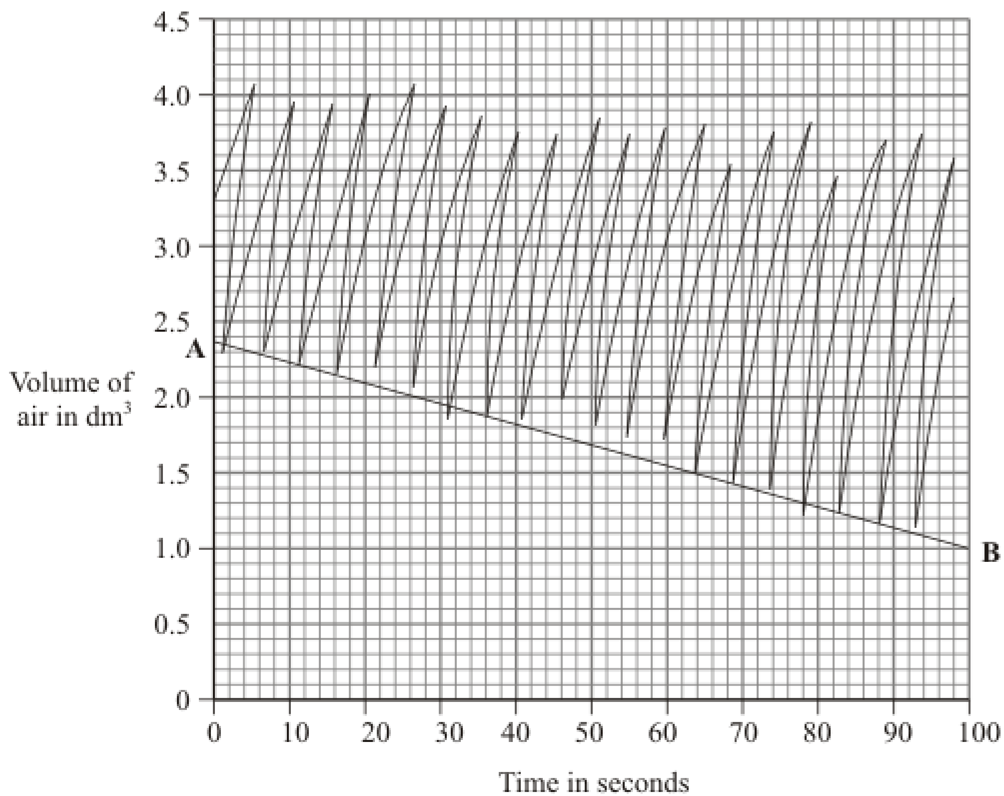
(Total 7 marks)

6

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.

____

____

____

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?

____

____

____

____

____

____

____

(4)

(Total 7 marks)

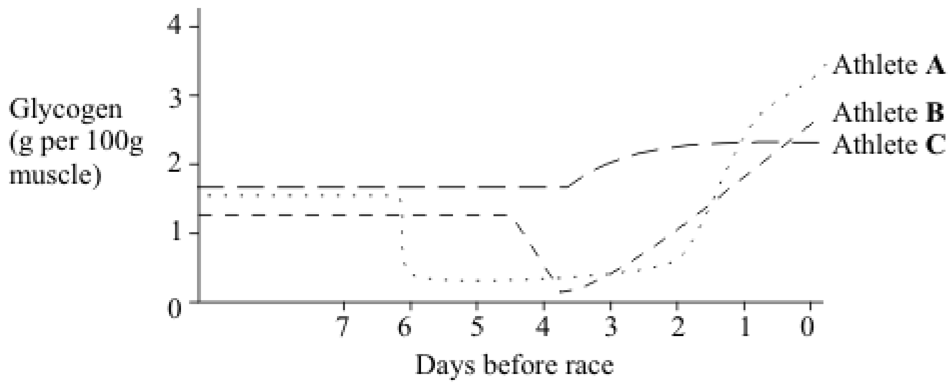
7 Marathon runners are recommended to have a high carbohydrate diet prior to a race. Three athletes tried out three dietary regimes prior to a marathon race.

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?

____

____

(1)

(ii) Describe how this effect occurs.

____

____

____

____

____

____

____

____

(3)

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

(3)

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

(2)

(Total 9 marks)

8 Low light intensity is one factor that limits the yield of a crop.

In Britain, many tomato growers use artificial lights to increase the yield of tomato crops.

The table shows the amount of natural daylight and artificial lamplight received by a tomato crop grown in a greenhouse.

Month	**Natural daylight received by tomato plant**		**Artificial lamplight given to tomato plant**		**Total light energy received by plant per day in J/cm^2**	**Percentage increase in growth resulting from artificial light**
	Day length in hours	**Light energy received by plant per day in J/cm^2**	**Hours of light given per day**	**Light energy received by plant per day in J/cm^2**		
January	8.1	239	18	492	731	206
February	9.9	492	18	492	984	100
March	11.9	848	12	328	1176	39
April	13.9	1401	2	55	1456	4
May	15.5	1786	0	0	1786	0
June	16.6	1960	0	0	1960	0
July	16.2	1849	0	0	1849	0
August	14.7	1561	0	0	1561	0
September	12.8	1064	2	55	1119	5
October	10.6	614	11	301	915	49
November	8.8	288	18	492	780	171
December	7.6	183	18	492	675	269

(a) Describe the pattern for the amount of light energy received from natural daylight by a tomato plant during the day.

____

____

____

____

____

____

(3)

(b) A tomato plant needs 600 J of light energy per cm^2 each day to grow and produce tomatoes.

Use this information and data from the table to suggest an explanation for the pattern of the artificial light given to the tomato plants.

____

____

____

____

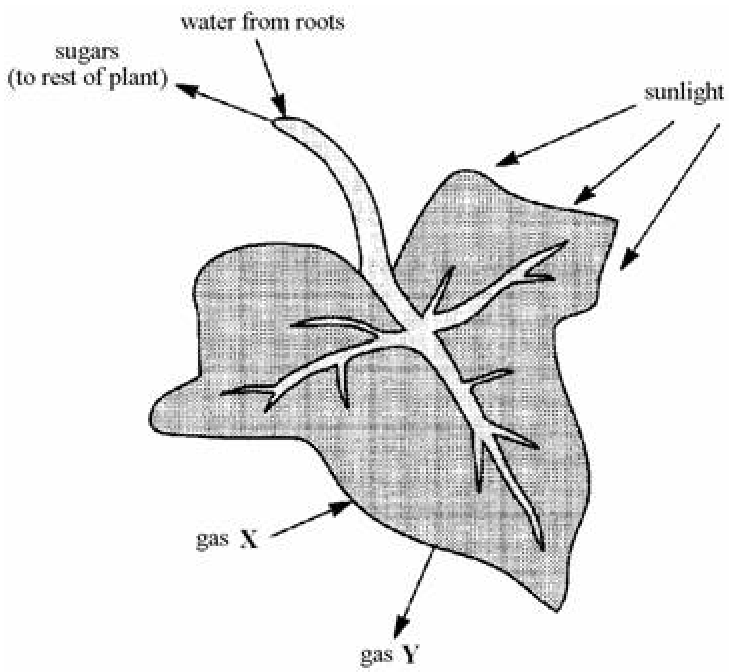
____

____

(2)

(Total 5 marks)

9 The diagram shows a plant leaf during photosynthesis.



(a) Name:

(i) gas **X**; _______________

(ii) gas **Y**. _______________

(2)

(b) Why is sunlight necessary for photosynthesis?

____

____

(1)

(c) Some of the sugars produced by photosynthesis are stored as starch in the roots. Explain, as fully as you can, why it is an advantage to the plant to store carbohydrate as starch rather than as sugar.

____

____

____

____

____

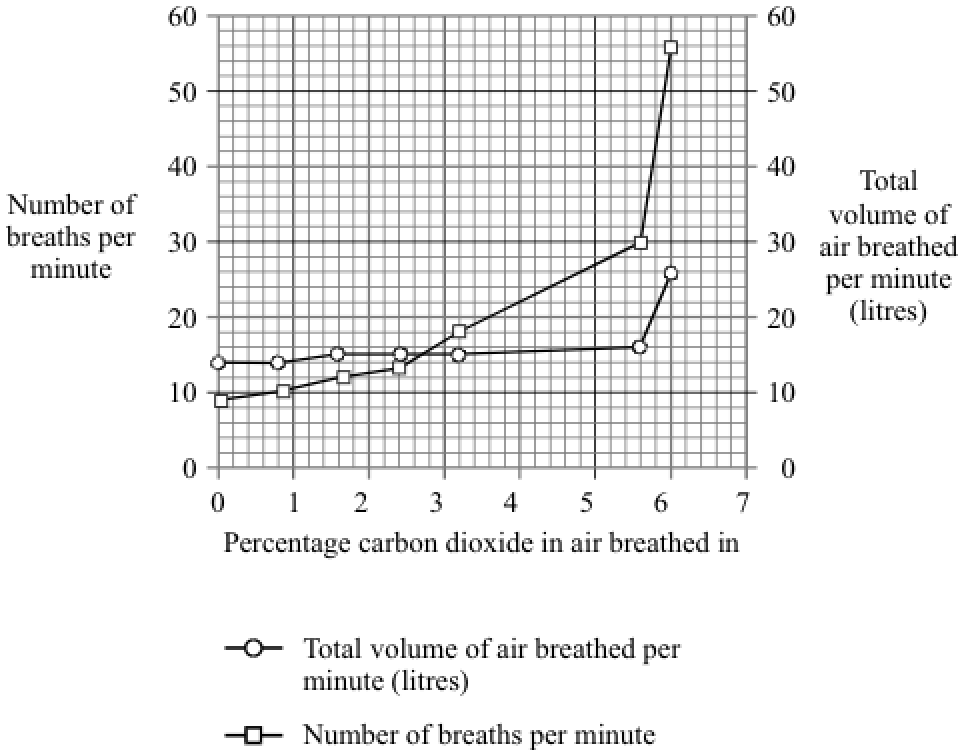
____

(3)

(Total 6 marks)

10 The graph shows the effect of increasing the carbon dioxide content of the inhaled air on:

- the number of breaths per minute;
- the total volume of air breathed per minute.



(i) Describe the effect of increasing the percentage of carbon dioxide in the inhaled air on the total volume of air breathed.

___

___

___

___

(2)

(ii) Suggest why the total volume of inhaled air is **not** directly proportional to the number of breaths per minute.

___

___

___

___

(2)

(Total 4 marks)

Mark schemes

1 (i) 0.25 × 100 / 25

gains 1 mark

but
1%

gains 2 *marks*

2

(ii) muscle contraction / limb movement / moving around / chewing
heartbeat / breathing / internal muscle activity
maintaining body temperature / keeps body warm
active uptake synthesising substances (*reject* growth)

any three for 1 mark each

3

[5]

2 any **three** from:

heat produced by muscles

<u>during</u> exercise

accept <u>when</u> working

by respiration

(skin) temperature over muscles rises / more blood to skin over muscles

*allow vasodilation **or** arterioles dilate over muscles*
reject capillaries dilate
sweating neutral

[3]

3 (a)

- appropriate scales (> halfway along each axis)
- all points correctly plotted to better than ½ a square
- lines carefully drawn

(*allow* point to point in this case)

N.B.

- no mark available for labelling axes
- *allow* either orientation

for 1 mark each

3

(b) (i) *ideas that*

- energy transferred faster in 100m race

  (*not* more energy transferred)

- carbon dioxide produced faster during 1500m race

  for 1 mark each

(*allow* more carbon dioxide produced)

correct reference to twice / half as fast in either / both cases

for 1 further mark

3

(ii)
- respiration during 100m race (mainly) anaerobic
- respiration during 1500m race aerobic
- aerobic respiration produces carbon dioxide
- anaerobic respiration doesn't produce carbon dioxide / produces lactic acid

  any two for 1 mark each

2

(c) *ideas that*

- there is an oxygen debt / more than normal oxygen needed
- lactic acid needs to be oxidised / combined with oxygen

  for 1 mark each

2

[10]

4 carbon dioxide concentration

1

since atmospheric concentration very low / value give e.g. 0.03%

allow carbon dioxide used up

1

temperature high

allow if light chosen as a factor

1

light intensity high

allow If temperature chosen as a factor

1

[4]

5 (a) + light = + photosynthesis
+ light = + photosynthesis to a limit
limit depends on temp/CO_2 levels
+ CO_2 = + photosynthesis
+ temp = + photosynthesis
each for 1 mark

5

(b) need to raise optimum levels
when one other raised
to get max/economic yield
each for 1 mark

2

[7]

6 (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 <u>extra</u> 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]

7 (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]

8 (a) low in winter / named months /when the days are short

accept increases in spring / Dec – June

1

high in summer / named month(s) / (when days are long

decreases in autumn / June – December

1

reasonable quantitative statement

accept any reasonable calculated / translated quantitative statement

higher in summer than in winter for 2 marks
comparative statements may be worth 2 marks
but
8/11 times higher in summer than in winter for 3 marks

1

(b) no artificial light given in summer / light only given in winter

since natural light greatly exceeds minimum / 600 J (required to produce tomatoes)

accept day length if linked to light energy

OR

light only given in winter

as natural light less than the minimum needed (to grow them) or 600 J

OR

for 2 marks:
percentage increase in growth from artificial] light only significant in winter

2

[5]

9 (a) (i) carbon dioxide / CO_2 (*reject* CO)

(ii) oxygen / O_2 / O (water vapour neutral)

for 1 mark each

2

(b) (provides) energy

for one mark

1

(c) starch insoluble therefore water not taken in by osmosis

or

sugar is soluble / has small molecules may diffuse out therefore lost

(ignore *ref. to cells bursting)*

or

starch has large molecules

cannot diffuse therefore retained

for 1 mark each

3

[6]

10 (i) increase in CO_2 concentration leads to increase in volume of air inhaled

increase of % carbon dioxide has little effect over most of range / large increase when % carbon dioxide > 5.6 %

each for 1 mark

2

(ii) *idea that*

depth of breathing changes at low % carbon dioxide, in crease in % CO_2 results in volume of each breath increasing without increase / little increase in number of breaths

each for 1 mark

2

[4]