

Q1. **Figure 1** shows part of a single myofibril from a skeletal muscle fibre as it appears under an optical microscope.

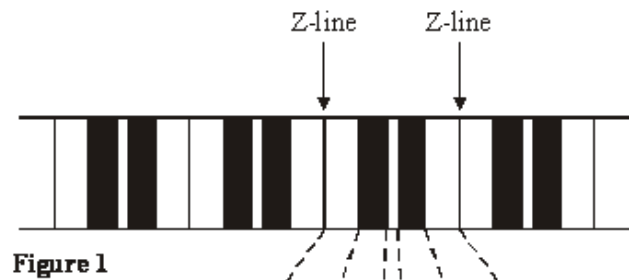


Figure 1

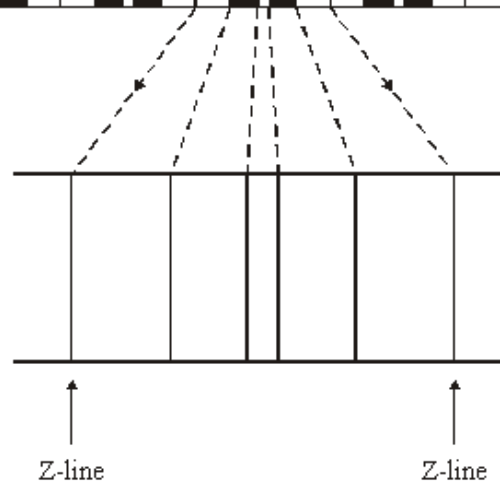


Figure 2

- (a) (i) Complete **Figure 2** to show the arrangement of actin and myosin filaments in this part of the myofibril as they would appear under an electron microscope. Label the actin and myosin filaments.

(2)

- (ii) Why are the details you have drawn in **Figure 2** visible under the electron microscope but not under the optical microscope?

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(1)

- (b) The myofibril in **Figure 1** is magnified $\times 8000$. A muscle fibre is $40\text{ }\mu\text{m}$ in diameter. Calculate the number of myofibrils which would fit side by side across the diameter of the muscle fibre. Show your working.

Answer myofibrils.

(2)
(Total 5 marks)

Q2. **Figure 1** shows part of a sarcomere.

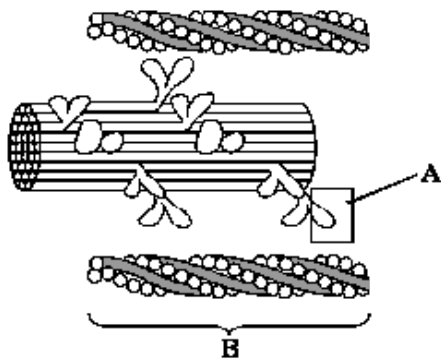


Figure 1

- (a) (i) Name the main protein in structure **B**.

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(1)

- (ii) Name the structure in box **A**.

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(1)

- (b) (i) Describe how calcium ions cause the myofibril to start contracting.

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(2)

- (ii) Describe the events that occur within a myofibril which enable it to contract.

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(3)

Slow and fast skeletal muscle fibres differ in a number of ways. Slow fibres get their ATP from aerobic respiration while anaerobic respiration provides fast fibres with their ATP. **Figure 2** shows a bundle of fast and slow fibres seen through an optical microscope. The fibres have been stained with a stain that binds to the enzymes which operate in the electron transport chain.

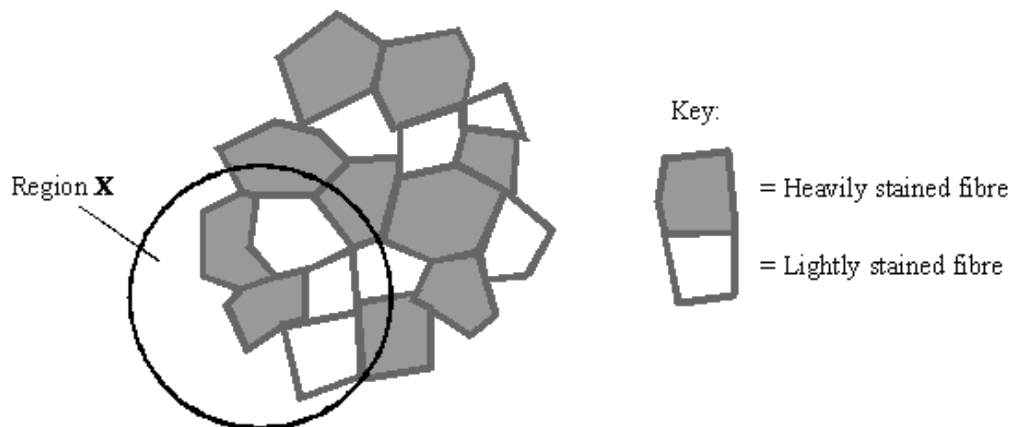


Figure 2

- S** (c) (i) Describe how you could calculate the percentage of fast fibres in this bundle.

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(1)

- (ii) The figure calculated by the method in part (c)(i) may not be true for the muscle as a whole. Explain why.

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(1)

- (d) The fibres in **Figure 3** correspond to those in region **X** of **Figure 2**. They were stained with a substance that binds to enzymes involved in glycolysis. Shade **Figure 3** to show the appearance of the fibres. Use the shading shown in the key.

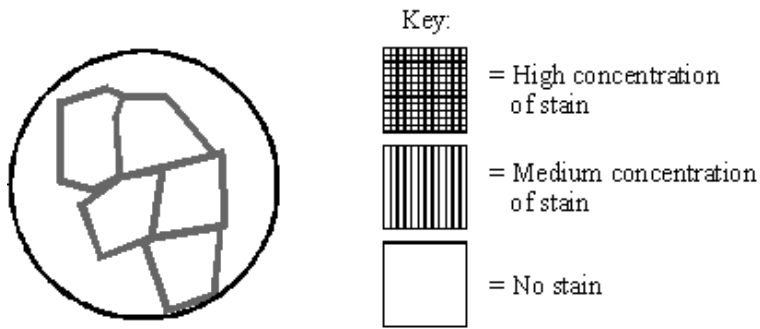


Figure 3

(2)

- S** (e) Recent research has shown that the difference in fibre types is due in part to the presence of different forms of the protein myosin with different molecular shapes.

Explain how a new form of myosin with different properties could have been produced as a result of mutation.

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(4)

(Total 15 marks)

Q3. (a) **Figure 1** shows part of a myofibril from skeletal muscle.

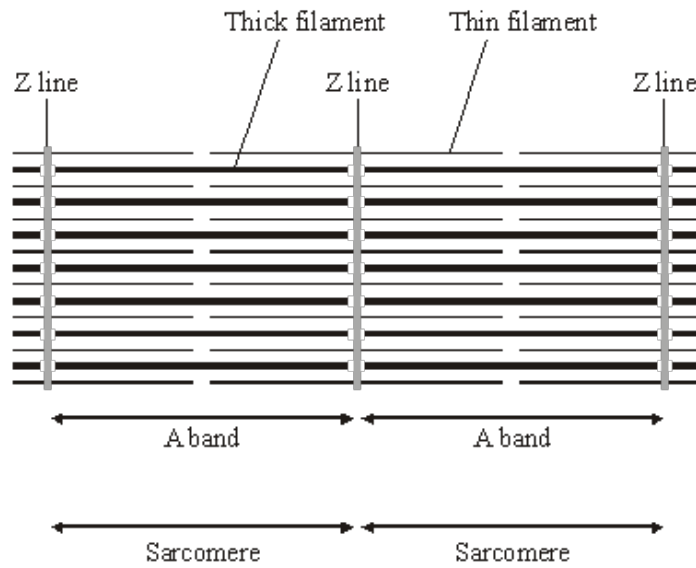


Figure 1

- (i) Describe **two** features, visible in the diagram, which show that the myofibril is contracted.

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2

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(2)

- (ii) Explain the role of calcium ions and ATP in bringing about contraction of a muscle fibre.

Calcium ions

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ATP

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(3)

- (b) **Figure 2** shows the structure of a neuromuscular junction. The vesicles contain acetylcholine.

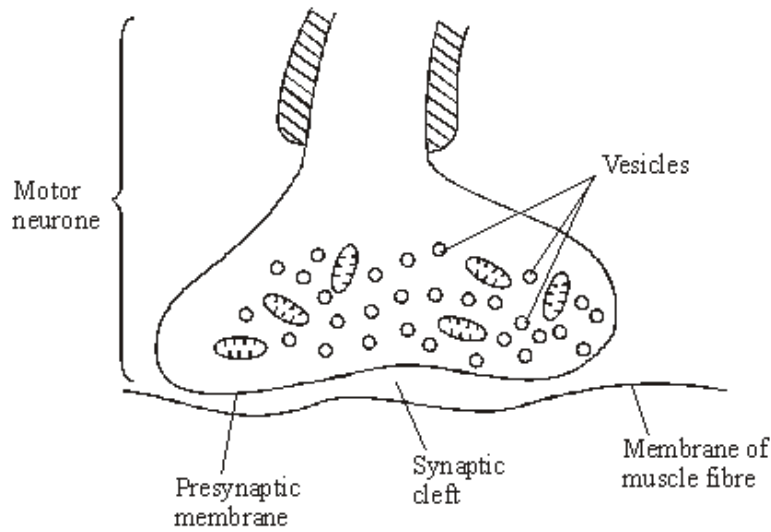


Figure 2

- (i) An action potential is generated at the cell body of the motor neurone. Explain how this action potential passes along the motor neurone to the neuromuscular junction.

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(3)

- (ii) When the action potential arrives at the neuromuscular junction, it results in the secretion of acetylcholine into the synaptic cleft. Explain how.

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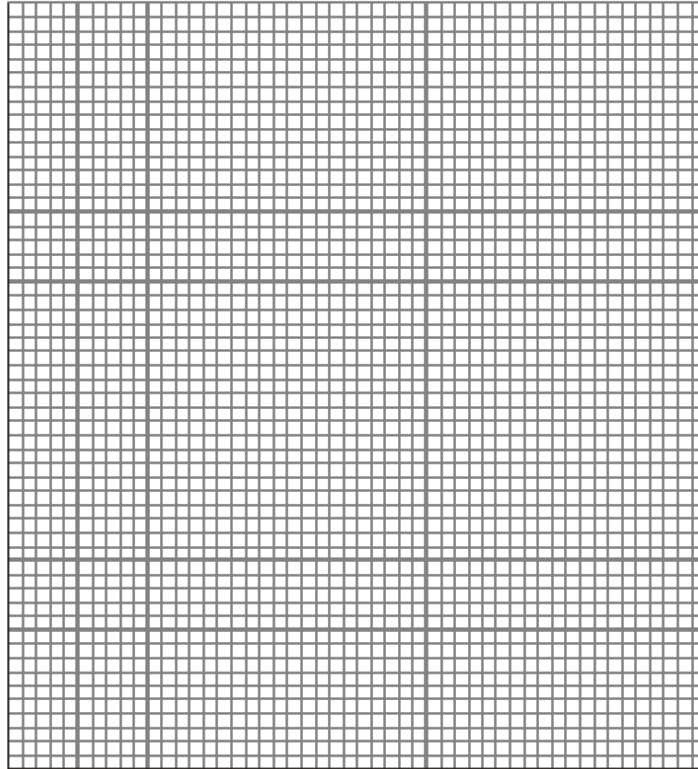
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(3)

- (c) Between the ages of 20 and 50, 10% of total muscle mass is lost. Between the ages of 50 and 80, a further 40% of the original total muscle mass is lost. Most of the muscle lost consists of fast fibres.

- (i) Plot a graph on the grid below to show the percentage of muscle mass remaining between the ages of 20 and 80. Assume that the rate of muscle loss in each age range is constant.



(3)

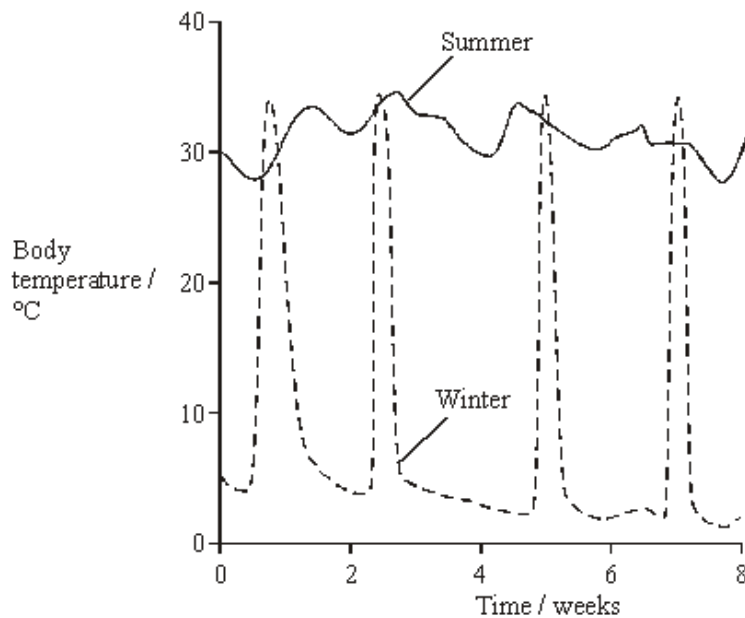
- (ii) Explain why explosive exercises, such as sprinting and weightlifting, will be more affected by this muscle loss than aerobic exercises, such as jogging.

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(1)

(Total 15 marks)

- Q4.** The echidna is an Australian mammal. In winter, its body temperature falls to a temperature similar to that of its environment and it hibernates. However, during the period of hibernation, it becomes active every few weeks and at these times its temperature rises to a level similar to its summer temperature. The graph shows how the echidna's temperature varies in the summer and in the winter.



- (a) Explain how the fall in body temperature to that of the environment helps the echidna to survive the winter.

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(2)

- (b) Explain how a higher body temperature is of benefit to an active echidna.

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(2)

(Total 4 marks)

- Q5.** (a) One effect of getting into a cold shower is a reduction in the amount of blood flowing through the capillaries near the surface of the skin. Explain how the cold water causes this response.

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(4)

- (b) (i) When exercising at 30 °C, the body is more likely to overheat in humid conditions than in dry conditions. Explain why.

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(2)

- (ii) Strenuous exercise leads to exhaustion more quickly in hot conditions than in cool conditions. One reason for this is a reduced blood supply to the muscles, which means that they receive less oxygen.

Suggest an explanation for the reduced blood supply to the muscles.

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(2)

(Total 8 marks)

Q6. MDMA is a compound that is often used as a recreational drug. It is commonly known as ecstasy. Unfortunately, a number of people have died soon after taking ecstasy.

A research team investigated the effects of MDMA. They chose to work with groups of mice. The mice in one group were injected with MDMA whilst a second group acted as a control.

(a) Suggest **two** reasons why the research team chose to use mice in this investigation.

- 1
- 2

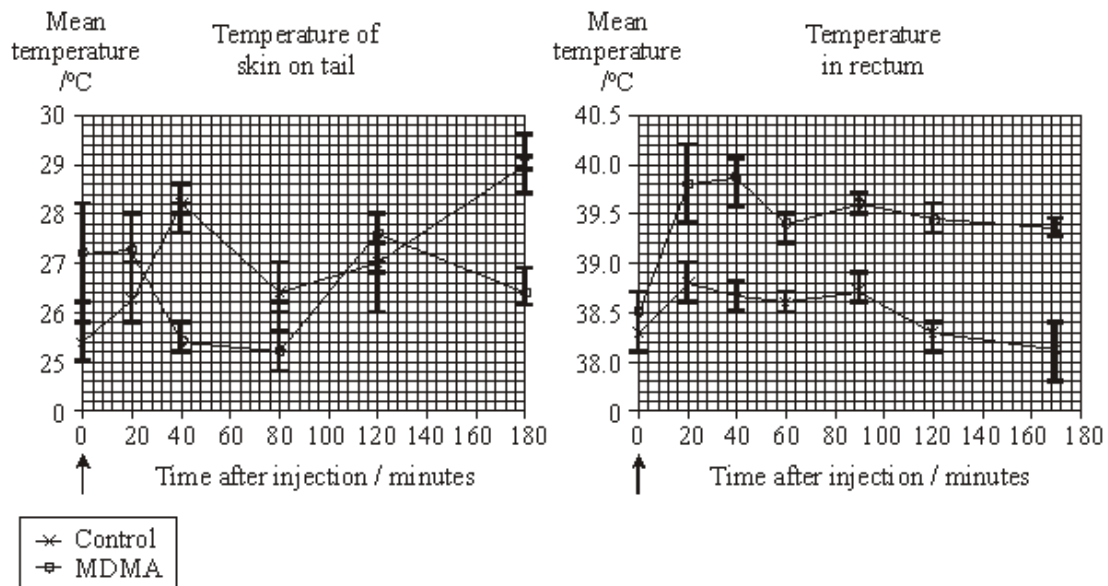
(2)

(b) How should the control group be treated?

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(1)

(c) For each mouse, the scientists monitored the temperature of the skin on its tail and the temperature in its rectum (lower part of the gut). The graphs show the mean temperatures, and standard deviations of these means, after the injections were administered.



(i) Explain why the tail temperatures were always lower than the temperature in the rectum.

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(2)

- (ii) The scientists concluded that MDMA causes death by stimulating heat generation. Use the data to evaluate their conclusion.

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(3)
(Total 8 marks)

Q7. (a) Sucrose, maltose and lactose are disaccharides.

- (i) Sucrase is an enzyme. It hydrolyses sucrose during digestion. Name the products of this reaction.

..... and

(2)

- (ii) Sucrase does **not** hydrolyse lactose. Use your knowledge of the way in which enzymes work to explain why.

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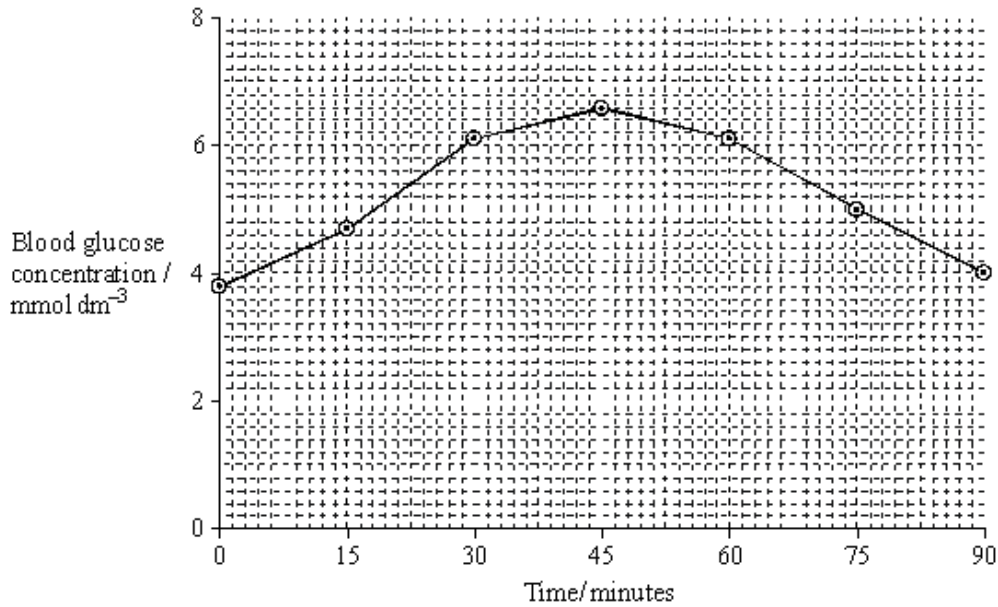
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(2)

- (b) A woman was given a solution of sucrose to drink. Her blood glucose concentration was measured over the next 90 minutes. The results are shown on the graph.



- (i) Describe how the woman's blood glucose concentration changed in the period shown in the graph.

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(2)

- (ii) Explain the results shown on the graph.

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(2)

- (iii) This woman was lactose intolerant.

On the graph, sketch a curve to show what would happen to her blood glucose concentration if she had been given a solution of lactose to drink instead of a sucrose solution.

(1)

(Total 9 marks)

Q8. (a) Describe how insulin reduces the concentration of glucose in the blood.

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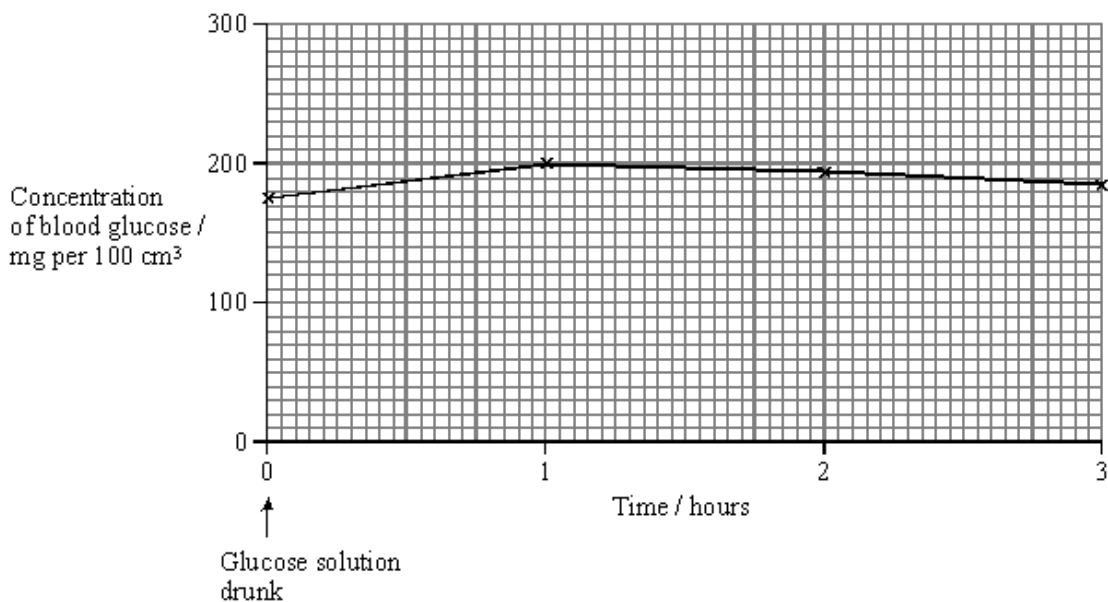
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(3)

Some people produce no insulin. As a result they have a condition called diabetes. In an investigation, a man with diabetes drank a glucose solution. The concentration of glucose in his blood was measured at regular intervals. The results are shown in the graph.



(b) Suggest **two** reasons why the concentration of glucose decreased after 1 hour even though this man's blood contained no insulin.

1

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2

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(2)

(c) The investigation was repeated on a man who did not have diabetes. The concentration of glucose in his blood before drinking the glucose solution was 80 mg per 100 cm³. Sketch a curve on the graph to show the results you would expect.

(1)

- (d) The diabetic man adopted a daily routine to stabilise his blood glucose concentration within narrow limits. He ate three meals a day: breakfast, a midday meal and an evening meal. He injected insulin once before breakfast and once before the evening meal.

The injection he used before breakfast was a mixture of two types of insulin. The mixture contained slow-acting insulin and fast-acting insulin.

- (i) Explain the advantage of injecting both types of insulin before breakfast.

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(2)

- (ii) One day, the man did not eat a midday meal. Suggest **one** reason why his blood glucose concentration did not fall dangerously low even though he had injected himself with the mixture of insulin before breakfast.

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(1)

(Total 9 marks)

Q9. Diabetes is a disorder affecting the ability to control blood glucose concentration. One type of diabetes can be due to an abnormality of the insulin receptors in the cell surface membranes of cells in the liver and muscles. A high blood glucose concentration and the presence of glucose in the urine are signs of this type of diabetes.

- (a) (i) Suggest **one** way in which the insulin receptors might be abnormal.

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(1)

- (ii) Explain how the presence of abnormal insulin receptors results in a high blood glucose concentration.

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(2)

- (iii) Explain how the kidneys normally prevent glucose appearing in the urine of a non-diabetic person.

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(3)

- (b) Twin studies have been used to determine the relative effects of genetic and environmental factors on the development of this type of diabetes. The table shows the concordance (where both twins have the condition) in genetically identical and genetically non-identical twins.

Concordance in genetically identical twins / %	Concordance in genetically non-identical twins /%
85	35

- (i) What do the data show about the relative effects of environmental and genetic factors on the development of diabetes?

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(1)

- (ii) Suggest **two** factors which should be taken into account when collecting the data in order to draw valid conclusions.

1

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2

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(2)

(Total 9 marks)

Q10. IAA is a specific growth factor.

- (a) Name the process by which IAA moves from the growing regions of a plant shoot to other tissues.

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(1)

- (b) When a young shoot is illuminated from one side, IAA stimulates growth on the shaded side. Explain why growth on the shaded side helps to maintain the leaves in a favourable environment.

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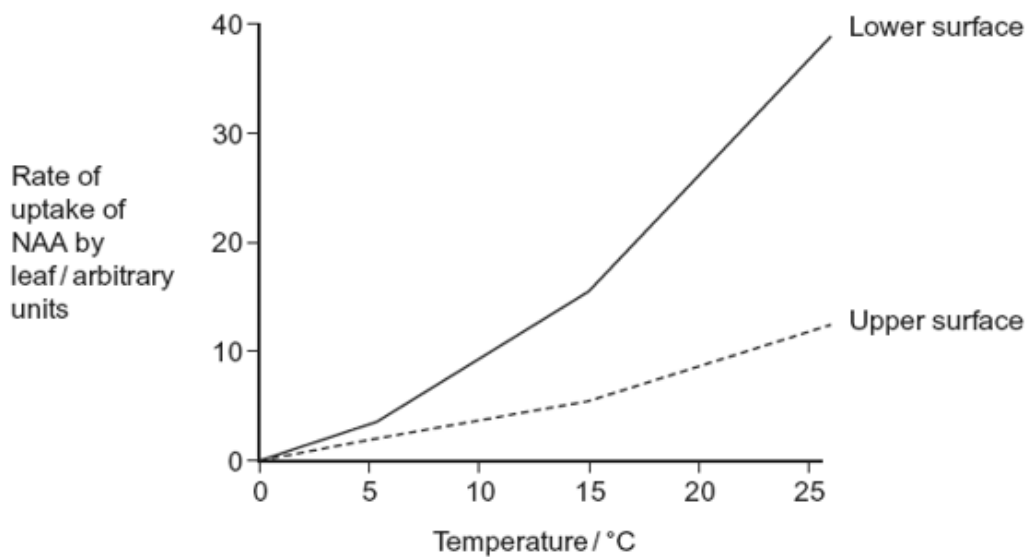
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(2)

NAA is a similar substance to IAA. It is used to control the growth of cultivated plants. Plant physiologists investigated the effect of temperature on the uptake of NAA by leaves. They sprayed a solution containing NAA on the upper and lower surfaces of a leaf. The graph shows their results.



- (c) Explain the effect of temperature on the rate at which NAA is taken up by the lower surface of the leaf.

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(2)

(d) There are differences in the properties of the cuticle on the upper and lower surfaces of leaves.

(i) Suggest how these differences in the cuticle might explain the differences in rates of uptake of NAA by the two surfaces.

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(2)

(ii) In this investigation, the physiologists investigated the leaves of pear trees.

Explain why the results might be different for other species.

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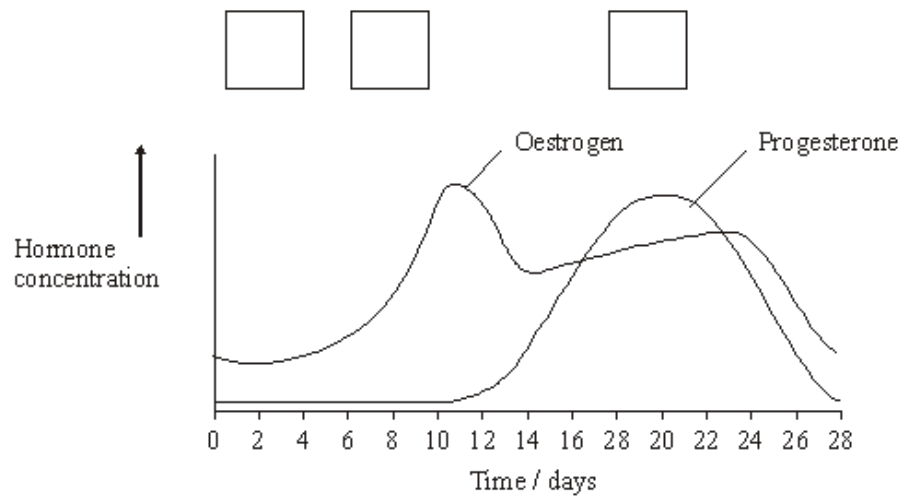
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(1)

(Total 8 marks)

- Q11.** (a) The graph shows the concentrations of two hormones during one sexual cycle of a human female. The diagram shows structures that produce these hormones.



Structures



- (i) Write the appropriate letters in the graph to show the order in which the structures labelled **P** to **R** appear during the cycle.
- (ii) Name the hormone that causes structure **Q** to develop.
- Describe **two** effects of progesterone on the uterus.
- Explain how oestrogen in contraceptive pills prevents fertilisation from taking place.

(1)

(1)

(2)

(2)

- (d) The sexual cycles of some female farm animals can be synchronised by giving them low doses of progesterone. When this treatment is stopped the animals come into oestrus a few days later. Explain how the withdrawal of progesterone causes them to come into oestrus.

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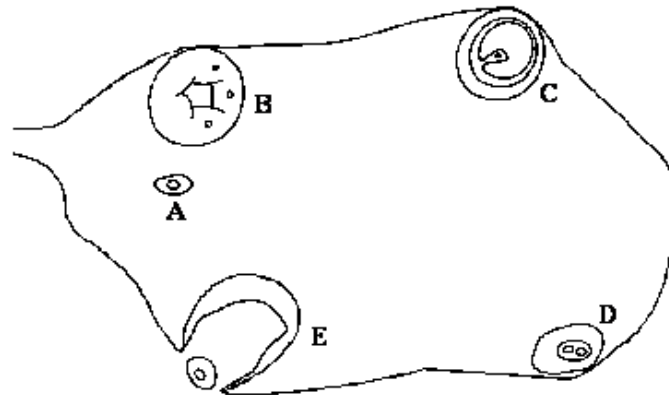
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(2)
(Total 8 marks)

- Q12.** (a) The diagram shows structures present in an ovary during an oestrous cycle of a mammal.



- (i) Starting with structure A, give the structures A to E in the order in which they appear in an oestrous cycle.

A

(1)

- (ii) Which of these structures produces most of the progesterone during an oestrous cycle?

(1)

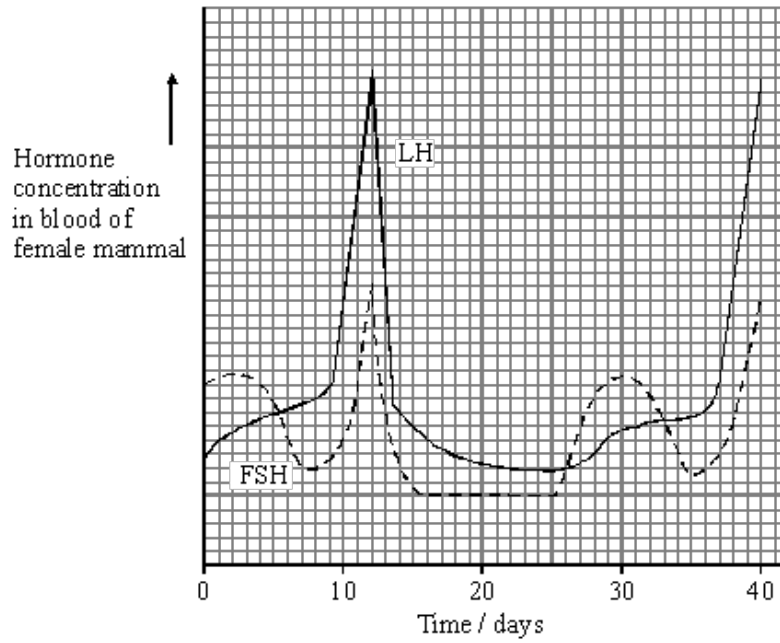
- (iii) Describe **one** effect of progesterone on the uterus.

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(1)

- (b) The graph shows the concentration of the hormones LH and FSH over 40 days.



- (i) On which day would you expect this mammal to ovulate?

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(1)

- (ii) Give the evidence from the graph which shows that pregnancy did not occur.

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(1)

(Total 5 marks)

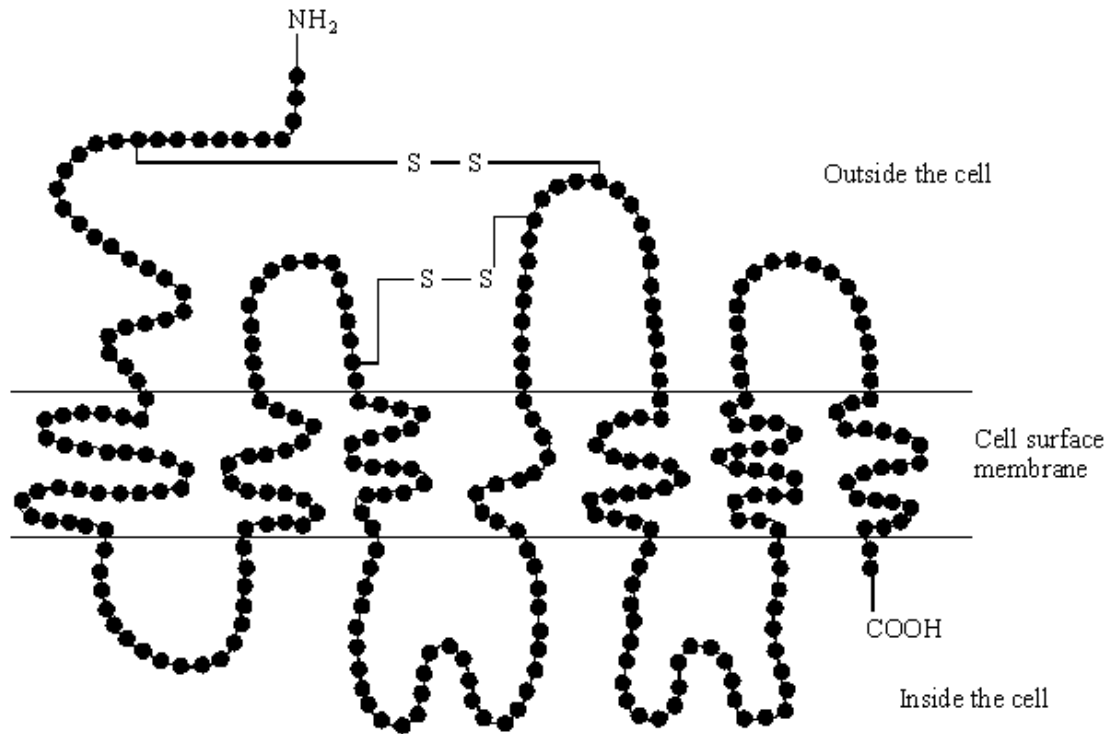
- Q13.** (a) Give **one** function of LH in females.

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(1)

In males, FSH stimulates sperm production and LH causes the release of testosterone. A hormone stimulates the release of FSH and LH by attaching to receptor molecules in the surface membrane of cells in the pituitary gland. The diagram shows one receptor molecule for this hormone.



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- S** (b) (i) Give **two** pieces of evidence from the diagram which suggest that the receptor molecule is a protein.

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(2)

- (ii) Explain how the tertiary structure of this protein is important for its function as a receptor molecule.

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(2)

- (c) Research has identified a substance which could be used as a male contraceptive pill. This substance binds to the receptor molecules in the pituitary gland and stops the release of FSH, but allows the release of LH to continue.

- (i) Explain **one** advantage of the substance not inhibiting LH release.

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(2)

- S** (ii) This substance is not a protein. Explain why a protein could **not** be used as an oral contraceptive.

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(2)

(Total 9 marks)

- M1.** (a) (i) Myosin filaments drawn longitudinally in A-band region;
Actin filaments drawn longitudinally from Z-line to edge of H-zone;
[Max. 1 mark if Actin and Myosin are not correctly labelled] 2
- (ii) Electron microscope has greater resolution / able to tell two
close objects apart better / electrons have shorter wavelength/
higher frequency; 1
- (b) Correct answer = 20;

Allow 1 mark for: $\frac{16 \times 1000}{8000}$;
OR

$$40 \div \frac{16}{8000}$$

2

[5]

- M2.** (a) (i) actin (*Accept* tropomyosin); 1
- (ii) myosin head; 1
- (b) (i) Ca^{2+} binds to [part of] the actin / troponin;
this causes tropomyosin to be displaced;
uncovers [myosin] binding sites [on actin] / allows actin to bind; max 2
- (ii) myosin heads bind to actin / cross bridge formation /
actomyosin formed;
myosin heads / crossbridges swivel / ratchet mechanism;
causing actin to slide relative to myosin;
energy provided by hydrolysis of ATP; max 3

- (c) (i) (number lightly stained fibres / total number of fibres) \times 100;
(actual numbers are 10/18 \times 100) 1
- (ii) sample not representative / large enough;
individual muscle fibres different sizes / contain different
number of myofibrils; max 1
- (d) all some stain = 1
fast dark and slow lighter = 2 2
- (e) change in base sequence in DNA;
addition / deletion / substitution of a base in DNA of the gene
which codes for myosin;
change in amino acid sequence / primary structure;
causes a different tertiary structure;
which alters the binding properties of myosin; max 4
- [15]

- M3.** (a) (i) H band not visible/reduced / little/no thick filament/myosin
only region / ends of thin filaments/actin close together;
I band not visible/reduced / little/no thin filament/actin only region;
A band occupies nearly all sarcomere / thick filament/myosin
close to Z line;
Large zone of thick-thin overlap; max 2
- (ii) *Calcium ions:*
Bind to troponin;
Remove blocking action of tropomyosin /
expose myosin binding sites;
- ATP:*
Allows myosin to detach from actin / to break cross bridge;
[allow attach and detach]
Releases energy to recock/swivel/activate myosin head / drive
power stroke; max 3
- (b) (i) Depolarisation of axon membrane/influx of Na⁺ establishes local
currents;
Change permeability to Na⁺ /open Na⁺ gates of adjoining region;
Adjoining region depolarises / influx of Na⁺ ;
This process repeated along axon / self propagation;
Correct reference to/description of saltatory conduction; max 3

- (ii) Depolarisation of (presynaptic) membrane;
 Ca^{2+} channels open / increased permeability to Ca^{2+} ;
 Influx of Ca^{2+} ;
 Vesicles move towards presynaptic membrane;
 Vesicles fuse with presynaptic membrane;
[If ions mentioned once assume candidate is referring to ions throughout; if no mention of ions penalise once only]

max 3

- (c) (i) 1. Correct axes labelled, correct orientation, linear scale;
 2. Key points (100%, 90% and 50%) plotted correctly;
 3. Plots joined by straight lines;
[allow reasonable hand-drawn straight lines]

3

- (ii) Fast fibres used (in explosive exercise);
[allow reverse for slow fibres]

1

[15]

- M4.** (a) Reduced rate of respiration / metabolism / chemical reactions;
 Energy conservation / less energy lost / less heat lost / conservation
 of stored fat / glycogen / food;

2

- (b) Optimum / fast / increased / temperature for enzymes / metabolism /
 chemical reactions / respiration;
 Optimum energy release for movement / faster movement /
 independent of environmental temperature;
Reject 'for faster activity'

2

[4]

- M5.** (a) (thermo)receptors in skin;
(accept receptors in hypothalamus if after reference to cooled blood)

impulses via nerves / neurones to or from;
(once only)

hypothalamus;
 heat gain/temperature centre (in hypothalamus);
 contraction /constriction of arterioles;
(not capillaries, or just vasoconstriction)

diversion through shunt vessels;

4 max

- (b) (i) reduced / no evaporation of sweat;
due to reduced gradient / saturation/high water content of air;
less heat loss by (latent) heat of evaporation;

2 max

- (ii) skin vessels open/vasodilatation;
(movement dq)

blood diverted from muscles / limited total volume of blood;

2

[8]

- M6.** (a) Easy to manage / can be kept safely in small space;
Genome / strains well known;
Physiology similar to humans / can be used to predict human behaviour

2 max

- (b) Same as control but inject with equal volume of solvent only;

1

- (c) (i) Heat lost from tail;
By conduction / convection / radiation;

2

Q Award credit to answers that refer to the evaporation of sweat from the tail.

Q Award credit to answers that are the converse of the above, relating to the rectal temperature

- (ii) Standard deviations show mean rectal temperatures are significantly different (in the two groups);
Rectal temperature indicates core temperature / heat generation;
Tail temperatures not significantly different (in the two groups);
Tail temperatures indicate no difference in heat loss;
None of the mice died (in this experiment);

Q If candidates fail to gain credit above, they can be awarded one mark for a clear statement that MDMA increases heat production but does affect not heat loss.

3 max

[8]

- M7.** (a) (i) Glucose;
Fructose;
Any order.

2

- (ii) Lactose has a different shape/structure;

Does not fit/bind to active site of enzyme/sucrase;

Only allow a second mark if reference is made to the active site.

Max 1 mark if active site is described as being on the substrate.

OR

Active site of enzyme/sucrase has a specific shape/structure;

Does not fit/bind to lactose;

Do not accept same shape.

2

- (b) (i) Rose and fell;

Peak at 45 (minutes) / concentration of $6.6 \text{ (mmol dm}^{-3}\text{)}$;

2

- (ii) Glucose (produced by digestion) is absorbed / enters blood;

Decrease as used up/stored;

2

- (iii) Curve roughly parallel to the x-axis or falling, starting from approximately the same point;

1

[9]

M8.

- (a) insulin binds to specific receptors (on membranes);
insulin activates carrier proteins / opens channels / causes more channels to form;
insulin increases the permeability of liver/muscle cells/tissues to glucose;
insulin action results in glucose conversion to glycogen / glycogenesis;

3 max

- (b) glucose is used in cell respiration / as energy source / in metabolism;
(must qualify how glucose is used)

glucose enters cells / converted to glycogen in cells;

glucose is excreted / in urine;

(do not credit no reabsorption of glucose in kidneys)

2 max

- (c) line from 80 mg, increasing but keeping below line for diabetic, dropping to 80 mg;
(line must stabilise at, or fluctuate around 80 mg)

1

- (d) (i) fast acting insulin reduces blood glucose from breakfast;
slow acting insulin reduces blood glucose from other meals before the evening meal / eliminates the need to inject at lunch;
(must be a reference to the meals)
(one mark if neither of the above but a clear reference is made to glucose conversion to glycogen);

2

- (ii) glucagon is still active;
glycogen converted to glucose / glycogenolysis;
insulin injected at breakfast causes cells to take up glucose
too slowly for levels to become dangerously low;
person is not active so little glucose used in respiration;
(do not credit statements about consuming large breakfasts)

1 max

[9]

M9.

- (a) (i) different shape/different tertiary structure/
different sequence of amino acids;

1

- (ii) insulin unable to attach to receptors;
reduced/no uptake of glucose into cells / no carrier proteins/
channels for glucose transport;

2

- (iii) glucose reabsorbed/absorbed into blood;
from proximal tubule;
by active transport/involving membrane carriers;

3

- (b) (i) larger genetic component;
(must be comparative)

1

- (ii) number of cases studied;
matched samples;
age of twins;
named environmental factor;;
(allow 2 marks for 2 different factors if no overlap in effect)

family history of diabetes;
method of diagnosis;
same sex in non-identical twins;

2 max

[9]

M10.

- (a) Diffusion;
Ignore references to simple/facilitated
Accept active transport

1

- (b) 1. Causes plant to bend/grow towards light / positive phototropism;
2. (Light) required for photosynthesis;

2

- (c) 1. More kinetic energy;
 2. Faster movement of molecules;
 3. More diffusion;
Ignore references to opening stomata.
Answer should be in context of more but comparative statement only necessary once.
- 2 max

- (d) (i) 1. Thick cuticle on upper surface / thin cuticle on lower surface / few stomata on upper surface / no stomata on upper surface;
 2. More diffusion / shorter diffusion pathway (on lower surface);
1. Ignore cuticle only on upper surface. Ignore references to more or less waxy.
2. If candidate writes about stomata accept ref to greater area for diffusion.
- 2

- (ii) Different species have different (qualified) properties;
Eg cuticle thickness
Leaf size
Number of stomata
- 1

[8]

- M11.** (a) (i) **R, P, Q;**
- 1
- (ii) luteinising hormone/LH;
- 1
- (b) stimulates growth of/maintains uterine lining; stimulates growth of blood vessels in uterine lining; stimulates invagination of uterine lining; stimulates production of mucus; inhibits contraction of uterus;
- 2 max

- (c) inhibits follicle stimulating hormone/FSH;
prevents follicle developing / releasing an ovum;
Reject stops ova being produced or release of follicle.

2

- (d) removes inhibition of FSH / FSH production starts;
stimulating follicle development;

OR

removes inhibition of LH / LH production starts;
stimulating ovulation;

2

[8]

M12. (a) (i) A D C E B ;

1

- (ii) B / corpus luteum;

1

- (iii) stimulates growth of/maintains uterus lining/endometrium /
stimulates growth of blood vessels in uterus lining /
stimulates development of glands in uterus lining /
stimulates secretion of fluid in uterine lining /
stimulates invagination of uterine lining;
(Reject ref. repair/wall of uterus, Ignore contractions)

1

- (b) (i) day 12 / day 40;

1

- (ii) LH falls after peak / FSH and/or LH rise again in another cycle;

1

[5]

M13. (a) ovulation;
development/maintenance of corpus luteum;
stimulates release of progesterone;

1 max

- (b) (i) amino and carboxyl groups;
sulphur/sulphide bonds;
across/spans whole membrane;

2 max

- (ii) specific shape;
which is complementary to hormone shape;
(max one mark if reference to active site)

2

- (c) (i) testosterone released / produced;
important for maintenance of secondary sexual characteristics /
sex drive/named characteristic;
2
- (ii) digested;
by proteases/named protease (in stomach/intestine);
2

[9]

- E1.**
- (a) Although in general part (i) was attempted, marks were not always obtained by candidates. A common error was to draw actin and myosin in roughly the correct places relative to each other but to pay little attention to the lines aligning the space for response and the drawing of the myofibril. Part (ii) was well understood and most candidates were able to recall the main advantages of electron microscopes.
 - (b) This calculation produced fewer correct responses than the calculation later in the question paper. From the responses given it was apparent that few candidates were able to comprehend what they were being asked to do and did not measure the width of the sarcomere at 16mm. Those candidates that did make this measurement mostly went on to calculate the correct answer of 20.
- E2.**
- (a) (i) and (ii) A majority of candidates were able to identify A as the myosin head, although rather fewer were able to name actin as the main protein in the thin filament.
 - (b) In general, the responses to this section of the question revealed a pleasing level of knowledge and understanding.
 - (i) Many candidates, including otherwise weaker candidates, were able to describe the role of calcium ions in binding to troponin and removing tropomyosin from the myosin binding sites on the actin molecule.
 - (ii) Again, a good number were able to describe the role of ATP and the two proteins in bringing about contraction of the myofibril.
 - (c) (i) Only better candidates realised that to calculate the percentage of fast fibres, the number of fast fibres (lightly stained fibres) must be divided by the *total* number of fibres and this figure then multiplied by one hundred. Many weaker candidates multiplied the ratio of the two fibres by one hundred.
 - (ii) Most candidates could explain that the figure obtained might not be typical as different regions of a muscle may have different proportions of the two fibres, or because the sample used is such a small one as to be not necessarily reliable.
 - (d) Only really able candidates realised that *all* the fibres would undergo glycolysis, whether respiring aerobically or anaerobically. However, those respiring anaerobically would undergo glycolysis only (and not any further stages of the aerobic pathway) and so produce the enzymes used in glycolysis in greater concentrations.
 - (e) Many candidates interpreted this question as another concerning natural selection, despite the clear instruction to explain how a new form of myosin could be *formed as a result of mutation*. Good candidates were able to explain how alterations to the base sequence of DNA could result in a different mRNA and, as a result, a different primary structure of the protein. They then went on to explain how this would result in different folding of the molecule, tertiary structure and properties as a result.

- E3.** (a) In part (i), rather too many candidates failed to refer to the diagram in their answers. "The sarcomere has shortened" was the most common example of a factually correct statement which failed to answer the question. The role of ATP continued to cause confusion. There were many answers describing the role of ATP as attracting the myosin to the actin, clearly beyond the bounds of any degree of uncertainty.
- (b) Part (i) was the only question on the paper that was universally badly answered, with over 90% of candidates scoring one or zero. It was not easy to determine whether candidates were misinterpreting the question or simply did not understand how the impulse is propagated. Part (ii) produced better responses with many candidates gaining all three marks. Candidates who used incorrect charges on the ions, e.g. Ca^+ or Ca^{2-} , failed to gain marks and would have been better off writing the words 'calcium ions'. Another common error was to have the calcium ions being released as opposed to entering.
- (c) Although well answered, the graph in part (i) brought up several issues. Candidates making errors in graphs should be encouraged to obtain an additional sheet of graph paper from the invigilators and attach it to their script. Several candidates failed to gain marks because their final offering was not discernable from several previous attempts. Candidates should also be encouraged to use sharp pencils and rulers in constructing graphs. A level biology follows IOB guidelines on the construction of graphs and in this case failure to join the plots with straight lines was not rewarded. In this question, straight lines were required by the data presented in the stem anyway. In (ii), most candidates gave a correct response.
- E4.** (a) Most were successful here and pointed out that a reduction in the body temperature of the echidna would result in reduced metabolic rate and, hence, would help to conserve stored energy reserves such as fat or glycogen.
- (b) Here, most recognised that the temporary rise in body temperature of the animal would present the converse situation to that in part (a), but most candidates then merely re-stated the question, writing that the echidna could then be active. The final mark was only awarded, infrequently, for developing this point in relation to greater availability of energy for faster movement or enabling the echidna to move around despite the prevailing cold environmental conditions.
- E5.** (a) There were many good answers, describing fully the roles of the hypothalamus and the heat gain centre as well as the contraction of muscles in the arterioles. There were, however, many candidates who demonstrated misunderstandings. It was clear that many who used the term 'vasoconstriction' thought that it referred to contraction of capillaries, and there are still candidates who think that the capillaries move away from the skin surface. Some suggested a direct nervous link from the receptors to the blood vessels in the skin, and others invoked a hormone from the hypothalamus. Weaker candidates often referred also to hair erection, sweating and so on, having apparently not read the question carefully.
- (b) (i) This part also generated many good answers, although a significant number of candidates confused humidity with heat. Often answers were spoilt by careless expression. Quite large numbers stated that less sweat is produced in humid conditions, and candidates often appeared to have a poor grasp of the physical processes involved. Few referred to, or described, the idea of latent heat of evaporation, and some suggested that water droplets make the skin feel cold.

- (ii) Better candidates gave a good description of vasodilatation resulting in blood being diverted from the muscles, although few explicitly noted that there is a limited total volume of blood in the body. Weaker candidates postulated strange hypotheses such as that blood flow to the muscles is restricted so that the heat they generate does not cause over-heating, or that the oxygen supply is reduced so that the muscles have to work slower and produce less heat.

- E7.**
- (a) Most candidates were able to identify glucose as one of the monomers from which a molecule of sucrose was formed, but there was less certainty about the other. Part (ii) was designed to be accessible to grade E candidates and, in view of this, it was disappointing to see so few gaining full credit. There were a number of predictable errors such as in describing the active site as being on the substrate, and in maintaining that active site and substrate were the same shape. Credit was generally lost however because of a lack of precision in the answers. There were many general references to specificity that were simply worded in terms of sucrose and lactose not being 'specific to each other' or enzymes being specific to a particular substrate. Good answers amplified the concepts of shape and fit with appropriate reference to complementarity and the active site of the enzyme.
 - (b) It is encouraging to note that most candidates were able to describe the data in the graph with appropriate precision and gained full credit for their answers to part (i). There were, however, candidates who failed to distinguish between the terms 'describe' and 'explain' and offered inappropriate responses both here and in part (ii). In part (ii), better candidates generally identified the role of absorption in raising the glucose concentration and respiration or storage resulting in the fall after 45 minutes. Difficulties arose where candidates referred imprecisely to sugar, and there were many answers where the examiners were left unclear as to whether glucose or sucrose was being discussed. It was also apparent that many candidates considered the graph to be showing some aspect of enzyme activity and responded in terms of the effect of a particular parameter on substrate or product concentration. Candidates would be well advised to take the necessary time to read the introduction to questions based on data and to look carefully at the axes before embarking on their response.
- E8.**
- (a) Generally, this question was answered well, although a lack of precision in some answers cost candidates marks, for example, by failing to refer to receptors that are specific to insulin or by not stating the type of cell where the carrier proteins for glucose are located. Common misconceptions were observed when candidates implied that glucose would only enter cells when insulin was present. Even though this is a topic that is generally covered well by candidates at GCSE, a number still believes that insulin catalyses the production of glycogen and others that insulin is responsible for the breakdown of glycogen. The poor spelling of important technical terms also cost some candidates marks; glycogen and glucagon were most often incorrect.
 - (b) The role of glucose in respiration was a commonly given as a correct response and many candidates obtained both marks, usually by including a description about the excretion of glucose in urine. However, a surprisingly high proportion of candidates referred to glucose being lost in urea.
 - (c) Most candidates answered this question correctly. A common error was to begin the curve from 175 mg rather than from 80 mg as indicated in the question.

- (d) (i) Generally, this was answered well by candidates across a wide range of ability levels, but the idea that insulin breaks down glucose was a common misconception.
- (ii) References to the role of glucagon or the process of glycogenolysis were common, although many failed to gain the mark by confusing the spellings of these technical terms.

E9. This question also resulted in the full range of marks.

- (a) (i) Although most candidates correctly referred to shape as being important, many of these explained their answer in terms of active sites and so could not be awarded the mark.
- (ii) There were many full and accurate answers showing a good understanding of the role of insulin. However, many answers showed considerable confusion. Many candidates stated that glucose was unable to bind to the receptors, that the release of insulin was stopped or that insulin converted glucose to glycogen with no reference to glucose uptake into cells or enzyme activation.
- (iii) This was answered well by the majority of candidates. Most realised that the glucose was reabsorbed, but some stated that the molecule was too large to pass through Bowman's capsule. Similarly, most candidates stated correctly the site and method of reabsorption. Candidates tended to lose marks as a result of incomplete rather than incorrect answers.
- (b) This was answered well by the majority of candidates. The weaker candidates tended to repeat the data in the table rather than explaining it or did not make a comparison. Most candidates gave at least one valid factor, with many also scoring a second mark. Some failed to score because of vague references to the environment being the same, rather than giving a named environmental factor.

E10. (a) Although diffusion of auxin from the growing regions of a shoot is included in the specification, a considerable number of candidates failed to gain what should have been a readily accessible mark. Incorrect answers were broadly spread between inappropriate processes such as osmosis and behavioural responses such as tropism and kinesis.

(b) Those candidates who recognised that a growth response was involved recognised that the shoot would gain light for photosynthesis. There were, however, many vague answers that simply referred back to the favourable environment mentioned in the question.

- (c) Most of the candidates who attempted to explain rather than describe the data appreciated that a rise in temperature would result in an increase in the rate of diffusion. Few, however, related this to an increase in kinetic energy or to faster movement. Many phrased their answers in terms of stomatal closure at higher temperatures, contradicting information supplied in the graph.
- (d) Many of the candidates answering part (i) failed to heed the information given in the question stem and attributed the difference in rates of uptake to the absence of a cuticle on the upper surface. Of those who did take note of this information, a significant few confused cuticle and stomata, often writing of fewer cuticles being present through which water could pass. However, there were some excellent responses which attributed the difference in rate of uptake to either a thicker cuticle on the upper surface of the leaf or fewer stomata. Most candidates recognised that features and characteristics differed between species and offered realistic answers to part (ii).

E11. (a) Most candidates were able to give correct sequence R, P, Q for (i) but other suggestions were found.

In (ii), progesterone was a common incorrect answer.

- (b) Most candidates did not seem to read the question, so as well as referring to the effect of progesterone on the uterus lining they wrote about inhibition of other hormones. Few correctly referred to growth of blood vessels but instead talked about increased blood supply. Many preferred to write about the effect of lack of progesterone on the uterus instead.
- (c) Inhibition of FSH and LH was seen too often. Follicles were also being released and ova produced! These responses reflect poor use of language or misunderstanding. A few still answer in terms of the contraceptive pill 'fooling the body into thinking that it is pregnant'.
- (d) Many candidates understood that withdrawal of progesterone leads to release of FSH and/or LH, but went on to re-state what they were given in the question, i.e., that this causes the animals to come into oestrus, without explaining how this might happen.

E12. (a) In part (i) the most common error was to reverse B and E. In part (ii) a number of candidates unfortunately qualified an otherwise correct answer with the wrong letter, thereby cancelling the mark. Most found part (iii) easy though a few discussed effects elsewhere than in the uterus. It was pleasing that nearly all candidates referred to the lining rather than to the wall of the uterus.

- (b) A few candidates misread the graph. The evidence was usually appropriate but imprecise comments on rises and falls resulted in a failure to gain marks.

E13. This question produced a wide range of marks, with the most able candidates scoring full marks.

- (a) Nearly all candidates answered this question correctly. Most of them referred to the formation/maintenance of the corpus luteum or release of progesterone.
- (b)
 - (i) Most candidates scored one mark for mentioning the carboxyl and amino groups. Only a minority gave a second piece of evidence such as the presence of sulphur bonds or the fact that the molecule is a polymer spanning the membrane. Weaker candidates referred to features not shown by the diagram, such as many amino acids joined together.
 - (ii) This question was not answered well. The majority of candidates referred to the importance of the shape of the active site, with some basing their whole answer on enzyme action. Only a minority of candidates discussed the importance of the specific shape of a receptor being complementary to the hormone shape.
- (c)
 - (i) The majority of candidates scored both marks for stating that testosterone would still be released, and describing the importance of this.
 - (ii) Most candidates realised that a protein would be digested, and so were able to score one or two marks here.

