

Name: _____

Homeostasis and Response part 9 AQA Triple Biology

Class: _____

Date: _____

Time: **83 minutes**

Marks: **77 marks**

Comments:

1.

The echidna is a mammal that lives in Australia.

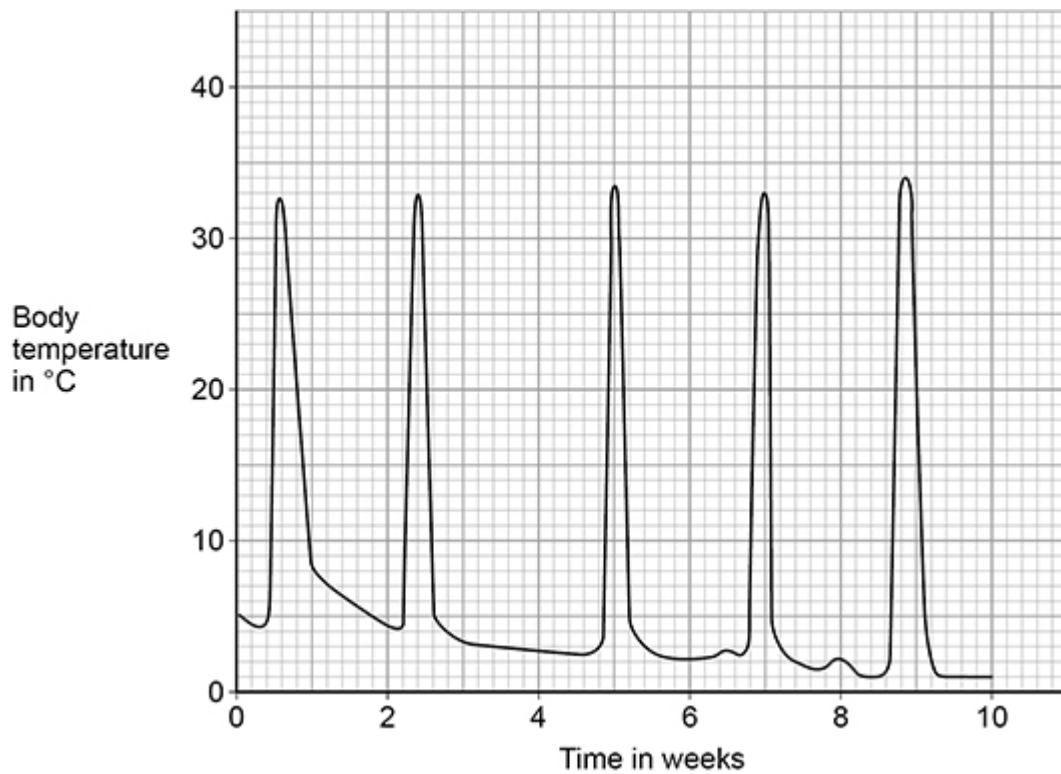
Figure 1 shows an echidna.

Figure 1



Figure 2 shows how the body temperature of the echidna varies during the cold winter months.

Figure 2



(a) Give the lowest and highest body temperatures for the echidna shown in **Figure 2**.

Lowest temperature = _____ °C

Highest temperature = _____ °C

In the cold winter months, the echidna hibernates.

Figure 2 shows that the echidna woke up from hibernation several times.

The echidna's body temperature increased to over 30 °C each time the echidna woke up.

(b) How many times did the echidna wake up?

Use information from **Figure 2**.

(1)

(c) Each time the echidna wakes up, it hunts for food.

Suggest why the echidna needs to eat food several times during hibernation.

(1)

(d) During hibernation:

- the echidna sleeps
- the echidna's body temperature decreases to below 5 °C
- the echidna uses food stored in its body cells to provide energy.

What process releases energy from stored food?

Tick (✓) **one** box.

Diffusion

Excretion

Respiration

(1)

(e) Most mammals use a lot of energy to evaporate sweat.

The echidna does **not** sweat.

Suggest **one** use of energy in the echidna's body.

(1)

The control of body temperature is important in the human body.

An athlete trained in a hot climate.

(f) On one day, the athlete lost 3 200 cm³ of water in sweat.

Evaporation of 1 cm³ of sweat requires 2.5 kJ of energy.

Calculate the energy the athlete used for evaporation of sweat.

Energy = _____ kJ

(2)

(g) On a different day the athlete used 6 000 kJ of energy to evaporate sweat.

The athlete's energy intake was 24 000 kJ.

Calculate the percentage of the athlete's energy intake used for evaporation of sweat.

Percentage = _____%

(2)

(h) Some days the athlete did **not** do any training and rested at home.

What effect would resting have on the volume of sweat produced each day?

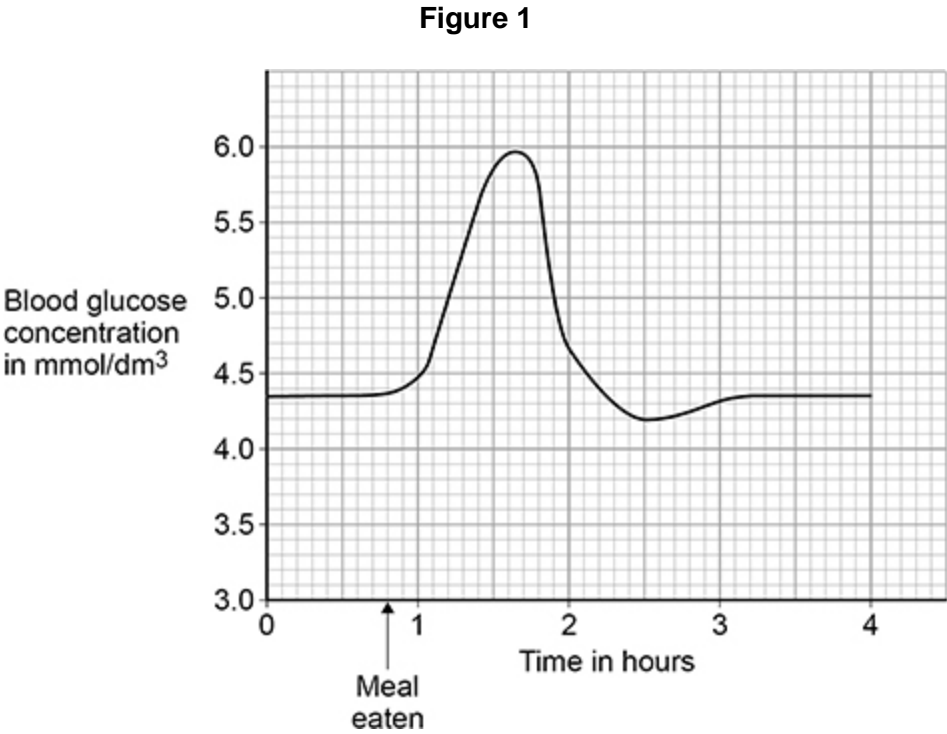
(1)

(Total 10 marks)

2.

It is important to control the concentration of glucose in the blood.

Figure 1 shows how the concentration of glucose in the blood of a person changed over 4 hours.



(a) Give **one** time when the concentration of **insulin** in the person's blood would be high.

Use **Figure 1**.

Time = _____ hours

(1)

(b) Explain the effect a high concentration of insulin has on blood glucose concentration.

Effect _____

Explanation _____

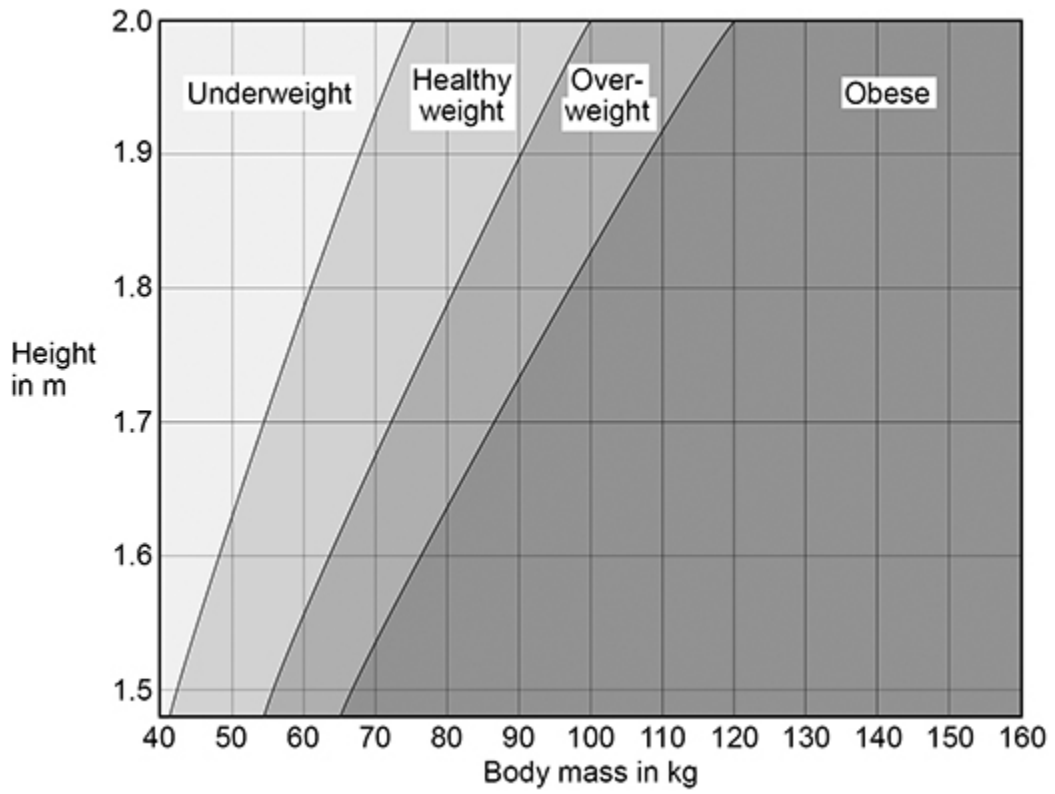
(3)

People with diabetes have difficulty controlling the concentration of glucose in their blood.

Type 2 diabetes is linked to obesity.

Figure 2 shows how to find if an adult's body mass is healthy for their height.

Figure 2



- (c) Person **A**:
- is 1.75 m in height
 - has a body mass of 52 kg.

What is person **A**'s weight category?

Tick (✓) **one** box.

Underweight

Healthy weight

Overweight

Obese

(1)

- (d) Person **B** is 1.9 m in height.

Give the range of body masses that would put person **B** in the healthy weight category.

Range from _____ kg to _____ kg

(1)

(e) Person **C** is obese.

A doctor thinks that person **C** has Type 2 diabetes.

The doctor tests a sample of blood from person **C**.

The table below shows:

- the results of the blood test
- the mean results for people who do **not** have diabetes.

	Concentration in blood	
	Person C	Mean for people who do not have diabetes
Cholesterol in mmol/dm ³	6.21	5.20
Glucose in mmol/dm ³	9.56	4.51
Insulin in arbitrary units	24.32	14.83

Type 2 diabetes occurs when body cells have a reduced response to insulin.

Give **two** ways the results of the blood test show that person **C** might have Type 2 diabetes.

1 _____

2 _____

(2)

(f) Give **two** ways that a person can reduce the chance of developing Type 2 diabetes.

1 _____

2 _____

(2)

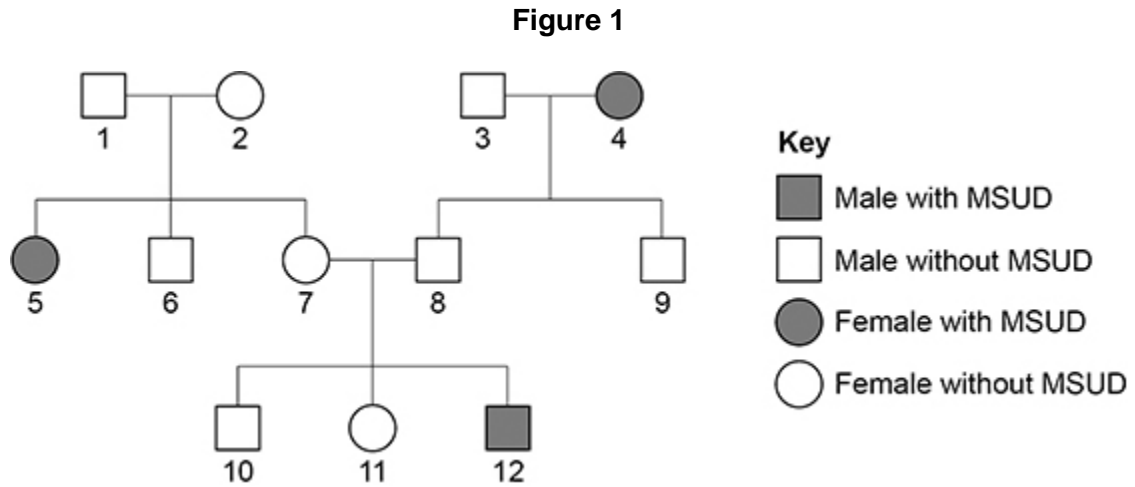
(Total 10 marks)

3.

Maple syrup urine disease (MSUD) is a rare inherited human condition.

MSUD is usually diagnosed early in childhood and can be controlled by having a low-protein diet.

Figure 1 shows the inheritance of MSUD in one family.



The allele for MSUD is recessive.

- (a) Give **one** piece of evidence from **Figure 1** which shows that MSUD is a recessive condition.

(1)

(b) Persons **7** and **8** in **Figure 1** are expecting a fourth child.

Determine the probability that the child will have MSUD.

You should:

- draw a Punnett square diagram
- identify the phenotype of each offspring genotype
- use the symbols:

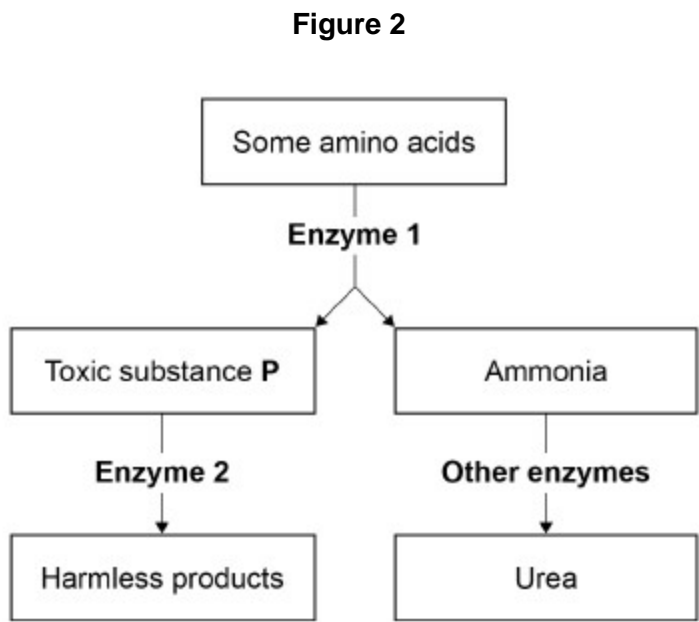
N = allele for **not** having MSUD

n = allele for MSUD.

Probability = _____

(4)

Figure 2 shows chemical reactions involved in the normal breakdown of some types of amino acid inside body cells.



A person with MSUD **cannot** make **Enzyme 2**.

(c) One of the final products shown in **Figure 2** is urea.

Where in the human body are the reactions shown in **Figure 2** most likely to occur?

Tick (✓) **one** box.

Kidney

Liver

Pancreas

Small intestine

(1)

Scientists can analyse blood samples or urine samples to see if a person has MSUD.

The test identifies high concentrations of toxic substance **P**, shown in **Figure 2**.

- (d) Explain why the **blood** of a person with MSUD will have a high concentration of toxic substance **P**.

Use information from **Figure 2**.

(3)

- (e) Explain why the **urine** of a person with MSUD will have a high concentration of toxic substance **P**.

(2)

- (f) Explain why a person with MSUD must have a low-protein diet.

(3)

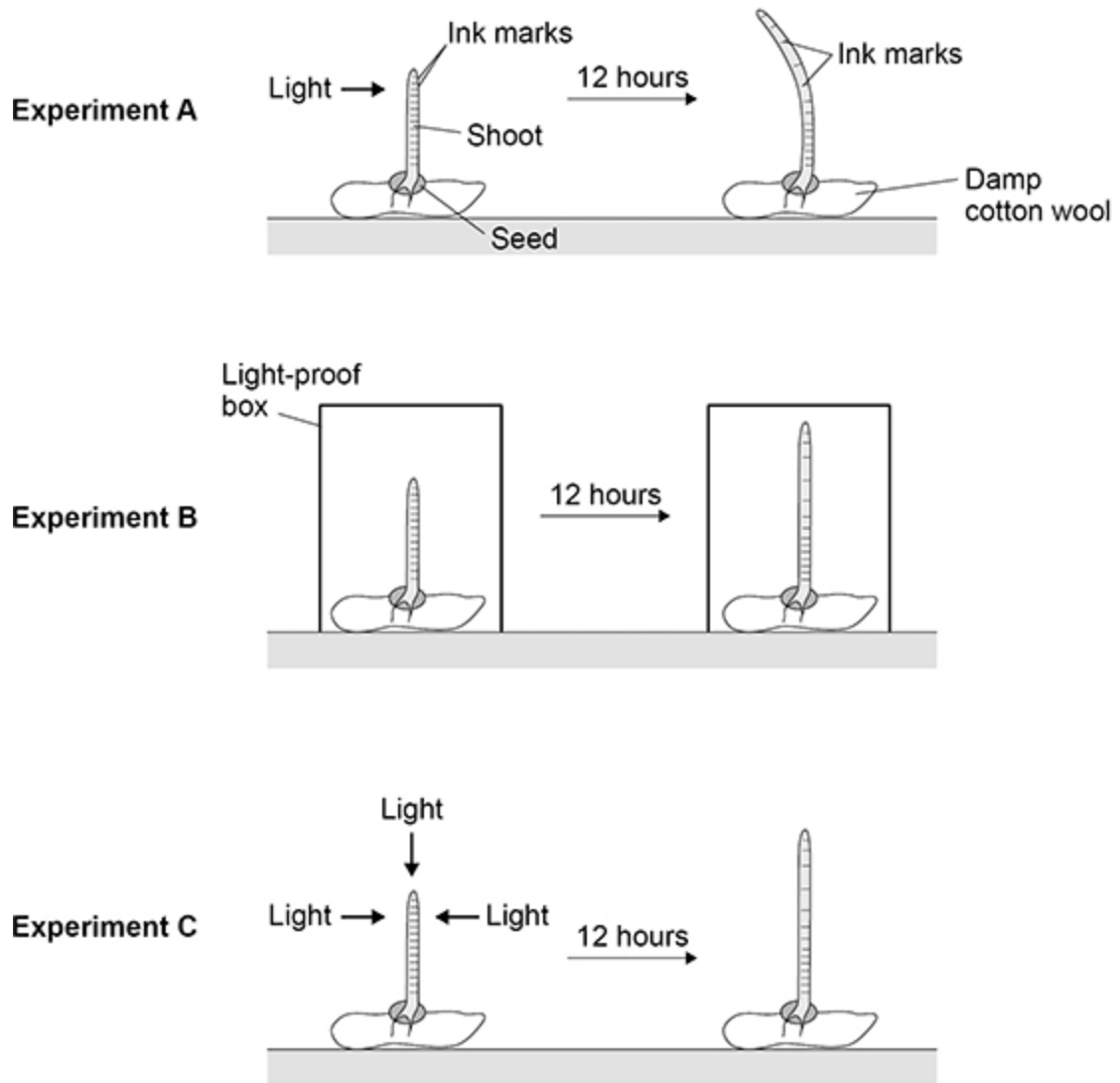
(Total 14 marks)

4.

Students investigated the response of plant shoots to one-sided light.

Figure 1 shows how the students set up three experiments.

Figure 1



(a) Suggest **two** control variables the students should have used in their investigation.

1 _____

2 _____

(2)

(b) Describe how experiment **B** and experiment **C** acted as controls for the investigation.

Experiment **B** _____

Experiment **C** _____

(2)

(c) Give **two** conclusions that the students could make from the **ink marks** on the shoot in experiment **A**.

1 _____

2 _____

(2)

(d) Name the type of response shown by the seedling in experiment **A**.

(1)

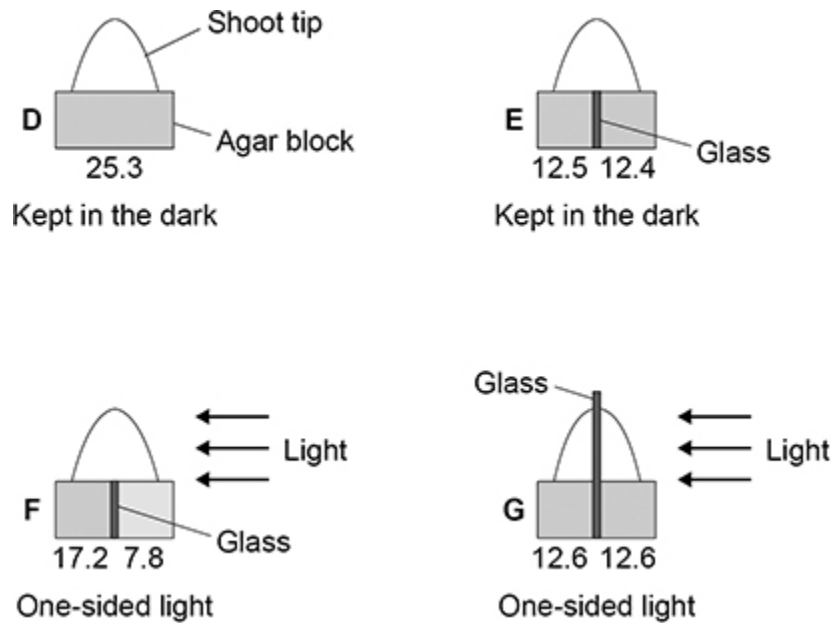
Auxin is a plant hormone. Auxin is made in the shoot tip.

Scientists investigated the role of auxin in the response of shoot tips to light.

This is the method used.

1. Grow four seedlings in the dark for a few days.
2. Cut the tip off the shoot of each seedling.
3. Place each shoot tip on a small block of agar jelly.
4. Place the shoot tips and agar in different conditions as shown in **Figure 2**.
5. After 24 hours, measure the mass of auxin in the agar blocks.

Figure 2



The numbers under each block show the mass of auxin that diffused into the blocks from the shoot tips.

The mass of auxin is given in arbitrary units.

(e) A scientist made a hypothesis:

'Light causes auxin to move from the side of the shoot nearest to the light to the side furthest from the light.'

Describe the evidence from **Figure 2** which supports the hypothesis.

(3)

(f) Another scientist made a different hypothesis:

'Light causes the breakdown of auxin.'

Give the evidence from **Figure 2** that shows that auxin is **not** broken down by light.

(1)

(Total 11 marks)

5.

An echidna is a mammal that lives in Australia.

Figure 1 shows an echidna.

Figure 1



Figure 2 shows how the body temperature of the echidna varies in warm weather and in cold weather.

Figure 2

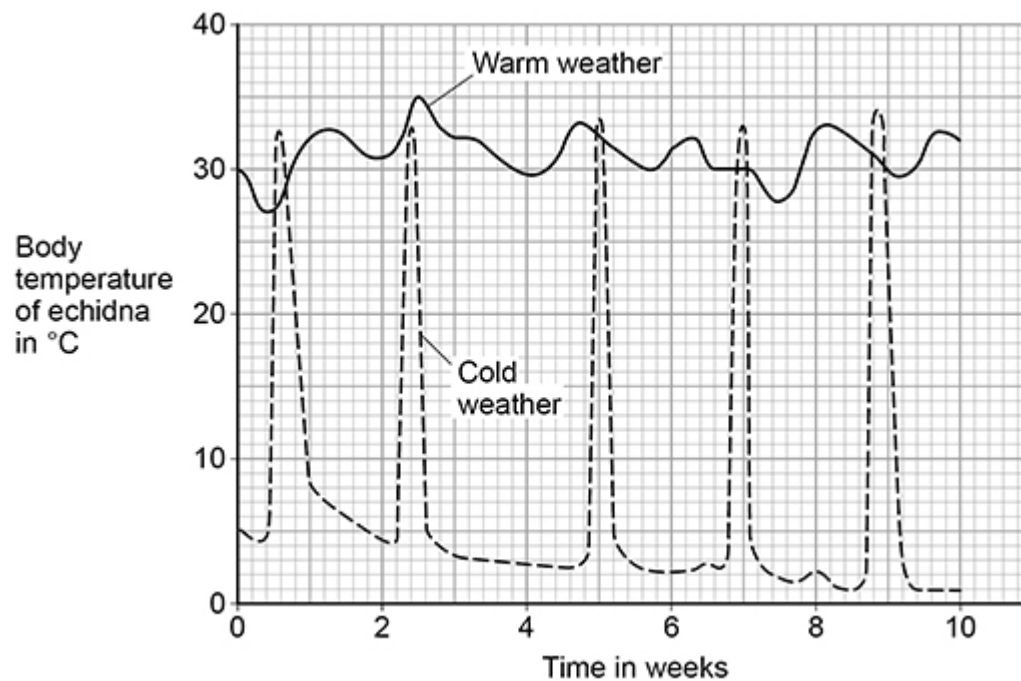
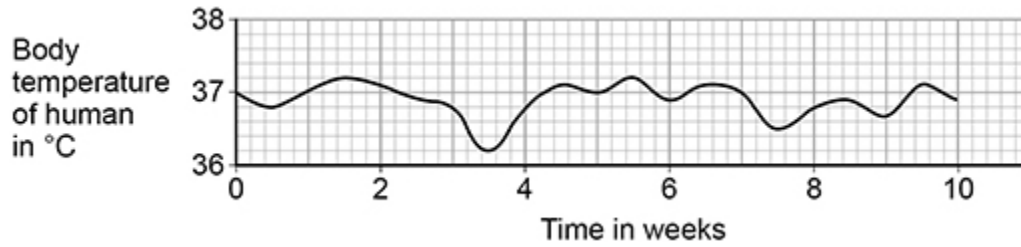


Figure 3 shows how human body temperature varies.

Figure 3



- (a) Compare the variation in body temperature of the echidna in warm weather with the variation in body temperature of the human.

Use data from **Figure 2** and **Figure 3**.

(2)

In the cold winter months, the echidna hibernates.

During hibernation:

- the echidna's body temperature decreases to below 5 °C
- the echidna sleeps for up to 17 days at a time
- the echidna's rate of metabolism slows down.

- (b) Explain why the decrease in body temperature is an advantage to the echidna during hibernation.

(2)

(c) During hibernation the echidna wakes up several times.

Each time the echidna wakes up it becomes active and its body temperature increases to over 30 °C.

Explain why the echidna has a higher body temperature when it is active.

(2)

(d) An echidna can dilate and constrict blood vessels in its skin.

Explain how the **dilation** of blood vessels in the skin can help to decrease body temperature.

(3)

An athlete trained in a hot climate.

The athlete lost a large volume of water each day in sweat.

(e) The athlete's energy intake each day from food was 20 000 kJ.

Evaporation of 1 cm³ of sweat requires 2.5 kJ of energy.

40% of the athlete's daily energy intake was used to evaporate sweat.

Calculate the volume of sweat the athlete lost each day.

Give your answer in dm³

1 dm³ = 1 000 cm³

Volume of sweat lost in one day = _____ dm³

(3)

(f) Suggest why the athlete was advised to take salt tablets each day.

(1)

(Total 13 marks)

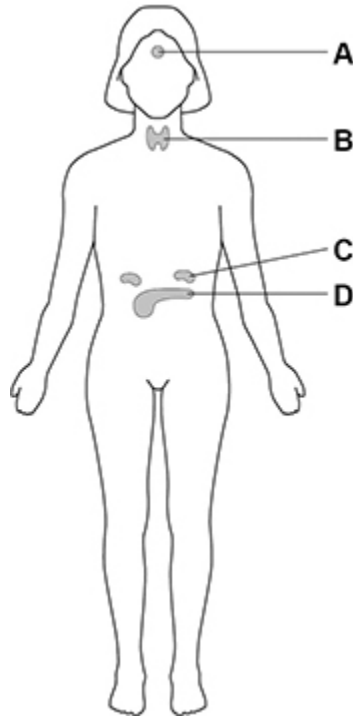
6.

Many internal processes of the human body are controlled by hormones.

Hormones are produced by glands.

Figure 1 shows glands in a woman's body.

Figure 1



(a) Which gland is the pituitary gland?

Tick (✓) **one** box.

A B C D

(1)

(b) Which gland is the pancreas?

Tick (✓) **one** box.

A B C D

(1)

The hormone insulin helps to decrease the blood glucose concentration.

Insulin causes its target organs to take in glucose from the blood.

(c) Which of the following is a target organ for insulin?

Tick (✓) **one** box.

Bladder

Heart

Liver

(1)

(d) The glucose is stored as an insoluble substance.

What is the insoluble storage substance that is formed from glucose?

Tick (✓) **one** box.

Glycogen

Protein

Urea

(1)

Scientists investigated the effect of a glucose drink on the concentration of glucose in a person's blood.

This is the method used.

1. Take a small sample of blood from the person.
2. Measure the concentration of glucose in the person's blood.
3. Give the person a drink containing 50 grams of glucose.
4. Measure the concentration of glucose in the person's blood at intervals.
5. Calculate the **change** in blood glucose concentration from the starting value.

Figure 2 shows the results.

Figure 2

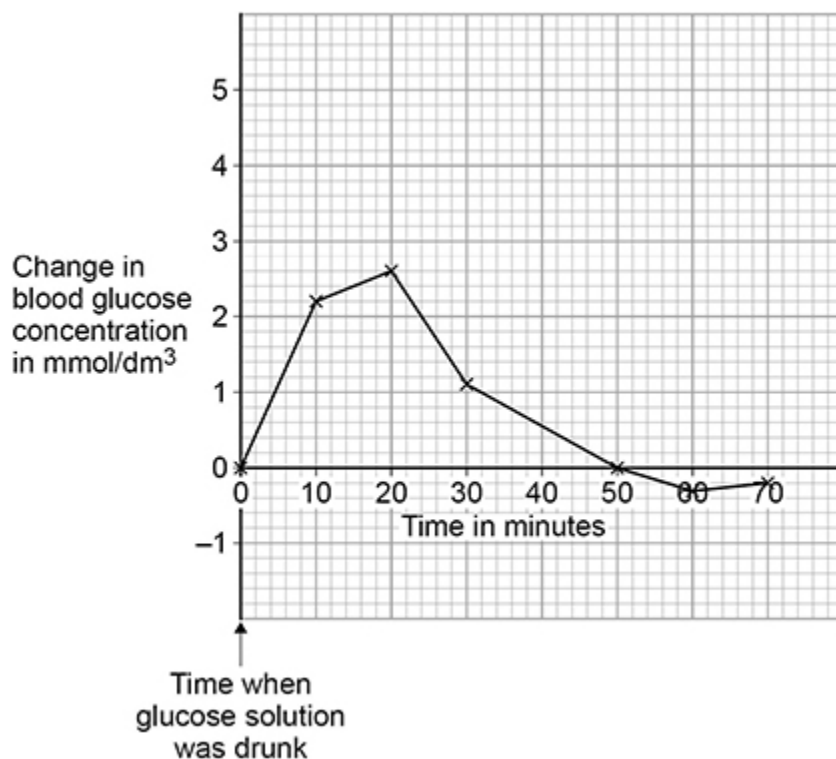


Figure 2 shows the **change** in blood glucose concentration.

- (e) At the start of the investigation, the blood glucose concentration was 5 mmol/dm³.

Calculate the highest blood glucose concentration during the investigation.

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

Highest blood glucose concentration = _____ mmol/dm³

(2)

- (f) What is the time taken for the blood glucose concentration to decrease from its highest value back to the starting value?

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

Time taken = _____ minutes

(1)

- (g) Why can you **not** be certain that your answer to part (f) is accurate?

(1)

- (h) **Figure 2** above shows the results for a person who does **not have** Type 2 diabetes.

Sketch a line on **Figure 2** to show the results you would expect for a person who **has** Type 2 diabetes.

(2)

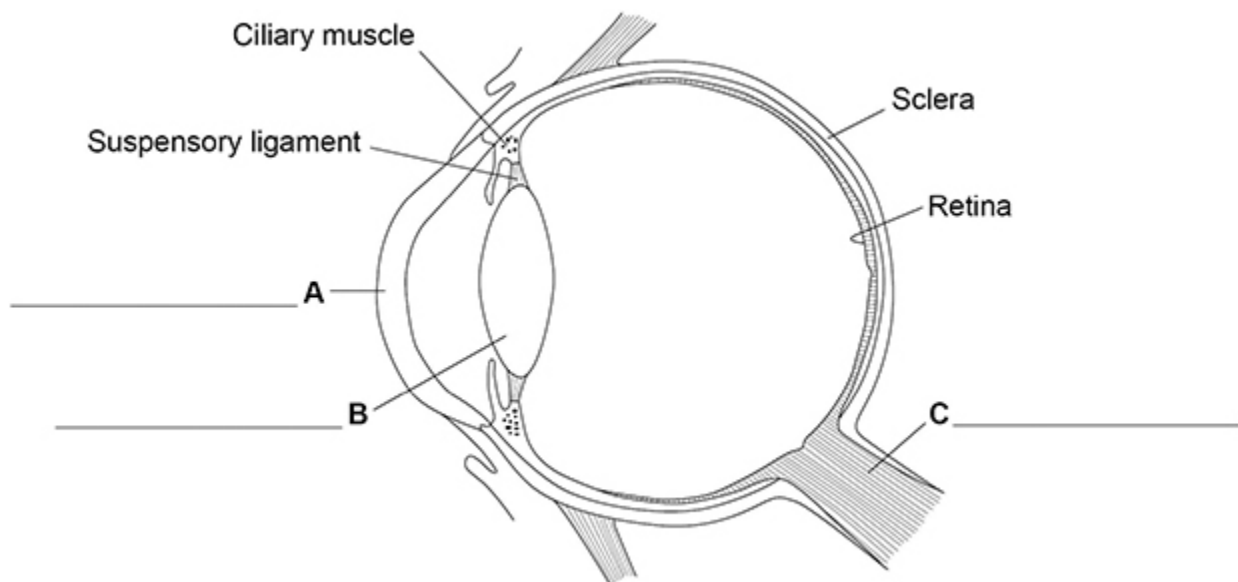
(Total 10 marks)

7.

The human eye can form images of objects that are at different distances away from the eye.

Figure 1 is a diagram of the eye.

Figure 1



(a) Label structures **A**, **B** and **C** on **Figure 1**.

Choose answers from the box.

cornea	eyelid	iris	lens	optic nerve
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(3)

The eye in **Figure 1** is focused on a distant object.

If the eye then focuses on the words in a book, changes would occur in the eye.

The light rays would be refracted more by the lens.

(b) How does the lens refract the light more?

Tick (✓) **one** box.

By becoming longer

By becoming thicker

By becoming transparent

(1)

(c) Which **two** structures control the shape of the lens?

Tick (✓) **two** boxes.

Ciliary muscles

Cornea

Iris

Sclera

Suspensory ligaments

(2)

- (d) To form a clear image, the light rays entering the eye must focus on one structure in the eye.

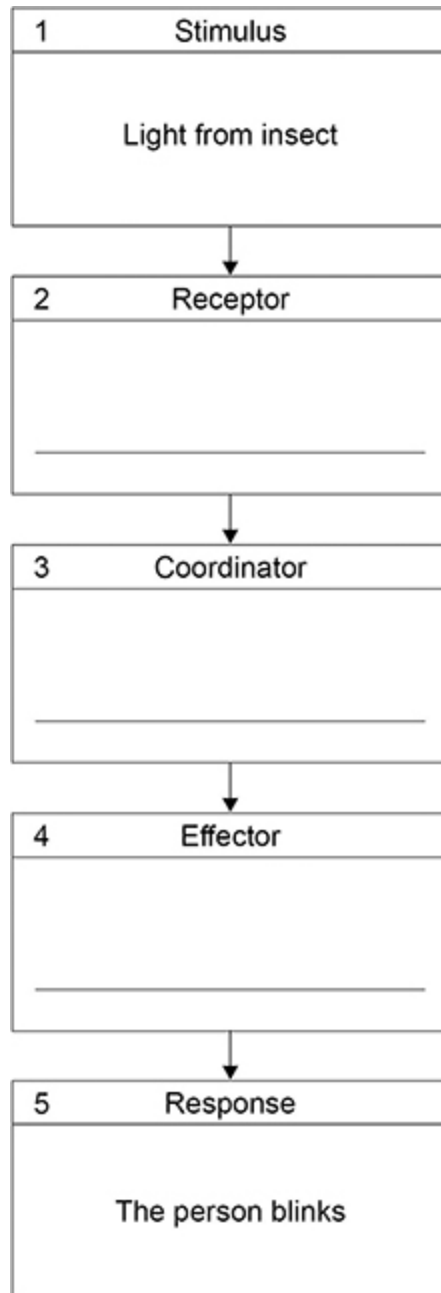
Name the structure.

(1)

(e) An insect flies near a person's eye. The person blinks. This is a reflex action.

Figure 2 shows the coordination system for this reflex action.

Figure 2



Complete **Figure 2**.

Choose answers from the box below.

Write **one** word in each of boxes **2**, **3** and **4** of **Figure 2**.

brain	cornea	iris	muscles	retina
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(2)
(Total 9 marks)

Mark schemes

1.

- (a) (lowest) 1 (°C)
allow a tolerance of ± 0.2 (°C)
- (highest) 34 (°C)
allow a tolerance of ± 0.2 (°C)
- both correct for 1 mark* 1
- (b) 5 / five 1
- (c) so stored food **or** glycogen does not run out
- or**
- to replace stored food **or** glycogen
- allow so stored fat does not run out*
- or to replace stored fat*
- or because stored food **or** glycogen / fat has run out*
- ignore to provide energy* 1
- (d) respiration 1
- (e) any **one** from:
- movement
allow functioning of internal organs – eg heartbeat
 - muscle contraction
 - keeping warm
 - growth / repair
allow synthesis / described
 - active transport 1
- (f) 3200×2.5 1
- 8000 (kJ) 1
- (g) $\frac{6000}{24\ 000} \times 100$ 1
- 25 (%)
- if no other mark awarded allow for 1 mark 0.25* 1

(h) reduced

do not accept no sweating

1

[10]

2.

(a) an answer in the range 1.1 to 2(.0) (hours)

1

(b) *effect:* lowered

1

explanation:

glucose taken in

or

glucose converted to glycogen

or

glucose used in respiration

1

by cells / liver / muscles

1

(c) underweight

1

(d) (from) 67.5 (kg to) 90 (kg)

allow in the range 67 to 68 (kg) for 67.5 (kg)

allow in the range 90 to 90.5(kg) for 90 (kg)

allow from 90 (kg to) 67.5 (kg)

1

(e) (person **C** has) higher glucose (than mean)

allow comparison of higher glucose using numbers

*allow (person **C**s) glucose is too high*

1

(person **C** has) higher insulin (than mean)

allow comparison of higher insulin using numbers

*allow (person **C**s) insulin is too high*

*do not accept (person **C** has) higher cholesterol*

ignore unprocessed data

1

answers must be comparative

(f) more exercise

allow example of (more) exercise

1

eat less carbohydrate / sugar **or** eat a low carbohydrate diet

allow eat less fat

allow eat a carbohydrate

controlled diet

if no other marks awarded allow 1 mark for

lose weight

or *maintain healthy weight*

or *eat less*

or *eat fewer calories*

ignore references to healthy / balanced diet or diet unqualified

1

[10]

3.

(a) parents without MSUD have a child with MSUD

allow 1 and 2 (without MSUD) have child 5 (with MSUD)

or

7 and 8 (without MSUD) have child 12 (with MSUD)

ignore MSUD skips a generation

1

(b) gametes correct:

N + n and **N + n**

1

correct derivation of offspring genotypes:

NN Nn Nn nn

allow correct for gametes stated

1

correct phenotype for each genotype

allow correct for offspring genotypes

ignore carrier

1

correct probability:

0.25 / ¼ / 25% / 1 in 4

allow correct answer only

allow 1:3

*do **not** accept 1 in 3 / 1:4*

1

(c) liver

1

- (d) (no enzyme 2 made **so**) cannot break down the toxic substance
*allow (no enzyme 2 made **so**) cannot change toxic substance into harmless products* 1
- the toxic substance is still made (from the amino acids)
allow toxic substance builds up over time
ignore concentration of toxic substance is high(er) 1
- toxic substance diffuses / moves (from cells) into the blood
ignore incorrect name of organ
*allow **P** for toxic substance throughout* 1
- (e) the toxic substance passes through filter in kidney
or
P passes through filter in kidney 1
- (some / all) not reabsorbed
*allow (some / all) not absorbed **back** into the blood*
***or** (some / all) not taken **back** into the blood*
ignore (some / all) not absorbed into the blood
***or** (some / all) not taken into the blood* 1
- (f) proteins contain amino acids
or
proteins are made of amino acids
allow proteins are broken down into amino acids 1
- must keep (certain) amino acids in low amount
allow (so) (certain) amino acids do not build up
allow (so) less of (certain) amino acids are produced 1
- (so) toxic substance **or P** does not build up in the body **and** cause damage to cells / tissues / organs 1

[14]

4.

(a) any **two** from:

- (same volume of) water
allow (same amount of) water
- (same) temperature
- (same) species / type of plant
- (same) age of shoot
allow (amount of) minerals / ions / salts
ignore (same) time
ignore (same) height of shoot
ignore carbon dioxide (concentration)
*do **not** accept light*

2

(b) **B** shows response (in **A**) is due to light (as **B** has no light)

- allow **B** gives a comparison between no light and (one-sided) light*
- ignore **B** shows the effect of no light*

1

C shows response (in **A**) is due to one-sided light (as **C** has light from all sides)

- allow **C** gives a comparison between all-round light and one-sided light*
- ignore **C** shows the effect of light from all sides*

1

(c) growth / elongation occurs (just) behind / below / at the tip

- allow no growth **or** very little growth at the base*
- ignore shoot is taller*

1

bending occurs (just) behind / below / at the tip

or

more growth on the side away from the light

1

- ignore reference to auxin*
- ignore reference to left and right sides*

(d) phototropism / phototropic

- allow positive phototropism*
- ignore tropism*
- do **not** accept negative phototropism*
- do **not** accept phototrophic / phototrophism*

1

- (e) in **F** there is more auxin in the side furthest from the light 1
- in **G** there is the same mass of auxin in each side 1
- in **F** auxin can move through the shoot but in **G** the glass prevents this 1

*ignore references to **D** and **E***

ignore references to left and right sides unless at least one is identified as side nearer to or further from the light

- (f) all four blocks have (approximately) the same mass of auxin
*allow examples such as mass of auxin in **D** / **E** is (about) the same as in **F** / **G***
or
those in light have same mass of auxin as those in dark 1

[11]

5.

- (a) echidna: 27 to 35 **or** by 8 (°C)
allow a tolerance of ± 0.5 (°C)
- and**
 human: 36.2 to 37.2 **or** by 1 (°C)
allow a tolerance of ± 0.1 (°C) 1

echidna is more variable

or

human fluctuates less

allow echidna is 7 (°C) more variable for 2 marks

allow echidna is 8 times more variable for 2 marks 1

- (b) loses less energy (from its body)
allow loses / wastes less heat 1

(so) body energy store lasts longer

allow glycogen / fat lasts longer

allow stored food lasts longer 1

OR

lower temperature gradient (between echidna and air) (1)

(so) loses less energy (1)

allow loses less heat

OR

less energy transferred maintaining (higher) body temperature (1)

allow less energy transferred for keeping warm

(so) more energy available for processes vital for life (1)

allow more energy for eg heart / brain function

ignore metabolism

1

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

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

(c) activity / movement requires energy from respiration

1

(and) respiration / metabolism releases heat (which increases body temperature)

1

OR

respiration / metabolism releases heat (which increases body temperature) (1)

(which) increases the rate of chemical reactions

or

increases enzyme activity (1)

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

1

(d) more blood flow near surface (of skin)

or

more blood flow to the skin

*do **not** accept blood vessels move nearer to surface of skin*

1

(so) more heat / energy is lost (from the blood)

1

cools blood which cools the body

ignore cools blood / body unqualified

1

(e) $\frac{20\,000 \times 40}{100 \times 2.5}$ or $\frac{8000}{2.5}$

1

3 200 (cm³)

1

3.2 (dm³)

allow an incorrectly calculated value correctly divided by 1000

1

- (f) to replace ions / salt lost (in sweat)
allow named example such as Na⁺
allow because ions / salt lost in sweat
allow to prevent (muscle) cramp

1
[13]

6.

(a) A

1

(b) D

1

(c) liver

1

(d) glycogen

1

(e) 2.6

allow answers in the range 2.5 to 2.7

1

7.6 (mmol/dm³)

*allow a correctly calculated value using student's value
 from graph + 5*

1

(f) 30 (minutes)

*allow ½-hour **or** 0.5 hour*

1

(g) points too far apart

or

no reading between 30 and 50 mins

allow no reading at 40 mins

or

points joined by straight lines

or

values could have fallen to zero change before 50 mins

allow not a curve of best fit

1

(h) higher values of y than given line

1

returning to(wards) zero change later than given line

1

[10]

- 7.** (a) A = cornea 1
- B = lens 1
- C = optic nerve 1
- (b) by becoming thicker 1
- (c) ciliary muscles 1
- suspensory ligaments 1
- (d) retina 1
- allow rods / cones / fovea*
- (e) retina
- brain
- muscles
- in this order only*
- 3 correct = 2 marks*
- 1 or 2 correct = 1 mark*

2

[9]