1. This question is about the nervous system.

(a) Describe the function of receptors in the skin.

_____

_____

_____

_____

(2)

(b) A response is caused when information in the nervous system reaches an effector.

(i) There are two different types of effector.

Complete the table to show:

- the two different types of effector

- the response each type of effector makes.

Type of effector	Response the effector makes
1 _____	_____ _____
2 _____	_____ _____

(4)

(ii) Some effectors help to control body temperature.

Give **one** reason why it is important to control body temperature.

_____

_____

(1)
(Total 7 marks)

2. The internal body temperature determines how much a person sweats. The graph shows the effect of different internal body temperatures on a person's rate of energy loss by sweating.
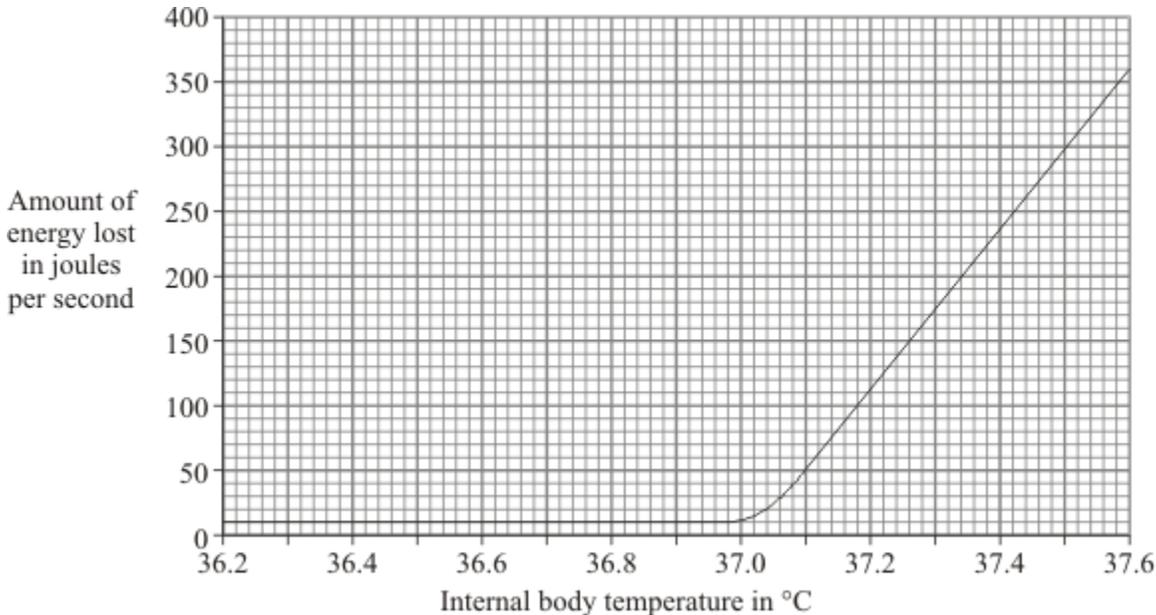
(a) How much more energy was lost from the body each second by sweating when the body temperature was 37.6 °C than when it was 36.6 °C? Show clearly how you work out your final answer.

_____

_____

Amount of energy = _____ joules per second

(2)

(b) Explain why a person would feel more thirsty when the body temperature was 37.6 °C than when it was 36.6 °C.

_____

_____

_____

_____

(2)

(c)   Explain how sweating helps to control body temperature.

_____

_____

_____

_____

_____

_____

(3)
(Total 7 marks)

3.   Conditions inside the human body are controlled.

(a)   What is the control of conditions inside the body called?

Tick (✓) **one** box.

Excretion   ☐

Fertilisation   ☐

Homeostasis   ☐

Osmosis   ☐

(1)

(b)   What are the **two** ways information is sent to control body conditions?

Tick (✓) **two** boxes.

By antigens ☐

By hormones ☐

By muscles ☐

By nerve impulses ☐
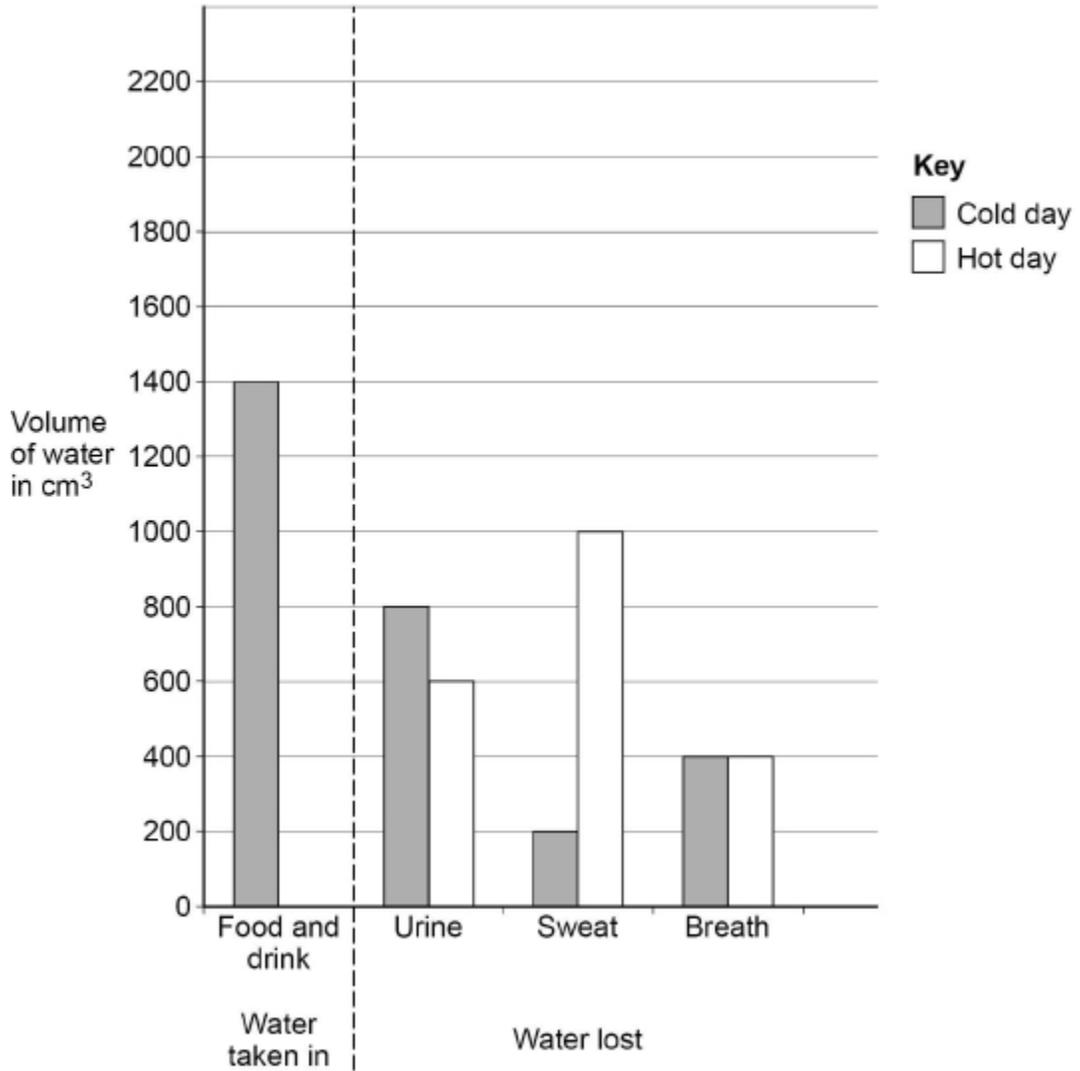
By red blood cells ☐

(2)

(c)   One condition in the body that needs to be controlled is the level of water.

Give **one** other condition in the human body that needs to be controlled.

_____

_____

(1)

The graph shows the volumes of water taken in and lost by one person.

The volume for water taken in on a hot day has **not** been plotted on the bar graph.

(d)   The person lost 1400 cm³ of water on the cold day.

How much extra water did they lose on the hot day?

_____

_____

_____

_____

Extra volume of water lost = _____ cm³

(2)

(e)   Explain why the volume of water lost on a hot day is higher than on a cold day.

_____

_____

_____

_____

(2)

(f)   A boy drank 750 cm^3 of water.

His total intake of water for that day was 3000 cm^3

Calculate the percentage of the boy's total intake that the 750 cm^3 represents.

_____

_____

_____

_____

Percentage = _____ %

(2)
(Total 10 marks)

4. This question is about homeostasis.

(a)   Define the term homeostasis.

_____

_____

_____

_____

(2)

(b)   Name the hormone released if the blood glucose concentration falls too low.

_____

(1)

Two people were sent to a hospital to find out if they have diabetes.

This is the method used at the hospital.

- Do not eat or drink after midnight. This is called fasting.
- Measure blood glucose concentration at 9.30 am
- Drink a glucose solution at 10.00 am
- Measure blood glucose concentration for the next 3 hours.

The graph shows the results.

Normal blood glucose concentrations

Fasting
$3.5 - 5.5$ mmol/dm^3

Non-fasting
$4.0 - 7.8$ mmol/dm^3
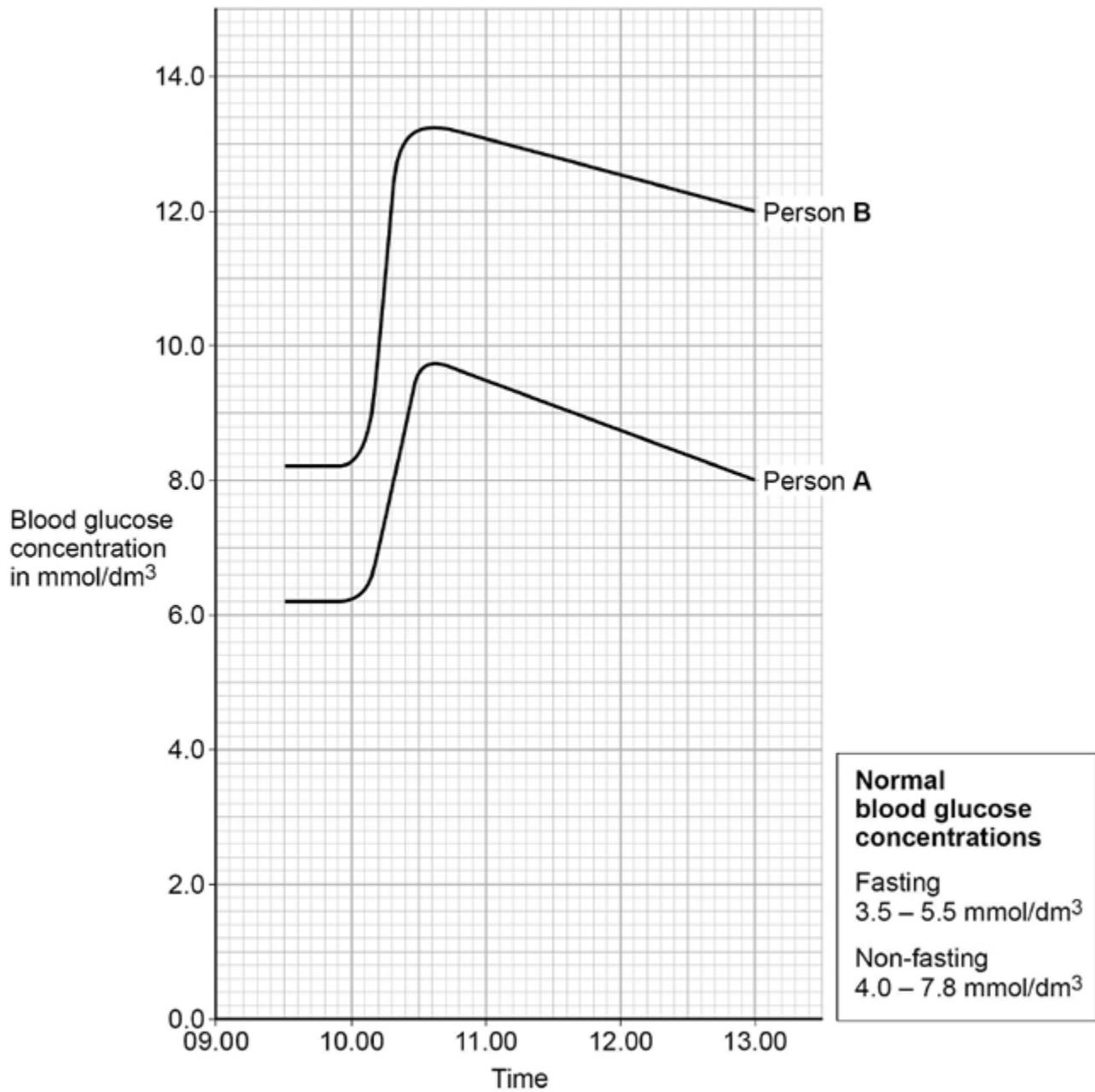
Person **A** and person **B** have diabetes.

(c)   Describe how the graph above shows that person **B** has diabetes.

Use data from the graph.

_____

_____

_____

_____

_____

_____

(3)

(d)   Person **A** and person **B** had a test to measure the concentration of insulin in their blood when they were fasting.

The table shows the results.

Person	Fasting blood insulin concentration in arbitrary units
A	280
B	20
Normal range	50–175

Suggest which type of diabetes person **A** and person **B** have.

Give a reason for each answer.

Person **A**

Type of diabetes _____

Reason _____

_____

Person **B**

Type of diabetes _____

Reason _____

_____

(2)

(e) Toxic hypoglycaemia syndrome (THS) has caused the deaths of hundreds of starving children in some tropical countries.

- The starving children have had nothing to eat all day.
- The starving children then eat many lychee fruits.
- The lychee fruits contain a molecule which stops an enzyme in the liver working.
- This enzyme normally converts stored fats into glucose.

Children who have eaten during the day are **not** affected by eating many lychee fruits.

Starving children may die from eating many lychee fruits but children who have eaten during the day are not affected.

Explain why.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(6)
(Total 14 marks)

5. Caffeine is a drug that decreases reaction time.

A group of sixteen students investigated the effect of caffeine on reaction time.

The students were all 15-year-old girls.

The group was divided into 8 pairs of students.

This is the method used.

1. Student **A** starts two stopwatches at the same time.

2. Student **A** then gives one of the stopwatches to Student **B**.

3. Student **A** says "stop" at the same time as stopping her stopwatch. Student **B** stops her stopwatch as quickly as possible after Student **A** says "stop".

4. The difference in time shown on the two stopwatches is recorded. This is the reaction time of Student **B**.

5. Student **B** drinks a caffeinated drink.

6. The students wait 15 minutes and then repeat steps 1 to 4.

(a) Suggest **one** control variable the students should have used in the investigation.

Do **not** refer to age or sex in your answer.

_____

_____

(1)

(b)   Suggest **two** sources of random error when using this method to measure a person's reaction time.

1 _____

_____

_____

2 _____

_____

_____

(2)

The table below shows the results.

Student pair	Decrease in reaction time after drinking the caffeinated drink in seconds
1	0.039
2	0.021
3	0.027
4	0.041
5	0.022
6	0.036
7	0.024
8	0.097

(c)   Why can a mode **not** be determined for the data in the table above?

_____

_____

(1)

(d)   The students decided the result from pair **8** was anomalous.

The students calculated that the mean decrease in reaction time was 0.030 seconds.

Describe how the students calculated the mean decrease in reaction time.

_____

_____

_____

(1)

(e)   Caffeine causes the release of adrenaline.

Adrenaline affects heart rate.

Explain how the effect of adrenaline on heart rate might cause reaction time to decrease.

_____

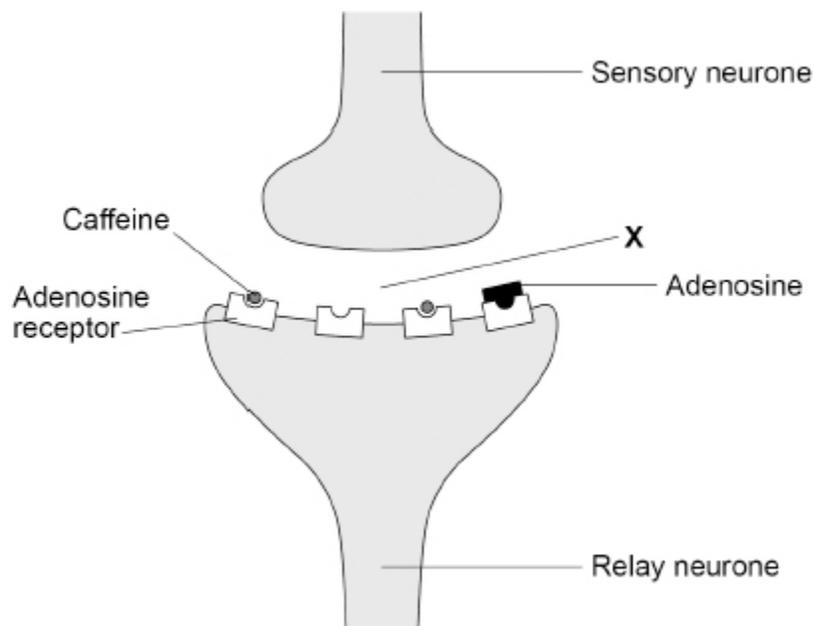_____

_____

_____

_____

_____

_____

_____

(4)

Adenosine is a different chemical made by the body.

Adenosine binds to receptors on relay neurones.

Adenosine decreases the number of impulses in relay neurones.

The figure below shows how caffeine binds to adenosine receptors on a relay neurone.

When caffeine binds to adenosine receptors it blocks the receptor so adenosine cannot bind.

(f)   Label **X** shows the gap between the sensory neurone and the relay neurone.

What is the name of the gap labelled **X**?

_____

(1)

(g)   Suggest why reaction time decreases when caffeine binds to adenosine receptors.

_____

_____

_____

_____

_____

_____

(2)
(Total 12 marks)

Mark schemes

1. (a) detect changes in surroundings **or** detect stimuli

allow any named stimulus for skin

1

convert information to impulse

allow send impulse to sensory neurones / brain

1

(b) (i)

muscle	contract(ion)
gland	release / secrete / produce chemical / hormone / enzyme

1 mark for each effector

1 mark for each response

response must match type of effector (if given)

ignore examples

ignore relax(ation) / movement for contraction

*do **not** allow expansion for muscles*

4

(ii) any **one** from:

- (maintain temperature at which) enzymes work best
- so chemical reactions are fast(est)
- prevent damage to cells / enzymes

allow prevent enzymes being denatured (by temperature being too high)

1

[7]

2. (a) 345 to 350

ignore working or lack of working

*use of 355 to 360 **and** 10 for **1** mark*

2

(b) any **two** from:

<u>more</u> sweating (at 37.6 °C)

'more' at least once in the first 2 points

<u>more</u> water loss **or** dehydration <u>occurs</u>

*do **not** accept prevents dehydration only*

blood becomes (more) concentrated / (more) salty **or** need to replace water

stimulation of the hypothalamus

2

(c)   any **three** from:

evaporation

of <u>water</u>

> *do **not** accept just water loss unqualified*

cools skin **or** uses heat from skin

cools blood / heat from blood (passing through skin)

> *related to sweating*
> *cooling the blood*
> *ignore vasodilation*

3

[7]

3.   (a)   homeostasis

1

(b)   by hormones

1

by nerve impulses

1

(c)   any **one** from:

> *ignore water*
*   temperature
*   (blood) glucose / sugar (concentration)

> *allow pH / ions / salts*
> *allow oxygen or carbon dioxide*

1

(d)

> *an answer of 600 (cm³) scores **2** marks*

2000 − 1400

> *allow 800 − 200*

1

600 (cm³)

1

> *if no mark awarded allow (600 + 1000 + 400 =) 2000 for **1** mark*

(e)   more sweat (on hot day)

1

cools the body

1

(f) $\dfrac{750}{3000} \times 100$

1

25 (%)

1

an answer of 25 (%) scores 2 marks

[10]

4. (a)   regulation / control / maintenance of internal conditions (of a cell / body)

allow keeping the internal conditions (of a cell / body) the same

1

for optimum (cell / enzyme activity)

allow description of optimum functioning (of cell / body)

1

(b)   glucagon

correct spelling only

1

(c)   any **two** from:

- fasting blood glucose is higher than normal range
- reached a very high concentration after glucose drink
- did not return to normal after 3 hours
- **or**
- fell slowly after reaching peak.

use of correct data in comparison to normal ranges given for any of the above points

allow ± half a small square for values quoted from the graph

1

ignore references to person A

2

(d)   (person A has Type) 2 (pancreas) producing (lots of) insulin but body cells cannot respond to it.

*allow cells becoming resistant to insulin for respond to insulin. do **not** accept the person has become resistant to insulin*

1

(person B has Type) 1 (pancreas) not producing enough insulin (to control concentration of glucose in the blood)

1

type of diabetes must be correct

(e) starving children have used up their glycogen stores

allow starving children have no / low glycogen stores

1

(so) would need (liver enzyme) to release glucose from fats

1

as enzyme is stopped from working they get low / no glucose

allow no working enzyme leads to hypoglycaemia

1

(cell) respiration is insufficient (so they die)

allow starving children use proteins to release energy (which leads to death)

1

children that are not starving have glycogen stores in liver / muscle

1

(so) glucagon will continue to release glucose (into the blood for them)

1

[14]

5. (a) any **one** from:
- previous intake of caffeine that day
- usual intake of caffeine (on previous days)
- concentration of caffeine
- volume of caffeine

allow named caffeinated drink for caffeine

*allow amount / mass / type of caffeine for **1** mark*

- time of day
- amount of sleep
- body mass
- previous experience of the test
- which hand (of student **B**) holds the stopwatch

allow fatigue

allow (body) weight / BMI

1

(b) any **two** from:
- (student **A**) does not press both start buttons simultaneously
- (student **A**) may not say stop and press button simultaneously
- student **B** could be distracted
- idea that student **B** anticipated student **A** stopping the stopwatch
- stopwatch malfunction

allow (stop)watches may not be <u>accurate</u>

2

(c)   no value / result / number occurs more than once
or
all the values / results / numbers are different

1

(d)   add(ed) the other (7) results and divide(d) by 7

allow correctly shown calculation

ignore leave out the result for pair 8

1

(e)   (adrenaline) increases heart rate

allow increases blood flow

1

(which) increases oxygen / glucose to brain / muscle (cells)

1

(which) increases rate of respiration

1

(so) releasing more energy for (faster / more) muscle <u>contraction</u>

allow (so) releasing more ATP for (faster / more) muscle <u>*contraction*</u>

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

1

(f)   synapse

allow synaptic cleft

1

(g)   fewer adenosine (molecules) can bind to the receptors
or
adenosine has no / less effect on the (relay) neurone

1

therefore impulses in relay neurone are more frequent

allow impulses in relay neurone are faster

allow there are more impulses in relay neurone

allow impulses in relay neurone not delayed / reduced (in number)

ignore caffeine binds to adenosine receptors

1

[12]