Homeostasis 1

Name: _____

Class: _____

Date: _____

Time: **80 minutes**

Marks: **74 marks**

Comments:

1. The concentration of glucose in the blood can be controlled.

(a) A person drinks a glucose solution.

What happens to the person's blood glucose concentration soon after drinking the glucose solution?

Tick (✓) **one** box.

Blood glucose concentration decreases. ☐

Blood glucose concentration stays the same. ☐

Blood glucose concentration increases. ☐

(1)

(b) Insulin controls blood glucose concentration.

Which organ produces insulin?

Tick (✓) **one** box.

Pancreas ☐

Pituitary ☐

Stomach ☐

(1)

(c) Organs affected by insulin are called target organs.

Which **two** organs are target organs for insulin?

Tick (✓) **two** boxes.

Liver	☐
Lung	☐
Muscle	☐
Ovary	☐
Spinal cord	☐

(2)

(d) Complete the sentences.

Choose answers from the box.

DNA	**glucose**	**glycogen**	**urea**

Insulin causes cells to take in _____.

The storage molecule made inside the cells is _____.

(2)

(e) Complete the sentence.

Choose the answer from the box.

increase	**stay the same**	**decrease**

Insulin causes blood glucose concentration to _____.

(1)

(f) Type 2 diabetes is caused when the body cells no longer respond to insulin.

Give **two** ways to reduce the risk of developing Type 2 diabetes.

Do **not** refer to insulin in your answer.

1 _____

_____

2 _____

_____

(2)

(Total 9 marks)

2. This question is about the hormones involved in reproduction.

(a) Name **one** hormone produced in the **ovaries**.

_____

(1)

(b) Give **one** function of the hormone that is produced in the **testes**.

_____

_____

(1)

Different methods of contraception can involve:

- barriers
- hormones.

(c) Condoms are a barrier method of contraception.

Give **one** advantage of condoms as a method of contraception compared with hormonal methods of contraception.

Do **not** refer to cost in your answer.

_____

_____

_____

(1)

(d) Describe how **hormones** are used in different methods of contraception.

(6)

(Total 9 marks)

3. The human body makes the hormone insulin and a chemical called C-peptide.

C-peptide concentration in the blood has a linear relationship with the amount of insulin the body produces.

(a) Which equation represents a linear relationship?

Tick (✓) **one** box.

$y = mc + x$ ☐

$y = mc^2 + x$ ☐

$y = mx + c$ ☐

$y = mx^2 + c$ ☐

(1)

(b) When the body makes insulin, C-peptide is also made.

The concentration of C-peptide in the blood is **not** increased by insulin injections.

Some people with Type 2 diabetes are **incorrectly** told they have Type 1 diabetes.

Doctors can test the concentration of C-peptide in the blood to check which type of diabetes a person has.

Explain:

- how the test can indicate which type of diabetes a person has
- the importance of finding out whether a person being treated for Type 1 diabetes actually has Type 2 diabetes.

(6)

Glucagon is a hormone produced by the body.

(c) Which organ produces glucagon?

Tick (✓) **one** box.

- Liver ☐
- Pancreas ☐
- Small intestine ☐
- Stomach ☐

(1)

(d) In some people, glucagon is produced in smaller quantities than is needed.

Explain why people who do **not** produce enough glucagon feel weak and tired.

_____

_____

_____

_____

_____

_____

_____

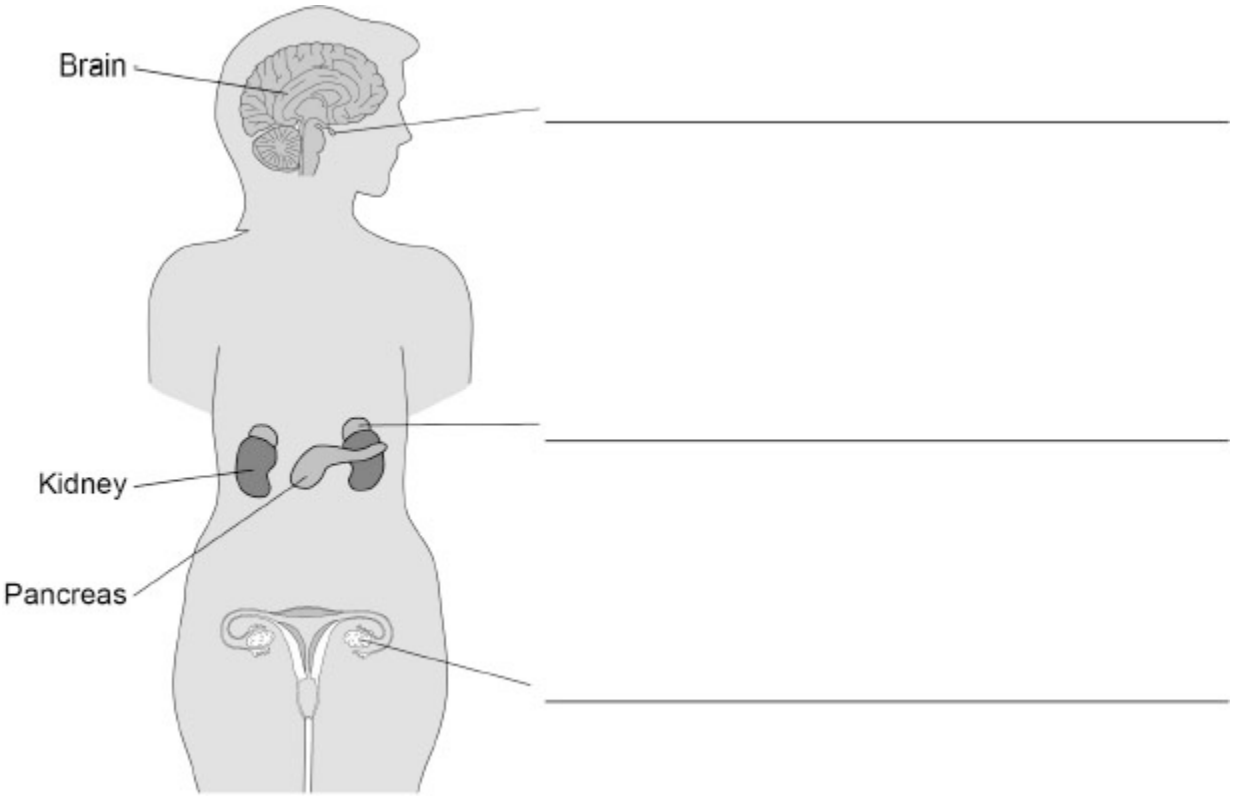
_____

(4)

(Total 12 marks)

4. **Figure 1** shows organs and glands in a human body.

Figure 1



(a) Label the glands on **Figure 1**.

Choose answers from the box.

adrenal gland	**ovary**	**pituitary gland**
testis	**thyroid gland**	

(3)

(b) Cells in the pancreas detect blood glucose concentration.

What type of cells **detect** blood glucose concentration?

Tick (✓) **one** box.

Coordinator cells ☐

Muscle cells ☐

Receptor cells ☐

(1)

(c) The pancreas produces insulin.

How is insulin transported from the pancreas to the rest of the body?

_____

_____

(1)

(d) Which organ is a target organ of insulin?

Tick (✓) **one** box.

Liver ☐

Small intestine ☐

Stomach ☐

(1)

(e) Which chemical is a store of glucose in human cells?

Tick (✓) **one** box.

Cellulose ☐

Glycogen ☐

Protein ☐

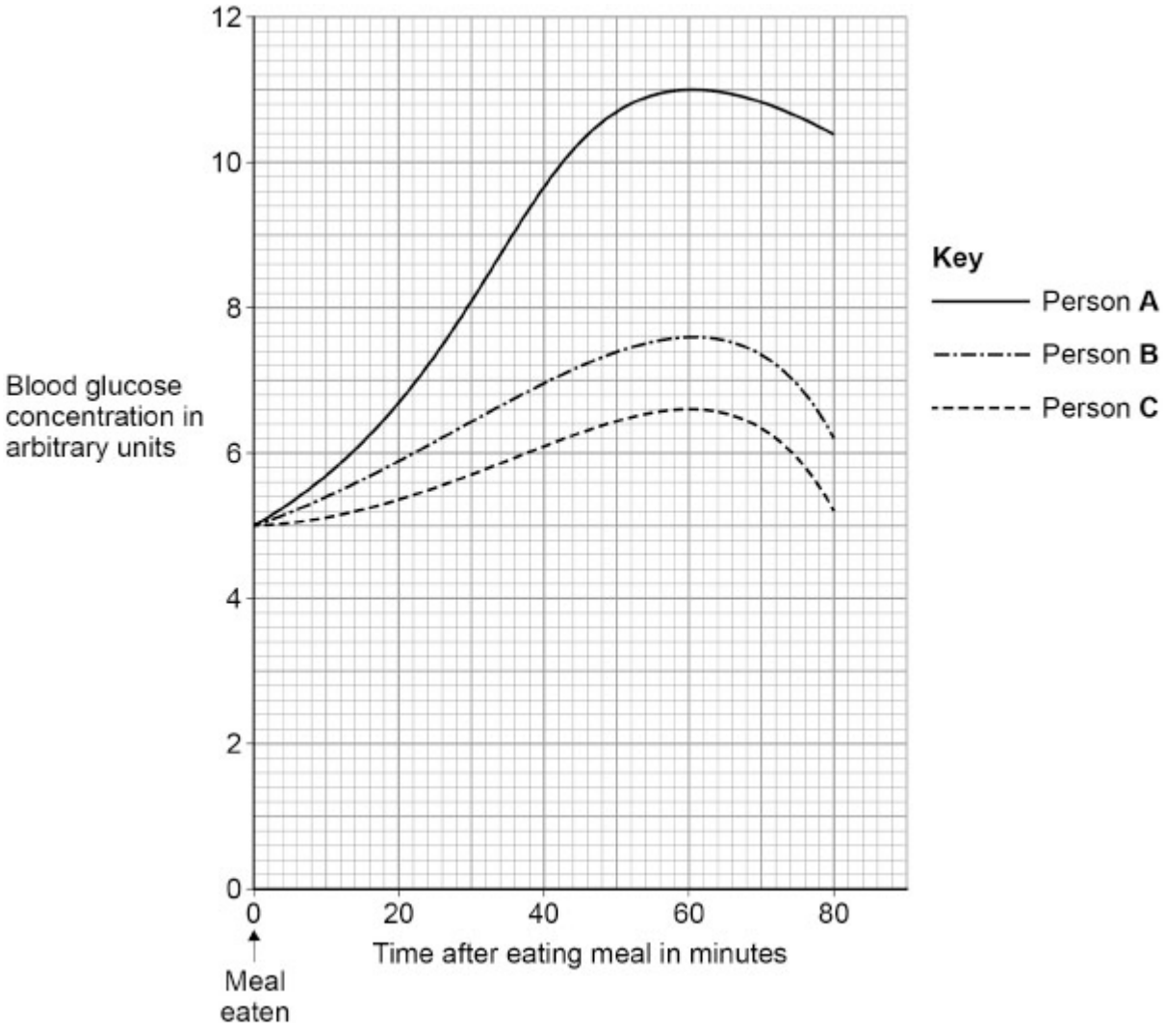
(1)

Three people each ate similar meals.

The blood glucose concentration of each person was recorded for 80 minutes after the meal.

Figure 2 shows the results.

Figure 2



(f) What was the **change** in blood glucose concentration in person **A** from 0 minutes to 60 minutes?

_____

_____

Change = _____ arbitrary units

(1)

(g) Describe the **trend** in the relationship between blood glucose concentration and time after the meal.

_____

_____

_____

_____

(2)

(h) A student concluded:

'Person **A** has diabetes'.

Explain how **Figure 2** supports the student's conclusion.

You should refer to insulin in your answer.

_____

_____

_____

_____

(2)

(i) Describe **two** ways a person with Type 2 diabetes could change their lifestyle to control their diabetes.

1 _____

_____

2 _____

_____

(2)

(Total 14 marks)

5. Students used a reaction test card in an investigation.

The reaction test card can be used to test the reactions of car drivers.

Figure 1 shows the reaction test card.

Figure 1

Reaction score	How fast are your reactions?
5	Too slow
4	A bit slow
3	OK
2	Good
1	Super

(a) Suggest why fast reactions are important for car drivers.

_____

_____

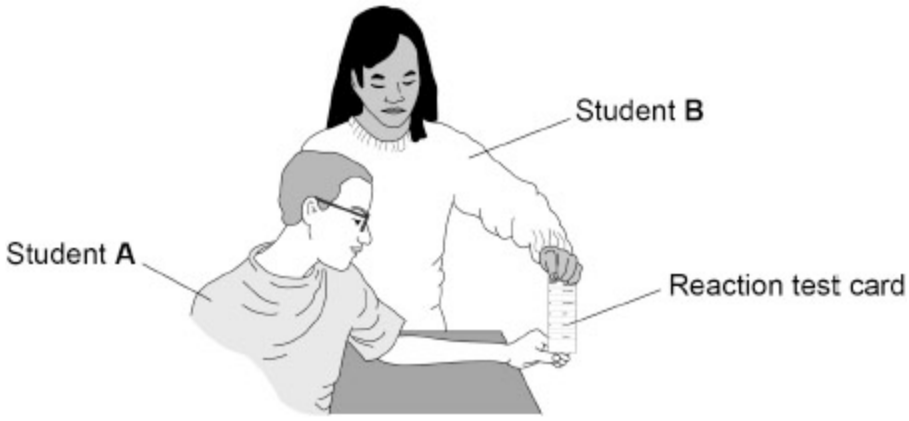
(1)

Students investigated the effect of number of hours of sleep on reaction time.

The students used the reaction test card shown in **Figure 1**.

Figure 2 shows the method used.

Figure 2



This is the method used.

1. Record the number of hours of sleep student **A** had the night before the test.
2. Student **B** holds the lower edge of the card level with the top of student **A**'s thumb.
3. Student **A** holds their thumb and forefinger slightly apart, with space for the card to drop.
4. Student **B** drops the card.
5. Student **A** catches the card as quickly as possible.
6. Record the number shown at the top of student **A**'s thumb.
7. Repeat steps 1 to 6 with seven other students.

(b) Draw **one** line from each type of variable to the example of that variable in the investigation.

Type of variable	**Example**
Control Variable	Number nearest top of thumb when student catches card
Dependent variable	Number of hours of sleep
Independent variable	Number of students tested
	Start with lower edge of card level with top of thumb

(3)

Figure 1 is repeated below.

Figure 1

Reaction score	How fast are your reactions?
5	Too slow
4	A bit slow
3	OK
2	Good
1	Super

(c) A student said:

'It would be better to use a ruler showing millimetres instead of the card in **Figure 1**.'

Why is the student correct?

Tick (✓) **one** box.

Students are familiar with a ruler but the card is new. ☐

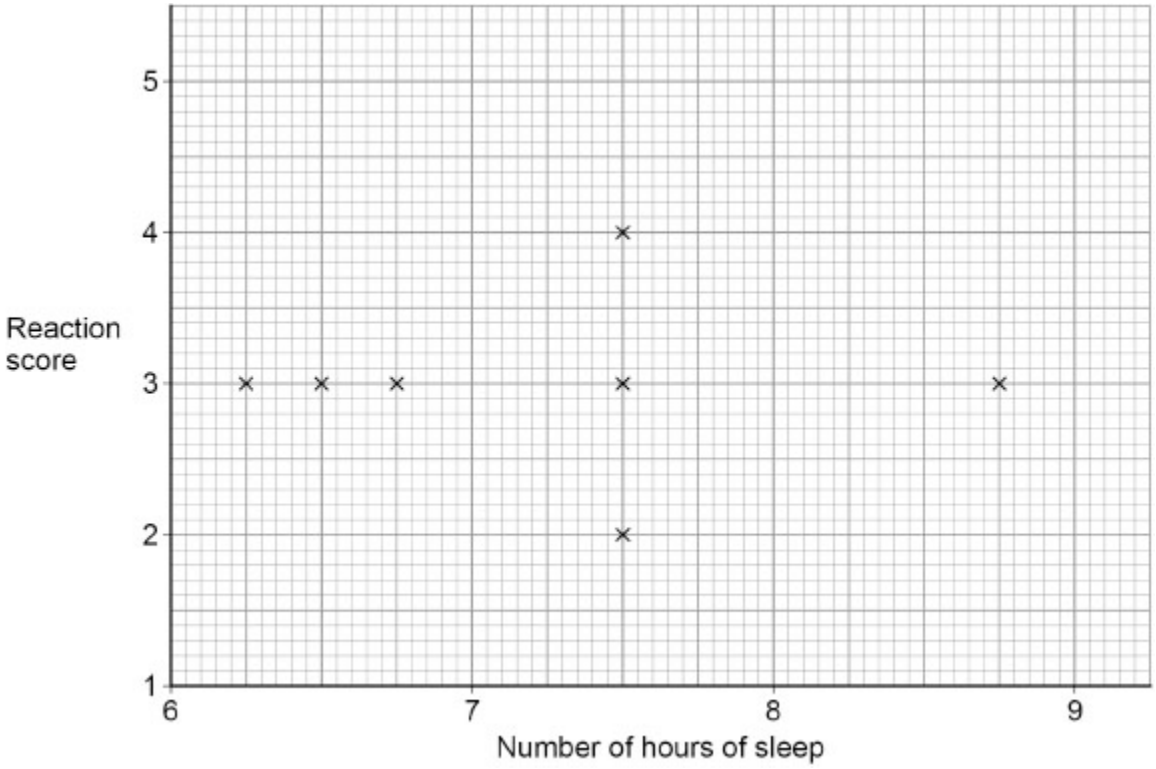
Students have very fast reactions. ☐

Students may catch the card between scores. ☐

(1)

Figure 3 shows the results for the seven other students.

Figure 3



(d) Student **A** had 8 hours and 30 minutes of sleep and a reaction score of 3

Plot the result for student **A** on **Figure 3**.

(1)

(e) The mean number of hours of sleep for all students was 7.4

What was the **mode** for the number of hours of sleep?

Mode = _____ hours

(1)

(f) A lower reaction score means a faster reaction.

What was the effect of increasing the number of hours of sleep on reaction time?

Use **Figure 3**.

Tick (✓) **one** box.

Reaction time decreased ☐

Reaction time stayed the same ☐

Reaction time increased ☐

(1)

(g) Suggest **two** ways the students could improve the investigation.

Do **not** refer to using a ruler in your answer.

1 _____

_____

2 _____

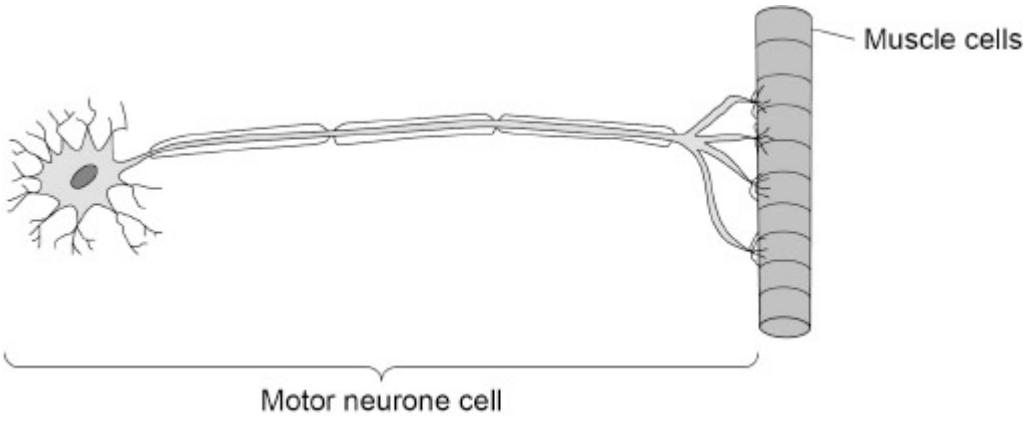
_____

(2)

(h) Motor neurones are involved in reactions.

Figure 4 shows a motor neurone.

Figure 4



Explain **one** way the motor neurone cell is adapted for its function.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 13 marks)

6. Hormones are released from endocrine glands.

(a) Which gland releases hormones to control other glands?

Tick (✓) **one** box.

Adrenal ☐

Pituitary ☐

Thyroid ☐

(1)

Several hormones can affect blood glucose concentration.

(b) Adrenaline can increase blood glucose concentration.

What is **one** other effect of adrenaline?

Tick (✓) **one** box.

Decreased breathing rate	☐
Decreased metabolic rate	☐
Increased blood flow to muscles	☐
Increased FSH production	☐

(1)

(c) Cells in the pancreas detect changes in blood glucose concentration.

What type of cell in the body detects changes?

_____

(1)

Scientists investigated whether blood glucose concentration affects reaction time.

The reaction times of ten people with Type 1 diabetes were measured.

This is the method used.

1. Tell one person to drink a glucose solution.
2. Monitor the person's blood glucose concentration.
3. Record the person's reaction time when the person's blood glucose concentration is:
    - 16 $mmol/dm^3$
    - 6 $mmol/dm^3$
    - 3 $mmol/dm^3$
4. Repeat steps 1 to 3 for the nine other people.

(d) People with Type 1 diabetes were selected for the investigation instead of people who did **not** have diabetes.

Explain why.

_____

_____

_____

_____

(2)

(e) Control variables between the different people in the investigation included:

- age
- sex
- food and drink consumed before and during the test.

Suggest **two other** control variables that should be used in the investigation.

1 _____

_____

2 _____

_____

(2)

(f) It was important for the scientists to monitor the health of each person during the investigation.

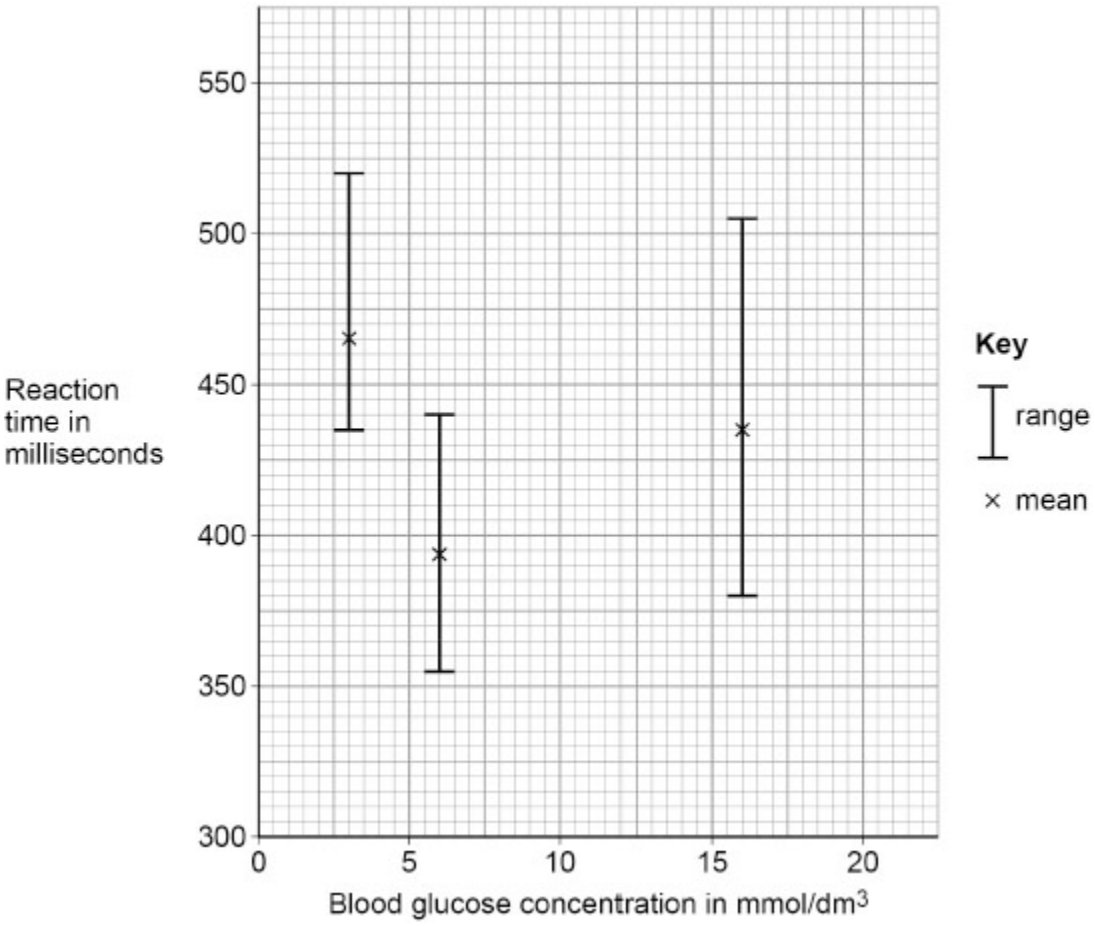
Suggest **one** reason why.

_____

_____

(1)

The figure below shows the results.



(g) People who do **not** have diabetes usually have a blood glucose concentration in the range of 4.0 mmol/dm^3 to 7.8 mmol/dm^3.

Describe how the results in the figure above show the importance of homeostasis.

_____

_____

_____

_____

_____

(2)

(h) Describe how blood glucose concentration is maintained within narrow limits in people who do **not** have diabetes.

(5)

(i) The scientists gave the hypothesis:

‘Optimum blood glucose concentration increases the production of chemicals that diffuse across synapses.’

Describe how an increase in the chemicals could decrease reaction time.

(2)

(Total 17 marks)

1. (a) blood glucose concentration increases

1

(b) pancreas

1

(c) liver

1

muscle

1

(d) glucose

1

glycogen

must be in this order

1

(e) decrease

1

(f) any **two** from:

- eat less carbohydrate / sugar
  or
  a low / controlled carbohydrate / sugar diet
- eat less fat

  *if neither mark awarded allow **1** mark for calorie controlled diet or reduced calorie diet*

  ignore references to healthy / balanced diet or diet unqualified

- lose (body) mass / weight
  or
  maintain healthy weight

- (more) exercise

  allow examples of (increased) exercise

  allow stop smoking

  allow named drug treatment eg metformin

  ignore take medicine / drug / insulin
  ignore pancreas transplant

2

[9]

2.

(a) oestrogen

allow phonetic spelling

allow other correct named hormone eg progesterone

*do **not** accept FSH / LH*

1

(b) any **one** from:

- (stimulates / causes) sperm production
- (stimulates / causes male) secondary sexual characteristics

allow (stimulates / causes) puberty

allow (stimulates / causes) named male secondary sexual characteristic(s) eg muscle growth

1

(c) any **one** from:

- protection / prevention against sexual transmitted diseases(s)

allow converse if clearly referring to hormonal methods

allow protects / prevents against STD(s) / STI(s)

allow protects / prevents against named STD / STI

- fewer / no side effects

allow do not affect menstrual cycle

allow fewer / no named (possible) side effects of hormonal contraceptives eg fewer / no headaches / nausea / acne

ignore do not affect hormones

ignore safer

- immediate

allow quicker to use

ignore temporary

- (may) contain a chemical to kill sperm

allow (may) contain spermicide

- (more) easily accessible
- described disadvantage of hormonal method(s) eg (contraceptive) pill could be forgotten

1

(d) **Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.

4-6

Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.

1-3

No relevant content

0

Indicative content

Method
- oral contraceptive **or** pill

Detail of how the contraception is used
- ○ taken daily **or** taken every 21/28 days **or** taken in a monthly cycle
- ○ containing progesterone
- ○ containing oestrogen
- ○ (hormones) absorbed into the blood

Method
- injection
- patch
- implant
- intrauterine system / device **or** IUD **or** IUS **or** coil

Detail of how the contraception is used
- ○ last several weeks / months
- ○ containing progesterone
- ○ slow release of progesterone / hormone
- ○ into blood

Detail (that can apply to all hormonal contraceptive methods)
- ○ to inhibit / reduce / prevent FSH (release)
- ○ (lack of FSH) so no eggs mature / develop
- ○ to inhibit / reduce / prevent LH (release)
- ○ (lack of LH) so no eggs released (from ovary) **or** so prevents ovulation
- ○ (progesterone) thickens (cervical) mucus
- ○ (mucus) prevents / reduces sperm movement (to uterus)
- ○ (oestrogen / progesterone) changes the thickness of the uterus lining
- ○ (uterus lining thickening / thinning) makes implantation less likely

For **Level 2**, answers must give details for the method(s) described.

[9]

3. (a) $y = mx + c$

1

(b) **Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.

5-6

Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.

3-4

Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

1-4

No relevant content

0

Indicative content

Type 1
- in Type 1 (diabetes) the pancreas does not produce (enough) insulin
- (so) C-peptide (concentration in blood) would be low(er)
- even if patient is taking / injecting insulin

Type 2
- in Type 2 (diabetes) the body / cells no longer respond to insulin
- in Type 2 (diabetes) insulin is produced
- (so) C-peptide (concentration in blood) would be high(er) / normal

The importance…
- if patient has Type 2 (diabetes) they could stop insulin injections
- insulin injections have side effects
- insulin injections are expensive
- (Type 2 diabetes) can be treated with a carbohydrate-controlled diet and / or (increased) exercise
- (Type 2 diabetes) can be treated with other medication (that is not injected)

For **Level 3**, details of Type 1 and Type 2 diabetes must be considered, with the link to C-peptide and the importance of the test described.

(c) pancreas

1

(d) (in people with glucagon deficiency)
when blood glucose concentration is low not enough glucagon is produced

allow (in people without glucagon deficiency) when blood glucose concentration is low glucagon is produced

ignore reference to organ that produces glucagon

1

(so) less / no glycogen converted to glucose

allow (so) less glucose produced from glycogen

1

(so) less glucose for respiration

1

(so) less energy released / transferred

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

1

[12]

4.

(a) pituitary (gland)

1

adrenal (gland)

1

ovary

must be in this order

1

(b) receptor cells

1

(c) (in / through / via) blood(stream)

allow (in / through / via) plasma
*allow (in / through / via) blood vessels **or** named blood vessel*
*do **not** accept (in / through / via) red / white blood cells*

1

(d) liver

1

(e) glycogen

1

(f) (11 - 5 =) 6 (arbitrary units)

*allow answer on **Figure 2** if not on answer line*

1

(g) increases

1

then decreases

allow decreases at the end
allow then returns to normal
ignore reference(s) to rate of increase or decrease
ignore reference to remaining constant between increase and decrease
ignore values of time / concentration

1

(h) high / higher / highest (blood) glucose / sugar (concentration)
or
fast / faster / fastest (blood) glucose / sugar (concentration) rise / increase
or
slow / slower / slowest (blood) glucose / sugar (concentration) decrease
or
(blood) glucose / sugar (concentration) has not decreased (much)

allow (blood) glucose / sugar (concentration) goes up to 11

1

(because) there is no / less insulin (produced by the body / pancreas)
or
(because cells of body / liver) not responding to insulin

allow (blood) glucose / sugar (concentration) took longer to decrease

1

(i) any **two** from:

- eat less carbohydrate / sugar **or** a low / controlled carbohydrate diet
- eat less fat

  *if neither of these awarded allow **1** mark for a calorie-controlled diet **or** reduced calorie diet*

  ignore go on a diet unqualified
- lose (body) mass / weight
- (more) exercise

  allow examples of (increased) exercise

  allow stop smoking

  ignore take medicine / insulin
  ignore named medicine
  ignore pancreas transplant

2

[14]

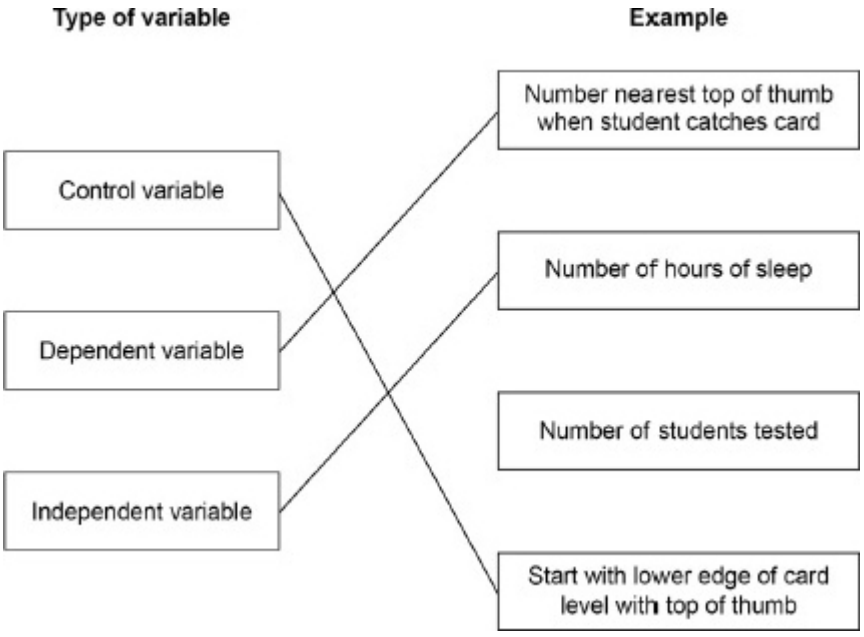
5. (a) any **one** from:

- (react in order) to brake / steer
- avoid accidents / collision / people / cars / objects

  allow for safety

1

(b)



*do **not** accept more than one line from a box on the left*

3

(c) students may catch the card between scores

1

(d) plot at 8.5 hours and reaction score 3

allow a tolerance of ±½ small square

1

(e) 7.5 (hours)

allow 7 ½ (hours)
allow 7 hours and 30 minutes
allow 7:30
*allow answer on **Figure 3** if no answer on line*
*do **not** accept 7.3*

1

(f) reaction time stayed the same

1

(g) any **two** from:

- repeat (card drop) for each student
- repeat on different days
- repeat on larger number of students
- repeat with wider range of sleep times

  if none of these awarded
  *allow **1** mark for repeat unqualified*
- control / same age
- control / same sex

  allow control / same gender
- control / same food / drink / caffeine / drugs (before test)
- control distance between thumb and forefinger
- control / same practice
- remove distractions
- use computer / phone reaction timer
- have more divisions on the card

  allow remove gaps between (reaction) scores
- record sleep time in smaller intervals

  *for **2** marks allow repeat for each student and calculate a mean*
  *for **2** marks allow repeat on different days and calculate a mean*

2

(h) long (cell)

1

to transport / carry the information / impulse(s) / signal

allow to transport / carry electrical messages
ignore to carry messages unqualified

1

from CNS / coordinator / spinal cord / brain to muscle(s) / effector

alternative approach 1

(many) branches (1)

allow (many) dendrites

to transport / carry the information / impulse(s) / signal (1)

allow to transport / carry electrical messages
ignore to carry messages unqualified

to many / several muscle cells (1)

alternative approach 2

attach to muscle cells (1)

to transport / carry the information / impulse(s) / signal (to muscle) (1)

for muscle contraction (1)

alternative approach 3

many mitochondria (1)

to respire (1)

*allow to release energy do **not** accept energy produced / made / created*

to assist / allow the information / impulse / signal to travel (1)

allow to assist / allow the transport / carriage of electrical messages

alternative approach 4

insulation **or** fatty sheath (1)

to transport / carry the information / impulse(s) / signal (1)

allow to transport / carry electrical messages

ignore to carry messages unqualified

(along the neurone) faster (1)

alternative approach 5
allow narrow (1)
so many (neurones) can fit in a small space (1)

1

[13]

6. (a) pituitary

1

(b) increased blood flow to muscles

1

(c) receptor(s) (cells / neurones)

allow sensory (cells / neurones)

1

(d) blood glucose (concentration) varies more (than in people who do not have diabetes)

allow converse if clearly describing people who do not have diabetes

allow blood glucose (concentration) increases / decreases more

allow blood glucose (concentration) goes very high

allow to get a sufficient range of blood glucose (concentrations)

1

(because) less / no insulin produced when blood glucose (concentration) increases
or
(because) less / no insulin produced to decrease blood glucose (concentration)

1

(e) any **two** from:

- prior familiarity with reaction time test

  ignore health unqualified

  allow practice

- type of (reaction time) test

  allow description of part of a reaction time test to control eg which hand is used to catch the ruler

- insulin (injections)

- example of named drug (that would affect reaction time)

  ignore caffeine / alcohol

- amount of sleep

  allow tiredness / sleep

- distractions

2

(f) low / high blood glucose (concentration) is dangerous / unsafe

allow (to monitor for) unconsciousness / coma / headache / dizziness

ignore hypoglycaemia / hyperglycaemia unqualified

1

(g) lowest reaction times recorded in (range of) blood glucose (concentration) found in people who do not have diabetes

*allow high **and** low blood glucose (concentration) increase (mean) reaction time*

allow lowest reaction times recorded in range 4.0 to 7.8 (mmol/dm^3)

1

homeostasis keeps blood glucose (concentration) in a narrow / small range
or
low(er) reaction times are a survival advantage

1

(h) when blood glucose (concentration) increases the pancreas releases insulin

allow when blood glucose (concentration) is / nears 7.8 (mmol/dm^3) the pancreas releases insulin

allow when blood glucose (concentration) is high the pancreas releases insulin

1

(insulin causes) glucose to move (from the blood) into the liver / muscle (cells)

in (liver / muscle) (excess) glucose is converted to glycogen

*if neither mark awarded allow **1** mark for glucose moves into cells*

1
1

when blood glucose (concentration) decreases the pancreas releases glucagon

allow when blood glucose (concentration) is / nears 4.0 (mmol/dm^3) the pancreas releases glucagon

allow when blood glucose (concentration) is low the pancreas releases glucagon

1

(glucagon causes) glycogen to be converted into glucose and released into the blood

allow (glucagon causes) glycogen to be converted into glucose which increases blood glucose (concentration)

1

(i) any **two** from:

(if more chemical produced / present)

- diffusion of chemical (across synapse) is faster
- an impulse in relay / motor / next neurone is more likely

  allow electrical signal for impulse throughout
  ignore signal / message

  allow an impulse in relay / motor / next neurone is faster / stronger / bigger

  allow there will be more impulses in relay / motor / next neurone(s)

- an impulse is more likely to reach muscle

  allow an impulse reaches muscle in less time
  allow an impulse reaches muscle faster
  allow bigger impulse causes faster muscle contraction

2

[17]