Homeostasis 5

Name: _____

Class: _____

Date: _____

Time: **78 minutes**

Marks: **71 marks**

Comments:

1. This question is about reproduction.

(a) Describe the difference between the way hormonal and non-hormonal methods of contraception work.

Give **one** example of each method of contraception.

_____

_____

_____

_____

_____

_____

(3)

The urine of women using hormonal methods of contraception contains high levels of progesterone.

Concentrations of 1–3 ng/dm^3 of progesterone are found in the water of rivers near sewage outflow points.

Scientists investigated the effect of different concentrations of progesterone in water on fish reproduction.

This is the method used.

1. Prepare tanks of water containing different concentrations of progesterone.

2. Put a breeding pair of fish into each tank.

3. Record the number of eggs produced per day by the female in each tank for 14 days.

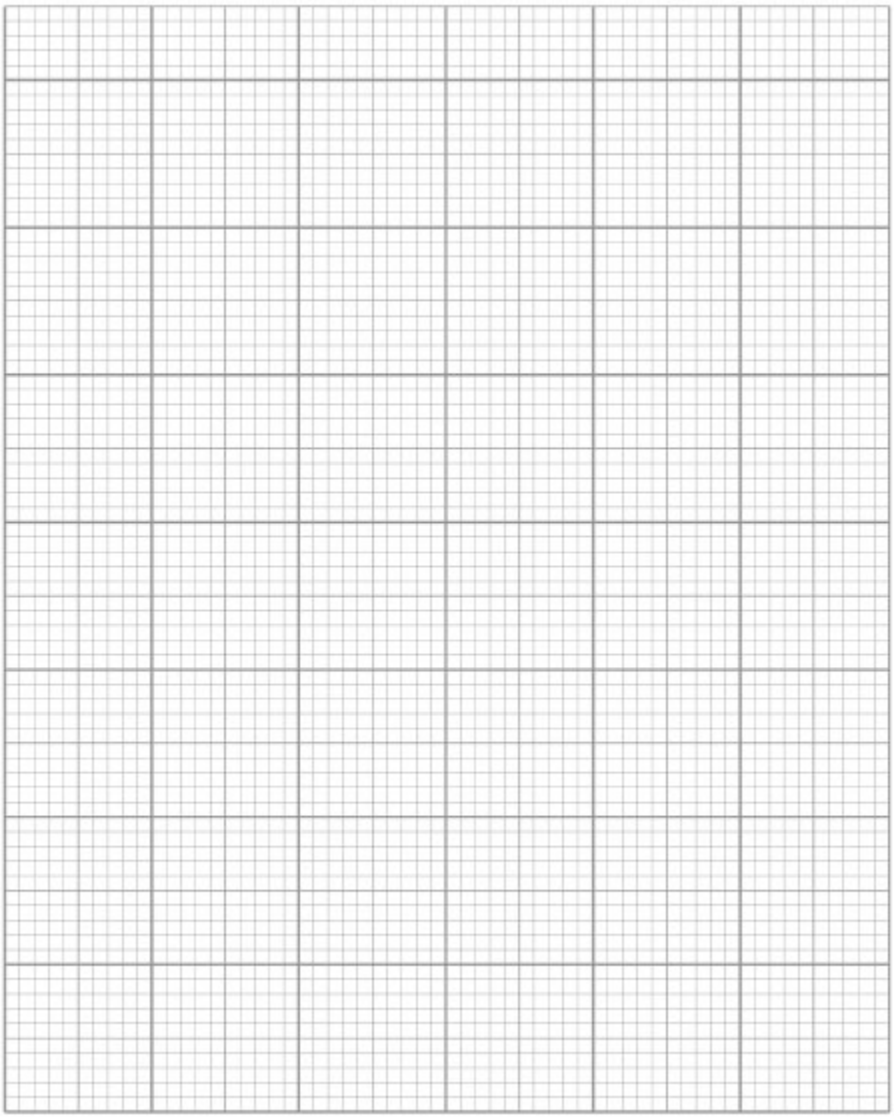
The table shows the results.

Concentration of progesterone in water in ng/dm^3	**Mean number of eggs produced per day**
0.0	28.6
0.8	4.5
1.5	3.2
3.0	2.8
10.0	1.1
20.0	0.2

(b) Plot the data from the table on the grid.

You should:

- label each axis
- use a suitable scale
- draw a line of best fit.



(4)

(c) Describe the effect on fish reproduction of the concentrations of progesterone found in rivers near sewage outflows.

Use data from your graph.

_____

_____

_____

_____

(2)

(Total 9 marks)

2. Control of blood glucose concentration is an important aspect of homeostasis.

When the blood glucose concentration is too high the hormone insulin is released.

(a) Name the hormone released when the blood glucose concentration is too low.

_____

(1)

(b) Explain how the **two** hormones keep the blood glucose concentration at the correct level in a healthy human body.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(5)

The two hormones which control blood glucose concentration are proteins.

Proteins are made according to information stored in the DNA structure of genes.

(c) Describe the structure of DNA.

(2)

(d) Describe how DNA controls the structure of a protein.

(2)

(e) Polydactyly and cystic fibrosis are both inherited disorders caused by faulty DNA.

- Polydactyly is caused by a dominant allele.
- Cystic fibrosis is caused by a recessive allele.

Mother **A** has polydactyly.

Mother **B** has cystic fibrosis.

Mother **A** is more likely to have a child with polydactyly than Mother **B** having a child with cystic fibrosis.

Explain why.

Assume the fathers of the children have no alleles for polydactyly or cystic fibrosis.

You may use genetic diagrams in your answer.

(3)

(Total 13 marks)

3. Fall armyworms are native to America.

Fall armyworms eat corn plants.

(a) The binomial name for fall armyworms is *Spodoptera frugiperda*.

Fall armyworms belong to an order of insects called Lepidoptera.

The table shows a classification table for the fall armyworm.

Complete the table.

Classification group	**Name**
Kingdom	
	Arthropoda
	Insecta
Order	Lepidoptera
Family	Noctuidae
	frugiperda

(2)

Fall armyworms have been found in Africa.

By 2016 they had spread rapidly destroying corn crops.

(b) Suggest **one** reason why the fall armyworms are spreading so rapidly in Africa.

_____

_____

(1)

(c) Fall armyworms:

- are **not** worms (annelids)
- are the caterpillars of moths (arthropods).

Describe **one** way scientists could tell if a new 'worm' they found should be classified as an annelid or as an arthropod.

_____

_____

(1)

(d) In parts of Africa, aeroplanes have been used to spray insecticide on crops, to kill the worms.

Explain the advantages and disadvantages of spraying insecticide on the corn crops.

(4)

(Total 8 marks)

4. Amylase is an enzyme that digests starch.

A student investigated the effect of pH on the activity of amylase.

This is the method used.

1. Mix amylase solution and starch suspension in a boiling tube.
2. Put the boiling tube into a water bath at 25 °C.
3. Remove a drop of the mixture every 30 seconds and test it for the presence of starch.
4. Repeat the investigation at different pH values.

The table below shows the students' results.

pH	Time when no starch was detected in minutes
5.0	7.0
5.5	4.5
6.0	3.0
6.5	2.0
7.0	1.5
7.5	1.5
8.0	2.0

(a) The student concluded pH 7.25 was the optimum pH for the amylase enzyme.

This is **not** a valid conclusion.

Suggest **two** reasons why.

1. _____

_____

2. _____

_____

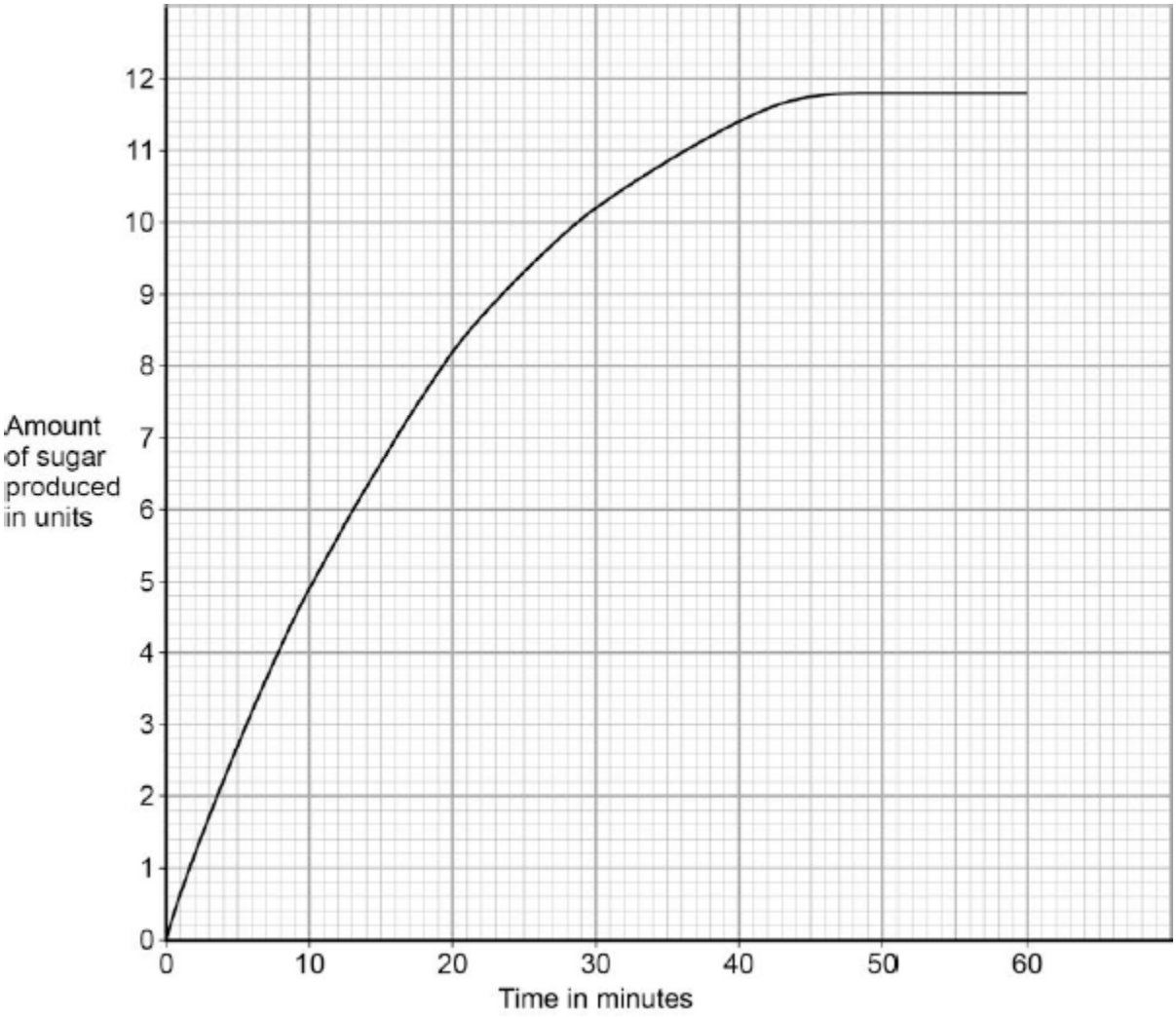
(2)

(b) The student did another investigation.

This is the method used.

1. Put amylase solution and starch suspension into a boiling tube.
2. Make the pH 7.25.
3. Put the boiling tube into a water bath at 25 °C.
4. Measure the amount of sugar produced every 30 seconds.

The results are shown in the figure below.



Calculate the mean rate of sugar produced per minute during the first 5 minutes.

_____

_____

Mean rate = _____ units per minute

(2)

(c) Iodine solution is added to a sample taken from the boiling tube after 10 minutes and 60 minutes.

Suggest what you would see in these samples.

After 10 minutes _____

_____

After 60 minutes _____

_____

(2)

(d) The scientist repeated the investigation at 37 °C.

Draw a line on the figure above to show the results the scientist would get.

(2)

(e) The same investigation was done at 65 °C.

How would this affect the results?

Explain why.

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 11 marks)

5. A person with Type 1 diabetes does **not** produce enough of the hormone insulin.

(a) Where is the hormone insulin produced?

Tick **one** box.

Brain ☐

Pancreas ☐

Pituitary ☐

Thyroid ☐

(1)

(b) How does insulin travel around the body?

_____

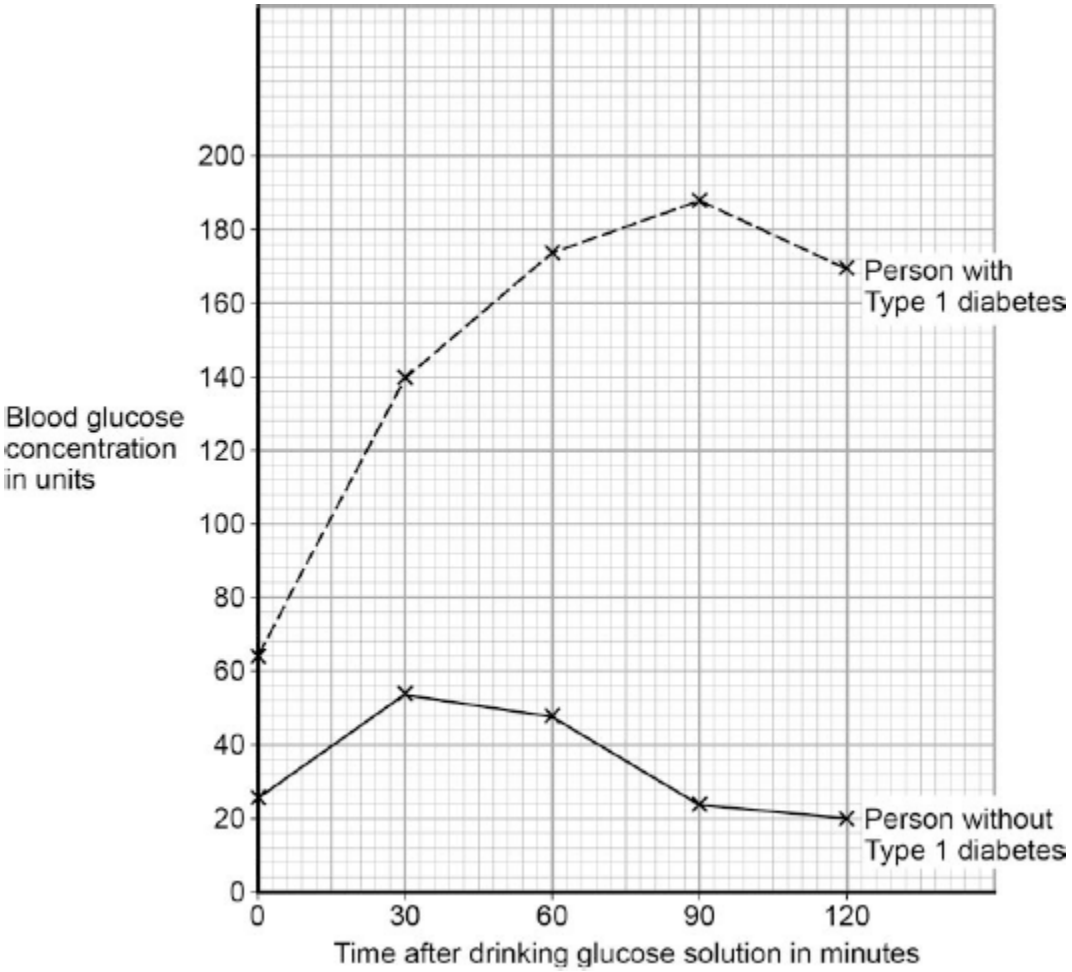
_____

(1)

(c) The same concentration and volume of glucose solution was given to two people.

- Person with Type 1 diabetes.
- Person without Type 1 diabetes.

The figure below shows how the blood glucose concentration of these two people changed after they each drank a glucose solution.



Look at the figure above.

Compare the blood glucose concentrations of the two people.

Include similarities and differences in your answer.

_____

_____

(4)

(d) People with diabetes may be asked to control their diet.

Explain how this can help to reduce the risk of developing health problems.

_____

_____

_____

_____

_____

_____

(3)

(Total 9 marks)

6. Neurones pass information around the body.

(a) Why are reflex reactions important?

_____

(1)

(b) Caffeine is a drug found in coffee.

After a person drinks coffee information passes through neurones in the nervous system more quickly.

Suggest a hypothesis for the effect of caffeine concentration on reaction time.

_____

_____

(1)

(c) Two students investigated the effect of caffeine concentration on reaction time.

This is the method used.

1. Student **A** drinks a cup of coffee.
2. Student **B** holds a ruler above Student **A**'s hand.
3. Student **B** drops the ruler.
4. Student **A** catches the ruler as quickly as she can.
5. The distance the ruler falls is recorded.

Suggest how this method could be improved to produce valid results.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(6)

(Total 8 marks)

7. People with Type 1 diabetes cannot control the concentration of glucose in their blood.

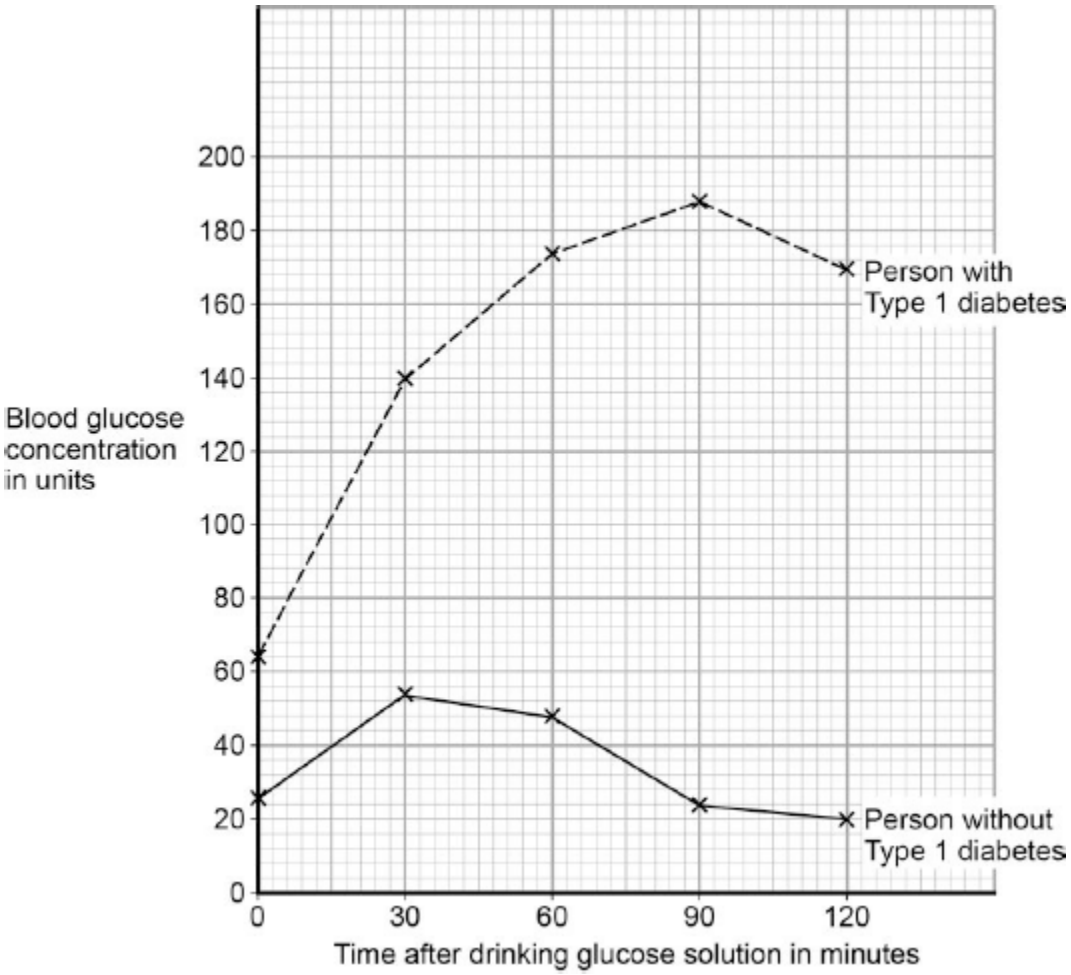
This is because they do **not** produce the hormone insulin.

The same concentration and volume of glucose solution is given to two people.

- Person with Type 1 diabetes.
- Person without Type 1 diabetes.

Figure 1 shows how the blood glucose concentration of these people changes after they each drink a glucose solution.

Figure 1



(a) The blood glucose concentration increases at a faster rate in the person with diabetes compared to the person without diabetes.

Calculate how much faster the rate of increase in blood glucose concentration is in the person with diabetes.

Give the rate of increase for the first 30 minutes after drinking the glucose solution.

Give your answer in units / h.

_____

_____

_____ Units / h

(2)

(b) The blood glucose concentration of the person without diabetes starts to change 30 minutes after drinking the glucose solution.

Explain why the blood glucose concentration changes.

_____

_____

_____

_____

(2)

(c) People with diabetes should try to keep their blood glucose concentration within the same range as a person without diabetes.

Most people with Type 1 diabetes regularly check their blood glucose concentration using a meter, as shown in **Figure 2**.

The meter reading is used to estimate how much insulin they need to inject.

Figure 2

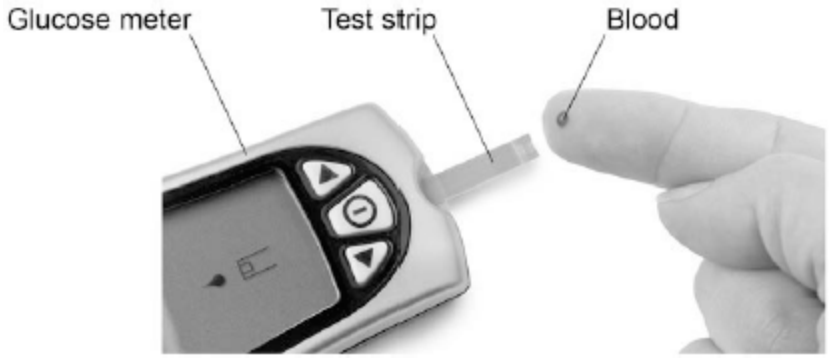
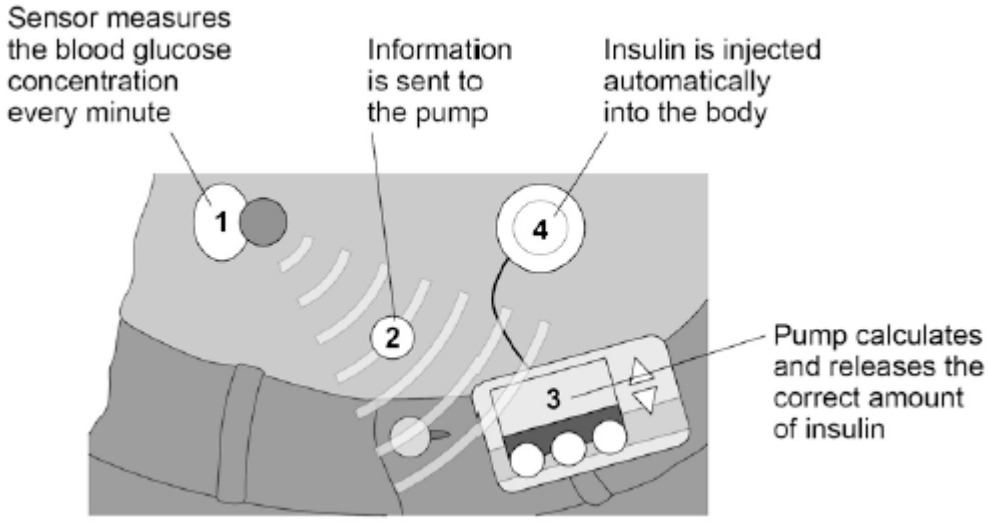


Figure 3 shows a new system.

It is connected to the person all the time.

Figure 3



The new system:

- gives better control of blood glucose concentration
- reduces the number of times the glucose concentration falls too low.

Evaluate the two systems as methods for controlling blood glucose concentrations for people with Type 1 diabetes.

Give a justified conclusion to your evaluation.

(4)

(d) How does the body respond if slightly too much insulin is injected into the body.

(5)

(Total 13 marks)

1.

(a) (hormonal uses chemicals / synthetic) hormones to prevent an egg being released

allow 'to prevent maturation of eggs'

1

(non-hormonal has a barrier which) prevents the sperm reaching an egg **or** prevents implantation

1

a correct example of each type

1

(b) suitable scales and axes labels correct

1

all points plotted accurately

*allow **1** mark for 5 accurate points*

2

line of best fit

*allow a bar chart for max **3** marks*

1

(c) decrease egg production

1

by between 6–10 times

allow ecf from their graph

1

[9]

2.

(a) glucagon

correct spelling only

1

(b) if glucose too high (insulin causes) glucose to enter liver / muscle cells
or
glucose to be converted to glycogen

1

so blood glucose levels fall

1

when glucose gets too low (glucagon causes) glycogen breakdown in liver / muscle cells

allow ecf from part (a)

1

so glucose enters blood and raises level again

1

this is called negative feedback

1

(c) any **two** from:

- polymer
- made of two strands
- (twisted) in a double helix

allow:

- *backbone of strands contains sugar and phosphate groups*
- *(cross) linked by pairs of bases*
- *correct names of four bases or base pairs*

2

(d) contains a code

1

for a sequence of amino acids which forms a specific protein

1

(e) mother **A** (polydactyly)

50% / half of children will have polydactyly if parent is heterozygous as it only takes one allele to show the disorder and half the sperm / ova / gametes will have faulty allele.

1

(and) all / 100% will have polydactyly if parent is homozygous as faulty gene will always be passed on

1

(but) for mother **B** (cystic fibrosis) none / 0% of children will have cystic fibrosis as it would need a second allele from the other parent before the disorder would be present

allow genetic diagram(s) if correct and offspring ratio clearly indicated.

1

[13]

3. (a)

	Animalia
Phylum	
Class	
Genus	*Spodoptera*
Species	

1
1

(b) any **one** from:

- no / few natural predators
- no / few pathogens / diseases
- more favourable climate
- plentiful food as corn crops grown over wide areas in Africa

1

(c) any **one** from:

- compare the structural features with those of annelids and arthropods

  allow named structural features eg is it a segmented worm, does it form a pupa, does it turn into an adult with legs.
- carry out DNA analysis and compare with known annelids and arthropods
- carry out electron microscopy of internal parts to see fine structure and compare with known annelids and arthropods

1

(d)

Level 2: Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	3-4
Level 1: Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	1-2
No relevant content	0
Indicative content **advantages** • killing worms will mean more corn / food for African people • so food security or no famine • it will stop the spread of the worms • so stop it reaching other countries and causing food shortages there • it will remove an invasive species • and so restore the natural ecosystem balance in the area **disadvantages** • insecticide will kill other (pollinating) insects • so will stop fertilisation of crops and lead to poor yields • insecticide will kill other insects • and upset the ecological balance in the area or reduce biodiversity in the area • insecticide may be toxic to humans • causing illness if they ingest it • insecticide may build up in the food chain • and poison / kill organisms further up the chain (ignore cost as it could be argued either way)	

4

[8]

4. (a) any **two** from:

- same result at pH 7 and 7.5
  or
  could be any pH between 7 and 7.5
  or
  not tested at pH 7.25
  or
  need to test at smaller pH intervals (between 7 and 7.5)
- accuracy of result only to nearest 0.5 minutes
- no repeats
- difficult to determine end point (colour)

2

(b) 2.7 / 5

1

0.54 (units per minute)

*allow 0.52 with no working shown for **2** marks*

1

*allow **1** mark for 0.52 **or** 0.56*

(c) (after 10 minutes) solution goes black

1

(after 60 minutes) solution stays the same
or
does not go black
or
goes slightly orange

1

(d) steeper curve

1

levels off at 11.8 units **and** before 45 minutes

1

(e) no / little sugar produced

allow a correct description of what the graph would look like

1

(because at 65 °C) the enzyme will be denatured

allow (because) the enzyme's shape will be changed

or

(because) the active site is damaged

1

(so) will no longer fit the starch
or
(so) will not be able to catalyse the reaction

1

[11]

5. (a) pancreas

1

(b) (in the) blood(stream)

allow in the (blood) plasma

1

*ignore dissolved **or** in solution*

(c) any **two** from:

- concentration rises and falls in both people
- concentration is higher at start / always in person with diabetes
- concentration rises higher in person with diabetes

allow correct use of figures

2

plus any **two** from:

- concentration rises more rapidly in person with diabetes
- concentration stays high for longer in person with diabetes
- concentration does not return to starting level during test in person with diabetes, yet concentration returns to starting concentration by 90 minutes in person without diabetes
- concentration goes below starting concentration only in person without diabetes

2

(d) reduce carbohydrate / glucose / sugar in diet

1

(so) blood glucose concentration does not increase as much

1

(so) there is reduced named effect (of prolonged high blood glucose)

allow reduced short or long term consequences such as tiredness

or

increase urination

or

thirst

***or** eye / kidney / nerve / heart disease*

1

[9]

6. (a) fast reaction to reduce / protect from harm

allow named examples

1

(b) high<u>er</u> caffeine concentration causes short<u>er</u> reaction time.

allow converse

ignore 'faster / slower <u>reaction</u> <u>time</u>'

1

(c) **Level 3 (5–6 marks):**
A coherent method is described with relevant detail, which demonstrates a broad understanding of the relevant scientific techniques and procedures. The steps in the method are logically ordered. The method would lead to the collection of valid results.

Level 2 (3–4 marks):
The bulk of a method is described with mostly relevant detail, which demonstrates a reasonable understanding of the relevant techniques and procedures. The method may not be in a completely logical sequence and may be missing some detail.

Level 1 (1–2 marks):
Discrete relevant points are made which demonstrate some understanding of the relevant scientific techniques and procedures. They may lack a logical structure and would not lead to the production of valid results.

0 marks:
No relevant content.

Indicative content

- use decaffeinated coffee as control
- control volume of coffee
- blind trial or do not tell students which coffee they are drinking
- left for standard time between drink and test
- at least 10 minutes
- control start position of ruler
- control other factors such as light in the room
- same person for different concentrations
- repeat for each caffeine concentration
- use a range of caffeine concentrations
- start with lowest concentration of caffeine
- use caffeine solution instead of coffee to control for other ingredients
- repeat investigation with more people and calculate means

6

[8]

7. (a) (76 − 28) × 2

1

96 (units / h)

*allow 96 (units / h) with no working shown for **2** marks*

1

*allow 1.6 units / min for **1** mark*
allow answer in range of 94–104
*(units / h) for **1** mark*

(b) increased blood glucose concentration causes insulin release from pancreas

1

which stimulates cells to absorb glucose / sugar from the blood, so blood glucose concentration decreases

1

(c) any **three** from:

*at least one advantage **and** one disadvantage of the system(s) must be given for full marks*

allow responses phrased in terms of the meter and injection systems

advantages of the new system:

- better control so reduces risk of future health problems

  allow fewer low / high blood glucose periods so safer
- no need to estimate dose of insulin
- less chance of giving too much / little insulin
- system works automatically / continuously so no need to test / inject

disadvantages of the new system:

- system is always attached so may restrict activities

  allow pump is difficult to hide
- pump has to be carried somewhere

  allow risk of discomfort
- pump will need re-filling
- risk of infection

  or

  risk of tissue damage (at injection site)
- line might come out

  accept new system more expensive

3

qualified conclusion: a statement as to which system is better with reference to at least one advantage and one disadvantage

for example, the new system is better because although it is more expensive, it works automatically

1

(d) blood glucose concentration goes too low

1

blood glucose concentration detected by pancreas

1

pancreas releases <u>glucagon</u>

1

(glucagon causes) cells to convert to glycogen into glucose

1

glucose released into blood

1

[13]