



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

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(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.

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(3)

(Total 13 marks)

2

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

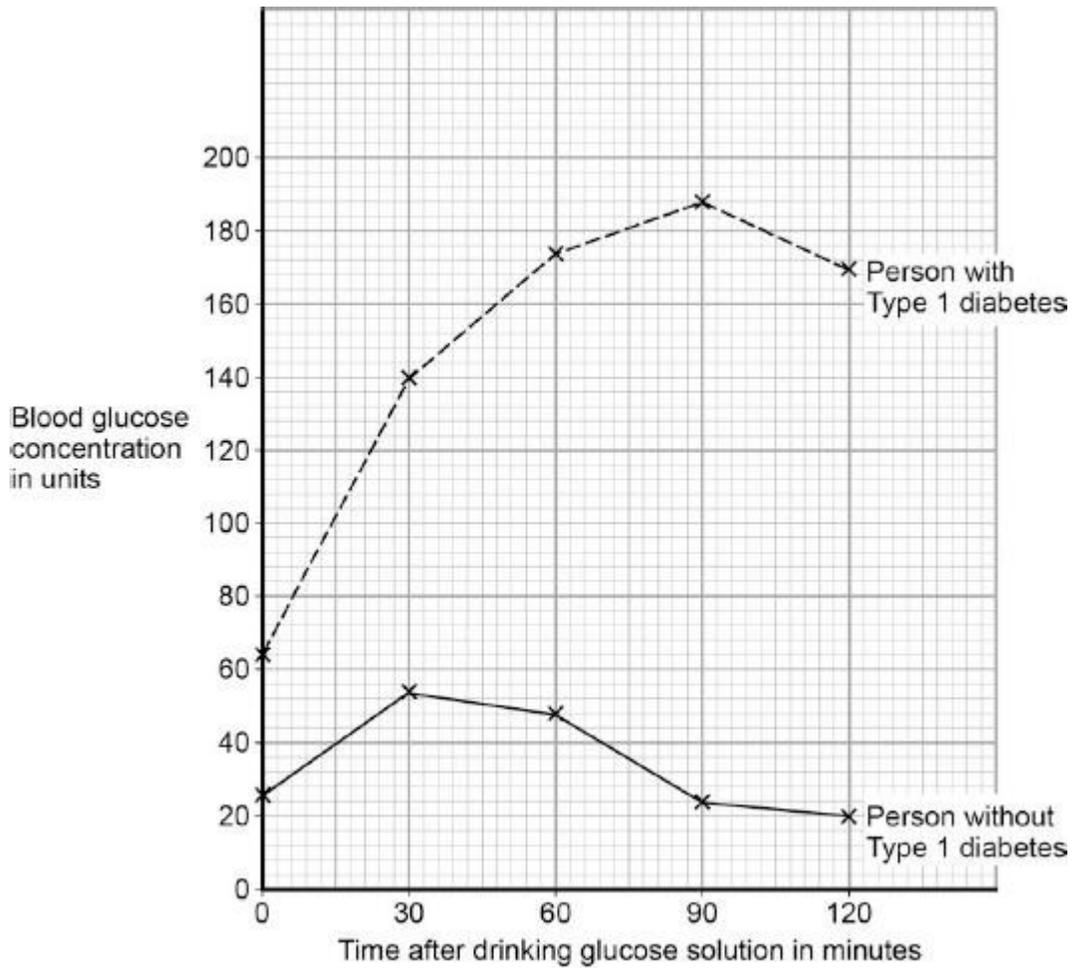
This is because they do **not** produce the hormone insulin.

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.

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\_\_\_\_\_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.

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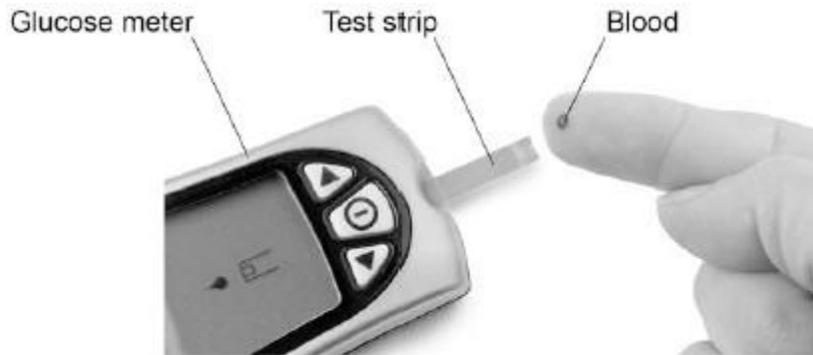
**(2)**

- (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**

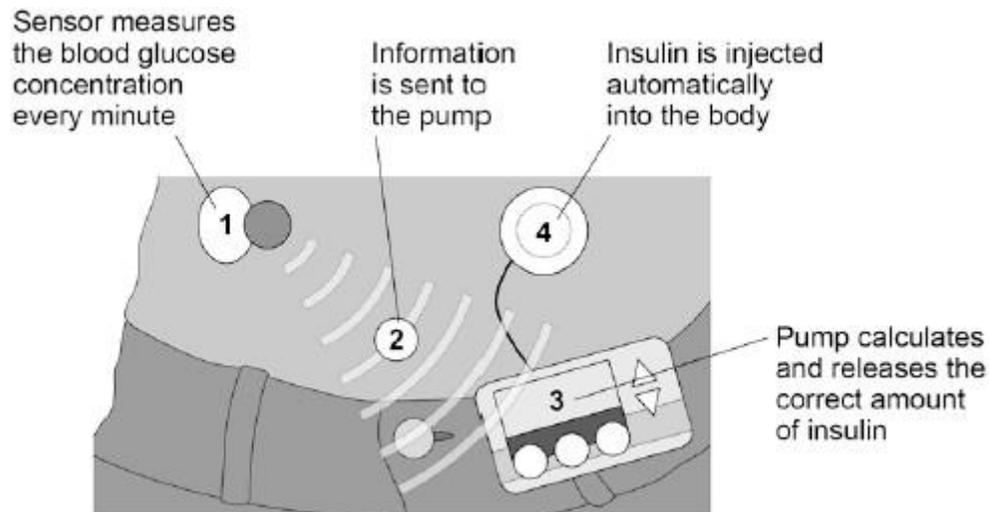


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**Figure 3** shows a new system.

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.

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**(4)**

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

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**(5)**

**(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
	<i>frugiperda</i>

(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.

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(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.

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(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.

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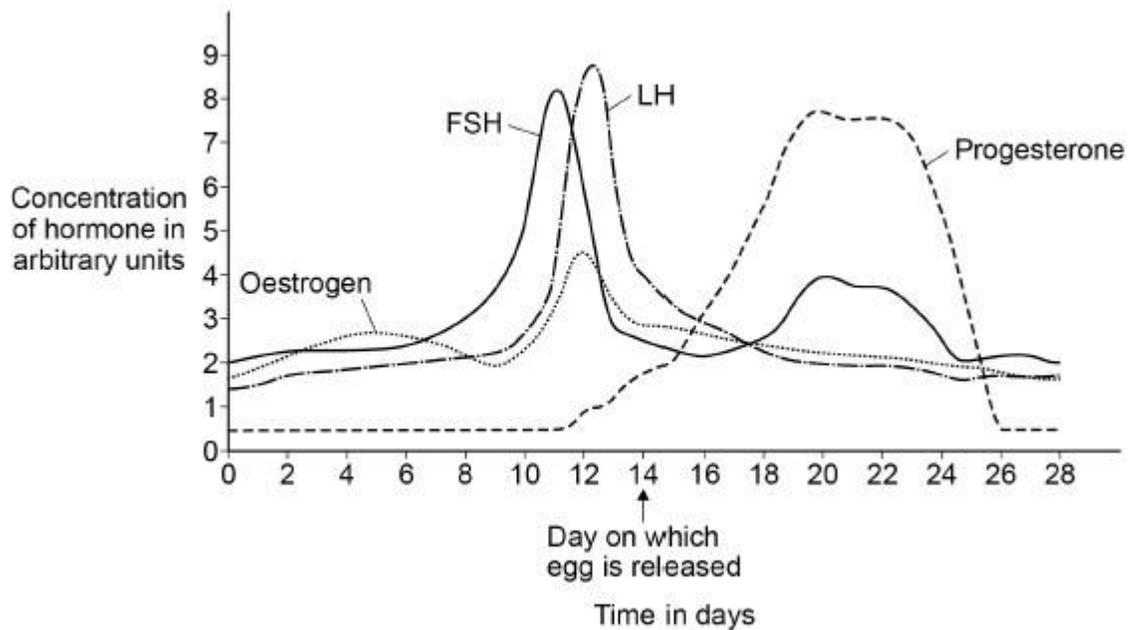
(4)

(Total 8 marks)

4

Female reproductive hormones interact to control the menstrual cycle.

The graph shows how the concentration of four hormones changes during a 28 day cycle.



(a) What are two effects of progesterone?

Tick **two** boxes.

Causes eggs to develop

Maintains the lining of the uterus

Stimulates oestrogen production

Stimulates LH production

Suppresses FSH

(2)

(b) In the graph menstruation starts on day 28.

Explain the change that takes place to cause menstruation.

Use information from the graph.

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(2)

(c) Injections of specific hormones are used to treat infertility.

Explain how these hormones can increase the chance of having a baby.

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(4)

(Total 8 marks)

**5**

Eukaryotic cells respire continuously to transfer energy.

(a) Give **two** uses of energy transferred by respiration in eukaryotes.

1. \_\_\_\_\_

2. \_\_\_\_\_

(2)

(b) Name the cell structure in a eukaryotic cell where aerobic respiration occurs.

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(1)

(c) Muscle cells and plant cells can respire anaerobically.

Compare the processes of anaerobic respiration in muscle and plant cells.

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(4)

(d) Anaerobic respiration in muscle cells creates an oxygen debt.

What does oxygen debt mean?

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(1)

(Total 8 marks)

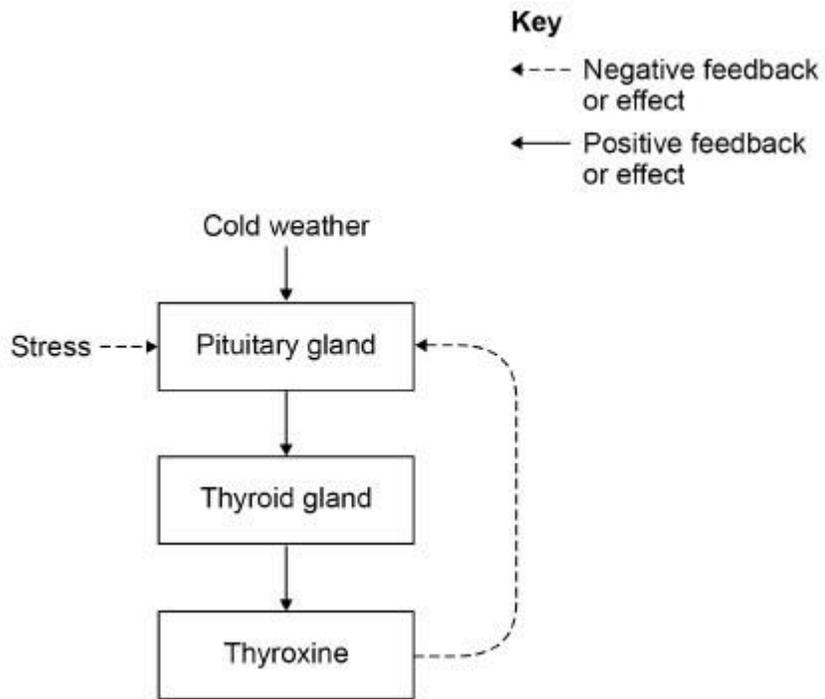
**6** Thyroxine is produced by the thyroid gland and released into the blood.

(a) What type of chemical is thyroxine?

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(1)

The diagram shows how the release of thyroxine is controlled.



(b) Explain how the body regulates the amount of thyroxine that is produced if the body is **not** stressed or cold.

Use information shown in the diagram.

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(2)

Thyroxine stimulates basal metabolic rate.

One important chemical reaction of metabolism is respiration.

- (c) Explain how the feedback mechanism in the diagram maintains normal body temperature in cold weather.

Use the information in the diagram and your own knowledge.

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**(3)**

- (d) People in stressful situations produce a chemical that reduces the activity of the pituitary gland.

Explain how this can cause people to gain weight.

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**(3)**

**(Total 9 marks)**

## Mark schemes

- 1 (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]**

**2**

(a)  $(76 - 28) \times 2$

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 glucagon

1

(glucagon causes) cells to convert to glycogen into glucose

1

glucose released into blood

1

**[13]**

3

(a)

	Animalia	}
Phylum		
Class		
Genus	<i>Spodoptera</i>	}
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)

<b>Level 2:</b> Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	3-4
<b>Level 1:</b> 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
<b>Indicative content</b> <b>advantages</b> <ul style="list-style-type: none"><li>• killing worms will mean more corn / food for African people</li><li>• so food security or no famine</li><li>• it will stop the spread of the worms</li><li>• so stop it reaching other countries and causing food shortages there</li><li>• it will remove an invasive species</li><li>• and so restore the natural ecosystem balance in the area</li></ul> <b>disadvantages</b> <ul style="list-style-type: none"><li>• insecticide will kill other (pollinating) insects</li><li>• so will stop fertilisation of crops and lead to poor yields</li><li>• insecticide will kill other insects</li><li>• and upset the ecological balance in the area or reduce biodiversity in the area</li><li>• insecticide may be toxic to humans</li><li>• causing illness if they ingest it</li><li>• insecticide may build up in the food chain</li><li>• and poison / kill organisms further up the chain</li></ul> (ignore cost as it could be argued either way)	

4

[8]

4

(a) maintains the lining of the uterus

1

suppresses FSH

1

(b) (sudden) drop in progesterone

1

causes the lining of the uterus to break away

1

- (c) FSH (injections) stimulate the growth / maturation of eggs (to be fertilised) 1
- FSH stimulates oestrogen release 1
- (which) stimulates uterus lining to develop (for the fertilised egg to implant into)  
*allow oestrogen stimulates LH production / release* 1
- LH stimulates ovulation / egg release 1

[8]

- 5 (a) any **two** from:
- synthesis of new molecules  
*allow named molecule eg starch / glycogen / cellulose / lipids / fats / proteins / hormones / antibodies*
  - for active transport
  - to keep warm (in mammals / birds)  
*allow description*  
*allow to keep warm (in animals)*  
*allow for movement (in animals)*  
*allow for transmission of nerve impulses (in animals)* 2
- (b) mitochondria / mitochondrion 1
- (c) both occur without oxygen 1
- both release (a small amount of) energy 1
- muscle cells produce lactic acid but plant cells produce ethanol 1
- muscle cells do **not** produce carbon dioxide but plant cells do  
*marks can be awarded from correct word or balanced symbol equations* 1
- (d) the amount of oxygen needed to react with the lactic acid formed  
*allow the amount of oxygen needed to break down **or** oxidise the lactic acid* 1

[8]

- 6 (a) hormone  
*ignore protein* 1
- (b) (once a certain amount of thyroxine has been produced)  
(thyroxine) inhibits / prevents / stops (pituitary gland from) stimulation of the thyroid gland 1  
so less thyroxine is produced 1
- (c) cold weather stimulates the pituitary gland, which stimulates the thyroid gland to produce more thyroxine 1  
increased / more thyroxine raises basal metabolic rate 1  
which increases rate of respiration, which increases body temperature 1
- (d) less stimulation of thyroid gland, so less thyroxine produced / released 1  
so basal metabolic rate decreases 1  
therefore reduced respiration rate, so more food stored as fat 1

[9]