

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

Penguins live mainly in the Antarctic. Penguins eat mainly fish.
Photograph 1 shows a penguin swimming underwater.

Photograph 1



© raywoo/iStock

(a) Use information from **Photograph 1** to suggest **three** ways the penguin is adapted for catching fish.

1. _____

2. _____

3. _____

(3)

- (b) The Antarctic winter is very cold. In the winter some species of penguin huddle together as shown in **Photograph 2**.

Photograph 2



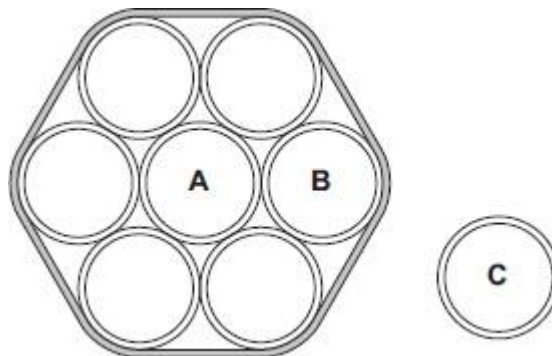
© Fuse

Suggest how the behaviour shown in **Photograph 2** helps the penguins to survive the Antarctic winter.

(3)

- (c) A student did an investigation to model the behaviour of the penguins shown in **Photograph 2**.

The diagram shows the apparatus the student used.



The student:

- held seven similar test tubes together with elastic bands as shown in the diagram
- stood a similar eighth tube in a test tube rack
- filled each of the eight tubes with hot water to the same level
- measured the temperature of the water in tubes **A**, **B** and **C** every 2 minutes for 20 minutes.

The table shows the student's results.

Time in Minutes	Temperature in °C		
	Tube A	Tube B	Tube C
0	65	65	65
2	65	65	64
4	65	64	63
6	64	64	62
8	64	63	61
10	64	63	60
12	63	62	59
14	63	62	58
16	63	61	57
18	62	61	56
20	62	60	55

(i) Give **two** variables that were controlled in the investigation.

1. _____

2. _____

(2)

(ii) Describe the patterns the data shows.

(2)

(iii) How far does the data from the model support the suggestion you made in part **(b)**?

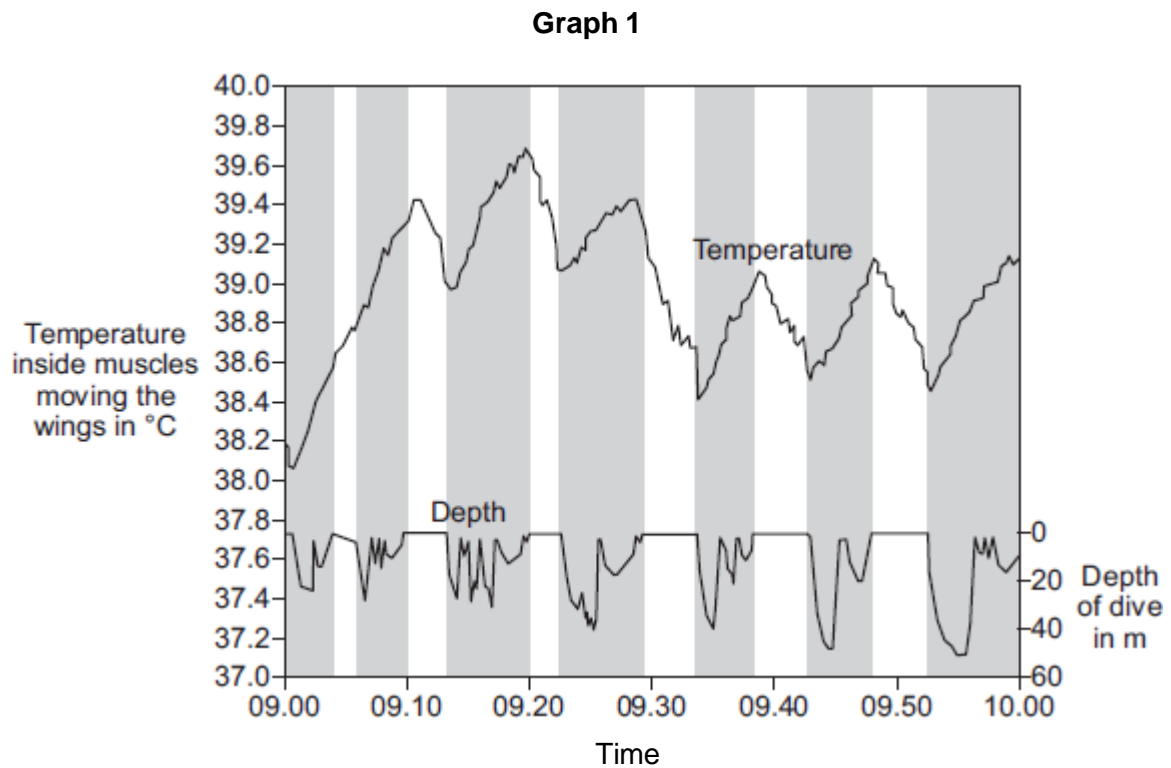
(2)

(d) Describe how blood vessels help control human body temperature.

(4)

- (e) Penguins control their body temperature in similar ways to humans. Scientists investigated changes in body temperature of penguins when the penguins were diving to catch fish.
- (i) **Graph 1** shows the relationship between the temperature of the muscles moving a penguin's wings and diving.

The shaded areas show when the penguin was diving.



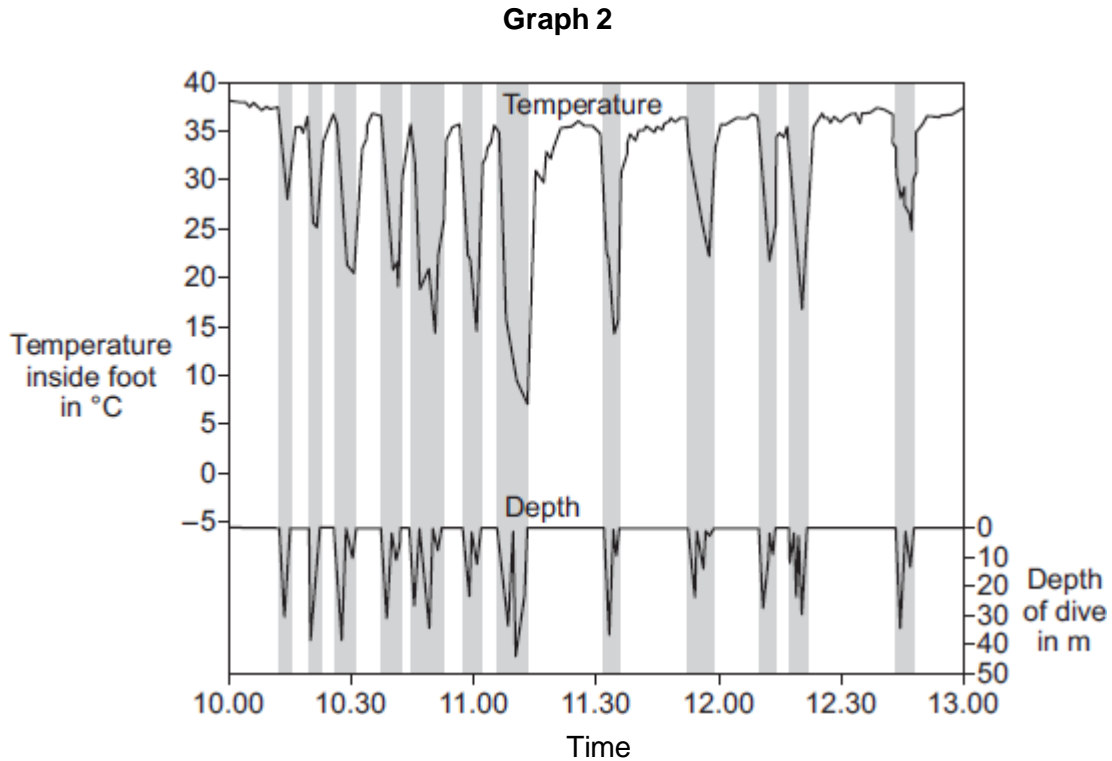
© Reprinted from Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology, Volume 135, P.J. Ponganis, R.P. Van Dam, D.H. Levenson, T. Knowler, K.V. Ponganis, G. Marshall, Regional heterothermy and conservation of core temperature in emperor penguins diving under sea ice, pp 477-487, copyright 2003, with permission from Elsevier

Suggest an explanation for the changes in temperature inside the muscles moving the penguin's wings.

(3)

- (ii) **Graph 2** shows the relationship between the temperature inside a penguin's foot and diving.

The shaded areas show when the penguin was diving.



© Reprinted from Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology, Volume 135, P.J. Ponganis, R.P. Van Dam, D.H. Levenson, T. Knowler, K.V. Ponganis, G. Marshall, Regional heterothermy and conservation of core temperature in emperor penguins diving under sea ice, pp 477-487, copyright 2003, with permission from Elsevier

Suggest an explanation for the changes in temperature inside the penguin's foot as it dives.

(3)
(Total 22 marks)

3

(a) Control systems help to keep conditions in the human body relatively constant.

What is the general name for the processes that keep body conditions relatively constant?

Draw a ring around the correct answer.

eutrophication

homeostasis

hydrotropism

(1)

(b) The concentration of glucose in the blood is controlled by hormones.

Use the correct answer from the box to complete each sentence.

glucagon	glycerol	glycogen
kidney	liver	pancreas

When the blood glucose concentration increases, an organ called

the _____ releases the hormone insulin.

Insulin causes glucose to move from the blood into the cells of the muscles

and the _____.

Inside these organs, the glucose is changed into a carbohydrate called

_____, which can be stored.

When the blood glucose concentration falls, another hormone is released,

which causes the storage carbohydrate to break down into glucose again.

This hormone is called _____.

(4)

- (c) A person with Type 1 diabetes does not make enough insulin.

The person needs to test their blood at intervals throughout the day.

If the concentration of glucose in their blood is too high, the diabetic person needs to inject insulin.

- (i) Insulin is a protein.

It must be injected and cannot be taken by mouth.

Explain why.

(2)

- (ii) Apart from injecting insulin, give **one other** way that a diabetic person could help to control the concentration of glucose in their blood.

(1)

- (d) Pet dogs have been trained to detect if the concentration of glucose in the blood of their diabetic owners is outside the normal healthy range. These dogs are called 'medical response dogs'.

The dogs respond in different ways. They may bark, jump up, or stare at their owners. They may even fetch a blood-testing kit.

- (i) Suggest what stimulus the dogs might be responding to when they behave like this.

(1)

- (ii) **Table 1** shows how the concentration of glucose varied in blood samples from five diabetic people. Measurements were made both before and after getting a medical response dog.

Table 1

		Mean percentage of blood samples with different concentrations of glucose from the five diabetic people		
	Number of blood samples measured	Low glucose	Within normal range of glucose	High glucose
Before getting a dog	1704	32.6	54.8	12.6
After getting a dog	1724	18.6	61.6	19.8

A survey was made of the effect of a medical response dog on the lives of 16 diabetic people.

Table 2 shows how well these diabetic people agreed with each statement in the survey.

Table 2

Statement in survey	Totally agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Totally disagree
I am more independent since getting my dog.	12	2	2	0	0
There are disadvantages to having a medical response dog.	0	0	4	4	8
I trust my dog to alert me when my sugar levels are low.	11	3	1	0	1
I trust my dog to alert me when my sugar levels are high.	6	7	0	1	2

Evaluate how useful medical response dogs are for warning diabetic people that the concentration of glucose in their blood is outside the normal range.

Use information from **Tables 1** and **2**.

(5)

- (e) **Table 3** shows the concentrations of some substances in the urine of a non-diabetic person and in the urine of a diabetic person.

Table 3

Substance	Concentration of substance in urine in g per dm ³	
	Non-diabetic person	Diabetic person
Protein	0	0
Glucose	0	2.0
Urea	20.0	19.5
Sodium ions	6.0	5.8

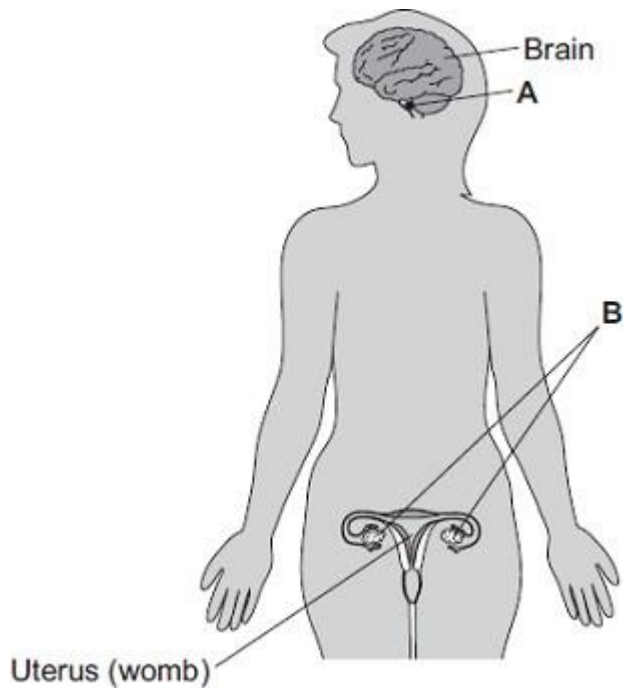
Compare the results for the non-diabetic person and the diabetic person.
Give reasons for any differences.

Use your knowledge of how the kidney works.

(5)
(Total 19 marks)

4

The diagram shows the position of two glands, **A** and **B**, in a woman.



(a) (i) Name glands **A** and **B**.

A _____

B _____

(2)

(ii) Gland **A** produces the hormone Follicle Stimulating Hormone (FSH).

FSH controls changes in gland **B**.

How does FSH move from gland **A** to gland **B**?

(1)

- (b) (i) A woman is not able to become pregnant. The woman does not produce mature eggs. The woman decides to have In Vitro Fertilisation (IVF) treatment.

Which **two** hormones will help the woman produce and release mature eggs?

Tick (✓) **one** box.

FSH and Luteinising Hormone (LH)

FSH and oestrogen

Luteinising Hormone (LH) and oestrogen

(1)

- (ii) Giving these hormones to the woman helps her to produce several mature eggs. Doctors collect the mature eggs from the woman in an operation.

Describe how the mature eggs are used in IVF treatment so that the woman may become pregnant.

(3)

- (iii) IVF clinics have been set a target to reduce multiple births.

At least 76% of IVF treatments should result in single babies and a maximum of 24% of treatments should result in multiple births.

Suggest **one** reason why the clinics have been set this target to reduce multiple births.

(1)

- (c) Two clinics, **R** and **S**, used IVF treatment on women in 2007. Doctors at each clinic used the results of the treatments to predict the success rate of treatments in 2008.

The table shows the information.

	Total number of IVF treatments in 2007	Number of IVF treatments resulting in pregnancy in 2007	Predicted percentage success rate in 2008
Clinic R	1004	200	18–23
Clinic S	98	20	3–56

- (i) Compare the success rates of the two clinics in 2007.

(1)

- (ii) The range of the predicted success rate in 2008 for clinic **R** is much smaller than the range of the predicted success rate for clinic **S**.

Suggest why.

(2)

(Total 11 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) any **three** from:

- streamlined shape enables it to swim quickly (to catch fish)
- wings (provide power) to move quickly (to catch fish)
allow 'flippers'
- wings used for steering
- white underside / dark top acts as camouflage (so prey less likely to see it)
- long / sharp beak to catch fish

3

(b) any **three** from:

- reduces (total) surface area of penguins exposed to wind / cold atmosphere
- reduced number of penguins exposed (to wind / cold)
accept reference to movement in or out of the huddle
accept outer ones insulate / act as barrier
- reducing heat loss
allow reduced cooling
- 'share' body warmth / heat

3

(c) (i) any **two** from:

- size of tubes
- volume of (hot) water
accept amount of (hot) water
- left for same length of time
allow measured at same time intervals
- starting temperature

2

(ii) any **two** from:

- tube alone (**C**) lost heat most (rapidly)
- tube **B** intermediate
- tube **A** least (rapidly)
allow correct use of figures for all 3 tubes
ignore just quoting final temperature

2

(iii) confirms suggestion

no mark awarded

accept correct answers referring to other suggestions in (b)

since (both outer and inner) tubes in bundle lost heat less rapidly (than 'stand – alone' tube)

comparison needed

1

penguins in a huddle lose less heat (than single ones)

accept 'it is the same for penguins'

1

(d) **if the core body temperature is too high**

blood vessels supplying the skin (capillaries) dilate / widen
*accept reference to arteries / arterioles but **not** veins / capillaries*
*do **not** accept references to movement of blood vessels*
ignore enlarge / expand
reference to skin / surface required only once

1

so that more blood flows through the (capillaries) in skin / near surface
*reference to 'more' needed at least once to gain **2** marks*

1

and more heat is lost
*reference to 'more' needed at least once to gain **2** marks*

1

if the core body temperature is too low

blood vessels supplying the skin (capillaries) constrict / narrow
allow full marks if 'too low' given first
*if no other marks awarded, allow vasodilation when too warm **and***
*vasoconstriction when too cold for **1** mark*

1

(e) (i) wings move to provide movement for diving
allow muscles contract / work

1

energy (for movement) comes from respiration
*do **not** allow produces / makes / creates energy*
allow energy comes from / is supplied by / is released by respiration

1

respiration / muscle contraction also releases heat
allow produces heat

1

(ii) any **three** from:

- feet not / less used **or** no muscle contraction in feet
allow little energy / heat released through respiration in feet
*do **not** allow veins / capillaries*
- vessels supplying feet constrict / less blood to feet
- so temperature in feet cools / decreases
- more heat loss from large surface area or rapid flow of cold water over foot

3

[22]

- 3** (a) homeostasis 1
- (b) in sequence:
- pancreas 1
- liver 1
- glycogen
correct spelling only 1
- glucagon
correct spelling only 1
- (c) (i) broken down / digested 1
- further detail eg into amino acids / by enzymes / by proteases 1
- (ii) diet / eating less sugar / less fat
ignore balanced diet
or
ignore 'dieting' / slimming diet
- exercise
accept pancreas transplant 1

(d) (i) sensible suggestion
eg (owner's) smell / sweating / change in owner's behaviour / dizziness / tiredness

1

(ii) any **five** from:
allow 1 mark for justified conclusion
do not allow full marks unless at least 1 pro and 1 con.

Pro:

- % below normal decreases
- % in normal increases
- reliable / repeatable / valid data as large number of samples
do not allow accurate / precise
- patients express satisfaction.

Con:

- may not be reliable as blood glucose measurements for only 5 patients / survey of only 16 (dog owners)
- % above normal increases / dogs are less good at detecting high glucose.

5

(e) glucose in urine of diabetic (and not in the non-diabetic)

1

urea and Na⁺ ions are similar in each / slightly lower in diabetic

1

+ any **three** from:

- no protein in either urine sample because protein too large / does not pass through filter
- glucose passes through filter in kidney
ignore glucose is reabsorbed
- non-diabetic: the / all glucose is reabsorbed / taken back into blood
- diabetic: (too much glucose so) cannot all be reabsorbed
- because diabetic has high concentration of glucose in blood
- urea and Na⁺ lower in diabetic because less water is reabsorbed (due to extra glucose in filtrate).

3

[19]

4 (a) (i) **A** – pituitary
allow hypothalamus

1

B – ovary / ovaries

1

(ii) in blood (stream)
accept in plasma
ignore dissolved

1

- (b) (i) FSH and Luteinising Hormone (LH) 1
- (ii) fertilised 1
 OR
 reference to sperm
- form embryos / ball of cells or cell division 1
- (embryo) inserted into mother's womb / uterus
allow (fertilised egg) is inserted into mother's womb / uterus 1
- (iii) any **one** from:
- multiple births lead to low birth weight
 - multiple births cause possible harm to mother / fetus / embryo / baby / miscarriages
allow premature
ignore reference to cost / ethics / population 1
- (c) (i) any **one** from:
- almost identical
allow S (slightly) more successful
 - both approximately 20% 1
- (ii) larger numbers (in clinic R) (in 2007)
allow only 98 (in S) (compared to 1004 (in R)) 1
- results likely to be more repeatable (in 2008)
allow more reliable
*do **not** accept more reproducible / accurate / precise* 1

[11]