

OCR A-LEVEL BIOLOGY B • H422

BIOLOGY



EXAM QUESTION PACK

5.3.1 THE PRINCIPLES AND IMPORTANCE OF HOMEOSTASIS

SCORE

/111

PERCENTAGE

%

STEMUP

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1(a) Fig. 3.1 is a diagram of a section through the human brain.

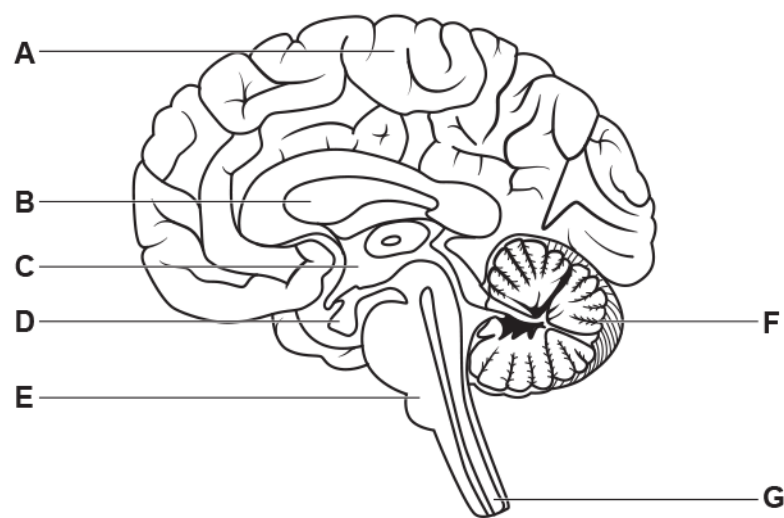


Fig. 3.1

The following table contains statements about areas of the brain shown in Fig. 3.1.

Complete the table using the most appropriate letter from Fig. 3.1. Each letter may be used once, more than once, or not at all.

Statement	Letter
fMRI shows this area of the brain to be active when playing a musical instrument.	
Temperature-sensitive neurones are located in this area of the brain.	
Traumatic injury to this area can lead to over- or under-production of sex hormones.	
This region of the brain controls heart rate and breathing rate.	
Stroke affecting part of this area of the brain could cause loss of conscious control of muscles in the arms or legs.	

[4]

(b) The brain contains the structures responsible for coordination of the control of body temperature.

An 80-year-old man was found in an unheated room when the outside temperature was below 0° C. The man had a weak pulse. A paramedic measured the man’s core body temperature as 34.2 °C.

(i) Explain how the paramedic could obtain an accurate measurement of core body temperature.

[2]

(ii) The paramedic concluded that the man was suffering from hypothermia.

Describe the biological processes that lead to hypothermia and the treatment for hypothermia.

(c) Fig. 3.2 shows monthly data for the treatment of cases of hypothermia (Fig. 3.2 a) and hyperthermia (Fig. 3.2 b) in the United States over a two-year period.

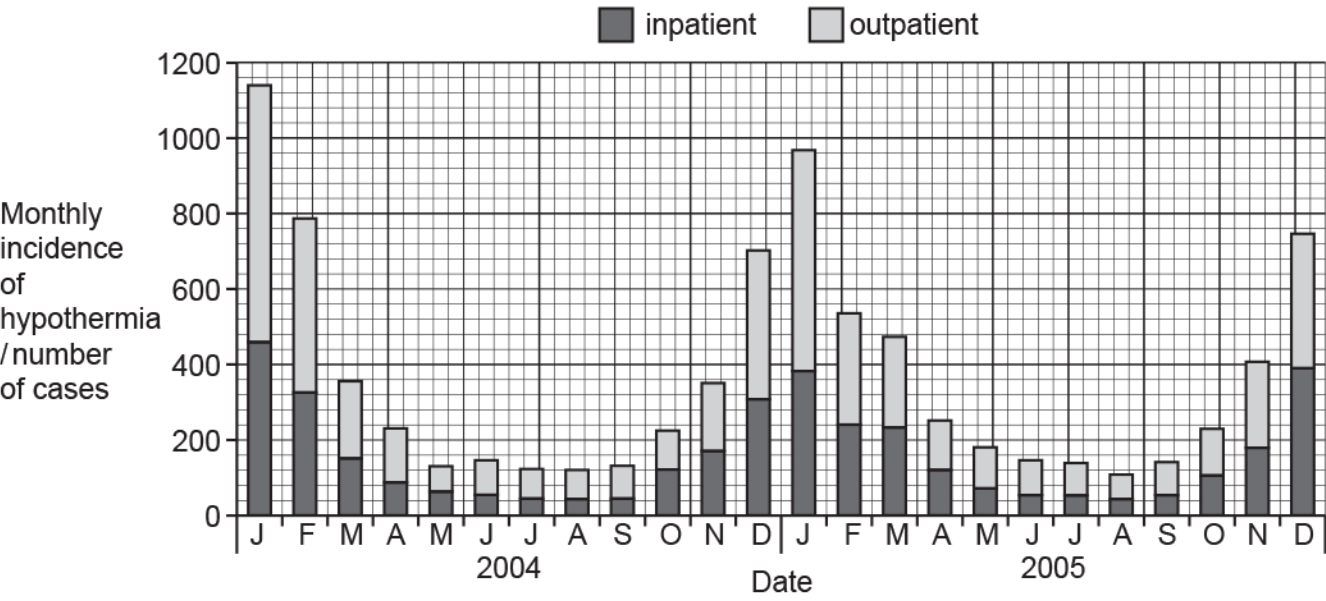
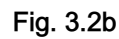


Fig. 3.2a



(i) Describe and explain the seasonal trends shown in the two graphs in Fig. 3.2.

[3]

----- [2]

(iii) A student looked at the data for hyperthermia and concluded that this was evidence for climate change.

Discuss the student's conclusion.

----- [3]

2 Which of the methods, **A** to **D**, is considered the **least** accurate method of measuring core body temperature?

- A axillary
- B oral
- C rectal
- D tympanic

Your answer

[1]

3 A body temperature measurement is $37.6\text{ }^{\circ}\text{C}$ with an absolute uncertainty of $0.2\text{ }^{\circ}\text{C}$.

Which of the options, **A** to **D**, is the relative uncertainty for this temperature measurement?

- A 0.20%
- B 0.27%
- C 0.53%
- D 1.06%

Your answer

[1]

4(a) Homeostatic mechanisms require hormones, such as thyroxine, to maintain a stable internal environment.

Iodine is required to produce thyroxine.

Explain why a deficiency in iodine could cause weight gain.

----- [1]

(b) The release of thyroxine is regulated by negative feedback and involves two other hormones, as shown in Fig. 32.

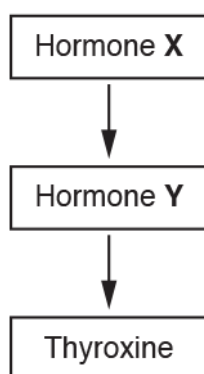


Fig. 32

(i) Identify hormones X and Y.

X -----

Y -----

[2]

(ii) Describe the **general** features of a negative feedback mechanism.

[3]

(c) Core body temperature is maintained between 36.5 °C and 37.5 °C.

Describe **and** explain **two** physiological mechanisms that would be initiated following a decrease in core body temperature.

1

2

[2]

(d) Doctors often take temperature measurements from the skin surface, inside the ear or inside the mouth.

Suggest why the ear provides a more accurate measurement of body temperature than the skin surface.

[2]

There is evidence that heart rate increases when people experience pain. Heart rate is one physiological factor that is regulated tightly and kept within narrow limits.

- (i) Name the process by which the internal environment of an organism is kept within narrow limits.

-----[1]

- (ii) A student made the following revision notes about the control of heart rate.

Complete the student's notes using the most appropriate word(s).

'The resting heart rate of an adult human is about 70 beats per minute. This is known as the set point. There are two types of receptor that control heart rate: _____ in the walls of the carotid artery that detect changes in blood pH and pressure receptors in the carotid artery and the aorta. When blood pressure rises, pressure receptors transmit nervous impulses to the _____ which decreases heart rate via the _____ nervous system. This is an example of _____.'

[4]

- (iii) Some doctors who study pain ask patients to give an estimate of the level of their pain by using a scale of 1 to 10.

Explain why some researchers think that measuring heart rate is a more accurate way of determining the level of pain.

-----[1]

- 6 Which of the options, A to D, is a condition caused by a positive feedback mechanism?

- A hypertension
- B type 1 diabetes
- C hypotension
- D hypothermia

Your answer

[1]

- 7 The control of blood glucose is essential because changes in blood glucose concentration will change the water potential of blood.

Water potential changes are detected by the osmoregulatory centre and adjustments are then made to the secretion of ADH.

- (i) State **one** reason, other than the effect that it has on water potential, why blood glucose concentrations must be controlled.

----- **[1]**

- (ii) State the location in the brain of the osmoregulatory centre and the source of ADH secretion.

osmoregulatory centre

source of ADH secretion

[1]

8(a) Homeostasis has been defined as ‘the maintenance of a *constant* or *stable* internal environment’.

Explain why the word ‘stable’ is more appropriate than the word ‘constant’ in a definition of homeostasis.

[2]

(b) The autonomic nervous system plays an important role in homeostasis.

The box below contains some terms that could be used to describe the features or activity of the two branches of the autonomic nervous system.

acetylcholine	adrenaline	decrease	glycogenesis
glycogenolysis	increase	noradrenaline	motor sensory

Complete Table 1.1 below by inserting the most appropriate term.

Terms may be used once, more than once or not at all.

Some boxes have been completed for you.

Feature or activity	Branch of autonomic nervous system	
	Parasympathetic	Sympathetic
Type of neurone	motor	
Process triggered in liver cells		
Effect on heart rate		
Neurotransmitter released at the SAN		noradrenaline

Table 1.1

(c) Control of body temperature is an important aspect of homeostasis. Conditions such as hypothermia can be fatal if not treated.

Fig. 1.1 compares the effects of three methods of treatment for mild hypothermia.

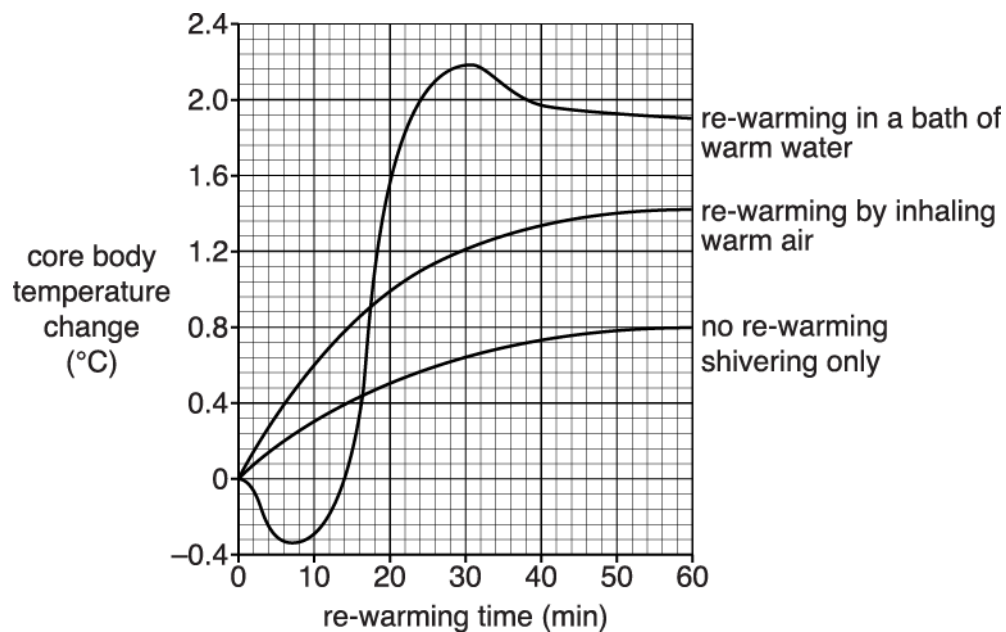


Fig. 1.1

- (i) Explain how shivering causes a rise in core body temperature.

[3]

- (ii) Fig. 1.1 shows that placing a person with hypothermia in a bath of warm water results in an initial drop in core body temperature.

Suggest **why** the core body temperature drops initially.

[2]

(d) Re-warming by inhaling warmed air is also known as **core re-warming**. Fig. 1.2 shows the route taken by the warm air as it is inhaled by the person.

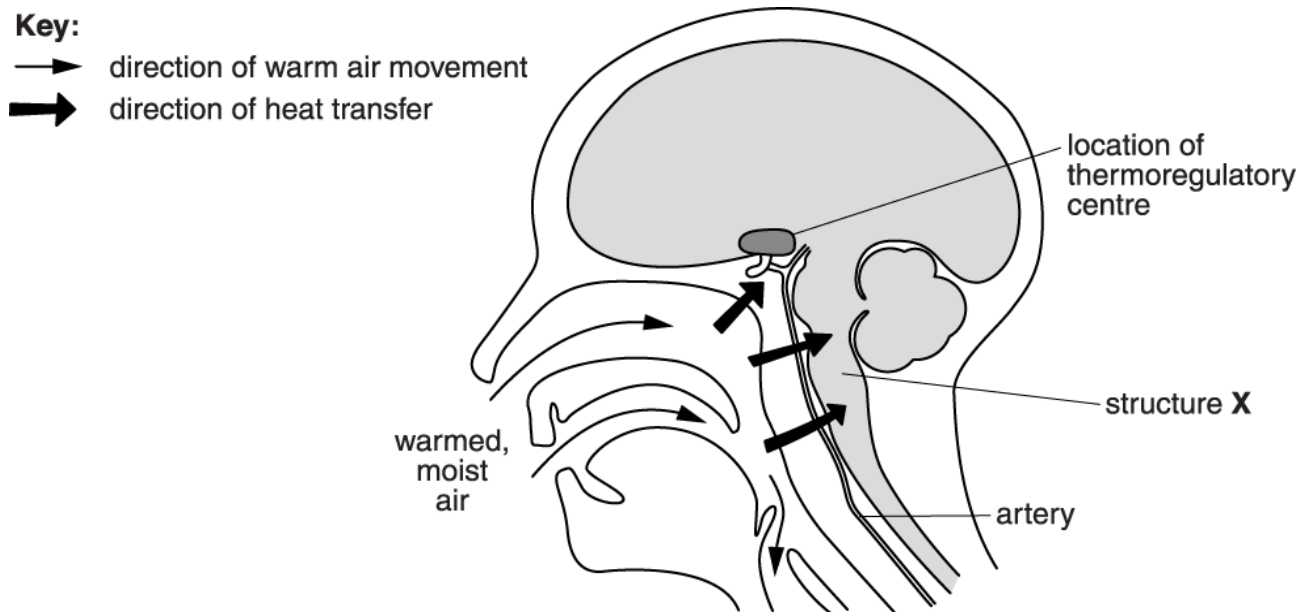


Fig. 1.2

(i) Name the part of the brain in which the thermoregulatory centre is located.

-----[1]

(ii) Identify structure X.

-----[1]

(iii) Using the information in Fig. 1.2, suggest why core re-warming is better than other methods of re-warming at treating severe hypothermia.

In your answer, you should refer to the symptoms of **severe** hypothermia.

-----[3]

9(a) Hot flushes are one of the symptoms associated with the menopause. These symptoms are thought to be linked to falling oestrogen levels.

Low levels of oestrogen are thought to disrupt the thermoregulatory centre in the brain.

Name the part of the nervous system which includes the brain **and** state the exact location of the thermoregulatory centre.

Part of nervous system

Exact location

[1]

(b) Hot flushes may last from 3 to 10 minutes.

Scientists investigating hot flushes carried out the following measurements to monitor changes in the body during a hot flush:

- blood flow in the skin
- sweating
- heart rate.

At the onset of a hot flush, there is a sudden increase in sweating. This is followed by vasodilation, which causes an increase in blood flow in the skin. Shortly after this, there is an increase in heart rate.

(i) Suggest why an increase in blood flow in the skin might result in an increase in heart rate.

[1]

(ii) Suggest **one further** effect on the body of increased vasodilation and sweating.

[1]

(c) Symptoms of the menopause such as hot flushes can be treated by hormone replacement therapy (HRT).

Some forms of HRT are provided as implants.

Explain why cyclical HRT treatments are not available as implants.

----- [1]

10(a) Recent studies, such as those carried out by the World Health Organisation, have noted an increase in the global incidence of **Type 1** diabetes.

Type 1 diabetes occurs due to changes in pancreatic tissue. Fig. 2.1 shows a photomicrograph taken of a section through pancreatic tissue.

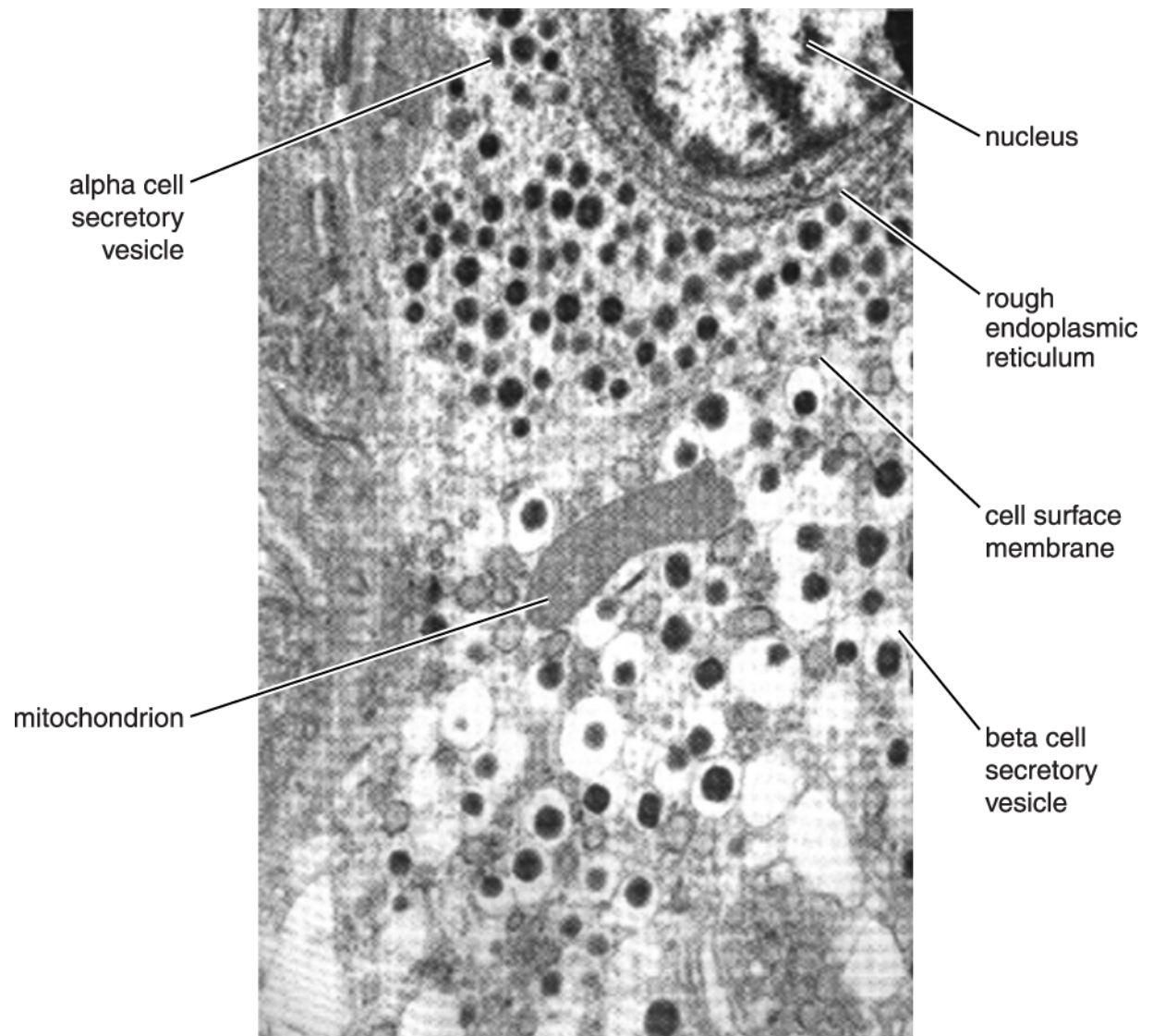


Fig. 2.1

(i) State the region of the pancreas from which this tissue section has been taken.

----- [1]

(ii) Which of the secretory vesicles contains the hormone that lowers blood glucose?

----- [1]

(b) The hormones produced by the region of the pancreas shown in Fig. 2.1 are both polypeptides.

Explain how these hormones are:

- produced by the secretory cells
- released from the secretory cells
- transported to their target organs.



In your answer you should refer to the organelles shown in the diagram and identify the target organs.

[8]

- 11 Different healthcare professionals are involved in the diagnosis and treatment of medical conditions and diseases.

Complete the table by inserting appropriate examples of the following in each row:

- the named medical condition or disease
- the healthcare professional
- a diagnostic test
- a treatment.

Medical condition or disease	Healthcare professional	Diagnostic test	Treatment
	radiographer	DEXA scan	calcium supplements
anaemia	nurse specialising in chronic kidney disease		
		pedigree analysis	
	paramedic	take core body temperature	application of ice packs

[6]

12(a) Deaths from hypothermia in the UK have greatly increased.

- (i) Give **two** visible symptoms that would suggest a patient has hypothermia?

----- [1]

- (ii) What evidence would confirm hypothermia?

----- [1]

- (iii) Between 2007 and 2011 the number of recorded cases of hypothermia were as follows:

Year	Number of patients treated in hospital	Number of patients over 60 years of age	Number of patients who died within 30 days of being admitted
2007	950	633	
2011	1876	1396	260

Table 2.1

In 2007, 14% of people with hypothermia treated in hospital died within 30 days of being admitted. Calculate how many people died as result of hypothermia in 2007.

Show your working.

Number of people who died ----- [2]

- (iv) What can be concluded about the susceptibility to hypothermia of people who are over the age of 60 years?

In your answer you should:

- analyse the data from Table 2.1
- suggest possible explanations for your conclusion.

You may use the space below if needed for any calculations.

[4]

(b) Body temperatures vary between different organisms. One method of measuring body temperature uses fibre optic thermometers.

A fibre optic thermometer has a resolution of 0.1 °C and a precision: ± 0.8 °C.

Calculate the percentage error of this thermometer for a temperature change of 5 °C.

Show your measuring. Give your answer to one decimal place.

percentage error ----- % [2]

13(a) Temperature control is a key aspect of homeostasis. Changes to skin temperature can be measured using an infrared sensor.

A group of students was comparing skin temperature at different locations on the arm. They used an infrared sensor, as shown in Fig. 3.1, and a data logger.

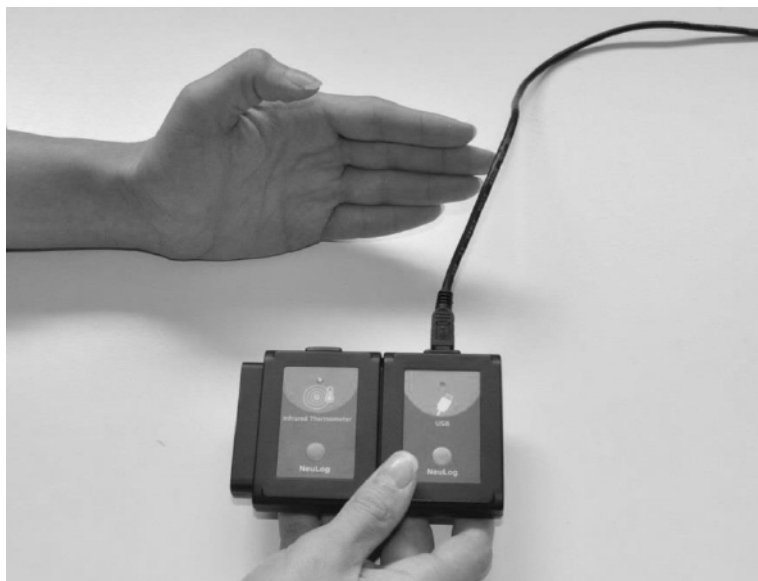


Fig. 3.1

The procedure they followed is described below.

- An infrared sensor was positioned a short distance from the hand of one student, as shown in Fig. 3.1.
- The sensor was aimed at a point on the hand, and temperature readings were recorded every 6 seconds for 2 minutes.
- The student then moved so that the sensor was aimed at the upper arm.
- Again the temperature was recorded every 6 seconds for 2 minutes.
- The data was downloaded and analysed.
- The procedure was repeated for each student in the group.

- (i) Suggest two variables that should be controlled in order to obtain a valid comparison of skin temperature in different parts of the arm. Explain how each of these variables could be controlled.

Variable 1 _____

Variable 2 _____

_____ [4]

(ii) Table 3.1 shows the data collected by the students using the procedure described on page 10.

Student	Temperature (°C)			
	Fingers	Upper arm	Difference (d)	Difference squared (d ²)
1	21.2	31.7	10.5	110.3
2	21.5	31.3	9.8	96.0
3	21.4	32.0	10.6	112.4
4	20.9	31.6	10.7	114.5
5	21.7	31.4	9.7	94.1
6	21.2	32.1	10.9	118.8
7	21.3	31.5	10.2	104.0
8	21.0	31.7	10.7	114.5
9	21.7	31.6	9.9	98.0
10	21.2	31.8	10.6	112.4
11	21.2	31.7	10.5	110.3
12	21.5	31.3	9.8	96.0
13	21.4	32.0	10.6	112.4
14	20.9	31.6	10.7	114.5
15	21.7	31.4	9.7	94.1
16	21.2	32.1	10.9	118.8
17	21.3	31.5	10.2	104.0
18	21.0	31.7	10.7	114.5
19	21.7	31.6	9.9	98.0
20	21.2	31.8	10.6	112.4
		Mean =	10.36	

Table 3.1

$$t = \frac{\bar{d}\sqrt{n}}{S_d}$$

where S_d is calculated from the formula:

$$S_d = \sqrt{\frac{\sum d^2 - n\bar{d}^2}{n-1}}$$

n = number of samples

$\bar{d}$ = mean difference.

Using the formulae provided, calculate the value of t for the data given in Table 3.1.

Show your working. Give your answer to **three** significant figures.

Answer = _____ [4]

- (iii) The students chose to carry out a **paired Student t -test** to analyse the data obtained.

Explain why this choice of test is appropriate.

----- [2]

- (iv) The skin temperature values obtained for the fingers were always approximately 10 °C lower than those

obtained for the upper arm.

The value of t obtained by the students indicated that this difference was significant.

Suggest one **biological** reason for the above observation. Explain your suggestion.

[2]

(b) * In some people, the ability to regulate body temperature declines with age.

Fig. 3.2 shows the mean changes to blood flow in the hand when two groups of elderly subjects, **Group A** and **Group B**, were subjected to three different temperature treatments.

Subjects in **Group A** showed a normal response to temperature changes. Subjects in **Group B** showed an abnormal response.

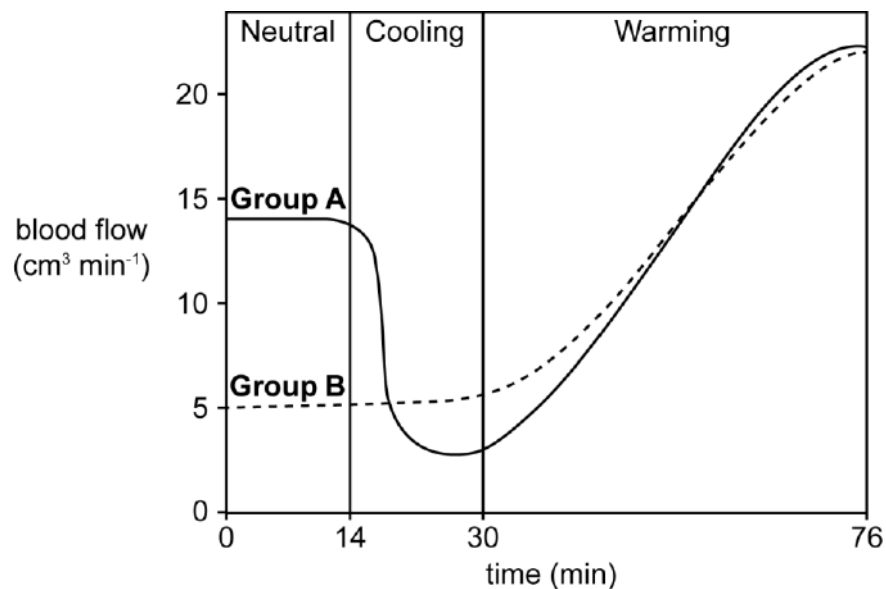


Fig. 3.2

Describe the physiological responses shown by **Group A** and **Group B** during the cooling and warming treatments.

[6]

14 The neurones in the sciatic nerve form part of the peripheral nervous system.

Some of the neurones connect receptors in the lower limb to the central nervous system.

Some of the neurones connect the central nervous system to different types of muscle tissue in the lower limb.

Tick the correct term or terms that apply to the sciatic nerve neurones described in the table below:

Description of neurone(s)	Sensory	Motor	Autonomic	Somatic
Stimulates muscle tissue and causes contraction				
Parasympathetic				
Contains a long dendron				
Involved in the plantar reflex				
Sympathetic				

[5]

15 The sympathetic and parasympathetic nervous systems affect heart rate.

Which of the options, A to D, would lead to a **decrease** in heart rate?

- A activation of the vagus nerve, releasing noradrenaline
- B activation of the vagus nerve, releasing acetylcholine
- C activation of the accelerator nerve, releasing noradrenaline
- D activation of the accelerator nerve, releasing acetylcholine

Your answer

[1]

END OF QUESTION PAPER

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance												
1	a		<table><tr><th>Statement</th><th>Letter(s)</th></tr><tr><td>fMRI shows these areas of the brain to be active when playing a musical instrument</td><td>A or F</td></tr><tr><td>Temperature-sensitive neurones are located in this area of the brain</td><td>C</td></tr><tr><td>Traumatic injury to either of these areas can lead to over- or under-production of sex hormones.</td><td>C or D</td></tr><tr><td>This region of the brain controls heart rate and breathing rate.</td><td>E</td></tr><tr><td>Stroke affecting part of this area of the brain could cause loss of control of muscles in the arms or legs.</td><td>A</td></tr></table> ✓✓✓✓ 5 correct = 4 marks, 4 correct = 3 marks, 3 correct = 2 marks 2 correct = 1 mark	Statement	Letter(s)	fMRI shows these areas of the brain to be active when playing a musical instrument	A or F	Temperature-sensitive neurones are located in this area of the brain	C	Traumatic injury to either of these areas can lead to over- or under-production of sex hormones.	C or D	This region of the brain controls heart rate and breathing rate.	E	Stroke affecting part of this area of the brain could cause loss of control of muscles in the arms or legs.	A	4(AO2.1) (AO1.1)(AO2.1)(AO1.1)(AO2.1)	
Statement	Letter(s)																
fMRI shows these areas of the brain to be active when playing a musical instrument	A or F																
Temperature-sensitive neurones are located in this area of the brain	C																
Traumatic injury to either of these areas can lead to over- or under-production of sex hormones.	C or D																
This region of the brain controls heart rate and breathing rate.	E																
Stroke affecting part of this area of the brain could cause loss of control of muscles in the arms or legs.	A																
	b	i	(use) tympanic / ear , method ✓ (because) eardrum shares its blood supply with the thermoregulatory centre ✓	2(AO1.1)													

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	<i>Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.</i> In summary: <i>Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)</i> <i>Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer.</i> <i>Then, award the higher or lower mark within the level, according to the Communication Statement (shown in italics):</i> ◦ <i>award the higher mark where the Communication Statement has been met.</i> ◦ <i>award the lower mark where aspects of the Communication Statement have been missed.</i> • The science content determines the level. • The Communication Statement determines the mark within a level. Level 3 (5–6 marks) A detailed description of the processes leading to hypothermia and a description of appropriate treatments, with no / minor errors or omissions. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) A description of the processes leading to hypothermia, with some errors or omissions and a limited description of an appropriate treatment. OR a detailed description of the processes leading to hypothermia (treatment is missing). <i>There is a line of reasoning presented with</i>	6(2 x AO1.1 4 x AO1.2)	Indicative scientific content: Processes • Hypothermia is lowering of body temperature outside normal range / below 35° C • Metabolic / enzyme reactions slow due to less kinetic energy. • So less metabolic heat is generated. • Positive feedback leads to body temperature falling further. Treatment Raise body temperature by: • Use of warm, dry blankets. • Move to a warm room. • Remove wet clothing. • Application of warm compresses to neck, groin and chest. • Warm, non-alcoholic drinks • Do not heat arms and legs as this forces cold blood back towards major organs. • Give expired air resuscitation if he stops breathing.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			<i>some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1–2 marks) A description of the processes leading to hypothermia, with major errors or omissions or a description of an appropriate treatment. <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks <i>No response or no response worthy of credit.</i>		
	c	i	<i>seasonal trend: most cases of hypothermia in winter / most cases of hyperthermia in summer ✓</i> <i>(because of) trends in seasonal temperatures ✓</i> <i>incidence of hyperthermia is greater ✓</i> <i>there is still some hypothermia in summer ✓</i>	Max 3(AO2.2)(AO2.2)(AO2.2)(AO2.2)	ALLOW incidence of hypothermia is lower
		ii	<i>higher proportion of hypothermia patients required hospital admission ✓</i> <i>(because) hypothermia is (usually) more life-threatening ✓</i> <i>(because) hypothermia is more likely to affect , older / more vulnerable , patients ✓</i>	max 2(AO2.2)(AO2.2)(AO2.2)	ALLOW a response based on the suggestion that more hyperthermia patients die before they reach hospital

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		iii	increase in hyperthermia between 2004 and 2005 ✓ climate change / global heating , could increase incidence of hyperthermia ✓ no evidence about average (summer) temperatures ✓ only 2 years' data is not enough to draw valid conclusion ✓	max 3(AO3.2)(AO3.2)(AO3.2)(AO3.2)	ALLOW increased reporting
			Total	20	
2			A	1 AO1.1	
			Total	1	
3			C	1 AO2.4	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
4	a		thyroxine regulates metabolic rate / rate of metabolism reduced	1	Examiner's Comments Some candidates correctly identified that less thyroxine would lower the metabolic rate and cause weight gain.
	b	i	X: thyrotropin-releasing hormone / TRH ✓ Y: thyrotropin / thyroid-stimulating hormone / TSH ✓	2	ALLOW thyrotrophin DO NOT ALLOW thyroxine stimulating hormone Examiner's Comments Only the more able candidates were able to recall TRH and thyrotropin/TSH.
		ii	any 3 from: maintain a system around a set point/norm ✓ <u>receptors</u> detect change (from set point) ✓ <u>effector(s)</u> produce change/response ✓ to return system to set point/norm ✓	max 3	ALLOW small fluctuations around a <u>set point/norm</u> AW e.g. ref to parameter too high or too low Examiner's Comments This question proved demanding, with most candidates using specific examples to illustrate their points rather than referring to the generalisations. Exemplar 4 A negative feedback mechanism is made up of a set point, around which the condition is meant to remain.  receptors which detect any deviations from the set point, a communication system  and effectors which produces changes  to return the value to within the acceptable range of the set point. [3] This answer covers all the marking points,

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	c		any 2 from: vasoconstriction / narrowing of blood vessels, to reduce heat loss from skin (surface) ✓ shivering / rapid muscle contraction, to generate heat (from respiration) ✓ erection of hairs (on skin) / piloerection, to trap air which insulates ✓	max 2	DO NOT ALLOW 'vasoconstriction of capillaries' DO NOT ALLOW 'prevents heat loss' <u>Examiner's Comments</u> Although this question was accessible to most candidates there were a number of common misconceptions that examiners came across during marking. Candidates should note the key points listed below.
	d		any 2 from: (ear) closest to/shares blood supply with hypothalamus/ thermoregulatory centre ✓ reading closer to <u>core</u> temperature, skin temperature may be colder/warmer ✓	max 2	<u>Examiner's Comments</u> Candidates found it difficult to explain this is a succinct way although many achieved one mark for the idea of the ear being closest to the thermoregulatory centre. Exemplar 5 <i>the inner ear has the same blood supply as the thermoregulatory centre in the hypothalamus. therefore it provides an accurate reading of core body temperature whereas the skin's surface is affected by the surrounding air temperature.</i> [2] This response covers the idea above plus it continues to explain why the skin surface temperature would not give an accurate representation of body temperature.
			Total	10	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
5		i	homeostasis ✓	1	IGNORE negative feedback Examiner's Comments Most candidates achieved the mark for (a)(i) although a minority of candidates wrote negative feedback.
		ii	chemoreceptors ✓ medulla oblongata ✓ parasympathetic ✓ negative feedback ✓	4	Examiner's Comments For (a)(ii), more able candidates answered all omissions with the detail required. Many candidates wrote autonomic for parasympathetic and medulla for medulla oblongata. Candidates could be reminded of the origins of some words / prefixes to help them realise that abbreviations or omissions would not be sufficient, e.g. Latin 'medulla' meaning 'middle region of an organ'.
		iii	an objective / quantitative measurement OR level of pain is (too) subjective ✓ <i>idea that</i> heart rate is controlled by the autonomic nervous system ✓	1	Examiner's Comments Most candidates achieved the mark for (a)(iii) with a good description of the subjectivity of the level of pain. A few candidates merely described the correlation of heart rate to pain without discussing the relevance of using this technique compared to another.
			Total	6	
6			D ✓	1	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
7		i	<i>idea that</i> glucose is a respiratory substrate OR (plasma) glucose is the only respiratory substrate for neurones OR if blood glucose too low neurones lose function / AW;	1	IGNORE ref to preventing hyper or hypo glycaemia without further qualification CREDIT idea of preventing a coma Examiner's Comments In (i) the question required applying knowledge of the role of blood glucose other than its effect on water potential. High blood pressure and damage to cells are due to the osmotic effect of glucose. A number of candidates also think that high blood glucose causes diabetes rather than being a symptom of it. Many candidates did answer in terms of the role of glucose as a respiratory substrate.
		ii	hypothalamus AND (posterior) pituitary;	1	Mark the first answer on each line. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks BOTH answers required for 1 mark DO NOT CREDIT anterior pituitary Examiner's Comments In (ii) many candidates lost marks by stating the anterior pituitary gland as the source of ADH secretion.
			Total	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance																	
8	a		<i>not constant because</i> idea that internal conditions, fluctuate / AW; <i>stable because</i> idea of set, limits / points;	2	CREDIT a response which uses examples e.g. core body temperature or water potential in blood plasma 'blood glucose levels rise and fall between 4 and 8 mmoldm⁻³ so are not constant' = 2 marks ACCEPT idea of optimum or normal level Examiner's Comments This was generally done well but use of the pronoun 'it' rather than referring to the internal environment meant some candidates did not make it clear that they were referring to the internal environment.																	
	b		<table><tr><th rowspan="2">Feature or activity</th><th colspan="2">Branch of autonomic nervous system</th></tr><tr><th>Parasympathetic</th><th>Sympathetic</th></tr><tr><td>Type of neurone</td><td></td><td>motor</td></tr><tr><td>Process triggered in liver cells</td><td><u>glycogenesis</u></td><td><u>glycogenolysis</u></td></tr><tr><td>Effect on heart rate</td><td>decrease</td><td>increase</td></tr><tr><td>Neurotransmitter released at the SAN</td><td><u>acetylcholine</u></td><td></td></tr></table>	Feature or activity	Branch of autonomic nervous system		Parasympathetic	Sympathetic	Type of neurone		motor	Process triggered in liver cells	<u>glycogenesis</u>	<u>glycogenolysis</u>	Effect on heart rate	decrease	increase	Neurotransmitter released at the SAN	<u>acetylcholine</u>		4	DO NOT CREDIT incorrect spelling of underlined terms since these have been provided Examiner's Comments The commonest mistake was to assume that, as motor was given for the parasympathetic then the sympathetic neurone must be sensory. As in previous sessions, candidates still confuse the terms glycogenesis and glycogenolysis.
Feature or activity	Branch of autonomic nervous system																					
	Parasympathetic	Sympathetic																				
Type of neurone		motor																				
Process triggered in liver cells	<u>glycogenesis</u>	<u>glycogenolysis</u>																				
Effect on heart rate	decrease	increase																				
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Question			Answer/Indicative content	Marks	Guidance
	c	i	muscles contract (and relax), repeatedly / rapidly / AW; (muscle cells) respire more; idea that respiration / metabolism, releases heat / is exothermic;	3	DO NOT CREDIT 'muscles contract' without some further qualification DO NOT CREDIT 'respiration' unqualified - look for idea of an increase in respiration rate / increase in metabolic rate DO NOT CREDIT 'produces energy' Examiner's Comments A number of candidates answering (i) seem to think that friction from moving muscles was responsible for heat but even otherwise good candidates used terms such as energy 'production' or referred to heat energy as a 'by-product' which was not credited. It is unfortunate that these terms are used colloquially instead of referring to energy release or transformation and candidates do need to be monitored carefully and encouraged to use the correct terminology.
		ii	1(warm water leads to) blood vessels in, skin / extremities, (vaso)dilating; 2(more) heat (energy) is lost; 3 <i>idea of</i> (warm) blood diverted from core to, skin/extremities OR (cold) blood circulated from skin / extremities to core	2	DO NOT CREDIT 'blood vessels dilate' without reference to location ACCEPT description of core e.g. from organs / named organs Examiner's Comments In (ii) many candidates were able to suggest that vasodilation in skin blood vessels would lead to further heat loss. There were some misconceptions regarding the effects of thyroxine suggesting that some candidates think the hormone plays a role in short term temperature regulation.
	d	i	hypothalamus;	1	ACCEPT phonetic spelling Examiner's Comments Answered well.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	medulla (oblongata);	1	ACCEPT phonetic spelling Examiner's Comments Answered well although some candidates mistook the medulla for the spinal cord.
		iii	two symptoms of hypothermia;	1	CREDIT any two of the following symptoms for one mark: stops shivering little or no breathing weak/irregular/no pulse difficulty speaking poor coordination / laboured movement confusion

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		iii	<i>core rewarming</i> temperature of, medulla (oblongata) / X, restored (rapidly) and <i>idea that</i> heart rate / pulse rate, is controlled (by medulla); temperature of, medulla (oblongata) / X, restored (rapidly) and <i>idea that</i> breathing rate, is controlled (by medulla); cerebrum temperature is restored and speech controlled (by cerebrum); cerebrum temperature is restored and cognitive function controlled (by cerebrum); temperature of, medulla (oblongata) / X, restored (rapidly) and shivering, is controlled by autonomic nervous system (in medulla); cerebellum temperature is restored (faster) and movement coordination, restored / AW;	2	LOOK FOR a link made from a symptom to restoring the temperature in the part of the brain responsible for that activity for the remaining two marks. ACCEPT ref to frontal lobe, motor cortex ACCEPT reference to muscles being coordinated by the cerebellum for this mark ACCEPT movement becomes less laboured IGNORE unconscious Examiner's Comments In (iii) the arrows on the diagram were indicating several areas of the brain. By requesting candidates to list the symptoms of severe hypothermia and then referring to Fig. 1.2 as directed, good candidates linked the symptoms to the relevant control area in the brain being warmed. Weaker candidates were mostly able to list symptoms but then failed to take any account of the diagram.
			Total	16	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
9	a		<i>part of nervous system</i> central / CNS AND <i>exact location</i> hypothalamus; ✓	1	Both correct answers required for the mark <u>Examiner's Comments</u> The commonest incorrect responses were spinal cord or autonomic.
	b	i	to maintain blood, pressure / AW; AVP;	1	 e.g. increase in respiration rate (due to temperature increase) so more oxygen required e.g. ref to sympathetic nervous system (also) causes increase in heart rate <u>Examiner's Comments</u> Part (i) was a stretch and challenge question and required an appreciation on the part of the candidates of the effect of vasodilation on blood pressure and need to maintain blood pressure.
		ii	(core body) temperature falls; dehydration; thirst; drop in water potential (in blood);	1	Mark the first answer. If the answer is correct and an additional answer is given that is incorrect or contradicts the (core body) temperature falls; correct answer = 0 marks IGNORE refs to increase in breathing rate <u>Examiner's Comments</u> In (ii) the question required a consequence of vasodilation and sweating whereas weaker candidates replied in terms of other responses to high temperatures.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	c		<i>idea that</i> in cyclical HRT progesterone is not given every day;	1	CREDIT explanations using reverse argument e.g. an implant would release hormones continuously <u>Examiner's Comments</u> While many candidates answered this well, some other responses were imprecisely worded in terms of how progestin and oestrogen were taken. The fact that implants release hormones continuously was the most common answer given.
			Total	4	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
10	a	i	Islet(s) of Langerhans;	1	ACCEPT upper or lower case, phonetic spelling Examiner's Comments This question was almost entirely AO1 but did contain marks which were synoptic with F221 (cell structure) and F224 (protein synthesis). Most candidates correctly identified the Islets of Langerhans in (a)(i) from the photomicrograph. A failure to gain credit usually resulted from either an imprecise answer ('endocrine tissue') or confusion with the glomerulus despite the question clearly being about the pancreas.
		ii	beta / β (cells);	1	Examiner's Comments This question was almost entirely AO1 but did contain marks which were synoptic with F221 (cell structure) and F224 (protein synthesis). In (a)(ii) again most candidates correctly stated beta cells.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	b		1 (gene(s) for hormones) transcribed / AW, in nucleus; 2 hormones / polypeptide / protein / synthesised, on ribosomes ; 3 (ribosomes / proteins synthesised / translation) on RER; 4 hormones / polypeptides / proteins, transfer to Golgi (apparatus); 5 (golgi) packages / AW, hormones into vesicles; 6 vesicles, fuse with / AW, cell surface membrane / hormones released by exocytosis; 7 mitochondria provide, energy / ATP, for (named) process; 8 (hormones) soluble in blood / transported in, blood / plasma; 9 (targets) muscle / liver; 10 ref to (hormone binding to) receptors on cell surface / plasma, membrane (of cells in target tissues);	7	ACCEPT hormone / named hormone / polypeptide for mps 1.2.3. and 4 1 ACCEPT a description of transcription such as 'mRNA (for hormones) being synthesised' 2. ACCEPT mRNA translated on ribosomes or a description DO NOT CREDIT if exocytosis is given as part of a list 7 CREDIT this mark if linked to any process from mp 1,2.,4, 5 DO NOT CREDIT 'produce energy' DO NOT CREDIT as part of a list with other non-target organs

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			QWC;	1	Award if: mp 8 and 9 have been awarded plus any two from mps 1,3,5,6,7 Examiner's Comments In part 2(b), several candidates answered the question in terms of homeostasis and wrote excellent answers to a question which had not been asked. In terms of homeostasis, a surprising number of candidates still believe that the alpha and beta cells are regulated by the hypothalamus and the pituitary. For those candidates who did attempt to address the question recurring errors included using the terms 'transcription' and 'translation' as if they were interchangeable, describing exocytosis as the release of vesicles into the blood stream and using the term 'active transport' to describe exocytosis. Examiners were happy to credit the link between mitochondria and use of ATP for exocytosis as ATP would be required, for example, to move vesicles to the cell surface membrane. However, the term 'active transport' is reserved for transmembrane transport which requires a specific ATP- driven protein 'pump' - a different form of transport to exocytosis. As stated in the introduction, too many candidates wrote about the release of glycogen or glucogen from alpha cells.
			Total	10	

Mark Scheme

Question			Answer/Indicative content				Marks	Guidance
11			Medical condition or disease	Healthcare Professional	Diagnostic Test	Treatment	6	MP2 CREDIT erythrocyte count / (total) blood cell count / haemoglobin concentration / haemocytometer count / haematocrit MP3 CREDIT erythropoietin / EPO. IGNORE Iron tablets MP4 CREDIT alternative examples of an inherited or genetic condition or disease Examiner's Comments This was answered well although vague descriptions to 'blood tests' could not be credited. Some candidates did not pick up on the reference to chronic kidney disease and answered in terms of iron tablets or even transfusions.
			1. osteoporosis ;					
					2. (red) blood cell count ;.	3. RhEPO ;		
			4. PKU/cystic fibrosis / AW ;	5. genetic counsellor ;				
			6. hyperthermia / heat stroke ;					
			Total				6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
12	a	i	Any two from: bouts of (violent) shivering slow / shallow breathing pale skin (1)	1	Mark first two answers only
		ii	a core (body) temperature of less than 35°C (1)	1	
		iii	133 (1)(1)	2	DO NOT ALLOW if answer is not a whole number ALLOW 1 mark for correct working $14 / 100 \times 950$
		iv	<i>Analysis</i> processing of data (1)(1) <i>Explanation (up to a maximum of 2 marks)</i> elderly more susceptible to hypothermia (1) (probably) due to cost of energy bills rising (1) ref to fuel poverty, resulting in choice between money for food or fuel / AW (1) less, able to / likely, to move around (1) AVP (1)	4	<i>Examples of data processing</i> Over 60s increase $= (1396 / 633) \times 100 = 220.5\%$ increase General increase $= (1876 / 950) \times 100 = 197.5\%$ increase Difference in % increase = 23.0% % of total admissions from the elderly 2007 $950 - 633 = (317 / 950) \times 100 = 33.1\%$ 2011 $1876 - 1396 = (500 / 1870) \times 100 = 26.7\%$ e.g. ref to arthritis
	b		16% (1)(1)	2	ALLOW one mark for correct working $(0.8 / 5) \times 100$
			Total	10	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
13	a	i	variable: distance of arm from sensor (1) control: keep distance same for both hand and arm (1) variable: (room) temperature (1) control: any reasonable control procedure (1) variable: activity of student (1) control: any reasonable control procedure (1)	4	ALLOW other alternative variables linked to an appropriate control procedure e.g. stay in same place in the room throughout, keep all doors and windows closed e.g. make sure arm is still throughout
		ii	$t = 109 (1)(1)(1)(1)$	4	Correct answer = 4 marks If answer incorrect, look for the following: $\Sigma d^2 = 2150 = 1 \text{ mark}$ $(2150 - 2146.592) \div 19 = 1 \text{ mark (0.17937)}$ Sqrt of 0.17937 = 0.42352 = SD = 1 mark $(10.36 \times 4.472) \div \text{SD} = 1 \text{ mark}$
		iii	<i>idea that</i> means can be calculated for hand and arm (1) <i>idea that</i> both data sets come from one individual (1)	2	
		iv	larger surface area to volume ratio in fingers (1) more heat loss from surface of fingers (1) more muscle mass in upper arm (1) more heat generated (in muscle) (1)	2	

Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
	b	* Read through the whole answer from start to finish, concentrating on features that make it a stronger or weaker answer using the indicative scientific content as guidance. The indicative scientific content indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the science content of the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer using the guidelines described in the level descriptors in the mark scheme. Once the level is located, award the higher or lower mark. The higher mark should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met. The lower mark should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing. In summary: • The science content determines the level. • The communication statement determines the mark within a level.		

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			Level 3 (5–6 marks) Provides a comprehensive description of the responses to falling and rising temperatures and links the responses correctly to the information in Fig.3.2 for both groups. <i>There is a well-developed line of reasoning which is clear and logically structured and uses scientific terminology at an appropriate level. All the information presented is relevant and forms a continuous narrative.</i> Level 2 (3–4 marks) Describes some of the responses to falling and rising temperatures and links the responses correctly to the information in Fig.3.2 for either Group A or B. <i>There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented is mostly relevant.</i> Level 1 (1–2 marks) Describes some of the responses to falling and rising temperatures with limited references Figure 3.2. <i>There is a logical structure to the answer. The explanation, though basic, is clear.</i> 0 marks No response or no response worthy of credit.	6	Indicative scientific points may include <i>When temperatures fall (Group A):</i> • vasoconstriction of arterioles in skin • reduced blood flow in skin capillaries • (so) vasoconstriction leads to less heat lost by radiation • hairs (on skin) pulled to vertical position • (so) less heat lost by convection • insulation conserving heat • shivering leads to more heat released through repeated muscle contraction • heat released from increased respiration rate <i>When temperatures fall (Group B):</i> • Group B show no change in blood flow on cooling • No evidence of vasoconstriction • (B) would continue to lose heat on cooling (resulting in hypothermia) <i>When temperatures rise (both):</i> • vasodilation of arterioles in skin • increased blood flow in surface capillaries • (so) more heat lost through radiation • sweating • (so) heat loss through evaporation of sweat • hairs lie flat • (so) more heat lost by convection
			Total	18	

Mark Scheme

Question			Answer/Indicative content					Marks	Guidance	
14								5	One mark for each correct row IGNORE autonomic or somatic for this mark point	
			Description	Sensory	Motor	Autonomic	Somatic			
					✓	✓	✓			(1)
					✓	✓				(1)
				✓		(✓)	(✓)			(1)
				✓	✓		✓			(1)
					✓	✓				(1)
			Total					5		
15			B					1		
			Total					1		