

1(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.

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[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:  $\pm 0.8$  °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]

2. 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.

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----- [1]

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

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----- [1]

3(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.

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[2]

(b). 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.

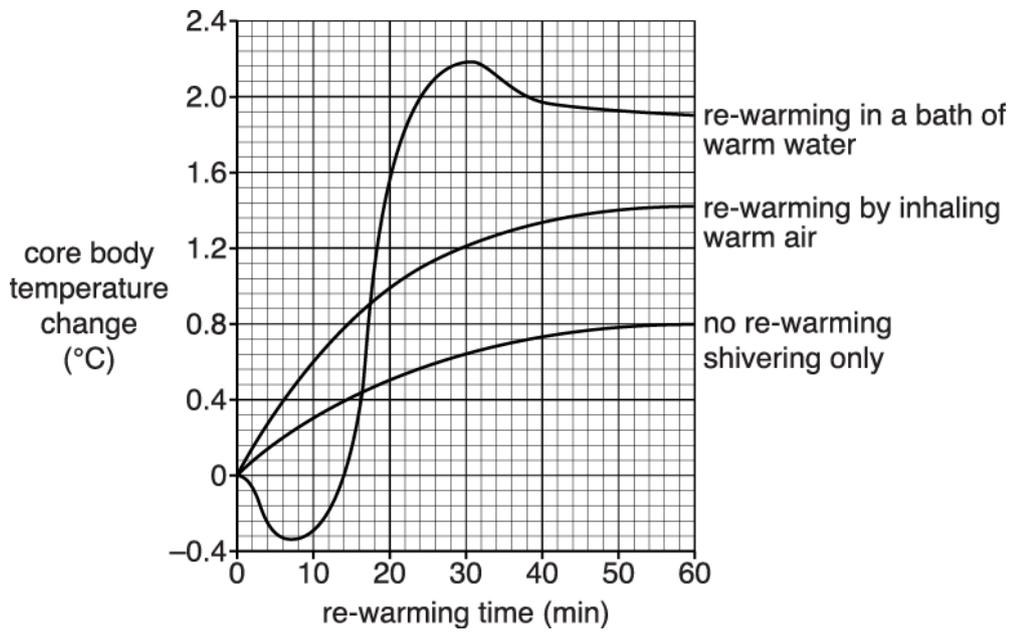


Fig. 1.1

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

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----- [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.

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----- [2]

(c). 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.

**Key:**

- direction of warm air movement
- ➔ direction of heat transfer

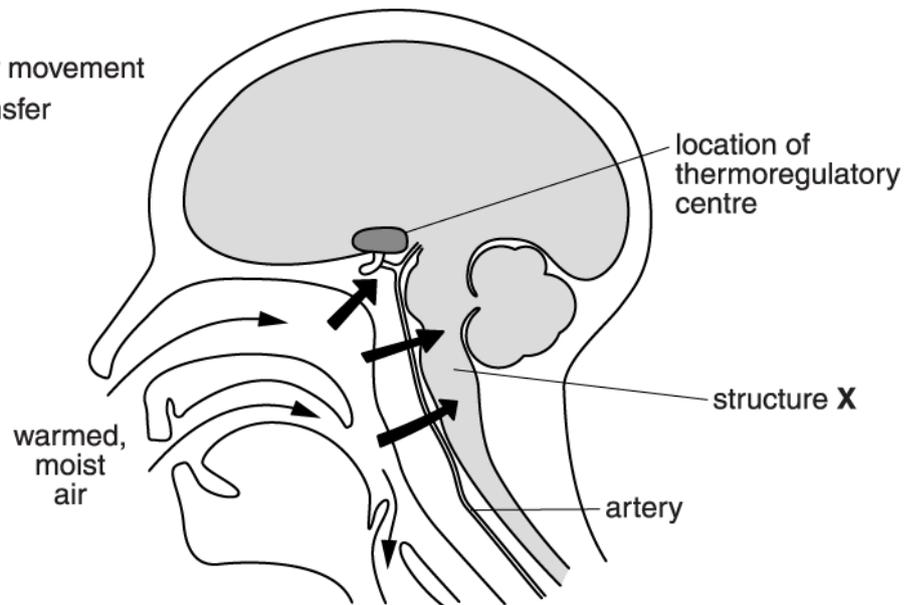


Fig. 1.2

(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.

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[3]

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.

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----- [1]

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

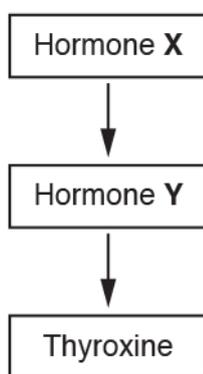


Fig. 32

(i) Identify hormones X and Y.

X -----

Y -----

[2]

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

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[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.

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2 -----  
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[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.

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[2]

END OF QUESTION PAPER

### Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
1	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	<b>DO NOT ALLOW</b> if answer is not a whole number <b>ALLOW</b> 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	<b>ALLOW</b> one mark for correct working $(0.8 / 5) \times 100$
			<b>Total</b>	<b>10</b>	

### Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
2		i	to maintain blood, pressure / AW;  AVP;	1	<p>e.g. increase in respiration rate (due to temperature increase) so more oxygen required</p> <p>e.g. ref to sympathetic nervous system (also) causes increase in heart rate</p> <p><b><u>Examiner's Comments</u></b></p> <p>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.</p>
		ii	(core body) temperature falls; dehydration; thirst; drop in water potential (in blood);	1	<p><b>Mark the first answer.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the (core body) temperature falls; correct answer = <b>0 marks</b></p> <p><b>IGNORE</b> refs to increase in breathing rate</p> <p><b><u>Examiner's Comments</u></b></p> <p>In (ii) the question required a consequence of vasodilation and sweating whereas weaker candidates replied in terms of other responses to high temperatures.</p>
			<b>Total</b>	<b>2</b>	

### Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
3	a	<p><i>not constant because</i> idea that internal conditions, fluctuate / AW;</p> <p><i>stable because</i> idea of set, limits / points;</p>	2	<p><b>CREDIT</b> 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<sup>-3</sup> so are not constant' = 2 marks</p> <p><b>ACCEPT</b> idea of optimum or normal level</p> <p><b>Examiner's Comments</b></p> <p>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.</p>
	b	i	3	<p><b>DO NOT CREDIT</b> 'muscles contract' without some further qualification</p> <p><b>DO NOT CREDIT</b> 'respiration' unqualified - look for idea of an increase in respiration rate / increase in metabolic rate</p> <p><b>DO NOT CREDIT</b> 'produces energy'</p> <p><b>Examiner's Comments</b></p> <p>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.</p>

### Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	<p>1 (warm water leads to) blood vessels in, skin / extremities, (vaso)dilating; 2 (more) heat (energy) is lost;</p> <p>3 <i>idea of</i> (warm) blood diverted from core to, skin/extremities <b>OR</b> ( cold) blood circulated from skin / extremities to core</p>	2	<p><b>DO NOT CREDIT</b> 'blood vessels dilate' without reference to location</p> <p><b>ACCEPT</b> description of core e.g. from organs / named organs</p> <p><b>Examiner's Comments</b></p> <p>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.</p>
	c	i	hypothalamus;	1	<p><b>ACCEPT</b> phonetic spelling</p> <p><b>Examiner's Comments</b></p> <p>Answered well.</p>
		ii	medulla (oblongata);	1	<p><b>ACCEPT</b> phonetic spelling</p> <p><b>Examiner's Comments</b></p> <p>Answered well although some candidates mistook the medulla for the spinal cord.</p>
		iii	<b>two</b> symptoms of hypothermia;	1	<p><b>CREDIT</b> any <b>two</b> of the following symptoms for <b>one</b> mark:</p> <p>stops shivering little or no breathing weak/irregular/no pulse difficulty speaking poor coordination / laboured movement confusion</p>

### Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
	iii	<p><i>core rewarming</i> temperature of, medulla (oblongata) / X, restored (rapidly) <b>and</b> <i>idea that</i> heart rate / pulse rate, is controlled (by medulla);</p> <p>temperature of, medulla (oblongata) / X, restored (rapidly) <b>and</b> <i>idea that</i> breathing rate, is controlled (by medulla);</p> <p>cerebrum temperature is restored <b>and</b> speech controlled (by cerebrum); cerebrum temperature is restored <b>and</b> cognitive function controlled (by cerebrum);</p> <p>temperature of, medulla (oblongata) / X, restored (rapidly) <b>and</b> shivering, is controlled by autonomic nervous system (in medulla);</p> <p>cerebellum temperature is restored (faster) and movement coordination, restored / AW;</p>	2	<p><b>LOOK FOR</b> 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.</p> <p><b>ACCEPT</b> ref to frontal lobe, motor cortex</p> <p><b>ACCEPT</b> reference to muscles being coordinated by the cerebellum for this mark <b>ACCEPT</b> movement becomes less laboured</p> <p><b>IGNORE</b> unconscious</p> <p><b>Examiner's Comments</b></p> <p>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.</p>
		<b>Total</b>	<b>12</b>	

### Mark Scheme

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

### Mark Scheme

Question		Answer/Indicative content	Marks	Guidance
	c	<p>any 2 from:  vasoconstriction / narrowing of blood vessels, to reduce heat loss from skin (surface) ✓</p> <p>shivering / rapid muscle contraction, to generate heat (from respiration) ✓  erection of hairs (on skin) / piloerection, to trap air which insulates ✓</p>	max 2	<p><b>DO NOT ALLOW</b> 'vasoconstriction of capillaries'  <b>DO NOT ALLOW</b> 'prevents heat loss'</p> <p><b>Examiner's Comments</b></p> <p>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.</p>
	d	<p>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 ✓</p>	max 2	<p><b>Examiner's Comments</b></p> <p>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.</p> <p><b>Exemplar 5</b></p> <p><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]</p> <p>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.</p>
		<b>Total</b>	<b>10</b>	