The diagram below shows the water balance for a person on a cold day.

The numbers show the volume of water, in cm\(^3\), the person’s body gained and lost.

(a) (i) How much water was lost from the body on the cold day?

Draw a ring around the correct answer.

1800 cm\(^3\) \hspace{1cm} 2400 cm\(^3\) \hspace{1cm} 3300 cm\(^3\) 

(1)

(ii) The volume of water gained by the body should balance the volume of water lost from the body.

How much water should the person have drunk to keep the balance?

______________________________________________________________

______________________________________________________________

Volume of water = ________________ cm\(^3\)

(2)

(b) (i) Name the process by which water is lost from the skin.

______________________________________________________________

(1)
(ii) Why does the body need to lose water from the skin?

______________________________________________________________
______________________________________________________________

(c) The next day was a hot day. The person gained the same volume of water and did the same activities.

(i) What effect did the increase in temperature have on the volume of water the person lost?

Tick (✔) one box.

Less water was lost through the skin.  

More water was lost through the skin.  

More water was lost in faeces.  

(ii) What effect would the increase in temperature have on the volume of urine the person lost?

Draw a ring around the correct answer.

decrease  increase  no change  

(Total 7 marks)
A scientist measured the volume of sweat lost between 9.00 am and 2.59 pm in one day by one person. The graph below shows the results.

(a) (i) Suggest what happened at 11.00 am.

Tick (✔) one box.

- The person moved into a cold room.
- The person removed their coat.
- The person started running a race.

(ii) Calculate the total volume of sweat lost between 11.00 am and 1.59 pm.

Total volume of sweat lost = __________ cm³
(iii) Suggest one way the person could replace the water that was lost as sweat.

______________________________________________________________
______________________________________________________________

(1)

(b) (i) Sweating helps keep our internal body temperature within a narrow range.
Which organ monitors body temperature?

Tick (✔) one box.

- brain
- kidney
- pancreas

(1)

(ii) The organ that monitors internal body temperature receives information about temperature from the skin.
Which structures in the skin send impulses with this information?

Tick (✔) one box.

- capillaries
- glands
- receptors

(1)

(c) How does sweating help to control body temperature?

___________________________________________________________________
___________________________________________________________________

(1)

(Total 6 marks)

Humans keep their internal conditions almost constant.

Body temperature is kept within a narrow range.

When the core body temperature is too low, this is detected by the thermoregulatory centre in the brain.
Describe how the body responds when a decrease in core body temperature is detected.

_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________

(Total 6 marks)

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.

<table>
<thead>
<tr>
<th>Type of effector</th>
<th>Response the effector makes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

(ii) Some effectors help to control body temperature.

Give one reason why it is important to control body temperature.

________________________________________________________________________

________________________________________________________________________

(Total 7 marks)
Many runners drink sports drinks to improve their performance in races.

A group of students investigated the effects of three brands of sports drink, A, B, and C, on the performance of three runners on a running machine. One of the runners is shown in the image below.

Table 1 gives information for each drink.

<table>
<thead>
<tr>
<th>Nutrient per dm³</th>
<th>Brand of sports drink</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Glucose in g</td>
<td>63</td>
</tr>
<tr>
<td>Fat in g</td>
<td>9</td>
</tr>
<tr>
<td>Ions in mg</td>
<td>312</td>
</tr>
</tbody>
</table>

© Keith Brofsky/Photodisc/Thinkstock
(a)  (i) In the investigation, performance was measured as the time taken to reach the point of exhaustion.

Exhaustion is when the runners could not run anymore.

All three runners:
• ran on a running machine until the point of exhaustion
• each drank 500 cm$^3$ of a different brand of sports drink
• rested for 4 hours to recover
• ran on the running machine again and recorded how much time they ran until the point of exhaustion.

The speed at which the runners ran was the same and all other variables were controlled.

The students predicted that the runner drinking brand B would run for the shortest time on the second run before reaching the point of exhaustion.

Use information from Table 1 to suggest an explanation for the students’ prediction.

_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________

(ii) If the balance between ions and water in a runner’s body is not correct, the runner’s body cells will be affected.

Describe one possible effect on the cells if the balance between ions and water is not correct.

_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
(b) When running, a runner's body temperature increases.

Describe how the brain monitors body temperature.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(3)

(c) (i) Table 2 is repeated here to help you answer this question.

Table 2

<table>
<thead>
<tr>
<th>Nutrient per dm³</th>
<th>Brand of sports drink</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Glucose in g</td>
<td>63</td>
</tr>
<tr>
<td>Fat in g</td>
<td>9</td>
</tr>
<tr>
<td>Ions in mg</td>
<td>312</td>
</tr>
</tbody>
</table>
People with diabetes need to be careful about drinking too much sports drink.

Use information from Table 2 to explain why drinking too much sports drink could make people with diabetes ill.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

(3)

(ii) Other than paying attention to diet, how do people with diabetes control their diabetes?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

(1)

(Total 10 marks)

In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.

The human body is kept at a constant internal temperature of about 37 °C.

Body temperature is monitored and controlled by the thermoregulatory centre in the brain.
Describe what happens in the body to keep the body temperature constant.

_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________

Extra space _____________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________

(Total 6 marks)

The graph shows the core body temperature and the skin surface temperature of a cyclist before, during and after a race.
(a) (i) When the cyclist finished the race, his core body temperature started to decrease.

How long did the race last?

______________________________________________________________

(1)
(ii) Describe and explain the different patterns shown in the core body temperature and skin surface temperature between 09.15 and 10.15.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

(6)

(iii) After 10.30, the core body temperature decreased.

Explain how changes in the blood vessels supplying the skin caused the skin surface temperature to increase.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
(2)
(b) During the race, the cyclist’s blood glucose concentration began to decrease.

Describe how the body responds when the blood glucose concentration begins to decrease.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
(3)
(Total 12 marks)

Humans maintain an almost constant body temperature.

(a) Describe the role of blood vessels in the control of body temperature.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
(4)
(b) An athlete can run a marathon in 2 hours 15 minutes on a dry day in outside temperatures up to 35 °C.

If the air is dry, his body will **not** overheat.

In humid conditions the same athlete can run the marathon in the same time. However, in humid conditions, if the outside temperature goes over 18 °C then his body **will** overheat.

Suggest an explanation for the athlete overheating in humid conditions.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(3)
(Total 7 marks)
One group of scientists is working in a hot desert and another group is working in a tropical rainforest.

The table shows information about the scientists and the conditions in the desert and the rainforest.

<table>
<thead>
<tr>
<th>Information</th>
<th>Hot desert</th>
<th>Rainforest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean core body temperature of scientists in °C</td>
<td>37.3</td>
<td>38.9</td>
</tr>
<tr>
<td>Air temperature in °C</td>
<td>36.0</td>
<td>35.5</td>
</tr>
<tr>
<td>Mean percentage concentration of moisture in the air</td>
<td>9.0</td>
<td>92.0</td>
</tr>
<tr>
<td>Mean wind speed at ground level in metres per second</td>
<td>12.0</td>
<td>3.0</td>
</tr>
</tbody>
</table>

(a) Both groups of scientists are doing similar jobs. The jobs cause the scientists to sweat a lot.

Use information from the table to explain the difference in the mean core body temperature of the two groups of scientists.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(b) Changes to blood vessels in the skin help to decrease body temperature.

Explain how.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(Total 4 marks)
The temperature in a sauna is much hotter than core body temperature.

A woman sits in a sauna.
The high temperature of the sauna causes the woman’s core body temperature to rise.

(a) When the woman’s core body temperature rises, the woman’s rate of sweating increases.
   Explain why.
   _____________________________________________________________________
   _____________________________________________________________________
   _____________________________________________________________________
   _____________________________________________________________________

(b) The woman comes out of the sauna.
The woman’s skin looks redder than when she went into the sauna.
Describe what happened to the blood circulation in her skin to cause this change in colour.
   _____________________________________________________________________
   _____________________________________________________________________
   _____________________________________________________________________
   _____________________________________________________________________

(c) After coming out of the sauna the woman gets into a bath of icy water.
This makes the woman shiver.
   (i) What process brings about shivering?
   _____________________________________________________________________
   _____________________________________________________________________
   (ii) Shivering increases body temperature.
   Explain how.
   _____________________________________________________________________
   _____________________________________________________________________
   _____________________________________________________________________
   _____________________________________________________________________

(Total 7 marks)
A walker falls through thin ice into very cold water.

The walker’s core body temperature falls. He may die of hypothermia (when core body temperature falls too low).

(a) (i) Which part of the brain monitors the fall in core body temperature?

(ii) How does this part of the brain detect the fall in core body temperature?

(1)

(b) While in the water the walker begins to shiver.

Shivering helps to stop the core body temperature falling too quickly.

Explain how.

(2)
(c) The walker had been drinking alcohol.

Alcohol causes changes to the blood vessels supplying the skin capillaries, making the skin look red.

(i) Describe the change to the blood vessels.

________________________________________________________________________________________

________________________________________________________________________________________

(1)

(ii) The walker is much more likely to die of hypothermia than someone who has not been drinking alcohol.

Explain why.

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

(2)

(Total 8 marks)

Conditions inside the body must be kept constant.

(a) Urea must be removed from the body.

(i) Name the organ which makes urea.

________________________________________________________________________________________

(1)

(ii) Which organ removes urea from the body?

________________________________________________________________________________________

(1)

(iii) What is urea made from?

________________________________________________________________________________________

(1)
A man sat in a room where the temperature was maintained at 40 °C. The temperature on the surface of his skin was monitored for 35 minutes. He swallowed an ice cold drink at the time indicated on the graph.

(b) The sweat glands contribute to the change in the temperature on the surface of the skin shown on the graph. Explain how.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(c) The blood vessels near the surface of the skin also contribute to the changes in skin temperature shown on the graph.

(i) How do the blood vessels in the skin change when the core body temperature falls?
___________________________________________________________________
___________________________________________________________________

(1)
During exercise an athlete’s core body temperature may rise.

(a) What causes this rise in core body temperature?

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(1)

(b) During a long race one athlete did not drink any liquid. Towards the end of the race the amount of sweat he produced began to fall.

(i) This athlete’s core body temperature increased more than that of other similar athletes who had drunk enough liquid during the race.

Explain why.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(2)

(ii) Describe one other way in which this athlete’s body would respond in order to reduce core body temperature.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(2)
(c) The graph shows the effects of showering for ten minutes at 15 °C and at 35 °C on core body temperature after a long race.

Suggest an explanation for the differences in core body temperature:

(i) between 0 and 2 minutes

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

(1)

(ii) between 4 and 10 minutes.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

(2)

(Total 8 marks)
The brain and the skin are involved in monitoring and controlling body temperature.

(a) Describe the parts played by the brain and the skin in monitoring body temperature.

(i) The brain

______________________________________________________________

______________________________________________________________

______________________________________________________________

______________________________________________________________

(ii) The skin

______________________________________________________________

______________________________________________________________
(b) The diagram shows a section through part of the skin.

The muscle labelled X controls the flow of blood into the skin capillary. When muscle X contracts, the flow of blood into the skin capillary is reduced.

Explain the role of muscle X in the control of body temperature.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(Total 6 marks)

(a) Each day, a boy ate food containing 12 000 kilojoules of energy. The boy's body used 80 per cent of this energy to maintain his core temperature.

(i) Name the process which releases energy from food.

___________________________________________________________________

(1)

(ii) Calculate the amount of energy that the boy would use each day to maintain his core body temperature. Show clearly how you work out your final answer.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Amount of energy used each day = _____________ kJ

(2)
(b) The diagram shows a section through human skin.

Explain how structure A helps to cool the body on a hot day.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(3)

(c) Body temperature is monitored and controlled by the thermoregulatory centre. Where in the body is the thermoregulatory centre?

___________________________________________________________________

(1)

(Total 7 marks)

The pictures show three mammals and their average body temperature in °C.

<table>
<thead>
<tr>
<th>Animal</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hamster</td>
<td>36.8 °C</td>
</tr>
<tr>
<td>Horse</td>
<td>38.0 °C</td>
</tr>
<tr>
<td>Sheep</td>
<td>39.2 °C</td>
</tr>
</tbody>
</table>

NOT TO SCALE
Describe **three** different ways by which most mammals are able to maintain a constant body temperature when the temperature of the environment falls.

_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________
_______________________________________________________________________

(Total 6 marks)
The graphs show the results of an investigation into the control of sweating in humans. The subject was placed in a chamber where the temperature was maintained at 45ºC. The subject swallowed ice at the times indicated on the graphs.

(a) What was the relationship between swallowing ice and the subject's skin temperature?

(i) skin temperature?

______________________________________________________________
______________________________________________________________
(ii) brain temperature?

______________________________________________________________

______________________________________________________________  (1)

(iii) rate of heat loss by sweating?

______________________________________________________________

______________________________________________________________  (1)

(b) Explain, as fully as you can, why the subject’s brain temperature, skin temperature and rate of heat loss by sweating were affected by swallowing ice in the way shown by the graphs.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

___________________________________________________________________

(8) (Total 11 marks)
The temperature at the surface of the skin can be measured by using a technique called thermography. Areas with higher temperature appear as a light shade on the thermographs. The drawings below show the results of an investigation in which thermographs were taken before and after exercise.

Explain, as fully as you can, the body mechanisms which affected the skin temperature to give the results shown in the drawings.

(Total 8 marks)

(a) Explain, as fully as you can, why respiration has to take place more rapidly during exercise.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(2)
(b) During exercise the process of respiration produces excess heat. Explain how the body prevents this heat from causing a rise in the core (deep) body temperature.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(4)
(Total 6 marks)

The gemsbok is a large herbivore that lives in herds in desert areas of South Africa. Gemsboks feed on plants that are adapted to living in dry conditions. There are not many rivers, lakes or ponds that can provide drinking water for the animals. The desert areas are hot during the day but cool at night. As the air cools at night it becomes moist, and the plants absorb the moisture.
Although the gemsbok lives in hot conditions, it does not sweat. During the day its body temperature can rise, but it is important that blood reaching the brain does not rise above 40°C. The drawing shows how the blood system is adapted to cool the blood which flows to the brain.

(i) Suggest an advantage to the gemsbok of not sweating.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

(1)

(ii) Explain how the blood is cooled in the cavities of the nose.

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

(2)

(iii) How does the structure of the rete help in keeping the brain cool?

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

(2)

(Total 5 marks)
Mark schemes

(a) (i) 2400 cm³

(ii) 1400 (cm³)

allow 2 marks for ecf of correct answer to [answer given in (a)(i) – 1000]
allow 1 mark for 2400 – (600 + 400) or equivalent with no or incorrect answer
allow 1 mark for ecf of answer given in (a)(i) – 1000 or equivalent with no or incorrect answer

(b) (i) sweat(ing)

allow evaporation
allow perspiration

(ii) any one from:
• for cooling
• to maintain body temperature

(c) (i) More water was lost through the skin.

(ii) decrease

(a) (i) The person started running a race.

(ii) 2300

(iii) drinking (water / sports drink)
or
through eating

(b) (i) brain

(ii) receptors

(c) cools us down

allow evaporates

allow evaporates

blood vessels supplying skin
allow vasoconstriction
\textbf{do not} allow capillaries / veins constricting
\textbf{do not} allow moving blood vessel

less blood flow (to / through capillaries / to skin)
\textit{allow blood flows further away from skin surface}

so less energy is lost (to the surroundings)
\textit{allow less heat is lost}

‘shivering’ by \textbf{muscle} (contraction)
\textit{allow muscles contract (and relax) rapidly}

releasing energy \textbf{or} respiring (more)
\textit{allow ‘heat produced’}
\textbf{do not} allow energy produced / made
\textbf{do not} allow energy for respiration
\textit{allow sweating stops / reduces}

\textit{ignore hair erection}

\begin{itemize}
\item \textbf{(a)} detect changes in surroundings \textbf{or} detect stimuli
\textit{allow any named stimulus for skin}
\item convert information to impulse
\textit{allow send impulse to sensory neurones / brain}
\end{itemize}

\begin{itemize}
\item \textbf{(b) (i)}
\begin{tabular}{|c|c|}
\hline
\textbf{muscle} & \textbf{contract(ion)} \\
\hline
\textbf{gland} & release / secrete / produce chemical / hormone / enzyme \\
\hline
\end{tabular}
\end{itemize}

\textit{1 mark for each effector}
\textit{1 mark for each response}
\textit{response must match type of effector (if given)}
\textit{ignore examples}
\textit{ignore relax(ation) / movement for contraction}
\textbf{do not} allow expansion for muscles
(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)

(a) (i) has the least amount of glucose
  allow least amount of fat or no fat

(to) transfer energy (for the run)
  allow (to) release energy (for the run)
  do not allow produces energy
  do not allow ‘energy for respiration’

(ii) any one from:
• cells will work inefficiently
• absorb too much water / swell / overhydrate
• lose too much water / shrink / dehydrate
  ignore turgid / flaccid
  cells burst is insufficient
  allow cramp in muscle.

(b) any three from:
• thermoregulatory centre
• (has temperature) receptors
• (which) monitor blood temperature (as it flows through the brain)
• (temperature) receptors in the skin
• (receptors) send impulses to the brain
  ignore vasoconstriction / vasodilation / sweating
  allow hypothalamus
  impulses sent to the thermoregulatory centre = 2 marks.
(c) (i) (sports drinks) contain a lot of glucose

(a person with diabetes) does not produce insulin or does not produce enough insulin

allow (person with diabetes) has cells which do not respond to insulin
do not allow insulin produced by liver

so blood glucose / sugar levels will rise too high or to a dangerous level

(ii) inject insulin
or
have an insulin pump (fitted)
do not allow swallow insulin
accept exercise
accept inhale insulin
accept take metformin or other correctly named drug
allow pancreatic transplant

Marks awarded for this answer will be determined by the Quality of Communication (QC) as well as the standard of the scientific response. Examiners should also apply a ‘best-fit’ approach to the marking.

0 marks
No relevant content.

Level 1 (1 – 2 marks)
There is a description of thermoregulation or at least one correct mechanism (skin, sweat glands or muscles) but roles may be confused.

Level 2 (3 – 4 marks)
There is a description of thermoregulation or some correct mechanisms (sweating, shivering, blood flow in the skin).

Level 3 (5 – 6 marks)
There is a clear description of thermoregulation by TC or skin and some correct control mechanisms.
examples of biology points made in the response:

full marks may be awarded for detailed description of what happens if the core temperature is either too high or too low

- temperature receptors in TC
- the TC detects (core) body / blood temperature
- temperature receptors in the skin send impulses to the TC, giving information about skin temperature
- if the core body temperature is too high: blood vessels / arterioles supplying the skin capillaries dilate / vasodilation
  do not accept refs to veins instead of arterioles or answers that imply blood vessels have moved up / down through the skin.
- so that more blood flows (through the skin) and more heat is lost
- sweat glands release more sweat to cool the body
- by evaporation
- if the core body temperature is too low: blood vessels supplying the skin capillaries constrict
- to reduce the flow of blood (through the skin) and less heat is lost
  allow idea of blood diverted to vital organs in extreme cold
- muscles may shiver to release (heat) energy
- from respiration, some of which is lost as heat

(a)  
(i) 1 hour 15 mins / 1.25 hours / 75 mins  
allow 1:15  
ignore 1.15 hours  

(ii) increase in (core / body) temperature  
ignore numbers  

(due to an) increase in respiration or more muscle contraction  
releasing energy (as a waste product)  
allow produces ‘heat’  
do not allow making energy  

skin temperature decreases  

(because there is) sweating  

(which) evaporates and cools the skin  
ignore references to vasodilation or vasoconstriction
(iii) (there is) dilation of vessels (supplying skin capillaries)

allow vasodilation
allow blood vessels widen
ignore expand
do not accept dilating capillaries or moving vessels

(so) more blood flows (near skin) (surface) or blood is closer (to the skin)
ignore ref to heat

(c) pancreas detects (low) blood glucose
produces glucagon
do not allow glucagon made in the liver

(so) glycogen is converted to glucose
allow adrenaline released which increases conversion of glycogen to glucose
or
reduced insulin production so less glucose into cells / less glucose converted to glycogen
for 1 mark

(a) if body temperature too high blood vessels supplying skin (capillaries) dilate / widen

do not accept capillaries / veins dilate/constrict

if body temperature is too low blood vessels supplying skin (capillaries) constrict / narrow

do not accept idea of blood vessels moving (through skin)
ignore expand
accept arteries / arterioles for ‘blood vessels’
if no reference to skin allow blood vessels dilate and blood vessels constrict for one mark

so more / less blood flows through skin (capillaries) or nearer the surface of the skin
must correctly relate to dilation or constriction

so more / less heat is lost (from the skin by radiation)
must correctly relate to dilation or constriction

(b) sweat released
cannot evaporate because of high humidity / all the water vapour in the air
so less heat lost / less cooling
or
it is evaporation of sweat that cools the body

(a) in rainforest:

    accept converse

(water from) sweat does not evaporate (as much)

    max 1 if not clear whether desert or rainforest

any one from:
• (due to) less wind / higher moisture / humidity
• less cooling effect

    ignore references to temperature

(b) blood vessels supplying capillaries dilate / widen or vasodilation

    do not award mark if candidate refers only to blood vessels dilating
    or to capillaries dilating.

    accept ‘arteries’ or ‘arterioles’ for ‘blood vessels supplying,
capillaries’ but do not accept ‘veins’.
    ignore expand / get bigger / relax / open
    do not accept idea of blood vessels moving

more blood (through skin / surface capillaries) leads to greater heat loss

(a) any two from

• reference to role of thermoregulatory centre detecting rise in
temperature (of blood or skin) or / causing increase in sweating

• more evaporation

    need to refer to more at least once to gain both marks

• more cooling / heat loss

    without reference to more only award max 1 mark if both ideas
given, eg cooling alone gets no marks
(b) blood vessels supplying (skin) capillaries
    do not accept capillaries / veins

    or
    arteries

    or
    arterioles

dilate / widen
    allow vasodilation
    do not accept idea of blood vessels moving
    note: marks are awarded independently
    accept shunt vessels close for 2 marks

(c) (i) muscle contraction
    ignore relaxing
    do not allow vasoconstriction

(ii) respiration
    (respiration) releases / produces heat
    reference to respiration is required for this mark

(a) (i) thermoregulatory centre
    allow thermoregulation centre
    allow hypothalamus

(ii) it has receptors
    ignore receptors in skin
    reference to temperature of blood
    allow plasma for blood

(b) muscles contract
    ignore relax / expand
    increased respiration or more heat released
    allow more heat produced
    if more not given allow respiration releases / produces heat
(c) (i) (blood vessels / arteries / arterioles) dilate / widen
   do not accept capillaries dilate
   ignore blood vessels get bigger / expand
   do not accept idea of blood vessels moving

(ii) more blood close to / near surface
   allow blood is closer to the surface
   do not accept idea of blood vessels moving

   more heat lost or heat lost faster or cools faster
   do not allow for idea of evaporation

(a) (i) liver

(ii) kidney
   allow urethra / bladder
   ignore ureter

(iii) (excess) protein / named / amino acids
   accept amino / ammonia

(b) less / no sweating
   allow ideas of how sweat glands change in order to reduce sweating

   less heat lost / evaporation

(c) (i) become narrower / constrict
   allow contract / get smaller etc
   allow less blood flows through vessels
   do not allow capillaries become narrower or reference to movement of vessels

(ii) reduced / no heat loss
   allow heat gained from room
(a) respiration

allow muscle contraction or muscle movement or exercise of muscles
allow metabolism / chemical reactions

(b) any two from:

- less / no water (available) for sweat
  allow dehydrated so less sweat
  allow converse if evident that response refers to athletes who have drunk liquid

- less / no heat lost / less / no cooling
  only need to refer to less / no once

- less / no evaporation (of sweat)

(ii) either

blood vessels supplying the skin or
blood vessels in skin

do not allow first mark if implied that skin capillaries dilate

dilate / widen / muscles relax
ignore enlarge / open
vasodilation in skin = 2 marks
allow hairs lie flat for 1 mark
allow less insulation for 1 mark if linked to hairs
allow more blood in skin for 1 mark if no other marks awarded
(c)  (i) cold / 15°C cools the body / blood (more)
    or reverse argument
    ignore reference to values for body temperature derived from graph

(ii) any two from:
    • cools slower at 15°C cold / 15°C
      allow converse arguments
    • cold / 15°C causes reduced blood flow to surface / skin
      ignore reference to capillaries
    • blood not cooled as much / as quickly
    • cold / 15°C causes shivering
    • muscles contract / more respiration / heat made

(a)  (i) thermoregulatory centre (in brain)
    accept hypothalamus
    (receptors sensitive to/measures) temperature of blood

(ii) any one from:
    • receptors (in skin)
    • (skin) sends information / signals / impulses / messages
to brain / thermoregulatory centre
(b) any three from:

(cold conditions)

• muscle (X) contracts when cold
• no / less blood through capillaries
• no / less heat lost / radiated
• no / less sweat produced

(hot conditions)

• muscle (X) relaxes/does not contract when hot
  \[\text{NB } X \text{ contracts when cold and relaxes when hot} = 2 \text{ marks}\]
• (more) blood through capillaries
• more heat lost / radiated
• more sweat produced

all other points must be clearly identified by correct conditions
max 2 if idea of capillaries moving but ignore capillaries dilate

3

(a) (i) respiration

(ii) 9600

if correct answer, ignore working / lack of working

\[\frac{80 \times 12000}{100} \text{ for 1 mark}\]

(b) any three from:

• dilates / widens or muscle in wall relaxes or sphincter opens
  do not accept expands or just gets bigger
• more blood flows near skin surface or more blood through capillaries
• heat lost by radiation / convection / conduction
  ignore evaporation
• heat loss from blood / cools blood

3
vasoconstriction/blood vessels near surface get narrower/decreased blood supply near surface of the skin or closing sweat pores

*any three pairs. 2 marks for each pair of features and explanations up to a maximum of 6 marks*

(which) prevents the heat being lost from the blood/prevents heat lost due to evaporation

*explanation must match feature to score the second mark*

____________________________

hair/fur stands on end or goose pimples

(this) increases the insulation effect

____________________________

shivering/increased muscular activity/movement/increased metabolism

(this) generates heat

*do not accept raise body temperature*

____________________________

behavioural changes/find somewhere warm/put on clothes / huddling / hibernate / grow extra fat / fur

(this) prevents/reduces heat loss

*do not accept keep warm*

(a) (i) increased shortly after ingestion then drops;

(ii) decreased shortly after ingestion then rises;

(iii) decreased shortly after ingestion then rises *each for 1 mark*
(b) 8 of:
ingestion of ice cools blood flowing in (gut wall);
brain temperature lowered;
reduced blood temperature detected by brain;
impulses sent to sweat glands;
sweat production decreased/sweat pores close;
evaporation of sweat reduced;
it is evaporation of sweat which cools skin/heat loss is less;
therefore skin temperature rises;
because external temperature greater than body temperature;
sensibly linked example;

\[ each \text{ for } 1 \text{ mark} \]

8 of e.g.:
muscles release energy as heat
blood flowing through muscles heated increased blood temperature sensed by
centre in brain
impulses to skin blood vessels
particularly overlying muscles used in exercise to dilate
increased surface flow in these regions
gives pattern shown on thermographs

\[ each \text{ for } 1 \text{ mark} \]

(a) more energy needed,
for increased muscular activity

\[ for 1 \text{ mark each} \]

(b) increased sweat production,
evaporation of sweat cools body,
vasodilation OWTTE,
more heat loss (by radiation)

\[ for 1 \text{ mark each} \]

(i) idea that reduce water loss (in dry area) / conserve water

\[ for 1 \text{ mark} \]

(ii) ideas of evaporation (of moisture) uses energy / heat
or
large surface area of blood vessels / dilation of blood vessels
for evaporation / radiation

\[ each \text{ for } 1 \text{ mark} \]
(iii) ideas of large surface area of (small) vessels / intertwining results in close contact of vessels idea that cool venous blood cools arterial blood

*each for 1 mark*