10. Homeostasis

Content

10.1 Structure and function of the skin

Learning outcomes

Candidates should be able to:

(a) define *homeostasis* as the maintenance of a constant internal environment

(b) explain the concept of control by negative feedback

(c) identify, on a diagram of the skin, hairs, sweat glands, temperature receptors, blood vessels and fatty tissue

(d) describe the maintenance of a constant body temperature in humans in terms of insulation and the role of temperature receptors in the skin, sweating, shivering, blood vessels near the skin surface and the coordinating role of the brain.

Homeostasis P2 QUESTIONS

M/J18/21/Q9

(a) Explain the concept of control by negative feedback.

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.....[4]

(b) Describe how **two named** components of the skin are involved in regulating body temperature in **hot** conditions.

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.....[6]

[Total: 10]

Homeostasis P2 QUESTIONS

O/N17/21/Q9

(a) Describe how the nervous system is involved in the maintenance of a constant body temperature.

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.....[6]

Homeostasis P2 QUESTIONS

O/N17/22/Q2

Fig. 2.1 shows changes in the body temperature of a person.

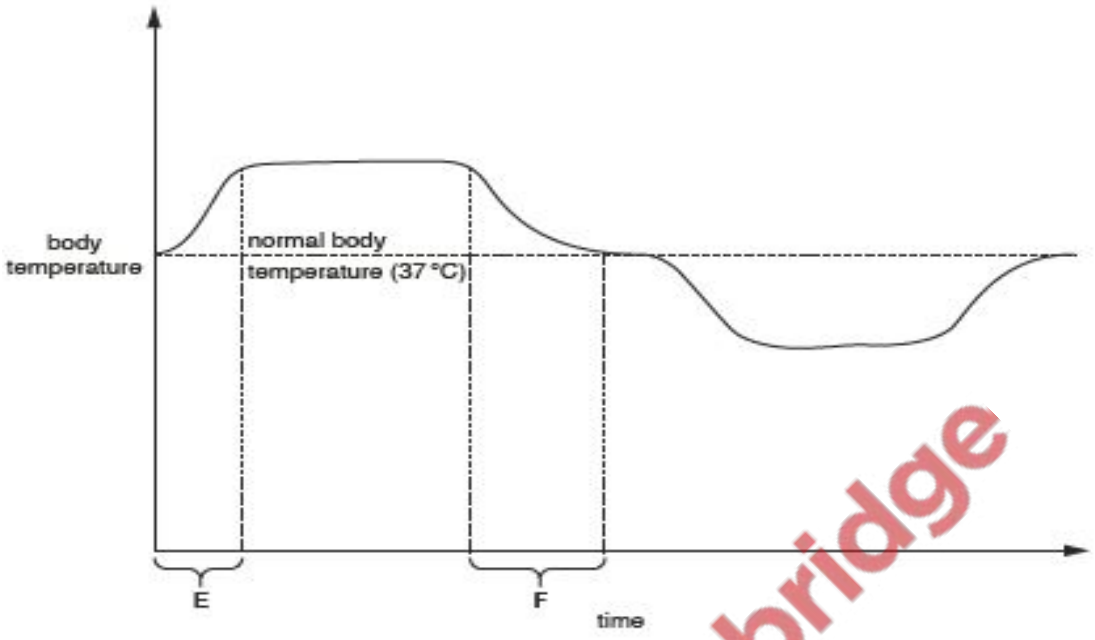

Fig. 2.1

(a) State the term for maintaining constant conditions, such as temperature, in the body.

.....[1]

(b) Suggest three things that could happen to account for the shape of the curve during time E.

1 .....

2 .....

3 .....

[3]

(c) Explain what is happening in the body to cause the change in body temperature at time F.

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.....[3]

(d) Name each of the following:

(i) the process by which the return to a set point, as illustrated by Fig. 2.1, is achieved.

.....[1]

(ii) the part of the brain that controls this process.

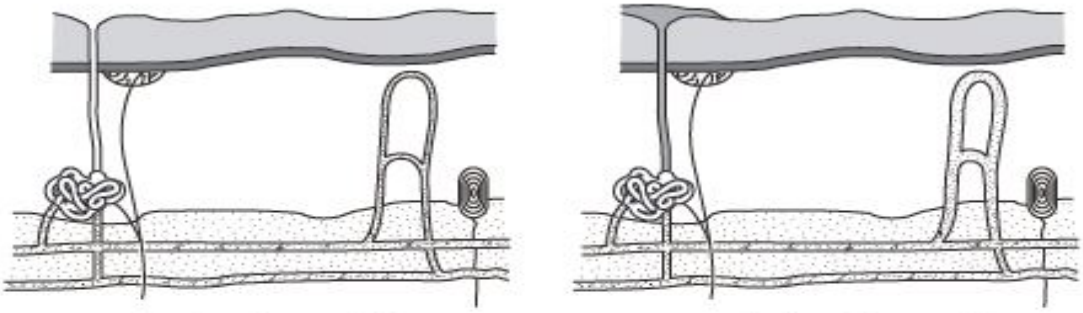
.....[1]

[Total: 9]

Homeostasis P2 QUESTIONS

M/J15/21/Q1

Fig. 1.1 shows a vertical section through the skin in two different environmental conditions, **A** and **B**.



skin in environmental condition **A**

skin in environmental condition **B**

Fig. 1.1

(a) On Fig. 1.1, label each of the following:

- a sweat gland
- a capillary. [2]

(b) Use the information in Fig. 1.1 to suggest how environmental condition **B** is different from environmental condition **A**.

.....

..... [1]

(c) **(i)** State **two** differences between the skin in environmental condition **A** and the skin in environmental condition **B**.

1 .....

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2 .....

..... [2]

(ii) Explain the advantages to a person in environmental condition **B** of the **two** differences you have stated in your answer to **(c)(i)**.

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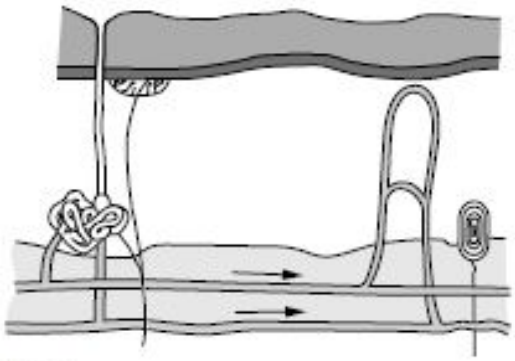
..... [3]

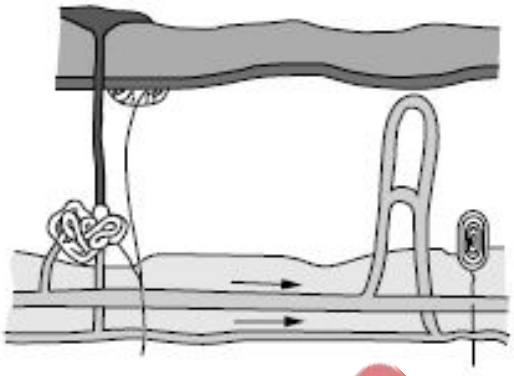
[Total: 8]

Homeostasis P2 QUESTIONS

O/N13/21/Q1

Fig. 1.1(a) and Fig. 1.1(b) show a section through the skin of a person at two different body temperatures.





Key

→ direction of blood flow

Fig. 1.1(a) **Fig. 1.1(b)**

(a) On Fig. 1.1(a), identify and label each of the following.

(i) a sweat gland

(ii) a temperature receptor. [2]

(b) **(i)** State what has happened to the body temperature to cause the changes shown in Fig. 1.1(b) compared with Fig. 1.1(a).

.....[1]

(ii) State **two** reasons for the answer you have given in **(b)(i)**.

1 .....

2 .....[2]

(c) **(i)** On Fig. 1.1(a), label and name the type of blood vessel that constricts when the body temperature falls. [2]

(ii) Explain the effects caused by constriction of the blood vessel you have named in **(c)(i)**.

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.....[4]

[Total: 11]

O/N13/22/Q6

(a) State the similarities between sweating and transpiration.

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.....[3]

(b) Describe the differences between sweating and transpiration.

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.....[7]

[Total: 10]

O/N11/21/Q3

Fig. 3.1 shows a section through human skin.

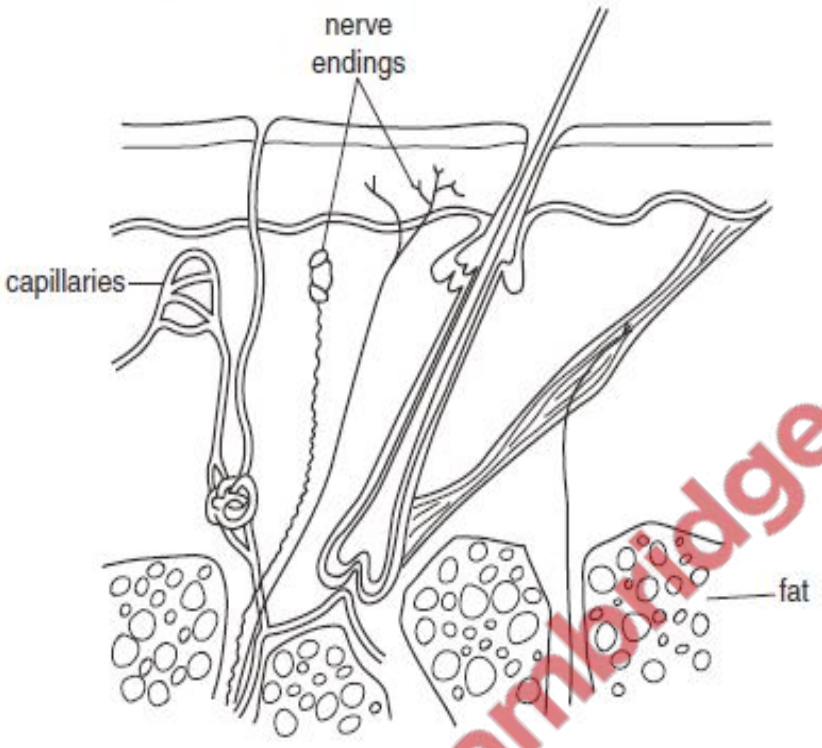

Fig. 3.1

(a) Suggest two possible functions of the nerve endings shown in Fig. 3.1.

1. .....

2. .....[2]

(b) Explain how the capillaries are involved in the loss of heat from the body during exercise.

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.....[3]

(c) Fig. 3.2 shows a yak. The yak is a large animal that lives at high altitudes (up to 5500 m).

Fig. 3.2

Suggest why

(I) the sweat glands of this animal are largely non-functional;

.....

.....

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.....[2]

(II) during those times of the year when food is plentiful, the yak stores a thick layer of fat beneath its skin;

.....

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.....[2]

(III) the yak has a compact body with small ears and short tail.

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.....[2]

[Total: 11]

M/J10/22/Q4

Fig. 4.1 shows some structures in a section through human skin.

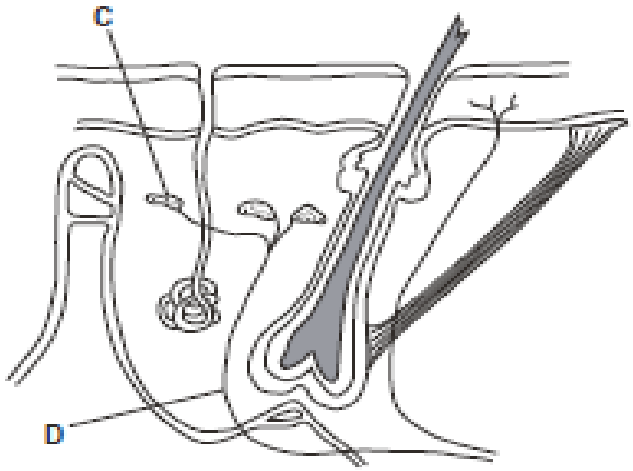

Fig. 4.1

(a) The body is able to maintain its internal environment within narrow limits. State the term for this process.

.....[1]

(b) Structures **C** and **D**, in Fig. 4.1, are involved in the process of temperature regulation.

Identify structures **C** and **D** and state the part they play in the process.

C .....

part played .....

.....

D .....

part played .....

.....[4]

(c) The consumption of alcohol causes the muscles in artery walls to relax.

Taking this info consideration, suggest why people who work in environmental temperatures below 5 °C might be advised not to drink alcohol before or during work.

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.....[3]

[Total: 8]

Mark schemes will use these abbreviations:
; separates marking points
/ alternatives
() contents of brackets are not required but should be implied
R reject
A accept (for answers correctly cued by the question, or guidance for examiners)
Ig ignore (for incorrect but irrelevant responses)
AW alternative wording (where responses vary more than usual)
AVP alternative valid point (where a greater than usual variety of responses is expected)
ORA or reverse argument
underline actual word underlined must be used by candidate
+ statements on both sides of the + are needed for that mark

M/J18/21/Q9

9(a) parameter / condition e.g. temperature **;**
change from set point / norm **AW ;**
detected **;**
reference to communication or named method (e.g.nerve / impulse / hormone) **;**
reference to control centre / coordinator / hypothalamus / brain **;**
response / corrective mechanism(s) **;**
reversal /correction of initial change / return to set point or norm **;**
4

9(b) any two from nerve ending / blood vessels / sweat gland / hair **;; 2**
(nerve ending)
detects / receptor **;**
change / increase in temperature **;**
impulse / (message) to brain **;**
(blood vessels)
dilate **;**
more blood to surface of skin **;**
reference to capillaries **;**
reference to increased radiation / heat loss **;**
(sweat gland / duct)
secretion / release / skin surface **+** sweat **;**
reference to evaporation **;**
(hair)
lowers **;**
less air trapped / loss of insulation **;**
4
A if with reference to capillaries

O/N17/21/Q9

9(a) hypothalamus **;**
reference to detecting blood temperature **;**

receptors **;**
in skin **;**
detect temperature **+** of surroundings **AW ;**
impulse **;**
sensory neurone **;**
to central nervous system / brain / spinal cord **;**
motor neurone **;**
effector **;**
named effector **;**
shiver / vasoconstriction or vasodilation / sweat increase or decrease **;**
reference to negative feedback **;**
6
A muscle or named effector / sweat gland

O/N17/22/Q2

2(a) homeostasis **; 1**
2(b) **1** body temperature increased **;**
2 exercise **AW ;**
3 increased / high **+** surrounding **AW** temperature **;**
4 increased / high **+** surrounding **AW** humidity **;**
5 hot **+** food / drink **;**
6 increased / high **+** metabolism / respiration **;**
7 fever / illness **;**
8 ovulation **;**
9 wear more clothes **AW ;**
3
2(c) **1** sweat **;**
2 evaporation **;**
3 vasodilation **AW ;**
4 reduced **+** metabolism / respiration **;**
5 more blood **+** to skin **;**
6 heat loss / radiation **;**
3
2(d)(i) negative feedback **; 1**
2(d)(ii) hypothalamus **; 1**

M/J15/21/Q1

1 (a) (i) sweat gland labelled ;
capillary labelled ;
R sweat duct [2]
(b) warmer ; must be a comparative statement [1]
(c) (i) sweat (present in B / ORA) ;

capillaries carry more blood (in
B / ORA) ;
capillaries wider / dilated (in B / ORA) ;
Ig constrict / shrink
[max 2]
(ii) evaporation (of sweat) ;
more blood near (surface of) skin ;
increased heat loss / cooling ;
allows regulation of temperature /
prevents overheating ;
[max 3]

M/J14/21/Q6

6 (a) maintenance of / constant ;
internal environment / conditions within the body ;
[2] A regulating / control
Ig specific examples
(b) (i) low temperature detected ;
by receptors / sensors on skin ;
brain ;
any two corrective mechanisms from
shivering / hairs raised / sweating reduced/stopped /
vasoconstriction of blood vessels (R of capillaries) ;;
temperature rises again ;
[4]
A hypothalamus
(ii)
(colon) water absorbed into blood ;
rise / excess (in water content of blood) detected ;
excess water excreted / removed / more urine produced AW ;
by kidney ;
correct ref. ureter / bladder / urethra in correct context ;
[4]
A ref. hypothalamus A correct ref. to ADH
A nephron
Total [10]

O/N13/21/Q1

(a) (i) label line must touch the sweat gland;
[1]
A label on gland or duct
A (i) = gland
(ii) label line must touch some part of receptor under
Malpighian layer;
[1]
(ii) = temp receptor
(b) (i) (temperature / it) increases / rises; [1] R cooler / decreases OWTTE

(ii) In either order:
sweat;
wider blood vessels / capillaries / more blood;
[2]
R veins
(c) (i) arteriole;
the upper horizontal blood vessel labelled;
[2]
A Artery
(the word – ignore what is labelled)
(ignore name given to it)
(ii) less blood (flows);
to capillaries (R capillaries constrict)
to sweat glands;
blood carries heat / less heat carried
less heat lost by skin / radiation ;
less sweat produced;
ref to latent heat of vaporisation;
[max 4]
A less heat lost by blood
[Total 11]

O/N13/22/Q6

6 (a) loss of water;
involves evaporation / as vapour;
to the atmosphere / surroundings;
cooling effect;
through pores AW;
in epidermis;
both affected by temp / humidity / wind (speed); [max 3]
(b) (Accept reverse arguments where relevant)
occurs in animals;
sweating ref. (loss of) urea / ions / salts / minerals;
under nervous control;
ref. homeostasis / determined by body temperature;
(sweat) glands / ducts;
sweat extracted from blood;
(from) skin;
transpiration from leaves / stems;
(helps to) bring ions up stem/xylem / to leaves/cells;
(helps to) bring water up stem/xylem / to leaves/cells;
consequence of stomata open for photosynthesis; [max 7]
[Total 10]

O/N11/21/Q3

3 (a) one per line, mark the first, any 2 from:
detection of pressure, temperature, pain, touch;; [2]
(A for ONE mark max. a reference to the detection of stimuli)

(b) dilation;
more blood;
blood carries heat;
heat lost from + body surface/skin/named heat transfer method;

capillaries supply sweat glands; [max 3]
(c) (i) (A reverse argument) very little sweat lost;
no need to sweat/sweating would be detrimental AW;
fur would inhibit evaporation;
less heat lost;
*ref. low external temperature; [max 2]
(ii) stores energy;
supplies energy/heat;
insulates (against heat loss);
*ref. low external temperature; [max 2]
(iii) (A reverse argument)
(for ears/tail) reduced surface/small surface area;
ref. small surface area to volume ratio for the whole animal (Assume that 'it' = the yak);
from which heat can be lost;
*ref. low external temperature; [max 2]
(n.b. * = once only)
[Total: 11]

M/J10/22/Q4

(a) homeostasis ; [1]
(b) C – receptor / sensor ;
detecting changes (in temperature) (A even if misidentified) ;
D – sensory / afferent + neurone / nerve cell or fibre (R nerve) ;
impulses to CNS / brain / spinal cord / (A even if misidentified) ; [4]
(c) more blood ;
to capillaries ;
(vaso)dilate (A with ref. to capillaries or arteri(ol)es) ;
blood carries heat ;
more heat lost ;
lowers body temperature (still) further / hypothermia / AW ; [3 max]