Thermoregulation Past Papers

1. Adders are snakes whose body temperature is dependent on the external temperature.

Which of these statements about adders are correct?

1. They have a wide range of ecological niches.
2. They use behavioural responses to help maintain optimum metabolic rate.
3. They have high energy costs to achieve homeostasis.

A 2 only
B 3 only
C 1 and 2 only
D 1 and 3 only

2. Mammals use several mechanisms to regulate their body temperature.

Which statement describes responses to a decrease in body temperature of a mammal?

A Vasodilation and an increase in metabolic rate
B Vasodilation and a decrease in metabolic rate
C Vasoconstriction and an increase in metabolic rate
D Vasoconstriction and a decrease in metabolic rate

3. The Gila monster (*Heloderma suspectum*) is a species of lizard that lives in North America. Its internal temperature is dependent on the environmental temperature.

Which row in the table identifies the metabolic cost to and the range of ecological niches of the Gila monster?

	Metabolic cost	Range of ecological niches
A	low	narrow
B	high	narrow
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4. Which row in the table identifies the temperature monitoring centre, and the location of an effector in thermoregulation in mammals?

	Temperature monitoring centre	Location of effector
A	hypothalamus	nerves
B	skin	hypothalamus
C	hypothalamus	skin
D	nerves	hypothalamus

5. Which of the following is true for conformers?

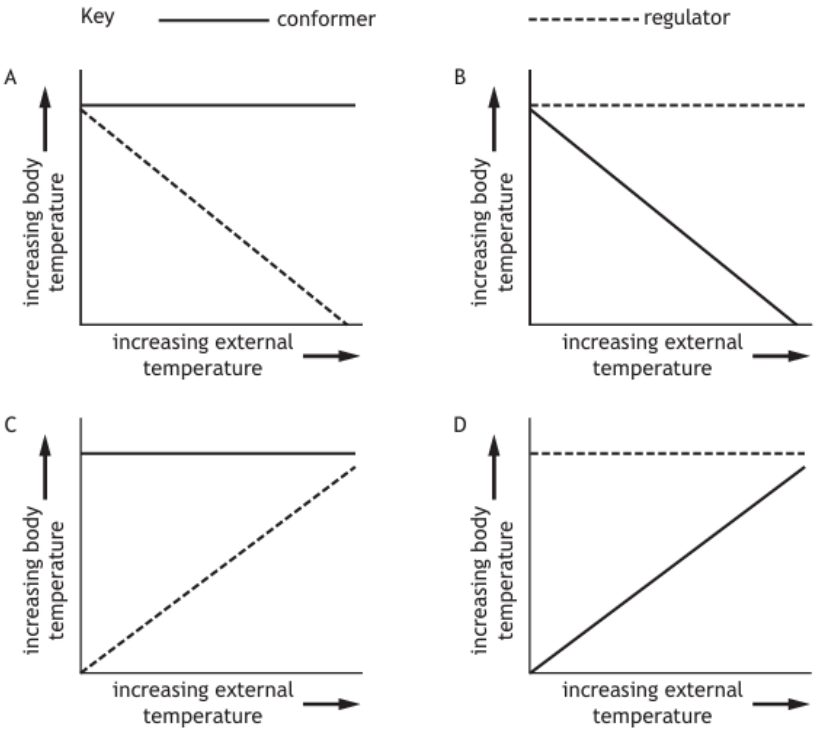
A They use negative feedback to control their internal environment
B They make behavioural responses to optimise metabolic rate
C They occupy a wide range of ecological niches
D They use energy from their metabolism to achieve homeostasis

6. . Which line in the table below describes correctly features of the control of body temperature in humans?

	Feature of the control of body temperature	
	Monitoring centre	*Form of communication with effector*
A	skin	hormonal
B	skin	nervous
C	hypothalamus	hormonal
D	hypothalamus	nervous

Thermoregulation Past Papers

6. Which graph shows the effect of an increase in external temperature on the body temperature of conformers and regulators?



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Which line in the table below shows the description of the salmon and the control of its ion pumps?

	Description of salmon	*Control of ion pumps*
A	conformer	by negative feedback
B	conformer	behavioural
C	regulator	by negative feedback
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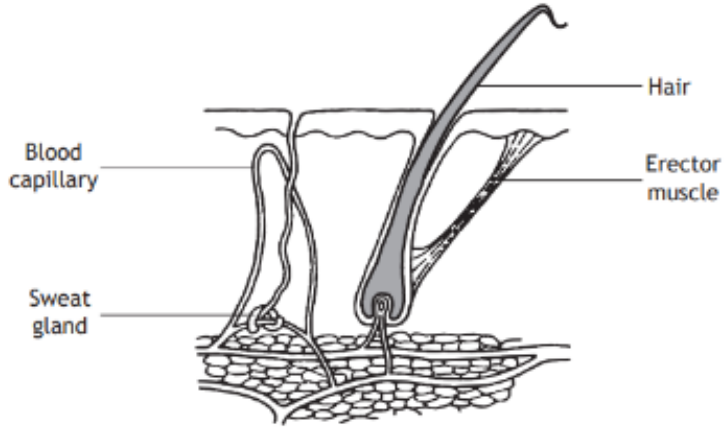
8 . The diagram below shows a section through the skin of a mammal.



Which line in the table below identifies the state of the erector muscle and the change in blood flow in the capillary which would be expected if the skin was exposed to low temperature?

	State of erector muscle	*Change in blood flow in capillary*
A	contracted	increase
B	contracted	decrease
C	relaxed	increase
D	relaxed	decrease

9 The ability of an organism to maintain its metabolic rate is affected by external abiotic factors such as

A temperature, salinity and pH

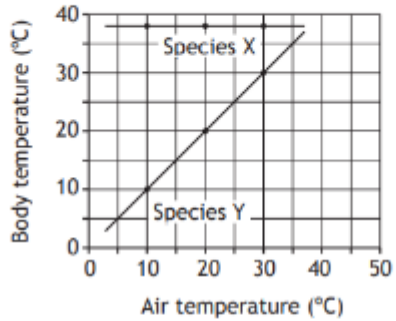
B disease, predation and food availability

C temperature, disease and predation

D pH, sterility and oxygen concentration.

Thermoregulation Past Papers

10 The graph below shows the relationship between air temperature and the body temperature of two animal species, X and Y.



Which line in the table below describes species X and Y?

	Species X	*Species Y*
A	regulator	regulator
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C	conformer	regulator
D	conformer	conformer

11 The following list describes changes which take place during temperature regulation in mammals.

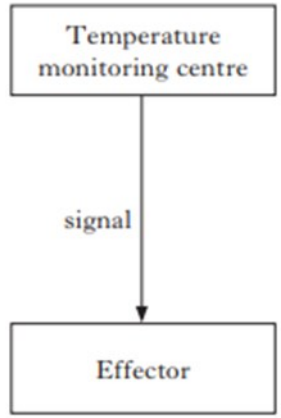
1 Vasodilation
2 Vasoconstriction
3 Contraction of hair erector muscles
4 Relaxation of hair erector muscles

Which of these changes takes place in response to a decrease in body temperature?

A 1 and 3 only
B 1 and 4 only
C 2 and 3 only
D 2 and 4 only

12 Changes in the body temperature of mammals are detected by a temperature monitoring centre. This sends a signal to effectors whose action returns the temperature to a normal level.

These events are summarised in the diagram below.



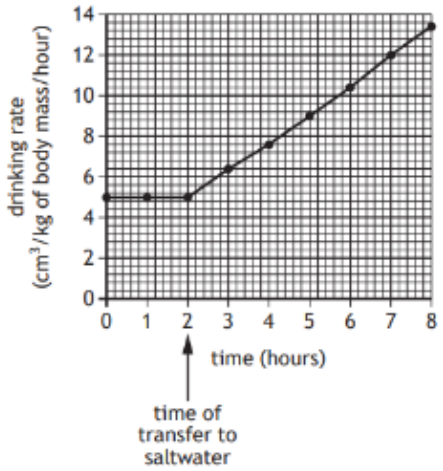
Which line in the table below identifies correctly the temperature monitoring centre, type of signal and the effector involved in this control?

	Temperature monitoring centre	*Type of signal*	*Effector*
A	skin	nervous	hypothalamus
B	hypothalamus	nervous	skin
C	skin	hormonal	hypothalamus
D	hypothalamus	hormonal	skin

Thermoregulation Past Papers

13. A sea trout (*Salmo trutta trutta*) was transferred from freshwater to saltwater.

The graph shows the change in the drinking rate of the sea trout.



The sea trout weighed 3 kg at 0 hours.

Calculate the volume of water the sea trout drank over the 2 hour period before it was transferred to saltwater.

A 5 cm^3

B 10 cm^3

C 15 cm^3

D 30 cm^3

14. The hypothalamus is the temperature monitoring centre in mammals that sends information to effectors to regulate body temperature.

Which row in the table identifies how the hypothalamus sends information to effectors and a corrective response to an **increase** in body temperature?

	How information is sent to effectors	Corrective response
A	bloodstream	vasoconstriction
B	bloodstream	vasodilation
C	nerves	vasoconstriction
D	nerves	vasodilation

15 Which of the following statements refers to regulators?

A Their internal environment changes with external environment.

B They live only within a narrow ecological niche.

C The maintenance of their internal environment has a high metabolic cost.

D Their optimum metabolic rate is maintained by behavioural responses alone.

16. Which of the following does NOT affect an animal's ability to maintain its metabolic rate.

A pH

B salinity

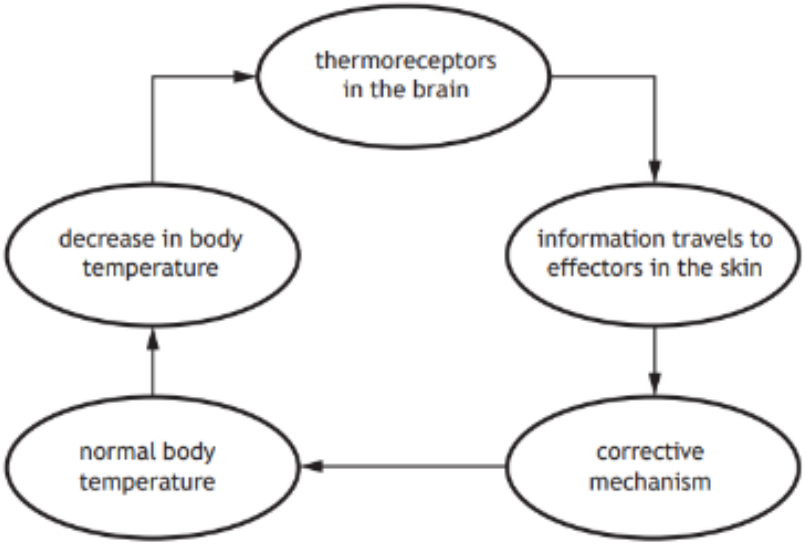
C light intensity

D temperature

15

Thermoregulation Past Papers

1. The diagram illustrates thermoregulation in mammals following a decrease in body temperature.



(a) (i) Name the type of control used in thermoregulation as shown in the diagram. **1**

(ii) Name the part of the brain in which thermoreceptors are found. **1**

(iii) State how information travels to the effectors in the skin. **1**

(b) Effectors in the skin include muscles in the walls of blood vessels.

(i) Describe the response of these effectors to a decrease in body temperature. **1**

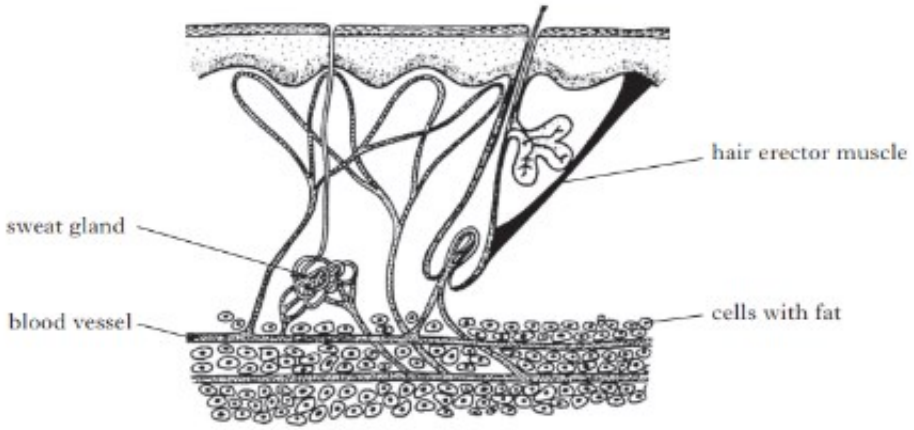
(ii) Explain how this response would help return body temperature to normal. **1**

(c) Explain why it is important for a mammal to regulate its body temperature. **1**

Thermoregulation Past Papers

Marks

2. The diagram below represents a section through the skin of a mammal.



(*a*) Select **one** structure labelled in the diagram and explain how it responds to a **decrease** in temperature to bring about a correction in body temperature.

Structure _____

Explanation _____

_____

_____ **2**

(*b*) (i) Explain the importance of thermoregulation to mammals.

_____

_____

_____ **2**

(ii) Reptiles have behavioural adaptations to help them to thermoregulate.

Give **one** example of this.

_____

_____ **1**

(*c*) Name **one** external abiotic factor, other than temperature, which can affect the ability of an organism to maintain its metabolic rate.

_____

3 a) Sweat production is a corrective mechanism used in the regulation of body temperature.

Explain why regulating body temperature is important to the metabolism of humans.

_____

_____ **1**

b) Give the term used for animals which can control their internal temperature by negative feedback.

_____ **1**

Thermoregulation Past Papers

3. An investigation was carried out into the effect of exposure to low temperature on human body temperature.

Two volunteers, A and B, were immersed in ice baths over an 8 minute period. Body temperatures were measured every 2 minutes.

The results are shown in the table.

	Body temperature (°C)	
Time of exposure (minutes)	Volunteer A	Volunteer B
0	37·2	37·1
2	36·9	36·9
4	36·4	36·8
6	35·8	36·8
8	35·2	36·7

(a) (i) Calculate the average decrease in body temperature per minute for Volunteer A during the investigation. **1**

Space for calculation

_____ °C/min

(ii) Using evidence from the results, suggest why the reliability of the results would be improved if more volunteers were included in the investigation. **1**

_____

_____

_____

(b) (i) Give an example of a corrective response to a decrease in body temperature and explain how it helps to regulate body temperature. **2**

Response _____

Explanation _____

_____

_____

_____

(ii) Human body temperature is usually maintained at 37 °C.

Apart from optimal enzyme activity, give one reason for the importance of thermoregulation to maintain metabolism. **1**

_____

Thermoregulation Past Papers

4 Mammals are regulators and can control their internal environment.

(a) Give **one** reason why it is important for mammals to regulate their body temperature. **1**

(b) (i) Name the temperature monitoring centre in the body of a mammal. **1**

(ii) State how messages are sent from the temperature monitoring centre to the skin. **1**

(c) The blood vessels in the skin of a mammal respond to a decrease in environmental temperature.

(i) Describe this response. **1**

(ii) Explain the effect of this response. **1**

5 Sea bass are saltwater fish that can regulate their internal salt concentration. They have specialised cells in their gills with protein pumps in the membrane. These pumps actively transport excess salt from their bodies.

(a) The specialised cells have many mitochondria.

Explain why this is necessary. **2**

(b) Many animal species regulate their body temperature.

Explain the importance of regulating body temperature. **1**

(c) Compare regulators and conformers in terms of their ecological niches. **1**

Thermoregulation Past Papers

6. The Komodo dragon is a species of lizard.

An investigation was carried out into the effect of environmental temperature on the metabolic rate of a Komodo dragon.

The results are shown in the table.

Environmental temperature (°C)	Oxygen consumption (cm^3/kg/hr)
20	0.4
25	0.7
30	1.1
35	1.4
40	1.7

(a) The Komodo dragon is a conformer.

Use evidence from the table to support this statement. **1**

(b) Describe how the investigation could be improved to give more reliable results. **1**

(c) Calculate the average increase in oxygen consumption per °C between 20 °C and 40 °C. **1**

Space for calculation

_____ cm^3/kg/hr

(d) Explain how increasing the environmental temperature leads to an increased metabolic rate in a Komodo dragon. **2**

(e) Name the type of response that allows conformers to tolerate variation in the environmental temperature. **1**

(f) Compare the range of ecological niches that can be occupied by conformers and regulators. **1**

Thermoregulation Past Papers

7 Freshwater crocodiles (*Crocodylus johnsoni*) in Northern Australia aestivate for up to three months. A study was carried out to investigate aestivation in freshwater crocodiles. The body temperature, metabolic rate, and air temperature were recorded.

The results are shown in the table.

Month	Average body temperature (°C)	Average metabolic rate (kJ/kg/day)	Average air temperature (°C)
August	25.9	36.0	26.2
September	27.9	26.1	28.0
October	27.8	26.5	27.5
November	28.9	25.7	29.5
December	28.7	36.7	28.9

a) Crocodiles are conformers.

a) e information from the table to support this statement. 1

b) Regulators increase their metabolic rate when there is a decrease in body temperature.

Describe one other corrective response to a decrease in body temperature.

Explain how this response returns body temperature to normal. 2

Description _____

Explanation _____

c) Suggest why high diffusion rates are important for regulators. 2

8) Describe and compare metabolism in conformers and regulators. 4

Thermoregulation Past Papers

9 Daphnia (*Daphnia pulex*) is a species of water flea that lives in fresh water. An investigation was carried out into the effect of water temperature on the heart rate of one Daphnia. The results are shown in the table. 5

Water temperature (°C)	*Heart rate* (beats per minute)
2	175
7	184
12	194
17	207
22	219

(a) Calculate the average increase in heart rate per °C between 2 °C and 22 °C. **1**

Space for calculation

_____ beats per minute per °C

(b) Daphnia is a conformer. Use evidence from the table to confirm this statement. **1**

_____

_____

(c) Explain how an increased water temperature would result in a higher metabolic rate in Daphnia. **2**

_____

_____

(d) State the type of response shown by conformers to maintain an optimum metabolic rate. **1**

_____

Thermoregulation Past Papers

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Thermoregulation Past Papers

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Which of these statements about adders are correct?

1. They have a wide range of ecological niches.
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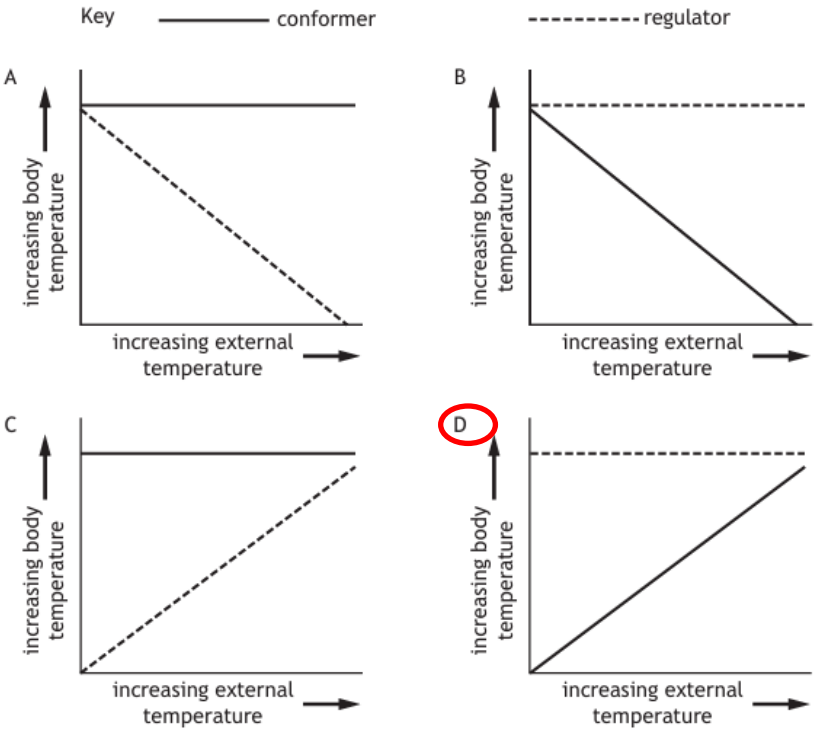
Thermoregulation Past Papers

6. Which graph shows the effect of an increase in external temperature on the body temperature of conformers and regulators?



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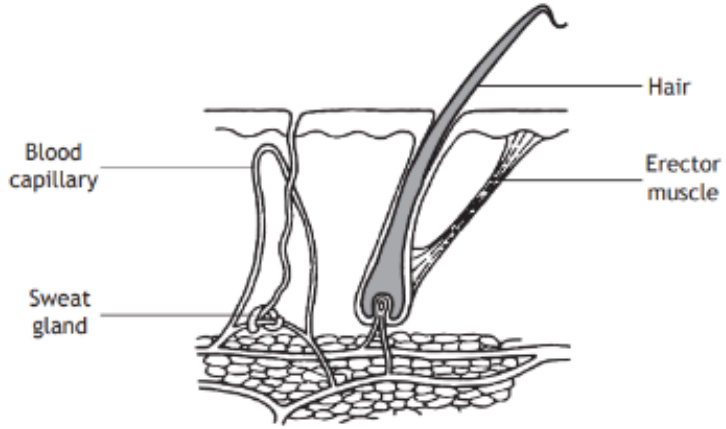

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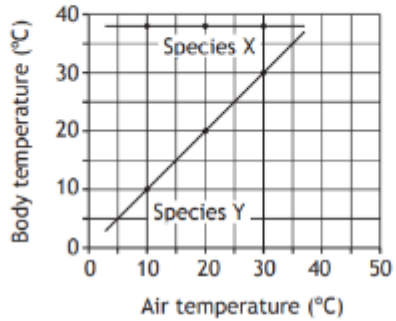

Which line in the table below describes species X and Y?

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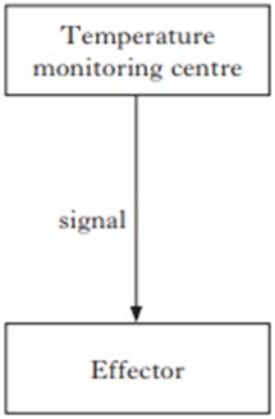

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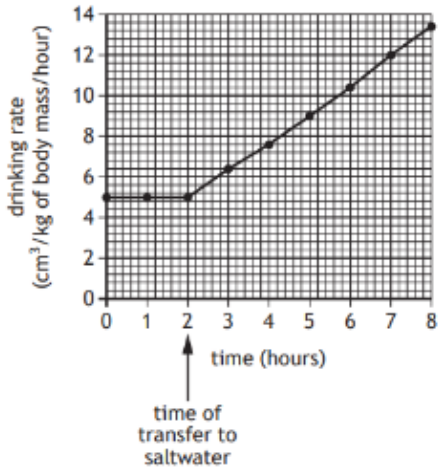
C	skin	hormonal	hypothalamus
D	hypothalamus	hormonal	skin

Thermoregulation Past Papers

13. A sea trout (*Salmo trutta trutta*) was transferred from freshwater to saltwater.

The graph shows the change in the drinking rate of the sea trout.



The sea trout weighed 3 kg at 0 hours.

Calculate the volume of water the sea trout drank over the 2 hour period before it was transferred to saltwater.

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D 30 cm^3

14. The hypothalamus is the temperature monitoring centre in mammals that sends information to effectors to regulate body temperature.

Which row in the table identifies how the hypothalamus sends information to effectors and a corrective response to an **increase** in body temperature?

	How information is sent to effectors	Corrective response
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B	bloodstream	vasodilation
C	nerves	vasoconstriction
D	nerves	vasodilation

15 Which of the following statements refers to regulators?

A Their internal environment changes with external environment.

B They live only within a narrow ecological niche.

C The maintenance of their internal environment has a high metabolic cost.

D Their optimum metabolic rate is maintained by behavioural responses alone.

16. Which of the following does NOT affect an animal's ability to maintain its metabolic rate.

A pH

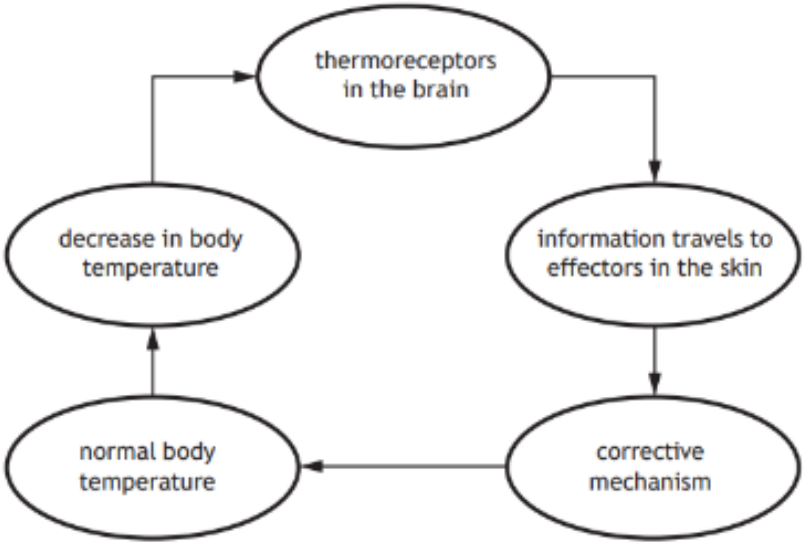
B salinity

C light intensity

D temperature

Thermoregulation Past Papers

1. The diagram illustrates thermoregulation in mammals following a decrease in body temperature.



(a) (i) Name the type of control used in thermoregulation as shown in the diagram. 1

Negative feedback

(ii) Name the part of the brain in which thermoreceptors are found. 1

hypothalamus

(iii) State how information travels to the effectors in the skin. 1

Nerve impulses (sending electrical signals)

(b) Effectors in the skin include muscles in the walls of blood vessels.

(i) Describe the response of these effectors to a decrease in body temperature. 1

Vasodilation of arteriole/blood vessel

(ii) Explain how this response would help return body temperature to normal. 1

Increased blood flow to skin

Increased heat loss (both for 1 mark)

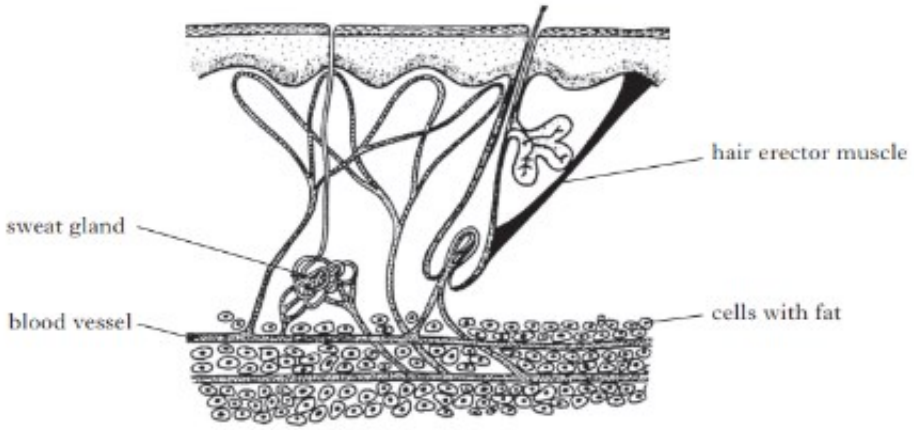
(c) Explain why it is important for a mammal to regulate its body temperature. 1

To keep enzymes at optimum activity OR to maintain high diffusion rates of

Thermoregulation Past Papers

Marks

2. The diagram below represents a section through the skin of a mammal.



(a) Select **one** structure labelled in the diagram and explain how it responds to a **decrease** in temperature to bring about a correction in body temperature.

Structure Hair erector muscle contracts OR blood vessel vasconstricts

Explanation Tra layer of insulating air OR reduce blood flow to skin & heat loss

2

(b) (i) Explain the importance of thermoregulation to mammals.

To keep enzymes at optimum activity OR to maintain high diffusion rates of oxygen/glucose

2

(ii) Reptiles have behavioural adaptations to help them to thermoregulate.

Give **one** example of this.

go into shade when too hot OR bask in sun when too cold

1

(c) Name **one** external abiotic factor, other than temperature, which can affect the ability of an organism to maintain its metabolic rate.

Salinity OR pH

3 a) Sweat production is a corrective mechanism used in the regulation of body temperature.

Explain why regulating body temperature is important to the metabolism of humans.

To keep enzymes at optimum activity OR to maintain high diffusion rates of oxygen/glucose

1

b) Give the term used for animals which can control their internal temperature by negative feedback.

Homeostasis/thermoregulation

1

Thermoregulation Past Papers

3. An investigation was carried out into the effect of exposure to low temperature on human body temperature.

Two volunteers, A and B, were immersed in ice baths over an 8 minute period. Body temperatures were measured every 2 minutes.

The results are shown in the table.

Time of exposure (minutes)	Body temperature (°C)	
	Volunteer A	Volunteer B
0	37·2	37·1
2	36·9	36·9
4	36·4	36·8
6	35·8	36·8
8	35·2	36·7

(a) (i) Calculate the average decrease in body temperature per minute for Volunteer A during the investigation. 1

Space for calculation

0.25 °C/min

(ii) Using evidence from the results, suggest why the reliability of the results would be improved if more volunteers were included in the investigation. 1

The results for the 2 volunteers are different/non consistent

(b) (i) Give an example of a corrective response to a decrease in body temperature and explain how it helps to regulate body temperature. 2

Response - Shivering (1)

Explanation - muscles contract, generating heat (1)

OR

Response - Hair erector muscles contract/hairs raised (1)

Explanation - traps a layer of warm/insulating air (1)

OR

Response - vasoconstriction/blood vessels (in the skin) get narrower (1)

Explanation - less blood flow to skin so less heat lost (1)

OR

Response - Increase in metabolic rate (1)

Explanation - Produces (more) heat(1)

(ii) Human body temperature is usually maintained at 37 °C.

Apart from optimal enzyme activity, give one reason for the importance of thermoregulation to maintain metabolism. 1

Higher diffusion rates of oxygen/glucose

Thermoregulation Past Papers

4 Mammals are regulators and can control their internal environment.

(a) Give **one** reason why it is important for mammals to regulate their body temperature. **1**

To keep enzymes at optimum activity OR to maintain high diffusion rates of oxygen/glucose

(b) (i) Name the temperature monitoring centre in the body of a mammal. **1**

hypothalamus

(ii) State how messages are sent from the temperature monitoring centre to the skin. **1**

Nerves by electrical impulses

(c) The blood vessels in the skin of a mammal respond to a decrease in environmental temperature.

(i) Describe this response. **1**

vasoconstriction

(ii) Explain the effect of this response. **1**

Decreased blood flow, decreased heat loss (both for 1 mark)

5 Sea bass are saltwater fish that can regulate their internal salt concentration. They have specialised cells in their gills with protein pumps in the membrane. These pumps actively transport excess salt from their bodies.

(a) The specialised cells have many mitochondria.

Explain why this is necessary. **2**

Mitochondria is the site of aerobic respiration (1)

Which produces ATP (1)

ATP is needed for active transport (1)

(b) Many animal species regulate their body temperature.

Explain the importance of regulating body temperature. **1**

Keep enzymes at their optimum activity OR

For high/higher diffusion rates

(c) Compare regulators and conformers in terms of their ecological niches. **1**

Regulators have a wider range of niches than conformers

Thermoregulation Past Papers

6 The Komodo dragon is a species of lizard.

An investigation was carried out into the effect of environmental temperature on the metabolic rate of a Komodo dragon.

The results are shown in the table.

Environmental temperature (°C)	Oxygen consumption (cm^3/kg/hr)
20	0.4
25	0.7
30	1.1
35	1.4
40	1.7

(a) The Komodo dragon is a conformer.

Use evidence from the table to support this statement. 1

As environmental temperature increases, oxygen consumption increases

(b) Describe how the investigation could be improved to give more reliable results. 1

Repeat at each temrperature OR

Use more dragons at each temperature

(c) Calculate the average increase in oxygen consumption per °C between 20 °C and 40 °C. 1

Space for calculation

0.065

_____ cm^3/kg/hr

(d) Explain how increasing the environmental temperature leads to an increased metabolic rate in a Komodo dragon. 2

Keep enzymes at optimum activity

Higher rates of diffusion (of oxygen)

More oxygen for aerobic respiration

(e) Name the type of response that allows conformers to tolerate variation in the environmental temperature. 1

behavioural

(f) Compare the range of ecological niches that can be occupied by conformers and regulators. 1

Regulators have wider range of niches compared to conformers

Thermoregulation Past Papers

7 Freshwater crocodiles (*Crocodylus johnsoni*) in Northern Australia aestivate for up to three months. A study was carried out to investigate aestivation in freshwater crocodiles. The body temperature, metabolic rate, and air temperature were recorded.

The results are shown in the table.

Month	Average body temperature (°C)	Average metabolic rate (kJ/kg/day)	Average air temperature (°C)
August	25.9	36.0	26.2
September	27.9	26.1	28.0
October	27.8	26.5	27.5
November	28.9	25.7	29.5
December	28.7	36.7	28.9

a) Crocodiles are conformers.

Use information from the table to support this statement. 1

As air temperature decreases body temperature decreases

b) Regulators increase their metabolic rate when there is a decrease in body temperature.

Describe one other corrective response to a decrease in body temperature.

Explain how this response returns body temperature to normal. 2

Description 1. Muscle contraction OR 2. vasoconstriction OR 3. hair erector muscles contract

Explanation 1. Muscle contraction generates heat OR

2. Less blood flow to skin, less heat lost. OR

3. Traps insulating layer of air

c) Suggest why high diffusion rates are important for regulators. 2

Any two

- High levels of glucose/oxygen into cell
- For aerobic respiration
- provides ATP required for temperature regulation/homeostasis

8) Describe and compare metabolism in conformers and regulators. 4

1. Conformers' metabolism/ metabolic rate/internal environment is... dependent on/affected by..... surroundings/external environment/ external factors/external variables	1
2. Conformers use behaviour to maintain optimum **metabolic** rate	1
3. Regulators can maintain/control/ regulate... their ... metabolism/metabolic rate/internal environment/... regardless of external conditions	1
4. Regulators requires energy for homeostasis/negative feedback	1
5. Conformers have **narrower** (ecological) niches (or converse)	1
6. Conformers have lower metabolic costs/rates of metabolism (or converse)	1
	(Max 4)