TEMPERATURE REGULATION

ANSWERS & MARK SCHEMES

QUESTIONSHEET 1

Statement	Ectotherm	Endotherm
Require metabolic heat to keep warm	~	~
Require external heat of sun to keep warm	\checkmark	×
Applies only to mammals	×	×
All possess sweat glands	×	×
All have thermoregulatory centre in hypothalamus	×	✓

5 TOTAL 5

QUESTIONSHEET 2

 (a) vasodilation; arterioles supplying skin carry more blood to near surface; increase heat loss due to radiation (from surface); 	3
sweat/sudorific glands; secrete an increased volume of sweat (onto skin surface);	
this evaporates removing latent heat of vaporisation (from the skin);	3
erector/arector pili/hair muscles; relax allowing hair shafts to lie flat; thus a thinner layer of insulating air is trapped; allowing increased loss by convection/conduction; (allow methods in any order)	max 3
(b) hedgehog's body temperature falls (by about 10 - 15°C) during hibernation; thus animal is very lethargic/torpid and susceptible to predators on waking; brown fat is very rich in mitochondria; brown fat is metabolised very quickly at this time; generates huge amounts of heat raising body temperature to normal (within ½ hour);	max 3
 (c) avoids periods of food scarcity/cold temperatures; thus animal avoids wasting unnecessary energy/food reserves; in searching for food/maintaining high body temperature; animal remains safe in nest avoiding predators/carnivores; 	max 3
	TOTAL 15

 (a) contains thermoreceptors; which sense the core temperature of the blood/body; contains the thermoregulatory centre (which receives impulses from thermoreceptors); this consists of the heat loss promoting centre and the heat gain promoting centre;
(b) heat losing centre operates mainly through the parasympathetic system/heat promoting centre is mainly sympathetic; sympathetic stimulation induces shivering /vasoconstriction of skin arterioles/ stimulates adrenal medulla to release adrenaline raising production of metabolic heat/contraction of hair muscles; reduction of sympathetic stimulation/ increased parasympathetic stimulation causes heat losing mechanisms to increase; vasodilation of skin arterioles/increased sweating/relaxation of hair muscles; max 3
 (c) fat content of adipose tissue is a good heat insulator; layer of subcutaneous adipose tissue thus reduces heat loss; thickness of skin adipose layer in different races is genetically and environmentally controlled/ref Inuit compared to Zulu; ref to blubber in seals/whales or others; ref to metabolic heat production from fat; max 4 TOTAL 10

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QUESTIONSHEET 4

2	 the fluctuation of a physiological value around a set point; in a regular rhythm over a 24 hour/daily time scale; 	(a) (i)
2	ii) menstrual cycle; over a period of a month;	(ii)
max 3	- 	(iii)
max 3	 K: elevated body temperature is being pushed back to mean; ref. to increased sweating to cool body using latent heat; ref to vasodilation to increase heat loss by radiation; ref to relaxation of hair muscles so that hair lies flat and does not trap insulating air; 	r(r(
1	rhythm initiated within the body/controlled by the hypothalmus;	(c) a rhy
TOTAL 11		

QUESTIONSHEET 5

(a) thick fur traps more air between the hairs; air is a poor conductor of heat and so a thicker layer reduces heat loss;	2
(b) sweat glands secrete a watery solution/sweat onto skin when body is too hot; this evaporates removing latent heat and so cools the body;	2
(c) fat/adipose tissue is a good insulator; thus a thicker layer will reduce heat loss by conduction more effectively;	2
 (d) (arteriole) shunt can undergo vasoconstriction/vasodilation; (thus) regulating the volume of blood which flows near the skin surface; (thus) regulating heat loss from radiation/conduction; 	max 2
	TOTAL 8

(a) as temperature rises oxygen consumption falls; (or converse)	
warmer (surface) temperature detected by thermoreceptors;	
impulses sent to adrenal medulla;	
reduces adrenaline secretion;	
which reduces metabolism and thus oxygen use falls;	max 4
(b) as temperature rises oxygen consumption rises;	
body temperature will rise as external temperature rises;	
thus enzymes work more quickly;	
thus metabolism speeds up and so oxygen requirement is increased;	max 3
	TOTAL 7

QUESTIONSHEET 7

 (a) need to use energy for synthesising protein/milk/meat/wool/eggs; minimum energy use in regulating temperature/ keeping warm/ cooling down; thus productivity higher; 	3
(b) lambs have little insulation /wool/ fat so need to be kept warmer; smaller so have larger surface area to volume ratio;	
<u>thus</u> tend to lose heat more easily (dependent mark); thermoregulatory control not yet fully developed; (allow converse points about sheep)	4
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	TOTAL 7

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QUESTIONSHEET 8

(a) Elephants:	have large thin ears without hair/with many blood vessels; these are constantly flapped thus losing heat (by radiation, conduction and convection);	2
(b) Dogs:	by evaporation from wet tongue/bronchial tree passages/air ways; effect is enhanced by panting to increase air flow over the surfaces;	2
(c) Rats:	have a long naked tail with many subcutaneous capillaries; this allows much heat loss by conduction/radiation;	2
(d) Cactus:	white colour reflects heat; reduced surface area for absorption of heat; (reject 'transpiration')	2
		TOTAL 8

(a) (i)	thermoreceptors; in hypothalamus/under skin;	2
(ii)	hypothalamus;	1
nece	temperature remains close to norm/optimum/varies little/highest; essary for normal metabolism/brain activity/organ activity/equivalent; oheral temperature much more variable/influenced by environment;	
	d flow to periphery reduced to reduce heat loss (by convection/conduction and radiation);	max 3
(c) (i)	vasoconstriction/blood shunted into core/deeper vessels to reduce heat loss;	1
(ii)	vasodilation occurs to prevent damage/bring oxygen/heat/to cells/tissues; sympathetic control is overidden/inhibited;	max 1
		TOTAL 8

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QUESTIONSHEET 10

 (a) ice cream in stomach cools core blood temperature; sensed by thermoreceptors in hypothalamus/mid-brain; stimulates heat promoting centre; impulses pass through sympathetic nervous system; (causing) erection of hair to trap insulating air (to warm skin); (causing) suppression of sweating so less heat lost (due to latent heat of vaporisation); (causing) vasoconstriction of skin arterioles so less heat lost from skin; thus skin temperature rises (consequential/dependent mark only); 	max 5
thus skin temperature rises (consequential/dependent mark only);	max 5
(b) low body temperature makes hedgehog very lethargic/at risk from predators;	
thus needs to get its temperature back to normal as quickly as possible (to increase its survival chances);	
ref to stores of brown fat;	
which have large numbers of mitochondria;	
these enable rapid fat metabolism generating ATP and heat;	
(brown fat) has a very high energy/calorific value;	
(thus) large amounts of heat are liberated very quickly (to raise body temperature);	max 5
(c) crocodiles are ectothermic/poikilothermic; (reject 'cold-blooded')	
bask in sun to absorb heat from the sun/solar radiation;	
use moist surfaces of mouth/buccal cavity/airways to lose heat;	
by evaporation of water taking away latent heat (of vaporisation);	
heat also lost by radiation from capillaries under epithelia lining buccal surfaces/airways;	
thus crocodiles exhibit a degree of temperature control;	max 4
	TOTAL 14

(a) (i)	(this question requires an explanation of the data, not a description of it)	
	blubber/lipid is a very good insulator;	
	and is (about) $50 - 60$ cms thick;	
	prevents heat loss from inside body to outside;	
	even though the temperature gradient is large/ ref to figures;	
	epidermis is at same temperature as water/ice and so no heat exchange at surface;	max 4
(ii)	blood vessels penetrate the blubber;	
	to form a capillary network just under the epidermis;	
	this is normally kept to a minimal flow by vasoconstriction (of arterioles);	
	vasodilation of arterioles would cause greater skin blood flow;	
	from which heat could be lost (by radiation);	max 4
(b) blubl	ber prevents heat loss when the polar bear is in water or on land;	
thick	x fur traps a thick layer of air which acts as an insulator/is a poor conductor;	
air be	ecomes displaced by water when swimming and so this insulation is lost;	
thus	the blubber is needed for insulation in water;	
	upplements the insulation of blubber when on land where air temperatures may be much lower than water temperatures are the second	eratures/ref
	e colour of fur is for camouflage/white colour reflects solar radiation;	max 4
	TC	TAL 12

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(a) camel lives in water deficient areas/deserts which are very hot in the day and very cold at night;	
when well-watered the camel can regulate its temperature rises by sweating;	
ref to heat loss due to latent heat (of vaporisation);	
if camel is dehydrated it conserves water by reducing sweating;	
thus rises in body temperature are less well controlled/body temperature rises higher;	
water has high specific heat capacity/retains much heat;	
less water in a dehydrated camel means less heat retained so night temperature falls lower/allow converse;	max 5
(b) much heat is lost through capillary networks of the external ears/pinnae (of hares);	
ears of the Arizona Jack-rabbit are enlarged to allow greater heat loss;	
since it lives in hot/dry/desert regions/little water available for sweat wastage;	
ears of Arctic hare are reduced to conserve heat/lower heat loss;	
since it lives in cold/tundra/polar regions;	max 3
(c) modern elephants/rhinocerus live in the tropics/warm climates/Africa/India;	
so do not need hair to retain heat/usually want to lose heat;	
mammoths/woolly rhinocerus lived in glaciated regions/ice age conditions/sub-polar conditions;	
so needed thick hair to trap an insulating layer of hair (to reduce heat loss);	max 3
то	TAL 11