

**QUESTIONSHEET 1**

Statement	Ectotherm	Endotherm
Require metabolic heat to keep warm	✓	✓
Require external heat of sun to keep warm	✓	×
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**

**QUESTIONSHEET 3**

- (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; **max 3**
- (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**

**QUESTIONSHEET 4**

- (a) (i) the fluctuation of a physiological value around a set point;  
in a regular rhythm over a 24 hour/daily time scale; 2
- (ii) menstrual cycle;  
over a period of a month; 2
- (iii) body temperature values are a result of metabolic heat;  
metabolic heat is a by-product of metabolism;  
metabolic rate fluctuates over a 24 hour cycle;  
under control of hormones such as adrenaline/insulin;  
rate highest in daytime during activity/lowest at night during sleep; max 3
- (b) X: 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; max 3
- (c) a rhythm initiated within the body/controlled by the hypothalamus; 1
- TOTAL 11**
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**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**
- 

**QUESTIONSHEET 6**

- (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;  
thus tend to lose heat more easily (dependent mark);  
 thermoregulatory control not yet fully developed; (allow converse points about sheep) 4
- 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**
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**QUESTIONSHEET 9**

- (a) (i) thermoreceptors;  
 in hypothalamus/under skin; 2
- (ii) hypothalamus; 1
- (b) core temperature remains close to norm/optimum/varies little/highest;  
 necessary for normal metabolism/brain activity/organ activity/equivalent;  
 peripheral temperature much more variable/influenced by environment;  
 blood 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 overridden/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**
- (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****QUESTIONSHEET 11**

- (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) blubber prevents heat loss when the polar bear is in water or on land;  
thick fur traps a thick layer of air which acts as an insulator/is a poor conductor;  
air becomes displaced by water when swimming and so this insulation is lost;  
thus the blubber is needed for insulation in water;  
fur supplements the insulation of blubber when on land where air temperatures may be much lower than water temperatures/ref  
wind-chill factor;  
white colour of fur is for camouflage/white colour reflects solar radiation; **max 4**

**TOTAL 12**

**QUESTIONSHEET 12**

- (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/rhinoceros live in the tropics/warm climates/Africa/India;  
so do not need hair to retain heat/usually want to lose heat;  
mammoths/woolly rhinoceros 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**

**TOTAL 11**