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 - l5^{o}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 hypothalmus; **1**

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

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

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

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 overidden/inhibited; **max 1**

TOTAL 8

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/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**

TOTAL 11