

- M1.** (a) (i) (body temperature always equals the air temperature) because it cannot regulate its body temperature; 1
- (ii) lizard A can gain heat from the sun; 1
- (b) movement is dependent upon enzyme-catalysed reactions; molecules have less kinetic energy at lower temperatures; less enzyme activity; slower metabolism / rate of respiration / less ATP available; 2 max
- [4]**

- M2.** (a) 1. Adenylate cyclase activated / cAMP produced / second messenger produced; 2 max
2. Activates enzyme(s) (in cell);
3. (So) glycogenolysis / gluconeogenesis occurs / glycogenesis inhibited;  
 3. *Neutral: 'glucose produced' as given in the question stem*  
*Accept: correct descriptions of these terms*
- (b) (i) 1. Glucose/sugar in food would affect the results;  
 1. *Accept references to starch / carbohydrate*
2. Food/eating would affect blood glucose (level);
3. (Allows time for) blood glucose (level) to return to normal;  
 3. *Neutral: allows time for insulin to act* 1 max
- (ii) Type 2 diabetes is a failure to respond to insulin / still produces insulin / is not insulin-dependent; 1

(iii) (For) – 3 max

*A maximum of three marks can be awarded for each side of the argument*

1. Avoids injections / pain of injections;
2. Long(er) lasting / permanent / (new) cells will contain / express gene;  
*Ignore references to methodology e.g. sample size not known*
3. Less need to measure blood sugar / avoids the highs and lows in blood sugar;
4. Less restriction on diet;

(Against) – 3 max

5. Rats are different to humans;
6. May have side effects on humans;  
*6. Accept: virus may be harmful / disrupt genes / cause cancer*
7. Long(er) term effects (of treatment) not known / may have caused effects after 8 months;
8. (Substitute) insulin may be rejected by the body;

4 max

[8]

**M3.**

(a) insulin binds to specific receptors (on membranes);  
insulin activates carrier proteins / opens channels / causes more channels to form;  
insulin increases the permeability of liver/muscle cells/tissues to glucose;  
insulin action results in glucose conversion to glycogen / glycogenesis;

3 max

(b) glucose is used in cell respiration / as energy source / in metabolism;  
*(must qualify how glucose is used)*

glucose enters cells / converted to glycogen in cells;  
glucose is excreted / in urine;  
*(do not credit no reabsorption of glucose in kidneys)*

2 max

(c) line from 80 mg, increasing but keeping below line for diabetic, dropping to 80 mg;  
*(line must stabilise at, or fluctuate around 80 mg)*

1

(d) (i) fast acting insulin reduces blood glucose from breakfast;  
slow acting insulin reduces blood glucose from other meals before the evening meal / eliminates the need to inject at lunch;  
*(must be a reference to the meals)*  
*(one mark if neither of the above but a clear reference is made to glucose conversion to glycogen);*

2

- (ii) glucagon is still active;  
glycogen converted to glucose / glycogenolysis;  
insulin injected at breakfast causes cells to take up glucose  
too slowly for levels to become dangerously low;  
person is not active so little glucose used in respiration;  
*(do not credit statements about consuming large breakfasts)*

1 max

[9]

**M4.** (a) 1. 21 or 21.4;

*Correct answer = 2 marks outright*

2. One mark for the principle of difference / initial;  
*Ignore number of decimal places*

2

- (b) (i) Water intake linked to sweating / panting;

*Neutral: ref. to urine*

*Neutral: dehydration*

1

- (ii) 1. Food intake linked to (increased) respiration;

1. *Not 'increased metabolism'*

*Reject: decreases respiration*

*Neutral: references to environmental temperature increasing*

2. Food intake linked to heat / energy release / maintaining body temperature;

2. *This mark is independent of 1*

2

- (c) 1. Increased sweating so less water available (for milk production);

2. Less food so less energy / nutrients available (for milk production);  
2. *Not just 'less energy available (for milk production)'*

3. Enzymes not working at optimum temperature;

3. *Reject: references to enzyme denaturation*

1 max

- (d) (Skin temperature)

*Accept: converse arguments for rectal temperature*

1. Varies / fluctuates more / more heat lost / gained / (can be) further from core;

2. (As) more affected by environment / sweating / conduction / convection / radiation;

2. *Accept: 'not affected by' in relation to rectal temperature*

*Accept: named environmental factors*

*Accept: idea that skin is more exposed to the environment*

*Accept refs. to vasoconstriction / vasodilation*

2

- (e) Select a bull whose mother / offspring produced a high milk yield; 1
- (f) 1. Allows comparison; 2  
2. (As) different countries have different population / sample sizes; 2
- (g) 1. (Selective) advantage producing lactase / being lactose tolerant / able to digest milk / able to eat dairy foods; 4  
*Accept: converse arguments for people who are lactose intolerant*  
2. People (producing lactase) reproduce;  
3. (And) pass on gene / allele;  
*If mark point 2 has **not** already been given, then mark point 3 automatically gains 2 marks as reproduction must have occurred*  
4. Allele frequency increases;  
*4. Neutral: gene frequency increases / allele frequency changes  
Must be clearly stated and not implied*
- M5.** (a) Easy to manage / can be kept safely in small space; 2 max  
Genome / strains well known;  
Physiology similar to humans / can be used to predict human behaviour
- (b) Same as control but inject with equal volume of solvent only; 1
- (c) (i) Heat lost from tail; 2  
By conduction / convection / radiation;  
*Q Award credit to answers that refer to the evaporation of sweat from the tail.  
Q Award credit to answers that are the converse of the above, relating to the rectal temperature*
- (ii) Standard deviations show mean rectal temperatures are significantly different (in the two groups);  
Rectal temperature indicates core temperature / heat generation;  
Tail temperatures not significantly different (in the two groups);  
Tail temperatures indicate no difference in heat loss;  
None of the mice died (in this experiment);  
*Q If candidates fail to gain credit above, they can be awarded one mark for a clear statement that MDMA increases heat production but does affect not heat loss.* 3 max
- [15]
- [8]

- M6.** (a) moves to 40 °C side, then later to 20 °C;  
gets lighter in hot side and darker in cool side;  
lighter as it absorbs heat/darker as it loses heat;  
by conduction/convection/radiation; 3 max
- (b) lizard finds favourable environment;  
(helps it to) maintain constant body temperature;  
advantage of this, e.g. for enzyme activity; 2 max
- (c) receptors in blood vessels/skin;  
nerve impulses produced;  
go to coordinator/brain/hypothalamus;  
motor neurones send nerve impulses;  
to effectors/muscles; 3 max
- [8]**
- 
- M7.** (a) large surface area;  
so increases heat loss (to the air);  
OR  
increased blood flow into ears;  
so increases heat loss; 2 max
- (b) more movement needs greater energy use/ muscle contraction;  
more heat generated through respiration;  
OR  
in sun, more heat absorbed;  
harder to lose heat by sweating/vasodilation; 2 max
- [4]**
- 
- M8.** (a) (thermo)receptors in skin;  
*(accept receptors in hypothalamus if after reference to cooled blood)*
- impulses via nerves / neurones to or from;  
*(once only)*
- hypothalamus;  
heat gain/temperature centre (in hypothalamus);  
contraction /constriction of arterioles;  
*(not capillaries, or just vasoconstriction)*
- diversion through shunt vessels; 4 max

- (b) (i) reduced / no evaporation of sweat;  
due to reduced gradient / saturation/high water content of air;  
less heat loss by (latent) heat of evaporation;

2 max

- (ii) skin vessels open/vasodilatation;  
(movement of)

blood diverted from muscles / limited total volume of blood;

2

[8]

- M9.** (a) metabolic water / from respiration;  
*allow condensation reactions. Ignore 'oxidation'.*  
aerobic / use of oxygen;  
(*'From aerobic respiration' = 2 marks*)

2

- (b) 1 dry air (inhaled) causes evaporation from nasal passages /  
or converse;
- 2 cooling due to evaporation;
- 3 blood is cooled;
- 4 (cool blood) flows from nose to brain / cools brain / keeps  
brain at const. temp.;
- 5 allows activity (e.g. foraging for food / escaping predators /  
not restricted to staying in humid burrow (in hot conditions);
- 6 air with high water vapour content leaves lungs / is exhaled;
- 7 water condenses in nasal passages;
- 8 due to lower temperature;
- 9 water can be reabsorbed (into blood) / swallowed / water  
conservation / less water loss;

4 max

[6]

- M10.** (a) (i) Eaten;  
 Containing carbohydrate/sugar;  
 Glucose absorbed from intestine/into blood;  
 Long time after insulin injection/needs more insulin/has not taken insulin;  
 Does not convert glucose to glycogen/glucose not taken up from blood;
- 2 max
- (ii) Shows positive correlation/directly proportional;  
 A range of results for a particular value/values (for different colours) overlap;  
 Urine test only an arbitrary scale/not directly related to concentration/colour is subjective/few colour values;  
*Accept description*
- 3
- (b) Glycogen to glucose/glycogenolysis;  
*If name incorrect this disqualifies.*  
 By activating enzymes;  
 Gluconeogenesis;  
*Allow explanation in terms of glucose from a non-carbohydrate/named non-carbohydrate source.*
- 2 max
- [7]
- M11.** (a) (i) Hormones have widespread effect / affect different organs / affect different parts of the body / affect distant organs / only affect cells with right receptor;  
*Assume "they" refers to hormones.*
- 1
- (ii) 1. Hormones in blood;  
 2. Local chemical mediators spread by diffusion / spread directly;  
 1. *May be awarded where candidates refer to both as "they".*
- 2
- (b) 1. (Acetylcholine) released from/in presynaptic side;  
 2. Diffusion from higher concentration/to lower concentration;  
 3. Receptors in postsynaptic (side) / binds on postsynaptic (side);  
 2. *Mark for diffusion only awarded in context of unidirectional movement.*
- 2 max

(c) (i) 1. Rapid response;

2. Short duration;

*Specific wording is not important. It is the principles that matter here.*

*Points may be made by referring to figures.*

2

(ii)

	1	2	3
Percentage	80	0	0

*Ignore % sign.*

1

[8]

**M12. General Principles for marking the Essay:**

Four skill areas will be marked: scientific content, breadth of knowledge, relevance and quality of language. The following descriptors will form a basis for marking.

**Scientific Content** (maximum 16 marks)

Category	Mark	Descriptor
<b>Good</b>	16	Most of the material of a high standard reflecting a comprehensive understanding of the principles involved and a knowledge of factual detail fully in keeping with a programme of A-level study. Some material, however, may be a little superficial. Material is accurate and free from fundamental errors but there may be minor errors which detract from the overall accuracy.
	14	
	12	
<b>Average</b>	10	A significant amount of the content is of an appropriate depth, reflecting the depth of treatment expected from a programme of A-level study. Generally accurate with few, if any fundamental errors. Shows a sound understanding of most of the principles involved.
	8	
	6	
<b>Poor</b>	4	Material presented is largely superficial and fails to reflect the depth of treatment expected from a programme of A-level study. If greater depth of knowledge is demonstrated, then there are many fundamental errors.
	2	
	0	

**Breadth of Knowledge** (maximum 3 marks)

Mark	Descriptor
3	A balanced account making reference to most if not all areas that might realistically be covered on an A-level course of study.
2	A number of aspects covered but a lack of balance. Some topics essential to an understanding at this level not covered.
1	Unbalanced account with all or almost all material based on a single aspect
0	Material entirely irrelevant.

**Relevance** (maximum 3 marks)

Mark	Descriptor
3	All material presented is clearly relevant to the title. Allowance should be made for judicious use of introductory material
2	Material generally selected in support of title but some of the main content of the essay is of only marginal relevance.
1	Some attempt made to relate material to the title but considerable amounts largely irrelevant.
0	Material entirely irrelevant or too limited in quantity to judge.

**Quality of language** (maximum 3 marks)

Mark	Descriptor
3	Material is logically presented in clear, scientific English. Technical terminology has been used effectively and accurately throughout.
2	Account is logical and generally presented in clear, scientific English. Technical terminology has been used effectively and is usually accurate.
1	The essay is generally poorly constructed and often fails to use an appropriate scientific style and terminology to express ideas.
0	Material entirely irrelevant or too limited in quantity to judge.

[25]

**Additional notes**

Care must be taken in using these notes. It is important to appreciate that the only criteria to be used in awarding marks to a particular essay are those corresponding to the appropriate descriptors. Candidates may gain credit for any information providing that it is biologically accurate, relevant and of a depth in keeping with an A-level course of study. Material used in the essay does not have to be taken from the specification, although it is likely that it will.

These notes must therefore be seen merely as guidelines providing an indication of areas of the specification from which suitable factual material might be drawn.

In determining the mark awarded for breadth, content should ideally be drawn from each of the areas specified if maximum credit is to be awarded. Where the content is drawn from two areas, two marks should be awarded and where it is taken only from a single area, one mark should be awarded. However, this should only serve as a guide. This list is not exhaustive and examiners should be prepared to offer credit for the incorporation of relevant material from other areas of study.

- M13.** (a) (i) B; 1
- (ii) Fall in progesterone / progesterone same as at start / progesterone low at 25 days;  
*Ignore references to oestrogen* 1

- (b) Answer showing understanding of positive feedback i.e. more produces more / differs further;

Answer showing understanding of positive feedback correctly linked to oestrogen and LH i.e. more oestrogen produces more LH;;

*1 mark for basic idea*

*2 marks for idea illustrated correctly by example of oestrogen and LH*

*Answer must relate to oestrogen increasing not just high oestrogen*

2

- (c) 1. Progesterone has negative feedback effect / inhibits secretion of FSH/LH;  
2. (FSH) stimulates follicle development / ( LH) stimulates ovulation;

2

[6]

**M14.**

- (a) (i) different shape/different tertiary structure/  
different sequence of amino acids;

1

- (ii) insulin unable to attach to receptors;  
reduced/no uptake of glucose into cells / no carrier proteins/  
channels for glucose transport;

2

- (iii) glucose reabsorbed/absorbed into blood;  
from proximal tubule;  
by active transport/involving membrane carriers;

3

- (b) (i) larger genetic component;  
*(must be comparative)*

1

- (ii) number of cases studied;  
matched samples;  
age of twins;  
named environmental factor;;  
*(allow 2 marks for 2 different factors if no overlap in effect)*

family history of diabetes;  
method of diagnosis;  
same sex in non-identical twins;

2 max

[9]

- M15.** (a) (i) glucagon;  
*Insist on spelling* 1
- (ii) liver; 1
- (b) A change to the normal level initiates a response which reduces the effect/reverses/acts against the change; 1
- [3]**
- 
- M16.** (a) Reduced rate of respiration / metabolism / chemical reactions;  
Energy conservation / less energy lost / less heat lost / conservation of stored fat / glycogen / food; 2
- (b) Optimum / fast / increased / temperature for enzymes / metabolism / chemical reactions / respiration;  
Optimum energy release for movement / faster movement / independent of environmental temperature;  
*Reject 'for faster activity'* 2
- [4]**
- 
- M17.** (a) uptake of oxygen / production of carbon dioxide; 1
- (b) constriction / narrowing / shunt effect;  
of arterioles;  
less blood flow to capillaries;  
reduces heat loss via radiation / conduction / convection; 3 max
- (c) (i) metabolism releases heat;  
increase in environmental temperature provides heat / warms mammal;  
less heat required from metabolism which falls / levels off; 3
- (ii) lack of thermoregulatory control at high temp. / positive feedback;  
increase in temperature increases metabolism / respiration; 2
- [9]**

- M18.** (a) (i) maintaining a constant internal environment; 1
- (ii) *one mark for example of factor kept constant; one mark for explaining its importance;*
- e.g.  
 temperature / pH; optimum for enzymes / effect of pH /  
 temperature on enzyme activity;
- OR
- water potential / blood glucose;  
 effect of osmotic / blood glucose imbalance on cells; 2 max
- (b) (i) 1 hypothalamus (contains the thermoregulatory centre);  
 2 has receptors which detect temperature changes of blood;  
 3 receives impulses from receptors in skin;  
 4 nerve impulses transmitted (from hypothalamus / brain);  
 5 results in vasoconstriction / constriction of arterioles / dilation  
 of shunt vessels;  
 6 diversion of blood to core / specified organ / less blood to skin;  
 7 muscular contraction / shivering generates heat via respiration;  
 8 release of thyroxine / adrenaline;  
 9 increase in metabolic rate / respiration;  
 10 correct reference to negative feedback mechanisms; 7 max
- (ii) larger surface area to volume ratio;  
 less insulation / steeper thermal gradient;  
 more heat loss by conduction; 2 max
- (c) cannot interact with / move tropomyosin; (*allow troponin*)  
 from binding sites on actin;  
 (*reject active sites*)  
 myosin(heads) do not bind / actinomyosin not formed;  
 does not activate ATPase / energy not released from ATP; 3 max
- [15]**
- M19.** (a) Glucose (from digestion of meal) absorbed; 1
- (b) taken up by cells;  
 used in respiration / converted to glycogen; 2

- (c) 09:00 to 11:00 glucagon secreted;  
 (Glucagon) stimulates breakdown of glycogen to glucose;  
 11:00 to 12:00 insulin secreted;  
 Insulin stimulates uptake of glucose by cells / conversion to glycogen;  
 Explanation of negative feedback;  
*Q For the first marking point, answers must refer to glucagon.  
 References to spelling alternatives, such as glycogen, glycocon or  
 glucose should not be awarded credit*

4 max

[7]

- M20.** (a) On graph: X where glucose level is below norm  
 AND Y where glucose level is above norm;

1

- (b) EITHER  
 1. Use m-RNA + reverse transcriptase to produce gene / (c)-DNA;  
 2. Restriction enzyme to cut open plasmid;  
 3. Add sticky ends (to insulin gene and to plasmid);  
 OR Allow:  
 1. Cut out insulin gene / cut open plasmid with restriction enzyme;  
 2. Use same restriction enzyme on second DNA;  
 3. Reference to (complementary) sticky ends;  
 4. Use ligase to join 2 DNA molecules;  
 5. Modified plasmid taken up by bacteria;

max 4

[5]

**M21. General Principles for marking the Essay:**

Four skill areas will be marked: scientific content, breadth of knowledge, relevance and quality of language. The following descriptors will form a basis for marking.

**Scientific Content** (maximum 16 marks)

Category	Mark	Descriptor
<b>Good</b>	16	Most of the material reflects a comprehensive understanding of the principles involved and a knowledge of factual detail fully in keeping with a programme of A-level study. Some material, however, may be a little superficial. Material is accurate and free from fundamental errors but there may be minor errors which detract from the overall accuracy.
	14	
	12	
<b>Average</b>	10	Some of the content is of an appropriate depth, reflecting the depth of treatment expected from a programme of A-level study. Generally accurate with few, if any, fundamental errors. Shows a sound understanding of the key principles involved.
	8	
	6	
<b>Poor</b>	4	Material presented is largely superficial and fails to reflect the depth of treatment expected from a programme of A-level study. If greater depth of knowledge is demonstrated, then there are many fundamental errors.
	2	
	0	

**Breadth of Knowledge** (maximum 3 marks)

Mark	Descriptor
3	A balanced account making reference to most areas that might realistically be covered on an A-level course of study.
2	A number of aspects covered but a lack of balance. Some topics essential to an understanding at this level not covered.
1	Unbalanced account with all or almost all material based on a single aspect.
0	Material entirely irrelevant or too limited in quantity to judge.

**Relevance** (maximum 3 marks)

Mark	Descriptor
3	All material presented is clearly relevant to the title. Allowance should be made for judicious use of introductory material.
2	Material generally selected in support of title but some of the main content of the essay is of only marginal relevance.
1	Some attempt made to relate material to the title but considerable amounts largely irrelevant.
0	Material entirely irrelevant or too limited in quantity to judge.

**Quality of language** (maximum 3 marks)

<b>Mark</b>	<b>Descriptor</b>
3	Material is logically presented in clear, scientific English. Technical terminology has been used effectively and accurately throughout.
2	Account is logical and generally presented in clear, scientific English. Technical terminology has been used effectively and is usually accurate.
1	The essay is generally poorly constructed and often fails to use an appropriate scientific style and terminology to express ideas.
0	Material entirely irrelevant or too limited in quantity to judge.

[25]

**Topic areas for assessment of scientific content:**

- (1) principle of negative feedback – departure from a norm initiates changes which restore a system to the norm. (P)
- (2) importance in homeostasis; principles of detection of change, role of receptors, corrective response, role of effectors. (H)
- (3) thermoregulation; roles of thermoreceptors and hypothalamus in detection; heat loss and heat gain centres; sweating and vasodilatation in heat loss; vasoconstriction, hair erection, shivering and increased metabolism in heat gain. (T)
- (4) regulation of blood glucose; roles of receptors in pancreas, secretion of insulin or glucagon; effect of insulin on surface membrane receptors/carrier proteins in stimulating uptake of glucose and glycogenesis; role of glucagon in glycogenolysis. (G)
- (5) regulation of blood water potential; role of receptors in hypothalamus; secretion of ADH from pituitary; effect of ADH on permeability of d.c.t. and collecting duct; role of loop of Henle in maintaining high ion concentration in the medulla; effect on urine concentration. (W)
- (6) control of ventilation; stimulation of chemoreceptors in medulla; effect on inspiration; stimulation of stretch receptors in lungs; stimulation of expiratory cells in medulla. (B)
- (7) control of heartbeat; roles of chemoreceptors and pressure receptors; inhibitory and acceleratory centres in medulla; effect on SAN and rate of heartbeat; effect of change in rate on pH/pressure of blood. (HB)
- (8) metabolic pathways; examples of build-up of a product in a metabolic pathway resulting in inhibition of its formation. (M)
- (9) population stability; effect of increasing competition/predation on increasing population size and restoration of balance. (Pop)

- (10) (selection – stabilising selection resulting in constancy of species) (S)
- (11) (Oestrous cycle; effect of feedback on hormone production, e.g. oestrogen on FSH and progesterone on both FSH and LH. From Option 8) (O)

Any other sensibly argued example showing negative feedback should be credited.

In a good essay the description of the changes in a system should be clearly related to the principles of negative feedback, with sufficient detail for the relationship to be explained.

#### **Assessment of breadth of knowledge:**

- 3 marks Clear understanding of principle of negative feedback and coverage of 4 examples with sufficient detail to illustrate the principle effectively.
- 2 marks 3 examples described in some detail, but without necessarily making the link explicit.
- 1 mark reference to 2 examples.

#### **Guidelines for marking the essay**

##### **Introduction**

The essay is intended for the assessment of AO4 (Synthesis of knowledge, understanding and skills) and Quality of Written Communication (Sections 6.4 and 6.5 in the specification). Examiners are looking for

- evidence of knowledge and understanding at a depth appropriate to A level
- selection of relevant knowledge and understanding from different areas of the specification
- coverage of the main concepts and principles that might be reasonably be expected in relation to the essay title
- connection of concepts, principles and other information from different areas in response to the essay title
- construction of an account that forms a coherent response
- clear and logical expression, using accurate specialist vocabulary appropriate to A level

##### **Assessing Scientific Content**

Maximum 16 marks.

Descriptors are divided into 3 categories: Good (16, 14, 12), Average (10, 8, 6) and Poor (4, 2, 0). Only even scores can be awarded, i.e. not 15, 13, etc.

Examiners need first to decide into which category an essay comes.

### A good essay

- includes a level of detail that could be expected from a comprehensive knowledge and understanding of relevant parts of the specification
- maintains appropriate depth and accuracy throughout
- avoids fundamental errors
- covers a majority of the main areas that might be expected from the essay title (These areas are indicated in the mark scheme). (Occasionally a candidate may tackle an essay in an original or unconventional way. Such essays may be biased in a particular way, but where a high level of understanding is shown a high mark may be justified.)
- demonstrates clearly the links between principles and concepts from different areas.

Note that it is not expected that an essay must be 'perfect' or exceptionally long in order to gain maximum marks, bearing in mind the limitations on time and the pressure arising from exam conditions.

### An average essay

- should include material that might be expected of C/D/E grade candidates
- is likely to have less detail and be more patchy in the depth to which areas are covered, and to omit several relevant areas
- is likely to include some errors and misunderstandings, but should have few fundamental errors
- is likely to include mainly more superficial and less explicit connections

### A poor essay

- is largely below the standard expected of a grade E candidate shows limited knowledge and understanding of the topic
- is likely to cover only a limited number of relevant areas and may be relatively short
- is likely to provide superficial treatment of connections includes several errors, including some major ones

Having decided on the basic category, examiners may award the median mark, or the ones above or below the median according to whether the candidate exceeds the requirements or does not quite meet them.

### Marking the essay

In marking scientific content, letters in the margin show each key area covered; these are used to assess the breadth of criteria. A single tick is used to indicate accurate coverage of each significant area, and a double tick to emphasise 'good depth of content.' Errors are indicated with a cross. A squiggly line in the margin is used to highlight irrelevance and 'Q' to highlight poor use of terminology, unclear grammar and inappropriate style.

## Specific guidance for assessing Scientific Content and Breadth of Knowledge in Essays

The following provides guidance about topics which might be included in the essays. It is not an exclusive list; the assessment of scientific content does not place restrictions on topics that candidates might refer to, provided they are

- relevant;
- at an appropriate depth for A level and
- accurate.

It is not expected that candidates would refer to all, or even most, of the topics to gain a top mark; the list represents the variety of approaches commonly encountered in the assessment to the essays. In both essays, topics either from the option modules or beyond the scope of the specification should also given credit where appropriate.

### M22. Quality of Communication

The answers to all sections of this question require the use of continuous prose. Quality of language should be considered in crediting points in the scheme. In order to gain credit, answers should be expressed logically and unambiguously, using scientific terminology where appropriate.

- (a)
1. Deviation of a value from norm initiates corrective mechanisms;
  2. fluctuations in plasma glucose concentration detected by hypothalamus/ islet cells in pancreas;
  3. initial decrease, no food given (in plasma glucose) stimulates (increased) secretion of glucagon;
  4. increases (in plasma glucose) stimulate (increased) secretion of insulin;
  5. correct ref. to role of  $\alpha$  and/or  $\beta$  cells as secretors;
  6. correct ref. to interconversion of glycogen / glucose;
  7. increased/decreased uptake of glucose by cells (as appropriate)/correct ref to change in membrane permeability;

max 5

- (b) (i)
1. Sensors in skin/hypothalamus detect reduced temperature;
  2. heat gain centre activated/inhibition of heat loss centre;
  3. vasoconstriction/constriction of arterioles in skin surface:  
(**R** capillaries)
  4. dilation of shunt vessels/constriction of – capillary sphincter;
  5. less blood to skin surface/capillaries
  6. reduced heat loss by radiation;
  7. increased heat gain by increased metabolic rate/respiration/ movement/shivering;
  8. decreased heat loss by putting on clothes/huddling/reduced sweating;

max 5

- (ii)
1. Body temp./37 °C is optimum temp for enzymes;
  2. excess heat denatures enzymes/alters tertiary structure/  
alters shape of active site/enzyme;
  3. substrate cannot bind/eq,;
  4. reactions cease/slowed;
  5. too little reduces kinetic energy of molecules / molecules  
move more slowly;
  6. fewer collisions/fewer ES complexes formed'

max 5

[15]

- M23.** (a) as distance from skin surface increases the temperature increases/  
steep temperature gradient;  
temperature at depth of 50mm/inside of blubber similar to  
body core temperature;

2

- (b) EITHER
1. increased (blood) temperature results in increased blood flow through  
capillaries in blubber / vasodilation in blubber;
  2. increased skin temperature;
  3. increased loss of heat from skin;
  4. decreased temperature results in reduced blood flow through  
blubber capillaries/ vasoconstriction in blubber;
  5. correct reference to (sphincter/circular) muscles of arterioles;
  6. correct reference to role of shunt vessels;
- OR
1. decreased (blood) temperature results in decreased blood flow  
through capillaries in blubber / vasoconstriction in blubber;
  2. decreased skin temperature;
  3. decreased loss of heat from skin;
  4. increased temperature results in increased blood flow through  
blubber capillaries/ vasodilation in blubber;
  5. correct reference to (sphincter/circular) muscles of arterioles;
  6. correct reference to role of shunt vessels;

4 max

- (c) counter-current principle;  
temperature of blood flowing to flipper greater than that leaving it /  
temperature of blood greater in artery than vein;  
therefore heat (energy) transfer artery to vein;  
less heat lost as not transferred to environment/transferred to body core;

3 max

- (d)
1. salt/(sodium) ions diffuse into descending limb;
  2. water moves out of descending limb;
  3. salt/(sodium) ions actively removed from ascending limb;
  4. ascending limb impermeable to water;
  5. low water potential/ high concentration of ions in medulla/tissue fluid;
  6. water leaves collecting duct / distal tubule;
  7. due to difference in water potential / by osmosis;

6 max

[15]

- M24.** (a) (i) 1. (Increased temperature) increases rate of reactions / increases kinetic energy / increases metabolism;

2. More energy/more ATP;

3. Oxygen consumption linked to respiration;

*2 Needs reference to the idea of more.*

3

- (ii) Units given per gram / per unit mass / mass is standardised / variation in mass taken into account;

*Accept weight/size.*

*Ignore references to other size-related parameters.*

1

- (b) (i) Further away from the optimum, the greater the movement/ least/no movement at optimum;

1

- (ii) 1. (Outside optimum temperature) moves (between sun and shade);

2. Warm up or cool down;

*Accept converse of*

*Does not move;*

*At optimum temperature.*

2

- (c) 1. Evaporation (of water from lining of mouth);

2. Heat transferred from blood;

2

[9]

