CAMBRIDGE INTERNATIONAL EXAMINATIONS

Pre-U Certificate

MARK SCHEME for the May/June 2014 series

9790 BIOLOGY

9790/02 Paper 2 (Long Answer), maximum raw mark 120

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

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CAMBRIDGE
International Examinations

Notes:

The following abbreviations may be used in mark schemes:

/	alternative and acceptable answers for the same marking point
;	separates marking points
allow/accept / A	answers that can be accepted
AVP	any valid point – marking points not listed on the mark scheme but which are worthy of credit
AW / owtte	credit alternative wording / or words to that effect
ecf	error carried forward
ignore / I	statements which are irrelevant – applies to neutral answers
not / reject / R	answers which are not worthy of credit
ORA	or reverse argument
(words)	bracketed words which are not essential to gain credit
<u>words</u>	underlined words must be present in answer to score a mark

Section A

1 (a) 1 glucose and galactose as separate molecules, at least one labelled ;
2 + water / H_2O above the arrow ;
3 –H and –OH on position 1 of galactose and on position 4 of glucose ;

[3]

(b) (i) *P* < 0.05
1 this difference is (statistically) significant / AW ;
2 low lactose milk causes much less severity of symptoms in lactose intolerant people than normal milk ;

P > 0.05
3 this difference is not (statistically) significant / AW ;
4 no difference in severity of symptoms between lactose-intolerant people drinking low lactose milk and non-lactose-intolerant people drinking normal milk ;

[4]

(ii) 1 self-reporting symptoms / subjectivity ;
A qualitative / semi-quantitative
2 small sample size / only 15 in the control group ;
3 variation between individuals ;
e.g. age, gender, dietary and medical history, etc.
4 no error bars / standard deviations / standard errors, to show variation (within datasets) ;

[max 3]

(c) 1 a small amount of enzyme can treat a large volume of milk ;
2 possible to have continuous process ;
3 enzyme, remains active for longer / more stable ;
4 enzymes expensive to produce therefore immobilising enzymes, reduces costs / increases profits ;
5 enzyme can be, reused / recycled ;
6 downstream processing is easier / less contamination of product ;

[max 3]

[Total: 13]

2 (a) *accept size for volume*

1 the colder the habitat the greater the mean body mass of the mammal / negative correlation / ORA ;

max 4 from points below:

2 considerable variation at all temperatures ;
3 ref. to reasons for variation ;
e.g. different, behaviour / activity, shapes, fur thickness, stored fat, etc.
4 the lower the temperature, the greater the need to conserve heat / ORA ;
5 the greater the mass, the greater the volume / ORA ;
6 the greater the surface area to volume ratio, the greater the rate of heat loss / ORA ;
7 (for simple shapes) the greater the volume, the smaller the surface area relative to the volume / ORA ;
8 (for simple shapes) the surface area = length^2 and volume = length^3 / surface area = volume$^{0.67}$;

[max 5]

(b) (i) 1 air enters through <u>spiracles</u> ;
2 into a system of, tracheae / tubes, which branch to all parts of the body ;
3 (rings of) chitin support, tracheae / tubes ;
4 ventilation movements involving muscles / muscles make body expand and contract ;
5 movement of, thorax / abdomen ;
6 ref. to fluid-filled, blind-ending tubes / tracheoles ;

[max 3]

(ii) 1 increasing the concentration of the oxygen in the air increases the diffusion gradient ;
2 increases (rate of) diffusion ;
3 allows greater rate of respiration for, muscle activity / ATP production / growth ;
4 ref. respiration is aerobic ;
5 the size of an insect is limited by the rate at which oxygen can diffuse into its cells ;

[max 3]

[Total: 11]

3 (a) *all 4 must be correct to gain the mark*
A = adenine
G = guanine
C = cytosine
T = thymine ; **[1]**

(b) polymerase chain reaction / PCR ; **[1]**

(c) *assumption:*
1 that Neanderthals were, a subspecies of / the same species as, *Homo sapiens* / modern humans ;

2 that Neanderthals and modern humans could interbreed (to produce fertile offspring) ;
A any other species definition criteria

explanation:
3 it is not possible to confirm that they were able to interbreed with *H sapiens* ;
4 nor that (if they interbred) any hybrids produced would be fertile ;
5 it is not possible to obtain sufficient, morphological / physiological / behavioural / ecological / biochemical, data ;
6 only fragments of DNA are available / it is not possible to obtain sufficient DNA for complete analysis ;
7 small sample of Neanderthals ;

[max 3]

(d) 1 all the species share a (recent) common ancestor ;
2 the smaller the number of differences the, more closely related / more recently divergence occurred ;
3 examples ; ;
\+ e.g. chimpanzees are phylogenetically closest to *Homo sapiens* / humans / Neanderthals
4 gorillas and orangutans are more distantly related (to humans) than chimpanzees but nearer than macaques
macaques, are the most distantly related to humans (compared to any of the other species) / constitute the outgroup
5 data quote 1 between any pair of species ;
6 data quote 2 between any other pair of species ;
e.g. number of differences / description of bases at certain positions – see table on page 6
7 ref. this is part of the coding for a conserved protein / AW ;
8 ref. to cytochrome which performs the same function ;

the data must be treated with caution because:
9 the nucleotide sequences are only a small fraction of the whole genome ;
10 use of figures to support ;
e.g. 51 nucleotides equivalent to, (only) 17 amino acids
11 cytochrome is likely to be a larger, polypeptide / protein / ref. to length of gene ;
12 there will be variation within each species ;
13 these sequences come from one individual from each species ;
A small sample size / no idea of sample size for each species
14 ref. to mitochondrial, gene / DNA ;
15 AVP ; e.g. ref. to intron
some mutations are, neutral / silent

table of number of differences for marking points 5 and 6

	modern human	Neanderthal	chimpanzee	orangutan	gorilla	macaque
modern human		0	2	5	4	10
Neanderthal	0		2	5	4	10
chimpanzee	2	2		5	6	10
orangutan	5	5	5		9	13
gorilla	4	4	6	9		9
macaque	10	10	10	13	9	

[max 6]

(e) 1 (point) mutation **;**
2 change in a single base / substitution **;**
R addition / deletion / frame shift
3 mis-pairing during DNA replication **;**
4 mutagen / named mutagen **;**
A UV / X-rays / ionising radiation / AW
5 AVP **;** e.g. further detail of mutation
single nucleotide polymorphism / SNP

[max 3]

[Total: 14]

4 Planning Task

P defining the problem

P1 hypothesis or prediction **;**
hypotheses should cover outcome of both treatments on plant biodiversity and should be testable – no expectation of the direction of the hypotheses
e.g. there will be, a / no, difference in the effectiveness of mowing and sheep grazing at maintaining plant biodiversity

P2 theory to support hypothesis or prediction **; ;**
\+ e.g. sheep grazing increases plant biodiversity /
P3 the small plants are adapted to survive grazing pressure /
sheep are selective in what they eat /
sheep produce dung /
mowing is not selective and cuts down prickly shrubs as well as grass and small herbs

P4 identifying independent variable (mowing versus controlled sheep grazing) and dependent variable (biodiversity) **;**

P5 at least two control variables **;**
e.g. grazing intensity / number of sheep per unit area in grazed enclosure /
frequency of mowing / height of blades above ground /
the vegetation – select areas with similar, vegetation / environmental conditions, for the enclosures.

P6 risk assessment **;**
ref. to hazard and precaution
e.g. with respect to mowing / wildlife / handling sheep / AW

[6]

4 Planning Task (continued):

M methods

experimental design:

M1 divide a (relatively) homogeneous area of habitat ;
M2 into equal-sized enclosures that are grazed or mown ;
M3 a control enclosure that is not grazed or mown ;
M4 reasonable suggestion as to area of each enclosure ;
M5 replicate in different parts of the site / use of randomised block design ;
M6 determine biodiversity (in the enclosures) before start of investigation ;
M7 introduce sheep into grazed enclosure and keep at same density ;
M8 use a density that would have been maintained in the past ;
M9 mow at regular intervals ;
M10 (long-term) leave for a minimum of one year ;

[max 4]

sampling procedure:

M11 suitable method for random sampling / use of fixed quadrats ;
A transects
M12 in each quadrat count the number of plants of each species ;
A count the number of species (species richness)
M13 number of quadrats per plot (minimum of 5) ;
M14 justification for choice of quadrat size / justification for choice of type of quadrat ;
M15 repeat sampling throughout the investigation ;
M16 justification for choice of sampling times ;
e.g. ref. to seasonality, at same date each year / in growing season / when the rare plants are growing *or* flowering *or* setting seed

[max 4]

D interpretation of data or observations and identifying sources of error

calculations:

D1 (using plant data) calculate Simpson's index (D) ;
D2 using formula:

$$D = \sum \frac{n(n-1)}{N(N-1)}$$;

D3 where n = total number of individuals of each species in the quadrat sample (taken in turn $n_1 \ldots n_x$) and N is the total number of individuals in the whole sample (all species) ;
A alternatives 1–D or 1 / D
D4 the smaller the value of D / the greater the value of 1–D or 1 / D, the greater the biodiversity ;
D5 calculation of means of replicate plots if determined species richness ;
R calculate means of quadrat data per plot
D6 calculate change in biodiversity over the time of the investigation ;
D7 AVP ;

[max 4]

4 Planning Task (continued)

statistical analysis:

D8 use results made over the period to plot an appropriate graph of plant biodiversity against time **;**

D9 use a named statistical test for the data collected **;**
A Mann-Whitney U test, t-test

D10 justification for use of this test **;**

D11 comparison with control **;**
e.g. use any change to adjust results

D12 use of null hypothesis **;**

D13 ref. to probability **;**

[max 4]

[Total: 22]

Section B

5 (a) *description:*

1 mean stomatal density decreases ;
2 stomatal density has decreased steeply since 196 BP ;
3 no change between >2346 BP and 196 BP ;
4 comparative use of data ;

validity:

5 error bars show variation within samples / large variation within samples ;
6 overlapping errors bars indicates no significant difference between (most) means / samples ;
7 error bars for 3341 BP and 23 BP do not overlap ;
8 there is a significant difference over, 3318 years / period of study ;

9 a very long period / approximately 3500 years, represented by only five means ;
10 second sample, could be any age from 2346 BP / might be older than the first sample ;
11 large periods of time between samples / changes could have taken place between sampling dates ;
12 historical samples, are / likely to be, very small / non-representative ;
13 AVP ;

[max 6]

(b) (i) yes (no mark)

1 line on graph shows decrease ;
2 error bars for 8 °C do not overlap with error bars for 12–14 °C ;
3 significant difference between means for 8°C and 12–14 °C ;

no (no mark)

4 not enough data points ;
5 error bars show variation in context ;
6 AVP ; e.g. mean stomatal density rises and falls

[max 2]

(ii) *advantage:*
low stomatal density conserves water / AW ;

disadvantage:
less carbon dioxide absorbed for photosynthesis / AW ;

[2]

(c) (i) –20% ;

[1]

(ii) 1 ref. to data **;**
e.g. <u>most</u> species develop, a lower stomatal density / fewer stomata, at high CO_2 level but a minority showed an increase

increase:
2 may be species which live in wet places (where water loss by transpiration is not a problem) **;**
3 so they can take advantage of the abundant supply of CO_2 for, extra photosynthesis / higher growth rate **;**

no change:
4 cannot alter developmental pathway / cannot respond to change in CO_2 / AW **;**
A description involving, gene / biochemical, detail

decrease:
5 may be species that live in dry places (where water conservation is important) **;**
A ref. to xerophytes
6 ref. to increased, concentration / diffusion, gradient qualified with ref. to photosynthesis **;**
7 stomatal density reduction still provides same quantity of CO_2 for photosynthesis **;**
8 C3 and C4 / CAM species may respond differently to changes in CO_2 concentration **;**
9 AVP **; ;** e.g. other accompanying (structural / physiological) changes such as,
+ thicker cuticle / opening time of stomata
10 **[max 5]**

[Total: 16]

6 (a) 1 process initiated by light acting on guard cells ;
2 protons pumped out of guard cells ;
3 (this causes an) influx of potassium ions into the guard cells ;
4 lowering / making more negative, the water potential of the cell ;
5 water taken up by guard cells by osmosis ;
6 stretching the cell walls of the guard cells / making guard cell swell / increases turgor / becomes (more) turgid ;
7 difference in cell wall thickness of the guard cells causes stomatal opening ;
8 AVP ; e.g. circular thickening preventing increase in width of guard cell ;
ref. proton pumps in cell surface membrane ;
ref. potassium ion channels in cell surface membrane ;

[max 5]

(b) 1 prevents ions pumped into cells from leaking out ;
2 permitting the build-up of, an osmotic / a water potential, gradient ;

[2]

(c) (i) the leaf increases in surface area (but the total number of stomata remains the same) ; **[1]**

(ii) 1 a gene enables the plant cells to be able to produce brassinosteroids ;
2 brassinosteroids trigger the division of meristem mother cells to produce guard cell mother cells / AW ;
3 TMM suppresses / blocks, transcription of the gene responsible for brassinosteroid production ;
4 (suggestion that) CO_2 inhibits TMM ;
5 (and therefore) removes suppression / block to brassinosteroid production ;
6 (suggestion that) more CO_2 leads to increase in brassinosteroid production / activity ;

[max 3]

(d) 1 gibberellins promote stem elongation by stimulating cell elongation ;
2 cell elongation in plant cells is (normally) suppressed by, DELLA / a repressor protein ;
3 gibberellic acid (binds to a receptor and) causes the degradation of, DELLA / repressor protein, (allowing cell elongation) ;
4 gibberellin synthesis may be triggered off by (external / environmental) factors ;
5 gibberellin activity may be, affected / modified, by, auxin / IAA, concentration ; **[max 3]**

[Total: 14]

Section C

Marking Strategy

Sequence of marker activities for each essay.

1 Familiarise yourself with the expected content.

2 Read through the essay.

3 Write marginal notes on script, highlight evidence of breadth, exemplification and argumentation as well as major and minor errors of fact and irrelevant material.

4 Apply the general descriptors for:

- breadth
- argumentation
- communication
- spelling, punctuation and grammar.

5 Match the content of the essay with a descriptor for Scientific Content (20, 16, 12, 8, 4, 0 as appropriate) and then decide whether:

- all sub-descriptors at that level have been met so that the full mark for that level can be awarded
- three out of the four sub-descriptors have been met so that intermediate marks can be awarded (18, 14, 10, 6, 2)
- one or two of the sub-descriptors at that level have been met so that the full mark for the level below can be awarded.

6 Marks should be written at the end of the essay as follows:

B =
A =
C =
S =
SC =

Total =

Breadth **Maximum 3 marks**

Mark	Descriptors
	Candidate has:
3	given a balanced account including most of the relevant topic areas and selected a wide range of facts, principles, concepts and / or examples pertinent to the title.
2	given a fairly balanced account including some of the relevant topic areas and selected some of the appropriate facts, principles, concepts and / or examples pertinent to the title.
1	given an account including a few of the relevant topic areas and selected a few of the appropriate facts, principles, concepts and / or examples pertinent to the title.
0	given an account that relies on one topic area alone and selected a few of the appropriate facts, principles, concepts and / or examples pertinent to the title.

Argumentation **Maximum 3 marks**

Mark	Descriptors
	Candidate has:
3	developed and sustained a coherent argument throughout the essay leading to an appropriate conclusion showing insight.
2	introduced an argument and partially developed it but has not sustained it coherently throughout the essay.
1	shown evidence of an argument, but has not developed it successfully.
0	shown no evidence of argumentation.

Communication **Maximum 2 marks**

Mark	Descriptors
	Candidate has:
2	organised and presented information clearly and used correct terminology in appropriate contexts.
1	not organised material very well and not used terminology appropriately so that answer has to be re-read.
0	presented an unstructured answer with poor use of terminology.

Spelling, punctuation and grammar **Maximum 2 marks**

Mark	Descriptors
	Candidate has:
2	used spelling, punctuation and grammar accurately.
1	used spelling, punctuation and grammar accurately, but has made significant errors.
0	not used spelling, punctuation and grammar accurately.

Scientific Content **Maximum 20 marks**

Mark		Descriptors
		The candidate:
20	a	recalls and consistently uses all facts and principles (relevant to the essay)
	b	shows sound understanding of all principles and concepts
	c	writes accurately with no major errors and very few minor errors
	d	gives detail fully in keeping with that expected of candidates at the end of a programme of study designed to prepare candidates for university.
16	a	recalls and consistently uses most facts and principles (relevant to the essay)
	b	shows sound understanding of most principles and concepts
	c	writes accurately with no major errors and few minor errors
	d	gives detail fully in keeping with that expected of candidates at the end of a programme of study designed to prepare candidates for university.
12	a	recalls and consistently uses some facts and principles (relevant to the essay)
	b	shows sound understanding of some principles and concepts
	c	writes some material accurately with not more than one major error and some minor errors
	d	gives detail fully in keeping with that expected of candidates at the end of a programme of study designed to prepare candidates for university.

Mark		Descriptors
8		The candidate:
	a	recalls some facts and principles (relevant to the essay)
	b	shows some understanding of some principles and concepts
	c	writes some material accurately with more than one major error or many minor errors
	d	gives some detail appropriate for that expected of candidates at the end of a programme of study designed to prepare candidates for university
4	a	recalls a few facts and principles (relevant to the essay)
	b	shows limited understanding of a few principles and concepts
	c	writes material including many errors, some of which may be major errors
	d	gives a little detail appropriate for that expected of candidates at the end of a programme of study designed to prepare candidates for university.
0	a	recalls no relevant facts and principles
	b	shows no understanding of relevant principles and concepts
	c	writes irrelevant material or includes many major errors
	d	gives no detail appropriate for that expected of candidates at the end of a programme of study designed to prepare candidates for university.

Expected content

For each of the questions, guidance is given as to the kind of content from the syllabus that may be appropriate to answering the question. Some candidates will include all of these areas and others may write in more detail about these or may include other relevant topics, in each case reflecting the candidate's reading-around the subject and personal research and other interests. Some topics, both in the candidate's answers and in the following expected content, may not be directly on the syllabus, but it is important to credit such responses where they are given and thus they are included here.

7 Contrast the social behaviour of the dunnock, the red deer and a named primate. Discuss the selective advantages of each type of behaviour and the extent to which you consider these patterns of behaviour to be innate. [Total: 30]

Learning outcomes: 3.2 (k), (*l*), (n); 5.1 (c)

Dunnock:
male establishes territory prior to courtship and defends it
females also have territories of their own but smaller than those of male
courtship ritual prior to mating establishes bonding
many dunnocks establish a (more or less) monogamous pair bond
but some females may engage in a relationship with two males and sometimes a single male will bond with two females
sometimes more than one male will share a territory with more than one female
one, the alpha male will spend a lot of time guarding the female
the beta male may have access to several females (when the alpha male is not looking)

Red deer:
females live in groups with young all year round
there is a dominant female who leads the group
males compete for a group of females in the rutting season
fighting is quite violent but the loser is not usually killed, but breaks off the engagement
the male who wins the herd does most of the breeding
no one-to-one pair bonding

Primates:
e.g. chimpanzee
live in group of males and females
social structure: social hierarchy – alpha male and alpha female
alpha male has pick of females – does most of the breeding
other males are tolerated so long as they do not challenge the alpha male
the males of the group hunt and may defend territory as a team co-ordinated through social hierarchy
communicate by sounds, gestures and facial expressions
some chimpanzees make 'tools' and there is evidence that they pass on their 'skills' to offspring; some say this is evidence of a culture – a non-genetic transmission of behavioural traits

Advantages of behaviour:
the group is important for protection and nurturing of the young – increases chances of survival
in all three cases there is a long period of parental care when the young and the females are vulnerable and the pair bonding (dunnocks) and herd or group contributes to their survival
competition between males (establishing and guarding territories in dunnock), stags fighting and the social hierarchy of chimpanzees ensures that only the strongest (and presumably fittest in evolutionary terms) breed and pass on genes to the offspring
members of, herd / group, are related therefore share in the passing on of gene pool
the fact that male deer live apart from herd outside breeding and then compete for herds ensures a degree of outbreeding and maintains genetic diversity **;**
dunnocks – a balance between the (evolutionarily fit) alpha male investing a lot of effort into defending his territory and helping to ensure the survival (mostly) of his offspring with 50% of his genes and the opportunistic mating of the females contributes to genetic diversity
chimpanzee groups involve team work (defending territory, hunting) and social hierarchy makes for good team work and survival of the group

When marking higher order skill marks look for comparative/contrasting/drawing parallels approach, as opposed to writing about each species separately, and for considering the innate issue.

Is the behaviour innate?
understanding of innate – genetically determined rather than acquired
in all three cases, behaviour is stereotypical – members of each species tend to behave in a similar way, suggesting it is wholly or mainly innate
some evidence of tool use and passing on skills in chimpanzees could be regarded as a form of flexible behaviour that involves learning and passing on traces of a culture
this would not be innate but learned
of course, the flexible behaviour which permits learning is the product of evolution and therefore genetically transmitted

8 Describe and explain examples of directional, stabilising and disruptive selection. Suggest which types of selection might contribute to the emergence and subsequent development of a new species and describe the circumstances under which this may take place.

[Total: 30]

Learning outcomes: 2.3 (b), (d), (g); 2.4 (a)

A clear explanation of what is meant by selection in an evolutionary context:

For *each* of directional, stabilising and disruptive selection there needs to be:
- a clear definition and explanation
- a description (including appropriate graph – it should be clear that this is actually a frequency distribution graph
- a description of the relative frequency of alleles
- an appropriate example

For a good content mark the candidate would need to deal with all or most of the bullet points above for the three types of selection sufficiently well to clearly distinguish between them, and to address the speciation issue.

The discussion of the latter (see below) would open up the opportunity to demonstrate the higher order skills of argumentation and linking ideas.

A clear understanding of species in terms of genetic isolation and breeding incompatibility
definition of speciation
disruptive selection – most obvious form of selection that might lead to speciation, but could it alone go as far as speciation?
the importance of isolation and interruption of gene flow: geographic, behavioural, ecological allopatric speciation described
once the population was isolated then directional selection would drive the isolated population's gene pool in accordance with local selective pressures
eventually equilibrium would be established as directional selection progressed to stabilising selection
unless there was further environmental change in which case directional selection would resume

9 Describe the general features of a homeostatic system, illustrating your answer by the control of blood sugar concentration and osmoregulation in the human body. Explain how a malfunction of the mechanism controlling blood sugar concentration can affect osmoregulation. **[Total: 30]**

Learning outcomes: 3.4 (a), (b), (c), (e), (f), (i)

General features of a homeostatic system:
means of monitoring change within the body
means of communication between monitoring site and the regulatory organ
means of regulation if factor rises above norm
means of regulation if factor falls below norm
negative feedback

Blood glucose concentration:
glucose needs to be continually available in the blood otherwise cells will be unable to respire or will have to use stored fat or glycogen until stored substrates used up and cell stops functioning – brain / nerve, cells particularly vulnerable since have no stored glycogen
blood glucose rises when food (containing glucose / starch) is eaten
food intake may be influenced by food availability – an environmental matter
absorbed from the gut
blood glucose falls due to respiration when cells absorb glucose from blood
the extent to which glucose is used up depends on energy expenditure, which depends on level of muscular activity, which depends on what is going on in the environment
glucose level monitored by, islets of Langerhans / alpha and beta cells, in pancreas
when too high, insulin produced by beta cells
glucose absorbed by cells, condensed to glycogen and stored
too little glucose and glucagon released from alpha cells of islets
glycogen broken down to glucose into blood
role of liver in control of blood glucose level – glucose storage and deamination
actions of insulin and glucagon on the hepatocyte including role of membrane receptors and second messengers as well as membrane permeability to glucose

Osmoregulation:
water intake through drinking and in food
water availability depends on availability – an environmental matter
water lost due to sweat – related to environmental temperature
a lot of water secreted into gut but most of it reabsorbed – but some lost in faeces
concentration of body fluid must be kept constant to avoid damage to cells by osmosis
too low a concentration and cells may burst, too high and cells may become dehydrated
monitoring of osmotic potential of blood plasma by hypothalamus
production of ADH in posterior pituitary under control of hypothalamus
brief outline of filtration and reabsorption in the kidney tubules
role of ADH in control of reabsorption of water
if water level in blood falls too low, there is no stored water, although metabolic water can be released by respiring lipid (important in camels)
when water is in short supply, hypothalamus intrudes into consciousness and causes increasing sensation of thirst
role of G-protein receptors in transduction of signals including increased extracellular ADH and glucagon concentration

To demonstrate higher order skills, candidates need to recognise contrasts and comparisons between both systems as homeostatic mechanisms by using at least some of the points below along with good argumentation and synopticity.

Connections / contrasts and comparisons:

homeostasis defined

both systems enable a human to maintain a constant internal environment despite significant and unpredictable changes in the environment

regulation of blood glucose concentration depends on a reservoir of carbohydrate as stored glycogen

whereas most terrestrial animals do not have a reservoir of stored water available for osmoregulation (exceptions involving metabolic water, particularly in desert animals)

Effects of malfunctions of one system on the function of the other:

malfunction of, islets of Langerhans / beta cells – not enough insulin – type 1 diabetes – surplus glucose released in urine

excess glucose passing through the nephrons and collecting ducts may lead to excessive urine production and dehydration due to osmosis

where blood glucose is low due to diabetes it may be supplemented by breakdown of protein (gluconeogenesis) leading to an increase in urea concentration of the urine