

# Cambridge International AS & A Level

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**BIOLOGY****9700/42**

Paper 4 A Level Structured Questions

**October/November 2024****MARK SCHEME**

Maximum Mark: 100

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Published

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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 International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the October/November 2024 series for most Cambridge IGCSE, Cambridge International A and AS Level components, and some Cambridge O Level components.

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This document consists of **19** printed pages.

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptions for a question. Each question paper and mark scheme will also comply with these marking principles.

**GENERIC MARKING PRINCIPLE 1:**

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

**GENERIC MARKING PRINCIPLE 2:**

Marks awarded are always **whole marks** (not half marks, or other fractions).

**GENERIC MARKING PRINCIPLE 3:**

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

**GENERIC MARKING PRINCIPLE 4:**

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

**GENERIC MARKING PRINCIPLE 5:**

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

**GENERIC MARKING PRINCIPLE 6:**

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

**Science-Specific Marking Principles**

- 1 Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
- 2 The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
- 3 Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
- 4 The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.

**'List rule' guidance**

For questions that require ***n*** responses (e.g. State **two** reasons ...):

- The response should be read as continuous prose, even when numbered answer spaces are provided.
- Any response marked *ignore* in the mark scheme should not count towards ***n***.
- Incorrect responses should not be awarded credit but will still count towards ***n***.
- Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response.
- Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

**6 Calculation specific guidance**

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form (e.g.  $a \times 10^n$ ) in which the convention of restricting the value of the coefficient ( $a$ ) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

**7 Guidance for chemical equations**

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

**Mark scheme abbreviations**

;	separates marking points
/	alternative answers for the same point
<b>A</b>	accept (for answers correctly cued by the question, or by extra guidance)
<b>R</b>	reject
<b>I</b>	ignore
( )	the word / phrase in brackets is not required, but sets the context
<b>AW</b>	alternative wording (where responses vary more than usual)
<b>underline</b>	actual word given must be used by candidate (grammatical variants accepted)
<b>max</b>	indicates the maximum number of marks that can be given
<b>ora</b>	or reverse argument
<b>mp</b>	marking point (with relevant number)
<b>ecf</b>	error carried forward
<b>AVP</b>	alternative valid point

Question	Answer				Marks
1(a)(i)	<b>A</b> – podocyte ; <b>B</b> – (capillary) endothelial cell ;				2
1(a)(ii)	<b>high(er)</b> , hydrostatic / blood, pressure ; <b>Ignore ref. to water potential</b> <u>basement membrane</u> acts as a filter / only small molecules can pass through <u>basement membrane</u> ;				2
1(b)	component of blood plasma in glomerulus	component in newly formed glomerular filtrate	component in urine		3
	glucose	same	not present	;	
	large proteins	not present	not present	;	
	urea	same	increased	;	
1(c)	<i>posterior pituitary gland</i> – releases (more) ADH ; <b>A</b> secretes <i>kidney</i> – reabsorbs more water / urine more concentrated / lower volume of urine ; <b>OR</b> (more) aquaporins added to membrane of collecting duct (cells) / membrane of collecting duct (cells) more permeable to water ;				2

Question	Answer	Marks
2(a)	<p><i>any six from:</i></p> <p>1 mutation / described ;      2 genetic drift / described ;      3 founder effect / group separated from main population to found a new population ;      4 bottleneck effect / large fall in population ;      5 natural / directional / disruptive, selection ; <b>Ignore</b> artificial / stabilising selection      6 migration / gene flow / interbreeding between populations ;      7 genetic recombination / linkage groups broken / crossing over ;      8 AVP ; e.g. effect larger in small populations</p>	6
2(b)	<p><i>any three from:</i></p> <p>1 inbreeding / described ;      2 produces homozygous plants / increases homozygosity ;      3 outbreeding / described ;      4 hybridisation / producing a hybrid ;      5 hybrids / offspring / F1, are (all) heterozygotes / have increased heterozygosity ;</p>	3

Question	Answer	Marks
3(a)	<p><b>any three from:</b></p> <p>1 manipulation of, genetic material / gene / DNA <b>or</b> described ;</p> <p>2 <i>ref. to</i> gene / allele, transfer (into, cell / organism) <b>or</b> described ;</p> <p>3 expression of gene ;</p> <p>4 (named) phenotype modified / (named) protein produced ;</p> <p>5 AVP ; e.g. <i>ref. to</i> gene editing / produce GMO</p>	3
3(b)(i)	<p><b>any three from:</b></p> <p>1 <b>add</b>, healthy / normal / correct / functional, gene / allele, to virus ;</p> <p>2 inject virus into eye ;</p> <p>3 gene integrated into (eye cell) genome / DNA ;</p> <p>4 gene / allele, expressed to produce functioning, protein / enzyme ;</p> <p>5 AVP ; e.g. adeno-associated virus / AAV voretigene neparvovec (drug)</p>	3
3(b)(ii)	<p><b>any one from:</b></p> <p>1 easily accessible / easy to inject ;</p> <p>2 low risk of immune response ;</p> <p>3 (eye small in size so) small amount of gene therapy treatment needed / AW ;</p>	1

Question	Answer			Marks																																					
3(c)(i)	<p><b>any three from:</b></p> <p>1 (overall) improvement in acuity of both eyes <b>or</b> (overall visual) acuity of both eyes becomes more negative ;</p> <p>2 treated eye, has <b>more</b> improved acuity / has <b>more</b> negative (visual) acuity ; <b>ora</b></p> <p>3 <i>ref. to</i> anomalous result at month 9 / result that does not fit the pattern at month 9 ;</p> <p>4 data quote – values of one eye at two months <b>or</b> values of both eyes at one month ;</p> <table border="1" data-bbox="339 552 938 1362"> <thead> <tr> <th data-bbox="339 552 467 636">time / months</th><th colspan="2" data-bbox="467 552 938 636">change in visual acuity / au</th></tr> <tr> <th data-bbox="339 636 467 736"></th><th data-bbox="467 636 720 736">eye not treated</th><th data-bbox="720 636 938 736">eye treated</th></tr> </thead> <tbody> <tr> <td data-bbox="339 736 467 790">0</td><td data-bbox="467 736 720 790">0.00</td><td data-bbox="720 736 938 790">0.00</td></tr> <tr> <td data-bbox="339 790 467 844">1</td><td data-bbox="467 790 720 844">-0.12</td><td data-bbox="720 790 938 844">-0.20</td></tr> <tr> <td data-bbox="339 844 467 898">2</td><td data-bbox="467 844 720 898">+0.02</td><td data-bbox="720 844 938 898">-0.40</td></tr> <tr> <td data-bbox="339 898 467 952">3</td><td data-bbox="467 898 720 952">0.00</td><td data-bbox="720 898 938 952">-0.50</td></tr> <tr> <td data-bbox="339 952 467 1006">4</td><td data-bbox="467 952 720 1006">-0.13</td><td data-bbox="720 952 938 1006">-0.52</td></tr> <tr> <td data-bbox="339 1006 467 1060">5</td><td data-bbox="467 1006 720 1060">-0.22 or -0.23</td><td data-bbox="720 1006 938 1060">-0.52</td></tr> <tr> <td data-bbox="339 1060 467 1114">6</td><td data-bbox="467 1060 720 1114">-0.15</td><td data-bbox="720 1060 938 1114">-0.54</td></tr> <tr> <td data-bbox="339 1114 467 1168">7</td><td data-bbox="467 1114 720 1168">-0.12</td><td data-bbox="720 1114 938 1168">-0.50</td></tr> <tr> <td data-bbox="339 1168 467 1222">9</td><td data-bbox="467 1168 720 1222">-0.15</td><td data-bbox="720 1168 938 1222">-0.33</td></tr> <tr> <td data-bbox="339 1222 467 1276">10</td><td data-bbox="467 1222 720 1276">-0.08</td><td data-bbox="720 1222 938 1276">-0.52</td></tr> <tr> <td data-bbox="339 1276 467 1330">12</td><td data-bbox="467 1276 720 1330">-0.12</td><td data-bbox="720 1276 938 1330">-0.54</td></tr> </tbody> </table>	time / months	change in visual acuity / au			eye not treated	eye treated	0	0.00	0.00	1	-0.12	-0.20	2	+0.02	-0.40	3	0.00	-0.50	4	-0.13	-0.52	5	-0.22 or -0.23	-0.52	6	-0.15	-0.54	7	-0.12	-0.50	9	-0.15	-0.33	10	-0.08	-0.52	12	-0.12	-0.54	<b>3</b>
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Question	Answer	Marks
3(c)(ii)	<p><i>any three from:</i></p> <p>1 <b>mutated</b> DNA is, deleted / removed / cut out <b>or</b> DNA replaced with <b>normal</b> DNA ;  <b>Ignore</b> exon X is deleted as this is mRNA not DNA  <b>Reject</b> gene deleted / cut out</p> <p>2 specific (locations) / between exon 26 and exon 27, (in the genome) ;</p> <p>3 functional protein / CEP290, now made  <b>OR</b>  correct functioning of photoreceptors ;</p> <p>4 acts on person's own DNA ;</p> <p>5 AVP ; e.g. STOP codon no longer present</p>	3

Question	Answer	Marks
4(a)	<p><i>parental genotype</i>      <b>Rr</b>    x    <b>Rr</b></p> <p><b>AND</b>  <i>gametes</i>      <b>(R)</b>    <b>(r)</b>    <b>(R)</b>    <b>(r)</b> ;</p> <p><i>offspring genotype</i>      <b>RR</b>    <b>Rr</b>    <b>(Rr)</b>    <b>rr</b>    ;</p> <p>                            red    red    red    yellow    ;</p>	3

Question	Answer	Marks
4(b)	<p>1 <math>ratio=9:3:3:1</math> ;  <i>any two from:</i></p> <p>2 independent / random, assortment ;</p> <p>3 of, homologous chromosomes / bivalents / sister chromatids ;</p> <p>4 stage of meiosis ; e.g. metaphase 1 or metaphase 11</p> <p><b>Ignore ref. to crossing over / recombinants</b></p>	3

Question	Answer			Marks																				
5(a)	<table border="1"> <thead> <tr> <th>statement</th> <th>discontinuous variation</th> <th>continuous variation</th> <th></th> </tr> </thead> <tbody> <tr> <td>often involves one gene only</td><td>✓</td><td></td><td></td></tr> <tr> <td>environmental factors may affect gene expression</td><td></td><td>✓</td><td></td></tr> <tr> <td>there is an additive effect of genes that contributes to the phenotype</td><td></td><td>✓</td><td></td></tr> <tr> <td>there are distinct differences between the various forms of a characteristic</td><td>✓</td><td></td><td>;;;</td></tr> </tbody> </table>	statement	discontinuous variation	continuous variation		often involves one gene only	✓			environmental factors may affect gene expression		✓		there is an additive effect of genes that contributes to the phenotype		✓		there are distinct differences between the various forms of a characteristic	✓		;;;			4
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5(b)(i)	<p>ref. to spread of results about the <u>mean</u> ;</p>			1																				

Question	Answer	Marks
5(b)(ii)	<p><math>t = 4.255</math> ;;;</p> <p>give 2 marks: if answer is 4.25 or 4.26 if answer is more than 4 significant figures e.g. 4.255439871 if answer is incorrectly rounded to 4 significant figures e.g. 4.256</p> <p><i>if answer incorrect then max 2 for working</i> numerator = 4.2 denominator = 0.986972</p> <p>ecf - if no working mark given then allow one mark for 12.02 as the answer</p>	3
5(b)(iii)	<p>1 there is a higher (mean) concentration of serum 25-OHD in summer ; <b>ora</b>  <i>any two from:</i></p> <p>2 value of <math>t / 4.255 &gt; \text{critical value} / 3.773</math> ;</p> <p>3 there is a <u>significant difference</u> between the two means ;</p> <p>4 any <u>difference</u> is not due to chance / <u>difference</u> due to chance less than 0.0001% ;</p> <p>ecf from incorrect answer to 5bii</p>	3
5(b)(iv)	<p>genetic <b>AND</b> environmental  <b>OR</b>          an example of a genetic cause <b>AND</b> an example of an environmental cause ;</p>	1

Question	Answer	Marks
6(a)(i)	redox ;	1
6(a)(ii)	blue to colourless ;	1
6(b)(i)	<p><i>any two from:</i></p> <p>1 volume / mass / concentration, of yeast suspension ;</p> <p>2 volume / mass / concentration, of glucose (solution) ;</p> <p>3 volume / concentration, of DCPIP ;</p> <p>4 AVP ; e.g. time when DCPIP is added / pH</p>	2
6(b)(ii)	<p><i>any three from:</i></p> <p>1 the less time taken (for DCPIP) to change colour the higher the rate of respiration ; <b>or</b>  <i>rate increases up to 40 °C</i></p> <p>2 due to increase in, kinetic energy / KE ;</p> <p>3 due to <b>more</b> enzyme-substrate complexes formed <b>or</b> due to <b>more</b> (successful / effective) collisions between enzymes and substrates <b>or</b> <b>more</b> enzyme catalysed reactions ;  <i>rate decreases after 40 °C</i></p> <p>4 due to denaturation of (named respiration) enzyme ;</p> <p>5 further detail ; e.g. active site shape change / optimum temperature 40 °C</p>	3

Question	Answer	Marks
7(a)	1 calculate $R_f$ value(s) ; 2 $(R_f = \frac{\text{distance moved by pigment (from baseline)}}{\text{distance moved by solvent (from baseline)}})$ ; 3 compare with, known / standard / table, values ;	3
7(b)	<i>any three from:</i> 1 absorb light wavelengths <b>not</b> absorbed by, reaction centre / primary pigment / chlorophyll a ; <b>A</b> harvest 2 so extend the range of wavelengths absorbed ; 3 pass <b>energy</b> to, reaction centre / primary pigment / chlorophyll a ; 4 <i>ref. to accessory pigments</i> ;	3

Question	Answer	Marks
7(c)	<p><i>any seven from:</i></p> <p>1 carbon dioxide, <b>reacts / combines</b>, with, ribulose bisphosphate / RuBP ;</p> <p>2 (catalysed by) rubisco ;</p> <p>3 <i>ref. to</i> carbon (dioxide) fixation ;</p> <p>4 unstable 6C compound ;</p> <p>5 forms 2 (molecules of) glycerate 3-phosphate / GP ;</p> <p>6 glycerate 3-phosphate / GP, <b>reduced</b> to, triose phosphate / TP ;</p> <p>7 <b>by</b> reduced NADP and ATP ;</p> <p>8 triose phosphate / TP, used to regenerate RuBP ;</p> <p>9 glycerate 3-phosphate / GP, forms amino acids ;</p> <p>10 (some) TP forms, (named) hexoses / sucrose / maltose / starch / cellulose / glycerol / lipids / amino acids ;</p> <p>11 <i>ref. to</i> Calvin cycle ;</p>	7

Question	Answer		Marks																						
8(a)(i)	X – Schwann (cell) ; <b>Ignore</b> myelin sheath (as not a cell)  Y – cell body ; <b>A</b> cytoplasm		2																						
8(a)(ii)	intermediate neurone ; <b>A</b> relay neurone / sensory neurone		1																						
8(b)	<table border="1"> <thead> <tr> <th>correct order</th> <th>letter of stage</th> </tr> </thead> <tbody> <tr><td>1</td><td><b>C</b></td></tr> <tr><td>2</td><td><b>F</b></td></tr> <tr><td>3</td><td><b>A</b></td></tr> <tr><td>4</td><td><b>E</b></td></tr> <tr><td>5</td><td><b>J</b></td></tr> <tr><td>6</td><td><b>I</b></td></tr> <tr><td>7</td><td><b>G</b></td></tr> <tr><td>8</td><td><b>B</b></td></tr> <tr><td>9</td><td><b>H</b></td></tr> <tr><td>10</td><td><b>D</b></td></tr> </tbody> </table> <p><b>C F A E</b> all above <b>J</b> ;  <b>C F A E</b> in correct order ;   <b>I G B H</b> between <b>J</b> and <b>D</b> ;  <b>I G B H</b> in correct order ;</p>	correct order	letter of stage	1	<b>C</b>	2	<b>F</b>	3	<b>A</b>	4	<b>E</b>	5	<b>J</b>	6	<b>I</b>	7	<b>G</b>	8	<b>B</b>	9	<b>H</b>	10	<b>D</b>		4
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Question	Answer	Marks
8(c)	<p><i>any four from:</i></p> <p><i>allow 'no' for 'less' or 'fewer'</i></p> <ol style="list-style-type: none"> <li>1 less / fewer, <math>\text{Ca}^{2+}</math> enter (pre)synaptic knob ;</li> <li>2 less / fewer, vesicles, move to / fuse with, presynaptic membrane ;</li> <li>3 less, ACh released / exocytosis of ACh ;</li> <li>4 less binding of ACh to receptors (on sarcolemma) ;</li> <li>5 fewer, <math>\text{Na}^+</math> channels open / <math>\text{Na}^+</math> enter (muscle fibre) ;</li> <li>6 less depolarisation of sarcolemma / threshold potential not reached / fewer action potentials generated ; <b>Ignore</b> postsynaptic membrane</li> <li>7 less <math>\text{Ca}^{2+}</math> released from SR / less binding of <math>\text{Ca}^{2+}</math> to troponin / fewer sites exposed / fewer cross bridges ;</li> </ol>	4

Question	Answer	Marks
9(a)	<p><i>any three from:</i></p> <ol style="list-style-type: none"> <li>1 loss of habitat / example ;</li> <li>2 hunted / poaching / increased predation ;</li> <li>3 climate change / example ;</li> <li>4 competition for, food / resources / example ;</li> <li>5 <b>new</b> disease ;</li> <li>6 illegal pet / fur, trade ;</li> </ol>	3

Question	Answer	Marks														
9(b)	<p>1 large / steep, increase from 1980 to 1990 ;</p> <p>2 plateau / remains constant <b>or</b> slight changes / fluctuates ;</p> <p>3 data quote (two numbers and two years) ;</p> <table border="1" data-bbox="332 414 871 870"> <thead> <tr> <th data-bbox="332 414 557 473">year</th><th data-bbox="557 414 871 473">number of lemurs born</th></tr> </thead> <tbody> <tr> <td data-bbox="332 473 557 531">1970</td><td data-bbox="557 473 871 531">5</td></tr> <tr> <td data-bbox="332 531 557 590">1980</td><td data-bbox="557 531 871 590">32 / 33</td></tr> <tr> <td data-bbox="332 590 557 649">1990</td><td data-bbox="557 590 871 649">175</td></tr> <tr> <td data-bbox="332 649 557 708">2000</td><td data-bbox="557 649 871 708">175</td></tr> <tr> <td data-bbox="332 708 557 767">2010</td><td data-bbox="557 708 871 767">184 / 185</td></tr> <tr> <td data-bbox="332 767 557 870">2020</td><td data-bbox="557 767 871 870">170</td></tr> </tbody> </table>	year	number of lemurs born	1970	5	1980	32 / 33	1990	175	2000	175	2010	184 / 185	2020	170	3
year	number of lemurs born															
1970	5															
1980	32 / 33															
1990	175															
2000	175															
2010	184 / 185															
2020	170															
9(c)(i)	<p><b>any three from:</b></p> <p>1 stress (in captivity) ;</p> <p>2 reproductive cycle disrupted ;</p> <p>3 may reject mate / refuse to breed / do not have correct (courtship) behaviour ;</p> <p>4 lack of suitable mates ;</p> <p>5 enclosure too small / not natural environment ;</p> <p>6 expensive ;</p> <p>7 AVP ; e.g. inbreeding</p>	3														

Question	Answer	Marks
9(c)(ii)	increase / maintain, <b>genetic</b> diversity / heterozygosity / hybrid vigour / gene pool <b>OR</b> reduce, inbreeding depression / homozygosity ;	1

Question	Answer	Marks
10(a)	<p><i>any four from:</i></p> <p>1 changes in factor / stimulus, detected by receptor ;</p> <p>2 <i>ref. to CNS / brain / coordinator ;</i></p> <p>3 impulses / (named) hormone, sent to, (named) effector / muscle / gland ;</p> <p>4 (named) effector / muscle / gland, carries out response ;</p> <p>5 factor <b>returns</b> to, set point / norm ;</p> <p>6 negative feedback ;</p> <p>7 AVP ; e.g. cell signalling</p>	4

Question	Answer	Marks
10(b)	<p><b>any three from:</b>  <i>cell signalling carries on</i></p> <p>1 / 2 two details ;; e.g. glucagon binds to receptors / adenylyl cyclase stimulated / G protein activated / cAMP formed / protein kinase A activated / enzyme cascade</p> <p>3 no / less, (functioning) glycogen phosphorylase (produced)  <b>OR</b>      non-functioning glycogen phosphorylase (produced)  <b>OR</b>      no / less, glycogen phosphorylase activated ;</p> <p>4 change in, tertiary structure / active site ;</p> <p>5 (so) less / no, glycogen converted to glucose / glycogenolysis ;</p>	3
10(c)	<p><b>any three from:</b></p> <p>1 no / less, (functioning) glycogen synthase (produced) <b>or</b> non-functioning glycogen synthase (produced) <b>or</b> no / less, glycogen synthase activated ;</p> <p>2 high / increase in, blood glucose <u>concentration</u> (following this meal) ;</p> <p>3 (so) glucose (excreted) in urine ;</p> <p>4 more lipid synthesis ;</p> <p>5 inhibits release of glucagon ;</p> <p>6 AVP ; e.g. affects blood water potential / dehydration / thirst / tiredness / coma / affects blood pressure</p>	3