



National  
Qualifications  
2017

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**2017 Human Biology**  
**Higher**  
**Finalised Marking Instructions**

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## General marking principles for Higher Human Biology / Biology

*This information is provided to help you understand the general principles you must apply when marking candidate responses to questions in this paper. These principles must be read in conjunction with the detailed marking instructions, which identify the key features required in candidate responses.*

- (a) Marks for each candidate response must always be assigned in line with these general marking principles and the Detailed Marking Instructions for this assessment.
- (b) Marking should always be positive. Marks should be awarded for what is correct and not deducted for errors or omissions.
- (c) If a specific candidate response does not seem to be covered by either the principles or detailed Marking Instructions, and you are uncertain how to assess it, you should seek guidance from your Team Leader.
- (d) There are no half marks awarded.
- (e) Where a candidate makes an error in the first part of a question, credit should normally be given for subsequent answers that are correct with regard to this original error. Candidates should not be penalised more than once for the same error.
- (f) Unless a numerical question specifically requires evidence of working to be shown, full marks should be awarded for a correct final answer (including units, if appropriate) on its own.
- (g) Bulleted lists should not be used for extended response questions. Candidates must respond to the “command” word as appropriate and write extended answers in order to communicate fully their knowledge and understanding. Candidate responses in the form of bulleted lists may not be able to access the full range of available marks.
- (h) In the detailed marking instructions, if a word is underlined then it is essential; if a word is **(bracketed)** then it is not essential.
- (i) In the detailed marking instructions, words separated by / are **alternatives**.
- (j) A correct answer can be negated if:
  - an extra, incorrect, response is given
  - additional information that contradicts the correct response is included.
- (k) Where the candidate is instructed to choose one question to answer but instead answers both questions, both responses should be marked and the better mark awarded.
- (l) Unless otherwise required by the question, use of abbreviations (e.g. DNA, ATP) or chemical formulae (e.g. CO<sub>2</sub>, H<sub>2</sub>O) are acceptable alternatives to naming.
- (m) If a numerical answer is required and units are not given in the stem of the question or in the answer space, candidates must supply the units to gain the mark. If units are required on more than one occasion, candidates should not be penalised repeatedly.
- (n) Incorrect spelling is given. Sound out the word(s).
  - If the correct word is recognisable then give the mark.
  - If the word can easily be confused with another biological term then **do not** give the mark e.g. glucagon and glycogen.

(o) **Presentation of data:**

- If a candidate provides two graphs, in response to one question, mark both and give the higher score.
- If a question asks for a particular type of graph/chart and the wrong type is given, then full marks cannot be awarded. Candidates cannot achieve the plot mark but **may** be able to achieve the mark for scale and label. If the x and y data are transposed, then do not give the scale and label mark.
- If the graph uses less than 50% of the axes then do not give the scale and label mark.
- If 0 is plotted when no data for this is given, then do not give the plot mark (i.e. candidates should only plot the data given).

(p) Marks are awarded only for a valid response to the question asked. For example, in response to questions that ask candidate to:

- **identify, name, give or state**, they need only answer or present in brief form;
- **describe**, they must provide a statement as opposed to simply one word;
- **explain**, they must provide a reason for the information given;
- **compare**, they must demonstrate knowledge and understanding of the similarities and/or differences between topics being examined;
- **calculate**, they must determine a number from given facts, figures or information;
- **predict**, they must indicate what may happen based on available information;
- **suggest**, they must apply their knowledge and understanding to a new situation.

## Marking Instructions for each question

### Section 1

Question	Answer	Mark
1.	C	1
2.	D	1
3.	A	1
4.	C	1
5.	A	1
6.	B	1
7.	C	1
8.	A	1
9.	A	1
10.	C	1
11.	C	1
12.	B	1
13.	D	1
14.	B	1
15.	B	1
16.	C	1
17.	D	1
18.	B	1
19.	D	1
20.	D	1

## Section 2

Question		Expected answer(s)	Max mark	Additional guidance
1.	(a)	Mitosis.	1	Do not accept cell division.
	(b)	Connective.	1	
	(c)	The gene(s) coding for haemoglobin is switched on/expressed in the red blood cell but is switched off/ not expressed in the white blood cell.	1	Comparison must be made between red and white blood cells. Accept 'it' for haemoglobin.
	(d)	Cell divides excessively/unregulated division occurs.  <b>OR</b>  Cell does not respond to regulatory signals.	1	Accept replicates/multiplies but not reproduces for division.  Accept uncontrollably for excessively.  Accept mitosis for cell division.
	(e)	(i)	15	1
		(ii)	0.1	1

Question			Expected answer(s)	Max mark	Additional guidance
2.	(a)	(i)	One <u>nucleotide/base</u> is replaced with another.	1	Accept substituted/changed/swapped for replaced. Do not accept references to mRNA. Do not accept it changes the nucleotide/base sequence/codon.
		(ii)	One <u>amino acid</u> is changed/the sequence of <u>amino acids</u> is changed.  OR  The enzyme is shorter due to the presence of a <u>stop codon</u> .	1	Accept the protein/enzyme will contain a different amino acid.  Do not accept the active site is changed unless qualified by reference to amino acids.  Accept that the wrong/a different amino acid will be formed/produced/made.
	(b)	(i)	Phenylalanine cannot be broken down/converted (to tyrosine).  OR  Enzyme 1 does not break down <u>phenylalanine</u> /lead to the production of <u>tyrosine</u> .	1	Accept 'it' for phenylalanine. Do not accept 'transferred' for broken down.  Accept 'it' for phenylalanine.
		(ii)	They get tyrosine from their diet.	1	Answer must indicate that the dietary protein contains tyrosine.  Accept - the intermediate compound could be produced from a different metabolic pathway.
	(c)	(i)	Post-natal (screening).	1	
		(ii)	Restricted diet/low phenylalanine diet.	1	Accept altering/controlling their diet.
	(d)		25	1	

Question		Expected answer(s)	Max mark	Additional guidance														
3.	(a)	<p>To allow (time for) the reaction to take place/phenolphthalein to be produced/substrate to be broken down.</p> <p><b>OR</b></p> <p>So the enzyme/phosphatase is not denatured</p> <p><b>OR</b></p> <p>So the enzyme/phosphatase can work at its optimum pH.</p>	1	<p>Accept the alkali could stop/inhibit/change/affect the reaction.</p> <p>Accept to allow the enzyme and inhibitor/substrate to react.</p>														
	(b)	<p>1. Concentration of inhibitor / alkali / enzyme / phosphatase.</p> <p>2. Type of alkali.</p> <p>3. Temperature of solutions/test tubes.</p> <p>4. pH of solutions/test tubes/alkali.</p> <p style="text-align: right;"><b>(Any 2 from 4)</b></p>	2	<p>Do not accept 'amount' in place of concentration.</p> <p>Do not accept use the same colorimeter.</p> <p>Do not accept temperature of room/environment.</p> <p>Accept enzyme/inhibitor/substrate for solutions.</p> <p><i>If candidate lists three or more variables and one is wrong they can only score 1 mark.</i></p>														
	(c)	<p>Axes have correct scales and labels. <b>(1)</b></p> <p>Points correctly plotted and line drawn. <b>(1)</b></p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Concentration of substrate (M)</th> <th>Absorbance (units)</th> </tr> </thead> <tbody> <tr> <td>0.05</td> <td>0.20</td> </tr> <tr> <td>0.10</td> <td>0.30</td> </tr> <tr> <td>0.20</td> <td>0.48</td> </tr> <tr> <td>0.40</td> <td>0.64</td> </tr> <tr> <td>0.60</td> <td>0.78</td> </tr> <tr> <td>0.80</td> <td>0.90</td> </tr> </tbody> </table>	Concentration of substrate (M)	Absorbance (units)	0.05	0.20	0.10	0.30	0.20	0.48	0.40	0.64	0.60	0.78	0.80	0.90	2	<p>Candidate cannot access the scale mark if they use less than half of the graph paper.</p> <p>If the scales start at zero there must be a zero entered. A common zero is acceptable if both scales start at zero. The scales do not have to start at zero but final number must be equal to or above 0.8M and 0.9 Units.</p> <p>If the axes are transposed the candidate loses the scale mark.</p> <p>Line must go through all points.</p>
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Question		Expected answer(s)	Max mark	Additional guidance
	(d)	<p>As the substrate concentration increases there is an increase in absorbance/intensity of colour. (1)</p> <p>This indicates that more phenolphthalein/product has been produced</p> <p><b>OR</b></p> <p>This indicates that there is greater enzyme activity. (1)</p>	2	
	(e)	<p>The absorbance levels will remain low/lower/not increase/increase less (at each substrate concentration).</p>	1	Do not accept that substrate concentration will have no effect on absorbance/will decrease absorbance.

Question			Expected answer(s)	Max mark	Additional guidance
4.	(a)	(i)	Oestrogen stimulates/causes the production/triggers the release of <u>LH</u> .	1	
		(ii)	3:1	1	
	(b)	(i)	1:4	1	
		(ii)	Endometrium thickness continues to increase after oestrogen concentration decreases (between day 14 and day 20).	1	Answer should focus on trends and not compare individual points.
	(c)		Endometrium thickness would not fall/not decrease/remain high/stay above 4.5.  <b>OR</b>  Oestrogen concentration would remain constant/stay the same/stay around 30 units/would not decrease/remain high.	1	
	(d)		Fertility drugs prevent the negative feedback effect of <u>oestrogen</u> .  <b>OR</b>  Fertility drugs mimic the action of <u>FSH/LH</u> .  <b>OR</b>  Fertility drugs stimulate the production of <u>FSH/LH</u> .	1	

Question			Expected answer(s)	Max mark	Additional guidance
5.	(a)	(i)	Artery/arteriole.	1	
		(ii)	Vasoconstriction/contraction/ constriction.  <b>OR</b>  Narrowing of the lumen/cavity/ channel.	1	
	(b)	(i)	Endothelium/epithelium/ endothelial/epithelial.	1	
		(ii)	Pressure forces substances out/ through the capillary wall.  <b>OR</b>  By pressure filtration.	1	Do not accept diffusion on its own but it does not negate if pressure description is also given.  Accept pushed/forced as alternatives for pressure. Do not accept squeezed.
		(iii)	Proteins.	1	Do not accept red blood cells/ haemoglobin. Accept enzyme/antibody/ hormone.
	(c)		Absorbs (excess) tissue fluid.  <b>OR</b>  Returns lymph/tissue fluid to the blood/circulatory system.	1	

Question		Expected answer(s)	Max mark	Additional guidance
6.	(a)	Systolic is when the heart beats/contracts/constricts <u>and</u> diastolic is when the heart relaxes/rests/does not beat.	1	Accept atria and ventricles in place of heart but do not accept atria on its own.
	(b)	(It/the cuff/pressure) squeezes/closes/squashes/compresses the artery/vessel.  OR  (It/the cuff/ pressure) cuts off/restricts/prevents blood flow/circulation.	1	
	(c) (i)	Fatty material/cholesterol/fibrous material/calcium builds up.  OR  An atheroma/plaque forms. (1)  Diameter of lumen/cavity/channel of <u>artery</u> reduced.  OR  Loss of elasticity in <u>arterial</u> wall. (1)	2	Accept hardening of the <u>arteries</u> .
	(ii)	The <u>cholesterol</u> level/concentration increases in the arteries/vessels/blood/endothelium.  OR  Less <u>cholesterol</u> is removed from the arteries/vessels/blood/is taken to the liver.	1	Answers mentioning from the body cells do not negate but must be linked to the liver.

Question		Expected answer(s)	Max mark	Additional guidance
7.	(a)	<p>The number of cases (of pulmonary embolism) increases with age. (1)</p> <p>The number of cases is higher in women taking HRT compared to those taking the placebo/not taking HRT. (1)</p>	2	<p>Do not accept answers that focus on one specific age group.</p> <p>Candidates must compare taking HRT to taking the placebo.</p>
	(b)	<p>The difference in cases between taking HRT or the placebo is not large/may not be significant.</p> <p><b>OR</b></p> <p>There are only a small number of cases compared to the large sample size/from 12 000 women.</p>	1	<p>Accept the difference between the two groups of women is small/not significant.</p> <p>Answer must indicate that the difference is between two groups.</p>
	(c)	<p>(Differences in) diet/smoking/degree of exercise/level of cholesterol/blood pressure/genes/weight/drugs/medication/alcohol/diabetes/high blood pressure/obesity.</p>	1	<p>Do not accept lifestyle/age/gender/ill health/underlying medical conditions</p> <p>Accept ethnicity.</p>
	(d)	<p>They used a large sample size/12 000 women/large groups/groups of 4 000 women.</p>	1	<p>Do not accept answers linked to validity such as a wide range of women/different age groups but these answers do not negate correct answers.</p> <p>Do not accept used a suitable number of women/repeated the experiment.</p>
	(e)	<p>(i)</p> <p>Between the ages of 10 and 35 average bone mass increased and then it decreased between 35 and 80. (1)</p> <p>It increased from 50% to 100%/by 50%</p> <p><b>OR</b></p> <p>It decreased from 100% to 46%/by 54%. (1)</p>	2	<p>Accept it increases up to the age of 35 and then decreases.</p> <p>Must indicate % for at least one figure.</p>
		<p>(ii)</p> <p>Any value from 37 to 38.</p>	1	

Question		Expected answer(s)	Max mark	Additional guidance
8.	(a)	Mitochondrion/mitochondria.	1	
	(b)	1. <u>Vesicle</u> fuses with membrane/ releases neurotransmitter.  2. <u>Neurotransmitter</u> diffuses/moves across the gap /synaptic cleft/synapse  3. Neurotransmitter binds to/joins with the <u>receptor</u> .  4. Sufficient/a minimum amount of neurotransmitter is required (to transmit impulse).  <b>(Any 3 from 4)</b>	3	Answer must indicate attachment to receptor.  Accept - threshold must be reached.
	(c)	Effect - Increased number of/sensitivity of receptors.  Consequence - Leads to addiction.	2	

Question		Expected answer(s)	Max mark	Additional guidance
9.	(a)	Medulla.	1	
	(b)	They cause opposite effects/work against each other.  <b>OR</b>  The sympathetic speeds up heart (rate) <u>and</u> the parasympathetic slows down heart (rate).	1	Accept they do opposite things.  Accept one speeds up the heart and one slows it down.
	(c)	(i) 58	1	
		(ii) 32	1	
	(d)	The <u>SAN</u> controls the heart (rate/beat)/acts as a pacemaker/ still sends impulses (to the AVN)/is auto rhythmic.	1	
	(e)	There is a greater change (from the resting rate) when the parasympathetic nerve is blocked (compared to when the sympathetic is blocked)  <b>OR</b>  Blockage of the parasympathetic nerve raises heart rate by 18/32 (beats) while blockage of the sympathetic nerve lowers it by 14 (beats).	1	Answer must indicate a comparison.  Answer must refer to nerve blockage.  Units not essential.
	(f)	It increases breathing rate.  <b>OR</b>  It decreases digestive processes/ digestion/peristalsis.	1	<i>Also accept any of the following.</i>  It stimulates the adrenal gland. It increases the release of adrenaline. It diverts blood to the skeletal muscles. It diverts blood away from the digestive system. It increases sweating/perspiration. It increases the volume of air entering the lungs. It dilates pupils in the eye.  Do not accept prepares body for 'fight or flight' response.

Question		Expected answer(s)	Max mark	Additional guidance
10.	(a)	Antigens.	1	
	(b)	<p><u>Phagocytosis</u> is carried out on the <u>pathogen</u>.</p> <p><b>OR</b></p> <p><u>Pathogen</u> is engulfed/captured by phagocyte <u>and</u> broken down. (1)</p> <p>Phagocyte displays (fragments of) antigen/X (on the surface/membrane).</p> <p><b>OR</b></p> <p>Phagocyte becomes an antigen-presenting cell. (1)</p>	2	Phagocytosis must be described.
	(c)	Cytokines.	1	
	(d)	<p>Allows a faster/greater response to the same pathogen/antigen/infection.</p> <p><b>OR</b></p> <p>Individual does not develop the same infection again.</p>	1	<p>Accept that second/secondary exposure/response indicates the same pathogen is involved.</p> <p>Accept rapid cell division for faster response but do not accept rapid reproduction of cells.</p> <p>Accept it is easier to fight the same pathogen/infection again.</p>
	(e)	It survives/hides within <u>phagocytic cells/phagocytes</u> .	1	Accept antigen presenting cell for phagocyte.

Question			Expected answer(s)	Max mark	Additional guidance
11.	(a)	(i)	85-71/85-7/86	1	
		(ii)	1921 - 1951	1	
		(iii)	<ol style="list-style-type: none"> <li>1. Development or availability of vaccines/immunisation/ establishment of herd immunity</li> <li>2. Improvement in water supply/chlorination of drinking water</li> <li>3. Improved sanitation/waste disposal systems/hygiene/ housing/living conditions</li> <li>4. Improved storage/handling/ availability/production of food/diet</li> <li>5. Improved health care/ medical facilities/medical treatments/medicines/ drug therapy/antiseptics/ sexual health.</li> </ol> <p style="text-align: center;"><b>(Any 2 from 5)</b></p>	2	<p><b>Note</b> - if no direction is given in both answers give one mark. e.g. health care and sanitation with no indication of improvement.</p> <p><b>Note</b> candidates may access two marks within one sentence. This is acceptable here.</p>
	(b)	(i)	78, 78, 78	1	
		(ii)	<p>(In 1861) a large number of deaths occurred in childhood.</p> <p><b>OR</b></p> <p>(In 1861) there was large childhood/infant mortality.</p> <p><b>OR</b></p> <p>Individuals have survived childhood.</p> <p><b>OR</b></p> <p>Individuals have survived/ avoided illnesses/diseases (in childhood).</p>	1	Do not accept answers that relate to immunity.

Question		Expected answer(s)	Max mark	Additional guidance
12.	A	<p><b>Structure</b></p> <ol style="list-style-type: none"> <li>1 DNA is composed of <u>nucleotides</u> containing <u>deoxyribose</u> (sugar), phosphate and base.</li> <li>2 There is a sugar phosphate backbone.</li> <li>3 The four bases are adenine, thymine, cytosine and guanine.</li> <li>4 Cytosine bonds/pairs with <u>Guanine</u> <u>and</u> Adenine bonds with Thymine.</li> <li>5 Bases/two strands are joined by hydrogen bonds.</li> <li>6 <u>Strands</u> are anti-parallel/run in opposite directions/3' to 5' and 5' to 3'.j</li> <li>7 DNA/two <u>strands</u> form a <u>double helix</u> (shape).</li> </ol> <p><b>Replication</b></p> <ol style="list-style-type: none"> <li>a DNA/double helix is unwound /unzipped.</li> <li>b A <u>primer</u> is needed at the start of replication/attaches to DNA strand.</li> <li>c <u>DNA polymerase</u> adds nucleotides to the <u>3' end</u> (of a new/growing strand/primer).</li> <li>d One strand is replicated continuously and the other strand is replicated in fragments/discontinuously.</li> <li>e The strand replicated in fragments is joined together by <u>ligase</u>.</li> </ol>	9	<p>Accept A, T, C and G for point 4.</p> <p>Accept double-stranded for two strands.</p> <p>Award mark if candidate clearly indicates when primer is needed.</p>

Question		Expected answer(s)	Max mark	Additional guidance
12.	B	<p><b>Structure</b></p> <ol style="list-style-type: none"> <li>1 RNA is single stranded.</li> <li>2 It is composed of <u>nucleotides</u> containing ribose (sugar), phosphate and base.</li> <li>3 The four bases are uracil, adenine, cytosine and guanine.</li> <li>4 Groups of three bases/nucleotides form <u>codons</u> in mRNA/<u>anticodons</u> in tRNA.</li> <li>5 Start/stop codons exist.</li> <li>6 tRNA folds due to base pairing/has an attachment site for a <u>specific</u> amino acid.</li> <li>7 rRNA (and protein) forms a ribosome.</li> </ol> <p><b>Transcription</b></p> <ol style="list-style-type: none"> <li>a Transcription occurs in the nucleus.</li> <li>b <u>RNA polymerase</u> forms mRNA/ unbinds and unzips DNA.</li> <li>c (Complementary) base pairing occurs - adenine with uracil, guanine with cytosine.</li> <li>d The primary transcript/mRNA contains <u>introns</u> and <u>exons</u>.</li> <li>e Introns are removed/ exons remain after (RNA) <u>splicing</u>.</li> <li>f (Splicing)forms the <u>mature</u> transcript/mRNA.</li> </ol>	9	Accept helicase unwinds and unzips DNA for point b. Accept A, U, C and G for point c.

[END OF MARKING INSTRUCTIONS]