National
Qualifications
2022

2022 Human Biology

Higher

Paper 1 – Multiple choice

Finalised marking instructions

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Marking instructions for each question

Question	Response	Mark
1.	C	**1**
2.	D	**1**
3.	C	**1**
4.	C	**1**
5.	A	**1**
6.	A	**1**
7.	D	**1**
8.	A	**1**
9.	B	**1**
10.	C	**1**
11.	B	**1**
12.	B	**1**
13.	C	**1**
14.	B	**1**
15.	D	**1**
16.	D	**1**
17.	D	**1**
18.	A	**1**
19.	A	**1**
20.	C	**1**
21.	D	**1**
22.	B	**1**
23.	A	**1**
24.	C	**1**
25.	B	**1**

[END OF MARKING INSTRUCTIONS]

National
Qualifications
2022

2022 Human Biology

Higher – Paper 2

Finalised marking instructions

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General marking principles for Higher Human Biology

Always apply these general principles. Use them in conjunction with the marking instructions for each question, which identify the key features required in candidates' responses.

(a) Always use positive marking. This means candidates accumulate marks for the demonstration of relevant skills, knowledge and understanding; marks are not deducted for errors or omissions.

(b) If a 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 must seek guidance from your team leader.

(c) Do not award half marks.

(d) Where a candidate makes an error in the first part of a question, award marks for subsequent answers that are correct with regard to this original error. Do not penalise candidates more than once for the same error.

(e) Unless a numerical question specifically requires evidence of working to be shown, award full marks for a correct final answer (including units, if appropriate) on its own.

(f) Candidates should not use bulleted lists to answer extended-response questions. They must respond to the 'command' word as appropriate and provide extended answers 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.

(g) In the detailed marking instructions, if a word is **underlined** then it is essential; if a word is **(bracketed)** then it is not essential.

(h) In the detailed marking instructions, words separated by / are **alternatives**.

(i) A correct response can be negated if the candidate includes:
- an extra, incorrect, response
- additional information that contradicts the correct response

(j) Where the candidate is instructed to choose one question to answer but instead answers two questions, mark both responses and award the higher mark.

(k) Unless otherwise required by the question, the use of abbreviations (for example DNA, ATP) or chemical formulae (for example CO_2, H_20) are acceptable alternatives to naming.

(l) 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, do not penalise candidates repeatedly.

(m) If incorrect spelling is given:
- If the correct word is recognisable then award the mark.
- If the word can easily be confused with another biological term, then **do not** award the mark, for example glucagon and glycogen.

(n) Presentation of data:

- If a candidate provides two graphs, in response to one question, mark both and award the higher mark.
- If a question asks for a particular type of graph/chart and the candidate gives the wrong type, do not award full marks. 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 award the scale and label mark.
- If the graph uses less than 50% of the axes then do not award the scale and label mark.
- If 0 is plotted when no data for this is given, then do not award the plot mark — candidates should only plot the data given.

(o) Only award marks for a valid response to the question asked. For example, in response to questions that ask candidates 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

Question			Expected response	Max mark	Additional guidance
1.	(a)	(i)	Germline (stem cell)	**1**	Accept gamete mother cell.
		(ii)	Mitosis	**1**	Do not accept meiosis.
		(iii)	They can differentiate into/form all cell types/any cell type **OR** All the genes can be switched on	**1**	Accept specialise/becomes for differentiate. Do not accept divide for differentiate. Accept all genes are switched on/ none of the genes are switched off.
	(b)		(The tissue stem cell) switches on/ expresses/activates/triggers specific genes. **OR** (The tissue stem cell) produces/ expresses specific proteins/ proteins characteristic for that cell/ red blood cells.	**1**	Accept certain/particular for specific. Accept different genes are expressed. Addition of switching off genes does not negate.
	(c)		(Patient's own stem) cells will not be attacked/destroyed by the immune system/white blood cells. **OR** (Stem) cells/tissue will not be rejected. **OR** Patient does not need a donor/can be treated faster.	**1**	Do not accept answers about ethical benefits. Accept allergic reaction for rejection. Accept no need to take immune-suppressing drugs.

Question			Expected response	Max mark	Additional guidance
2.	(a)		The temperature/it decreases to 50 to 65°C. **OR** The temperature/it decreases from 92 to 98° C to 50 to 65 ° C. **OR** The temperature/it decreases by 27 to 48°C.	**1**	Accept any value within the ranges. Units must be given correctly at least once. If any value is given for step 1 or step 2, it must be correct. If all PCR temperature changes are given, candidate must highlight step 2.
	(b)	(i)	DNA polymerase.	**1**	Accept Taq polymerase. Do not accept polymerase on its own.
		(ii)	It will not be denatured (when heated/by high temperatures). **OR** It will allow multiple cycles (without the enzyme needing replaced). **OR** The temperature range of PCR is greater than the temperature range of DNA polymerase.	**1**	Accept the optimum temperature is higher.
	(c)		1024	**1**	

Question			Expected response	Max mark	Additional guidance
3.	(a)		1. Volume/thickness/area/mass/ weight/concentration/pH/type of (nutrient) gel. 2. Size/diameter of dish/thickness of dish lid/type of dish. 3. Temperature of incubator/dishes/ apparatus/suspension/water. 4. Intensity/wavelength of radiation/use the same lamp. **OR** Distance/strength of lamp. **Any 2**	**2**	Only penalise the use of amount once. Do not accept concentration/type/pH of yeast. Do not accept temperature of lamp/UV/room/environment. Accept level/sources of background light/keep in darkness. If candidate lists three or more variables and at least one is correct they score one mark for the question. If all answers are correct they score two marks.
	(b)		To prevent too many cells/ colonies growing (in the dishes). **OR** To spread out/separate the cells/ colonies. **OR** So the (number of) cells/colonies growing could be easily counted/ seen/(accurately) measured.	**1**	Accept to allow (all) cells/colonies to access space/nutrients/resources. Accept to allow (all) cells/colonies to be exposed to the UV light. Accept yeast for cells/colonies.

<table>
<tr><th colspan="3">Question</th><th>Expected response</th><th>Max mark</th><th>Additional guidance</th></tr>
<tr><td>3.</td><td>(c)</td><td>(i)</td><td>Axes have correct scales and labels. (1)
Points correctly plotted and lines drawn. (1)

<table><tr><th>Length of UV exposure time (min)</th><th>Number of yeast cell colonies</th></tr><tr><td>1</td><td>70</td></tr><tr><td>3</td><td>66</td></tr><tr><td>5</td><td>58</td></tr><tr><td>7</td><td>46</td></tr><tr><td>9</td><td>30</td></tr></table></td><td>2</td><td>Any 3 values to establish a linear scale. Zero at the origin is not essential.

Data can be plotted outwith the numbered scale.

Scale breaks are not acceptable.

If the axes are transposed do not award the scale mark.

Candidate cannot access the scale mark if the plotted points use less than half the graph paper.

The line must touch all points.</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>As the length of UV exposure time increases fewer yeast cells/colonies survive/live.
OR
As the length of UV exposure time increases more yeast cells/colonies die/do not survive.</td><td>1</td><td>Do not accept as the length of UV exposure time increases the number of yeast cells/colonies decreases.

Answer must not only refer to number of yeast cells growing.</td></tr>
<tr><td></td><td></td><td>(iii)</td><td>10</td><td>1</td><td></td></tr>
</table>

Question			Expected response	Max mark	Additional guidance
4.	(a)		Exons	**1**	
	(b)		848	**1**	
	(c)	(i)	Alternative (RNA) splicing.	**1**	Do not accept alternative DNA splicing.
		(ii)	Different mature transcripts are formed. **OR** Different exons/coding regions remain/are retained/expressed/ translated.	**1**	Accept different exons are left out/excluded.
	(d)	(i)	An/one/the <u>intron</u> has been retained. **OR** Not all <u>introns</u> are removed.	**1**	Do not accept an intron being inserted/substituted/added.
		(ii)	The protein will not fold properly. **OR** The protein shape/length will change. **OR** The sequence/number of amino acids will have changed.	**1**	Answer must refer to structure. Accept longer or shorter for length will change. Accept answers linking stop codon to making the protein shorter. However, any mention of other named mutations negates.

Question			Expected response	Max mark	Additional guidance
5.	(a)		The concentration/solubility/ mass/weight/size of each tablet/ painkiller/inhibitory substance may have been different.	**1**	Accept strength/dosage for concentration. Accept they/them for painkillers.
	(b)		(15 cm^3 of) water and (5 cm^3 of) pepsin. **OR** Keep everything the same but replace painkiller solution with water/placebo.	**1**	Incorrect volumes negate. Mention of egg white does not negate.
	(c)		Original mass/2 g minus final mass equals mass lost (of egg white). **OR** Calculate the difference/change/ decrease in mass (of egg white).	**1**	Answer must describe how mass of egg white broken down was calculated. Accept weight for mass.
	(d)		Aspirin	**1**	
	(e)		Repeat the investigation with each painkiller. **OR** Repeat the investigation and calculate averages/an average.	**1**	Accept experiment for investigation. Accurate/valid negates.

Question			Expected response	Max mark	Additional guidance
6.	(a)	(i)	Matrix	**1**	
		(ii)	Electron transport chain	**1**	Do not accept E.T.C.
		(iii)	(It contains) ribosomes which are the site of protein synthesis/translation. **OR** (It contains) DNA which can be transcribed/copied into mRNA (to help form proteins).	**1**	Ribosome answer must refer to location of protein synthesis.
	(b)	(i)	Muscle (tissue) contains many/ more mitochondria. **OR** Muscle (tissue) requires more/lots of ATP/energy. **OR** Muscle (tissue) has a higher rate of respiration.	**1**	
		(ii)	Slow twitch.	**1**	
	(b)	(iii)	Their mitochondria do not produce enough ATP. **OR** There is a lack/low supply of ATP/ energy available (to the muscle). **OR** They/their muscles cannot carry out aerobic respiration (efficiently)/can only carry out glycolysis/fatigue quickly. **OR** They/their muscles produce (too much) lactate/have a buildup of lactate. **OR** Endurance activities/long distance running requires (a high proportion of) slow twitch fibres.	**1**	Do not accept slow twitch muscles.
	(c)		It converts lactate to pyruvate. **OR** It converts pyruvate into acetyl/ acetyl CoA.	**1**	

Question			Expected response	Max mark	Additional guidance
7.	(a)	(i)	FSH – (stimulates) development/ maturation/growth of the follicle. **OR** FSH – stimulates/causes the production of oestrogen (by the follicle). **(1)** Oestrogen – (stimulates) proliferation/repair/thickening/ regeneration of the endometrium. **OR** Oestrogen – prepares the endometrium for implantation. **OR** Oestrogen – makes cervical mucus thinner/less viscous/easier for sperm to swim through. **OR** Oestrogen – stimulates/causes (a surge in) the secretion of LH (by the pituitary gland). **OR** Oestrogen – (high concentrations) inhibit FSH/LH production/pituitary gland or causes negative feedback. **(1)**	**2**	Do not accept formation/production of follicle. Accept lining of the uterus for endometrium. Accept alters/changes the viscosity/consistency of cervical mucus.
		(ii)	Corpus luteum	**1**	
	(b)	(i)	The pill/it/oestrogen/progesterone has a negative feedback/inhibitory effect on the pituitary (gland). **(1)** FSH (concentrations) decrease/ remain low/do not increase (throughout the menstrual cycle). **(1)**	**2**	Answer must refer to negative feedback/inhibition, not a general description.
		(ii)	Low/decreased concentrations of progesterone/oestrogen/hormones (cause the breakdown of the endometrium/menstruation). **OR** The inactive pills/they do not contain progesterone/oestrogen/ hormones.	**1**	Accept levels for concentration. Accept less/a drop in progesterone/ oestrogen/hormones.
	(c)		It prevents/stops/delays ovulation.	**1**	Any reference to implantation negates.

Question			Expected response	Max mark	Additional guidance
8.	(a)		37.2	**1**	
	(b)		9	**1**	
	(c)	(i)	0.59	**1**	
		(ii)	Ovulation/release of an ovum/egg	**1**	
	(d)	(i)	Contraction of the ventricles/ ventricular systole.	**1**	Do not accept systole on its own. Do not accept a heartbeat. Any reference to atrial systole or diastole negates.
		(ii)	3	**1**	
	(e)		The <u>cervical/cervix</u> mucus is thin(ner)/watery.	**1**	Accept thickness/viscosity/ consistency of cervical mucus.

Question			Expected response	Max mark	Additional guidance
9.	(a)		X – Glucagon Y - Liver	**2**	
	(b)		1. (The individual) fasts/does not eat for a period of time. 2. (The individual) then drinks a glucose solution. 3. Blood glucose concentrations/ levels are then measured regularly/for at least two hours. **Any 2 from 3** 4. A diabetic's blood glucose concentration/level is higher/ starts higher. **OR** A diabetic's blood glucose concentration/level increases to a much higher level. **OR** A diabetic's blood glucose concentration/level takes longer to return to the starting concentration/does not return to initial value. **(1)**	**3**	Accept sugar for glucose. Accept monitored for measured regularly. Point 4. must be comparative.

Question			Expected response	Max mark	Additional guidance
10.	(a)		X – cell body Y – axon	**2**	Accept cytoplasm for X
	(b)	(i)	Broken down by enzymes/enzyme degradation. **OR** Reuptake/reabsorption **OR** Taken back into presynaptic neuron.	**1**	Do not accept diffusion.
		(ii)	To prevent continuous/prolonged stimulation. **OR** To prevent continuous/repeated impulses/impulse transmission. **OR** To allow another/a new/the next impulse to be transmitted.	**1**	
	(c)	(i)	Insulates the axon. **OR** Increases the speed of impulses (conduction).	**1**	
		(ii)	Glial (cells)	**1**	
	(d)		The (number of) cases in males peaks at/decreases from/increases to (age) 55-64 while females peaks at/decreases from/increases to (age) 45-54. **OR** From (age) 0-14 to 45-54 the (number of) cases rise faster in females than in males. **(1)** The (number of) cases in females is always higher (than in males). **(1)**	**2**	Answer must refer to (number of) cases. Accept highest for peaks. Do not accept single age group comparisons. Do not accept changes which only consider age 45-54 to 55-64. Do not accept age 0-54. Accept the (number of) cases in males is always lower (than in females).

Question			Expected response	Max mark	Additional guidance
11.	(a)		They take impulses/signals from (sensory) receptors/sense organs to the CNS/brain/spinal cord/inter neurons.	**1**	Accept examples of sense organs.
	(b)	(i)	Several/four (rod) cells/neurons (link) to one neuron/cell.	**1**	Answer must refer to cells/neurons rather than impulses only. An incorrect number of neurons negates.
		(ii)	Each rod cell releases a small number of neurotransmitters (when stimulated). **OR** Summation of weak stimuli occurs. **(1)** Enough neurotransmitter molecules are released (to trigger an impulse). **OR** The threshold is reached (to trigger an impulse). **(1)**	**2**	
	(c)		Autosomes/autosomal chromosomes. **OR** Any chromosome that is not a sex chromosome.	**1**	Accept any chromosome number between 1 and 22. Do not accept chromosomes on its own.

Question			Expected response	Max mark	Additional guidance
12.	(a)		(Skiing) increases levels/production/ it.	**1**	
	(b)		Endorphins/they reduce the intensity of pain/act as a (natural) painkiller.	**1**	
	(c)	(i)	(Morphine binds to and) stimulates endorphin receptors. **OR** (Morphine) mimics (the action of) endorphins.	**1**	
		(ii)	It decreases the number/sensitivity of receptors. **OR** It causes desensitisation of receptors.	**1**	Do not accept the amount of/a decrease in receptors. Accept less/fewer receptors for a decrease in number. Any reference to addiction does not negate.

Question			Expected response	Max mark	Additional guidance
13.	(a)		(As age increases) from 20-29 to 30-39 the number of cases/ it increases and then it decreases from 30-39 to 90-99. **(1)** (It increases) from 24 to 38 per 100 000/increases by 14 per 100 000. **OR** (It decreases) from 38 to 8 per 100 000/decreases by 30 per 100 000. **(1)**	**2**	Accept it increases to 30-39 and then it decreases. Must use age ranges from the graph rather than single years (eg 20-29 to 30-39 not 20-39). Must mention per 100 000 once.
	(b)	(i)	4.5	**1**	
		(ii)	Many females with cervical cancer/ it have died by/before this age. **OR** There are less/decreased cases/ low number of females with it.	**1**	Do not accept general answers that refer to dying from old age.
	(c)		19:2	**1**	
	(d)		(Cancer) cells fail to attach to each other/to the tumour. **OR** (Cancer) cells spread through the body/in the blood.	**1**	Answers must include cells.
	(e)		There are no cases below 20/in teenage years/between 0-19/ 10-19. **OR** From (age) 20-29/after teenage/in adult years there are cases (of cervical cancer). **OR** Cervical cancer is common in (age) 20-29/30-39/40-49.	**1**	Accept 20s/30s/40s

Question			Expected response	Max mark	Additional guidance
14.	(a)	(i)	To prevent the virus/cell/it from reproducing/replicating/producing proteins (and so causing influenza). **OR** To prevent it causing influenza/flu/ disease/illness/symptoms (in the vaccinated individual).	**1**	Do not accept to stop you getting the virus.
		(ii)	The surface proteins/they are/ act as antigens. **OR** The surface proteins/they are recognised as foreign/non-self/by lymphocytes. **(1)** Formation of memory cells/ production of antibodies/ lymphocytes occurs **OR** They trigger/cause the immune response **(1)**	**2**	Accept lymphocyte receptors binding to the surface proteins/them as recognition by lymphocytes.
		(iii)	To enhance/improve the immune response. **OR** To make the vaccine/it more effective/efficient.	**1**	Do not accept enhances the vaccine.

Question			Expected response	Max mark	Additional guidance
14.	(b)	(i)	(Antibody concentration/it) rises faster. **OR** (Antibody concentration/it) reaches its maximum/peak in a shorter time. **OR** (Antibody concentration/it) takes less time to start increasing/there is no delay in the increase in antibody concentration. **OR** (Antibody concentration/it) remains high for longer/decreases more slowly. **OR** (Antibody concentration/it) doesn't return to low levels. **Any 2 from 5**	**2**	
		(ii)	Memory cells/they produce B lymphocytes/specific lymphocytes/ clones of lymphocytes. **OR** Memory cells/they divide (rapidly) to form a clonal population.	**1**	Do not accept lymphocytes on its own. T lymphocytes negates.
	(c)		Phagocytes engulf the pathogen/ virus/antibody complex/bacteria. **(1)** Lysosomes release/contain enzymes. **(1)** Enzymes destroy/digest/break down the pathogen/virus/antibody complex/bacteria. **(1)** **Any 2 from 3**	**2**	

Question			Expected response	Max mark	Additional guidance
15.	A		**Formation** 1. The formation of a thrombus/clot is referred to as thrombosis. 2. (Atheromas may) rupture/damage the endothelium/artery wall. 3. Clotting factors are released/ produced. 4. Clotting factors activate a cascade/series of reactions. 5. (The enzyme) prothrombin is converted to thrombin. 6. Thrombin causes fibrinogen to form fibrin. 7. Fibrin forms a mesh(work)/ net(work) (of threads) that clots the blood/seal the wound. **OR** Fibrin provides a scaffold for the formation of scar tissue. **Effects** a. A thrombus/clot may break loose/detaches forming an embolus and travels through the blood(stream). b. A clot/thrombus/thrombosis embolus/embolism in a <u>coronary artery</u> may lead to a heart attack/ myocardial infarction/MI. c. A clot/thrombus/thrombosis/ embolus/embolism in an <u>artery</u> in the brain may lead to a stroke. d. Cells/tissues are deprived of oxygen leading to their death. e. A deep vein thrombosis/DVT can occur (most commonly) in the leg/a peripheral vein. f. The clot/thrombus from DVT can (break off and) cause a <u>pulmonary</u> embolism (in the lungs).	**9**	5. Use of inactive/active must be correct. 6. Use of soluble/insoluble must be correct. a. Accept blocking blood flow as travels through the blood. e. Do not accept peripheral artery.

Question			Expected response	Max mark	Additional guidance
15.	B		**Production** a. Cholesterol is produced/ synthesised by (all) cells/in the liver. b. A diet high in saturated fats causes an increase in cholesterol (levels). c. Statins reduce cholesterol (levels)/inhibit cholesterol production. **Transport** 1. HDL/High density lipoproteins transport (excess) cholesterol to the liver (for elimination). 2. This prevents accumulation/ build-up of cholesterol in the blood. 3. (Regular) physical activity/ exercise raises HDL/HDL:LDL/ lowers cholesterol levels (in the blood). 4. LDL/Low density lipoproteins transport cholesterol to (body) cells. 5. LDL receptors then take cholesterol/LDL into the cell (where cholesterol is released). 6. Negative feedback inhibits the synthesis of new (LDL) receptors/ prevents the uptake of (more) cholesterol/LDL. 7. LDL can deposit (excess) cholesterol in the arteries/under the endothelium. 8. (Excess/increased) cholesterol can form atheromas/plaques/ lead to atherosclerosis. **Maximum 7 marks** **Role** d. Cholesterol is found in/forms part of the cell membrane. e. Cholesterol is used to make sex hormones/testosterone/ oestrogen/progesterone.	**9**	**To achieve full marks must have at least one mark from each section.** 6. Accept once the cell has enough cholesterol as negative feedback. 8. High HDL:LDL/higher HDL can decrease (the chance of) an atheroma/plaque (size)/ atherosclerosis.

[END OF MARKING INSTRUCTIONS]