

# Markscheme

November 2019

Biology

Standard level

Paper 3

25 pages

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**Section A**

Question		Marking point	Answers	Notes	Total
1.	a	a b	potato: 0.26 mol dm <sup>-3</sup> ✓ carrot: 0.50 mol dm <sup>-3</sup> ✓	<i>Allow a range of 0.22–0.32 Allow a range of 0.45–0.55 (Allow 1 max if no units or either unit is omitted)</i>	2
	b		different dissolved solutes/sugars/sucrose/salts/molarities ✓ <b>OR</b> may have been grown in different soils giving their tissues different contents ✓ <b>OR</b> may have been stored under different conditions ✓ <b>OR</b> may be more dehydrated / different water content ✓ <b>OR</b> different types of tissue / different age ✓	<i>Do not accept starch.</i>	1 max

(continued...)

(Question 1 continued)

<b>c</b>	<b>a</b>	the data show clear trends <b>OR</b> a trend line could be drawn through these data <b>OR</b> there are no outliers ✓	<b>2 max</b>
	<b>b</b>	the error bars/standard deviations shown <b>OR</b> the error bars/standard deviations vary with concentration ✓	
	<b>c</b>	sample size is unknown ✓	
<b>d</b>	<b>a</b>	the change in mass indicates whether the tissue has gained/lost water ✓	<b>2 max</b>
	<b>b</b>	the pieces of tissue will not be the same mass «at the beginning of the experiment» ✓	
	<b>c</b>	to compare the relative changes in mass ✓	

2.	a		temperature <b>OR</b> lactose/substrate concentration <b>OR</b> Inhibitors / cofactors ✓	<i>Do not accept pH or acidity.</i>	<b>1 max</b>
	b	a	test samples for the concentration/amount of products/glucose/fructose/substrate/lactose ✓	<i>Accept use Benedict/Fehling to see change in amount of reducing sugar</i>	<b>2 max</b>
		b	take samples of the reaction mixture at regular/timed intervals ✓	<i>Must indicate that samples are taken at timed intervals</i>	
		c	repeated measurements «at the different pH values» ✓		
		d	measure independent/controlled/standardised/variables / temperature ✓		

3.	a		<b>a</b>	small drops applied <b>OR</b> use fine needle/pipette ✓	<i>Need idea of 'small'</i>	<b>2 max</b>
			<b>b</b>	several drops applied «to get strongly coloured spot» ✓		
			<b>c</b>	each drop must be dry before the next is applied ✓		
			<b>d</b>	drops applied to the origin/baseline/bottom line/just above the level of the solvent ✓	<i>End is too vague</i>	
	<b>b</b>		TLC develops faster <b>OR</b> clearer separation/colours/bands/spots «on a TLC» <b>OR</b> easier to calculate the Rf values <b>OR</b> shorter chromatograms can be used <b>OR</b> TLC uses less solvent ✓	<i>Clearer alone is not enough for the mark, candidates must state what is clearer</i>	<b>1 max</b>	
	c		<b>a</b>	leaves are green because they contain chlorophyll ✓		<b>2 max</b>
			<b>b</b>	chlorophylls/leaves reflect green light / absorb blue/red light ✓		
			<b>c</b>	other pigments masked/hidden by chlorophylls ✓		

**Section B**

**Option A — Neurobiology and behaviour**

Question		Marking point	Answers	Notes	Total
4.	a		neurulation ✓		1
	b		neural plate <b>OR</b> neural groove <b>OR</b> ectoderm ✓		1
	c		spina bifida ✓	<i>Accept a description of spina bifida</i>	1
	d	a	neurons differentiate from neural tube / stem cells ✓		2 max
		b	axons/dendrites grow ✓		
		c	«axon growth is» directed by chemicals/growth substances ✓		
		d	neurons migrate ✓		
		e	synapses form ✓		

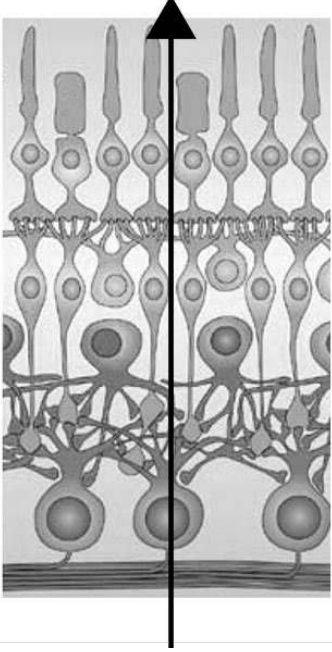
5.	a		a	I: skull bone/cranium ✓		2 max
			b	II: «left cerebral» hemisphere OR III «right cerebral» hemisphere ✓		
	b			less white matter OR bigger space in the middle/ventricles OR overall area/volume of cortex/cerebrum is reduced/space between cortex/cerebrum and cranium bigger/number of folds is reduced OR slower nerve transmission OR fewer synapses OR function of cerebral hemispheres diminished ✓		1 max

(continued...)



(Question 5 continued)

<b>c</b>	<b>a</b>	the cerebral hemispheres are responsible for higher order functions ✓		<b>3 max</b>
	<b>b</b>	the folding permits an increased surface area without increasing the cranium size <b>OR</b> permits high surface area to volume ratio ✓		
	<b>c</b>	increased surface/volume permits more synapses ✓		
	<b>d</b>	humans have a highly developed/highly folded cerebral cortex ✓		
	<b>e</b>	folding decreases distances therefore faster communication ✓		

<b>6.</b>	<b>a</b>			 <p>[Source: reprinted by permission from Springer Nature: Nature Reviews Neuroscience Parallel processing in the mammalian retina, Heinz Wässle, 2004, <i>Nat Rev Neurosci</i> <b>5</b>, 747–757 (2004) doi:10.1038/nrn1497]</p>	<i>Accept any arrow pointing upwards</i>	<b>1</b>
	<b>b</b>			A: bipolar cell B: ganglion cell ✓	<i>Both required</i>	<b>1</b>

(continued...)

(Question 6 continued)

<b>c</b>			<i>Accept any of these points made on an annotated diagram.</i>	<b>3 max</b>
	<b>a</b>	right eye receives information/stimuli/light from both «left and right» visual field ✓		
	<b>b</b>	light from the left visual field goes to the right side of the retina <b>OR</b> vice versa ✓		
	<b>c</b>	impulses «from retina» carried along the optic nerve ✓		
	<b>d</b>	«optic» nerves cross at «optic» chiasma ✓		
	<b>e</b>	impulses from the left side of the retina goes to the left side of the brain <b>OR</b> vice versa ✓		

7.			<b>a</b>	vibrations transmitted by the oval window «to the inner ear» ✓		<b>4 max</b>
			<b>b</b>	sound waves cause vibrations/waves in cochlear fluid ✓		
			<b>c</b>	sensory hairs «attached to the basement membrane» are moved by the waves in the fluid ✓		
			<b>d</b>	each frequency stimulates a specific groups of hair cells ✓		
			<b>e</b>	higher frequencies detected closer to the base of the cochlea <b>OR</b> vice versa ✓		
			<b>f</b>	impulses transmitted by the auditory nerve to the brain ✓		

Section B

Option B — Biotechnology and bioinformatics

Question		Marking point	Answers	Notes	Total
8.	a		blackwater <b>OR</b> brownwater/sewage <b>OR</b> feces <b>OR</b> organic solid waste <b>OR</b> paper pulp <b>OR</b> other biodegradable material ✓	<i>Do not accept methane and CO<sub>2</sub>.</i>	1
	b		temperature warm <b>and</b> oxygen concentration low / anaerobic ✓	<i>Accept above room temperature / 20 to 70°C for warm, depending on bacteria used. Both required</i>	1

(continued...)

(Question 8 continued)

<b>c</b>	<b>a</b>	in batch culture product is withdrawn at the end of the «organisms» growth phases whereas in continuous culture product is withdrawn while the organism is growing / <i>OWTTE</i> ✓		<b>2 max</b>
	<b>b</b>	in batch culture all of the growth medium/nutrients are added at the beginning whereas in continuous culture, growth medium/nutrients are added at a constant rate / <i>OWTTE</i> ✓		
	<b>c</b>	batch culture is carried out in large scale fermenters whereas continuous culture could be in small scale ✓		
	<b>d</b>	continuous can run for a longer time than batch ✓		

9.	a		transfer of resistance genes to non-transgenic/organic crops <b>OR</b> transfer of resistance genes to wild relatives/development of weed resistance ✓		1 max
	b		separate fields by at least 5m because at this distance no cross pollination occurs ✓	<i>Needs a reason</i>	1 max
	c		«Gram» negative ✓		1
	d	a	genes to be transferred are introduced into a tumour-inducing/Ti plasmid/vector ✓		3 max
		b	«embryo, seedling leaf» tissue is damaged/wounded / callus formed ✓		
		c	<i>A. tumefaciens</i> recognizes/is chemically attracted to damaged/wounded tissue ✓		
		d	<i>A. tumefaciens</i> transfers tumour-inducing/Ti plasmid/vector into plant cell ✓		
		e	plasmid integrates into plant cell genome ✓		

10.	a		AAT and ATG and TGC <b>OR</b> ATG and TGC and GCG ✓	<i>All three triplets required.</i>	1
	b		a significant length of DNA that begins with a start codon and ends with a stop codon ✓	<i>Significant length or similar phrase required</i>	1

11.	a	a	both cause pressure to drop ✓	3 max
		b	pressure always higher in both compared to control ✓	
		c	nanofiltration causes least drop in pressure <b>OR</b> ultrafiltration causes the most drop in pressure ✓	
		d	the drop in pressure for ultrafiltration is more irregular than for nanofiltration ✓	
	b		using bacteriophages/viruses <b>OR</b> adding biocides/bactericides/chlorine <b>OR</b> using cell dispersal agents ✓	1
c	a	biofilms are composed of different species of bacteria/communities of microbes ✓	4 max	
	b	«biofilms» form an extracellular film/slime/EPS/exopolipeptide/exopolysaccharides ✓		
	c	microbes of biofilms show coordination/cooperation/quorum sensing ✓		
	d	individual microbes have a greater chance of survival in the biofilm «than on their own» ✓		
	e	biofilms have antibiotic resistance ✓		
	f	there are exchanges of nutrients between the microbes which is not possible for individual cells ✓		



Section B

Option C — Ecology and conservation

Question		Marking point	Answers	Notes	Total
12.	a	a	as light level changes so does the percentage cover «of blackberry» ✓		2 max
		b	distribution is higher at intermediate/moderate light intensities ✓	<i>Accept appropriate numerical values</i>	
		c	little growth at low light intensities <b>OR</b> little growth at high light intensities ✓	<i>Accept appropriate numerical values</i>	
		d	distribution is bell shaped ✓		
	b		only energy can be lost/gained/exchanged/transferred «with the exterior» <b>OR</b> only matter is constant/recycled ✓		1

(continued...)

(Question 12 continued)

<b>c</b>			<i>Award [3 max] if only one side of the argument is given.</i>	<b>4 max</b>
	<b>a</b>	<i>Advantages:</i> can show the energy loss/transfer between trophic levels ✓		
	<b>b</b>	permits a «quantitative» comparison between ecosystems ✓		
	<b>c</b>	shows change over time ✓		
	<b>d</b>	<i>Disadvantages:</i> are difficult to produce accurately ✓		
	<b>e</b>	require destructive methods to obtain the data ✓		
	<b>f</b>	do not show all the interactions/food chains/feeding relationships «between different members of the community» ✓		
	<b>g</b>	cannot represent organisms that feed at different trophic levels ✓		

13.	a		<p>a large effect on the ecosystem/community structure/environment«relative to abundance»</p> <p><b>OR</b></p> <p>influence the balance of other populations in the ecosystem</p> <p><b>OR</b></p> <p>other species in the habitat would also disappear</p> <p><b>OR</b></p> <p>many other species dependent on them for survival ✓</p>		1 max
	b		<p><b>a</b></p> <p>both describe the habitat/role/relationship occupied by a species ✓</p> <hr/> <p><b>b</b></p> <p>the fundamental niche is the potential role of a species in its ecosystem and realized niche is the actual role</p> <p><b>OR</b></p> <p>the fundamental niche depends on the adaptations of a species whereas the realized niche is limited by competition/predation</p> <p><b>OR</b></p> <p>realized niche is «usually» smaller than fundamental niche ✓</p>		2 max

14.	a	a	radioisotopes entered the sea/found in the water «in Japan» ✓		3 max
		b	taken up by producers/phytoplankton/enter gills of fish ✓		
		c	producers eaten by consumers/fish ✓		
		d	«radioisotopes» are passed on up the food chain <b>OR</b> contaminated fish are eaten by tuna /other fish ✓		
		e	radioisotopes are not easily excreted ✓		
		f	at each level there is bioaccumulation/biomagnification ✓		
	b			<i>Award mp for species not group.</i>	3 max
		a	presence/absence indicate environmental conditions ✓		
		b	changes in the environment affect these species ✓	<i>Number or type of species</i>	
		c	«relative» numbers of individuals/indicator species can be used to calculate a biotic index ✓		
		d	changes monitored over time ✓	<i>Example of time frame</i>	
		e	changes can lead to measures to protect the environment ✓		
f	example of an indicator species <b>AND</b> what it indicates «e.g. <i>Tubifex</i> for sediment pollution» ✓	<i>Award marks for a species, not a group.</i>			

15.	a		changes/increases/decreases richness/biodiversity/evenness/the numbers of species ✓		1 max
	b	i	name of species and where it is invasive e.g. introduction of cane toads in Australia ✓	<i>Accept common name of species but not general groups e.g. toads.</i>	1
		ii	<p><b>a</b> &lt;interspecific&gt; competition with endemic/native species ✓</p>	<i>May be outlined using a specific example</i>	2 max
<p><b>b</b> may cause the extinction/reduction of endemic/native species  <b>OR</b>  reduces biodiversity  <b>OR</b>  becomes invasive ✓</p>					
<p><b>c</b> does not have endemic / natural predators so may increase in numbers ✓</p>					
<p><b>d</b> upsets the balance between predators and prey  <b>OR</b>  disrupts food chains ✓</p>					

Option D — Human physiology

Question		Marking point	Answers	Notes	Total
16.	a	a	increasing the mass of almonds eaten increases the energy content of feces ✓		2 max
		b	some of the energy consumed in foods may not be absorbed/is lost/egested in feces ✓		
		c	can't draw conclusions as the data is incomplete ✓		
	b	a	A calorimeter/calorimetry is used ✓		3 max
		b	food is burned/heated/combusted to release energy/heat ✓		
		c	the energy/heat is used to heat up water ✓		
		d	the rise in temperature of the water allows the energy in the food to be calculated ✓		
		e	energy from the food = specific heat capacity of water x mass of water x temperature rise ✓	Accept alternative correct formula	
	c		cellulose/lignin/fibre ✓		1

17.	a	i		sight/smell of food <b>OR</b> negative/positive feedback <b>OR</b> nervous control/vagus/parasympathetic nerve stimulation <b>OR</b> hormonal control / gastrin / secretin / somatostatin ✓		<b>1 max</b>
		ii		exocrine ✓	<i>Do not accept name of specific digestive gland.</i>	<b>1</b>
	b	i		small intestine/duodenum/ileum/jejunum ✓	<i>Villi alone not acceptable. Accept intestinal villi.</i>	<b>1</b>
		ii	a	microvilli increase the surface area for absorption ✓	<i>Each adaptation needs function stated. Do not accept villi, microvilli is required.</i>	<b>2 max</b>
	b		many mitochondria produce ATP/energy «for active transport» ✓			
	c		vesicles resulting from endocytosis ✓			

18.	a		<b>a</b>	erythrocytes/red blood cells have a lifespan of approximately 120 days ✓		4 max
			<b>b</b>	erythrocytes/red blood cells taken in by phagocytosis ✓		
			<b>c</b>	«phagocytosis» by Kupffer cells ✓		
			<b>d</b>	hemoglobin splits into globin and heme groups ✓		
			<b>e</b>	iron removed / recycled ✓		
			<b>f</b>	heme without iron becomes bile pigment/bilirubin ✓		
			<b>g</b>	globin/protein digested/hydrolysed to amino acids ✓		
	<b>b</b>		<p><i>Cause:</i> Hepatitis / liver cancer / cirrhosis / parasite infection / excess production of bile pigments/bilirubin / blocked bile ducts / gall stones ✓</p> <p><i>Consequence:</i> yellowing/discoloration of skin/sclera/white of the eye / dark urine / grey feces / brain damage in infants ✓</p>	<i>Do not accept toxins or alcohol</i>	2	



<b>19.</b>			<b>a</b>	«heart sounds» produced by the closing of the valves ✓	.	<b>3 max</b>
			<b>b</b>	first sound «lub» is due to «closure of» the atrioventricular valves ✓	<i>Accept bicuspid/mitral and tricuspid.</i>	
			<b>c</b>	second sound «dup» is due to «closure of» the semilunar valves ✓	<i>Accept pulmonary/aortic valves.</i>	
			<b>d</b>	sequence of sounds is lub dup ✓	<i>OWTTE</i>	

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