Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

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Biology

Standard level

Paper 3

25 pages

Section A

Question			Marking point	Answers	Notes	Total
1.	a		a b	potato: 0.26 mol dm^{-3} ✓ carrot: 0.50 mol dm^{-3} ✓	*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)*	**2**
	b			different dissolved solutes/sugars/sucrose/salts/molarities ✓ **OR** may have been grown in different soils giving their tissues different contents ✓ **OR** may have been stored under different conditions ✓ **OR** may be more dehydrated / different water content ✓ **OR** different types of tissue / different age ✓	*Do not accept starch.*	**1 max**

(continued...)

(Question 1 continued)

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

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

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

Section B

Option A — Neurobiology and behaviour

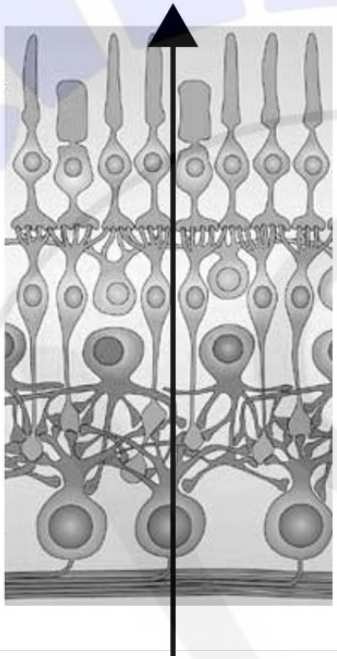
Question			Marking point	Answers	Notes	Total
4.	**a**			neurulation ✓		**1**
	b			neural plate **OR** neural groove **OR** ectoderm ✓		**1**
	c			spina bifida ✓	*Accept a description of spina bifida*	**1**
	d		***a***	neurons differentiate from neural tube / stem cells ✓		**2 max**
			b	axons/dendrites 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...)

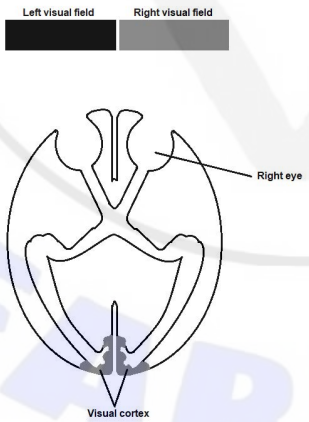
(Question 5 continued)

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

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

(continued...)

(Question 6 continued)

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

7.			***a***	vibrations transmitted by the oval window «to the inner ear» ✓		**4 max**
			b	sound waves cause vibrations/waves in cochlear fluid ✓		
			c	sensory hairs ‹attached to the basement membrane› are moved by the waves in the fluid ✓		
			d	each frequency stimulates a specific groups of hair cells ✓		
			e	higher frequencies detected closer to the base of the cochlea **OR** vice versa ✓		
			f	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 **OR** brownwater/sewage **OR** feces **OR** organic solid waste **OR** paper pulp **OR** other biodegradable material ✓	*Do not accept methane and CO_2.*	1
	b			temperature warm **and** oxygen concentration low / anaerobic ✓	*Accept above room temperature / 20 to 70°C for warm, depending on bacteria used.* *Both required*	1

(continued...)

(Question 8 continued)

	c		***a***	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 / *OWTTE* ✓		**2 max**
			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 / *OWTTE* ✓		
			c	batch culture is carried out in large scale fermenters whereas continuous culture could be in small scale ✓		
			d	continuous can run for a longer time than batch ✓		

9.	**a**			transfer of resistance genes to non-transgenic/organic crops **OR** 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✓	*Needs a reason*	**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	*A. tumefaciens* recognizes/is chemically attracted to damaged/wounded tissue ✓		
			d	*A. tumefaciens* transfers tumour-inducing/Ti plasmid/vector into plant cell ✓		
			e	plasmid integrates into plant cell genome ✓		

10.	**a**			AAT **and** ATG **and** TGC **OR** ATG **and** TGC **and** GCG ✓	*All three triplets required.*	**1**
	b			a significant length of DNA that begins with a start codon and ends with a stop codon ✓	*Significant length or similar phrase required*	**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 **OR** ultrafiltration causes the most drop in pressure ✓		
			d	the drop in pressure for ultrafiltration is more irregular than for nanofiltration ✓		
	b			using bacteriophages/viruses **OR** adding biocides/bactericides/chlorine **OR** 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 ✓	*Accept appropriate numerical values*	
			c	little growth at low light intensities **OR** little growth at high light intensities ✓	*Accept appropriate numerical values*	
			d	distribution is bell shaped ✓		
	b			only energy can be lost/gained/exchanged/transferred «with the exterior» **OR** only matter is constant/recycled ✓		1

(continued...)

(Question 12 continued)

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

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

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 **OR** contaminated fish are eaten by tuna /other fish ✓		
			e	radioisotopes are not easily excreted ✓		
			f	at each level there is bioaccumulation/biomagnification ✓		
	b				*Award mp for species not group.*	**3 max**
			a	presence/absence indicate environmental conditions ✓		
			b	changes in the environment affect these species ✓	*Number or type of species*	
			c	«relative» numbers of individuals/indicator species can be used to calculate a biotic index ✓		
			d	changes monitored over time ✓	*Example of time frame*	
			e	changes can lead to measures to protect the environment ✓		
			f	example of an indicator species ***AND*** what it indicates «*e.g. Tubifex* for sediment pollution» ✓	*Award marks for a species, not a group.*	

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 ✓	*Accept common name of species but not general groups e.g. toads.*	**1**
		ii	***a***	‹interspecific› competition with endemic/native species ✓	*May be outlined using a specific example*	**2 max**
			b	may cause the extinction/reduction of endemic/native species **OR** reduces biodiversity **OR** becomes invasive ✓		
			c	does not have endemic / natural predators so may increase in numbers ✓		
			d	upsets the balance between predators and prey **OR** disrupts food chains ✓		

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

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

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