

Markscheme

November 2017

Biology

Higher level

Paper 3

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Section A

Question		Answers	Notes	Total
1.	a	a. solvent will move up «the TLC plate/stationary phase» ✓ b. pigments will move up «the TLC plate/stationary phase carried by solvent» ✓ c. pigments will move at different rates/separate ✓		2 max
1.	b	a. $R_f = \frac{\text{distance moved by pigment}}{\text{distance moved by solvent «front»}}$ OR distance moved by pigment relative to distance moved by solvent ✓ b. each pigment has/is represented by a specific R_f «value» ✓ c. used to identify different pigments ✓ d. R_f «value» depends on density/solubility/polarity of the pigment in solvent ✓	Allow “compound” or “molecule” instead of pigment	3 max
1.	c	chlorophyll carotene xanthophyll	Accept other valid pigments Do not accept pigments named by colour Award [1] for any two correct Award [1] for chlorophyll a AND (chlorophyll) b	1 max

Question			Answers	Notes	Total
2.	a		<p>a. hypothesis not supported as there is a «slight» increase/not much difference in sperm count between the 1980s and the 2000s</p> <p>OR</p> <p>hypothesis not supported as similar means/values for both groups ✓</p> <p>b. no information on sample size ✓</p> <p>c. no information/data provided on pollution levels/types of pollution ✓</p> <p>d. other factors affecting sperm count not considered</p> <p>OR</p> <p>other elements than sperm count could be affected ✓</p> <p>e. data limited to Kolkata/one country/one city</p> <p>OR</p> <p>pollution may affect spermatogenesis elsewhere ✓</p>		3 max
2.	b	i	<p>62 mm Y400 = 0.155 mm/155 μm/micrometers/10⁻⁶ m</p> <p>OR</p> <p>61 mm Y 400 = 0.153 mm/153 μm/micrometers/10⁻⁶ m ✓</p>	<p><i>Calculation and units required. Accept correct answers expressed in cm</i></p>	1
2.	b	ii	<p>spermatogonium</p> <p>OR</p> <p>primary spermatocyte ✓</p>		1

Question		Answers	Notes	Total
3.	a	a. radioactive isotopes used to label viruses/bacteriophages/phages ✓ b. proteins labelled with radioactive sulphur/ ³⁵ S and DNA labelled with radioactive phosphorous/ ³² P ✓ c. phage infects bacterium ✓ d. only viral DNA enters bacterium «viral coat/capsid/shell do not» ✓ e. parts of phage remaining outside bacterial cell are removed OR bacteria are separated from phage parts «by centrifuge» ✓ f. bacteria contain the labelled/radioactive DNA ✓		3 max
3.	b	a. regulate gene expression ✓ b. act as promoter ✓ c. role in chromosome pairing/crossing over/recombination ✓ d. introns ✓	OWTTE	1 max

Section B

Option A — Neurobiology and behaviour

Question			Answers	Notes	Total
4.	a	i	rodents ✓		1
4.	a	ii	a. more neurons means more synapses/connections ✓ b. higher cognitive ability ✓ c. capacity for information processing increased ✓	<i>OWTTE</i>	2 max
4.	b		a. sensory function ✓ b. information processing ✓ c. memory/learning ✓ d. motor function ✓	<i>Do not accept “language”</i>	1 max
4.	c		a. parts/lobes/proportions more highly developed in humans «than in other animals» ✓ b. folding/wrinkles/sulci/gyri ✓ c. increases surface area ✓ d. larger mass of cerebral cortex «relative to body mass» ✓ e. enables higher order functions ✓	<i>Do not accept answers that only refer to the “brain” in general instead of the “cortex”</i>	3 max

Question			Answers	Notes	Total
5.	a	i	bipolar «cell/neuron» ✓		1
5.	a	ii	arrow pointing from right to left ✓		1
5.	b		a. reduction/elimination of pain OR to block sensory perception ✓ b. blocks synaptic transmission between «sensory neurons and CNS» ✓ c. allows patient to remain aware ✓ d. prevent reflex causing blinking/eye movement ✓	OWTTE OWTTE	2 max
5.	c		a. sex/X-linked «genetic trait» ✓ b. results from absent/defective cone cells ✓ c. cannot distinguish between red and green ✓		2 max

6.	a		foraging behaviour disrupted more «in the presence of simulated ship noise» ✓		1
6.	b		a. affects searching for food/foraging/selecting optimum prey ✓ b. increased risk of starvation/less food «for survival» ✓ c. cause migration/relocation/moving to other foraging area ✓ d. individuals less distracted by noise will survive OR leads to natural selection ✓ e. decline in population ✓	OWTTE	3 max

Question			Answers	Notes	Total
7.	a		<p>a. each neuron can make multiple synapses/connections ✓</p> <p>b. at birth neurons are mainly unconnected ✓</p> <p>c. after birth «up to 2 years» neurons start to make synapses/connections with other neurons</p> <p>OR</p> <p>«up to 2 years» number of synapses/connections increase ✓</p> <p>d. «increase in synapses» occurs rapidly due to learning/new experiences ✓</p> <p>e. brain makes many more connections than are required ✓</p> <p>f. «after 2 years/in adults» synaptic/neural <u>pruning</u> causes the loss of unused neurons/synapses/connections ✓</p>	<p><i>Do not accept more neurons are made. Refer only to synapse density as it is the question wording</i></p>	4 max
7.	b		<p>activities/functions spread across the brain</p> <p>OR</p> <p>activities/functions taken over by other areas of the brain ✓</p>		1
7.	c	i	<p>right motor cortex</p> <p>OR</p> <p>right <u>cerebral</u> hemisphere ✓</p>		1
7.	c	ii	<p>medulla «oblongata» ✓</p>		1

Question	Answers	Notes	Total
8.	<p><i>innate behaviour: [3 max]</i></p> <p>a. inherited «from parents»/controlled by genes ✓ b. develops independently of environment</p> <p>OR</p> <p>not modified by experience/learning ✓</p> <p>c. species specific/shared by all members of species ✓ d. developed by natural selection/increases chance of survival/reproduction ✓ e. valid example of innate behaviour ✓</p> <p><i>learned behaviour: [3 max]</i></p> <p>f. develops as a result of experience/environmental stimulus ✓ g. is a process of gaining new knowledge or skills ✓ h. not inherited «from parents»</p> <p>OR</p> <p>not controlled by genes ✓</p> <p>i. may or may not increase chance of survival and reproduction ✓ j. valid example of learned behaviour ✓</p>	<p><i>Only mark the first example if more provided</i></p> <p><i>Only mark the first example if more provided</i></p>	<p>6 max</p>

Option B — Biotechnology and bioinformatics

Question		Answers	Notes	Total
9.	a	a. both transgenic «strains» show more growth/mean mass than nontransgenic ✓ b. wild nontransgenic «strain» showed less growth than wild transgenic OR greatest difference between wild nontransgenic and transgenic «strains» OR wild «strain» showed less growth/mean mass in nontransgenic but reverse in transgenic ✓ c. mean mass/growth in domestic nontransgenic «strain» lower than «domestic» transgenic ✓ d. error bars overlap for domestic nontransgenic and transgenic «strains» ✓	Allow vice versa Allow vice versa	2 max
9.	b	gene for growth hormone has been assimilated/is expressed in the transgenic trout OR more growth hormone produced/expressed in transgenic trout ✓		1
9.	c	a. indicates successful uptake of recombinant DNA ✓ b. identifies transgenic organisms ✓ c. example of a marker gene ✓	eg: antibiotic resistance gene in bacteria	2 max
9.	d	a. transgenes may be transferred to other species/organisms ✓ b. may alter ecosystem/food chain ✓ c. may outgrow other species OR decrease biodiversity OR outcompete nontransgenic individuals/trout ✓		2 max

Question		Answers	Notes	Total
10.	a	<i>S. unisporus</i> ✓		1
10.	b	BLASTn/sequence alignment software ✓	"n" required in BLASTn	1
10.	c	a. easy to grow OR easy/cheap to produce large amounts OR fast generation time ✓ b. genomes are small/easy to manipulate ✓ c. metabolically diverse ✓ d. industrial applications/biopharming ✓ e. no ethical issues «with yeast» ✓		3 max
10.	d	a. identify different viral/influenza strains ✓ b. genetic testing/testing for genetic disease mutations ✓ c. tissue typing ✓ d. vaccine development ✓		1 max

Question		Answers	Notes	Total
11.	a	a. properties not present in individuals but present/develop only in the aggregate ✓ b. develop structure/architecture/scaffolding OR develop an «extracellular» matrix/EPS ✓ c. signaling/communication ✓ d. migration/movement ✓ e. resistant to antimicrobial agents ✓ f. cooperates through quorum sensing ✓	OWTTE	3 max
11.	b	a. sewage/waste water treatment/trickle filter beds ✓ b. «bio»remediation of contaminated soil/water ✓ c. metal extraction from ore deposits/microbial leaching ✓	Accept other valid positive application eg: decay/breakdown contaminants, such as petroleum	1 max
11.	c	a. contamination/pollution «of water system» OR «microbial growth of biofilm» causes disease through water systems ✓ b. difficult to eliminate «from water systems» ✓ c. fouling/clogging of water pipes ✓ d. corrosion of water pipes ✓	OWTTE	2 max

Question		Answers	Notes	Total
12.	a	a. constant nutrient medium «supply» needed/maintained ✓ b. optimal mixing ✓ c. fermented in sterile bioreactor ✓ d. alpha-galactosidase production/general conditions assayed/screened/monitored «throughout the process» ✓ e. continuous removal of alpha-galactosidase/products ✓		3 max
12.	b	a. pH ✓ b. «dissolved» oxygen ✓		2

13.		a. produces useful pharmaceuticals/drugs/proteins ✓ b. inserts genetic material/genes into host plants/animals ✓ c. produces more complex drugs/proteins than prokaryotic organisms OR no post-translation modification with prokaryotes «so no complex proteins» ✓ d. valid example ✓ e. issues regarding contamination of other organisms OR possible ecological effects ✓ f. plants process proteins differently than humans ✓ g. proteins produced by plants may cause allergic reaction ✓ h. some proteins are intellectual property ✓ i. example of ethical issue ✓	Allow verifiable examples, eg: antithrombin/coagulation factors «in goats», development of Norwalk virus/ cholera toxin vaccines «in tomatoes»	6 max
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Option C — Ecology and conservation

Question			Answers	Notes	Total
14.	a	i	a. more extinct than endangered «in mammals as opposed to reptiles and birds» ✓ b. total percentage extinct plus endangered mammals lower than reptiles and birds ✓		1 max
14.	a	ii	a. cats/invasive species compete with native species for food/habitat/resources ✓ b. invasive species/cats may reduce/endanger native populations ✓ c. invasive species/cats may change the structure/balance of the food web/chain ✓	OWTTE	2 max
14.	a	iii	a. control population/sterilization «of cats»/culling/hunting ✓ b. keep household cats indoors ✓		1 max
14.	b	i	a. early warning system ✓ b. provide information on environmental conditions/ecosystem ✓	OWTTE OWTTE	1 max
14.	b	ii	a. ex-situ/zoos/captive breeding ✓ b. control predators ✓ c. in-situ/management of natural reserves/breeding habitats/parks/resources/clean-up pollution ✓ d. education OR government legislation ✓	Accept any other valid answer	2 max

Question			Answers	Notes	Total
15.	a	i	2000–2008 ✓		1
15.	a	ii	a. natality AND mortality ✓ b. immigration AND emigration ✓ c. resources/abiotic conditions/carrying capacity ✓ d. predation/hunting ✓		2 max
15.	b		capture–mark–release–recapture/Lincoln/Peterson method ✓		1
15.	c		a. population would decrease/may become extinct ✓ b. open realized niche for other organisms ✓ c. food web may change ✓ d. less intraspecific competition ✓	OWTTE	2 max

Question		Answers	Notes	Total												
16.	a	savanna/grassland ✓		1												
16.	b	<table border="1"> <thead> <tr> <th>Energy</th> <th>Nutrients</th> </tr> </thead> <tbody> <tr> <td colspan="2">a. both flow through the ecosystem ✓</td> </tr> <tr> <td>b. source of energy is the Sun</td> <td>source of nutrients is soil/rock ✓</td> </tr> <tr> <td>c. lost as heat between each trophic level</td> <td>escape food chain/web as litter/feces/detritus/etc ✓</td> </tr> <tr> <td>d. is not recycled</td> <td>are recycled ✓</td> </tr> <tr> <td colspan="2">e. both used for metabolism/growth ✓</td> </tr> </tbody> </table>	Energy	Nutrients	a. both flow through the ecosystem ✓		b. source of energy is the Sun	source of nutrients is soil/rock ✓	c. lost as heat between each trophic level	escape food chain/web as litter/feces/detritus/etc ✓	d. is not recycled	are recycled ✓	e. both used for metabolism/growth ✓		Award [2 max] if no comparison addressed. Accept answers not presented as a table	3 max
Energy	Nutrients															
a. both flow through the ecosystem ✓																
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d. is not recycled	are recycled ✓															
e. both used for metabolism/growth ✓																
16.	c	<ul style="list-style-type: none"> a. reduction in biodiversity ✓ b. biomagnification occurs ✓ c. change in abiotic conditions ✓ d. global warming ✓ e. community changes ✓ f. health hazards/mutations ✓ g. other valid issue ✓ 	<ul style="list-style-type: none"> eg: loss of soil quality/loss of ozone layer eg: methane, acid rain, climate change eg: increase in pest species eg: animals choking on plastic, cancer, etc eg: poisoning from toxins/pollutants 	3 max												

Question			Answers	Notes	Total
17.	a	i	the potential/full range of conditions under which an organism can live ✓		1
17.	a	ii	competition for resources/named resource OR competitive exclusion «limits the niche» ✓		1
17.	b		a. «endo»symbiotic/mutualistic relationship ✓ b. zooxanthellae/photosynthetic algae/dinoflagellates live in coral tissues ✓ c. coral provides protection for algae/dinoflagellates ✓ d. algae/dinoflagellates provide minerals/products of photosynthesis/oxygen/sugars to coral ✓		2 max

18.			<p><i>causes:</i></p> <p>a. excess nutrients/nitrates/phosphates in an aquatic system ✓ b. natural runoff from soil/erosion/weathering of rocks ✓ c. runoff of fertilizers «from agricultural land/golf courses» ✓ d. partially treated sewage/animal waste discharged into waterways ✓</p> <p><i>consequences: [4 max]</i></p> <p>e. algal blooms ✓ f. blocks light for photosynthetic organisms ✓ g. dead organisms sink to bottom of water and decompose ✓ h. decomposers/microorganisms increase BOD/use oxygen ✓ i. oxygen/DO availability for other organisms decreases ✓ j. decrease in biodiversity/disappearance of organisms ✓</p>	OWTTE	6 max
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Option D — Human physiology

Question			Answers	Notes	Total
19.	a		probability of GI damage increases with increased «gastric» acidity OR positive correlation ✓	<i>OWTTE</i> <i>Do not accept “directly proportional”</i>	1
19.	b		a. proton pump inhibitors reduce stomach acid «production» ✓ b. antacid/medication to neutralize/decrease acidity ✓ c. «lower acidity» allow GI damage/ulcers to heal ✓ d. antibiotics for <i>H. pylori</i> /bacterial infection ✓ e. diet/lifestyle changes/eliminate smoking/alcohol ✓ f. surgery needed with extensive gastric damage ✓	<i>Accept cauterization.</i>	3 max
19.	c		a. <i>Helicobacter pylori</i> / <i>H. pylori</i> «infection» ✓ b. use of non-steroidal anti-inflammatory drugs/NSAID/aspirin/ibuprofen ✓	<i>Accept valid examples of NSAID but do not accept trade names</i>	1 max

20.	a	i	a. regulates the «basal» metabolic rate/BMR ✓ b. controls body temperature ✓		1 max
20.	a	ii	a. steroid hormone passes through cell/plasma membrane ✓ b. binds to receptor «proteins» in cytoplasm ✓ c. receptor–hormone complex travels to nucleus ✓ d. binds to DNA/chromatin ✓ e. promotes/inhibits the transcription of specific genes ✓ f. codes for/produces specific proteins ✓		3 max

(continued...)

(Question 20 continued)

Question			Answers	Notes	Total
20.	b		a. iodine is an essential nutrient/cannot be synthesized by the body ✓ b. iodine is required for thyroid hormones/thyroxin production ✓ c. some areas in the world have iodine deficient soil/low iodine in their diet ✓ d. supplementation will reduce stunted growth and mental development/cretinism in babies born to mothers associated with thyroid deficiency ✓ e. thyroid deficiency will lead to health problems ✓		2 max
21.	a	i	bilirubin ✓		1
21.	a	ii	normal production: [2 max] a. <u>red</u> blood cells/erythrocytes/hemoglobin broken down «in the liver» ✓ b. hemoglobin/heme «from red blood cells» is converted to bilirubin/bile pigment ✓ c. bilirubin/bile pigment transferred to bile and «normally» eliminated in the feces ✓ change with jaundice: d. «in jaundice» liver does not excrete/eliminate bilirubin/bile pigments ✓ e. caused by immaturity/dysfunction/disease «of the liver» OR blockage of bile ducts OR increase in red blood cells breakdown ✓ f. therefore bilirubin/bile pigment accumulates in the blood ✓		4 max
21.	b		a. sinusoids have open pores/fenestrations/discontinuous endothelium and capillary endothelium is continuous/does not contain fenestrations ✓ b. Kupffer cells are located inside sinusoids but not in capillaries ✓ c. sinusoids larger in diameter/wider than capillaries ✓		2 max

Question		Answers	Notes	Total
22.	a	intercalated disc ✓		1
22.	b	a. cells are myogenic/self-excitatory ✓ b. cells are joined end to end OR cells are joined by intercalated disc ✓ c. «intercalated discs» allow for faster propagation «of signal» ✓ d. cells contract together for coordinated contraction ✓ e. contain many mitochondria ✓ f. cells are branching/Y-shaped ✓ g. controlled by pacemaker/sinoatrial/SA and atrioventricular/AV nodes ✓		4 max
22.	c	stethoscope OR electrocardiograph/ECG ✓	<i>Allow other valid example.</i>	1

Question	Answers	Notes	Total
23.	<p><i>benefits:</i></p> <p>a. improved performance/endurance at lower oxygen levels</p> <p>OR</p> <p>improved performance/endurance when returning at low altitude ✓</p> <p>b. due to higher concentration erythrocytes/red blood cells/hemoglobin ✓</p> <p>c. more oxygen transported/circulating «due to increase in hemoglobin/RBC number» ✓</p> <p>d. improved metabolic/lung efficiency/gas exchange ✓</p> <p>e. increase in myoglobin/number of capillaries/mitochondria ✓</p> <p><i>risks:</i></p> <p>f. altitude sickness/stroke/lower immunity ✓</p> <p>g. increased muscle tissue breakdown ✓</p> <p>h. effects are not immediate/not permanent/extended training at high altitude required ✓</p> <p>i. may be unfair to competitors who cannot train at high altitude ✓</p>		6 max