N17/4/BIOLO/HP3/ENG/TZ0/XX/M

Diploma Programme
Programme du diplôme
Programa del Diploma

# Markscheme

## November 2017

## Biology

## Higher level

## Paper 3

21 pages

## Section A

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| 1. | a | | a. solvent will move up «the TLC plate/stationary phase» ✓<br>b. pigments will move up «the TLC plate/stationary phase carried by solvent» ✓<br>c. pigments will move at different rates/separate ✓ | | 2 max |
| 1. | b | | a. $R_f = \frac{\text{distance moved by pigment}}{\text{distance moved by solvent «front»}}$<br>***OR***<br>distance moved by pigment relative to distance moved by solvent ✓<br>b. each pigment has/is represented by a specific $R_f$ «value» ✓<br>c. used to identify different pigments ✓<br>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<br>carotene<br>xanthophyll | *Accept other valid pigments*<br>*Do not accept pigments named by colour*<br>*Award **[1]** for any two correct*<br>*Award **[1]** for chlorophyll a **AND** (chlorophyll) b* | 1 max |

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

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| 3. | a | | a. radioactive isotopes used to label viruses/bacteriophages/phages ✓<br>b. proteins labelled with radioactive sulphur/$^{35}S$ and DNA labelled with radioactive phosphorous/$^{32}P$ ✓<br>c. phage infects bacterium ✓<br>d. only viral DNA enters bacterium «viral coat/capsid/shell do not» ✓<br>e. parts of phage remaining outside bacterial cell are removed<br>***OR***<br>bacteria are separated from phage parts «by centrifuge» ✓<br>f. bacteria contain the labelled/radioactive DNA ✓ | | **3 max** |
| 3. | b | | a. regulate gene expression ✓<br>b. act as promoter ✓<br>c. role in chromosome pairing/crossing over/recombination ✓<br>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 ✓<br>b. higher cognitive ability ✓<br>c. capacity for information processing increased ✓ | *OWTTE* | **2 max** |
| **4.** | **b** | | a. sensory function ✓<br>b. information processing ✓<br>c. memory/learning ✓<br>d. motor function ✓ | *Do not accept "language"* | **1 max** |
| **4.** | **c** | | a. parts/lobes/proportions more highly developed in humans «than in other animals» ✓<br>b. folding/wrinkles/sulci/gyri ✓<br>c. increases surface area ✓<br>d. larger mass of cerebral cortex «relative to body mass» ✓<br>e. enables higher order functions ✓ | *Do not accept answers that only refer to the "brain" in general instead of the "cortex"* | **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<br>***OR***<br>to block sensory perception ✓<br>b. blocks synaptic transmission between «sensory neurons and CNS» ✓<br>c. allows patient to remain aware ✓<br>d. prevent reflex causing blinking/eye movement ✓ | *OWTTE*<br>*OWTTE* | **2 max** |
| **5.** | **c** | | a. sex/X-linked «genetic trait» ✓<br>b. results from absent/defective cone cells ✓<br>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 ✓<br>b. increased risk of starvation/less food «for survival» ✓<br>c. cause migration/relocation/moving to other foraging area ✓<br>d. individuals less distracted by noise will survive<br>***OR***<br>leads to natural selection ✓<br>e. decline in population ✓ | *OWTTE* | **3 max** |

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

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

**Option B — Biotechnology and bioinformatics**

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

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

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

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

| | | | | | |
|---|---|---|---|---|---|
| **13.** | | | a. produces useful pharmaceuticals/drugs/proteins ✓<br>b. inserts genetic material/genes into host plants/animals ✓<br>c. produces more complex drugs/proteins than prokaryotic organisms<br>***OR***<br>no post-translation modification with prokaryotes **«**so no complex proteins**»** ✓<br>d. valid example ✓<br>e. issues regarding contamination of other organisms<br>***OR***<br>possible ecological effects ✓<br>f. plants process proteins differently than humans ✓<br>g. proteins produced by plants may cause allergic reaction ✓<br>h. some proteins are intellectual property ✓<br>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** |

**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» ✓<br>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 ✓<br>b. invasive species/cats may reduce/endanger native populations ✓<br>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 ✓<br>b. keep household cats indoors ✓ | | **1 max** |
| **14.** | **b** | **i** | a. early warning system ✓<br>b. provide information on environmental conditions/ecosystem ✓ | *OWTTE*<br>*OWTTE* | **1 max** |
| **14.** | **b** | **ii** | a. ex-situ/zoos/captive breeding ✓<br>b. control predators ✓<br>c. in-situ/management of natural reserves/breeding habitats/parks/resources/clean-up pollution ✓<br>d. education<br>***OR***<br>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 ✓<br>b. immigration ***AND*** emigration ✓<br>c. resources/abiotic conditions/carrying capacity ✓<br>d. predation/hunting ✓ | | **2 max** |
| **15.** | **b** | | capture–mark–release–recapture/Lincoln/Peterson method ✓ | | **1** |
| **15.** | **c** | | a. population would decrease/may become extinct ✓<br>b. open realized niche for other organisms ✓<br>c. food web may change ✓<br>d. less intraspecific competition ✓ | *OWTTE* | **2 max** |

<table>
<tr><th colspan="3">Question</th><th>Answers</th><th>Notes</th><th>Total</th></tr>
<tr><td>16.</td><td>a</td><td></td><td>savanna/grassland ✓</td><td></td><td>1</td></tr>
<tr><td>16.</td><td>b</td><td></td><td>
<table>
<tr><th>Energy</th><th>Nutrients</th></tr>
<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>
</table>
</td><td>Award [2 max] if no comparison addressed.<br>Accept answers not presented as a table</td><td>3 max</td></tr>
<tr><td>16.</td><td>c</td><td></td><td>a. reduction in biodiversity ✓<br>b. biomagnification occurs ✓<br>c. change in abiotic conditions ✓<br>d. global warming ✓<br>e. community changes ✓<br>f. health hazards/mutations ✓<br>g. other valid issue ✓</td><td><br><br>eg: loss of soil quality/loss of ozone layer<br>eg: methane, acid rain, climate change<br>eg: increase in pest species<br>eg: animals choking on plastic, cancer, etc<br>eg: poisoning from toxins/pollutants</td><td>3 max</td></tr>
</table>

| 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<br>***OR***<br>competitive exclusion **«**limits the niche**»** ✓ | | **1** |
| **17.** | **b** | | a. **«**endo**»**symbiotic/mutualistic relationship ✓<br>b. zooxanthellae/photosynthetic algae/dinoflagellates live in coral tissues ✓<br>c. coral provides protection for algae/dinoflagellates ✓<br>d. algae/dinoflagellates provide minerals/products of photosynthesis/oxygen/sugars to coral ✓ | | **2 max** |

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

**Option D — Human physiology**

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| **19.** | **a** | | probability of GI damage increases with increased «gastric» acidity<br>***OR***<br>positive correlation ✓ | *OWTTE*<br>*Do not accept "directly proportional"* | **1** |
| **19.** | **b** | | a. proton pump inhibitors reduce stomach acid «production» ✓<br>b. antacid/medication to neutralize/decrease acidity ✓<br>c. «lower acidity» allow GI damage/ulcers to heal ✓<br>d. antibiotics for *H. pylori*/bacterial infection ✓<br>e. diet/lifestyle changes/eliminate smoking/alcohol ✓<br>f. surgery needed with extensive gastric damage ✓ | *Accept cauterization.* | **3 max** |
| **19.** | **c** | | a. *Helicobacter pylori*/*H. pylori* «infection» ✓<br>b. use of non-steroidal anti-inflammatory drugs/NSAID/aspirin/ibuprofen ✓ | *Accept valid examples of NSAID but do not accept trade names* | **1 max** |
| **20.** | **a** | **i** | a. regulates the «basal» metabolic rate/BMR ✓<br>b. controls body temperature ✓ | | **1 max** |
| **20.** | **a** | **ii** | a. steroid hormone passes through cell/plasma membrane ✓<br>b. binds to receptor «proteins» in cytoplasm ✓<br>c. receptor–hormone complex travels to nucleus ✓<br>d. binds to DNA/chromatin ✓<br>e. promotes/inhibits the transcription of specific genes ✓<br>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 ✓<br>b. iodine is required for thyroid hormones/thyroxin production ✓<br>c. some areas in the world have iodine deficient soil/low iodine in their diet ✓<br>d. supplementation will reduce stunted growth and mental development/cretinism in babies born to mothers associated with thyroid deficiency ✓<br>e. thyroid deficiency will lead to health problems ✓ | | **2 max** |

| | | | | | |
|---|---|---|---|---|---|
| **21.** | **a** | **i** | bilirubin ✓ | | **1** |
| **21.** | **a** | **ii** | *normal production*: ***[2 max]***<br>a. <u>red</u> blood cells/erythrocytes/hemoglobin broken down **«**in the liver**»** ✓<br>b. hemoglobin/heme **«**from red blood cells**»** is converted to bilirubin/bile pigment ✓<br>c. bilirubin/bile pigment transferred to bile and **«**normally**»** eliminated in the feces ✓<br><br>*change with jaundice*:<br>d. **«**in jaundice**»** liver does not excrete/eliminate bilirubin/bile pigments ✓<br>e. caused by immaturity/dysfunction/disease **«**of the liver**»**<br>***OR***<br>blockage of bile ducts<br>***OR***<br>increase in red blood cells breakdown ✓<br>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 ✓<br>b. Kupffer cells are located inside sinusoids but not in capillaries ✓<br>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 ✓<br>b. cells are joined end to end<br>***OR***<br>cells are joined by intercalated disc ✓<br>c. «intercalated discs» allow for faster propagation «of signal» ✓<br>d. cells contract together for coordinated contraction ✓<br>e. contain many mitochondria ✓<br>f. cells are branching/Y-shaped ✓<br>g. controlled by pacemaker/sinoatrial/SA and atrioventricular/AV nodes ✓ | | 4 max |
| 22. | c | | stethoscope<br>***OR***<br>electrocardiograph/ECG ✓ | *Allow other valid example.* | 1 |

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