**ib** Diploma Programme
Programme du diplôme
Programa del Diploma
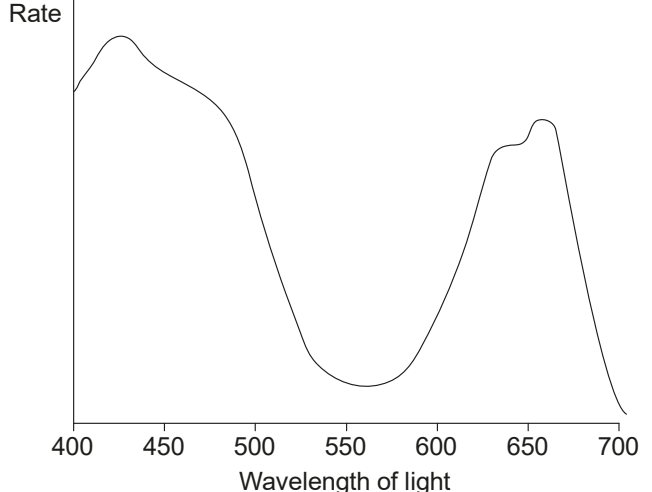
# Markscheme

# November 2018

# Biology

# Standard level

# Paper 3

18 pages

**ib** International Baccalaureate
Baccalauréat International
Bachillerato Internacional

## Section A

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| 1. | a | | to remove any starch already in the leaf<br>***OR***<br>so any starch found in the leaf was made during the experiment<br>***OR***<br>to prevent further production of starch ✔ | | 1 |
| 1. | b | i | X ***AND*** Y ✔ | *Both needed* | 1 |
| 1. | b | ii | W ***AND*** X ✔ | *Both needed* | 1 |
| 1. | b | iii | *pro (yes it could be evidence)*:<br><br>a. starch is a product of photosynthesis ✔<br><br>*con (not necessarily evidence)*:<br><br>b. starch could be made elsewhere «in the plant» and transported to/stored in leaves<br>***OR***<br>starch could be made by another process «other than photosynthesis»<br>***OR***<br>starch is being detected although glucose is the direct product ✔<br><br>*limitations of experiment*:<br><br>c. starch depletion may take more than 24 hours «of dark»<br>***OR***<br>starch production may take more than 6 hours «of light»<br>***OR***<br>starch should have been measured before and after ✔ | *OWTTE* | 2 max |

*(continued…)*

*(Question 1 continued)*

| | Question | | Answers | Notes | Total |
|---|---|---|---|---|---|
| **1.** | **c** | **i** | sketch showing 2 peaks at either end of the spectrum ✔ |  Rate ... Wavelength of light (400 450 500 550 600 650 700) | **1** |
| **1.** | **c** | **ii** | it would be a straight line/have no peaks <br> *OR* <br> no photosynthesis ✔ | *Accept a labelled horizontal line in the bottom third of the y-axis.* <br><br> *Do not accept "lower line" or "lower photosynthesis"* | **1** |
| **1.** | **d** | | «having the leaf partly white would be» no selective advantage/cannot compete <br> *OR* <br> natural selection would reduce the frequency of the mutation causing variegated leaves <br> *OR* <br> occur due to artificial selection ✔ | *Some reference to evolution or natural selection required* <br><br> *Do not accept reference to photosynthesis alone* | **1** |

| | Question | | Answers | Notes | Total |
|---|---|---|---|---|---|
| 2. | a | | 12 breaths per minute/6 litres per minute ✔ | *breaths per minute.* *Accept answers from 5.5 to 6 litres per minute.* *Answer must include breaths or litres and a standard unit of time.* *Correct:* *eg: 12 breaths / minute* *eg: 0.1 L sec$^{-1}$ or 6 L min$^{-1}$* *Incorrect:* *eg: but 12 breaths = 0 marks* | 1 |
| 2. | b | | a. the volume of air per breath increases **OR** the volume of each breath reaches a maximum/levels off **OR** frequency of ventilation/breaths per minute increases ✔<br><br>b. exercise increases «rate of cellular» respiration/energy use/blood $CO_2$/acidity ✔<br><br>c. exercise causes increased demand for oxygen/removal of carbon dioxide ✔<br><br>d. maximum rate/depth of ventilation is determined by the capacity of the student ✔ | | **2 max** |
| 2. | c | | «total resting lung volume» would be greater ✔ | | 1 |

| | | | | | |
|---|---|---|---|---|---|
| 3. | a | | a. telophase ✔<br><br>b. chromatids/chromosomes have been pulled to the poles of the cell **OR** «2» new/daughter nuclei forming ✔ | *Do not accept cytokinesis* | 2 |
| 3. | b | | 0.3 *or* 30 % ✔ | | 1 |

# Section B

**Option A — Neurobiology and behaviour**

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| **4.** | **a** | | 1000 ✔ | *Working not required* | **1** |
| **4.** | **b** | | a.  skeletal muscle uses more total energy than the brain ✔<br><br>b.  the brain uses more energy per kg than skeletal muscle<br>    **OR**<br>    the brain has higher metabolic rate ✔ | *Accept numerical answers if comparative terms are used* | **2** |
| **4.** | **c** | | a. «brain requires more» energy to maintain a proper ionic balance/homeostasis/active transport ✔<br><br>b. «brain requires more» energy for synapses/neurotransmitters ✔<br><br>c. «brain requires more» energy for thinking and memory ✔<br><br>d. skeletal muscle active on demand but brain constantly active ✔ | | **1 max** |
| **4.** | **d** | | a. does not require conscious thought ✔<br><br>b. can respond to emergency situation and «actively» return the body to normal ✔<br><br>c. medulla/brain stem controls involuntary activities ✔<br><br>d. *eg*: swallowing/breathing/heart rate ✔ | *Accept other valid examples* | **2 max** |

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| **5.** | **a** | | a. «the process shows» the growth of an axon/dendrites/extensions ✓ | | |
| | | | b. differentiation/forming a specialized neuron ✓ | | **2 max** |
| | | | c. responding to a chemical stimulus ✓ | | |
| **5.** | **b** | | a. the neuron forms synapses/multiple connections «with other neurons» *OR* a neural network forms *OR* more dendrites ✓<br><br>b. some synapses/connections in excess of what is required *OR* some synapses/connections not used ✓<br><br>c. it could be removed by neural pruning/apoptosis ✓<br><br>d. it could migrate to another place ✓ | | **2 max** |
| **5.** | **c** | | a. allows brain to change/adjust/make new synapses throughout lifetime/with experience/learning ✓<br><br>b. allows regeneration of neurons after brain trauma *OR* allows other area «of the brain» to take over a function after brain trauma ✓<br><br>c. selective advantage/increases chance of survival ✓ | *OWTTE* | **1 max** |

| | Question | | Answers | Notes | Total |
|---|---|---|---|---|---|
| **6.** | **a** | **i** |  visual cortex ✔ | *Accept any label within the area shown on the image* | **1** |
| **6.** | **a** | **ii** | pituitary gland ✔ | | **1** |
| **6.** | **b** | | a  magnetic field is used to make pictures of brain/organs/structures ✔<br><br>b. an fMRI shows changes in blood flow ✔<br><br>c. increased blood flow associated with activity in specific areas of the brain ✔<br><br>d. performance of task matched with active area of brain ✔ | | **2 max** |

| | | | | | |
|---|---|---|---|---|---|
| **7.** | **a** | | pinna/auricle ✔ | | **1** |
| **7.** | **b** | | a. sound travels in «longitudinal» waves/vibrations ✔<br><br>b. vibrations in the air cause vibration of the eardrum ✔<br><br>c. the vibrations/sounds are passed on to the bones/ossicles «of the middle ear» ✔<br><br>d. the bones amplify the sound/vibrations ✔<br><br>e. «bones» transmit sound/vibrations to the oval window ✔<br><br>f. vibration of oval window causes fluid movement in the cochlea «in the inner ear» ✔<br><br>g. hair cells move with the vibrations/sound ✔ | | **4 max** |

**Option B — Biotechnology and bioinformatics**

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| 8. | a | | phytoene synthase ✔ | | 1 |
| 8. | b | | a. by detecting a marker/resistance'/sequencing gene ✔ | *Accept using PCR to detect the marker gene* | 1 |
| 8. | c | | a. «Ti/tumour inducing» plasmid of *A. tumefaciens*/bacterium causes tumours/galls ✔  b. Ti incorporates genes «of β-carotene synthesis» **OR** Ti is used as a vector of the gene «for β-carotene» ✔  c. recombinant plasmids reintroduced into *A. tumefaciens*/bacterial cells ✔  d. bacteria infect rice plant cells ✔  e. the newly incorporated gene produces β-carotene/Golden Rice ✔ | | 3 max |

| | | | | | |
|---|---|---|---|---|---|
| 9. | a | | a. amylopectin is «more» branched/has 1,6 bonds **OR** amylopectin is less soluble in water ✔  b. both made up of glucose **OR** both are polysaccharides **OR** both are helical in shape **OR** both contain glycosidic bonds ✔ | *Accept converse statements* | 2 max |
| 9. | b | | amflora contains «almost» no amylose/«almost» all amylopectin ✔ | | 1 |

*(Question 9 continued)*

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| **9.** | **c** | | used in the paper/glue/textile/concrete industry ✓ | | **1** |
| **9.** | **d** | | a. encourages monocultures/reducing biodiversity ✓<br><br>b. may reduce natural resistance to pests/disease ✓<br><br>c. may cross-pollinate with non-GM crops ✓<br><br>d. disruption of practices of farming/agricultural land not being used for food production ✓<br><br>e. crop-to-crop gene flow ✓ | | **1 max** |

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| **10.** | **a** | | AUG ✓ | | **1** |
| **10.** | **b** | | 5′ end contains a phosphate group «on carbon 5»<br>***OR***<br>3′ carbon contains a hydroxyl/OH group «on carbon 3» ✓ | | **1** |
| **10.** | **c** | | a. the gene code occurs in triplets ✓<br><br>b. the stop codon would not be part of the reading frame ✓<br><br>c. the code for a polypeptide would contain more codons ✓ | | **2 max** |
| **10.** | **d** | | a. bioinformatics is the application of computer technology to biological information<br>   ***OR***<br>   information is stored in a database<br>   ***OR***<br>   bioinformatics is used in analyzing genomes ✓<br><br>b. allows for searches/comparisons/analysis of ORF/open reading frame ✓<br><br>c. the computer searches for a start codon and a stop codon «and within a distance of 60+ codons» ✓ | | **2 max** |

| Question | Answers | Notes | Total |
|---|---|---|---|
| **11.** | a. bacteriophages are viruses of bacteria/prokaryotes ✔<br><br>b. each bacteriophage is specific to certain bacterial groups<br>*OR*<br>they can be used to target specific bacteria ✔<br><br>c. can be used in sewage plants<br>*OR*<br>can kill bacteria that cause water contamination/disinfect water<br>*OR*<br>can kill bacteria that form biofilms at water purification plants ✔<br><br>d. can kill strains resistant to antibiotics<br>*OR*<br>can kill strains resistant to chlorine/chemical disinfectants ✔<br><br>e. «presence of» bacteriophages also act as indicators of bacteria present ✔<br><br>f. generally not harmful to humans ✔ | | **4 max** |

## Option C — Ecology and conservation

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| **12.** | **a** | | 1 kg ✔ | *Working not required* | **1** |
| **12.** | **b** | | 120 kg ✔ | *Working not required* | **1** |
| **12.** | **c** | | a. small amount of/least food resources used in production ✔<br><br>b. high yield means less energy lost in respiration<br>   **OR**<br>   high yield means less waste of inedible material ✔<br><br>c. other resources/cost of production/nutritional values not mentioned ✔<br><br>d. sustainability requires knowledge of the effect on the environment/<br>   pollution/contamination of water supply<br>   **OR**<br>   sustainability requires minimal use of drugs/chemicals/antibiotics ✔<br><br>e. example of ethical issue ✔ | *eg: habitat, heating, water*<br><br><br><br>*eg: it may spread diseases to wild population* | **2 max** |

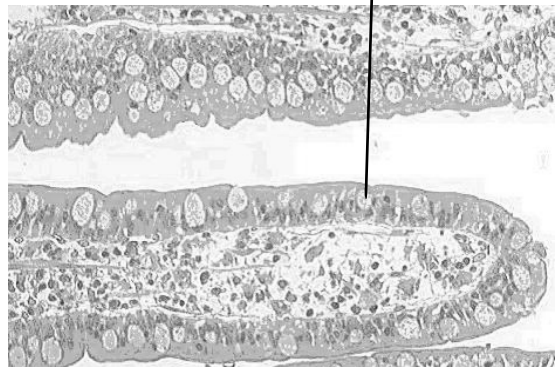| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| **13.** | **a** | | dragonfly nymph **AND** midge larva<br>**OR**<br>all except mayfly ✔ | *Both needed* | **1** |
| **13.** | **b** | | indicator species ✔ | | **1** |
| **13.** | **c** | | richness is how many species there are in an area while evenness is how similar in number the populations of each species are ✔ | | **1** |
| **13.** | **d** | | a.  the edge of an ecosystem has different features from the centre ✔<br><br>b.  the edge has greater biodiversity ✔<br><br>c.  it is an area of overlap between two ecosystems/habitats ✔<br><br>d.  it has species from both ecosystems<br>    **OR**<br>    it has species not found in either ✔<br><br>e.  reduction in biodiversity due to human interference ✔ | *eg: amount of wind, light* | **2 max** |

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| 14. | a | | Japanese stiltgrass ✔ | | 1 |
| 14. | b | | produce seeds which spread when cutting<br>**OR**<br>avoid vegetative proliferation/cloning<br>**OR**<br>may provide habitats for other species ✔ | *Accept any other reasonable answer* | 1 |
| 14. | c | | a. «biotic» competition with native plants<br>    **OR**<br>    disrupt the food chain/ecosystem ✔<br><br>b. competition for abiotic factors ✔<br><br>c. reduce competitive exclusion / avoid overlapping niches ✔<br><br>d. can cause changes to soil ✔<br><br>e. break/damage/cause death/extinction of native plants ✔ | *Accept competition for light/space/water/etc for b*<br><br><br>*eg: Rhododendrons/conifers acidify the soil, making it difficult for other species to grow* | 2 max |
| 14. | d | | a. «control» introduced species should only target alien plants<br>    **OR**<br>    «control» introduced species should not outcompete endemic species ✔<br><br>b. should not upset food chains/habitats ✔<br><br>c. should have some natural control/predator ✔<br><br>d. should not spread outside required area/not become invasive themselves<br>    **OR**<br>    field testing for effectiveness ✔ | | 2 max |

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| **15.** | **a** | | «overall» water temperature increasing<br>***OR***<br>the range of fluctuations increases ✔ | *Do not accept the trend is fluctuating* | **1** |
| **15.** | **b** | | a. the coral and the algae have a symbiotic/mutualistic relationship<br>   ***OR***<br>   two different organisms live together and depend on each other ✔<br><br>b. algae expelled from coral/relationship broken ✔<br><br>c. coral produces carbon dioxide from respiration ✔<br><br>d. the algae use the carbon dioxide to carry out photosynthesis/produce nutrients ✔<br><br>e. without the nutrients from the algae the coral are liable to starve ✔<br><br>f. coral dies/is susceptible to disease ✔ | *Do not accept effects on species other than coral* | **4 max** |

**Option D — Human physiology**

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| **16.** | **a** | | loss of skeletal/heart muscle «containing protein» ✔ | | **1** |
| **16.** | **b** | | a. adipose tissue has a high energy value✔<br><br>b. adipose tissue may be lost before affecting body metabolism/homeostasis ✔<br><br>c. body will use up adipose reserves first before using muscle and organs for energy ✔ | *Accept fat for adipose tissue* | **2 max** |
| **16.** | **c** | | a. loss of mass similar in anorexia and starvation ✔<br><br>b. loss could also be due to disease/feeding difficulties/other disorder/poverty/social unrest ✔<br><br>c. lack of food intake in anorexia nervosa due to emotional disorder<br>    **OR**<br>    desire to lose weight/refusal to eat characteristics of anorexia nervosa ✔<br><br>d. loss of «cardiac» muscle is characteristics of anorexia nervosa ✔ | | **2 max** |

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| **17.** | **a** | | 8 ✔ | | **1** |
| **17.** | **b** | | a. «paddles/electrodes/defibrillator» deliver an electric shock to the heart ✔<br><br>b. depolarizes cardiac muscle ✔<br><br>c. enables the pacemaker/SA node to regain control ✔ | | **2 max** |
| **17.** | **c** | | a. impulses initiated from the AV node spread across heart ✔<br><br>b. impulses travel along Purkinje fibres/across ventricles ✔<br><br>c. causing depolarization of the ventricles<br>    **OR**<br>    that triggers ventricular contraction ✔ | | **2 max** |

| | Question | | Answers | Notes | Total |
|---|---|---|---|---|---|
| **18.** | **a** | | arrow pointing at an epithelial cell ✔ | *Accept a bracket label to show the epithelium*<br><br>epithelial cell layer<br><br> | **1** |
| **18.** | **b** | | a. microvilli/brush border to increase surface area ✔<br><br>b. numerous mitochondria for energy for active transport ✔<br><br>c. have transport proteins for specific nutrients ✔<br><br><br>d. single layer of cells/short distance allowing for diffusion ✔ | *Explanation must be included for each characteristic eg: "glucose, amino acids"* | **2 max** |

| Question | | | Answers | Notes | Total |
|---|---|---|---|---|---|
| 19. | a | i | Kupffer cell ✔ | | 1 |
| 19. | a | ii | a. ingests red blood cells by phagocytosis ✔<br><br>b. splits the hemoglobin into heme «and globin»<br>    **OR**<br>    heme group broken down into iron «and bilirubin»<br>    **OR**<br>    hemoglobin broken down into iron ✔<br><br>c. releases iron for transport ✔ | | 2 max |
| 19. | b | | a. the dual supply is the hepatic artery and the hepatic portal vein ✔<br><br>b. blood in «hepatic» artery provides oxygen to the liver «tissues» ✔<br><br>c. the «hepatic portal» vein carries blood from the gastrointestinal tract/intestines ✔<br><br>d. the «hepatic portal» vein carries blood rich in nutrients ✔<br><br>e. this allows the nutrients to be stored/processed<br>    **OR**<br>    sugar/glucose/glycogen is stored and released in response to hormones ✔<br><br>f. prevents osmotic imbalance due to absorbed nutrients in the blood ✔ | *Both needed* | 4 max |