

Markscheme

May 2016

Biology

Standard level

Paper 3

Section A

| Question | | | Answers | Notes | Total |
|----------|---|-----|--|--|-------|
| 1. | a | i | a. 0.28 «moles dm ⁻³ » ✓ b. 0.56 «osmoles dm ⁻³ » ✓ | <i>Allow answers in the range of 0.27 to 0.29 «moles dm⁻³».</i> <i>Allow answers in the range of 0.55 to 0.57 «osmoles dm⁻³».</i> | 1 |
| | | ii | a. «any» part of the line above 0 percent change in mass ✓ b. 0 to 0.28 molarity of NaCl solution ✓ | <i>Allow ECF for upper value of molarity.</i> | 1 max |
| | | iii | a. too few samples weighed ✓ b. not dried before weighing ✓ c. samples from different sources ✓ d. not cut all same way so different surface area ✓ e. temperature of each sample not the same ✓ f. potatoes not left for the same time in the solutions ✓ g. error due to the limitation of the apparatus/equipment ✓ | <i>Differentiate between errors and mistakes eg: do not accept "balance read incorrectly".</i> <i>Do not accept mass/weight differences.</i> | 1 max |
| | b | | a. at the peak the sodium channels close ✓ b. the potassium channels open ✓ c. potassium ions flow out ✓ d. repolarization occurs ✓ e. delay in closing of potassium channels ✓ f. hyperpolarization results ✓ g. sodium and potassium pump re-starts to restore ions to resting/previous potentials/concentrations ✓ | <i>Accept Na⁺ and K⁺ ions.</i> <i>Award [2 max] if answer refers to part of graph before X.</i> | 3 max |

| Question | | Answers | Notes | Total | | | | | | | | | | | | | | | | |
|----------|--|--|--|-------------------|--------------|--|----|---------------------------------|--|---|----|---|--|---|----|--|--|---|-----------------------------------|-------|
| 2. | a | 1.717 ✓ | | 1 | | | | | | | | | | | | | | | | |
| | b | half ¹⁴ N and half ¹⁵ N OR one/new strand ¹⁴ N and one/old strand ¹⁵ N OR half labelled ✓ | <i>Must indicate equal quantities eg: 50 % of each or 1 strand of each.</i> | 1 | | | | | | | | | | | | | | | | |
| | c | a. «as replication is semi-conservative» each new strand is built on parental/old/template strand ✓ b. generation 3 shows DNA that is mostly made of ¹⁴ N ✓ c. when <i>E. coli</i> replicates, half of its new DNA must always contain ¹⁴ N when growing in an ¹⁴ N growth medium ✓ d. every new generation of <i>E. coli</i> always has a smaller proportion of «labelled» ¹⁵ N in its DNA «than the previous generation» ✓ e. each new generation has half the amount of ¹⁵ N in previous generation ✓ | <i>Accept answers in an annotated diagram. Do not give a mark for “semi-conservative”.</i> | 3 max | | | | | | | | | | | | | | | | |
| | d | <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 5%;"></th> <th style="width: 35%;">semi-conservative</th> <th style="width: 35%;">conservative</th> <th style="width: 25%;"></th> </tr> </thead> <tbody> <tr> <td>a.</td> <td>«daughter» DNA is half parental</td> <td>«daughter» DNA is all parental OR all «daughter» DNA is new</td> <td style="text-align: center;">✓</td> </tr> <tr> <td>b.</td> <td>one strand of the «daughter» DNA is new</td> <td>«daughter» DNA is all parental OR all «daughter» DNA is new</td> <td style="text-align: center;">✓</td> </tr> <tr> <td>c.</td> <td>both strands of parental DNA are separated</td> <td>both strands of parental DNA remain together</td> <td style="text-align: center;">✓</td> </tr> </tbody> </table> | | semi-conservative | conservative | | a. | «daughter» DNA is half parental | «daughter» DNA is all parental OR all «daughter» DNA is new | ✓ | b. | one strand of the «daughter» DNA is new | «daughter» DNA is all parental OR all «daughter» DNA is new | ✓ | c. | both strands of parental DNA are separated | both strands of parental DNA remain together | ✓ | <i>Table format not required.</i> | 2 max |
| | semi-conservative | conservative | | | | | | | | | | | | | | | | | | |
| a. | «daughter» DNA is half parental | «daughter» DNA is all parental OR all «daughter» DNA is new | ✓ | | | | | | | | | | | | | | | | | |
| b. | one strand of the «daughter» DNA is new | «daughter» DNA is all parental OR all «daughter» DNA is new | ✓ | | | | | | | | | | | | | | | | | |
| c. | both strands of parental DNA are separated | both strands of parental DNA remain together | ✓ | | | | | | | | | | | | | | | | | |

| Question | | Answers | Notes | Total |
|----------|---|---|--|--------------|
| 3. | a | a. negative correlation OR inverse relationship ✓ b. decrease in calcification as atmospheric CO ₂ /pCO ₂ rises ✓ | <i>Do not accept "negative" alone.</i> | 1 max |
| | b | matter does not exchange/enter/leave but energy exchanges/enters/leaves ✓ | | 1 |

Section B

Option A — Neurobiology and behaviour

| Question | | Answers | Notes | Total |
|----------|---|---|---|-------|
| 4. | a | /: neural tube ✓ //: notochord ✓ | | 2 |
| | b | differentiation/neurogenesis «in the neural tube» ✓ | | 1 |
| | c | a. plasticity allows the nervous system to adapt «structurally» OR plasticity allows cortical remapping/new connections ✓ b. neurons «axons» grow in response to stimulation/experience ✓ c. unused neurons die/are lost through pruning ✓ | <i>Accept synapses in place of neurons.</i> | 2 max |
| 5. | a | /: cerebral cortex/hemisphere OR cerebrum ✓ //: cerebellum ✓ | | 2 |
| | b | the left side of visual field in both eyes ✓ | <i>Reference to both left and right eyes is required.</i> | 1 |

| Question | | Answers | Notes | Total |
|----------|--|---|-------|-------|
| 6. | | a. «sensory hair cells found in semicircular canals» detect movement of the head ✓ b. fluid in the canals lags behind movement of head OR inertia of fluid makes it move more slowly than head ✓ c. fluid movement causes “hairs” of hair cells to bend ✓ d. bending of hairs causes nearby sensory neuron to conduct signal ✓ e. hairs in all three semicircular canals «which are at right angles so» detect head movement in any direction ✓ f. signals passed on to the nerve/brain ✓ | | 3 max |

| | | | | |
|----|---|--|--|-------|
| 7. | a | the higher the body mass, the higher the brain mass OR positive correlation ✓ | | 1 |
| | b | 8: 10000 or 1: 1250 or 8×10^{-4} or 0.0008 ✓ | | 1 |
| | c | a. ratio for humans is furthest above line of best-fit/correlation curve ✓ b. although elephant/whale have much larger body mass than human the ratio is smaller than human ✓ OR elephants/dusky dolphins/blue whales have greater brain mass but much larger body mass ✓ c. chimp with similar body mass has lower brain mass ✓ d. average body mass does not indicate variation within species ✓ e. data not clear as both scales are exponential ✓ | <i>mp e: Allow other discussion to explain why data not clear.</i> | 3 max |

| Question | Answers | Notes | Total |
|----------|--|---|-------|
| 8. | a. photoreceptors in the retina detect reflected light/stimulus «from the page» ✓ b. transmitted via the optic nerve to the visual cortex/brain/occipital lobe ✓ c. interpreting occurs in the cerebral cortex ✓ d. cerebral cortex involved in thinking ✓ e. cerebral cortex involved in memory ✓ f. motor/cerebral cortex involved in motor control OR motor neurons sends impulses to muscle to move ✓ g. Broca's area is a region in the cortex linked to speech production ✓ | Accept rods and cones in place of photoreceptors. | 4 max |

Option B — Biotechnology and bioinformatics

| Question | | Answers | Notes | Total |
|----------|---|---|---|-------|
| 9. | a | fermentation ✓ | | 1 |
| | b | a. O ₂ «uptake» ✓ b. CO ₂ «production» ✓ c. cell density ✓ d. pressure ✓ e. speed of stirrer ✓ f. quantity of nutrients/substrate/named nutrient ✓ | | 1 max |
| | c | <i>Aspergillus niger</i> ✓ | <i>Complete genus and species name is required.</i> | 1 |

| Question | | Answers | Notes | Total |
|----------|---|--|-------|-------|
| 10. | a | <p>a. «the hypothesis is supported as» less total land is plowed in 2001 ✓</p> <p>b. «the hypothesis is supported as» the amount of land used for conventional plowing is less in 2001 ✓</p> <p>c. «the hypothesis is supported as» the amount of land used for reduced plowing has increased in 2001 ✓</p> <p>d. there is a negative correlation between increased GT soybean planted and area of land plowed ✓</p> | | 2 max |
| | b | <p>a. involves database search for DNA sequence similar to unknown gene ✓</p> <p>b. function of similar sequence used to infer the function of the unknown target gene ✓</p> <p>c. use of nucleotide blast/BLASTn ✓</p> | | 2 max |
| | c | continuous/unbroken stretch of DNA between start codon and stop codon ✓ | | 1 |
| | d | <p>a. biolistics uses a gun device ✓</p> <p>b. fires particles coated with DNA/gene ✓</p> <p>c. at plant tissue ✓</p> | | 2 max |

| Question | | Answers | Notes | Total |
|----------|---|---|---|-------|
| 11. | a | a. they show emergent properties ✓ b. they contain cooperative aggregates of microorganisms ✓ c. the microorganisms cooperate through communication/quorum sensing ✓ d. the microorganisms are highly resistant to antimicrobial agents ✓ e. they adhere to a variety of surfaces ✓ f. formation/secretion of EPS/extracellular polymeric substances ✓ | | 2 max |
| | b | biofilms show a much higher percentage of <i>M. avium</i> than water ✓ | Accept inverse answer. Accept numerical answers. | 1 |
| | c | a. conditions on the showerhead favour bacterial growth ✓ b. eg: moisture/temperature/nutrients ✓ c. «solid» surface on which to accumulate ✓ d. quorum reached OR critical concentration of signal molecules ✓ e. shower heads are seldom cleaned ✓ | | 3 max |

| Question | Answers | Notes | Total |
|----------|---|-------|-------|
| 12. | a. bioremediation is the use of microorganisms to metabolize toxins to remove them from the environment ✓ b. specific area or ecosystem affected by pollution ✓ c. name of pollutant ✓ d. source of pollutant ✓ e. identity of microorganism used ✓ f. manner in which microorganism makes use of pollutant ✓ g. supporting steps technicians have to undertake ✓ | | 4 max |

Option C — Ecology and conservation

| Question | | Answers | Notes | Total |
|----------|---|--|---|-------|
| 13. | a | <p>a. <i>P. gonocephala</i> is found over a greater range of temperatures ✓</p> <p>b. <i>P. gonocephala</i> is found between 16.5 degrees and 23.0 degrees whereas <i>P. montenegrina</i> is not OR <i>P. gonocephala</i> is found at a higher temperature ✓</p> <p>c. both are found in temperatures of 6.5 degrees to 16.5 degrees ✓</p> | <p>Note: do not accept just numbers (T) of ranges without comparing/contrasting clearly.</p> <p>Do not accept “both show a greater range” alone as this comes from graph C not A and B as the question asks.</p> | 2 max |
| | b | <p>a. realized niche is one which an organism actually occupies ✓</p> <p>b. presence of a competitive species/<i>P. gonocephala</i> narrows the niche ✓</p> <p>c. limited by competition OR competitive exclusion ✓</p> <p>d. the realized niche is colder/smaller range in the presence of <i>P. gonocephala</i> ✓</p> | | 2 max |

| Question | | Answers | Notes | Total |
|----------|---|---|---|---------------------|
| 14. | a | <p>«in the older sand dunes you would expect»</p> <ul style="list-style-type: none"> a. more complex deeper soil ✓ b. buildup of organic matter ✓ c. better water retention ✓ d. higher nutrient content ✓ e. support larger diversity of soil organisms ✓ f. soil is less likely to be blown away OR soil is more stable ✓ g. a different pH ✓ | <p><i>Accept inverse answers related to younger sand dunes.</i></p> | <p>3 max</p> |
| | b | <ul style="list-style-type: none"> a. climate is defined by temperature and rainfall ✓ b. absence of rainfall/water/humidity leads to desert ✓ c. moderate amount of rainfall leads to grassland ✓ d. high levels of rainfall leads to forest ✓ e. temperature determines type of grassland/forest ✓ | | <p>3 max</p> |

| Question | | Answers | Notes | Total |
|----------|---|--|--|-------|
| 15. | a | a. toxin at lowest concentrations in organisms at lowest trophic level ✓ b. toxin concentration builds/is magnified in organisms at each successively higher trophic level ✓ c. toxins often fat-soluble OR can accumulate in body tissues ✓ d. toxin/chemical is not metabolized/excreted ✓ | | 2 max |
| | b | i | fox ✓ | 1 |
| | | ii | unlike the other two predators, it is a mammal OR has other sources of food OR different biochemistry/metabolism ✓ | 1 |
| | c | a. PCBs biomagnify in all three predator prey relationships ✓ b. PCBs biomagnify most in rodent–buzzard/least in rodent–fox relationship ✓ c. greatest range of PCB biomagnification occurs in rodent–buzzard ✓ d. biomagnification in birds is higher than in mammals ✓ | | 2 max |

| Question | Answers | Notes | Total |
|----------|---|-------|--------------|
| 16. | <ul style="list-style-type: none"> a. species introduced into habitat/ecosystem ✓ b. disrupt food chains ✓ c. reduce the number of organism that occupy similar niches ✓ d. they can over consume prey species ✓ e. reduce availability of prey species for other consumers ✓ f. they can over consume a native predator ✓ g. leading to loss of control on numbers of prey species ✓ h. their impact will reduce the biodiversity ✓ i. can lead to extinction of some species ✓ j. may have no natural predators/control ✓ | | 4 max |

Option D — Human physiology

| Question | | Answers | Notes | Total | |
|----------|---|--|---|---|----------|
| 17. | a | a. canola AND flaxseed/walnut ✓ b. both have ratios within or close to recommended ratio ✓ | <i>Both needed.</i> | 2 | |
| | b | a. fatty acids which have to be obtained in the diet ✓ b. fatty acids which cannot be synthesized in the body ✓ | | 2 | |
| | c | i | hypothalamus ✓ | <i>Do not accept appetite control centre.</i> | 1 |
| | | ii | a. transmit impulses from brain to gland cells «in stomach» ✓ b. stimulate secretion by «stomach» gland cells ✓ c. stimulates secretion of gastric acid ✓ d. example of parasympathetic response eg: slows heart ✓ e. transmit sensory information to the brain ✓ | 1 max | |

| Question | | Answers | Notes | Total |
|----------|---|---|-------|-------|
| 18. | a | a. acidity activates digestive enzyme «pepsinogen» ✓ b. hydrolysis/breakdown of food ✓ c. acidity destroys unwanted bacteria/pathogens ✓ d. provides optimum pH for enzymes/pepsin to function ✓ | | 2 max |
| | b | a. heavier stool mass meant less time in digestive tract ✓ b. refined diet/English students had lightest stool and longest intestinal time <i>OR</i> refined diet/English students had longest intestinal time ✓ c. unrefined diet/high fiber gives heaviest stool <i>OR</i> unrefined diet/high fiber gives least time in intestinal tract ✓ d. mixed diet has medium transit time <i>OR</i> mixed diet has medium stool mass ✓ | | 2 max |
| | c | a. increased contact time between intestinal wall and food ✓ b. increase interaction with surface and undesirable food chemicals ✓ c. the density/hardness of the stool can make it harder to egest causes damage to tissues ✓ d. increases digestive tract conditions/diseases/constipation ✓ | | 1 max |

| Question | | Answers | Notes | Total |
|----------|---|---|---|-------|
| 19. | a | <p><i>I:</i> portal venule ✓</p> <p><i>II:</i> Kupffer cell ✓</p> <p><i>III:</i> «hepatic» sinusoid ✓</p> <p><i>IV:</i> hepatocyte/hepatic cell ✓</p> | <p><i>Award [1] for any two correctly labelled.</i></p> <p><i>Do not accept portal vein in place of venule.</i></p> | 2 max |
| | b | <p>a. can store or release glucose OR regulate nutrient levels ✓</p> <p>b. can remove toxins from/detoxify blood ✓</p> <p>c. produce plasma proteins ✓</p> <p>d. synthesis of cholesterol/phospholipids/bile salts ✓</p> | <p><i>Do not accept functions of Kupffer cells (eg: breaking down red blood cells).</i></p> | 2 max |

| Question | | Answers | Notes | Total |
|----------|---|---|-------------------------|-------|
| 20. | a | waist to hip ratio as increasing ratio shows increasing CHD incidence/increasing BMI does not ✓ | <i>Reason required.</i> | 1 |
| | b | a. cardiac muscle transmits electrical signals OR cardiac muscle is myogenic ✓ b. SA node initiates signal ✓ c. signal spreads over atria ✓ d. reaches the AV node ✓ e. signal passes through bundle of His/Purkinje fibres ✓ f. signal delayed at AV node/bundle of His ✓ g. delay allows ventricles to fill «as atria contract» ✓ h. conducting fibers spread signal across ventricle walls ✓ i. ventricles contract ✓ | | 4 max |