

# Markscheme

May 2016

Biology

Standard level

Paper 3

19 pages

Section A

Question			Answers	Notes	Total
1.	a	i	a. 0.28 «moles dm <sup>-3</sup> » ✓ b. 0.56 «osmoles dm <sup>-3</sup> » ✓	<i>Allow answers in the range of 0.27 to 0.29 «moles dm<sup>-3</sup>».</i> <i>Allow answers in the range of 0.55 to 0.57 «osmoles dm<sup>-3</sup>».</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<sup>+</sup> and K<sup>+</sup> 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 <sup>14</sup> N and half <sup>15</sup> N <b>OR</b> one/new strand <sup>14</sup> N and one/old strand <sup>15</sup> N <b>OR</b> 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 <sup>14</sup> N ✓ c. when <i>E. coli</i> replicates, half of its new DNA must always contain <sup>14</sup> N when growing in an <sup>14</sup> N growth medium ✓ d. every new generation of <i>E. coli</i> always has a smaller proportion of «labelled» <sup>15</sup> N in its DNA «than the previous generation» ✓ e. each new generation has half the amount of <sup>15</sup> 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"> <thead> <tr> <th></th> <th>semi-conservative</th> <th>conservative</th> <th></th> </tr> </thead> <tbody> <tr> <td>a.</td> <td>«daughter» DNA is half parental</td> <td>«daughter» DNA is all parental <b>OR</b> all «daughter» DNA is new</td> <td>✓</td> </tr> <tr> <td>b.</td> <td>one strand of the «daughter» DNA is new</td> <td>«daughter» DNA is all parental <b>OR</b> all «daughter» DNA is new</td> <td>✓</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>✓</td> </tr> </tbody> </table>		semi-conservative	conservative		a.	«daughter» DNA is half parental	«daughter» DNA is all parental <b>OR</b> all «daughter» DNA is new	✓	b.	one strand of the «daughter» DNA is new	«daughter» DNA is all parental <b>OR</b> 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
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Question		Answers	Notes	Total
3.	a	a. negative correlation <b>OR</b> inverse relationship ✓  b. decrease in calcification as atmospheric CO <sub>2</sub> /pCO <sub>2</sub> rises ✓	<i>Do not accept “negative” alone.</i>	<b>1 max</b>
	b	matter does not exchange/enter/leave but energy exchanges/enters/leaves ✓		<b>1</b>

**Section B**

**Option A — Neurobiology and behaviour**

Question		Answers	Notes	Total
4.	a	I: neural tube ✓ II: notochord ✓		2
	b	differentiation/neurogenesis «in the neural tube» ✓		1
	c	a. plasticity allows the nervous system to adapt «structurally» <b>OR</b> 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	I: cerebral cortex/hemisphere <b>OR</b> cerebrum ✓ II: 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 <b>OR</b> 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 <b>OR</b> positive correlation ✓		1
	b	8: 10000 <b>or</b> 1: 1250 <b>or</b> $8 \times 10^{-4}$ <b>or</b> 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 ✓ <b>OR</b> 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 <b>OR</b> motor neurons sends impulses to muscle to move ✓ g. Broca's area is a region in the cortex linked to speech production ✓	<i>Accept rods and cones in place of photoreceptors.</i>	<b>4 max</b>

Option B — Biotechnology and bioinformatics

Question		Answers	Notes	Total
9.	a	fermentation ✓		1
	b	a. O <sub>2</sub> «uptake» ✓ b. CO <sub>2</sub> «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	a. «the hypothesis is supported as» less total land is plowed in 2001 ✓ b. «the hypothesis is supported as» the amount of land used for conventional plowing is less in 2001 ✓ c. «the hypothesis is supported as» the amount of land used for reduced plowing has increased in 2001 ✓ d. there is a negative correlation between increased GT soybean planted and area of land plowed ✓		2 max
	b	a. involves database search for DNA sequence similar to unknown gene ✓ b. function of similar sequence used to infer the function of the unknown target gene ✓ c. use of nucleotide blast/BLASTn ✓		2 max
	c	continuous/unbroken stretch of DNA between start codon and stop codon ✓		1
	d	a. biolistics uses a gun device ✓ b. fires particles coated with DNA/gene ✓ c. at plant tissue ✓		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 <b>OR</b> <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><b>Note:</b> 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 <b>OR</b> 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"> <li>a. more complex deeper soil ✓</li> <li>b. buildup of organic matter ✓</li> <li>c. better water retention ✓</li> <li>d. higher nutrient content ✓</li> <li>e. support larger diversity of soil organisms ✓</li> <li>f. soil is less likely to be blown away <b>OR</b> soil is more stable ✓</li> <li>g. a different pH ✓</li> </ul>	<i>Accept inverse answers related to younger sand dunes.</i>	<b>3 max</b>
	b	<ul style="list-style-type: none"> <li>a. climate is defined by temperature and rainfall ✓</li> <li>b. absence of rainfall/water/humidity leads to desert ✓</li> <li>c. moderate amount of rainfall leads to grassland ✓</li> <li>d. high levels of rainfall leads to forest ✓</li> <li>e. temperature determines type of grassland/forest ✓</li> </ul>		<b>3 max</b>

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 <b>OR</b> 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 <b>OR</b> has other sources of food <b>OR</b> 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.	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 <b>AND</b> flaxseed/walnut ✓ b. both have ratios within or close to recommended ratio ✓	<i>Both needed.</i>	<b>2</b>	
	b	a. fatty acids which have to be obtained in the diet ✓ b. fatty acids which cannot be synthesized in the body ✓		<b>2</b>	
	c	i	hypothalamus ✓	<i>Do not accept appetite control centre.</i>	<b>1</b>
		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 ✓	<b>1 max</b>	



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: portal venule ✓</p> <p>II: Kupffer cell ✓</p> <p>III: «hepatic» sinusoid ✓</p> <p>IV: hepatocyte/hepatic cell ✓</p>	<p>Award [1] for any two correctly labelled.</p> <p>Do not accept portal vein in place of venule.</p>	2 max
	b	<p>a. can store or release glucose <b>OR</b> 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>Do not accept functions of Kupffer cells (eg: breaking down red blood cells).</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 <b>OR</b> 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