

# Markscheme

**May 2016**

**Biology**

**Higher level**

**Paper 3**

23 pages

**Section A**

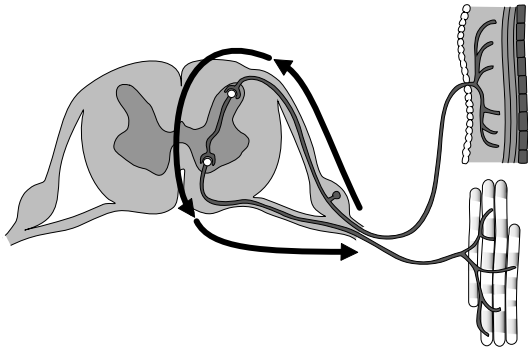
Question		Answers	Notes	Total
1.	a	a. negative correlation/inverse relationship ✓ b. exponential decrease in calcification as pCO <sub>2</sub> /concentration/atmospheric CO <sub>2</sub> rises ✓ c. as CO <sub>2</sub> increases calcification decreases ✓	<i>Do not accept "negative" alone.</i>	<b>1 max</b>
	b	a. allows atmospheric CO <sub>2</sub> concentration to be controlled/varied ✓ b. control other variables ✓ c. closed system so no external processes affect experiment ✓		<b>1 max</b>
	c	<p><b>Alternative 1</b></p> a. corals have parts/shells/«exo»skeleton made of calcium carbonate ✓ b. calcium carbonate «shells» dissolve in acid conditions ✓ c. acid/high CO <sub>2</sub> conditions reduces availability of calcium carbonate «for forming shells» <b>OR</b> negatively affects enzymes involved in calcification ✓		<b>2 max</b>
		<p><b>Alternative 2</b></p> d. CO <sub>2</sub> is «significant» greenhouse gas causing rise in ocean temperatures ✓ e. higher ocean temperatures/acidification leads to rejection of <i>zooxanthellae</i> <b>OR</b> higher ocean temperatures/acidification leads to coral bleaching ✓		

Question		Answers	Notes	Total
2.	a	xylem ✓		1
	b	a. it has a stylet embedded in it <b>OR</b> aphids insert their stylets into phloem ✓  b. is closer to the surface/exterior/outside the xylem ✓  c. cells smaller than xylem tissue «below it» ✓  d. smaller «companion» cells are adjacent to larger «sieve tube» cells ✓		1 max
	c	a. aphids tap into phloem with their stylets «to use sap as a food source» ✓ b. plants grown in radioactive CO <sub>2</sub> / <sup>14</sup> CO <sub>2</sub> incorporate it into carbohydrate ✓ c. phloem contents/sap/fluid flows through the stylet ✓ d. aphid body severed/cut from stylet «after stylet inserted into phloem» ✓ e. analyze «sap/fluid exuded from stylet» for solutes/carbohydrates <b>OR</b> radioactive-labelled carbon can be detected «in the phloem sap» ✓ f. stylets at different parts of the plant can show sequence/rate of movement ✓		3 max
3.	a	«all» juvenile shoots root more successfully/significantly/show higher percentage rooting success ✓	<i>Need comparative wording for the mark.</i>	1
	b	a. juvenile shoots have more undifferentiated/meristem/dividing tissues ✓ b. juvenile shoots have faster response to auxin ✓		1 max

Question		Answers	Notes	Total
	<b>c</b>	<p>a. the starting leaf area/size/mass/length of cutting would need to be kept similar in all treatment groups ✓</p> <p>b. light/temperature/nutrients/rooting mixture/moisture would need to be the same for all plants and both treatment groups ✓</p> <p>c. cutting taken from same relative point of the shrub/branch ✓</p>	<p><i>A brief description is required rather than a simple naming of the variable.</i></p> <p><i>Accept other reasonable answers.</i></p>	<b>1 max</b>
	<b>d</b>	<p>a. increases <u>cell</u> elongation/growth/enlargement <b>OR</b> has effect on rate of mitosis ✓</p> <p>b. changes the pattern of gene expression <b>OR</b> promotes transcription of some genes ✓</p> <p>c. changes the pH of the extracellular environment/cell wall <b>OR</b> increases activity of proton pumps ✓</p> <p>d. breaks cross links/connections between cellulose fibres in cell wall ✓</p> <p>e. increases cell <u>wall</u> plasticity ✓</p> <p>f. «varying» auxin concentrations have different effects in different parts of the plant ✓</p>		<b>3 max</b>

**Section B**

**Option A — Neurobiology and behaviour**

Question			Answers	Notes	Total
4.	a	i	8 months ✓		1
		ii	a. neural pruning <b>OR</b> loss of neurons ✓  b. through apoptosis/programmed cell death ✓  c. loss of dendrites/axon branches/synapse elimination ✓  d. due to lack of use ✓  e. «in older age» damage to brain/strokes/chemical abuse ✓		3 max
	b		I: interneuron/relay neuron ✓  II: sensory neuron ✓		2
	c		arrow drawn on diagram to show correct direction of impulse ✓  	Arrow can also be a single loop through interneuron showing complete pathway or two arrows to and from interneuron.	1

Question		Answers	Notes	Total
5.	a	the higher the body mass, the higher the brain mass <b>OR</b> positive correlation ✓		1
	b	bat ✓		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/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: – Accept other discussion to explain why data not clear.</i>	3 max

Question	Answers	Notes	Total
6.	<p>a. more than one presynaptic neuron can form a synapse with the same postsynaptic neuron ✓</p> <p>b. summation involves combining the effects of «excitatory and inhibitory» neurotransmitters/potentials  <b>OR</b>                      action potentials form depending on the balance of signals of excitatory and inhibitory signals ✓</p> <p>c. E1 and E2/two excitatory potentials/effects are added ✓</p> <p>d. «E1 and E2/two excitatory potentials» depolarizes membrane ✓</p> <p>e. «membrane potential» goes above threshold  <b>OR</b>                      generate action potential ✓</p> <p>f. effect of inhibitory neurotransmitter/potential/ I1 cancels effect of excitatory neurotransmitter/E1  <b>OR</b>                      effect of inhibitory neurotransmitter/potential/ I1 prevents threshold being reached when E1 applied ✓</p>		3 max

Question		Answers	Notes	Total
7.	a	<p>a. unconditioned stimulus triggers a response automatically/innately ✓</p> <p>b. sight/smell of food «naturally» triggers salivation in dogs ✓</p> <p>c. conditioned stimulus is a previously neutral stimulus «eg: sound of bell» ✓</p> <p>d. that becomes associated with the unconditioned stimulus «and is learned» ✓</p> <p>e. triggers a conditioned response, salivation with sound before food ✓</p>	<p><i>Award [2 max] if no reference to Pavlov's investigation.</i></p>	3 max
	b	<p>a. food is more abundant ✓</p> <p>b. temperature is more tolerable ✓</p> <p>c. more suitable habitat ✓</p>		2 max
	c	<p><b>Alternative 1</b></p> <p>a. females have their cubs/are lactating at same time ✓</p> <p>b. can suckle/care for each other's cubs while others hunt ✓</p> <p>c. cubs are more likely to survive when they are raised in a nursery rather than by a solitary mother ✓</p> <p><b>Alternative 2</b></p> <p>d. a group of <u>male</u> cubs, of same age, leave the pride at the same time ✓</p> <p>e. so can compete for dominance of another pride more effectively ✓</p>		2 max



Question	Answers	Notes	Total
<p><b>d</b></p>	<p>a. involve changes in neurons caused by slow-acting neurotransmitters ✓                      b. neurons make new connections/increase number of synapses ✓                      c. «short-term» memory depends on change in strength of existing neuronal connections ✓                      d. long-term potentiation «LTP» is a lasting increase in strength of synaptic transmission ✓                      e. more receptors added to enhance synaptic transmission ✓</p>		<p><b>2 max</b></p>
<p><b>8.</b></p>	<p>a. detected by the cones  <b>OR</b>                      cones are photoreceptors ✓                      b. they are located in the retina/concentrated in the fovea ✓                      c. three types of cones that absorb different wavelengths of «visible» light ✓                      d. cones absorb light passing impulse to bipolar cell ✓                      e. bipolar cells connected to ganglion cells ✓                      f. there is one to one connection of cones to bipolar cells  <b>OR</b>                      one to one connection of bipolar cells to ganglion cells ✓                      g. relayed to the optic nerve ✓                      h. right field of vision «of both eyes» is sent to the left part of the brain ✓                      i. information is passed to the visual cortex/occipital lobe ✓</p>	<p><i>Vice versa</i></p>	<p><b>6 max</b></p>

**Option B — Biotechnology and bioinformatics**

Question			Answers	Notes	Total
9.	a		a. NADH is required as a reducing agent/electron donor/hydrogen donor/co-enzyme/limiting factor for the production of succinate ✓ b. high levels of FDH1 produce greater quantities of NADH which is required for conversion of glucose «via intermediates» to succinate ✓		1 max
	b		a. lactate/ethanol ✓ b. CO <sub>2</sub> «favoured by high FDH1 levels» ✓		1 max
	c		a. raw materials are supplied in continuous amounts ✓ b. products/wastes are continuously extracted ✓ c. conditions are monitored/regulated to keep variables at a steady state ✓		2 max
	d		genetic processes/rate limiting chemicals/regulatory processes are being optimized ✓		1

10.	a	i	resistance is «exponentially» <u>increasing</u> ✓	OWTTE	1
		ii	a. increased growth/differential survival of resistant population <b>OR</b> natural selection for glyphosate resistance ✓ b. evolution of resistance is possible due to pre-existing variability ✓ c. «strong» selective pressure «by application of glyphosate» ✓		1 max

Question	Answers	Notes	Total
b	a. increased crop yields <b>OR</b> reduced demand for more land ✓  b. less application of other herbicides «to control weeds» <b>OR</b> glyphosate can replace more toxic/persistent herbicides ✓  c. less need for tilling/plowing/ploughing <b>OR</b> less soil erosion ✓  d. «less plowing/herbicide application» uses less fuel/less emissions produced ✓		2 max
c	a. <i>Agrobacterium tumefaciens</i> «Ti» plasmid causes tumours in the plant it infects ✓ b. donor gene inserted into Ti plasmid ✓ c. along with antibiotic resistance gene ✓ d. construct/recombinant Ti plasmid re-inserted into an <i>A. tumefaciens</i> bacterium ✓ e. infect leaf with bacterium «and grow on antibiotic medium» ✓ f. «some surviving» cells contain the gene/are glyphosate resistant ✓		3 max

Question		Answers	Notes	Total
11.	a	uses it as an energy source/carbon source/electron acceptor ✓	<i>Do not accept "metabolizes" it.</i>	1
	b	a. to allow for the formation of a <u>biofilm</u> <b>OR</b> does not get washed away/can be re-used ✓ b. increases surface area which increases contact between bacteria and dye ✓		1 max
	c	a. name of microorganism ✓ b. name of pollutant ✓ c. outline of action ✓	<i>eg: Pseudomonas</i> <i>Must use at least Genus name.</i>  <i>eg: oil</i>  <i>eg: uses oil as energy/carbon source</i> <i>OR</i> <i>degrades oil</i>  <i>Allow other valid checked examples</i>	3

12.	a	it is from a North Atlantic population ✓		1
	b	it is from dolphin/species that is not on the list ✓		1
	c	a. collected DNA sample is small/too minute to study ✓ b. DNA from tissue sample amplified «by PCR» <b>OR</b> obtain increased yields/quantities of specific DNA sequences ✓ c. test primers «from legal species» are used ✓ d. example of genes used «to construct test primers» ✓ e. if no amplification occurs, then test is negative ✓	<i>eg: 18S ribosome, cytochrome C oxidase</i>	3 max

Question		Answers	Notes	Total
	d	a. sequence a sample of DNA/protein from the tissue ✓ b. run a BLAST/sequences alignment software search for similar sequences «of DNA/protein» ✓ c. a match can be used for species identification <b>OR</b> percentage similarity of sequences used to build up cladogram ✓ d. BLASTp is used if protein sequenced <b>AND</b> BLASTn if DNA sequenced ✓	<i>Both needed.</i>	<b>2 max</b>
13.		a. infected individual will have pathogens/antigens in bodily fluids ✓ b. test contains immobilized/fixed antibodies to the pathogen/antigen ✓ c. if present, antigen binds to «immobilized» antibody/capture molecule ✓ d. solution is washed and only fixed antigen-antibody complexes persist ✓ e. then a detection antibody linked to an enzyme is added ✓ f. reacts with fixed antigen-antibody complex ✓ g. a chromogenic/potentially fluorescent substance is added ✓ h. enzyme changes substance to a different/detectable colour ✓ i. the presence of colour is a positive response/absence of colour a negative response ✓		<b>6 max</b>

**Option C — Ecology and conservation**

Question		Answers	Notes	Total
14.	a	a. line transect <b>OR</b> a line is identified and individual walks the line ✓ b. decision on where to start and end the line/transect ✓ c. samples taken every <u>20 m</u> /at regular intervals ✓		2 max
	b	a. activity of soil microorganisms/ammonification/nitrogen fixation ✓ b. urine/feces/other nitrogenous waste ✓ c. dead organisms ✓ d. fertilizers «on edge of forest» ✓		2 max
	c	a. greater distance from an open field where they are applying fertilizer ✓ b. more ammonium absorbed/recycled ✓ c. less ammonium in rain reaches soil/trapped in treetops ✓		1 max

Question		Answers	Notes	Total
15.	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 that which organism actually occupies ✓</p> <p>b. presence of another 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
16.	a	a. increases ✓ b. at a greater rate early on ✓ c. seems to plateau/levels off ✓		2 max
	b	a. forest developed ✓ b. increase in biomass «over years» requires rainfall ✓ c. water is a limiting factor to photosynthesis ✓		2 max
	c	a. initially there is low competition for sunlight/resources ✓ b. photosynthesis allows accumulation of biomass ✓ c. biomass rises as larger plants replace smaller plants ✓ d. «in later stages» biomass increase limited due to competition for resources <b>OR</b> biomass stabilizes as climax community reached ✓		2 max
	d	a. development of mature trees requires xylem/wood ✓ b. xylem/wood contributes to biomass but not respiration ✓ c. photosynthesis/production greater than respiration ✓ d. photosynthesis/production continues to accumulate biomass <b>OR</b> accumulated biomass remains/increases ✓		2 max



Question		Answers	Notes	Total
17.	a	«coloured object» mistaken for food <b>OR</b> skimming of ocean surface for food leads to plastic intake ✓		1
	b	a. ocean currents concentrate plastic debris ✓ b. Kure receives more debris than Oahu ✓ c. more plastic available/more exposure to human populations/waste in the environment of Kure ✓		2 max
	c	a. «macro» plastics blown/carried/washed from land sources into the ocean ✓ b. degraded overtime ✓ c. to form microplastic fragments ✓ d. substances already containing microplastics «eg: washing/cleansing products» get into water ✓		2 max
	d	a. microplastic ingested by organisms at lower trophic levels ✓ b. accumulates in the tissues/guts of organisms ✓ c. becomes concentrated in the organs/tissues of organisms as moves through the food chain/at higher trophic levels ✓		2 max

Question	Answers	Notes	Total
18.	<p>a. sampling does not count every organism so may not be a true estimate ✓</p> <p>b. highly mobile marine animals unevenly distributed so difficult to estimate population size ✓</p> <p>c. transects/quadrats used to estimate populations of stationary organisms ✓</p> <p>d. useful on rocky shores/beaches/intertidal zones/reef ✓</p> <p>e. estimation of mobile larval stages of stationary organisms/coral more difficult ✓</p> <p>f. capture-mark-release-recapture useful for mobile animals in restricted environments ✓</p> <p>g. example of organism can estimate by this technique ✓</p> <p>h. drawback of technique ✓</p> <p>i. echolocation/sonar used to estimate the population size of fish that form shoals ✓</p> <p>j. echolocation cannot distinguish between species ✓</p> <p>k. the age structure of «commercially» caught fish can be used to estimate population size ✓</p> <p>l. restricted-age fish «as bycatch» dumped before landing so biased estimates  <b>OR</b>                      depends on accuracy/honesty of those catching fish ✓</p>	<p><i>Vice versa</i></p> <p><i>Accept other valid limitation.</i></p>	<p><b>6 max</b></p>

Option D — Human physiology

Question		Answers	Notes	Total	
19.	a	<p>a. «essential amino acids» must be obtained from the diet ✓</p> <p>b. they cannot be synthesized by the body <b>OR</b> they cannot be synthesized from other amino acids ✓</p>		2 max	
	b	i	tyrosine can only be synthesized when phenylalanine is in the diet ✓	<i>Accept inverse: if phenylalanine is not in the diet the person will not be able to synthesize tyrosine.</i>	1
		ii	<p>recessive inherited «genetic» condition <b>OR</b> they lack «the enzyme» phenylalanine hydroxylase <b>OR</b> mutated form of PAH gene ✓</p>		1
	c	<p>a. contain <u>all</u> of the essential amino acids ✓</p> <p>b. human milk has higher levels of 5 «out of 9» essential amino acids than cow milk <b>OR</b> human milk has the same or more of essential amino acids except histidine and lysine compared to cow milk ✓</p> <p>c. human milk is the same or higher in all essential amino acids except histidine compared with hen egg <b>OR</b> human milk has higher levels of 4 «out of 9» essential amino acids compared with hen egg ✓</p> <p>d. «limitation» human milk contains less histidine than both hen egg <b>AND</b> cow milk ✓</p>	<i>Both needed.</i>	2 max	

Question	Answers	Notes	Total
<p><b>d</b></p>	<p><i>Prolactin</i></p> <ul style="list-style-type: none"> <li>a. produced by the anterior pituitary ✓</li> <li>b. stimulates mammary glands to grow ✓</li> <li>c. stimulates the production of milk ✓</li> </ul> <p><i>Oxytocin</i></p> <ul style="list-style-type: none"> <li>d. produced in neurosecretory cells «in hypothalamus» <b>OR</b> stored/secreted by posterior pituitary ✓</li> <li>e. suckling/nursing stimulates oxytocin release <b>OR</b> example of positive feedback ✓</li> <li>f. «contractions» cause ejection/release of milk from mammary glands ✓</li> </ul>	<p>Award <b>[2 max]</b> if response only mentions one of the hormones.</p>	<p><b>3 max</b></p>
<p><b>e</b></p>	<ul style="list-style-type: none"> <li>a. presence of ducts ✓</li> <li>b. presence acini/acinar/secretory cells ✓</li> <li>c. ducts leads to a body surface/cavity/gut ✓</li> </ul>		<p><b>2 max</b></p>

Question		Answers	Notes	Total
20.	a	38 hours ✓	<i>Accept 38 hours to 40 hours. Units required.</i>	1
	b	a. higher digestible matter content, longer residence time ✓ b. slower movement/peristalsis due to lack of fiber ✓ c. fiber/indigestible material attracts water to feces/lumen/intestinal contents ✓ d. more digestible material increases water absorption «into large intestine» ✓ e. hardens stool/constipation and further increases residence time ✓		3 max
21.	a	a. septum depolarizes <b>OR</b> signal from AVN/atrioventricular node ✓ b. conducting fibers carry impulses through the ventricle wall <b>OR</b> carry impulse through Bundle of His/Purkinje fibers ✓ c. ventricles depolarize <b>OR</b> atrioventricular valves close ✓ d. atria repolarize ✓ e. ventricle contraction/systole initiated ✓	<i>Do not accept the alternative mp if other valves closing is mentioned as well.</i>	2 max

Question	Answers	Notes	Total
b	a. epinephrine/peptide/protein/hydrophilic hormones bind to «receptors in» plasma membrane ✓ b. involves synthesis/release/activation of second messenger/cyclic AMP/cAMP ✓ c. triggers cascade of events ✓ d. leads to promotion/inhibition of enzymes <b>OR</b> causes activation of protein kinase ✓ e. causes the hormone effect ✓		3 max
c	use a defibrillator to restore/reset normal rhythm/to shock the heart/restore heart beat <b>OR</b> application of an electric discharge to the chest to restore normal rhythm ✓	Do not accept pacemaker  Need something more than one word answer as this is an “outline”.	1
d	a. high CO <sub>2</sub> levels lead to decrease in pH/increased acidity ✓ b. chemoreceptors found in the medulla oblongata/aorta/carotid artery ✓ c. they are able to detect a change in blood pH/CO <sub>2</sub> concentration ✓ d. «chemoreceptors» send message/impulse to the respiratory centre ✓ e. respiratory centre «in medulla oblongata» controls ventilation rate ✓ f. triggers an increase in the ventilation rate to rid the body of CO <sub>2</sub> ✓	Accept inverse statements using low CO <sub>2</sub> concentration/higher pH.	3 max

Question	Answers	Notes	Total
22.	<p>a. stores glucose as glycogen  <b>OR</b>  releases glucose from glycogen ✓</p> <p>b. under influence of insulin/glucagon «respectively» depending on blood glucose levels ✓</p> <p>c. some nutrients in excess can be stored in the liver ✓</p> <p>d. the liver detoxifies blood  <b>OR</b>  the liver removes/breaks down toxins/alcohol/drugs «from the blood» ✓</p> <p>e. Kupffer cells engulf bacteria ✓</p> <p>f. Kupffer cells breakdown erythrocytes/red blood cells/hemoglobin by phagocytosis ✓</p> <p>g. hemoglobin is split into heme and globin ✓</p> <p>h. iron from heme/hemoglobin breakdown is carried to the bone marrow «to produce new hemoglobin in new red blood cells»  <b>OR</b>  excess iron stored in liver ✓</p> <p>i. surplus cholesterol is converted to bile salts  <b>OR</b>  cholesterol is synthesized ✓</p> <p>j. «hepatocytes» produce plasma proteins ✓</p>	<p><i>Accept vitamin A or D stored.</i></p> <p><i>Accept specific plasma proteins such as albumin.</i></p>	<p><b>6 max</b></p>