



Markscheme

May 2017

Biology

Higher level

Paper 2

18 pages

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Section A

Question		Answers	Notes	Total
1.	a	45 «pmol g ⁻¹ » ✓	<i>Allow answers in the range of 44 «pmol g⁻¹» to 46 «pmol g⁻¹».</i>	1
	b	less auxin as the leaves become older/larger OR negative correlation from L1 to L4 ✓ L4 and L6 leaves have least auxin concentration OR L4 and L6/older leaves have about the same concentration of auxin/do not have significantly different concentrations ✓	<i>Vice versa</i>	2
	c	a. NPA decreased the «mean» number of roots per rooted cutting «by about 5x» ✓ b. NPA decreased the «mean» length per root «by more than half» ✓ c. NPA decreased the «mean» total root length per planted cutting «to about 2% of control» ✓ d. NPA inhibited the formation of roots OR decreased all three measures ✓	<i>Accept other correct statements of overall changes in values. The word “mean” is not required.</i> <i>OWTTE</i> <i>OWTTE</i>	2 max

(continued...)

(Question 1 continued)

Question		Answers	Notes	Total
d	i	a. both decrease up to 6 hours/initially ✓ b. NPA-treated decrease more/at a faster rate than control «up to 6 hours» ✓ c. after 6 hours, control increases while NPA treated continues to fall ✓		2 max
	ii	a. NPA «appears to have» no effect on concentrations/transport of auxin in L6 as control and NPA-treated remain at same «low» level ✓ b. NPA «probably» inhibits the auxin efflux pumps/transport «in the leaves» as the levels drop in NPA-treated in stem base «but not in control» ✓ c. the transport of auxin to the stem base must occur from younger leaves OR L6 is not the source of auxin in the stem base ✓ d. NPA inhibits the auxin pumps/transport «in the leaves» as the levels drop in NPA-treated in stem base ✓	OWTTE A valid reason must be given for the mark. OWTTE A valid reason must be given for the mark.	2 max
e		a. L1 has the highest concentration of auxin so appears to be/is the main source/the producer of auxin ✓ b. as leaves age, they «appear to» decrease the production of auxin ✓ c. the stem base is an auxin sink as seen by the accumulation in the control stem base «where roots form» ✓ d. high concentration of auxin «in the stem base» promotes root formation ✓	Vice versa OWTTE Vice versa	3 max

(continued...)

(Question 1 continued)

Question		Answers	Notes	Total
	f	i	mRNA/RNA ✓	1
		ii	<p>a. at 2 and 24 hours, auxin levels are similar and at 2 and 24 hours <i>GH3</i> levels are similar ✓</p> <p>b. the pattern for the formation of auxin is similar to the pattern of transcription of the <i>GH3</i> gene</p> <p>OR</p> <p>both decrease and then increase ✓</p> <p>c. «however» there is a lag between the peaks of the <i>GH3</i> transcription and the peaks of auxin ✓</p>	<p><i>A comparison must be made to award marks. Do not award marks for simple completion of the table.</i></p> <p>2 max</p>
		iii	<p>a. the data «partially» supports the conclusion</p> <p>OR</p> <p>the relationship is not clear ✓</p> <p>b. the auxin concentration «seems to» rise before the transcription level increases</p> <p>OR</p> <p>there is a lag between auxin concentration changing and transcription level changing</p> <p>OR</p> <p>the auxin concentration falls before the transcription level falls ✓</p> <p>c. more data is needed «before two hours/after 24 hours» ✓</p>	<p><i>To award mp b, awareness of the lag should be demonstrated</i></p> <p>2 max</p> <p><i>OWTTE</i></p>

Question		Answers	Notes	Total	
2.	a	<p>a. competitive inhibitor «slows the reaction rate as it» competes for the active site OR competitor has similar shape/structure/composition to substrate «and slows the reaction rate» ✓</p> <p>b. binding of competitor is reversible ✓</p> <p>c. «as the substrate concentration increases» more substrate binds to the active site than the competitor «and reaction rate increases» ✓</p> <p>d. «as the substrate concentration increases» the reaction rate reaches the maximum plateau «same as with no inhibitor» ✓</p>		2 max	
	b	i	the inner mitochondrial membrane cristae/thylakoid membrane ✓	1	
		ii	<p>a. protons build up in the intermembrane space due to electron transport chain ✓</p> <p>b. protons move through ATP synthase down the concentration gradient ✓</p> <p>c. catalyses formation of ATP ✓</p>	<p>OWTTE</p> <p>Accept H⁺ ions in place of protons</p> <p>OWTTE</p>	2 max

Question		Answers	Notes	Total
3.	a	a. water molecules are polar OR can form hydrogen bonds ✓ b. cohesion between water molecules allows continuous water columns OR cohesion between water molecules allows transpiration stream «to form in xylem» ✓ c. adhesion of water to the walls of xylem vessel «helps water rise» ✓ d. water evaporates at environmental temperatures allowing transpiration pull ✓	OWTTE	2 max
	b	«measurement of» solute concentration of a solution ✓	OWTTE	1
	c	cell 2 because it has plasmolized/lost water/volume has decreased ✓		1
	d	decreased ✓		1

Question			Answers	Notes	Total
4.	a	i	earthworm/woodlouse ✓		1
		ii	bacteria/fungi ✓	<i>Do not accept protozoans or nematodes as they are consumers.</i>	1
	b		eukaryote/eukaryota/eukarya ✓		1
	c		<p>a. light energy of Sun is converted by plant/autotroph to chemical energy «in carbon compounds through photosynthesis» ✓</p> <p>b. detritivores/saprotrophs decay plant material «that accumulates in the soil» to obtain energy ✓</p> <p>c. consumers release energy from the carbon compounds by cell respiration energy lost as heat ✓</p> <p>d. energy is used by organisms for metabolism ✓</p> <p>e. energy is transferred between organisms/trophic levels through the food chains/web ✓</p> <p>f. energy is lost at each trophic level «so lengths of food chains/web are restricted»</p> <p>OR</p> <p>approximately 80/90 % of energy is lost «between trophic levels» ✓</p>	<p><i>Award mark points that refer to the specific organisms from this food web.</i></p> <p><i>OWTTE</i></p> <p><i>For mp e, accept specific example such as energy is transferred from primary to secondary consumer etc.</i></p> <p><i>Vice versa</i></p>	3 max

Question			Answers	Notes	Total
5.	a	i	a. radiation ✓ b. chemical mutagens/carcinogens/papilloma virus/cigarette smoke ✓	<i>Do not accept low energy radiation/visible light/radio waves.</i> <i>Do not accept air pollution on its own as it is too vague. Accept carcinogenic viruses.</i>	1 max
		ii	base substitution/insertion/deletion/frameshift ✓	<i>Do not accept <u>diseases</u> caused by mutation such as sickle cell anemia as an answer on their own.</i>	
	b	i	a. jointed appendages ✓ b. «chitinous» exoskeleton ✓ c. segmented body OR bilateral symmetry OR mouth AND anus OR paired appendages ✓	<i>mp c features in arthropods that are also shared with other phyla.</i> <i>Accept "open circulatory system".</i>	2 max

(continued...)

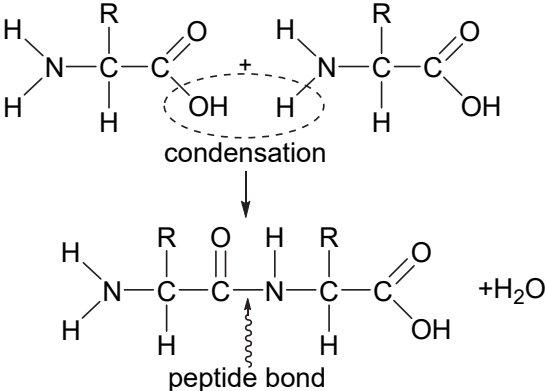
(Question 5 continued)

Question		Answers	Notes	Total
	ii	<p>a. «scientists would accept» hypothesis A as the better one as mutations are random ✓</p> <p>b. scientists would reject hypothesis B because characteristics acquired during the lifetime of the individual being inherited is Lamarckian/not part of the evolution by natural selection theory/not all mutations are heritable ✓</p> <p>c. «the resistance» mutation would be present in the population initially and not caused by the shampoo «as hypothesis B states» ✓</p> <p>d. both hypotheses include variation in the population of lice «resistant and non-resistant» ✓</p> <p>e. variation is necessary for natural selection to occur ✓</p> <p>f. frequency of the best adapted increases and these individuals <u>reproduce/pass on resistance to their offspring</u>, so the resistant population increases «so hypothesis A is better» ✓</p>	<p><i>OWTTE can be used for any of the answers in this part.</i></p>	<p>3 max</p>

Section B

Clarity of communication: [1]

The candidate's answers are clear enough to be understood without re-reading. The candidate has answered the question succinctly with little or no repetition or irrelevant material.

Question	Answers	Notes	Total
<p>6. a</p>	<p>a. each amino acid with a COO⁻/COOH group at one end AND a NH₂/NH₃⁺ at the other ✓</p> <p>b. CH in middle with H or R group attached ✓</p> <p>c. peptide bond correctly drawn between N and C=O ✓</p> <p>d. COO⁻/COOH group at one end of dipeptide AND NH₂/NH₃⁺ at other end ✓</p> <p>e. loss of water ✓</p> <p>eg:</p> 	<p><i>Both needed.</i></p> <p><i>mp a requires the double bond to be shown between the C and O.</i></p> <p><i>Both needed.</i></p>	<p>4 max</p>

(continued...)

(Question 6 continued)

Question	Answers	Notes	Total
b	<p>a. A, P and E binding sites are on the large subunit of the ribosome ✓</p> <p>b. initiation of translation starts with binding of met-tRNA to the start codon ✓</p> <p>c. large sub-unit binds with «start» tRNA in the P site ✓</p> <p>d. A binding site holds the tRNA with the next amino acid to be added ✓</p> <p>e. peptide bond is formed between the amino acids of the A site and the polypeptide at the P site ✓</p> <p>f. polypeptide is transferred to the tRNA in the A site ✓</p> <p>g. the tRNA «with polypeptide» in A site then moves to P site</p> <p>OR</p> <p>P binding site holds the tRNA attached to the growing polypeptide ✓</p> <p>h. E binding site «exit» is where the tRNA «from P site without amino acid» leaves the ribosome ✓</p>	<p><i>Accept annotated diagrams of the sites.</i></p>	<p>4 max</p>

(continued...)

(Question 6 continued)

Question	Answers	Notes	Total
c	a. each antibody corresponds to a specific antigen ✓ b. antibodies are necessary for immunity/resistance to «infectious» disease ✓ c. macrophage/phagocyte ingests/engulfs pathogen ✓ d. macrophage/phagocyte digests pathogen ✓ e. macrophage/phagocyte displays antigen from pathogen ✓ f. antigens of a pathogen correspond to a specific T lymphocytes/cells OR T lymphocytes/cells are activated by antigen binding ✓ g. T lymphocytes/cells activate B lymphocytes/cells ✓ h. «B cells» divide by mitosis to form many/clones of plasma cells ✓ i. plasma cells secrete specific antibody ✓ j. some «activated» B lymphocytes/cells act as memory cells ✓	Accept annotated diagrams of the process.	7 max

(Plus up to [1] for quality)

Question		Answers	Notes	Total
7.	a	a. can be sympatric or allopatric ✓ b. temporal isolation by members of difference populations reproducing at different times ✓ c. behavioural isolation by difference in courtship behaviours ✓ d. geographic isolation by a population being separated by river/mountain/barrier to contact ✓ e. polyploidy ✓	OWTTE OWTTE <i>An example of a geographic barrier is required</i>	3 max
	b	a. spermatogonia «2n» are undifferentiated germ cells ✓ b. spermatogonia mature and divide «by mitosis» into primary spermatocytes «2n» ✓ c. primary spermatocytes divide by meiosis I into secondary spermatocytes «1n» ✓ d. secondary spermatocytes divide by meiosis II into spermatids «1n» ✓ e. spermatids differentiate/mature into spermatozoa/sperm ✓ f. Sertoli/nurse cells provide nourishment/support to these developing cells ✓ g. Leydig/interstitial cells produce testosterone ✓	OWTTE	4 max

(continued...)

(Question 7 continued)

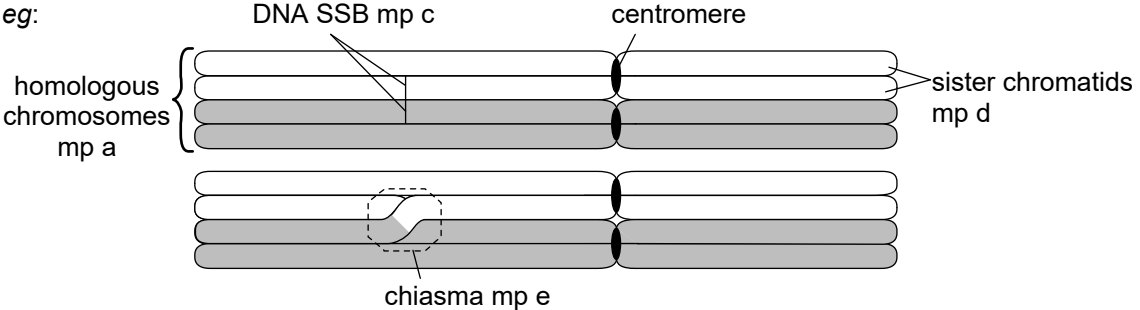
Question	Answers	Notes	Total
<p>c</p>	<p>a. anterior pituitary/hypophysis secretes FSH which stimulates ovary for follicles to develop ✓</p> <p>b. follicles secrete estrogen ✓</p> <p>c. estrogen stimulates more FSH receptors on follicle cells so respond more to FSH ✓</p> <p>d. increased estrogen results in positive feedback on «anterior» pituitary ✓</p> <p>e. estrogen stimulates LH secretion ✓</p> <p>f. estrogen promotes development of endometrium/uterine lining ✓</p> <p>g. LH levels increase and cause ovulation ✓</p> <p>h. LH results in negative feedback on follicle cells/estrogen production ✓</p> <p>i. LH causes follicle to develop into corpus luteum</p> <p>OR</p> <p>follicle cells produce more progesterone ✓</p> <p>j. progesterone thickens the uterus lining ✓</p> <p>k. high progesterone results in negative feedback on pituitary/prevents FSH/LH secretion ✓</p> <p>l. progesterone levels drop and allow FSH secretion ✓</p> <p>m. falling progesterone leads to menstruation/degradation of uterine lining ✓</p>	<p>Award [5 max] if no reference to feedback is made.</p>	<p>8 max</p>

(Plus up to **[1]** for quality)

Question		Answers	Notes	Total
8.	a	a. mitosis is the division of a nucleus to produce two genetically identical daughter nuclei ✓ b. consists of four phases: prophase, metaphase, anaphase, telophase ✓ c. cytokinesis occurs after mitosis ✓ d. interphase is the metabolically active phase between cell divisions ✓ e. the interphase consists of the S phase, G1 and G2 ✓ f. DNA replicates in the S phase ✓ g. cell growth OR preparation for mitosis OR duplication of organelles in G1 and G2 ✓	OWTTE	4 max

(continued...)

(Question 8 continued)

Question	Answers	Notes	Total
<p>b</p>	<p>a. «crossing over/chiasmata shown between» homologous chromosomes ✓</p> <p>b. centromere drawn and labelled ✓</p> <p>c. single strand break «SSB»/DNA cut between homologous chromosomes ✓</p> <p>d. non-sister chromatids labelled</p> <p>OR</p> <p>sister chromatids labelled ✓</p> <p>e. chiasma between homologous chromosomes labelled «shown forming after SSB» ✓</p> <p>eg:</p> 	<p><i>Homologous chromosomes must be labelled and correctly drawn.</i></p> <p><i>It is likely that more than one diagram will need to be included to demonstrate the stages.</i></p>	<p>3 max</p>

(continued...)

(Question 8 continued)

Question	Answers	Notes	Total
c	<p>a. mRNA conveys genetic information from DNA to the ribosomes «where it guides polypeptide production» ✓</p> <p>b. gene expression requires the production of specific mRNA «through transcription» ✓</p> <p>c. most genes are turned off/not being transcribed at any one time/regulated OR some genes are only expressed at certain times ✓</p> <p>d. some genes are only expressed in certain cells/tissues OR «cell» differentiation involves changes in gene expression ✓</p> <p>e. transcription factors/proteins can increase/decrease transcription ✓</p> <p>f. hormones/chemical environment of cell can affect gene expression ✓</p> <p>g. example of cell environment ✓</p> <p>h. transcription factors/proteins may prevent or enhance the binding of RNA polymerase ✓</p> <p>i. nucleosomes limit access of transcription factors to DNA/regulate gene expression/transcription OR activate or silence genes ✓</p> <p>j. DNA methylation/acetylation appears to control gene expression «as epigenetic factor» OR methylated genes are silenced ✓</p> <p>k. «some» DNA methylation patterns are inherited ✓</p> <p>l. introns may contain positive or negative gene regulators OR gene expression can be regulated by post-transcriptional modification/splicing/mRNA processing ✓</p>	<p>eg: auxin/insulin/cytoplasmic gradient in embryo</p>	8 max

(Plus up to [1] for quality)