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MARK SCHEME

Maximum Mark: 100

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Question	Answer	Marks
1(a)(i)	the longer the loop of Henle the lower the water potential of the urine ;	1
1(a)(ii)	1 dry environment / AW ; 2 need to conserve water / AW ;	2
1(b)	<i>microvilli:</i> 1 large(r) surface area ; 2 for absorption of, Na^+ / glucose / amino acids ; <i>many mitochondria:</i> 3 provide, energy / ATP ; R produce energy 4 for, Na^+ / K^+, pumps ; OR for active transport of, Na^+ / K^+ ; <i>tight junctions between cells:</i> 5 hold adjacent cells together ; 6 fluid cannot pass between cells / substances must pass through cells ;	6

Question	Answer	Marks
2(a)(i)	4 correct = 2 marks 2/3 correct = 1 mark <i>glycolysis:</i> 1 cytoplasm / cytosol / sarcoplasm ; <i>link reaction:</i> 2 mitochondrial matrix ; <i>Krebs cycle:</i> 3 mitochondrial matrix ; <i>oxidative phosphorylation:</i> 4 inner (mitochondrial) membrane / cristae ;	2
2(a)(ii)	<i>two from:</i> 1 too big to pass through (membrane / glucose's protein channel) ; 2 polar / AW ; 3 no specific, transport / carrier / channel, protein (for phosphorylated glucose) ;	2 max

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Question	Answer	Marks
2(b)	<i>five from:</i> <i>in anaerobic conditions:</i> 1 only, glycolysis / conversion of glucose into pyruvate, occurs ; 2 (only) produces 2 molecules of ATP (net) ; 3 (only) substrate-linked phosphorylation (occurs) ; 4 pyruvate converted to lactate ; 5 lactate is energy-rich / AW ; 6 oxygen not available as final electron acceptor ; 7 electron transport chain / chemiosmosis / oxidative phosphorylation, does not occur ; 8 most ATP is produced (in aerobic conditions) in, electron transport chain / chemiosmosis / oxidative phosphorylation ;	5 max
2(c)	<i>three from:</i> 1 reference oxygen debt ; 2 converts lactate to, pyruvate / glucose ; 3 in liver (cells) ; 4 re-oxygenate, haemoglobin / myoglobin ; 5 meet demands of continued increased metabolic rate / AW ;	3 max

Question	Answer	Marks
3(a)(i)	A – aleurone layer ; B – endosperm ; C – embryo ;	3

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Question	Answer	Marks
3(a)(ii)	<i>six from:</i> - embryo / C, produces / releases, gibberellin ; (arrow 1) gibberellin moves into, aleurone layer / A ; - gibberellin stimulates production of amylase ; (arrow 2) amylase moves into, endosperm / B - hydrolyses / breakdown, starch to maltose ; (arrow 3) maltose / glucose, moves into, embryo / C ; - for respiration / to release energy / for ATP production ; - for, germination / growth ;	6 max
3(b)(i)	3.6 ; $\mu\text{m min}^{-1}$ OR $\mu\text{m} / \text{min}$;	2
3(b)(ii)	<i>two from:</i> - auxin binds with receptor (on cell surface membrane) ; - proton pumps activated ; H^+ pumped into cell wall ;	2 max

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Question	Answer	Marks
3(b)(iii)	<i>three from:</i> 1 expansins activated / AW ; A optimum pH for expansins 2 loosens bonds in cellulose microfibrils ; 3 K⁺ ions enter cells (lower water potential) ; 4 (so) cells take in water by osmosis / AW ; 5 (increase in turgor causes) cell walls to stretch ;	3 max

Question	Answer	Marks
4(a)(i)	<i>three from:</i> 1 reference to limiting factors ; 2 (limiting factor) not carbon dioxide ; 3 (limiting factor possibly) light intensity / temperature ;	2 max
4(a)(ii)	<i>three from:</i> <i>sugar cane:</i> ORA barley 1 (rate of photosynthesis) higher rate, at lower concentrations of CO₂ / initially ; 2 levels off / becomes constant, at lower rate of photosynthesis ; 3 levels off / becomes constant, at a lower carbon dioxide concentration ; 4 data quote to support mp2 or mp3 ; e.g. mp2 – sugar cane at 7–7.5 au and barley at 14 au OR mp3 – sugar cane at 60–70 au and barley at 500 au	3 max

Question	Answer	Marks
4(a)(iii)	<i>four from:</i> 1 sugar cane / C4 plants, can reduce photorespiration ; 2 correct ref. to adaptation to reduce photorespiration ; e.g. RuBP and rubisco, in bundle sheath cells / kept away from air OR tightly packed mesophyll cells 3 enzymes in, sugar cane / C4 plants, have high(er) optimum temperature ; 4 carbon dioxide absorbed by mesophyll cells ; 5 carbon dioxide, fixed by PEP carboxylase / combines with PEP ; 6 PEP carboxylase has higher affinity for carbon dioxide than rubisco ;	4 max
4(b)	<i>conditions (max two):</i> 1 low light intensity ; A at night / in the dark 2 dry conditions ; 3 high temperatures ; 4 high light intensity ; 5 high wind speed / AW ; <i>benefits (max two):</i> 6 reduce transpiration (rate) ; 7 (so) conserves water ; 8 retains turgidity of cells ; 9 (physical) support of plant / prevents wilting ;	4 max

Question	Answer	Marks																									
5(a)	having identical alleles (of a gene) ;	1																									
5(b)	MmDd ;	1																									
5(c)	<table border="1"><tr><td>gametes</td><td>MD</td><td>Md</td><td>mD</td><td>md</td></tr><tr><td>MD</td><td>MMDD dark purple</td><td>MMDd dark purple</td><td>MmDD dark purple</td><td>MmDd dark purple</td></tr><tr><td>Md</td><td>MMDd dark purple</td><td>MMdd purple</td><td>MmDd dark purple</td><td>Mmdd purple</td></tr><tr><td>mD</td><td>MmDD dark purple</td><td>MmDd dark purple</td><td>mmDD white</td><td>mmDd white</td></tr><tr><td>md</td><td>MmDd dark purple</td><td>Mmdd purple</td><td>mmDd white</td><td>mmdd white</td></tr></table> order D/d followed by M/m, or M/m followed by D/d are both acceptable one mark for gametes ; two marks for genotypes ; ; two marks for phenotypes linked to genotypes ; ; ratio = 9 dark purple : 3 purple : 4 white ;	gametes	MD	Md	mD	md	MD	MMDD dark purple	MMDd dark purple	MmDD dark purple	MmDd dark purple	Md	MMDd dark purple	MMdd purple	MmDd dark purple	Mmdd purple	mD	MmDD dark purple	MmDd dark purple	mmDD white	mmDd white	md	MmDd dark purple	Mmdd purple	mmDd white	mmdd white	6
gametes	MD	Md	mD	md																							
MD	MMDD dark purple	MMDd dark purple	MmDD dark purple	MmDd dark purple																							
Md	MMDd dark purple	MMdd purple	MmDd dark purple	Mmdd purple																							
mD	MmDD dark purple	MmDd dark purple	mmDD white	mmDd white																							
md	MmDd dark purple	Mmdd purple	mmDd white	mmdd white																							

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Question	Answer	Marks
6(a)	46.5 – 47 ;;; <i>if answer incorrect allow marks for working</i> $q^2 = 0.4$; $p = 0.368$ OR $p = 0.37$;	3
6(b)	<i>four from:</i> 1 mutation ; 2 migration (into, or out of, the population) ; 3 non-random mating occurs ; 4 the population is small ; 5 selective pressure occurs against one of the, alleles / genotypes ; 6 reproduction is asexual ; 7 organism is haploid ;	4 max

Question	Answer	Marks
7(a)	sensory neurone – receives, input/impulses, from receptor ; relay/intermediate/internuncial, neurone – passes impulses on to motor neurone ; motor neurone – sends impulses/output, to the effector ;	3
7(b)	<i>six from:</i> A: 1 Na⁺ cannot enter post-synaptic neurone ; 2 no, depolarisation/action potential, (in post-synaptic neurone) ; B 3 Ca²⁺ cannot enter pre-synaptic neurone ; 4 vesicles cannot, move towards/fuse with, pre-synaptic membrane ; C 5 ACh cannot be released ; 6 into synaptic cleft ; D 7 ACh not broken down ; 8 continuous depolarisation/action potential, of post-synaptic neurone ;	6 max

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Question	Answer	Marks
8(a)	6 ; 18 ;	2
8(b)(i)	<i>three from:</i> 1 inbreeding depression / lack of hybrid vigour ; 2 more chance that harmful recessive alleles may be expressed ; 3 decrease in heterozygosity / increase in homozygosity ; 4 less genetic variation ;	3 max
8(b)(ii)	<i>three from:</i> 1 use sustainable palm oil plantations ; 2 create / leave, corridors between family groups in different parts of the forest ; 3 ban hunting ; 4 create national parks ; 5 educate local people ; 6 re-locate orangutans ; 7 reforestation ;	3 max

Question	Answer	Marks
8(b)(iii)	<i>three from:</i> 1 captive breeding ; 2 detail e.g. IVF / ICSI / sperm banks ; 3 education ; 4 release back into the wild ; 5 research ; 6 health monitoring ;	3 max

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Question	Answer	Marks
9(a)	<i>seven from:</i> <i>ecosystem:</i> 1 self-sustaining unit ; 2 self-contained / defined, area ; 3 community of organisms ; 4 living and non-living / biotic and abiotic ; 5 reference to, interactions / interdependence ; 6 reference to, energy flow / food webs ; <i>niche:</i> 7 role of organism / how it fits in, (in an ecosystem) ; 8 (including) where it lives ; 9 how it obtains its energy / reference trophic level ;	7 max

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Question	Answer	Marks
9(b)	<i>eight from:</i> 1 <u>random</u> (sampling) ; 2 (frame) quadrat ; 3 use cover scale ; 4 estimate % cover ; 5 species frequency ; 6 systematic sampling ; 7 line / belt, transect ; 8 sample at set distances ; 9 mark – release – recapture ; 10 method of, capture / marking ; 11 returned to habitat and left ; 12 population estimate = $\frac{\text{no of individuals in first sample} \cdot \text{no of individuals in second sample}}{\text{no of individuals marked in second sample}}$; 13 appropriate mathematical / statistical technique ;	8 max

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Question	Answer	Marks
10(a)	<i>nine from:</i> 1 production of a large number of copies of a length of DNA / amplification of DNA ; 2 rapid ; 3 only small sample of DNA needed ; 4 DNA, denatured / separated into two strands, by heat / at 95 °C ; 5 primer (DNA) added ; 6 reference to annealing at, 60–65, °C ; 7 reference complementary base pairing ; 8 DNA / Taq, polymerase ; 9 replicates (template) strand at, 70–75, °C ; 10 heated again to separate strands / process repeated ; 11 Taq polymerase, is heat stable / has high optimum temperature ; 12 does not need replacing each cycle ; 13 efficient process ;	9 max

Question	Answer	Marks
10(b)	<i>six from:</i> 1 small / circular, piece of (double-stranded) DNA ; 2 replicate independently / multiple origins of replication ; 3 high copy number ; 4 easy to extract from bacteria ; 5 can be cut using restriction, enzyme / endonuclease ; 6 gene / DNA, can be inserted ; 7 can be taken up by bacteria ; 8 may contain genes for antibiotic resistance / can carry marker genes ; 9 helps in identifying transformed bacteria ; 10 acts as a vector ; 11 may carry promoter ;	6 max