

Mark Scheme for January 2011

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All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

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Question			Expected Answer	Mark	Additional Guidance
1	(a)	(iii)	<p>1 artificial insemination / AI ;</p> <p>2 in vitro fertilisation / IVF ;</p> <p>3 <i>idea of</i> progeny testing ;</p> <p>4 embryo transplantation / use of surrogate mother ;</p> <p>5 cloning ;</p> <p>6 genetic screening / use of gene probes ;</p> <p>7 AVP ;</p> <p>8 AVP ;</p>	2 max	<p>Mark the first suggestion on each line</p> <p>1 IGNORE performance testing</p> <p>2</p> <p>3</p> <p>4 CREDIT embryo splitting</p> <p>5</p> <p>6 ACCEPT genetic engineering</p> <p>7 eg • sex selection technique / screening X and Y sperm</p> <p>8 eg • portmanteau animals</p>
1	(b)	(i)	<i>idea of</i> change to , <u>DNA</u> / <u>base(s)</u> / <u>nucleotide(s)</u> ;	1	
1	(b)	(ii)	natural / directional , selection ;	1	ACCEPT evolution DO NOT CREDIT genetic drift
1	(c)	(i)	<p><i>regulatory</i> <i>idea that</i> makes , repressor protein / transcription factor or <i>idea that</i> product switches (structural / another) gene , on / off ;</p> <p><i>structural</i> <i>idea that</i> makes , enzyme / polypeptide / protein ;</p> <p><i>relationship between the 2</i> <i>idea that</i> regulatory <u>gene</u> , controls / affects , the expression of structural <u>gene</u> ;</p>	2 max	<p>ACCEPT ‘makes regulatory protein’</p> <p>ACCEPT ‘switching on / off’ for idea of control IGNORE explanation involving repetition of word “regulates”</p>

Question		Expected Answer	Mark	Additional Guidance
1	(c) (ii)	lactose has been , removed / digested / respired / broken down (by bacteria) ; to , lactic acid / lactate / other sugars ; yogurt still a good source of , calcium / vitamins ;	2 max	DO NOT CREDIT if context wrong (eg heat) eg • glucose (and galactose)
1	(d)	1 lactose binds to repressor protein ; 2 changes , shape / structure (of protein) ; 3 removes it from / stops it binding to , operator ; 4 RNA polymerase binds to promoter ; 5 <i>idea that</i> (so that Z and Y) are , transcribed / <u>m</u> RNA made ;	3 max	1 DO NOT CREDIT regulator substance 2 IGNORE ref. to active site 3 4 DO NOT CREDIT DNA polymerase 5 CREDIT lactose permease and β -galactosidase for Z and Y IGNORE gene , switched on / expressed
Total			16	

Question		Expected Answer			Mark	Additional Guidance
2	(a)		voluntary (skeletal)	involuntary (smooth)	cardiac	<p>For each box, mark the first answer that will result in a mark being awarded. If an additional answer is given that is incorrect or contradictory then = 0 marks</p> <p>IGNORE information in second or third boxes across row that is identical to 1st or 2nd box – each box should be different (as Q asks for differences between the types)</p> <p>eg striated(✓) unstriated(✓) striated = 2</p> <p> multinucleate(✓) uninucleate(✓) uninucleate = 2</p> <p> striated(✓) unstriated(✓) striated multinucleate uninucleate uninucleate(✓) = 3</p> <p>CREDIT drawings if feature such as striated / multinucleate / uninucleate, are clearly shown</p> <p>* ACCEPT description of striated / non striated (eg stripey)</p> <p>** ACCEPT control , blood pressure / diameter of blood vessels / diameter of airways</p> <p>** CREDIT vasoconstriction / vasodilation , for controlling diameter of blood vessels</p>
		cellular structure	*striated / bands of actin & myosin or cylindrical cells or multinucleate ;	*unstriated / *non striated or spindle-shaped cells or uninucleate ;	*striated or branched cells or uninucleate or interlocking / junctions / intercalated discs ;	
		function	to move , bones / skeleton / joints / (named) limbs ;	<i>idea of</i> **controlling diameter of , arteries / arterioles / bronchi / bronchioles or peristalsis or uterine contraction or control pupil size ;	to pump blood / AW ;	
					6	

Question		Expected Answer	Mark	Additional Guidance
2	(b)	<p><i>voluntary</i> intercostal / diaphragm ;</p> <p><i>involuntary</i> bronchi / bronchioles / arteries / arterioles / aorta / oesophagus ;</p> <p><i>cardiac</i> heart ;</p>	3	<p>CREDIT trapezius / deltoid / pectorals / latissimus dorsi / rotator cuff muscles ACCEPT 'between the ribs' for intercostal</p> <p>DO NOT CREDIT named artery not found in thorax IGNORE gut unqualified</p> <p>ACCEPT walls of , atria / ventricle(s)</p>
2	(c)	<p>(cardiac) D ; (clapping) B ; (bicycle) C ;</p>	3	
2	(d)	<p><i>monkeys rather than rats</i></p> <p>1 <i>idea that</i> (humans & monkeys) closely related / share more genes / share a common ancestor ;</p> <p>2 (humans & monkeys) both <u>primates</u> ;</p> <p>3 <i>idea that</i> brain / body , structure / physiology / behaviour , similar (to humans) ;</p> <p>4 monkey brain bigger (than rat) ; max 2</p> <p><i>comment</i></p> <p>5 argument in favour ;</p> <p>6 argument against ; max 2</p>	3 max	<p>MAXIMUM 2 marks from either section</p> <p>1 DO NOT CREDIT 'monkeys are closest ancestors to humans'</p> <p>2</p> <p>3 ACCEPT having a similar response to treatment</p> <p>4</p> <p>5 eg • to alleviate human suffering / can save lives</p> <p>6 eg • causes , pain / distress / stress , to monkeys DO NOT CREDIT 'cruel to monkeys' unqualified 'right to life of monkeys' / monkeys killed</p>

Question	Expected Answer	Mark	Additional Guidance
2 (e)	<p><i>appropriate parts of nervous / endocrine systems</i></p> <p>1 sympathetic (motor neurones) stimulated ; 2 <u>noradrenaline / norepinephrine</u> ; 3 neurotransmitter released at , neurovascular junction / organs ; 4 <u>adrenaline</u> (secreted / released into blood) ; 5 from <u>adrenal</u> , <u>glands</u> / <u>medulla</u> ; 6 <i>idea of</i> adrenaline / noradrenaline , binding to receptors (on target tissue) ; 7 AVP ;</p> <p><i>effect on structures containing 3 types of muscle</i></p> <p>C8 <i>idea of</i> heart beats faster ; C9 <i>idea of</i> heart beats more forcefully ;</p> <p>S10 alter blood flow / increase blood pressure ; S11 less blood flow to , gut / skin ; S12 reducing gut secretions / making skin pale ; S13 smooth muscle in gut relaxes / peristalsis slows down ; S14 smooth muscle in airways relaxes / airways wider ; S15 iris radial muscle contracts / pupil dilates ;</p> <p>V16 <i>idea of</i> breathing / intercostals contracting / diaphragm contracting , faster ; V17 more blood flow to (skeletal) muscles ; V18 <i>idea of</i> (named skeletal) muscles being primed for action ;</p> <p>19 AVP ;</p>	8 max	<p>ACCEPT phonetic spelling throughout</p> <p>1 2 3 May be awarded in the context of acetylcholine 4 5 6 7 eg <ul style="list-style-type: none"> • correct ref to corticosteroids • correct ref to medulla oblongata C = cardiac C8 C9 S = smooth S10 eg <ul style="list-style-type: none"> • constriction / dilation , of arterioles S11 S12 S13 ACCEPT involuntary for smooth S14 ACCEPT involuntary for smooth S15 V = voluntary V16 V17 V18 ACCEPT 'leg muscles' as named eg CREDIT glycogenolysis in muscle for priming 19 eg <ul style="list-style-type: none"> • erector pili muscles raise hairs </p>
	QWC – linking structure to response ;	1	Award if 2 different mps from mps 1 – 7 correctly linked to 2 different mps from mps C7 – V17
	Total	24	

Question		Expected Answer	Mark	Additional Guidance																								
3	(a)	<p><i>climate - tropical versus temperate</i> <i>tropical has ...</i></p> <p>1 higher temperature / hotter ; 2 more (sun)light / days longer ; 3 photosynthesis faster ;</p> <p>4 <i>idea that</i> more storage of , organic molecules / biomass / energy or more formation of , organic molecules / biomass ;</p> <p>5 AVP ;</p> <p><i>vegetation - woodland or rainforest versus grassland(s)</i> <i>woodland or forest has ...</i></p> <p>6 <i>idea of greater</i> complexity / greater biodiversity / more niches ; 7 competition for space less limiting ; 8 AVP ;</p>	4 max	<p>CREDIT reverse arguments for temperate</p> <table border="1"> <thead> <tr> <th></th> <th><i>tropical</i></th> <th><i>temperate</i></th> </tr> </thead> <tbody> <tr> <td><i>temperature</i></td> <td>higher</td> <td>lower</td> </tr> <tr> <td><i>light intensity</i></td> <td>more</td> <td>less</td> </tr> <tr> <td><i>photosynthesis</i></td> <td>more</td> <td>less</td> </tr> <tr> <td><i>biomass made</i></td> <td>more</td> <td>less</td> </tr> </tbody> </table> <p>eg</p> <ul style="list-style-type: none"> • less seasonal change • faster , mineral cycling / decomposition <p>CREDIT reverse arguments for grassland</p> <table border="1"> <thead> <tr> <th></th> <th><i>wood</i></th> <th><i>grassland</i></th> </tr> </thead> <tbody> <tr> <td><i>complexity</i></td> <td>more</td> <td>less</td> </tr> <tr> <td><i>competition</i></td> <td>less</td> <td>more</td> </tr> </tbody> </table> <p>eg</p> <ul style="list-style-type: none"> • greater , humidity / shelter 		<i>tropical</i>	<i>temperate</i>	<i>temperature</i>	higher	lower	<i>light intensity</i>	more	less	<i>photosynthesis</i>	more	less	<i>biomass made</i>	more	less		<i>wood</i>	<i>grassland</i>	<i>complexity</i>	more	less	<i>competition</i>	less	more
	<i>tropical</i>	<i>temperate</i>																										
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<i>complexity</i>	more	less																										
<i>competition</i>	less	more																										
3	(b)	<p>(bomb) calorimeter ;</p> <p>detail of technique ;</p> <p>detail of , measurement / analysis ;</p>	2 max	<p>eg</p> <ul style="list-style-type: none"> • known / dry , mass of (organic material) • (material) burnt in oxygen <p>eg</p> <ul style="list-style-type: none"> • temperature rise of water measured • known volume of water • calculation described / converted to kJ 																								

Question			Expected Answer		Mark	Additional Guidance
3	(c)	(i)	(perch) 22 ; (cow) 1 ;		2	
3	(c)	(ii)	1 higher in bobcat / lower in cow ; <i>for bobcat</i> 2 more (energy) absorbed ; ora 3 less (energy / waste) egested ; ora 4 correct comparative figs. quoted from table ; 5 meat more digestible ; ora 6 mainly protein and fat ; 7 contains no <u>cellulose</u> ; ora		3 max	1 DO NOT CREDIT figs alone IGNORE refs to grasshopper and perch ALLOW ecf if cow calculated as > 6 in (i) 2 3 4 bobcat 83(%) <u>and</u> cow 40(%) (absorbed) or bobcat 17(%) <u>and</u> cow 60(%) (egested) 5 6 7
3	(c)	(iii)	1 <u>grasshopper</u> ; 2 <i>idea of</i> high conversion to biomass figure ; 3 <i>idea of</i> herbivore / primary consumer / low(er) trophic level than perch ; 4 <i>idea of</i> more food available ; 5 <i>idea of</i> one stage of energy loss in food chain not two / more energy passes through food chain (to humans) ;		3 max	If perch is suggested, candidate can only access mp 2 = max 1 If bobcat or cow suggested, then = 0 1 2 ACCEPT ref to more energy accumulated in body ACCEPT mp2 in context of perch for max 1 3 4 5
Total					14	

Question			Expected Answer	Mark	Additional Guidance
4	(a)	(i)	<p><i>description</i></p> <p>1 lactose decreases <u>and</u> qualified ;</p> <p>2 ammonia decreases <u>and</u> qualified ;</p> <p>3 ammonia , plateaus / constant , at c. 2 (a.u.) (between 55 -140 h) ; max 2</p> <p><i>explanation</i></p> <p>4 <i>idea that</i> lactose / ammonia , used , for growth / to make biomass ;</p> <p>5 lactose / ammonia , used to make penicillin ;</p> <p>6 lactose broken down to glucose (and galactose) ;</p> <p>7 lactose / glucose , used for , respiration / energy ;</p> <p>8 ammonia used to make named N-containing molecule ; max 2</p>	4 max	<p>max 2 for description and max 2 for explanation</p> <p>If bacteria mentioned, penalise once and then apply ecf.</p> <p>If incorrect units used, penalise the mark point and then apply ecf for subsequent mark points.</p> <p>1 eg • single figure quote either at start (96 / 97 (a.u.)) or levelling-off point (45 - 60 h) or end (65 -70 h)</p> <p>2 eg • single figure quote either at start (34 (a.u.)) or levelling-off point (40 - 55 h)</p> <p>3</p> <p>4</p> <p>5</p> <p>6</p> <p>7 IGNORE ammonia</p> <p>8 eg • amino acids / protein / nucleotides / nucleic acids / chitin / glycoprotein</p>

Question			Expected Answer	Mark	Additional Guidance
4	(a)	(ii)	<p>lactose and ammonia levels , stay high / oscillate ;</p> <p>biomass , continues to rise / does not level off ;</p>	2	<p>If bacteria mentioned, penalise once and then apply ecf. IGNORE incorrect ref to stationary phase</p> <p>DO NOT CREDIT 'remains constant' without the idea of more being added</p> <p>ACCEPT 'biomass , rises and falls / levels off' only if reference made to harvesting / removal</p>
4	(a)	(iii)	<p><i>idea that</i> most penicillin produced after main growth phase ; after 24 h / when nutrients declining ;</p> <p>not needed for growth ; (however evidence not entirely clear as) production begins during biomass log phase ;</p>	2 max	<p>If bacteria mentioned, penalise once and then apply ecf. IGNORE incorrect ref to stationary phase</p>
4	(b)	(i)	<p>1 to avoid unwanted microbe , entry / presence ;</p> <p>2 so no competition for nutrients ;</p> <p>3 so conditions remain unchanged ;</p> <p>4 so no decrease in yield ;</p> <p>5 so no contamination of , batch / product / penicillin or batch is unusable ;</p> <p>6 to prevent escape of , microbes / fungus / <i>Penicillium</i> / spores ;</p>	3 max	<p>If bacteria mentioned, penalise once and then apply ecf.</p> <p>1 : IGNORE pathogens</p> <p>2 :</p> <p>3 :</p> <p>4 :</p> <p>5 : DO NOT CREDIT contamination unqualified</p> <p>6 :</p>

Question			Expected Answer	Mark	Additional Guidance
4	(b)	(ii)	temperature - as it affects enzymes ; pH - as it affects enzymes ; oxygen content – ref. respiration ; AVP ;	3 max	If bacteria mentioned, penalise once and then apply ecf. DO NOT CREDIT air eg <ul style="list-style-type: none"> ● salt concentration – affects osmosis / water potential / enzymes ● removal of waste gases (CO₂) – reduce pressure / prevents explosion of fermenter ● speed of stirrer – ensure even , mixing / temperature
Total				14	

Question		Expected Answer	Mark	Additional Guidance
5	(a)	<p>A DNA polymerase / <u>Tag</u> polymerase ;</p> <p>B restriction endonuclease ;</p> <p>C (DNA) ligase ;</p> <p>D plasmid(s) ;</p> <p>E reverse transcriptase ;</p>	5	<p>Mark the first answer on each prompt line. If an additional answer is given that is incorrect or contradicts the correct answer, then = 0 marks</p> <p>B ACCEPT restriction enzyme or named example DO NOT ACCEPT restriction endonucleus</p>
5	(b)	<p>1 <i>hospital</i> WBCs , easy to obtain / obtained from blood sample ;</p> <p>2 WBCs good source of DNA ;</p> <p>3 mutant gene's location unknown / need to look in whole genome ;</p> <p><i>biotechnology company</i></p> <p>4 <i>idea that</i> insulin made in pancreas ;</p> <p>5 many <u>mRNA</u> copies there / <u>mRNA</u> easier to find ;</p> <p>6 AVP ;</p>	4 max	<p>1 ACCEPT <i>idea that</i> these cells less , painful / expensive / dangerous , to obtain</p> <p>2</p> <p>3</p> <p>4</p> <p>5</p> <p>6 eg • introns already removed in mRNA</p>

Question		Expected Answer	Mark	Additional Guidance
5	(c)	<p><i>advantages of PCR</i></p> <p>A1 PCR quicker ; E1 explanation ;</p> <p>A2 PCR uses less equipment ; E2 explanation ;</p> <p>A3 PCR uses less space ; E3 explanation ;</p> <p>A4 PCR less labour-intensive / easier / (some parts of process) less costly ; E4 explanation ;</p> <p>A5 PCR combines selection of gene and amplification but in vivo requires separate steps ; E5 explanation ;</p> <p><i>contd</i></p>		<p>For A marks points must be comparative - need to either match the 2 processes and state the advantage (eg PCR is quick and in vivo is slow) or use a comparative adjective (-----er, less, more, least, most, better, best etc) as shown in the mark scheme.</p> <p>For the related E mark, accept any explanation that is true of one of the processes <i>and relates to the advantage described</i>. (Note that in some cases a statement could be considered as an advantage or as an explanation.)</p> <p>A1</p> <p>E1 eg</p> <ul style="list-style-type: none"> ● few hours versus weeks ● 30 cycles ● no bacterial growth or screening stages <p>A2</p> <p>E2 eg</p> <ul style="list-style-type: none"> ● tube and heat block for PCR ● multiple test tubes or agar plates for in vivo <p>A3</p> <p>E3 eg</p> <ul style="list-style-type: none"> ● DNA and enzyme more compact than whole cells ● no growth medium required ● in vivo requires many plates to be , stored / incubated / refrigerated <p>A4</p> <p>E4 eg</p> <ul style="list-style-type: none"> ● PCR set to run and left ● in PCR gene is identified & cloned in one stage ● in vivo requires work to pick out and transfer colonies ● in vivo requires more purification of DNA at end <p>A5</p> <p>E5 eg</p> <ul style="list-style-type: none"> ● primer selects only correct gene to be copied ● in vivo needs probe to identify correct gene

Question		Expected Answer		Mark	Additional Guidance		
5	(c)	<i>contd</i>	A6	PCR safer ;		A6	eg <ul style="list-style-type: none"> • PCR uses DNA and enzymes • PCR does not use whole cells which could cause contamination
			E6	explanation ;		E6	
			A7	PCR can use lower quality DNA ;		A7	eg <ul style="list-style-type: none"> • can use , old / prehistoric / forensic , DNA
			E7	explanation ;	E7		
			A8	<i>advantages of in vivo</i>		A8	eg <ul style="list-style-type: none"> • Taq polymerase occasionally inserts wrong base • early mutation reproduced many times in PCR • exact correct sequence needed for making therapeutic proteins
			E8	in vivo less prone to mutation ; explanation ;	E8		
			A9	in vivo less expensive ;		A9	eg <ul style="list-style-type: none"> • materials for growing bacteria cheap • PCR chemicals / primers / Taq polymerase / high temperatures , expensive
			E9	explanation ;	E9		
			A10	in vivo less technically complex ;		A10	eg <ul style="list-style-type: none"> • conditions not so critical • optimising PCR takes time
			E10	explanation ;	E10		
			A11	in vivo useful , when gene less well known /		A11	eg <ul style="list-style-type: none"> • searching for new gene • obtains complete gene • PCR has limited size (for cloning)
			E11	as longer piece of DNA can be cloned ; explanation ;	E11		
					7 max		
			QWC – clearly stated advantage linked to correct explanation ;		1	2 pairs of A & E marks awarded. (eg A1 & E1 and A5 & E5 A9 & E9 and A4 & E4 etc)	
				Total	17		

Question		Expected Answer	Mark	Additional Guidance
6	(a)			Mark the first answer on each prompt line for all parts of (a). If an additional answer is given that is incorrect or contradicts the correct answer, then = 0 ACCEPT phonetic spelling
6	(a)	(i) <u>tropism(s)</u> ;	1	IGNORE named tropism eg phototropism
6	(a)	(ii) (plant) hormone / growth substance / growth regulator / pgr ;	1	
6	(a)	(iii) <u>deciduous</u> ;	1	
6	(a)	(iv) <u>conservation</u> ;	1	DO NOT CREDIT preservation
6	(a)	(v) decomposer(s) ;	1	ACCEPT saprotroph / saprophyte / saprobiont IGNORE fungi / bacteria DO NOT CREDIT detritivore
6	(a)	(vi) nitrogen fixation ;	1	ACCEPT nitrogen fixing DO NOT CREDIT nitrogen fixing bacteria
6	(b)	(i) stimulus identified ; organism named and normal response described ; response , stops / lessens , after repeated stimulation / over time ;	3	eg • touch eg • sea anemone withdrawing tentacles 'learning to ignore' is not quite enough
6	(b)	(ii) organism named and voluntary behaviour described ; reinforcer / reward / punishment , identified ; behaviour , increases (for reward) / decreases (for punishment) , in frequency ;	3	eg • dog begging eg • food reward / treat

Question			Expected Answer	Mark	Additional Guidance
6	(b)	(iii)	<p>primate species identified ;</p> <p>behaviour described ;</p> <p>purpose / importance , stated ;</p>	3	<p>Marks can be awarded in general context of social interaction instead of a specific piece of behaviour described.</p> <p>CREDIT English names eg chimpanzee, gorilla, orang-utan, (named) monkey, lemur or ape</p> <p>IGNORE humans</p> <p>eg</p> <ul style="list-style-type: none"> • include dominance hierarchy interactions (play, aggressive, affiliative) • allogrooming • communication behaviours (vocal, facial, postural) • passing on of , cultural / tool-using, knowledge • <i>idea of</i> prolonged / frequent , mother-infant interactions <p>CREDIT answers relating to benefit to group or to individual</p> <p>eg • with respect to access to food, resources or mates</p> <p>eg • reducing , disease / parasites</p>
Total				15	

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