

**Biology**

Advanced GCE A2 7881

Advanced Subsidiary GCE AS 3881

**Mark Scheme for the Components**

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**January 2008**

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by Examiners. It does not indicate the details of the discussions which took place at an Examiners' meeting before marking commenced.

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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### Advanced Subsidiary GCE Biology (3881)

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# Advice to Examiners on the Annotation of Scripts

1. Please ensure that you use the **final** version of the Mark Scheme.  
You are advised to destroy all draft versions.
2. Please mark all post-standardisation scripts in red ink. A tick (✓) should be used for each answer judged worthy of a mark. Ticks should be placed as close as possible to the point in the answer where the mark has been awarded. The number of ticks should be the same as the number of marks awarded. If two (or more) responses are required for one mark, use only one tick. Half marks ( $\frac{1}{2}$ ) should never be used.
3. The following annotations may be used when marking. No comments should be written on scripts unless they relate directly to the mark scheme. Remember that scripts may be returned to Centres.  
  
x = incorrect response (errors may also be underlined)  
^ = omission mark  
bod = benefit of the doubt (where professional judgement has been used)  
ecf = error carried forward (in consequential marking)  
con = contradiction (in cases where candidates contradict themselves in the same response)  
sf = error in the number of significant figures
4. The marks awarded for each part question should be indicated in the margin provided on the right hand side of the page. The mark total for each question should be ringed at the end of the question, on the right hand side. These totals should be added up to give the final total on the front of the paper.
5. In cases where candidates are required to give a specific number of answers, (e.g. 'give three reasons'), mark the first answer(s) given up to the total number required. Strike through the remainder. In specific cases where this rule cannot be applied, the exact procedure to be used is given in the mark scheme.
6. Correct answers to calculations should gain full credit even if no working is shown, unless otherwise indicated in the mark scheme. (An instruction on the paper to 'Show your working' is to help candidates, who may then gain partial credit even if their final answer is not correct.)
7. Strike through all blank spaces and/or pages in order to give a clear indication that the whole of the script has been considered.
8. An element of professional judgement is required in the marking of any written paper, and candidates may not use the exact words that appear in the mark scheme. If the science is correct and answers the question, then the mark(s) should normally be credited. If you are in doubt about the validity of any answer, contact your Team Leader/Principal Examiner for guidance.





Question	Expected Answers	Marks
3 (a) (i)	<i>If choice of reasons given, then <u>all</u> must be correct</i> different , R groups / side chains / formulae ; one has , sulphur / S ; ora <b>R</b> S molecule / S ion / extra S	1 max
(ii)	<i>Line should not extend more than halfway along the neighbouring bond</i> circle drawn around , line between C and N / C – N / CONH ;	1
(b)	sequence / order , of amino acids ; <b>R</b> line / row	1
(c) (i)	hydrogen / H (bonds) ; <b>A</b> Van de Waals forces / hydrophobic interactions / <u>double</u> covalent <b>R</b> H <sub>2</sub> bonds	1
(ii)	globular ; <b>A</b> conjugated (but do not credit twice) <b>R</b> non-fibrous  $\alpha$ (alpha) chains and $\beta$ (beta) chains / 2 types (of polypeptide chain) ; <b>R</b> 4 types <b>R</b> 2 / 4 , polypeptide chains <b>R</b> $\alpha$ & $\beta$ glucose  contains haem / contains Fe / contains porphyrin ring / contains prosthetic group / conjugated ;  transport function in blood / carries oxygen / carries (some) carbon dioxide ;	4
		<b>[Total: 8]</b>

.....

Question	Expected Answers	Marks
4 (a)	<p><i>Q is about water as a <b>transport medium</b>.</i></p> <p><i>Ignore refs. to properties such as heat capacity, density, surface tension, etc.</i></p> <ol style="list-style-type: none"><li>1 dipole / positive <u>and</u> negative charge / polar ; <b>R</b> charged / ions</li><li>2 hydrogen bonding between <u>water molecules</u> ;</li><li>3 liquid , at 'normal' temperatures / between 0°C and 100°C / over a wide range of temperatures ; <b>R</b> room temp.</li><li>4 hydrogen bonding allows water to , flow as a body / AW ; <i>ignore ref. to adhesion / cohesion</i></li><li>5 <u>solvent</u> ;</li><li>6 <u>dissolves</u> , ionic compounds / polar compounds / charged compounds / some covalent compounds / gas(es) / named eg ;</li><li>7 detail of dissolving action ;</li><li>8 AVP ; e.g. able to , support / carry , blood cells / gametes / fruits / seeds / other valid eg non toxic</li></ol>	4 max



Question	Expected Answers	Marks
(b) 1	phospholipid , separates cell contents from exterior / acts as (physical) barrier ; <b>NOT protects</b>	
2	(phospholipid) allows <b>diffusion</b> (of suitable substance) / selective / stops some substances passing through / allows some substances through ; <i>R semi-permeable / partially permeable / things</i>	
3	(carrier / transport / transmembrane) protein used for , <b>active transport</b> (of suitable substance) / described ; <i>R channel protein</i>	
4	(channel / carrier / transport / transmembrane) protein used for <b>facilitated diffusion</b> (of suitable substance) ;	
5	hydrophilic channel / water-lined pore ;	
6	protein changes shape ;	
7	aquaporins for transport of water ;	
8	transport proteins are <b>specific</b> ;	
9	glycoprotein / glycolipid , for cell recognition / for signalling / act as <b>antigens</b> ;	
10	(glycoproteins / glycolipids are) receptors for / attachment of , <b>hormones / neurotransmitters / antibodies</b> / named eg ; <i>R detection ignore recognition site</i>	
11	(glycoproteins / glycolipids allow) attachment of one cell to another ;	
12	cholesterol , determines <b>fluidity</b> / maintains mechanical stability (of membrane) ; <i>ignore support / strengthen</i>	
13	(cholesterol) allows , bulk flow / <b>endocytosis / exocytosis / pinocytosis / phagocytosis</b> ;	
14	(as) membrane is self sealing ;	
15	AVP ; e.g. named protein (eg Na <sup>+</sup> /K <sup>+</sup> pump) in active transport secretion of named substance ref. saturated v unsaturated phospholipids related to fluidity (some proteins are) enzymes attached to membrane carbohydrate chains form H bonds with water to stabilise membrane	<b>8 max</b>

**QWC ~ quality of the use and organisation of scientific terms**

At least 4 of the terms in bold, used in the correct context.

**1**

**[Total: 13]**



Question	Expected Answers	Marks
6 (a) (i)	<p><b>K</b> nitrite (ions) ; <b>A</b> <math>NO_2^-</math> / <i>nitrate III</i>  <b>L</b> urea ; <b>A</b> <i>uric acid / ammonium</i> / <math>NH_4^+</math>  <b>R</b> <i>ammonia</i></p>	2
(ii)	<p><b>M</b> excretion / deamination / ornithine cycle ; <b>R</b> <i>urination</i>  <b>N</b> egestion / defaecation ; <b>R</b> <i>excretion</i></p>	2
(iii)	<p>nitrification / oxidation / nitrifying ; <b>R</b> <i>nitrifying bacteria</i></p>	1
(b) (i)	<p>(nitrogen) compounds from (grazing) animals returned to soil ;  <b>(A</b> <i>ammonium / urea / protein / amino acid</i>  <i>ignore ammonia</i>  <b>R</b> <i>nitrogen alone / nitrate / nitrite</i> )  in urine <u>and</u> faeces / by excretion <u>and</u> egestion / by M <u>and</u> N ;  <b>R</b> <i>excretion for both</i>  (nitrogen) compounds from grass returned to soil ;  <b>(A</b> <i>protein / amino acid</i> )  when grass , dies / decays / rots / decomposes ;  <i>ignore breaks down</i>  presence of , nitrifying bacteria / <i>Nitrosomonas / Nitrobacter</i> ;  addition of fertiliser ;  sow / plant / grow , clover / legume ;</p>	3 max
(ii)	<p>clover , has (root) nodules / is a legume ;  <i>Rhizobium</i> in <u>root nodules</u> ;  (bacterium) fixes nitrogen / converts <math>N_2</math> to <math>NH_4^+</math> /  converts <math>N_2</math> to <math>NO_3^-</math> ;  clover does not remove , nitrogen compounds / nitrates , from soil ;  nitrogen compounds , returned / released , to soil when clover ,  decays / rots / decomposes ;  <b>(A</b> <i>ammonium / amino acids</i>  <i>ignore breaks down</i>  <b>R</b> <i>protein / nitrogen</i> )</p>	3 max
		<b>[Total: 11]</b>

## 2802 Human Health and Disease

Abbreviations, annotations and conventions used in the Mark Scheme	/	= alternative and acceptable answers for the same marking
	;	= point
	NOT	= separates marking points
	<b>R</b>	= answers which are not worthy of credit
	( )	= reject
	_____	= words which are not essential to gain credit
	ecf	= (underlining) key words which <b>must</b> be used to gain credit
	AW	= error carried forward
	A	= alternative wording
	ora	= accept or reverse argument

**Question**      **Expected Answers**      **Marks**

1 (a)

	<i>Vibrio (cholerae)</i> ; <b>R</b> vibro / vibio		
		( <i>Anopheles</i> ) mosquito / vector ;	(anti-)malarial drugs / named / avoid being bitten / break life cycle of mosquito / described / vaccine <b>A</b> prophylactic drugs
	HIV / Human Immunodeficiency Virus		
	<i>Mycobacterium</i> <b>R</b> <i>Microbacterium..</i> ( <i>tuberculosis / bovis</i> ) ;	droplet (infection) / cough / sneezes / air- borne / unpasteurised dairy products / uncooked beef ;	

6

(b)

D ;  
A ;  
C ;  
E ;  
**R** if two letters on row or if letter unclear

4

[Total: 10]

Question	Expected Answers	Marks
2 (a)	<p><i>we are looking for immediate effects</i></p> <p>(the heart rate) increases ;  use of figs. to compare ; (<i>must be two figs one activity compared with standing 121</i>)</p> <p>(active) muscles respire, more / at higher rate ; <b>R</b> faster  require more, oxygen / glucose ;  release more carbon dioxide ;  increased blood flow <u>to muscles</u> required / AW ;  adrenalin released ;  AVP ; e.g. removal of lactate  e.g. more ATP needed for muscle contraction</p>	<b>max 3</b>
(b)	<p><i>ignore any statement to do with lungs or heart rate or pulse</i></p> <p>increased stroke volume ;  increased cardiac output ;  increased force of contraction / heart pumps harder ;  increased (systolic) blood pressure ;  blood diverted to muscles / vasodilation in muscles ;  blood diverted away from gut / vasoconstriction in gut ;  blood diverted, away from skin (at first) / towards skin (later) ;</p> <p>AVP ; e.g. blood becomes more acidic  more lactate / CO<sub>2</sub> in blood</p>	<b>max 2</b>
(c)	<p>maximum <u>safe</u> heart rate is 207 ;  his heart rate had, reached / gone above, the <u>safe</u> maximum / 207 ;  <b>A</b> heart rate too high, became exhausted</p>	<b>max 1</b>
(d)	<p>run / cycle / swim / other example of suitable exercise ;  at least three times per week ;  for at least 20 minutes ;  to raise heart rate to, 60 - 80% of maximum (145 bpm) / resting + 60% /  AW ;  to 50-55% VO<sub>2</sub> max / AW ;  extend duration / intensity over time ;</p>	<b>max 3</b>

Question	Expected Answers	Marks
(e)	<p>reduce <u>resting</u> heart rate ;            increase stroke volume ;            increase cardiac output ;            increase, size / strength, of heart <u>muscle</u> / hypertrophy ;            decrease, resting blood pressure / risk of hypertension ; <b>A</b> decrease resting diastolic BP            increase, volume of blood / number of RBC / amount Hb ;</p> <p>increase tidal volume ;            increase vital capacity ;            increase capillaries in lungs ;</p> <p>increase size / strength of, skeletal / named, muscles ;            increase capillarity of muscles ;            increase, size / number, of mitochondria in muscles ;            increase stores of, fat / glycogen / myoglobin, in muscles ;</p> <p>increased tolerance to lactate / increased removal of lactate ;            improved recovery after exercise ;</p> <p>use up body fat / weight loss ; <b>A</b> ref to obesity            improve, resistance to infection / immunity ;            reduce risk of, atherosclerosis / CHD / osteoporosis / stroke / cancer ;            reduce <u>blood</u> cholesterol concentration ;            improve, balance / coordination / strength / flexibility ;            improve, mental wellbeing / self-esteem / feel better ;</p>	max 3
<b>[Total: 12]</b>		

Question	Expected Answers	Marks
3 (a)	<p>woman A: A reverse arguments and AW</p> <p>less overweight ;  exercises more ;  drinks less (alcohol) ;  likely to be in better mental health ;  has friends / social life ;</p> <p>AVP ; e.g.  insufficient detail to be sure / nothing about other factors that may affect health  both have poor (fatty) diet  more detail on the type of additional information needed</p>	max 3
(b)	<p>social health issues / no, friends / social life ;  mental health issues / lifestyle suggests she may be, unhappy / depressed ;  looking after three young children may be stressful ;  she may be drinking to relieve stress ;  health risks associated with excessive alcohol ;  not a balanced diet ;  little (aerobic) exercise ;  lifestyle increases susceptibility to degenerative diseases ;  no signs of symptoms of disease, may be developing or increasing risk of developing (non-infectious) diseases ;  named example of disease / diabetes / CHD / atherosclerosis / stroke / hypertension;  AVP; e.g. probably little fresh fruit and veg, little, dietary fibre / antioxidants / vitamins</p>	max 3
(c)	<p>assess health risks of certain, lifestyles / behaviours ;  link disease to, lifestyle / behaviour ;  (use to) educate public ;  suitable economic statement e.g. to help set appropriate premium ;  look at, changes over time / regional differences ;  evaluate success of health promotion programmes / AW ;  target funding ;</p>	max 2
		[Total: 8]

Question	Expected Answers	Marks
4 (a)	<p><i>assume answer refers to 4.2 unless otherwise stated</i></p> <p>enlarged air spaces ;  walls between alveoli broken down / alveoli, fused / damaged ; <b>A</b> fewer alveoli  smaller surface area ;</p> <p><b>R</b> difference in background colour</p>	<b>max 2</b>
(b)	<p>less effective, gaseous exchange / oxygenation of, blood / haemoglobin / AW ;  breathlessness / short of breath / wheezing / noisy breathing ;  more difficult to breathe out / exhale / expire / AW ;  increased heart rate ;  less able to do (aerobic) exercise ;  AVP ; e.g. pale (blue) colour to skin / may need to wear oxygen mask /  enlarge (right side of) heart / barrel chest</p>	<b>max 2</b>
(c)	<p>inactivates / damages / destroys / paralyses, cilia ; <b>R</b> kills  stimulates increased mucus production / goblet cells enlarged ;  mucus cannot be moved away ;  bacteria accumulate / infection more likely ;  macrophages / phagocytes / white blood cells, move to area ;  release elastase / break down elastic fibres ;  alveoli less able to recoil ;  alveoli burst ;  AVP ; e.g. tar in smoke inhibits, protein inhibitor / <math>\alpha</math> antitrypsin</p>	<b>max 4</b>
(d)	<p><i>epidemiological <u>evidence</u></i></p> <p>high correlation between smoking and lung cancer / most people with lung cancer, smoke / have smoked AW ;  the more cigarettes smoked the greater the risk ;  the longer has been a smoker the greater the risk ;</p> <p>stop smoking and risk of cancer reduces ;  lung cancer death rate lags 20 years behind statistics on numbers of smokers ;</p> <p>more men than women smoked in the past, linked to greater number of cases / deaths among men / AW ;  <b>A</b> lung cancer rare / unknown, before cigarette smoking became common  ora  lower incidence in smokers who do not inhale ; (e.g. pipe and cigar smokers)</p> <p>ref to studies involving British doctors ;  ref to evidence about passive smoking ;  AVP ;</p>	<b>max 2</b>



Question	Expected Answers	Marks
	<p><i>experimental evidence</i></p> <p>experimental animals forced to breathe smoke develop tumours similar to human lung tumours ; ref to affect of filter ; carcinogens have been isolated from tar / smoke ; when tar is painted on animal cells it induces tumours ; AVP ; e.g. mutagens in tar mimic DNA changes in cancer</p>	<b>max 1</b>

**[Total: 11]**

Question	Expected Answers	Marks
5 (a)	injection of antibodies ; specific to tetanus ; provides immediate protection ; AVP ; e.g. antibody is an antitoxin	max 2
(b)	<p>1 exposure to antigenic material ;</p> <p>2 whole live organism / dead organism / harmless version of organism / preparation of surface antigens / harmless form of toxin ;</p> <p>3 activate immune system / causes immune response / causes primary (immune) response ;</p> <p>4 engulfed by phagocytes ;</p> <p>5 presentation of antigens (on surface of, macrophage / APC / dendritic cell);</p> <p>6 (clonal) selection of specific B cells ;</p> <p>7 clonal expansion of (B / T) cells / cells, divide / clone ;</p> <p>8 (differentiation to) produce (B) memory cells ;</p> <p>9 (memory cells) remain in body for years / provide, long-term protection / memory ;</p> <p>10 (clonal) selection of specific T cells ;</p> <p>11 release of cytokines ;</p> <p>12 stimulate B cells / macrophages ;</p> <p>13 production of memory T cells ;</p> <p>14 immune system may be defective / underdeveloped ;</p> <p>15 malnutrition / insufficient protein in diet ;</p> <p>16 more than one strain / antigenic, variation / drift / shift / pathogen may change antigens regularly ;</p> <p>17 antigenic concealment / pathogen lives inside host cells / pathogen uses host antigens /pathogen lives in gut ;</p> <p>18 pathogen eukaryotic / has many antigens ;</p> <p>19 AVP ; e.g. pathogen or toxin build up being too rapid for response e.g. rabies, lassa fever passive immunity from breast milk may destroy antigens before immunity developed using immunosuppressant</p>	<p>max 6</p> <p>max 3</p> <p>max 8</p>
	<b>QWC – clear well organised using specialist terms; (4 terms used)</b>	1
	antigen                      attenuated                      phagocyte / macrophage / phagocytosis clone                              memory cell                      immunological memory plasma cell                      cytokines                      pathogen antigenic shift / drift              antigenic concealment clonal selection              clonal expansion              antigen presentation APC                                  artificial active immunity antibody                              immune response	

[Total: 11]

Question	Expected Answers	Marks
6	<p>different plants contain different nutrients / some plant materials do not contain many useable nutrients ;            (wide range of foods) needed to provide, all / named / essential, components of diet /            complementary foods needed to get all nutrients ;            compensate for absence of animal derived foods ;            less supplements need to be taken ;</p>	max 2
	<p>whole grain has more fibre ;            most of nutrients in outer layer / fibre / husk ;            wholemeal has, more / wider range of, nutrients than refined / refining removes nutrients ;            (fibre) helps avoid, constipation / bowel cancer / AW ;            fibre can reduce blood cholesterol level / reduce risk of CHD ;            vitamins needed for healthy metabolism / vitamin E is an antioxidant ;</p>	max 2
	<p>essential fatty acids, cannot be made in the body / must be in diet ;            essential fatty acids used to make other fatty acids / phospholipids ;            vegans will not have shortage ;            polyunsaturated fatty acids linked to less risk of, atherosclerosis / deposition in arteries ;</p>	max 2
	<p>nuts and pulses / named example, contain, (first class) protein ;            good source of <u>essential</u> amino acids ;            protein / amino acids, needed, to build new cells ;            compensate for absence of protein in flesh ;</p>	max 2
<b>[Total: 8]</b>		

## 2803/01 Transport - Written Paper

<b>Abbreviations, annotations and conventions used in the Mark Scheme</b>	/	=	alternative and acceptable answers for the same marking point
	;	=	separates marking points
	NOT	=	answers which are not worthy of credit
	<i>R</i>	=	reject
	( )	=	words which are not essential to gain credit
	<u>      </u>	=	(underlining) key words which <b>must</b> be used to gain credit
	ecf	=	error carried forward
	AW	=	alternative wording
	A	=	accept
	ora	=	or reverse argument

Question	Expected Answers	Marks
1 (a)	V; T; R; X; S;	5

[Total: 5]

Question	Expected Answers	Marks
2 (a) (i)	stem ; A shoot	1
	(ii) E ;	1
(b) (i)	<u>sucrose</u> ; R list	1
	(ii) <i>source</i> . where assimilate / sucrose / AW, made / released from storage / loaded / AW ; <i>sink</i> . where assimilate / sucrose / AW, used / respired / stored / converted to starch / unloaded / AW ; R needed	2 max
(c)	1 mass / bulk flow ; 2 active mechanism / uses ATP / AW ;  <i>apoplast route</i> 3 H <sup>+</sup> / protons, pumped out from companion cell / AW ; R hydrogen 4 <i>idea of</i> co-transporter / protein / carrier ; 5 assimilate / AW, goes with H <sup>+</sup> ; 6 assimilate / AW, (diffuses) into sieve tubes via plasmodesmata ;  <i>or symplast route</i> 3 enter companion cell via plasmodesmata ; 4 converted to larger sugars / raffinose / AW ; A larger molecule 5 can't return / only pass into sieve tube ; 6 ATP required to produce raffinose / AW ;  <b>max 4</b> apoplast / symplast route  7 sugars in sieve tube lower water potential / AW ; 8 water enters / AW ; 9 <i>idea of</i> pressure (gradient) ; 10 <i>idea of</i> lack of, resistance in sieve tube / AW ; 11 unloading / AW, by, diffusion / reverse of above ; 12 AVP ; role of transfer cells / passage via pores in <u>sieve plates / sieve pores</u> ;	max 6
	<b>QWC – legible text with accurate spelling, punctuation and grammar;</b>	1

[Total: 12]

Question	Expected Answers	Marks
3 (a) (i)	4 ;	1
	(ii) first oxygen does not attach easily / AW ; next (two) attach easily ; final one does not attach easily / <i>idea of</i> rapid dissociation / <i>idea of</i> most sites occupied ; <i>idea of</i> attachment changing molecular shape / structure / AW ;  allow 1 mark for general idea that ease of attachment varies if above detail not given	2 max
(b)	(X) corresponds to pO <sub>2</sub> range of, (named) tissues / cells / organs ; R lungs, body, capillaries (tissues etc) need much oxygen / are respiring ; ( <i>relate to release</i> ) <i>idea that</i> (small) drop in pO <sub>2</sub> gives, drop in saturation (of haemoglobin) / (much) release of oxygen / AW ; data from Fig. to support ;  <i>Many candidates discuss loading - could get data mark</i>	3 max
(c) (i)	sigmoid curve drawn to right ; starts at or near 0 and rises to 98% or a bit below (not below 80%) ;  <i>if curve to left may award 2<sup>nd</sup> marking point. NB it must end at or above 98%</i>	2
(ii)	carbon dioxide is a product of (aerobic) respiration / more carbon dioxide if exercising / active / in muscle / AW ; means that (more) oxygen released / Hb less saturated with oxygen ; (oxygen) needed for (more aerobic) respiration / respiring tissue ;	2 max
		<b>[Total: 10]</b>

Question	Expected Answers	Marks
4 (a)	dry / AW ; R hot / harsh reduce / AW ; R stop / prevent / AW waxy / wax / waterproof ; water vapour / humid air / moist air / AW ; R water, molecules, droplets, particles etc stomata / guard cells ; A stoma	

[Total: 5]

Question	Expected Answers	Marks
5 (a) (i)	45 (%) ;; A 44.8-44.9  <i>1 mark for working if answer wrong</i> $7.1 - 4.9 = 2.2$ / AW A 2.2 alone or $7.1$ divided by $4.9 \times 100 = 144.9$	2
(ii)	less oxygen at altitude / lower partial pressure of oxygen / AW ; suitable comparative partial pressures e.g. 20 and below 15 ; R % haemoglobin won't be fully saturated / AW ; (more red blood cells) means more Hb ; to get (enough) oxygen to the tissues / body / AW ; stop effects, of altitude sickness / named effect t ;	3 max
(iii)	match the ages of the people ; match the gender of the people ; match the mass ; both at sea level before man went to 5000M ; match ethnicity ; ensure all are healthy ; take more samples from an individual for a mean ; use more individuals ; try different times at altitude / A longer / shorter time at altitude ; try different altitudes ; ref to other controls e.g. amount of exercise / aerobic fitness ; compare the same person / people, at different altitudes ; compare rbc count at start and end ; AVP ;	3 max
(b) (i)	converts carbon dioxide and water to carbonic acid ; A chemical equation (which dissociates) into $H^+$ and $HCO_3^-$ ; R hydrogen / H $H^+$ combines with Hb / formation of HHb ; (results in) oxygen release ; ref to buffering / described ; maintains steep (diffusion) gradient for $CO_2$ into red blood cells / AW ;	3 max
(ii)	means <u>more</u> / AW carbon dioxide in blood / <u>higher</u> levels sensed by brain ; (resulting in) breathing rate / depth, increasing ; so more oxygen taken in ;  less $H^+$ (formed) ; (so) less HHb (formed) / AW ; (so) more oxygen bound to haemoglobin / AW ;	2 max
		[Total: 13]



## 2803/03 Practical Examination

<b>Abbreviations, annotations and conventions used in the Mark Scheme</b>	/	=	alternative and acceptable answers for the same marking point
	;	=	separates marking points
	NOT	=	answers which are not worthy of credit
	<b>R</b>	=	reject
	( )	=	words which are not essential to gain credit
	<u>      </u>	=	(underlining) key words which <b>must</b> be used to gain credit
	ecf	=	error carried forward
	AW	=	alternative wording
	A	=	accept
	ora	=	or reverse argument

### ○ Planning Exercise

The mark scheme for the planning exercise is set out on page 4. The marking points **A to U** follow the coursework descriptors for Skill P.

Indicate on the plans where the marking points are met by using a tick and an appropriate letter.

There are 14 marking points for aspects of the plan and two marks for quality of written communication (QWC).

### ○ Practical Test

Pages 5 to 10 have the mark scheme for Questions 1 and 2 for the Practical Test.

**AS Biology. Planning exercise**

Checking Point	Descriptor	The candidate
A	P.1a	Plans a suitable procedure that involves testing bananas that have been kept at a minimum of two temperatures for more than one day for starch and/or reducing sugars ;
B	P.1a	Gives a prediction about the effect of temperature on starch and/or sugar content of bananas ;
C	P.1b	Selects suitable apparatus and materials for maintaining different temperatures <b>and</b> testing for starch content / starch grains / reducing sugars ; <b>R</b> 'iodine'
D	P.3a	States that starch is <b>hydrolysed</b> to, glucose / maltose ;
E	P.3a	Identifies at least 2 key variables to control, e.g. type / batch of bananas, duration of test, volume of banana pulp tested, volume of Benedict's solution ; <b>R</b> 'amount'
F	P.3b	Decides on an appropriate number of measurements to take, minimum of <b>five</b> different temperatures ;
G	P.3b	Decides on an appropriate range of temperatures to use (e.g. range $\geq 20^{\circ}\text{C}$ ) ;
H	P.3b	Describes way of obtaining reliable results, e.g. taking three readings / carrying out three replicates (e.g. three samples of same banana / three bananas) ;
I	P.5a	<b>Uses</b> appropriate scientific knowledge and understanding in developing a plan, e.g. structure of amylose and amylopectin, chemistry of Benedict's test, effect of temperature on enzyme activity, tertiary structure of enzymes, action of amylase ;
J	P.5a	<b>Uses</b> results from preliminary practical work or previous practical work to inform the plan ;
K	P.5a	Refers to a safety aspect - gives hazard and precaution e.g. Benedict's solution, heating ;
L*	P.5b	<i>Gives a clear account, logically presented with accurate use of scientific vocabulary (QWC) ;</i>
M	P.7a	<b>Describes</b> way(s) of preparing banana tissue to obtain isolated starch grains / sugars in solution, e.g. liquidising and filtering ;
N	P.7a	<b>Describes</b> how precise results are obtained, e.g. use of colorimeter, drying to constant mass, scale on side of centrifuge tube, use of graticule / grid / haemocytometer, colour comparator, field of view qualified ;
O	P.7a	<b>Uses</b> information from at least <b>two</b> identified sources, e.g. text book, web site, article, class notes ;
P	P.7b	Shows how results are to be presented in a table with units where appropriate ;
Q*	P.7b	<i>Uses spelling, punctuation and grammar accurately ;</i>
R	P.7b	Explains that results are to be expressed per unit, mass / volume, of banana tissue ;
S	P.7b	Explains how data would be interpreted to show the effect of temperature, e.g. graph to show change in starch / sugar over time at each temperature, final concentration at different temperatures, percentage change over time, uses calibration curve ; <i>graph must have labels and units – numbers not necessary</i>
T	P.7b	Comments on / explains need for, precision, e.g. test banana at day 0;
U	P.7b	Comments on validity, e.g. need to test for non-reducing sugars, sugars used in respiration / converted to other compounds ;

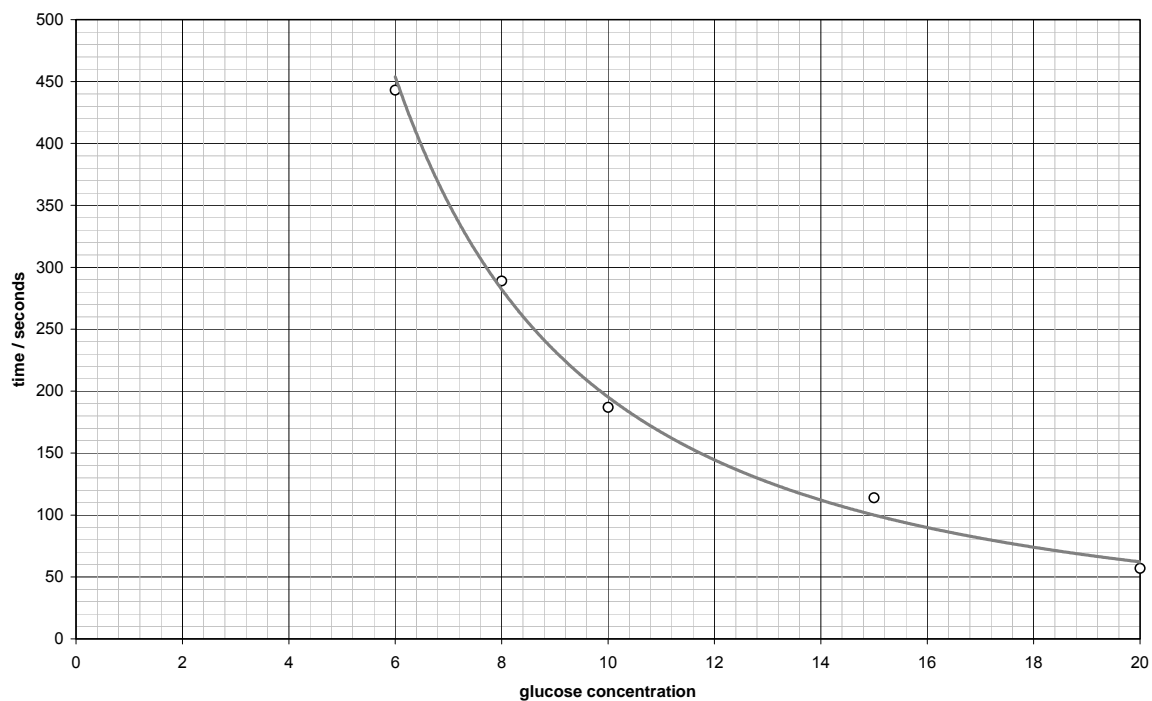
Point mark up to 14 by placing letters **A to U excluding L and Q** in the margin at appropriate points. Then award 1 mark for each of **L** and **Q** (QWC).

**Total: 16**

Example of results for Q.1 (b)

glucose concentration / %	time for colour change / seconds
6	443
8	289
10	187
15	114
20	57

Graph for Q.1 (c)



Question	Expected Answers	Marks
1 (a) (i)	determine end point / decide when solution is, clear / colourless ; A when pink colour goes  make sure same end point is used each time ;  R control / compare unqualified	2
(ii)	will introduce oxygen into the solution ; reverse the colour change / slow down the reaction ; R 'the reaction will go faster'	2
(b)	table format with column / row headings ; glucose concentration and time for colour change ; R time unqualified glucose concentration in, left hand column / first row ; <i>ignore test-tube letter</i> units in column <i>or</i> row headings (% <i>and</i> seconds / minutes (and seconds)) ; A <i>ecf</i> if no glucose concentration R if units in body of table time recorded in seconds ; correct trend ; (see example on page 5)	5
(c)	axes correct with glucose concentration on the horizontal axis ; good use of space, axes scaled appropriately ; R if half the graph paper or less is used R if minutes used and not scaled correctly axes titles and units ; <i>ecf</i> from the table points plotted accurately ; joined by an appropriate line of best fit ; R if extends beyond first and last point unless used for estimating F/G  intercepts for F and G shown on graph ;	6
(d)	<i>description</i>  1 increasing glucose concentration, time to change decreases / faster 2 reaction ; 3 not linear / AW ; 4 quotes at least two figures ; A tube letters / a calculation, e.g. % of .. correct ref to anomalous result(s) ; A 'there are no anomalies'  <i>explanation</i>  5 6 glucose is a reducing, sugar / agent ; 7 <i>idea of</i> more glucose, more collisions ; 8 manganate (II) / product, is colourless / AW ; A yellow AVP ; e.g. manganate (VII) reduced to manganate (II)	6 max
(e)	states times for F and G with units ; time for F is more than for G ; concentrations for F and G stated ; F = 5 – 9 % (7% +/- 2 %) ; G = 15 – 19 % (17% +/- 2 %) ;	4

Question	Expected Answers	Marks																											
(f)	<p>(i) <i>answers must correspond with concentrations obtained - apply ecf as appropriate</i></p> <p>F = sports drink ; G = high energy drink ;</p> <p style="padding-left: 40px;">A 9% as sports drink</p>	1																											
	<p>(ii) <i>accept following points for sugars or for complex carbohydrates</i></p> <table border="0" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center; width: 45%;">sugars</th> <th style="text-align: center; width: 10%;">or</th> <th style="text-align: center; width: 45%;">complex carbohydrates</th> </tr> </thead> <tbody> <tr> <td>(water) soluble</td> <td></td> <td>insoluble ;</td> </tr> <tr> <td>small molecule</td> <td></td> <td>large molecule ;</td> </tr> <tr> <td>absorbed (into blood), immediately / quickly</td> <td></td> <td>absorbed, slowly / only after digestion ;</td> </tr> <tr> <td>diffuse through cell membranes / ref to facilitated diffusion</td> <td></td> <td>cannot diffuse through membranes ;</td> </tr> <tr> <td>do not need to be, digested / hydrolysed / broken down</td> <td></td> <td>need to be, digested / hydrolysed / broken down ;</td> </tr> <tr> <td>ref to absorption in the stomach</td> <td></td> <td>absorbed in the intestine ;</td> </tr> <tr> <td>fast energy release</td> <td></td> <td>slow energy release ;</td> </tr> <tr> <td>AVP</td> <td></td> <td>AVP ;</td> </tr> </tbody> </table>	sugars	or	complex carbohydrates	(water) soluble		insoluble ;	small molecule		large molecule ;	absorbed (into blood), immediately / quickly		absorbed, slowly / only after digestion ;	diffuse through cell membranes / ref to facilitated diffusion		cannot diffuse through membranes ;	do not need to be, digested / hydrolysed / broken down		need to be, digested / hydrolysed / broken down ;	ref to absorption in the stomach		absorbed in the intestine ;	fast energy release		slow energy release ;	AVP		AVP ;	2 max
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Question      Expected Answers      Marks

(g) *improvement must be linked with limitation*

	limitation	improvement
1	reaction already begun when timing begins / AW ;	start timing when potassium manganate (VII) is added / AW ;
2	difficult to judge the end point (as difficult to decide when can read the print clearly) ;	use a colorimeter / repeat several times to improve decision of end point / use Benedict's and weigh ppt ;  R use colour comparators
3	<i>either</i> only carried out once / no repeats / no replicates ; R not reliable unqualified <i>or</i> not able to check for anomalous results ;	repeat twice / carry out three readings for each concentration / AW ;  A 'many'
4	difficult to plot curve with confidence / not enough concentrations / too few points plotted on graph ;	use more concentrations of glucose / use any stated concentration(s) within range used ;
5	could not determine concentrations, greater than 20% / less than 6% ;	extend the range / use stated concentrations greater than 20% / use less than 6% ;
6	can only estimate concentrations of, F / G, because unsure of, best fit line / intercept ;	do more intermediate concentrations of glucose near estimate, of F / G ;
7	small change in time at higher concentration gives large effect on the estimate ;	repetitions / more intermediates / use a colorimeter / dilute sample and adjust ;
8	syringe not accurate for reading volume ; R air bubbles	use, graduated pipette / burette / fancy syringe ;
9	shaking not standardised ;	use a glass rod / invert test-tubes / AW ;  R 'standardised shaking'
10	AVP ; e.g. another syringe problem such as using potassium manganate (VII)  temperature fluctuates	AVP ; e.g. an appropriate improvement  thermostatically-controlled water bath

R refs to contamination

8 max

[Total: 28 max]

Question	Expected Answers	Marks
2 (a) (i)	<i>drawing</i>	
	clear continuous lines ; <b>R</b> if any shading correct (oval) shape with two distinct layers (accept three including very thin inner layer) ; correct relative thicknesses of two layers ;	<b>3</b>
	(ii) <i>labelling</i> lumen ; tunica media / AW ; tunica, externa / adventitia ; tunica, intima / interna (if drawn or if label line goes to edge of lumen) ; endothelium (if label line points to edge of lumen) ; <b>A</b> <u>squamous epithelium</u> elastic, tissue / fibres / lamina(e) / membranes ; <u>smooth muscle</u> ; collagen / fibrous tissue ; vasa vasorum / blood vessel ;	
	(iii) <i>annotations</i>  (tunica media) purple / AW ; } <b>A</b> shades e.g. dark / darker / light (tunica externa) red / AW ; } <b>R</b> white for lumen ref to appearance of elastic tissue / fibres, e.g. wavy lines ;	<b>7 max</b>
(b) (i)	<i>if correct answer (340-400) is given award two marks if incorrect answer or no answer, award one mark for multiplying by four</i>  <i>each square = 4 mm<sup>2</sup></i>  number of squares (85-100) ; (total area = 85-100 x 4 =) 340-400 (mm <sup>2</sup> ) ;	<b>2</b>
	(ii) <i>correct answer (82-85) gains 2 marks, allow ecf from (b)(i) if outside agreed limits if not a whole number award one mark if answer incorrect or not given, award one mark for correct working procedure</i>  answer from (i) divided by 2230 multiplied by 100, subtracted from 100 ;  <i>or</i>  answer from (i) subtracted from 2230, calculated as a percentage of 2230 ;  82-85 (%) ;	<b>2</b>

Question	Expected Answers	Marks
(c)	<p><i>reduction in supply of</i> glucose / fatty acids ; R nutrients oxygen ;</p> <p><i>build up / reduced removal of</i> carbon dioxide ; lactate / lactic acid ;</p> <p>anaerobic respiration / less or no aerobic respiration ; less energy available for ; contraction ;</p> <p>death of (heart / cardiac) <u>muscle</u> ; A fatigue / works less efficiently / AW</p>	<p><b>4 max</b></p>
(d)	<p>atheroma / plaque / thrombosis / blockage, can occur anywhere along an artery ;</p>	<p><b>1</b></p>

**[Total: max 16]**



## 2804 Central Concepts

Question	Expected Answers	Marks
1 (a)	<p>A (<i>lag phase</i>)</p> <p>1 slow, cell division / reproduction; <i>Do not credit growth</i></p> <p>2 adjustment to environment / AW;</p> <p>3 induction of genes / AW;</p> <p>4 synthesis of enzymes;</p> <p>B (<i>exponential / log phase</i>)</p> <p>5 rate of, cell division / reproduction at maximum / AW; <b>A</b> rapid , fast</p> <p>6 population doubles each unit time / exponential growth;</p> <p>7 no / few, limiting factors; <b>A</b> named environmental factor</p> <p>C (<i>deceleration phase</i>)</p> <p>8 rate of cell division slowing;</p> <p>9 limiting factors taking effect; <b>A</b> named environmental factor</p> <p>D (<i>stationary phase</i>)</p> <p>10 number of cells being produced = number of cells dying;</p> <p>11 due to, waste products / lack of nutrients / lack of oxygen; <b>A</b> lack of space,</p> <p>12 more competition ref to carrying capacity; <b>A</b> approaching carrying capacity for C</p> <p>13 E (<i>decline / death / senescence, phase</i>)</p> <p>14 number of cells dying greater than cells being formed; ref to waste products / lack of nutrients / lack of oxygen; <b>A</b> lack of space, more competition</p> <p>15</p> <p>16 allow relevant data quote anywhere in description; AVP; e.g. binary fission/ population reaching zero due to closed system.</p> <p><i>Accept birth rate and death rate as alternative wordings for marking points 10 and 13.</i></p> <p><i>Credit marking point 11 or 14 <u>once only</u></i></p>	max 7
	<p><b>QWC – clear, well organised using specialist terms. Award this mark if they have correctly referred to <i>three</i> out of the <i>five</i> stages by name.</b></p>	1
(b) (i)	<p>maximum, size/number of, population / a species that can be supported in a, habitat / ecosystem / area / environment;</p> <p><b>A</b> maximum size of, a population / species determined by limiting factors</p>	1
(ii)	<p>algae / food / nutrient;</p> <p>predators;</p> <p>disease;</p> <p>space / rock availability;</p> <p>competition;</p>	max 2

[Total: 11]

Question	Expected Answers	Marks
2 (a) (i)	protein / polypeptide; <b>R</b> enzyme, peptide	1
	(ii)	
	1 binds / forms complex, (with lactose);	
	2 alters structure / changes shape;	
	3 repressor molecule detaches / cannot bind; <i>Ignore where it binds</i>	max 2
	(iii) <u>operator</u> ;	1
(b) (i)	observable characteristics of an organism / AW; <b>A</b> expression of an allele	1
	(ii)	
	1 altered DNA;	
	2 altered mRNA (of repressor);	
	3 altered amino acid sequence (of repressor); <b>A</b> no repressor produced	
	4 change to, structure / shape (of repressor);	
	5 (repressor protein) unable to, bind to / block, operator;	
	6 RNA polymerase can bind to promoter;	
	7 transcription / translation (continues);	
		max 4
(c) (i)	$X^r X^r$ ; $X^r Y$ ; <b>A</b> $X^r -$ $X^R X^r$ / $X^r X^R$ ; $X^R Y$ ; <b>A</b> $X^R -$	4
	(ii) altered shape/ non functional / no, carrier protein; less / no, (re)absorption of phosphate <b>or</b> more / all, phosphate excreted; from glomerular filtrate; low phosphate levels in <u>blood / bones</u> ;	
		max 2
		[Total: 15]

Question	Expected Answers	Marks
3 (a)	<u>apical dominance</u> ;	1
(b)	<p><i>lanolin only</i> – growth of, lateral bud / leafy shoot;            IAA – reduced /no growth / AW; <b>A</b> inhibits growth            GA – leafy shoot develops; <b>A</b> promotes growth            longer / bigger / bushier / more leaves;</p> <p><i>longer leafy shoot = 2 marks</i>  <i>longer leafy shoot compared with lanolin only = 3 marks</i></p> <p><i>IAA plus GA</i>– longer / no leaves / forms underground stem / lateral shoot;</p>	max 4
(c) (i)	<p><u>eukaryotic</u>;  <u>hyphae / mycelium</u>;            coenocytic / AW;            (cell walls) made of <u>chitin</u>;            heterotrophic; <b>A</b> saprotrophic / parasitic            (reproduction by) <u>spores</u>;  <u>glycogen</u> (food store);</p>	max 3
(ii)	<p>1 ref humans;            2 identify/ choose, plants with desired characteristics / named example e.g. disease resistance;            3 another example of characteristic e.g. taste, high yield;            4 cross / breed (selected plants);            5 details of crossing technique; <b>A</b> ref to pollination / fertilisation            6 plant seeds from cross;            7 select plants with desired characteristics;            8 repeat over many generations;</p>	max 5
(iii)	<p>vegetative propagation / asexual reproduction; <b>R</b> self pollination            grow from tubers;            take cuttings;            tissue culture ;            AVP; e.g. detail of technique of taking cuttings or using tissue culture</p>	max 2
		<b>[Total: 15]</b>

Question	Expected Answers	Marks
4 (a) (i)	<u>glycolysis</u> ;	1
(ii)	cytoplasm / cytosol / sarcoplasm;	1
(iii)	pyruvate / pyruvic acid;	1
(iv)	4; <b>A</b> some ref to 4 being made	1
(b)	<i>role</i>	
1	coenzyme / cofactor;	
2	(for) removal of hydrogen / dehydrogenation / dehydrogenase enzymes;	
3	acts as, hydrogen acceptor / hydrogen carrier (from one compound to another);	
	<b>A</b> hydrogen ions, atoms	
P4	<i>fate if oxygen present (max 4)</i>	
P5	enter mitochondrion;	
P6	via shuttle system;	
P7	(go to) inner mitochondrial membrane / cristae;	
P8	NADH dehydrogenase;	
P9	hydrogen split into protons and electrons;	
P10	electrons to ETC;	
	protons to intermembranal space; <b>A</b> form proton gradient	
A11	<i>fate if oxygen absent (max 3)</i>	
A12	remains in cytoplasm / cytosol;	
A13	<u>ethanal</u> to <u>ethanol</u> ;	
A14	using hydrogen from NAD reduced; <b>R</b> molecules ref to <u>ethanol</u> dehydrogenase; <b>A</b> alcohol dehydrogenase	
15		
16	NAD oxidised; <b>A</b> recycle AVP; e.g. NAD reduced formed between triose phosphate to pyruvate	max 7
	<b>QWC –legible text with accurate spelling, punctuation and grammar</b>	1
(c)	no decarboxylation / AW; single step; lactate dehydrogenase; reversible;	
	<i>apply ora throughout</i>	max 3

[Total: 15]

Question	Expected Answers	Marks
5 (a)	<p><u>glycogenesis</u>;</p> <p><u>gluconeogenesis</u>;</p> <p><u>glycogenolysis</u>;</p> <p><u>link reaction</u>;</p> <p><u>Krebs cycle</u>;</p>	5
(b) (i)	<p>for calculation mark must have read 400 and 150 off the graph or write 250;</p> <p>63%;</p> <p>62.5 = 1 mark</p>	2
(ii)	<p>1 (following glucose meal) blood glucose levels rise /AW;</p> <p>2 insulin released;</p> <p>3 (more) glucose enters liver cells / increased substrate concentration;</p> <p>4 glycogen synthetase, produced / formed / AW;</p> <p>5 <b>results in</b> increased <u>activity</u> of glycogen synthetase; (<b>must be linked to 3</b></p> <p>6 <b>or 4</b>)</p> <p>7 glucose converted to glycogen / glycogenesis;</p> <p>8 less, glycogen phosphorylase formed / produced;</p> <p>9 <b>results in</b> decreased activity of glycogen phosphorylase; (<b>must be linked</b></p> <p>10 <b>to point 7</b>)</p> <p>reduced, glycogenolysis / breakdown of glycogen to glucose;</p> <p>ref to suitable supporting data quote for 5 or 8; <i>Ignore lack of units</i></p>	max 5
(c) (i)	<u>islets of Langerhans</u> ;	1
(ii)	$\beta$ ; A beta	1
(d) (i)	cell (surface) membrane / plasma membrane;	2
(ii)	protein / polypeptide / glycoprotein / glycolipid;	
(ii)	<p>increases membrane permeability (to glucose);</p> <p>increases activity of glycogen synthetase /decrease activity of glycogen phosphorylase;</p> <p>increases glycogenesis / decreases glycogenolysis;</p> <p>(increases rate of) conversion of glucose to fat (in adipose tissue);</p> <p>rate of respiration increases;</p>	max 2
(e)	<p>insulin still being produced;</p> <p>lack of insulin receptors;</p> <p><u>cells</u> do not respond to insulin;</p> <p>likely to be suffering from, type II / insulin independent diabetes;</p>	max 2

[Total: 20]

Question	Expected Answers	Marks
6 (a) (i)	(the factor) which is at its, least favourable / nearest its minimum, value; (the factor which) if increased would speed up process; factor which limits the rate of a, reaction / process;	max 1
(ii)	guard cells lose turgidity / AW; closure of stomata; restricts carbon dioxide entry (through stomata); <b>R</b> stops carbon dioxide entry ref. to ABA and stomatal closure;	max 2
(b)	shade plant more photosynthesis at low light intensities / ora; sun plant more photosynthesis at high light intensities / ora; shade plant reaches, compensation point / <u>net</u> rate of photosynthesis, at low light intensity / ora; shade plants , plateau / max photosynthetic rate, at low light intensities / ora;	max 2
(c) (i)	fewer, cells / named cells/ less, biomass / named tissue (present per leaf surface area); <b>A</b> fewer mitochondria;	1
(ii)	(at low light intensity) rate of photosynthesis / primary productivity, low; small amount of sugars formed / AW; <b>R</b> food, nutrients sugars / photosynthetic products used in respiration; <i>idea of</i> low rate of respiration means products used slowly / ora;	max 3
(d) (i)	Group 1 21 mg (CO <sub>2</sub> ) cm <sup>-2</sup> h <sup>-1</sup> ; Group 3 7.5 mg (CO <sub>2</sub> ) cm <sup>-2</sup> h <sup>-1</sup> ; <i>No units max 1</i> <i>If units shown once and figures correct 2 marks</i>	2
(ii)	detect light intensity; ref to PGRs; PGR works via genetic control; different, growth rate / pattern /appearance; <b>A</b> example of phenotypic feature	max 3
		[Total: 14]

## 2805/01 Growth, Development and Reproduction

<b>Abbreviations, annotations and conventions used in the Mark Scheme</b>	/	=	alternative and acceptable answers for the same marking point
	;	=	separates marking points
	NOT	=	answers which are not worthy of credit
	<b>R</b>	=	reject
	( )	=	words which are not essential to gain credit
	_____	=	(underlining) key words which <b>must</b> be used to gain credit
	ecf	=	error carried forward
	AW	=	alternative wording
	A	=	accept
	ora	=	or reverse argument

**Question**      **Expected Answers**      **Marks**

1 (a)      *Accept anglicised or phonetic version of correct term*

	plantae ;
	prokaryotae / protocista ;
	fungi / plantae ;

**3 max**

(b)      eukaryotic / multicellular / membrane bound organelles ;  
heterotrophic / described / ora ;  
no cell walls ;  
no chloroplasts ;  
no large vacuoles / only small vacuoles ;  
locomotion / moves ;  
AVP ; e.g. growth all over body

**2 max**

(c) (i) *Hydra*  
AVP ; e.g. stick insect / jelly fish / ribbon worm

**1 max**

(ii) *Mark separately from (i)*  
*If Hydra is chosen*

buds grow / budding ;  
towards base of body / cells in both layers ;  
divide by mitosis / genetically identical / clones ;  
bulge / swelling, forms / increase in size / becomes cylindrical ;  
develops mouth and tentacles ;

*if alternative to Hydra chosen*  
AVP ;;;

**3 max**

Question	Expected Answers	Marks
	<p>(iii) one parent no need to find a mate ;  no, waste of gametes / energy used in producing gametes ;  large number of offspring ;  can colonise an area quickly / high success rate ; <b>R</b> <i>rapid alone</i>  <u>genetically</u> identical ;  features adapted to environment remain / AW ;</p>	2 max
(d)	<p>(i) too many chromosomes / two nuclei not viable / AW ;  DNA / genetic material, only from sheep A / ora ;  would cause (more) variation if used / embryo would not be a clone / AW ;  AVP ; e.g. DNA / genes of B not desirable</p>	1 max
	<p>(ii) large cell / larger than body cell / large quantity of cytoplasm ;  stored energy / nutrients ;  primed for division / AW ;  contains cytoplasmic genes / organizers / AW ;  AVP ; e.g. not specialised for reproduction <b>R</b> <i>any reference to</i>  <i>chromosomes of B</i></p>	1 max
		[Total: 13]



Question	Expected Answers	Marks
2 (a)	<i>Mark points in either section if in correct context to max 4</i>	
	<i>meiosis</i>	
P1	<u>pollen mother cells</u> divide by meiosis ;	
P2	(pollen mother cells) are diploid ;	
P3	four haploid cells formed ;	
P4	<u>tetrad</u> ;	
P5	restore diploid number at fertilisation ;	
P6	increase <u>genetic</u> variation ;	
P7	e.g. of how variation occurs in meiosis ;	
P8	AVP ;	4 max
	<i>mitosis</i>	
M9	production of large numbers ;	
M10	genetically identical pollen grains ;	
M11	pollen grain nucleus, divides (by mitosis) ; <i>R just 'pollen divides'</i>	
M12	into generative nucleus ;	
M13	(generative) nucleus divides (by mitosis), into two male gametes ;	
M14	and pollen tube nucleus ;	
M15	controls growth of pollen tube / AW ;	
M16	AVP ; pollen mother cells formed by mitosis ;	4 max
	<b>QWC – legible text with accurate spelling, punctuation and grammar ;</b>	<b>7 max</b>
		<b>1</b>
(b)	1 large petals / open flowers, easy for insects to enter ;	
	2 attracted by bright colour ; <i>R refs to scent</i>	
	3 guidelines visible only in UV light ;	
	4 UV / guidelines, visible to insects ;	
	5 guide insects to nectaries ;	2 max
	6 pollen sticks together / AW ;	
	7 string / pollen, sticks / AW, to insect ;	
	8 sticks / AW to <u>stigma</u> ;	
	9 AVP ; e.g. other animals cannot see it	2 max
		<b>3 max</b>
(c)	(i) dioecious ; <b>A</b> dioecy or phonetic spelling	<b>1 max</b>
	(ii) female plants produce / male plants do not produce, seeds / fruits / berries ;	
	long distance between trees, so no pollination / AW ;	
	need external, (pollinating) agent / named ;	
	pollination less successful / no chance of self pollination ;	<b>1 max</b>
	(iii) protandry / described ;	
	protogyny / described ;	
	self-incompatibility / S genes / described ;	
	heterostyly / explained ; <i>R anther above stigma without relevant explanation</i>	
	AVP ; e.g. monoecious / described	<b>1 max</b>

Question	Expected Answers	Marks
(d)	<ol style="list-style-type: none"><li>1 <u>natural</u> selection ;</li><li>2 artificial selection / described ;</li><li>3 more, <u>genetic</u> variation / <u>genetically</u> different trees / increasing gene pool</li><li>4 (variety) ;</li><li>5 environmental change / named, may occur ;</li><li>6 some likely to be better adapted / described ; <i>A idea of increased</i></li><li>7 <i>survival</i></li><li>8 survive to reproduce ; idea of increased frequency of advantageous genes / ora ; pass (favourable) alleles / traits / advantages, to offspring ;</li></ol>	<b>4 max</b>

**[Total: 18]**

Question	Expected Answers	Marks
3 (a)	(layer of) glycoproteins removed ; plasma proteins removed ; cholesterol in membrane reduced ; from surface of sperm ; removed by enzymes ; can swim more rapidly / AW ; may be more sensitive to chemicals / AW ; membrane more permeable to calcium ions ; AVP ;	3 max
(b)	<i>mitochondria</i> release energy ; <i>R produce energy</i> from respiratory substrate / named, in semen / seminal fluid ; produce ATP ; from <u>aerobic</u> respiration ; for movement of sperm / described ;	3 max
	<i>acrosome</i> acrosome swells ; membrane fuses with membrane of sperm (head) ; enzymes / named, released ; by exocytosis ; digest path through follicle cells ; (another) enzyme / named, digests path through zona pellucida ; AVP ; e.g. needs a lot of acrosomes enables cortical reaction	4 max 5 max
(c)	<i>Mark first answer for (c) (i) to (iii)</i>	
(i)	ectopic pregnancy ; sexually transmitted infection / pelvic infection / PID / other named ; surgery ; sterilisation ; AVP ; e.g. scar tissue genetic <i>R cancer unqualified</i>	1 max
(ii)	ensure events are coordinated / AW ; ref to named hormones, qualified ; prevent further development of oocytes ; <i>R egg</i> know exact stage of development / when to collect oocytes / so oocytes not released early ; AVP ; so that menstrual cycle does not continue	1 max
(iii)	damage / cause bleeding in, vagina / ovary / oocyte / named organ ; cause infection ; risk from anaesthetic ; AVP ;	1 max

Question	Expected Answers	Marks
(iv)	<i>R all references to fertilisation</i>	
	<i>advantage</i> more likely that one will implant / AW ; AVP ; e.g. less wastage of embryos	1 max
	<i>disadvantage</i> reference to risk from multiple pregnancy ; lower birth masses ; premature birth ; one may be less well nourished ; AVP ; e.g. relevant ethical / moral objection	1 max
		<b>2 max</b>
(d)	<b>D1</b> no. of pregnancies <u>and</u> live births, decreases with age ; <i>may be implied in</i> <b>D2</b> <i>figs</i> <b>D3</b> comparative figs from graph ; <b>D4</b> no. of live births decreases more rapidly / ora ; AVP ; e.g. negative correlation additional relevant comment on data	3 max
	<b>E1</b> <b>E2</b> older oocytes less likely to be fertilised / ora ; <b>E3</b> implantation less likely in uterus of older women ; <b>E4</b> fewer / unbalanced, hormones, produced in older women ; <b>E5</b> miscarriage rate increases with age ; <b>E6</b> ref. to, age of menopause / approaching menopause ; <b>E7</b> ref. to possible health problems increasing with age ; AVP ; e.g. genetic defects increase with age poor nutrition weaker cervix	3 max
		<b>4 max</b>

[Total: 17]

Question	Expected Answers	Marks
4 (a) (i)	$\frac{171.0 - 86.5}{86.5} \times 100 ;$ <p>97.69 (%) ;      <b>A 97.7%</b></p>	<p><i>wrong answer correct method 1 max</i>  <i>correct answer only 2 max</i></p> <p><b>2 max</b></p>
(ii)	<p>accurate ref to three zones / described ;    <i>ref to differentiation neutral</i>  cells take up water by osmosis ;  vacuole expands ;  synthesise new materials ;  example of new materials ;  (turgor) pressure / stretching, elongation occurs / AW ;  greater increase in length than width ;  AVP ; e.g. ref to role of plant growth regulators / auxin / gibberellin</p>	<b>3 max</b>
(b) (i)	<p>sucrase / invertase is specific ;  ref to active site ;  forms enzyme substrate complex ;  <u>hydrolysis</u> of sucrose ;  breaks glycosidic bonds ;  detail on reaction e.g. bonds named ;  AVP ; e.g. further detail of enzyme activity / lowers activation energy</p>	<b>3 max</b>
(ii)	<p>optimum activity at low pH / AW ;  ref to proton gradient / cotransport / H<sup>+</sup> ;  AVP e.g. electrical potential / potential difference ;</p>	<b>1 max</b>
(iii)	<p>in respiration / release of energy / ATP production ;  production of cellulose / starch / new cell wall / manufacture lignin / inulin /  other named function ; <b>R growth unqualified</b>  contribute to turgor pressure / decrease water potential / allows entry of  water by osmosis ;</p>	<b>2 max</b>
		<b>[Total: 11]</b>

Question	Expected Answers	Marks
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5 (a)

<i>vagina</i>	semen / sperm, deposited ; allows entry of penis / AW ; allows exit of baby / AW ;
<i>cervix</i>	(mucus plug) closes off uterus/ ora ; dilates during birth ; <b>R prevents entry of sperm unqualified</b>
<i>wall of uterus</i>	muscles contract during childbirth ; and at orgasm to help sperm into uterus ; <b>R all refs to implantation</b>
<i>oviduct</i>	fertilisation occurs ; move ovum / secondary oocyte / zygote / embryo, to uterus ;
<i>fimbriae</i>	collect <u>secondary</u> oocytes after ovulation ;

5 max

- (b) secrete, hormones / oestrogen / progesterone ;  
(secreted) directly into blood ;  
no ducts ;

2 max

- (c) 1 accurate time reference ;  
2 as **corpus luteum** degenerates ;  
3 fall in level of **progesterone** ;  
4 lining / **endometrium**, is shed / broken down ;  
5 in **menstruation** ;  
6 **oestrogen** ;  
7 from **follicle** cells ;  
8 ref. to **theca** ;  
9 repairs / thickens, endometrium / lining ;  
10 approx 3 times thicker ;  
11 blood vessels / glands, develop / glandular activity stimulated ;  
12 ovulation controlled by surge oestrogen / **FSH / LH**;  
13 **progesterone** helps maintain thickness ;  
14 secreted from **corpus luteum** ;  
15 AVP ; e.g. ref to role of **GnRH**,  
role of **LH** in formation CL  
FSH in regulating oestrogen production

7 max

**QWC – clear well organised using specialist terms ;**

1 max

Award QWC if four of following used in correct context and sequence:

<i>corpus luteum</i>	<i>oestrogen</i>
<i>progesterone</i>	<i>follicle</i>
<i>endometrium</i>	<i>theca</i>
<i>menstruation</i>	GnRH / FSH / LH

Question	Expected Answers	Marks
(d)	iron, replacement of red blood cells / needed to make Hb / prevents anaemia ; protein, production of, follicle cells / cells in endometrium / peptide hormones / to maintain enough body mass to menstruate ; lipids, cell membranes in, follicle / endometrium / food reserves in secondary oocyte; AVP ; role of folate / Vit B12, for utilisation of iron, cholesterol for cell membranes / steroid / reproductive, hormones / named, vitamin C for iron uptake	<b>2 max</b>
		<b>[Total: 17]</b>

Question	Expected Answers	Marks
6 (a) (i)	develops from ovary ; contains pericarp ; contains seeds ; produced by sexual reproduction ; AVP ;	1 max
(b)	X sepal ; A calyx ; Y ovary <u>wall</u> ; Z <u>ovule</u> ;	3 max
(c) (i)	external stimuli / oxygen / sunlight / day length / increase in temperature ; PGRs / named ; activate / AW , promoter / regulator gene / gene switch ; ref to <i>lac</i> operon ; starts transcription / stage of transcription described ;	2 max
(ii)	less / no, pectinase produced ; <u>calcium pectate</u> not broken down / removed ; less / no, enzyme reactions ; needed to soften cell wall / AW ;	2 max
(iii)	inhibit gene <b>P</b> / ripening gene / ethene ; keep in oxygen free atmosphere / keep in CO <sub>2</sub> atmosphere ; keep at low temperature ; AVP ; e.g. genetically engineered / Flavr Savr tomatoes, increase cytokinin	2 max
(iv)	allows time for transport / storage / AW ; ready when consumers want them ; customers may prefer them under ripe ; extend ripening period ;	1 max
(d)	abscission ; ABA stimulates fruit fall ; usually fall in levels of auxins promotes fruit fall ; high auxin concentration may also promote fruit fall (if applied late) ; ethane, inhibits growth / promotes, ageing / senescence / ripening ; cytokinins slow ageing / ripening / fruit fall ;	3 max

[Total: 14]



## 2805/02 Applications of Genetics

<b>Abbreviations, annotations and conventions used in the Mark Scheme</b>	/	= alternative and acceptable answers for the same marking point
	;	= separates marking points
	NOT	= answers which are not worthy of credit
	<b>R</b>	= reject
	( )	= words which are not essential to gain credit
	<u>      </u>	= (underlining) key words which <b>must</b> be used to gain credit
	ecf	= error carried forward
	AW	= alternative wording
	A	= accept
	ora	= or reverse argument

Question	Expected Answers	Marks
1 (a) (i)	(dominant) epistasis ; B epistatic A hypostatic ; prevents transcription of A ; product of B binds to, promoter / AW, of A ; prevents translation of A mRNA ; product of B binds to, mRNA / ribosome ; product of B inhibits enzyme encoded by A / B codes for enzyme which breaks down pigment ;	<b>max 3</b>
(ii)	<i>parental phenotypes</i> (AABB) white (aabb) white ; ( <i>genotypes given in question</i> ) <i>gametes</i> AB ab ; <i>F<sub>1</sub> genotype and phenotype</i> all AaBb white ; <i>F<sub>1</sub> gametes</i> AB Ab aB ab ; <b>A from P. square</b> <i>F<sub>2</sub> genotypes</i> all correct ;; <i>delete 1 for each of first two mistakes</i> <i>F<sub>2</sub> phenotypes</i> correctly related to genotypes ; <b>A key</b> <i>F<sub>2</sub> ratio</i> 13 white : 3 red ; ( <i>see Punnett square</i> )	<b>8</b>
(b) (i)	genes linked / AW ; ref. locus involved in production of toxin ; resistance inherited with, allele A / allele b ; close together (on same chromosome / in same linkage group) ; few without resistance from crossing over ;	<b>max 2</b>
(ii)	crossing over has occurred ; in, meiosis I / prophase I ; exchange of (part of) non-sister chromatids ; diagram ; mutation ;	<b>max 2</b>

[Total: 15]

Question	Expected Answers	Mark
2 (a) (i)	<p>shows role of genotype in variation ;  proportion of (phenotypic) variation due to genotype ;  <math>V_G / V_P</math> ;  ref., broad sense heritability / narrow sense heritability ;</p>	max 2
(ii)	<p>success depends on choosing parents who owe desirable trait to genotype / AW ;  not to their environment ;  cannot select for, variation due to environment / <math>V_E</math> ; (ora)  successful selective breeding requires high heritability ; (ora)  cannot select for values <math>&lt; 0.02</math> ;</p>	max 2
(iii)	<p>value of 1 = no environmental effect / value of 0 = no genetic effect ;  indicates whether condition is likely to be inherited ;  ref. 2 examples from table compared <u>re</u> inheritance ;</p>	max 2
(b)	<ol style="list-style-type: none"> <li>1 <u>phenotypic</u> variation ;</li> <li>2 result of genotype and environment ;</li> <li>3 <math>V_P = V_G + V_E</math> ;</li> <li>4 leaves from same plant genetically identical ;</li> <li>5 bar (somatic) mutation ;</li> <li>6 variegation / presence of white edges, genetic ;</li> <li>7 present in all leaves of plant 2 / absent in all leaves of plant 1 ;</li> <li>8 extent of white environmental ;</li> <li>9 variation in shape environmental ;</li> <li>10 larger size plant 1 leaves (than 2) genetic ;</li> <li>11 variation in size, environmental / age ;</li> <li>12 light intensity / light wavelength / shading ;</li> <li>13 height above ground ;</li> <li>14 internal factors ;</li> <li>15 flowering shoot / PGS ;</li> <li>16 ref. heritability ;</li> <li>17 AVP ; e.g. green v. variegated is discontinuous variation / shape and size are likely to be continuous variation</li> </ol>	max 8
	<p><b>QWC – quality of use and organisation of scientific terms ;</b>  <b>(Award when clearly organised and 3 of the following terms are used appropriately: phenotype, genotype, heritability, environment, variation / variance, equation)</b></p>	1

[Total: 15]

Question	Expected Answers	Marks
3 (a)	so that desired (artificial) cross can be made ; to save having to remove stamens / AW ; to prevent self, pollination / fertilisation ; to, prevent inbreeding / promote outbreeding ; to, prevent inbreeding depression / promote hybrid vigour ;	max 3
(b)	via sticky ends ; complementary (bases) ; A to T / C to G ; both cut with same restriction enzyme ; may be cut with blunt ends ; if so given sticky ends ; ref. terminal transferase ; ref. ligase ; result is, rDNA / recombinant DNA ;	max 4
(c)	recognition that chloroplast has loop DNA not chromosome ; easier to insert into loop of DNA (than into chromosomes) ; less material to penetrate ; no associated (structural) protein ; less likely to disrupt nuclear genes / AW ; self-replicating ; similar to bacterial genome ;	max 2
(d)	combines with, oxaloacetate / a 4-C compound ; to give, citrate / a 6-C compound ; CoA recycled ; ref., Krebs cycle / link reaction ; ref. decarboxylation / dehydrogenation ; produces, fatty acids / chlorophyll / amino acids ;	max 3
(e)	rate of reaction $\propto$ [E] ; provided [S] not limiting ; active site, better fit / higher affinity ; lower activation energy ; faster turnover rate / AW ; enzyme, more stable / less easily denatured ; promoter ensures expression of transgene / AW ; detail ; (e.g. many copies mRNA) so [E2] > [E1] ; AVP ; e.g. number of collisions	max 3

[Total: 15]

Question	Expected Answers	Marks
4 (a)	<p>explant of, meristematic / cambium / totipotent / pluripotent, tissue ;            explant surface sterilised ;            ref. production of protoplasts ;            sterile nutrient ;            PGS to stimulate, mitosis / division ; <i>A appropriate named PGS</i>  <u>callus</u> formed ;            subdivided ;            PGS to stimulate differentiation ; <i>A appropriate named PGS</i>  <u>plantlet</u> formed ;            hardening medium / sterile soil ;</p>	max 4
(b)	<p>to maintain <u>genetic</u> variation ;            to, maintain large gene pool / prevent genetic erosion / AW ;            to maintain <u>phenotypic</u> variation ;            to maintain as many traits as possible ;            to prevent future inbreeding problems ;  <i>R material not surviving</i></p>	max 2
(c)	<p>acts as (field) gene bank ;            may have desirable trait(s) ;            for use in future (breeding programme) ;            for future genetic engineering ;            e.g. tolerance / resistance / wanted chemical / other ;</p>	max 3
(d)	<p>to find out what conditions are tolerated ;            to find <u>optimum</u> conditions ;            edaphic / topographic, conditions as well as temperature ;            to find out whether variation (already) exists ;            so plant cultivated in correct conditions somewhere ;</p>	max 2
(e)	<p><i>maintenance</i>            as large a variety of seeds as possible ;            seeds dehydrated ;            to <math>\leq 5\%</math> water ;            stored frozen ;            provided seeds, orthodox / not recalcitrant ; <i>max 3</i></p> <p><i>used</i>            germination test, at intervals / e.g. every 5 years ;            when germination falls below 85% ;            seeds grown and fresh seed collected and stored ;            supplies seeds for future, breeding / repopulation ; <i>max 3</i></p>	max 4

[Total: 15]

Question	Expected Answers	Marks
5 (a) (i)	<p><i>condition</i> Down('s) syndrome ;</p> <p><i>reason</i> trisomy 21 / three chromosomes 21 ;</p>	2
(ii)	<p>non-disjunction / AW ;</p> <p>in meiosis ;</p> <p>first polar body has no chromosome 21 ;</p> <p>gives, 2<sup>o</sup> oocyte / ovum / gamete, with 2 chromosomes 21 ;</p> <p>normal sperm has 1 chromosome 21 ;</p> <p>fertilisation adds third chromosome 21 ;</p> <p>more likely in older oocyte ;</p>	max 4
(b)	<p><i>advantages</i></p> <p>[of microarray-based comparative genomic hybridisation (array-CGH)]</p> <p>A1 can identify presence of disorder ;</p> <p>A2 allows palliative treatment to be started / AW ;</p> <p>A3 allows potential parents to decide whether to have children ;</p> <p>A4 or to avoid risk by using AI(D) ;</p> <p>A5 or to avoid risk by using, egg / embryo, donation ;</p> <p>A6 or to use IVF with pre-implantation test ;</p> <p>A7 or to abort fetus after test ;</p> <p>A8 or to adopt ;</p> <p>A9 AVP ; e.g. <i>removes uncertainty</i></p> <p style="text-align: right;"><i>max 5</i></p> <p><i>disadvantages</i></p> <p>D1 needs genetic counselling ;</p> <p>D2 presence of abnormality may not affect health ;</p> <p>D3 may be, junk DNA / non-coding region / AW ;</p> <p>D4 individual worried unnecessarily ;</p> <p>D5 fetus might be aborted unnecessarily ;</p> <p>D6 false negatives and positives ;</p> <p>D7 ethical problem of termination ;</p> <p>D8 risk of procedure ;</p> <p>D9 effect on other members of family ;</p> <p>D10 AVP ; e.g. unwanted embryos generated by IVF / problem of test when no treatment available / discrimination by insurers or employers</p> <p style="text-align: right;"><i>max 5</i></p>	max 8
	<b>QWC - legible text with accurate spelling, punctuation and grammar;</b>	1

[Total: 15]

Question	Expected Answers	Marks
6 (a)	1 compatibility determined by, HLA / MHC ; 2 4 / 6, loci / genes ; 3 code for, antigens / glycoproteins / recognition markers ; 4 each with many alleles ; 5 hence very large number of possible combinations ; 6 loci / genes, linked / inherited as haplotype ; 7 chances of suitable donor outside family very small / ora ; 8 non-compatible donation will be rejected / ora ; 9 more important to match, some / B and DR, than others ; 10 even when matched anti-rejection drugs needed ;	max 5
(b) (i)	[urea] begins falling when treatment starts ; falls to that of normal (rats) ; after 6 days treatment ; effect does not persist ; rises as soon as treatment stops ; to original level after, 7/8, days ;	max 3
(ii)	continue upward rise at $\pm$ constant rate ;	1
(iii)	[ammonia] rises ; toxic / AW ; still needs to be excreted ; changes pH ; undoes work of liver ; urea produced by combining ammonia and carbon dioxide / ref. ornithine cycle ;	max 2
(iv)	pass transgene to other bacteria ; mechanism of transfer between bacteria ; pass transgene via virus to other organisms ; ref. to gut bacteria ; escape capsules (and colonise gut) with, undesirable / unforeseen, consequence ; escape to environment (from faeces) ; pass to normal person whose N metabolism then upset ; unethical with reason ; may not have same effect on humans (so risk involved in first trial) ; AVP ; e.g. mutation of the bacteria	max 4

[Total: 15]

## 2805/03 Environmental Biology

<b>Abbreviations, annotations and conventions used in the Mark Scheme</b>	/	=	alternative and acceptable answers for the same marking point
	;	=	separates marking points
	NOT	=	answers which are not worthy of credit
	<b>R</b>	=	reject
	( )	=	words which are not essential to gain credit
	<u>      </u>	=	(underlining) key words which <b>must</b> be used to gain credit
	ecf	=	error carried forward
	AW	=	alternative wording
	A	=	accept
	ora	=	or reverse argument

Question	Expected Answers	Marks
1 (a) (i)	<i>Brazil</i> reduced forest cover;  <i>Rwanda</i> increased forest cover;	2
(ii)	56.1% <b>accept</b> 56%;  (477 698 / 851 488 x 100)	max 1
(b)	loss of topsoil / soil erosion / AW ; ref to effect of soil erosion e.g. silting of rivers ; loss of soil fertility ; increase in release of carbon dioxide ; idea of potential for increase in global climate change / (enhanced) greenhouse effect ; loss of habitats ; loss of species / biodiversity ; change in local weather patterns ; change in water availability ;	max 3
(c)	no figures for forest size prior to 2005 ; no way of telling what type of forest was lost for each country ; no data to suggest what the state of the forest was for each country ; no information on species (potentially) lost due to deforestation ; ref to comparative size of forest ; AVP ; e.g. values for soil erosion ;  <b>R</b> ref to size difference of country	max 2
(d)	food webs have many connections / AW ; organisms can switch diets ; species removal may have indirect effects / AW ; e.g. organisms that rely on their waste <i>or</i> interaction with other organisms ; removal of keystone species ; ref to example e.g. removal of agoutis in Amazonian study ; changes might take a long time to occur ; <i>idea</i> of lack of scientific knowledge ; ref to the difficulty of identifying trophic levels ;	max 3

Question	Expected Answers	Marks
(e)	(i) carbon, absorbed / stored / used / metabolised (from atmosphere) / AW ;	max 1
	(ii) <i>Answers if explained as a carbon sink</i>	
	young plants ; fast growth ; high net primary productivity / AW ; idea of storage capacity / oil production / hydrocarbons ; AVP e.g. idea of storage capacity of oil / hydrocarbon ;	
	<b>or</b>	
	<i>Answers if explained as a carbon source</i>	
	oil palms are short lived species ; they do not store carbon over time ; reduced wood density and so less carbon stored ; plantations regularly harvested and carbon released back into atmosphere; AVP; ora if answered from a rainforest view point	max 2

[Total: 14]



Question	Expected Answers	Marks
2 (a)	increase ; comparative data quote ; colour intensity fluctuates / AW ; ref. significant rise from 1985 (mid 1980's) ;	max 2
(b) (i)	comparative seasonal changes explained e.g. ref to light intensity, temperature, nutrients ; linked change to level of photosynthesis and chlorophyll production ; idea of grazing / predation / AW ; idea of thermoclines ; idea of seasonal upwelling currents ;	max 2
(ii)	1955 colour intensity fluctuates, 2000 intensity constant from March to October ; 1955 2 / 3 separate peaks, seasons or peaks approx April, August and October (high intensity) ; 2000 has one long peak, March to October (high intensity) ; 1955 low intensity (white regions) Jan/Feb and June, in 2000 no low intensity regions ;	max 3
(c)	increase of chlorophyll production / AW ; increase <u>rate</u> of reactions / photosynthesis ; ref to kinetic energy ; ref to enzymes ; e.g. RuBPase / carboxylase / dehydrogenase / DNA polymerase / AW ; increased fixation of carbon dioxide ; temperature is a limiting factor in, photosynthesis / growth / AW ;	max 3
(d) (i)	non-living / physical / chemical ;	max 1
(ii)	presence of a predator / zooplankton / AW ; predating upon food source and hence reducing numbers ;  size of phytoplankton population ; idea of production of toxins from phytoplankton ;  ref. to density dependent factors ; intraspecific competition ; for (named) nutrient ;	max 2

Question	Expected Answers	Marks
(e)	<p>max 2 for increase in named gases ;</p> <p>then 1 from appropriately linked source ;</p> <p><i>increase in carbon dioxide from motor cars / industry / fossil fuels / deforestation ;</i></p> <p><i>increase in methane from increased agriculture / cattle / rice production ;</i></p> <p><i>increase in nitrous oxide(s) from increased use / production of fertilisers ;</i></p> <p><i>increase in CFCs from refrigerants / AW ;</i></p> <p><i>increase in water vapour ;</i></p> <p><i>and</i></p> <p>short wave energy passes through gases ;</p> <p>long wave energy reflected from earth ;</p> <p>gases trap the heat / re-radiated energy / AW ;</p> <p>energy redirected back to earth ;</p> <p><b>R</b> consequences of increase in gases</p>	<p><b>max</b> <b>5</b></p>

**[Total:18]**

Question	Expected Answers	Marks
3 (a)	nervous system ; brain ; CNS ; PNS ; synapses ; spinal cord;	max 1
(b)	some insects are resistant to pesticides ; idea of, resistant genes / genetic resistance / AW ; (resistant insects not killed) and survivors reproduce / AW ; resistant gene spreads to offspring ; pests have rapid reproduction ; immigration to other areas (spreading resistance) ; may kill beneficial insects ; may not kill target pest species / idea of wrong pesticide ;	max 3
(c)	1 locate / find pest species ; 2 breed / acquire wasps ; 3 introduce wasps / wasp eggs to pests ; 4 introduce wasps only when population of pests is at a certain level ; 5 idea of monitoring populations of predator pest / AW ; 6 reintroduce predators when necessary ; 7 idea of no pesticide treatment / AW ;	max 5
	8 assess damage to grass ; 9 ref. to sampling techniques ; 10 decrease in population of armyworms / AW ; 11 ref to suitable techniques for population measure ; 12 user surveys i.e. from golfers / AW ; 13 ref to control green / course / AW ; 14 ref to time periods of study / AW ; 15 idea of beneficial agent becoming pest ; 16 AVP ; e.g. further detail to points 9 and 11 ;	max 5
		max 8
	<b>QWC – legible text with accurate spelling, punctuation and grammar;</b>	1
		<b>[Total: 13]</b>

Question	Expected Answers	Marks
4 (a)	<p><i>award one mark for an advantage and one mark for a disadvantage</i></p> <p><i>advantages</i> quick / easy (assessment) ; unskilled staff can carry out assessment ; easy interpretation from public ;</p> <p><i>disadvantages</i> less accurate because it is qualitative / AW ; not all pollutants sampled ; does not look at the biotic and abiotic quality of the water ; ref to subjectivity / difficulty of comparing with other people ;</p>	<p><b>1 max</b></p> <p><b>1 max</b></p> <p><b>max 2</b></p>

Question	Expected Answers	Marks
<b>(b)</b>	<p>Any <b>two</b> of the following 1 mark for factor and 1 mark for explanation</p> <p>oxygen (concentration) ; needed for all respiring organisms / AW ; ref to decomposition of organic matter ;</p> <p>nitrate (concentration) ; increase plant growth / eutrophication / lowered oxygen ;</p> <p>waste products from agriculture e.g. slurry ; increase plant growth / eutrophication / lowered oxygen ;</p> <p>nitrite (concentration) ; toxic / poisonous to aquatic life / ref to blue-baby ;</p> <p>ammonia (concentration) ; toxic / causes fish gills to clump together and swell ;</p> <p>pH ; (extremes) denature ; (pH changes) alter the uptake of essential mineral ions in plants ; affects reproduction in fish ; can cause release of toxic ions into the water ;</p> <p>temperature ; warmer temperatures reduce oxygen content of the water ; change in temperatures may affect enzyme systems ; may affect the behaviour of organisms ;</p> <p>turbidity ; reduction in light availability ; reduction in overall rate of photosynthesis ;</p> <p>salinity ; ref to osmotic effect ; ref to correct functioning of cells ;</p> <p>speed of water flow ; idea of reduction in pollution effect ;</p> <p>AVP ; e.g. other named factor with explanation such as specific heavy metal;</p>	<b>max 4</b>
<b>(c)</b>	<p>(eutrophication often leads to) algal / plant growth ; algae tends to blanket water surface ; algae tend to be either, green / red, in colour ; colour change might indicate excessive plant growth ;</p>	<b>max 2</b>

Question	Expected Answers	Marks
(d)	<p><i>water</i>            named example e.g. stonefly nymphs / mayfly nymphs / freshwater shrimps / caddis larvae / tubifex / rat tailed maggot / chironomids ;            easy to recognise / identify ;            look for degree of pollution indicated e.g. stonefly only live in clean water ;            presence / absence / number / other measure of species ;</p> <p><i>air</i>            lichen / named lichen / orchids / bromeliads ;            easy to, recognize / identify ;            look for degree of pollution indicated e.g. lichens cannot tolerate high levels of pollution;            presence / absence / number / other measure, of species ;</p>	max 3
(e)	<p>combustion of fossil fuels / vehicle emissions / metal smelting ;            two named gases e.g. SO<sub>2</sub>, NO<sub>x</sub> and hydrocarbons ;            dissolving in rain / forming acid rain (forming nitric and sulphuric acids) ;            credit for a correct chemical equation ;            ref. to dry deposition ;            decreased biodiversity ;            damage to fish gills ;            ref. to permeability of calcium ;            reduced reproductive rates / embryos ;            ref to homing in salmon ;            ref to reduced bone density ;            increase in aluminium ions leading to toxic water ;            ref to effects on aquatic plants e.g. effect upon enzymes ;</p>	max 5

[Total: 16]

Question	Expected Answers	Marks
5 (a)	no trees found, between 50 – 90m or in middle / 0 – 10m or at start / AW; greatest percentage cover of trees recorded between 10 – 30m and 100 – 130m ; ref comparison between ends of transect ; ref to comparative data quote for percentage cover ;	max 2
(b)	competition, from other (tree) species / for space / from disease ; incorrect nutrient availability / condition for scarlet oak ; competition for other named resource ; change in soil structure or pH along transect ; idea of firebreak clearing / river / road / AW ; idea of spreading from original population ; idea of not planted there / cut down / forest fire / deforested ;	max 2
(c)	width represents relative abundance of species ; easy to see distribution / AW ; easy to see abundance / AW ;	max 1
(d)	line transect is a long line and all organisms that touch it are recorded ; belt transect has width / area / uses quadrats ; line transect generates only qualitative data / belt generates quantitative data ; belt transect measures abundance (line transect does not) ;	max 2

(e)

<b>particle size</b> (max 3)	1	use of <b>soil sieves</b> ;
	2	or rub between fingers to obtain subjective assessment ;
	3	or shake up with water
	4	and calculate % layers with settling particles / or as used with sieve ;
	5	ref to table and particle classes / analysis ;
	6	ref to particle analysis pyramid / triangle / AW ;
<b>water content</b> (max 3)	7	weigh sample of soil ;
	8	heat soil at up to 110°C ;
	9	weigh to <b>constant mass</b> ;
	10	calculation of water content / or use of probe ;
<b>Humus / organic content</b> (max 3)	11	calculate dry mass of soil sample ;
	12	crush sample ;
	13	heat to high temperature / burn ;
	14	re-weigh ;
	15	calculation of humus content ;
living organisms	16	use of <b>Tullgren funnel</b> or <b>Baermann funnel</b> ;
	17	ref to method ;
	18	use of <b>key</b> ;
<b>litter content</b>	19	mix sample with water ;
	20	retrieval of organisms from top layer ;
	21	calculate % / identify different fragments ;
<b>soil profile</b>	22	use of <b>auger</b> / dig soil pit / AW ;
	23	depth of <b>horizons</b> / AW ;
<b>soil nutrients</b>	24	use of <b>nitrate / calcium / phosphate kits</b> ; ( <i>credit once</i> )
	25	ref to use of these ;
<b>air content</b> (max 3)	26	take known volume of soil ;
	27	place in container of given size ;
	28	add water ;
	29	calculation of volume of water and air content ;
<b>permeability</b>	31	pour water onto soil / AW ;
	32	measure <b>percolation rate</b> / AW ;
	33	compare this to known rate / analysis / AW ;

30 - 1 mark for idea of replication

max 8

**QWC – clear well organised using specialist terms ;****Any of 3 emboldened terms**

1

**[Total: 16]**



Question	Expected Answers	Marks
6		
(a)	<p>soil may be contaminated e.g. by farming equipment pesticides or fertilisers ;</p> <p>soil structure may be poor ;</p> <p>soil might be too nutrient rich / or nutrient poor ;</p> <p>soil might need to be, removed / improved ;</p> <p>biodiversity may be very low ;</p> <p>land may have no natural barriers such as through the removal of hedgerows ;</p> <p>may cause the spread of weeds onto neighboring land ;</p> <p>opposition from, local residents / farming community ;</p> <p>idea of cost and time to change land use / AW ;</p> <p>species might need to be re-introduced / AW ;</p> <p>AVP;</p>	max 4
(b)	<p>money from visitors / ecotourism / AW ;</p> <p>benefit to local economy by the creation of jobs / grants / AW ;</p>	max 2
(c)	<p>idea of every tree cut one is planted ;</p> <p>coppicing (with standards), AW ;</p> <p>pollarding / description ;</p> <p>ref to selective felling ;</p> <p>cycle of cropping and re-growth ;</p>	max 3
(d)	<p>government targets ;</p> <p>performance league tables ;</p> <p>finances for not reaching targets (allow for fines against individuals) /</p> <p>incentives for reaching targets / taxes ;</p> <p>AVP ; e.g. education or legislation</p>	max 2
(e)	<p>cellulose is, complex / a glucose polymer ;</p> <p>specific enzymes required to breakdown cellulose ;</p> <p>decomposition is temperature dependent and is a slow process ;</p> <p>mulch will tend to be anaerobic / AW ;</p> <p>ref to decomposing bacteria being mostly aerobic ;</p> <p>idea of effect of chemicals in paper affecting the process e.g. inhibition of enzymes ;</p> <p>AVP;</p>	max 2
		[Total: 13]

## 2805/04 Microbiology and Biotechnology

Abbreviations, annotations and conventions used in the Mark Scheme	/	=	alternative and acceptable answers for the same marking point
	;	=	separates marking points
	NOT	=	answers which are not worthy of credit
	<b>R</b>	=	reject
	( )	=	words which are not essential to gain credit
	<u>      </u>	=	(underlining) key words which <b>must</b> be used to gain credit
	ecf	=	error carried forward
	AW	=	alternative wording
	A	=	accept
ora	=	or reverse argument	

<b>Question</b>	<b>Expected Answers</b>	<b>Marks</b>
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1 (a) (i)

example	type of microorganism	prokaryotic	cell wall	mitochondria	autotrophic nutrition
<i>Escherichia coli</i>					
<i>Saccharomyces</i>	fungus <b>A</b> yeast	x	✓	✓	x
<i>Fusarium graminearum</i>	fungus;	x	✓	✓	x
<i>Chlamydomonas</i>		x	✓	✓	
<i>Nitrobacter</i>	bacterium	✓	✓	x	✓
<i>Plasmodium falciparum</i>	protocist <b>A</b> protozoa;	x			x

if ✓ and blanks, assume blanks as x (do not allow mixture of blanks and x)  
two marks for second column, 5 marks for rows

**6 max**

(ii) (*E. coli* / *Saccharomyces* / *F. graminearum* / *P. falciparum*)

heterotrophic (nutrition) ;

do not carry out, photosynthesis / chemosynthesis / described ; ora  
further detail ;

e.g. idea that need to obtain / unable to synthesise, organic  
compounds / AW

(*Saccharomyces* / *F. graminearum*)

saprotrophic (nutrition) ; **A** saprobiotic / saprophytic

further detail e.g. obtain organic compounds from dead or decaying matter  
/ AW ;

(*P. falciparum*)

parasitic (nutrition) ;

further detail e.g. obtain organic compounds by living in / on living  
organisms / AW ;

**2 max**

(iii) *E. coli* = murein / peptidoglycan ;

*Nitrobacter* = murein / peptidoglycan ;

*Saccharomyces* = mannan and glucan / mannoglucan ; **A** glucose and  
mannose polymers;

*Chlamydomonas* = cellulose ;

*Fusarium* = chitin ;

**2 max**

Question	Expected Answers	Marks
1 (b) (i)	<p><i>must score in each section to gain max 6</i>  <i>allow ecf in Z if <u>E. coli</u> given as Gram positive or both possibilities given at X and Y</i></p> <p><i>accept in any section in correct context, once each only</i>            bacillus / rod-shaped (cells) ;            red / pink (colour) ;            Gram negative;</p> <p><i>Student X - cells seen because</i>            purple / crystal violet (stain), washed out / decolourised (using alcohol) / AW ;            counterstained with, carbol fuschin / safranin / AW ;            ref. composition of cell wall ;</p> <p><i>Student Y</i>            nothing visible / AW / no bacteria present ;            smear / cells, washed off ;            cells not heat fixed / fixed to slide ;</p> <p><i>Student Z</i>            nothing visible / AW ;            cells present but not seen / colourless / AW ; <b>A</b> not counterstained by,            carbol fuschin / safranin <i>allow once only</i>            purple / crystal violet (stain), washed out / decolourised (using alcohol) / AW ;</p>	<p><i>allow once only</i></p> <p><b>6 max</b></p>
(ii)	<p>lab coat and eye protection / AW ;</p> <p><i>qualified ref. to</i>            aseptic technique ;            flame ;            flammability alcohol ;            stains ;            chemicals risk ;            glassware risk ;            electrical risk (microscope) ;            health risk to student ;</p>	<p><b>4 max</b></p>
		<p><b>20]</b>  <b>[Total:</b></p>

Question	Expected Answers	Marks
2 (a) (i)	curve continued to pass through correct plots and curves ;	1
(ii)	<p>40 - 60g dm<sup>-3</sup> h<sup>-1</sup> ;; <i>only award two marks if evidence that right hand y axis used</i></p> <p style="text-align: center;"><i>and values taken from steepest part of curve</i></p> <p><i>one mark max if evidence of concentration ÷ time</i></p> <p style="text-align: center;"><math>\frac{y}{x}</math></p> <p>           30 = 160 - 180            32 = 260 - 280            34 = 360 - 380            36 = 460 - 480         </p> <p style="text-align: center;">} <i>range of acceptable values at each time</i></p>	2
(iii)	<p><i>max 3 if no description</i></p> <p><i>glucose</i></p> <p>decreases, with correct data quote / detailed description of curve ;  glucose used in respiration / respiratory substrate ;  provides, energy / ATP ; <b>R</b> produce / create, energy  for growth / biosynthesis / AW ; <b>A</b> production named organic compound  provides, C / H / O ;  less rapid decrease after rapid growth phase / <i>ora</i> ;</p> <p style="text-align: right;">3 max</p> <p><i>nitrogen</i></p> <p>nitrogen for penicillin ; <i>allow once for either</i>  decreases with correct data quote / detailed description of curve ; e.g.  remains at 2.5 gdm<sup>-3</sup> / levels off / AW</p> <p>nitrogen for, amino acids / proteins ;  nitrogen for, nucleic acids / nucleotides / bases / DNA / RNA ;  decrease during growth phase / AW ;  levels off because, in stationary phase / no growth ;</p> <p style="text-align: right;">3 max</p>	4 max
(b)	<p><i>either supported</i></p> <p>(secondary metabolite / penicillin), produced after the main / rapid growth phase ;  <b>A</b> in stationary phase <i>ora not produced in lag / log phase</i></p> <p>shown by, high levels / steep curve (penicillin) ;  figures quoted to support ; e.g. produced after 16 hours  (high rate when) nutrients / glucose, declining / AW ;</p> <p><i>or not supported</i></p> <p>(secondary metabolite / penicillin), produced after the main / rapid growth phase ;  <b>A</b> in stationary phase  but penicillin production, begins / occurs, in main growth phase ;  (biomass) curve does not show stationary phase / curve continues to increase / AW ;</p> <p>figures quoted to support ;</p>	2 max

Question		Expected Answers	Marks																																																						
2	(c)	<p><i>award mark if comparison obvious</i>  <i>must have advantages and disadvantages to score max</i>  <i>must have at least one mp from each section (1-14) to score max</i></p> <table border="1"> <thead> <tr> <th></th> <th><i>batch</i></th> <th><i>continuous</i></th> </tr> </thead> <tbody> <tr> <td>1</td> <td>easier to, monitor / control, conditions</td> <td>harder to, monitor / control / maintain, conditions ;</td> </tr> <tr> <td>2</td> <td>need to sterilise after each batch / more regular sterilisation required</td> <td>longer time intervals between sterilisations ;</td> </tr> <tr> <td>3</td> <td>downstream processing less easy</td> <td>easier downstream processing ;</td> </tr> <tr> <td>4</td> <td>less productive / AW</td> <td>more productive ;</td> </tr> <tr> <td>5</td> <td>(good) for (primary and) secondary metabolite production</td> <td>unable to produce secondary metabolites ;</td> </tr> <tr> <td>6</td> <td>less productive for primary metabolites</td> <td>(good) for primary metabolites ;</td> </tr> <tr> <td>7</td> <td>reactions can go on to completion</td> <td>reactions cannot go on to completion ;</td> </tr> <tr> <td>8</td> <td>fermenter more versatile / more simple design <b>A</b> easier to use</td> <td>fermenter less versatile / more complex design ; <b>A</b> less easy to use</td> </tr> <tr> <td>9</td> <td>larger fermenters used</td> <td>smaller fermenters can be used ;</td> </tr> <tr> <td>10</td> <td>more space required</td> <td>less space required ;</td> </tr> <tr> <td>11</td> <td>less susceptible to contamination</td> <td>more susceptible to contamination ;</td> </tr> <tr> <td>12</td> <td>if contaminated only one batch lost</td> <td>if contaminated, losses high ;</td> </tr> <tr> <td>13</td> <td>less likely to block (shorter time)</td> <td>more likely to block (longer time) ;</td> </tr> <tr> <td>14</td> <td>less consistent quality of product</td> <td>more consistent quality of product ;</td> </tr> <tr> <td>15</td> <td colspan="2">ref. to cheaper if linked to relevant points above ;</td> </tr> <tr> <td>16</td> <td colspan="2">AVP ; e.g. ref. to foaming, further detail on above points,</td> </tr> <tr> <td>17</td> <td colspan="2">examples of AVP ; products made by both types of fermentation</td> </tr> </tbody> </table>		<i>batch</i>	<i>continuous</i>	1	easier to, monitor / control, conditions	harder to, monitor / control / maintain, conditions ;	2	need to sterilise after each batch / more regular sterilisation required	longer time intervals between sterilisations ;	3	downstream processing less easy	easier downstream processing ;	4	less productive / AW	more productive ;	5	(good) for (primary and) secondary metabolite production	unable to produce secondary metabolites ;	6	less productive for primary metabolites	(good) for primary metabolites ;	7	reactions can go on to completion	reactions cannot go on to completion ;	8	fermenter more versatile / more simple design <b>A</b> easier to use	fermenter less versatile / more complex design ; <b>A</b> less easy to use	9	larger fermenters used	smaller fermenters can be used ;	10	more space required	less space required ;	11	less susceptible to contamination	more susceptible to contamination ;	12	if contaminated only one batch lost	if contaminated, losses high ;	13	less likely to block (shorter time)	more likely to block (longer time) ;	14	less consistent quality of product	more consistent quality of product ;	15	ref. to cheaper if linked to relevant points above ;		16	AVP ; e.g. ref. to foaming, further detail on above points,		17	examples of AVP ; products made by both types of fermentation		8 max
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		<b>[Total:</b>	<b>18]</b>																																																						

Question	Expected Answers	Marks
3 (a) (i)	<p><i>no</i></p> <p><i>2 marks for any logical explanation showing that limit of visibility greater than dimensions of bacterium (accept values using 1µm instead of 4 µm) e.g</i></p> <p><math>(1 \mu\text{m}) = 0.001 \times 10^{-3} \text{ m} / 0.01 \times 10^{-4} \text{ m} / 1 \times 10^{-6} \text{ m} / 0.001 \text{ mm} = 1 \mu\text{m} ; ;</math></p> <p><math>(4 \mu\text{m}) = 0.004 \times 10^{-3} \text{ m} / 0.04 \times 10^{-4} \text{ m} / 4 \times 10^{-6} \text{ m} / 0.004 \text{ mm} = 4 \mu\text{m} ; ;</math></p> <p><math>(0.1 \text{ mm}) = 0.1 \times 10^{-3} \text{ m} / 1 \times 10^{-4} \text{ m} / 100 \times 10^{-6} \text{ m} = 100 \mu\text{m} ; ;</math></p> <p><i>1 mark if argument correct but error in calculation</i></p>	2 max
(ii)	<p>stationary ; <i>for one mark</i></p> <p>(spores form) under conditions of stress / nutrients depleting ; asexual reproduction / binary fission, no longer occurring ;</p>	2 max
(b) (i)	<p>idea of different microorganisms have different nutritional requirements / potatoes offer limited nutrients / some microorganisms require additional nutrients ; some microorganisms unable to use starch ; lack of appropriate enzyme ; AVP ; e.g. ref. oxygen requirements, chemical in potato inhibitory</p>	2 max
(ii)	<p>prevents <u>contamination</u> / <u>contaminants</u> ; (of culture from) airborne, bacteria / spores / AW ; prevents escape of bacteria / fungi / spores from culture (into environment) / AW ; AVP ; e.g. results visible (without lid removal) / AW (contaminating) microorganisms outcompete / prevent growth of culture / AW</p>	2 max
(c) (i)	<p>identify the mammal with the disease ; <b>A</b> idea that mammal will get the disease confirm which colony was inoculated (to cause the disease) ; identify causative organism in colony / AW ; ref. to any valid method e.g. microscopical examination / Gram stain / shape / metabolite / toxin, production / biochemical tests ;</p>	2 max
(ii)	<p><i>justified</i></p> <p>cells spread out sufficiently ; one cell divides into two cells / binary fission / asexual reproduction ; <b>A</b> cells originate from one ancestor / AW <b>R</b> mitosis clone (of cells) / identical cells, form a colony / AW ; different microorganisms form colonies with different appearances / textures / colours ;</p> <p><i>not justified</i></p> <p>cells may not be spread sufficiently ; one cell divides into two cells / binary fission ; colonies formed may contain more than one cell type ; (therefore) difficult to distinguish different types ;</p>	max 2

Question	Expected Answers	Marks
3 (c) (iii)	<p>still solid at, incubation temperatures (for pathogens) / 37 °C / any relevant temperature ;</p> <p>microorganisms can be added to, molten / liquid, agar ;</p> <p>solidifies / sets, more quickly ;</p> <p>(relatively) inert / unreactive ;</p> <p>not digested by microorganisms / remains solid (as not digested) ;</p> <p>can use exact quantities of nutrients / use for synthetic media ; <i>ora</i> AVP ; e.g. less required when making up</p> <p>melts at much higher temperatures / 100 °C ;</p> <p>so thermophiles can be cultured at higher temperatures ;</p>	3 max
(d)	<p><i>mark to max 3 if not streak plate</i></p> <p>ref. to (inoculating)loop, flamed / alcohol flamed / sterilised (allowed to cool) ;</p> <p>ref. to. flame neck of tube (before / after) ;</p> <p>ref. to transfer e.g. using loop to obtain a sample / inoculum from culture and adding to agar ; <i>must have both aspects</i></p> <p>raise the lid of the agar dish, slightly / away from face / AW ;</p> <p>description of streak method ;</p> <p>further detail ;</p> <p>e.g. streak across one side of the surface of the agar (4-5 times)</p> <p>turn the plate and streak again from the end of the last streaks</p> <p>repeat around the outside of the plate</p> <p>on the last streak, finish in the centre (with a 'squiggle')</p> <p>incubate for reasonable time (24-48 hrs), safe temperature (below 30 °C)</p>	4 max
<b>[Total:</b>		<b>19]</b>

Question	Expected Answers	Marks
4	<p>1 microorganisms, carry out <u>aerobic, respiration / digestion</u> / require <u>oxygen</u> ;</p> <p>2 to remove / break down / AW, organic / waste matter / AW ;</p> <p>3 removal of (other) chemical waste from, industry / commercial practices ;</p> <p>4 ref. to a specific, breakdown / enzyme produced ;  e.g. urea to ammonia and carbon dioxide / urease  organic carbon <math>\rightarrow</math> CO<sub>2</sub>  organic nitrogen <math>\rightarrow</math> NH<sub>3</sub> <math>\rightarrow</math> NO<sub>3</sub><sup>-</sup>  organic phosphorus <math>\rightarrow</math> PO<sub>4</sub><sup>3-</sup>  organic sulphur <math>\rightarrow</math> H<sub>2</sub>S <math>\rightarrow</math> SO<sub>4</sub><sup>2-</sup>  ammonia <math>\rightarrow</math> nitrites  nitrites <math>\rightarrow</math> nitrates  hydrolysis of macromolecules e.g. proteins <math>\rightarrow</math> amino acids</p> <p>5 <u>inorganic</u> nutrients / named, produced / released ;</p> <p>6 carbon dioxide and water produced ;</p> <p>7 ref. recycling / cycles of matter ;</p> <p>8 effluent produced less polluting / BOD reduced / improved clarity / less turbid ;</p> <p>9 named microorganism e.g. *<i>Nitrosomonas</i>, <i>Nitrobacter</i>, <i>Pseudomonas</i>, <i>Zoogloea</i> ;</p> <p>10 ref. another role of, bacteria / protoctista / protozoa ; e.g. feeding off other  microorganisms to avoid overgrowth (so prevents blocking of filters etc), members of a community / food web / autotrophs / heterotrophs</p> <p>11 (<i>Zoogloea</i>) floc-forming / form clumps ;</p> <p>12 suspended particles stick to clumps for other organisms to digest ;</p> <p>13 pathogenic microorganisms / AW, eliminated by other microorganisms / pathogens, poor competitors / are prey ;</p> <p>14 AVP ;</p> <p>15 AVP ;</p> <p>e.g. recycling of some microorganism into next batch  ref. to nitrification / oxidation  additional mp 4  increasing cell numbers / biomass (to deal with sewage)  changing community profile with varying sewage contents  secretion of sticky polysaccharides (to allow floc formation)</p> <p>*e.g. named organisms <i>Achromobacter</i>, <i>Beggiatoa</i>, <i>Brevibacterium</i>, <i>Caulobacter</i>, <i>Cytophaga</i>, <i>Flavobacterium</i>, <i>Hyphomicrobium</i>, <i>Sphaerotilus</i>, <i>Proteus</i>, <i>Thiobacillus</i>, <i>Bacillus</i>, <i>Aeromonas</i>, <i>Alcaligenes</i>, <i>Fusarium</i></p>	
	<p><b>QWC – clear well organised using specialist terms</b> three from floc / floc-forming, <i>Zoogloea</i>, any other two named organisms, effluent, pathogen(ic), named breakdown, nitrification, protoctista, protozoa, nematode, auto / heterotroph, competition, turbidity, aerobic respiration / aerobic digestion, BOD</p>	7 max
		1
	<b>[Total:</b>	<b>8]</b>



Question	Expected Answers	Marks
5 (a) (i)	sprayed / added to crops (to kill insect pests) ; idea of persisting, in / on, plant crop <i>or</i> passed onto animals (food chain) ; ref. to leaching / run off, into water courses / AW ; water to water treatment plant / used as drinking water / used as water source ;	2 max
(ii)	ref. to affecting nervous system / nerve agents ; ACh not broken down / synaptic transmission impaired / AW ; continuous stimulation of post-synaptic membranes ; AVP ; e.g. detail of inhibition	2 max
(iii)	<i>allow mps from suitable labelled / annotated diagram max 4 if principle of inhibition not noted (e.g. organophosphate in river water sample and acetylcholine added as substrate)</i>  partially permeable membrane ; allows organophosphate to <u>diffuse</u> through ; biological recognition layer ; (contains) immobilised acetylcholinesterase ; organophosphate binds to acetylcholinesterase ; (because of) complementary shape to active site / binds elsewhere on enzyme ; A ref. to action of competitive / non-competitive inhibitor ref. to adding acetylcholine (to obtain product / acetate / choline and acetate) ; (organophosphate binding) product formation inhibited ; ref. to higher concentration of organophosphate linked to greater inhibition / less product ; acetate / H <sup>+</sup> / choline, detected by transducer / electrode ; converted to electric signal / impulse / current ;	5 max
(iv)	<i>any three valid, e.g.</i> sensitive / detection of small concentrations ; accurate ; quantitative ; rapid results ; portable / can test in the field ; continuous monitoring ; (very) specific ; reusable ; ease of use ; small sample only required ;	3 max
(b) (i)	ref. to specificity (of immobilised, molecule / enzyme) ; glyphosate, wrong shape / not complementary shape / doesn't fit (e.g. at active site) / different enzyme needed / AW ; binding does not occur ; require enzyme(s) that are, inhibited by / complementary to, glyphosate ;	2 max



Question	Expected Answers	Marks
6	<i>autoimmunity</i> → autolysis ; <b>A</b> lysis A → B ;	<i>condensed</i> → hydrolysed ; <i>DNA</i> → RNA ; <i>low</i> → high ; <b>[Total: 5]</b>

## 2805/05 Mammalian Physiology and Behaviour

<b>Abbreviations, annotations and conventions used in the Mark Scheme</b>	/	=	alternative and acceptable answers for the same marking point
	;	=	separates marking points
	NOT	=	answers which are not worthy of credit
	<b>R</b>	=	reject
	( )	=	words which are not essential to gain credit
	<u>      </u>	=	(underlining) key words which <b>must</b> be used to gain credit
	ecf	=	error carried forward
	AW	=	alternative wording
	A	=	accept
	ora	=	or reverse argument

Question	Expected Answers	Marks
1 (a) (i)	14.28 – 14.30 ;;  <i>allow one mark for working if answer incorrect</i> e.g. $\frac{1 \times 100}{7}$ or $\frac{9 \times 100}{63}$	<i>accept 2 marks for correct answer</i>  <b>2</b>
(ii)	chemical ;	<b>1</b>
(b)	1 give, reward / reinforcer, when cancerous urine detected ; <b>A</b> positive 2 reinforcement 3 detail of how reward given ; e.g. praise/food 4 negative / no, reinforcement for incorrect identification ; 5 repeated (many times) ; 6 associative learning / links cancerous urine with reward ; 7 operant conditioning ; <b>R</b> classical conditioning AVP ; e.g. dogs allowed to get used to normal human urine / AW e.g. detail of response to cancerous urine i.e. sits down	<b>4 max</b>
(c)	<i>accept ora if dog mentioned instead of cat</i> 1 different allele ; 2 mutation / deletion ; 3 incorrect, transcription / translation ; 4 change in, primary structure / amino acid sequence / secondary structure ; 5 change in, tertiary structure / folding / 3D structure ; 6 change to / missing, binding site / AW ;	<b>R</b> active site <b>3 max</b>
(d) (i)	1. not, inherited behaviour / genetic / instinctive ; 2. requires learning ; 3. behavior not shown by all members of the species / not stereotypic ; 4. adaptation to environment / AW ;	<b>2 max</b>
(ii)	1. eats, more / animal, protein / food ; 2. contains all <u>essential</u> amino acids / amino acids needed for (muscle) growth ; 3. easily digested / less fibre ; 4. gene mutation ;	<b>2 max</b>

**[Total:14]**



Question	Expected Answers	Marks
3 (a)	<u>pentadactyl</u> ;	1
(b)	A – phalange ; B – humerus ; C – carpal / metacarpal ; D – radius ;	A radius and ulna 4
(c)	ball and socket / synovial ;  movement in all planes / rotary movement / 360 <sup>0</sup> movement / universal movement ;	2
(d)	1 much exercise in early life ; 2 overuse of joints ; 3 joint injury ; 4 overweight / AW ; 5 earlier degeneration of cartilage / cartilage wears down faster than replaced ;	3 max
(e) (i)	1. endorphins attach to <u>opiate</u> receptors ; 2. ref. presynaptic, knob / membrane ; 3. stop Ca <sup>2+</sup> diffusing in ; 4. no ACh released ; 5. no / less, binding of ACh on receptors ; 6. on postsynaptic membrane ; 7. fewer / no, action potentials / impulses, to pain centre / brain ;	4 max
(ii)	<i>any one from</i> no need to use drugs / no drug dependency ; patient can control the treatment / AW ; no side effects ; cheaper ; not invasive ;	1 max
		<b>[Total: 15]</b>

Question	Expected Answers	Marks
4 (a)	<b>P</b> label to RER / ribosome ; <b>Q</b> label to disc ; <b>R</b> label to foot of cell ;	<b>3</b>
(b)	vertical arrow pointing <u>upwards</u> ;	<b>1</b>
(c)	1 light absorbed by rhodopsin ; 2 <b>opsin</b> (protein) in membrane ; 3 <b>retinal</b> on (outer) surface ; 4 rhodopsin unstable ; 5 retinal part, changes shape / straightens ; 6 11- <b>cis</b> -retinal ---> all- <b>trans</b> -retinal ; 7 retinal no longer fits binding site on opsin ; 8 Na <sup>+</sup> and K <sup>+</sup> channels close / Na <sup>+</sup> and K <sup>+</sup> cannot diffuse in or out ; 9 <b>Na<sup>+</sup> / K<sup>+</sup>, pump</b> continues ; 10 greater p.d. / -40 --> -70 mV ; 11 (rod) cell <b>hyperpolarised</b> ; 12 <u>no</u> transmitter released ; 13 neurotransmitter <b>inhibitory</b> ;  14 AVP ; e.g. dark adaptation / rhodopsin breaks down rhodopsin bleached / rhodopsin resynthesised	<b>7 max</b>

**QWC – clear well organised using specialist terms;**

*Three of the following words must be included: opsin, retinal, cis, trans, hyperpolarised, inhibitory, Na<sup>+</sup> / K<sup>+</sup> pump.*

**1**

(d)

pigment stimulated			colour perceived by brain
B	G	R	
yes	yes	yes	white
yes	yes	no	<b>blue-green / cyan / turquoise</b>
yes	no	yes	<b>purple / magenta</b>
yes	no	no	<b>blue</b>
no	yes	yes	<b>orange-yellow / brown</b>
no	yes	no	<b>green</b>
no	no	yes	<b>red</b>
no	no	no	black

6 = 3 marks

4/5 = 2 marks

2/3 = 1 mark

**3****[Total: 15]**

Question	Expected Answers	Marks
5 (a)	1 albumin / plasma protein, in blood / not in tissue fluid ; 2 albumin / plasma protein, too large to pass out of capillary ; 3 ref. gaps between capillary cells ; 4 solute / water, potential of blood lower than in tissue fluid / ora ; 5 ( <i>high hydrostatic pressure at arterial end</i> ) due to, contraction / pumping, of heart / narrowing of vessels ; 6 hydrostatic pressure greater than, solute / water, potential gradient ( <i>fluid passes out of blood</i> ) ; 7 ( <i>low hydrostatic pressure at venous end</i> ) due to resistance of capillaries ; 8 (hydrostatic) pressure less than, solute / water, potential gradient ( <i>fluid passes into blood</i> ) ;	5 max
(b)	1 less, albumin / globulin / plasma proteins, in blood / made by liver ; 2 ref. higher water potential in the blood ; 3 more fluid lost (to tissue fluid) at arterial end ; 4 fluid not reabsorbed (at venous end of capillary) ; 5 <u>oedema</u> ;	2 max
(c)	1 fats used, in respiration / to make ATP ; 2 fat / lipid / triglycerides → fatty acids ; 3 fatty acids → acetyl CoA / acetate / ethanoate ; 4 acetyl CoA / acetate / ethanoate → Krebs cycle ; 5 acetyl CoA / acetate / ethanoate → acetoacetate / ketone ; 6 glycerol → glycolysis ; 7 gluconeogenesis from glycerol ;	3 max
(d)	increases appetite / encourages feeding / ref. over eating ;	1
(e) (i)	31 ;; <i>2 marks for correct answer</i>  <i>accept one mark for working</i> e.g. $\frac{80}{2.56}$	2
(ii)	parents heterozygous ; student T homozygous recessive ; does not produce leptin / insensitivity to leptin ; ref. to diet / lack of exercise	2 max
		[Total:15]



Question	Expected Answers	Marks
6 (a)	<p><i>description</i></p> <p>1 sharp / rapid, increase before gallop ;            2 no readings during gallop / peak may have occurred, during gallop / just            3 after gallop ;            4 decrease after gallop ;            paired figs relating to increase or decrease (plus units) ;</p> <p>5 <i>explanation</i>            sympathetic nervous system, stimulates adrenal gland / causes secretion            of adrenaline ;            heart rate increases ; <b>ora</b>            widening of bronchioles ; <b>ora</b>            glycogen → glucose ; <b>ora</b></p>	<p>3 max</p> <p>3 max</p> <p>5 max</p>
(b)	<p>1 impulses / action potentials, from medulla oblongata ;            2 ref. parasympathetic ;            3 vagus nerve ;            4 ref. SAN ;            5 heart rate slows down ;            6 decreased force of contraction ;            7 (slight) fall in blood pressure ;            8 AVP ; e.g. ref. O<sub>2</sub> debt / high CO<sub>2</sub>, immediately after gallop</p>	<p>4 max</p>
(c) (i)	<p><i>any two from</i>            ionising radiation / UV light ;            carcinogens / named e.g. ;            virus ;            genetic / inherited ;            spontaneous mutation ;</p>	<p>2 max</p>
(ii)	<p>switch on oncogenes ;            uncontrolled, cell division / mitosis ;            growth of tumour ;            non-specialised cells ;</p>	<p>2 max</p>
(iii)	<p><i>any two from</i>            breathing ;            blood pressure ;            peristalsis ;</p>	<p>2 max</p>
(iv)	<p>radiotherapy / chemotherapy ;</p>	<p>1</p>
		<p>[Total: 16]</p>

## 2806/01 Unifying Concepts in Biology - Written Paper

<b>Abbreviations, annotations and conventions used in the Mark Scheme</b>	/	=	alternative and acceptable answers for the same marking point
	;	=	separates marking points
	NOT	=	answers which are not worthy of credit
	<b>R</b>	=	reject
	( )	=	words which are not essential to gain credit
	_____	=	(underlining) key words which <b>must</b> be used to gain credit
	ecf	=	error carried forward
	AW	=	alternative wording
	A	=	accept
	ora	=	or reverse argument

Question	Expected Answers	Marks
1 (a)	same <u>genus</u> ; different species ; similar, features / characteristics ; closely-related / share a (recent) common ancestor ;	2 max
(b)	1 reds survive well or better alone ; 2 reds & greys similar when alone ; 3 in both types of woodland ; 4 reds decrease when greys also present ; 5 <u>competitive exclusion</u> ; 6 must share similar ecological niche ; 7 comparative data quote ;	3 max
(c)	<i>survival higher in deciduous because</i> 1 more, productive / food ; 2 greater variety of food ; 3 if one food source runs out, another can be used / more continuous food supply ; 4 more complex food web ; 5 less <u>intraspecific</u> competition ; 6 less <u>predation</u> / predators have more species to eat / do not just rely on squirrels ; 7 more, nesting sites / hibernation sites / suitable microhabitats ;	2 max
(d)	1 tannins denature proteins ; 2 ref. enzymes / membrane carrier proteins ; 3 macromolecules / polysaccharides / proteins / fats, cannot be digested ; AW 4 (macromolecules) cannot be absorbed ; 5 too big to, diffuse / pass through, cell membranes / pores ; 6 (young mammals) egest / do not assimilate, food ; <b>R</b> excrete	3 max
(e) (i)	Golgi apparatus ;	1
(e) (ii)	grey squirrels have higher concentration of PRPs ; <b>ORA</b> grey squirrels have PRPs specific to acorn tannins ;	2

[Total: 13]

Question	Expected Answers	Marks
2 (a)	bronchi / bronchioles ;	1
(b)	acts faster ; <b>ORA</b> acts directly on, target region / lungs / bronchi / bronchioles ; <b>A</b> airways avoids, breakdown / alteration, by digestive system ; <b>AW</b> reduces / prevents, relaxation of smooth muscle elsewhere in body ; avoids / lessens, side effects / named side effects (elsewhere in body) ;	3 max
(c)	(same shape as noradrenaline so) salbutamol, binds / fits into / attaches to ; to, noradrenaline / complementary, receptors ; <u>on</u> smooth muscle ; causes relaxation ; of circular muscle ; AVP ; e.g. detail of receptor / ligand-gated channel	3 max
(d)	salbutamol is a $\beta$ -agonist ; (salbutamol) opposes $\beta$ -blocker ; <b>A</b> negate each other / cancel out (salbutamol might) speed up heart rate ; $\beta$ -blocker might worsen asthma ; <b>AW</b> AVP ; e.g. potential danger to person of increasing heart rate	2 max
(e)	catalyses a reaction ; <b>AW</b> (causes) hydrolysis ; (therefore an) enzyme ; enzymes are proteins ; detail of enzyme structure ; e.g. globular / 3D / ref. active site / 3 <sup>o</sup> folding can be inhibited ; AVP ; ref. word ending -ase	3 max

Question	Expected Answers	Marks
(f)	<p>1 react, phospholipids / substrate, with, phospholipase A2 / enzyme ;</p> <p>2 fixed volume of each ;</p> <p>3 control, temperature / pH / other named variable ;</p> <p>4 measure initial rate of reaction ;</p> <p>5 detail ;</p> <p>6 repeat with (addition of fixed amount of) beclomethasone ;</p> <p>7 describe effect of inhibition / rate of 6 less than rate of 1 ;</p> <p>8 vary, phospholipid / substrate, concentration ;</p> <p>9 graph results with phospholipid concentration on x axis and rate on y axis ;</p> <p>10 see if raising substrate concentration, reduces inhibition / increases rate ;</p> <p>11 <b>AW</b></p> <p>12 if so, it is competitive / there is competition ; AVP ; e.g. repeats, vary inhibitor concentration</p>	<p>6 max</p> <p>1</p>
	<b>QWC – legible text with accurate spelling, punctuation and grammar;</b>	

[Total: 19]

Question	Expected Answers	Marks
3 (a) (i)	1 photosynthesis ; 2 make, carbohydrates / named carbohydrate ; 3 using CO <sub>2</sub> and H <sub>2</sub> O ; 4 carbohydrate converted to, organic compounds / lipids / proteins / nucleic acids ; 5 (due to) chloroplasts / chlorophyll ; 6 reflects green light / absorbs red and blue ; 7 not enough insects trapped ;	4 max
(ii)	red / brightly-coloured ; pattern ; smell ; nectar / sugar solution ; warmer ;	2 max
(b) (i)	differential permeability to ions ; <b>AW</b> movement / redistribution, of ions ; ref. Na <sup>+</sup> / K <sup>+</sup> , pumps / active transport ; ion channels open ; (facilitated) diffusion of ions ;	2 max
(ii)	calcium pectate ;	1
(iii)	water potential of cell lower / external $\psi$ higher ; water moves, from high to low $\psi$ / down $\psi$ gradient ; by osmosis ;	2
(c) (i)	lower / decreased, in waterlogged ; <b>AW ora</b>	1
(ii)	(insect) protein, digested / broken down ; by proteases ; to amino acids ; absorbed by plant ; for protein synthesis ; source of / extra, N for, faster / better, growth ; <b>ora</b> competitive / survival, advantage ; AVP ; N from DNA or other source	3 max

[Total: 15]

Question	Expected Answers	Marks
4 (a)	<p>extra pigment / fucoxanthin ; absorb additional wavelengths of light ;</p> <p>mucilage prevents drying out ; water needed for photosynthesis ;</p> <p>air bladders ; floats upright nearer, light / surface ;</p> <p>holdfast ; fastens it in suitable, position / light ;</p> <p>large surface area (of fronds) ; to maximize, light capture / CO<sub>2</sub> absorption ;</p>	4 max
(b)	<p>1 x 4 x 2 x 2 x 2 x 2 ; 64 ;</p>	2
(c) (i)	<p>(zygote) diploid ; (<i>Fucus</i>) diploid ; (sperm) haploid ;</p>	3
(ii)	<p>mitosis ;</p>	1
(d)	<p>quadrats ; (estimate) percentage cover / ACFOR ; of each species ; key ; transect qualified correctly ; A belt / line / interrupted from top of shore to sea level ; do at low tide ; AVP ; e.g. repeats, average, means of recording data</p>	3 max

[Total: 13]

## 2806/03 Practical Examination

<b>Abbreviations, annotations and conventions used in the Mark Scheme</b>	/	=	alternative and acceptable answers for the same marking point
	;	=	separates marking points
	NOT	=	answers which are not worthy of credit
	<b>R</b>	=	reject
	( )	=	words which are not essential to gain credit
	<u>      </u>	=	(underlining) key words which <b>must</b> be used to gain credit
	ecf	=	error carried forward
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### ○ Planning Exercise

The mark scheme for the planning exercise is set out on page 4. The marking points **A** to **T** follow the coursework descriptors for Skill P.

Indicate on the plans where the marking points are met by using a tick and an appropriate letter. There are 14 marking points for aspects of the plan and two marks for quality of written communication (QWC).

### ○ Practical Test

Pages 5 to 6 have the mark scheme for Questions 1 and 2 for the Practical Test.

**A2 Biology. Planning exercise**

Checking Point	Descriptor	The candidate
A	P.1a	plans a suitable procedure that uses submerged leaf discs from sun and shade leaves and a suitable variable to be tested e.g. light intensity, temperature, concentration of $\text{NaHCO}_3$ / $\text{CO}_2$ ;
B	P.1a	gives a prediction about both sun and shade leaves and the effect of their chosen variable, e.g. with an increase in light intensity the rate of photosynthesis increases more in sun leaves than in shade leaves; <i>could be taken from a graph</i>
C	P.1b	chooses suitable materials and equipment to include a light source, thermometer / thermostatically controlled water bath and timer ;
D	P.3a	explains that photosynthesis produces oxygen that collects in intercellular air spaces in the leaves (so leaves float) ; <b>A</b> reduces density of leaf <b>A</b> oxygen collects in spongy mesophyll
E	P.3a	identifies at least <b>two</b> key factors to control or take account of, e.g. size of syringe, size of leaf discs, no of leaf discs in syringe, volume of solution, concentration of solution, distance of light source, light intensity, temperature ;
F	P.3b	decides on number of measurements to make, i.e. minimum of <b>three</b> discs at each light intensity, $\text{NaHCO}_3$ / $\text{CO}_2$ concentration or temperature ;
G	P.3b	decides on an appropriate range for the independent variable, i.e. minimum of <b>five</b> different light intensities, $\text{NaHCO}_3$ / $\text{CO}_2$ concentrations or temperatures ; (limit temp range to 10-50°C / light range to 1-100 cm distance / $\text{NaHCO}_3$ at 0-1.0M)
H	P. 3 b	Describes ways of obtaining reliable results by including replicates ; two complete repeats / do experiment three times, (not just using more than 1 disc)
I	P. 5a	<b>uses</b> appropriate scientific knowledge and understanding to explain the effect of the chosen limiting factor or to account for the production of oxygen, e.g. photolysis of water / light dependent reaction on thylakoids, as source of oxygen ;
J	P.5a	<b>uses</b> information / results from preliminary work, previous practical work to inform the plan
K	P.5a	refers to safety aspect (hazard <b>and</b> precaution), e.g. hot / electric bench lamp, thermostatically-controlled water bath or allergy to plant ;
L*	P.5b	<i>gives a clear account, logically presented with accurate use of scientific vocabulary (QWC);</i>
M	P.5b	describes a way of producing precise results, e.g. time taken for, first / specific number of, leaf discs to, rise from the bottom of the syringe / reach the top of the syringe ; <b>R</b> all
N	P.7a	<b>uses</b> appropriate scientific knowledge and understanding to explain <b>three</b> expected <b>differences between sun and shade leaves</b> , e.g. leaf structure / enzymes / chloroplast structure / effect of light intensity on light dependent reaction / $\text{NaHCO}_3$ or $\text{CO}_2$ concentration or temperature on light independent reaction (Calvin cycle) ;
O	P.7a	<b>uses</b> information from <b>at least two identified secondary sources</b> , to develop a strategy ; e.g. text book, web site, class notes.
P	P.7a	shows how data are to be presented as a table, e.g. chosen limiting factor and time taken for discs to rise/rate;(headings must have correct units) <b>A</b> 1000/t <b>R</b> if units in body of table,
Q*	P.7a	<i>uses spelling, punctuation and grammar correctly (QWC) ;</i>
R	P.7a	describes / shows, how rates would be calculated, e.g. 1000/t ;
S	P.7a	describes / shows, how data are to be illustrated in <b>one</b> graph, x axis = limiting factor / y axis = rate ;
T	P.7b	comments on how to compare results for sun and shade leaves, e.g. suitable stats test (t-test); <b>R</b> $\chi^2$
U	P.7b	comments on validity by identifying variables that cannot be controlled, e.g. thickness of leaf discs, presence of veins in the discs or density of chloroplasts ;

Point mark up to **14** by placing letters A to U **excluding L and Q** in the margin at appropriate points.

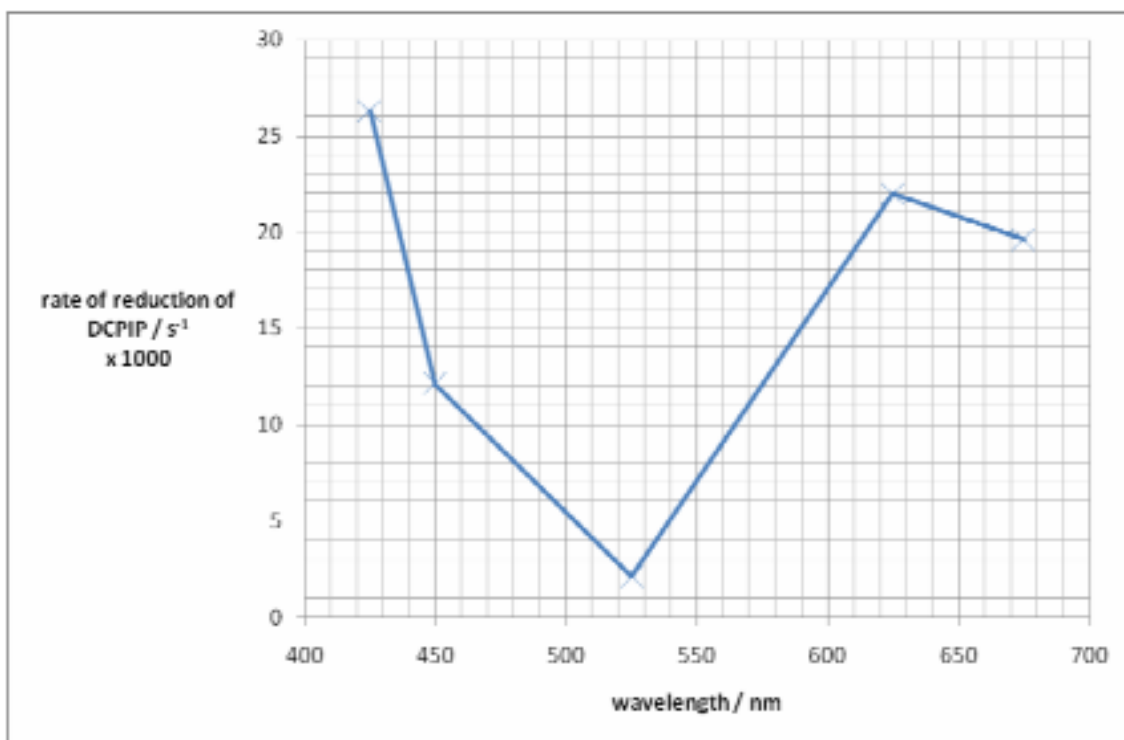
Then award **1** mark for each of **L** and **Q** (QWC).

**Total: 16**



## Examples of results for Q 1 a

Wavelength (nm)	Time to decolourise DCPIP (sec)	Rate ( $s^{-1}$ )
425	38	26.3
450	83	12.1
525	485	2.1
625	46	22
675	51	19.6





Question	Expected Answers	Marks
(d)	<p>tube containing DCPIP only ;  to show, leaf extract containing chloroplasts is needed for colour change /  DCPIP does not decolourise in light without chloroplasts / AW ;  <b>R</b> references to lack of light / use of white light as controls / keeping in the dark</p>	2
(e)	<p><b>limitations</b></p> <ol style="list-style-type: none"> <li>1 light intensity (through the different filters) is not the same / light not at same distance from each tube ;</li> <li>2 external / ambient, light / AW not controlled (when foil / filter is lifted); ignore ref to light from window</li> <li>3 ref to temperature not controlled (from bench lamp) ;  <b>R</b> variations in room temp.</li> <li>4 ref to concentration of CO<sub>2</sub> / concentration of NaHCO<sub>3</sub> , not controlled ;</li> <li>5 time before use of leaf extract ;</li> <li>6 tubes set up at different times ;</li> <li>7 filters placed over tubes at different times ;</li> <li>8 numbers / concentration, of, chloroplasts / chlorophyll, not the same in every tube ;</li> <li>9 subjective nature of colour change / difficult to see through filters ;</li> <li>10 no repeats / only done once / not able to check for anomalies ;</li> <li>11 colour standard changed colour (moving target idea) ;</li> <li>12 AVP ;</li> </ol> <p style="text-align: right;"><i>Max 6</i></p> <p><b>suggested improvements</b></p> <ol style="list-style-type: none"> <li>13 dark chamber with single light source ;</li> <li>14 heat screen between lamp and tube ; <b>R</b> water bath</li> <li>15 repeat twice / 3 readings, for each wavelength ;</li> <li>16 use, coloured filters over lamp or coloured bulbs of known wavelength and intensity ;</li> <li>17 more intermediate, colours /wavelengths, to plot more accurate graph ;</li> <li>18 mix extract before removing samples ;</li> <li>19 Fresh colour standard for each test ;</li> <li>20 AVP ;  e.g. turn on light and clock at the same time ;</li> </ol> <p><b>R</b> use of colorimeter (not suitable here)  <b>R</b> ref to volume of DCPIP used  <b>R</b> pipette inaccuracies  <b>R</b> use of buffer solution (used in preparation)</p> <p style="text-align: right;"><i>Max 6</i></p>	10 max
(f)	<p>NADP is, <u>terminal / final</u>, hydrogen carrier / AW ;  NADP reduced ; <b>A</b> NADPH<sup>+</sup> / NADPH<sub>2</sub>, is produced  by electrons from light dependent stage / photosystems / Z scheme ;  by, hydrogen ions / H<sup>+</sup> / protons, from photolysis of water ;</p> <p style="text-align: right;"><i>Max 3</i></p> <p>NADPH<sub>2</sub> / reduced NADP / NADPH + H<sup>+</sup>, reduces / converts / changes, GP  to, GALP / TP ;  in presence of ATP ;</p>	4 max [Total: 28 max]

Question	Expected Answers	Marks
2 (a)	<p><i>award two marks if correct answer (8.8 to 9.0 (µm)) is given incorrect answer (or no answer) but a figure divided by 15 000 = 1 mark</i></p> $\frac{13.3 - 13.5 \text{ (mm)} / 13\,300 - 13\,500 \text{ (µm)}}{15\,000}$ <p>8.8 – 9.0 (µm) ;</p> <p><i>actual measurement is 134 mm so allow +/- 1.0 mm</i></p>	2 max
(b)	<p><i>Some have interpreted this question as ‘appearance in the photo’ and others as ‘appearance in live chloroplasts’. Credit either answer.</i></p> <p>thylakoids – <b>A</b> intergranal lamellae  appear as thin lines/membranes (in layers) ; <b>A</b> threads / strands  grana -  appear as dark-coloured stacks of membranes (within the thylakoids) ;  <b>A</b> clumps, large dark regions  stroma -  appears as a dotted/speckled/watery region ;  starch grains -  appear as large/prominent bodies (in the stroma) ; <b>R</b> white / dark / black spots  envelope –  appears as a thin line around the edge ;  lipid droplets –  appear as (small) dark-coloured dots (in between the thylakoids) ;  <b>R</b> anything that could not be seen in an electron micrograph, e.g. chlorophyll etc.</p>	3 max
(c)	<p><b>Parts must be visible in figure 2.1</b></p> <p>thylakoid membranes provide large (surface) area ; ignore ref to chlorophyll  for light absorption ; <b>A</b> light dependent reaction  for ATP synthesis ; <b>A</b> chemiosmosis  stroma (with enzymes) for, light independent stage / Calvin cycle ;  for, light-independent stage / Calvin cycle ;  envelope to, concentrate / contain / isolate, reactants for photosynthesis, AW ;  starch grains for storage of glucose to prevent increase in OP ;  many ribosomes for synthesis of, proteins / enzymes, required for photosynthesis ;</p>	4 max

Question	Expected Answers	Marks
(d)	<b>Assume answers are about chloroplast in Fig. 2.2 (dark) unless told otherwise</b>	

*A the alternative order of features if the two figures are stated clearly*

<b>Fig 2.2</b>	<b>Fig 2.1</b>
fewer/thinner, membranes/thylakoids/lamellae	more/thicker, membranes/thylakoids/lamellae ;
fewer grana	more grana ;
smaller / thinner grana	larger / thicker grana ;
lipid granules/black spots, clustered in centre	lipid granules/black spots scattered throughout chloroplast ;
presence of pro-lamellar body / central body /AW	absence of pro-lamellar body / AW ;
membranes/lamellae radiate from centre / not in same direction as chloroplast axis	membranes/lamellae in same direction as chloroplast axis ;
fewer/smaller, starch grains <b>R</b> none	more/larger starch grains ;
chloroplast envelope, more clearly defined / double layer visible	chloroplast envelope not clearly defined / only single layer visible ;
comment on different appearance of stroma, e.g. more speckled	stroma, more diffuse/not speckled ;
ribosomes more prominent	ribosomes less prominent ;

**R** ref to chlorophyll / colour / etc

**4**  
**max**

Question	Expected Answers	Marks
(e)	<p>(ribosomes more active), so <u>more</u> protein is produced ; protein used to make enzymes ; enzymes needed for, light-independent stage / Calvin cycle ; enzymes / proteins needed to produce chlorophyll / pigment(s) ; (turns green as) chlorophyll is produced ; (some) chloroplast proteins are made in the cytoplasm ; proteins used for other named purpose ; accept up to three examples for 3 marks</p> <p>e.g. membrane-bound proteins ; production of cytochromes ; ATP synth(et)ase ; Rubisco ; starch synth(et)ase ; ribosomal proteins ; channel / carrier proteins in chloroplast envelope ;</p>	<p>6 max</p> <p><b>[Total: 16 max]</b></p>

# Grade Thresholds

Advanced GCE (Subject) (Aggregation Code(s))  
January 2008 Examination Series

## Unit Threshold Marks

Unit		Maximum Mark	A	B	C	D	E	U
2801	Raw	60	39	34	29	24	20	0
	UMS	90	72	63	54	45	36	0
2802	Raw	60	42	37	33	29	25	0
	UMS	90	72	63	54	45	36	0
2803A	Raw	120	93	83	73	63	53	0
	UMS	120	96	84	72	60	48	0
2803B	Raw	120	93	83	73	63	53	0
	UMS	120	96	84	72	60	48	0
2803C	Raw	120	90	81	72	64	56	0
	UMS	120	96	84	72	60	48	0
2804	Raw	90	65	58	51	44	38	0
	UMS	90	72	63	54	45	36	0
2805 A	Raw	90	68	61	54	47	41	0
	UMS	90	72	63	54	45	36	0
2805 B	Raw	90	60	53	46	39	33	0
	UMS	90	72	63	54	45	36	0
2805 C	Raw	90	63	57	51	46	41	0
	UMS	90	72	63	54	45	36	0
2805 D	Raw	90	67	59	51	44	37	0
	UMS	90	72	63	54	45	36	0
2805 E	Raw	90	64	57	50	43	37	0
	UMS	90	72	63	54	45	36	0
2806 A	Raw	120	88	79	70	62	54	0
	UMS	120	96	84	72	60	48	0
2806 B	Raw	120	88	79	70	62	54	0
	UMS	120	96	84	72	60	48	0
2806 C	Raw	120	83	75	67	60	53	0
	UMS	120	96	84	72	60	48	0

**Specification Aggregation Results**

Overall threshold marks in UMS (ie after conversion of raw marks to uniform marks)

	<b>Maximum Mark</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>U</b>
<b>3881</b>	300	240	210	180	150	120	0
<b>7881</b>	600	480	420	360	300	240	0

The cumulative percentage of candidates awarded each grade was as follows:

	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>U</b>	<b>Total Number of Candidates</b>
<b>3881</b>	7.3	24.3	50.5	75.1	95.1	0	929
<b>7881</b>	11.8	37.3	68.3	87.8	96.7	0	304

**1233 candidates aggregated this series**

For a description of how UMS marks are calculated see:

[http://www.ocr.org.uk/learners/ums\\_results.html](http://www.ocr.org.uk/learners/ums_results.html)

Statistics are correct at the time of publication.



# INSET events for new GCE Biology

for first teaching from September 2008

**Get Started** – towards successful delivery of the new specification.

These **new full day** courses will give guidance and support to those planning to deliver the new AS/A level Biology (H021/H421) specification from September 2008.

## Course dates and codes

Monday 28 April 2008 (Newport, CBIE401)

Tuesday 6 May 2008 (York, CBIE402)

Wednesday 14 May (London, CBIE403)

Thursday 15 May (London, CBIE407)

Friday 23 May (Plymouth, CBIE404)

Monday 2 June (London, CBIE408)

Thursday 5 June (Birmingham, CBIE405)

Tuesday 17 June (Manchester, CBIE406)

**Fee** – £130 including refreshments, lunch and course materials. £160 if you book within 7 days of the course date.

Places may be booked on these courses using the booking form available on-line ([http://www.ocr.org.uk/training/alevel\\_inset\\_training.html](http://www.ocr.org.uk/training/alevel_inset_training.html)). Please quote the course code in any correspondence.

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