

Biology

Advanced GCE A2 7881

Advanced Subsidiary GCE AS 3881

Mark Schemes for the Units

June 2006

3881/7881/MS/R/06

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

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Any enquiries about publications should be addressed to:

OCR Publications
PO Box 5050
Annersley
NOTTINGHAM
NG15 0DL

Telephone: 0870 870 6622
Facsimile: 0870 870 6621
E-mail: publications@ocr.org.uk

CONTENTS

Advanced GCE Biology (7881)

Advanced Subsidiary GCE Biology (3881)

MARK SCHEME ON THE UNITS

Unit	Content	Page
2801	Biology Foundation	1
2802	Human Health and Disease	9
2803/01	Transport	17
2803/03	Practical Examination	23
2804	Central Concepts	31
2805/01	Growth, Development and Reproduction	39
2805/02	Applications of Genetics	49
2805/03	Environmental Biology	57
2805/04	Microbiology and Biotechnology	69
2805/05	Mammalian Physiology and Behaviour	85
2806/01	Unifying Concepts in Biology	93
2806/03	Practical Examination	101
*	Grade Thresholds	109

Mark Scheme 2801

June 2006

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
	R	= reject
	()	= words which are not essential to gain credit
	_____	= (underlining) key words which must 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)	(place) where , organism / animal / plant / population / community , lives ; R things / named organism	1
(ii)	<u>role</u> of organism in, the ecosystem / AW ; A habitat / environment / community / area / place R population	1
(iii)	living / biotic, and , non-living / abiotic , components that interact ;	1
(b)	population = one <u>species</u> and community = more than one / all , <u>species</u> / <u>population</u> ;	1
(c) (i)	1 some <u>food</u> not , eaten / accessible ; A an example 2 some, food / energy , not digested / egested / lost as faeces ; 3 (some assimilated) food / energy , lost in excretion ; 4 ref to decomposers ; 5 (some assimilated) food / energy , lost in respiration ; 6 <u>energy</u> lost, as heat / in movement / in metabolism ; 7 small proportion energy used for, growth / material, and is available to next trophic level ;	3 max
(ii)	1 plant material difficult to digest / animal material can be digested easily ; 2 ref to, cellulose / lignin / wood ; 3 no cellulase ; 4 (animal) gives similar spectrum of amino acids (as consumer) ; 5 less of the producer available to the 1 ^o consumer than 1 ^o consumer available to the 2 ^o consumer ; 6 AVP ; e.g. ref to gut bacteria <i>ignore references to numbers of organisms eaten or size of organisms</i>	2 max

[Total: 9]

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

- 2 (a)** **A** correct formulae
R choice (if contradictory)

<i>type of molecule tested</i>	<i>reagents used</i>	<i>positive result</i>	<i>negative result</i>
<i>protein</i>	biuret / copper sulphate and sodium (or potassium) hydroxide ;	purple / mauve / lilac ;	<i>blue solution</i>
fat / lipid / oil / triglyceride ; A phospholipid	<i>alcohol and water</i>	<i>white emulsion</i>	<i>clear liquid</i>
<i>starch</i>	iodine (in potassium iodide solution) ;	blue-black / black ;	<i>yellow solution</i>

5

- (b) (i)** **R** references to fruit juice

use same volume of glucose solution ;
 use same volume of Benedict's solution ;
 use same concentration of Benedict's solution ;
 boil for the same length of time ;
 calibrate colorimeter / AW ;

A strength / same batch
A heat
A same, filter / colorimeter

2 max

- (ii)** 6.5 ;

1

- (iii)** hydrolyse, filtrate / juice / bond / non-reducing sugar ;
either
 with acid, neutralise / add alkali
or
 treat with, sucrase / invertase ;

either, if started with filtrate ...

boil with Benedict's + test filtrate / repeat original procedure ; **A** heat

or, if started with juice ...

boil with Benedict's + test filtrate / repeat original procedure, to measure difference in absorbance with original ;

2 max

[Total: 10]

Question	Expected Answers	Marks
3 (a) (i)	nucleus / nuclear envelope / nuclear membrane ;	1
(ii)	(made up of) one type of / (squamous) epithelium, cell(s) ; A same R similar alone (group of) cells performing the same function(s) ; A task / job	1 max
(iii)	large surface area ; permeable ; thin / short, diffusion path ; moist ; good blood supply / close to blood ; well ventilated / in contact with respiratory medium ;	2 max
(b) (i)	haemoglobin / haem ; R Hb	1
(ii)	iron / Fe^{2+} / Fe^{3+} ; R ion / Fe / Fe^{+}	1
(c)	award two marks if correct answer (14 000) is given incorrect answer (or no answer) but correct working = 1 mark ecf rules apply for one mark max 14 000 ; ; R units in the answer allow 14666.67 or rounded correctly (e.g. 15 000) (for 22 mm) 13333.33 or rounded correctly (e.g. 13 000) (for 20 mm) A 1 mark for 20 / 21 / 22 mm $\div$ 1.5 or equivalent or ecf (for measurements 15 – 25 mm)	2

Question	Expected Answers	Marks
(d)	<i>active transport</i>	
1	against concentration gradient / described ; A up	
2	uses, energy / ATP ;	
	<i>facilitated diffusion</i>	
3	down concentration gradient / described ; A with R along / across	
4	no, energy / ATP, required ; A passive	
	<i>protein carrier (in either or undefined)</i>	
5	attaches on one side of the membrane ;	
6	protein, moves / turns / changes shape ;	
7	releases on other side of the membrane ;	
	<i>channel protein (facilitated diffusion only)</i>	
8	forms, pore / passage, through centre of the protein ;	
9	hydrophilic conditions / water lined ;	
10	<u>phospholipid</u> (bilayer) prevents, diffusion / passage / entry, of (some) , molecules / ions ; R substances	
11	polar / water soluble / not lipid soluble / too big / suitable named e.g. ;	
12	appropriate use of protein <u>in both</u> ;	
13	ref to specificity of protein to substance transported ;	
14	AVP ; (for extra detail of transport mechanism)	
		7 max
	QWC - legible text with accurate punctuation, spelling and grammar ;	1
		[Total: 16]

Question	Expected Answers	Marks
4 (a) (i)	breaking a bond with the addition of water ; A <i>named bond</i>	1
(ii)	<u>fatty</u> (<u>acids</u> produced) ; [H ⁺] increased / more acidic / products are acidic / acids produced ; ‘fatty acids produced’ = 2 marks	2
(iii)	<i>do not credit, substrate used up / lack of enzyme / end product inhibition</i> pH, too low / not optimum ; A <i>too acidic</i> enzyme <u>denatured</u> ; equilibrium reached ; further detail ;	2 max
(b)	reduces rate ; A <i>stops</i> R <i>inhibits</i> fits into, allosteric site / site other than active site ; A ‘fits into active site <u>permanently</u> ’ alters, shape / charge, of active site ; so substrate cannot, fit to active site / bind to active site / form ESC ; will not reach V _{max} ; increasing substrate concentration has no effect (on the rate) ;	3 max
		[Total: 8]

Question	Expected Answers	Marks
5	prophase ; centromere ; A <i>kinetochore</i> R <i>centrosome</i> membrane / envelope ; chromosomes / centromeres ; A <i>chromatids</i> R <i>homologous chromosomes / bivalents</i> anaphase ; poles / ends ; A <i>centrioles / asters</i> R <i>sides</i> cytokinesis ; genetically ; R <i>telophase / cytokinin</i>	8

[Total: 8]

Question	Expected Answers	Marks
6 (a)	R first reference to ^{15}N being radioactive <i>semi-conservative replication would give</i> - one, template / original / old / parent, strand and one, new / daughter, strand ; - complementary base pairing / joining of new nucleotides / other detail of forming the new strand ; <i>data shows that</i> - two isotopes in <u>molecule</u> / <u>molecule</u> contains both ^{14}N and ^{15}N ; - one strand with, 'heavy' N / ^{15}N ; R molecule - one strand with, 'light' N / ^{14}N ; R molecule - no <u>molecules</u> with only, 1 isotope / ^{14}N / ^{15}N ; <i>some points, particularly 4 and 5, could be awarded for a correctly labelled or keyed diagram</i>	4 max
(b)	<i>correct answer only - do not accept from a selection</i> A ; C ; C <u>and</u> E ;	3
(c)	1 band = 0 3 bands = 0 band drawn for ^{14}N <u>and</u> $^{14}\text{N}/^{15}\text{N}$ only ; thick for ^{14}N <u>and</u> thin for $^{14}\text{N}/^{15}\text{N}$;	2
		[Total: 9]

Mark Scheme 2802
June 2006

10

Question	Expected Answers	Marks
2 (a)	self-inflicted ; social ; A non-infectious	1 max
(b)	many factors contribute to risks / many risk factors / no one factor causes disease ; A if name two or more factors A a number of causes R many things	1
(c)	1 (carbon monoxide / nicotine) increases heart rate ; 2 (nicotine) constricts arterioles / vasoconstriction ; R arteries / blood vessels 3 (nicotine makes) platelets sticky ; 4 blood clot / thrombosis, more likely ; 5 increases blood pressure / hypertension ; 6 increases deposition of, fatty substances / cholesterol, <u>in</u> walls of arteries / formation of atheroma or plaque ; 7 increases (risk of), <u>a</u> therosclerosis / hardening of arteries ; 8 reduces <u>lumen</u> of artery ; 9 reduces, blood flow / oxygen supply, to heart, muscle / tissue ; 10 AVP ; e.g. carbon monoxide damages, walls / lining, of artery	3 max
(d)	<i>high in some places because (accept ora)</i> 1 more, animal / saturated fats, in diet ; 2 less, linolenic / linoleic, acids (in diet) ; A polyunsaturated 3 more salt (in diet) ; 4 high(er) incidence of obesity ; AW 5 high(er) prevalence of smoking ; AW 6 more alcohol abuse ; 7 less exercise (is undertaken) ; 8 high(er) stress levels ; 9 high(er) blood pressure ; 10 high(er), cholesterol / LDL, concentration in blood ; 11 hereditary factors / ethnicity ; 12 'at risk', gene / allele, may be more common ; A FHC gene 13 ref to education ; 14 AVP ; e.g. ref to differences in data collection 15 AVP ; e.g. ref specific dietary differences red wine / antioxidants ref to cholesterol-reducing drug(s) / food(s) ref to life expectancy (if low do not develop CHD) ref to maternal diet during pregnancy ref to diabetes	4 max

(e) *benefits to society*

fewer people have CHD / lower mortality due to CHD ;
 fewer drugs used ;
 fewer operations carried out / shorter waiting times ;
 e.g. by-pass surgery / heart transplant ;
 less, NHS / doctors', time taken up ;
 lower cost to NHS / more money to spend elsewhere ;
 fewer work days lost / less disability benefits paid out ;

benefits to individual

better quality of life ;
 live longer ;
 awareness of harm to body ;
 people eat, more healthily / less fatty food / less alcohol consumption ;
 people, exercise more / more active ;
 people do not smoke / less passive smoking ;

AVP ; e.g. lower levels of obesity

AVP ; e.g. stop people taking up smoking

3 max**[Total: 12]****Question****Expected Answers****Marks****3**

	pathogen ;
	degenerative ;
	aerobic ; R <i>aerobic respiration</i>
	tidal ;
	pandemic ;

5**[Total: 5]**

Question	Expected Answers	Marks
4 (a)	pathogen / bacterium, recognised as foreign ; antigens / pathogen is antigenic ; AW engulfed / phagocytosis / phagocytosis described / endocytosis ; in, vesicle / phagosome / vacuole ; lysosomes fuse to vesicle ; release, lysins / enzymes / named enzyme ; digest / break down, pathogen / bacterium / AW ; AVP ; e.g. ref to presentation of antigen hydrolysis release of HCl or H₂O₂ or toxins or free radicals into vesicle	4 max
(b) (i)	increase in pollution ; certain crops (oil seed rape) ; use of food additives ; diagnosis ; awareness ; use of antibiotics ; AVP ; e.g. better hygiene, less breast feeding, multiple vaccinations	1 max
(ii)	42 – 43 (%) ;	1
(c)	pollen ; dust ; dust mites (faeces) ; pollution / smoke ; dog / cat / animal, hair / fur ; A cat saliva feathers ; fungal spores ; aerosol spray / air freshener ; hay ; AVP ; e.g. nuts, ibuprofen, antibiotics AVP ;	2 max
(d)	contraction of (smooth) muscle ; constriction of, airways / bronchi / bronchioles ; A narrows R trachea R tighten increased mucus (secretion) / mucus blocks airways ; capillaries become leaky ; swelling of connective tissue / inflammation of airway ; secretion of histamine (by mast cells) ;	2 max

[Total: 10]

Question	Expected Answers	Marks
5 (a)	after a low carbohydrate diet athlete can exercise for, not long / (no more than) one hour ; AW ora statement of trend observed ; e.g. as carbohydrate in diet increases duration of exercise increases / carbohydrate loading improves performance ; AW ora use of figures as a comparison ; (look for 60, 125 – 130, and 185 – 190) A two / three, times duration statements	3 max
(b)	<i>penalise sugar once in the answer</i> glycogen is, source / store, of, energy / carbohydrate ; glycogen converted to glucose / glycogenolysis / glucogenesis ; glucose used in respiration ; to supply, energy / ATP, for muscle contraction ; more glycogen stored will last longer ; AVP ; e.g. using muscle glycogen may be more efficient than transporting glucose from liver	2 max

(c)

health of the heart, ref to

- 1 size / thickness, of heart muscle ;
- 2 stroke volume / cardiac output ;
- 3 ref to coronary arteries ; e.g. angina
- 4 ref to change in heart rate ;
- 5 increased, size / number, of mitochondria ;
- 6 reduced by hypertrophy ;

health of the lungs, ref to

- 7 dilation of the airways ;
- 8 (size of) tidal volume ;
- 9 (size of) vital capacity ;
- 10 rate of, breathing / ventilation ;
- 11 vascularisation of the alveoli ;
- 12 reduced by, respiratory illness / asthma / bronchitis / emphysema ;

health of the blood circulatory system, ref to

- 13 ability to supply, glucose / fatty acids, to muscle ;
- 14 ability to supply oxygen to the muscles ;
- 15 quantity of haemoglobin in the blood ;
- 16 number of red blood cells in the blood ;
- 17 ability to remove, lactate / carbon dioxide ;
- 18 capillary density of muscles (include heart muscle) ;
- 19 elasticity of the arteries ;
- 20 absence of, atheroma / fatty streaks ;
- 21 altitude training ;
- 22 erythropoietin ;
- 23 blood doping ;
- 24 AVP ; e.g. state of training / aerobic fitness / BMI
- 25 AVP ; smoker or not / ref to VO_2 max / ref to vasoconstriction
- 26 AVP ; age / congenital defects / performance enhancing drugs

8 max**QWC – legible text with accurate spelling, punctuation and grammar ;****1****[Total: 14]**

Question	Expected Answers	Marks
6 (a) (i)	human immunodeficiency (virus) / HI(V) ;	1
(ii)	<i>immune system unable to</i> reproduce (enough) T (helper) cells ; release cytokines ; stimulate B cells ; make plasma cells ; release antibodies ; stimulate macrophages ; stimulate T killer cells ; no humoral response ; make memory cells ;	3 max
(iii)	unprotected sexual intercourse ; reusing / sharing, needles ; R dirty / unsterile, needles blood transfusion / mixing blood ; R blood donation across placenta / child birth ; breast feeding ; needle stick ; AVP ;	3 max
(b)	person with AIDS is attacked by <u>bacteria</u> ; antibiotics effective against, bacteria / bacterial infection ; prevents, opportunistic / secondary, infections ; e.g. of bacterial infection ; (TB, pneumonia etc.) <i>mark first example only</i>	2 max
[Total: 9]		

Mark Scheme 2803/01
June 2006

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 R = reject () = words which are not essential to gain credit <u> </u> = (underlining) key words which must be used to gain credit ecf = error carried forward AW = alternative wording A = accept ora = or reverse argument
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Question	Expected Answers	Marks
1 (a) (i)	stem ;	1
	(ii) B ;	1
(b)	sucrose ;	1
(c) (i)	P = companion (cell) ; Q = sieve (tube) element / sieve tube cell ; R sieve tube / sieve cell	2
	(ii) <i>ecf - do not penalise sieve tube here</i>	
	1 sieve elements / Q, end to end <i>or</i> sieve plates perforated / sieve pores , for ease of flow / AW ;	
	2 companion cells / P, metabolically active / have many mitochondria / produce ATP / release energy / AW ; R make energy	
	3 (active) loading into, companion cell / P ; A into, sieve elements / Q	
	4 ref to proton pump ;	
	5 ref to co-transporter ;	
	6 role of plasmodesmata (between P and Q) ; R pores	
	7 sieve element / Q, has few organelles / AW, for, ease of flow / more sucrose / AW ;	
	8 ref to, unloading mechanism / (hydrostatic) pressure gradient ;	
	9 ref to one role for sieve plate e.g. electro-osmosis or stops 'bulging' ;	3 max
(d)	source when root converts, starch / insoluble carbohydrate, into sugars / AW ; sink when root either stores starch / (named) carbohydrate / assimilate or uses carbohydrate for, respiration / growth / AW ; high hydrostatic pressure makes it a source and low hydrostatic pressure a sink ; when loading it is a source and when unloading a sink;	
	<i>treat refs to (potato) tubers as neutral</i>	2 max
		[Total: 10]

Question	Expected Answers	Marks
2 (a)	award two marks if correct answer (7) is given incorrect answer (or no answer) but correct working = 1 mark 7 ; ; max 1 if not to nearest whole number R <u>answers</u> in cm calculation mark for showing division by 12	2
(b)	1 ref to tunica, intima / interna, tunica media <u>and</u> tunica, externa / adventitia ; 2 thick wall, stops bursting / withstands pressure idea ; 3 (relatively) narrow lumen to maintain pressure ; 4 elastic tissue / AW, allowing stretching / AW ; 5 elastic arteries near heart ; 6 elastic <u>recoil</u> ; 7 to even out surges of pressure / to maintain flow / AW ; A push idea 8 collagen provides (main) strength / AW ; 9 (smooth) endothelium (of tunica intima) to reduce friction / AW ; A epithelium or lumen lining / AW R epidermis 10 tunica media / AW, has (smooth) muscle <u>and</u> elastic tissue ; collagen is neutral 11 to prevent bursting / withstands pressure / AW ; look for link to tunica media 12 (smooth) muscle maintaining pressure ; A ref vasoconstriction / 'blood shunts' R pumping action 13 AVP ; e.g. idea that circular cross section allows max blood volume for minimum wall contact / AW	6 max
	QWC – clear, well organised using specialist terms ; award QWC mark if three of the following are used tunica (qualified once) lumen elastic / elastin collagen recoil smooth muscle endothelium vasoconstriction	1

[Total: 9]

Question	Expected Answers	Marks
3 (a)	water potential ; apoplast / apoplastic ; endodermis / Casparian strip ; Casparian strip / suberin / AW ; <i>only credit Casparian strip once</i> symplast / symplastic ; A symbol A apoplasm A starch sheath A vacuolar / symplasm / synplast R other gradients R anoplast R stele	
	<i>A endodermis in point 4 if point 3 is blank or neutral</i> <i>if more than one response in a gap, take first on list for points 1, 3 and 4.</i> <i>For apoplast and symplast look for single term i.e. R if put apoplast / symplast</i>	5
		[Total: 5]

Question	Expected Answers	Marks
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4 (a) (i)		blood in aorta	tissue fluid	lymph	blood in vena cava
	red blood cells		none ;		
	white blood cells	many / high ; R some			
	glucose concentration			low ; A none / some	
	pressure				low ;

4

(ii) *glucose*

carried / transported, in the blood ;
 passes through capillary walls to tissue fluid / AW ;
 used up / stored, in tissues / AW (so little in lymph) ;
 ref, respiration / glycogen ;
 high in vena cava as (absorbed) from gut / sent from liver / AW ;

3 max

pressure

high in aorta as comes from, heart / ventricles / AW ;
 increased, resistance / friction / AW, (causes drop) ;
 increased volume of capillary bed / AW, (causes drop) ;
 lost during formation of tissue fluid / AW ;
 low in, lymph / vena cava as, no mechanism for raising it / long distance from heart ;
R 'low in veins as it is returning to the heart'

3 max

4 max

- (b) carbon dioxide (diffuses) into red blood cells ; **R** blood only
 carbonic anhydrase ;
 carbon dioxide reacts with water ;
 to form, carbonic acid / H_2CO_3 / HCO_3^- ; **R** if linked with incorrect reaction
 carbonic acid, dissociates / AW, to give HCO_3^- ;

accept from equations $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3$ 

3 max

[Total: 11]

Question	Expected Answers	Marks
5 (a) (i)	T = <u>coronary</u> , artery / arteries ; U = <u>right</u> ventricle ; A cardiac muscle	2
(ii)	oxygen / glucose, will not reach, (heart / cardiac) <u>muscle</u> ; A less reduced / no, respiration ; (possible) coronary / heart attack / myocardial infarction / (possible) death ; A fibrillation / irregular beat / AW	2 max
(b) (i)	blood enclosed in vessels / AW ;	1
(ii)	ventricles not separated / one ventricle / partial or no septum / three chambers / left and right sides not separated ; <i>ora</i> for mammal single vessel from heart ; <i>ora</i> for mammal A aorta oxygenated and deoxygenated blood not (fully) separated ; <i>ora</i> for mammal blood passes twice through heart for complete circulation / systemic <u>and</u> pulmonary systems / to lungs and body ; <i>If only one animal described max 2</i>	3 max
(iii)	blood will not be fully oxygenated / Hb less fully saturated / deoxygenated and oxygenated blood mixed / AW ; still carrying carbon dioxide ; lower pressure <i>or</i> less, force / push / AW ;	2 max
		[Total: 10]

Mark Scheme 2803/03
June 2006

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
	R	=	reject
	()	=	words which are not essential to gain credit
	_____	=	(underlining) key words which <u>must</u> 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 the next page. 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

The mark scheme for Questions 1 and 2 for the Practical Test are on the pages following the mark scheme for the Planning Exercise.

AS Biology. Planning exercise

Checking Point	Descriptor	The candidate
A	P.1a	plans a procedure using a suitable method to measure rates of transpiration / water uptake, e.g. potometer, cobalt chloride papers, weighing leaves, uptake of water in test-tubes ;
B	P.1a	gives a prediction about the relationship between named factor and <u>rates</u> of transpiration in two named , plants / types of plant ; A from a graph
C	P.1b	selects apparatus for measuring, transpiration / water uptake, and for changing named factor ;
D	P.3a	defines transpiration in terms of, loss of water <u>vapour</u> / evaporation ;
E	P.3a	identifies at least 2 key factors to control or 'take account of' e.g. air temperature, humidity, light intensity, wind speed, leaf area ; not including named factor
F	P.3b	decides on appropriate range (minimum of five values) for, chosen factor ; (0+4 is OK)
G	P.3b	decides on appropriate number of measurements to take to ensure reliability i.e. minimum of three readings for all values of, chosen factor / independent variable ;
H	P.5a	uses appropriate scientific knowledge and understanding to justify prediction for named factor <i>or</i> types of plant, e.g. stomatal density / sunken stomata / hairs on epidermis / factor(s) affecting transpiration ;
I	P.5a	uses information or results from preliminary work or previous practical work in developing a plan ;
J	P.5a	refers to a specific safety precaution, e.g. care with cutting stems / leaves, putting twigs into rubber tubing and then onto glass tubing, electricity and water ;
K*	P.5b	<i>gives a clear account, logically presented with accurate use of scientific vocabulary (QWC) ;</i>
L	P.5b	plans to obtain precise results e.g. use of mm scale in potometer, reading balance to 2 dp, determining leaf area in mm ² , volumes to 0.5 cm ³ ; <i>can take from table</i>
M	P.7a	gives relevant information from any two written sources , e.g. class notes / text book / web site etc ; <i>must be cited in plan</i>
N	P.7a	shows how results (from plan) are to be presented in a table including unit(s) ;
O*	P.7a	<i>uses spelling, punctuation and grammar accurately (QWC) ;</i>
P	P.7b	explains how data would be interpreted to find answer to the investigation, e.g. plot graph of, mass loss / water loss / water uptake, against named factor ; <i>could be from prediction</i>
Q	P.7b	comments on precision and/or reliability e.g. difficult to keep conditions constant, plants need time to settle in potometer, uses method to determine leaf area, waits until rate of water uptake / loss is constant before taking results ; <i>not details of setting up</i>
R	P.7b	explains how to convert readings from potometer to volume of water, absorbed <i>or</i> calculates percentage mass loss / mass lost per unit time ;
S	P.7b	standardises results for different species by adjusting for leaf area, e.g. per unit area ;
T	P.7b	shows how to calculate <u>rate of</u> , water loss / water uptake , per unit area of leaf ;
U	P.7b	comments on validity of investigation, e.g. resistance of roots / effects of chosen factor on other factors / potometer measures water uptake, not transpiration ;

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

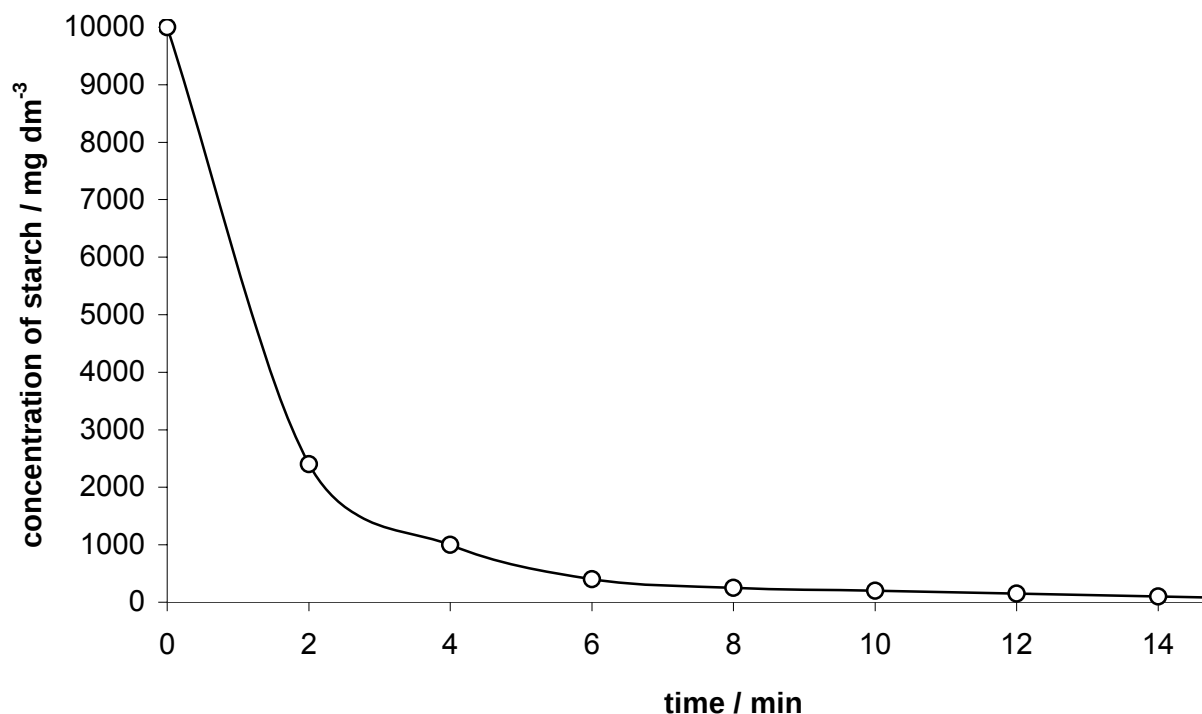
Then award **1** mark for each of **K** and **O** (QWC).

Total: 16

Expected results for **(a)**

time / min	colour (with iodine solution)		
	(A) distilled water / no enzyme	(B) amylase E1	(C) amylase E2
1	blue/black	red/brown	blue-black
2	blue/black	yellow-orange	blue-black
3	blue/black	yellow	blue-black
4	blue/black	yellow / no change	dark brown
5	blue/black	yellow	dark brown
6	blue/black	yellow	red-brown
7	blue/black	yellow	red-brown
8	blue/black	yellow	red-brown
9	blue/black	yellow	red-brown
10	blue/black	yellow	red-brown

time / min tube	colour (with iodine solution)									
	1	2	3	4	5	6	7	8	9	10
(A) distilled water	blue-black	blue-black	blue-black	blue-black	blue-black	blue-black	blue-black	blue-black	blue-black	blue-black
(B) E1	red-brown	yellow	yellow	yellow	yellow	yellow	yellow	yellow	yellow	yellow
(C) E2	blue-black	blue-blue	blue-black	dark brown	dark brown	red-brown	red-brown	red-brown	red-brown	red-brown

Expected graph for **(e)** - look for curve between 2 and 6 minutes, not straight lines

Question	Expected Answers	Marks
1 (a)	table format with times in left hand column <i>or</i> along the top ; (distilled) water / no enzyme, + E1 + E2 in, row / column, headings ; <i>treat A, B, C as neutral</i> informative, rows / column, headings – colour (with iodine solution) and time ; units (min / s) in, row / column, heading ; R if in body of table correct trend, e.g. A - blue/black / purple, B - yellow immediately / after one minute / after a few minutes, C - slower change to, light purple / red-brown / yellow ; <i>results do not have to be given for 10 minutes</i> C maybe blue/black throughout	5
(b) (i)	control ; (shows that) no, breakdown / hydrolysis / digestion / reaction, without enzyme ; A starch not broken down by water alone / no effect without enzyme ; comparison with other tubes (to show difference in colour / AW) ;	2 max
(ii)	maintains a constant pH / so pH is not a variable / AW ; enzyme activity is influenced by pH / AW ; any explanation, e.g. denaturation / ref to optimum pH ;	2 max
(iii)	equilibrate (before reaction starts) ; A 'acclimatise' / 'adjust', etc allow enzyme and substrate to reach, desired temperature / 40 °C ; A enzyme and substrate implied R optimum temperature is 40 °C	1 max
(c)	1 starch gives blue-black colour with <u>iodine</u> (solution) (ref to step 1) ; 2 A, remains blue-black ; R no change 3 B / E1, yellow + time ref ; A no change to iodine solution if in results table 4 C / E2, blue-black + time ref / red-brown + time ref ; 5 starch not, digested / hydrolysed / broken down, in A / + water ; R 'not affected' 6 no enzyme present / ora ; 7 starch, broken down / hydrolysed, in B / with E1 / in C / with E2 ; 8 starch to maltose ; 9 dextrins / short(er) chain polysaccharides ; 10 partial breakdown, in C / with E2 ; (check against results) A no breakdown if C is blue/black throughout 11 reaction / breakdown is, faster with E1 / slower with E2 ; 12 B or E1 has higher (enzyme) concentration / C or E2 has lower (enzyme) concentration ; A ref to number of enzyme molecules 13 ref to collisions ; 14 ref to active sites ; 15 ref to enzyme-substrate complexes ; 16 breakdown of glycosidic bonds ; 17 AVP ; e.g. maltose, does not change colour of iodine iodine inside amylose helix / AW amylase breaks every other glycosidic bond (to give maltose)	9 max

(d) 2400 - 2450 ;
1000 ; 2

(e) axes correct - time on horizontal axis, concentration of starch on vertical ;
axes scaled, with ascending scale ; **R** 'split scales' / short axis
axes titles and units ; **R** if absorbance is plotted
points plotted accurately ; ecf from (d)
best fit line showing exponential decrease ; *look for curve between 2 and 6 min*
R if beyond plotted points
if scaling is incorrect, then unlikely to award best fit line 5

(f) *accept ora where appropriate – note 'compared with the method you carried out'*
note - student's method is using the colorimeter

advantages

- 1 quantitative / gives numerical results / gives figures ;
- 2 easier to keep water bath at 25 °C (than 40 °C) ;
- 3 does not rely on judgement of colours / not subjective / AW ;
- 4 can convert to actual concentration of starch ;
- 5 easier to identify anomalous results ;
- 6 more accurate (i.e. closer to true value) ; **R** 'it is accurate'
- 7 can plot a graph ;
- 8 can calculate a rate of reaction ;
- 9 temperature lower (25 °C) so, reaction (**A** change) is slower / AW ;
- 10 temperature lower so enzyme less likely to be denatured ;
- 11 (only one sample so) less likely to be any cross-contamination ;
- 12 only one sample each time / 2 minute intervals, so easier to take samples at appropriate time intervals ;

disadvantages

- 13 no control ;
- 14 only one concentration of, amylase / enzyme ;
- 15 reaction may continue after removing sample ;
- 16 time gap between taking samples and taking readings ;
- 17 readings taken every two minutes / time intervals too long, no intermediate readings / AW ;
- 18 any appropriate comment about using a colorimeter ; (e.g. adjusting to zero each time)
- 19 AVP ; e.g. another comment about using the colorimeter
- 20 AVP ; systematic error / AW
cost / availability of colorimeter

R disadvantages of *my method*

R reliability (no repeats in either method)

10 max

[Total: max 30]

Question	Expected Answers	Marks
2 (a)	<i>drawing</i> three complete cells of appropriate shape (longer than wide) ; hexagonal / not regular shapes ; cell walls shown clearly with appropriate thickness ; R if gaps between the cells / shaded walls clear, continuous lines ; <i>labels</i> cell wall ; <i>label line to outside or middle of cell wall if membrane labelled</i> protoplasm / protoplast / cytoplasm ; A cytosol	6
	<i>mark (b) and (c) to max 10 – note that (b) is for description only</i>	
(b)	1 protoplast / cell contents / cell membrane / cytoplasm, pulls away (from cell wall) ; 2 pigment / colour, becomes more, intense / darker ; A 'colour is in the middle' / area of pigment shrinks 3 (white) space between, protoplast / cell contents / cell membrane / cytoplasm, and cell wall / AW ; 4 (strands of) cytoplasm / AW (as in 1), left attached to cell wall ; 5 contents of cell becomes rounded / AW ; 6 plasmolysis ; 7 no change to cell wall(s) / AW ; 8 AVP ; e.g. any ref to change to cell(s) with time	
(c)	<i>drawing</i> one cell drawn to the same size as any one of the cells in (a) ; R if > 1 cell plasmolysis shown clearly ; e.g. rounded cell contents, with or without cytoplasm attached to cell wall cell wall shown as two lines ; <i>annotations</i> (loss of water by) <u>osmosis</u> ; <u>down</u> water potential gradient ; A from high to low, water potential / ψ external solution / potassium nitrate (solution), occupies space between cell wall and, cell membrane / cytoplasm ; R ref to air space cytoplasm / cell membrane / protoplast, attached at plasmodesmata ; <i>following points if not given in (b)</i> protoplast / vacuole, shrinks or cytoplasm / membrane, pulls away from wall; plasmolysis ;	10 max
(d)	1 less surface area for loss of water <u>vapour</u> ; 2 ref to stomata ; e.g. leafy shoot has stomata / onion bulb has none or few stomata 3 ref to diffusion ; 4 leaf carries out photosynthesis / onion bulb does not ; 5 leaf has large(r) <u>surface area to volume ratio</u> ; 6 onion bulb is compact / AW ; 7 outer dead scale leaves / described, reduce water loss ; R ref to waxy cuticle 8 air cannot reach leaves in onion / onion not exposed to air / onion underground ; 9 ref to factor(s) influencing transpiration (e.g. humidity, temperature, light, wind)	4 max

[Total: max 14]

Mark Scheme 2804
June 2006

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
	R	=	reject
	()	=	words which are not essential to gain credit
	_____	=	(underlining) key words which <u>must</u> 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)	Q, S, P, N, M, R ;	1
	(ii) <i>accept correct names of stages</i>	
	Q ; A prophase 1 M ; A anaphase 2 Q / S ; A prophase 1 / metaphase 1 S ; A metaphase 1 R ; A telophase 2	5
	(iii) DNA replication ; synthesis of proteins / named protein ; A transcription / translation synthesis of membrane ; synthesis of, organelle(s) / named organelle ; respiration ; AVP ; e.g. centrioles <u>replicate</u> ;	2 max
(b) (i)	Individual 2 - X ^H Y ; Individual 5 - X ^h Y ; Individual 6 - X ^H Y ; Individual 9 - X ^H X ^h ; <i>max 2 if sex chromosomes not shown</i>	4
	(ii) half / 0.5 / 50% / 1 in 2 ; A 1:1, 50:50 R 1:2	1
	(iii) carriers have, both / H and h / dominant and recessive, alleles ; A are heterozygous R two alleles females have two X chromosomes / ora ;	2

[Total: 15]

Question	Expected Answers	Marks
2 (a) (i)	palisade (mesophyll) ; spongy (mesophyll) ; mesophyll / chlorenchyma – 1 mark	2
(ii)	1.7, 3.1, 4.0, 4.7, 4.9, 5.0 ;	1
(iii)	selection of two temperatures 10 °C apart ; <i>respiration</i> ref to release of carbon dioxide (in dark is measure of respiration) ; state two figures very close to value of 2, therefore supports ; (all steps in) respiration enzyme catalysed ; <i>photosynthesis</i> <i>data quotes must be from true rate of photosynthesis</i> only value between 5 °C and 15 °C is close ; photosynthesis does not support as (other) values not near 2 ; A data quote to illustrate this / ecf not just enzyme-controlled process / AW ;	4 max
(iv)	light intensity limiting factor ; low rate photosynthesis ; rate respiration increases at higher temperatures ; rate respiration, close to / exceeds, rate of photosynthesis ; A ora net primary productivity is lower / sugars broken down more quickly than formed ;	3 max
(b) 1	Calvin cycle ; <i>max 4 from marking points 2 to 10</i> 2 ribulose biphosphate carboxylase / rubisco ; <i>linked to marking point 3</i> 3 RuBP + carbon dioxide ; 4 (2 molecules of) GP ; A PGA 5 GP to TP ; A PGAL, GALP 6 uses ATP (from light reaction) ; <i>linked to marking point 5</i> 7 and red NADP / AW, (from light reaction) ; <i>linked to marking point 5</i> 8 some TP forms hexose sugars ; 9 (some) TP regenerates RuBP ; 10 AVP ; e.g. (unstable) 6C compound, detail of RuBP regeneration	5 max

accept an annotated diagram of the cycle

[Total: 15]

Question	Expected Answers	Marks
3 (a)	(i) soda lime / KOH / NaOH / carbabsorb ; R lime water	1
	(ii) absorb carbon dioxide ;	1
	(iii) reset manometer (at end of each trial) / AW ; measuring volume (of oxygen) ;	max 1
(b)	(i) the ratio of the volume of carbon dioxide given out in respiration to that of oxygen used (in unit time) / AW ;	
	A $\frac{\text{vol of carbon dioxide out}}{\text{vol of oxygen taken in}}$	1
	(ii) aerobic ; carbohydrate / sugar / glucose / glycogen / named sugar ;	2
(c)	1 ref to opening tap when changing temperature ; 2 ref to water bath ; 3 set / reset, manometer fluid ; 4 read initial fluid level (in manometer) ; 5 leave for suitable length of time (minimum 5 minutes) ; 6 measure, distance moved by fluid in unit time / time taken to move set distance ; 7 replication / repeat (at same temperature) ; 8 calculate mean ; A average 9 time to adjust to new temperatures / equilibrate ; A adjust to conditions 10 ref to role of tube C ; A control 11 calculate, volume of oxygen taken up in unit time / $1/t$ for each temperature ; A at each temperature plot distance moved by fluid against time and measure gradient of curve to determine rate 12 ref to measure mass of woodlice ; 13 express rate per gram ; 14 plot graph of rate against temperature ; 15 AVP ; e.g. same woodlice for each trial <i>or</i> use same, species / number of woodlouse 16 AVP ; e.g. suitable range of temperature (0 – 50 °C) with minimum five values	max 7
	QWC – legible text with accurate spelling, punctuation and grammar ;	1

[Total: 14]

Question	Expected Answers	Marks
4 (a) (i)	curve to have peaks to right of lemming peaks and must have two peaks between 1994 and 1996 and 1998 and 2000 respectively ; peaks below level of lemming peaks ;	2
(ii)	plenty / AW, of food ; few / AW, predators ; high population of alternative prey for predators ; no overcrowding / lots of breeding sites / AW ; less disease ; less competition from other species ; low environmental resistance ;	3 max
(b)	<i>interspecific</i> between two (or more) species ; two named species (on lemmings) ; <i>intraspecific</i> within species ; named species plus resource ; <i>if definitions of interspecific and intraspecific competition are the wrong way around can still gain one mark for correct examples of both types of competition</i>	3 max
(c)	maximum, size / number, of a, population / species ; <i>either</i> (supported) in a particular, habitat / ecosystem / area / environment ; <i>or</i> determined by <u>limiting factors</u> ;	2

[Total: 10]

Question	Expected Answers	Marks
5 (a) (i)	directly proportional / AW ;	1
(ii)	2.6 ;	1
(iii)	1 high levels of glucose in glomerular filtrate ; 2 unable to reabsorb <u>all</u> glucose (in, PCT / kidney tubule) ; A no more glucose can be reabsorbed 3 ref to glucose carriers / AW ; 4 at threshold value carriers, all saturated / limiting factor ; 5 AVP ; e.g. ref to renal threshold	3 max
(b)	too large ; to pass through <u>basement</u> membrane ; A description of basement membrane	2
(c)	1 detected by cells in pancreas ; 2 β cells of islets of Langerhans ; 3 insulin produced ; 4 secreted into, blood / circulation / HPV ; 5 cells / named example, take up <u>more</u> glucose ; 6 <u>more</u> glucose carriers in membrane ; 7 conversion to glycogen / glycogenesis ; 8 increased rate of glucose use in respiration ; 9 ref to negative feedback ; 10 glucose concentration kept below threshold value in glomerular filtrate ; 11 all reabsorbed in PCT ; 12 AVP ; inhibits glucagon secretion, suppresses gluconeogenesis	5 max
(d) (i)	<u>long</u> loop of Henlé <i>or/</i> deep / wide, medulla ; very low water potential in medulla / AW ; A higher concentration of salts collecting duct more permeable to water ; large number of, water permeable channels / aquaporins, in collecting duct ; more sensitive to ADH / more ADH produced ; AVP ; e.g. other correct ref to kidney histology <u>all</u> loops of Henlé are long CD more permeable to urea more capillary loops in medulla	3 max
(ii)	seeds contain, storage molecules / AW ; A named example of storage molecule aerobic ; respiration ; water is produced ; <i>linked to respiration</i> R reference to condensation reactions <i>accurate equation for aerobic respiration can gain 3 marks</i> <i>metabolic water = 2 marks</i>	3 max

[Total: 18]

Question	Expected Answers	Marks
6 (a)	form of <u>a</u> gene ; position of, gene / allele on, chromosome / DNA ;	2
(b)	1 <i>Woodland</i> more, dark / unbanded, snails or fewer, light / banded, snails ; 2 better camouflaged / ora ; 3 against, leaf litter / uniform background ; 4 relevant woodland data quote on colour and banding ; 5 <i>Grassland</i> more, yellow / banded, snails or fewer, dark / unbanded, snails ; 6 better camouflaged / ora ; (only award if missed point 2) 7 against, pale / yellow / green / variable, background ; 8 relevant grassland data quote on colour and banding ; 9 survivors posses advantageous <u>alleles</u> / ora ; 10 reproduce ; 11 pass <u>alleles on</u> (to, offspring / next generation) ; 12 ref to <u>stabilising selection</u> (in both habitats) ; 13 ref to other named selection pressure(s) ; 14 not a very mobile population <i>or</i> little, immigration / emigration ; 15 separate gene pools described ; 16 little mutation taking place ; A no new camouflage method over time 17 habitat stable ; 18 ref to why unfavourable alleles have not disappeared ; 19 AVP ; e.g. calculated average figures for both habitats	max 8
	QWC – clear, well organised using specialist terms ;	
	clear and well organised and must include marking points 4 and 8	1
[Total: 11]		

Question	Expected Answers	Marks
7 (a)	transmit (information) between neurones ; ensure one way transmission of impulses ; integration of nerve pathways ; A allows, convergence / divergence / summation filter out low level stimuli ; prevent overstimulation and fatigue ; ref to inhibition ; AVP ; e.g. role in, learning / memory	2 max
(b)	vesicles move to presynaptic membrane ; vesicles fuse with presynaptic membrane ; exocytosis / AW ; neurotransmitter moves across synaptic cleft ; neurotransmitter binds to receptor on postsynaptic membrane ; recycling of neurotransmitter / channels for uptake of neurotransmitter ;	3 max
(c)	1 to allow repolarisation to occur ; 2 by unblocking (neurotransmitter) receptor ; 3 prevents sodium channels remaining open ; 4 so more neurotransmitter can bind ; 5 new action potential is generated ; 6 to allow movement to occur ; 7 recycling of neurotransmitter ; 8 AVP ; <i>or</i> 1 permanently depolarised ; 2 receptors (permanently) blocked ; 3 sodium channels open ; 4 no more neurotransmitter can bind ; 5 no new action potential / action potentials continuously fired ; 6 continuous contraction / AW ; 7 no recycling of neurotransmitter ; 8 AVP ;	2 max
		[Total: 7]

Mark Scheme 2805/01
June 2006

[illegible]

(ii) *allow ecf if graph in (i) wrong*

counts living and dead bacteria ;
normally some dead in population ;
making total higher / AW ;
numbers of living fall / all eventually die ;
because resources used up ;
but total does not fall ;
AVP ; e.g. total eventually falls due to lysis

3 max

(d) (i) condensation / polymerisation ;

1

(ii) cell wall (components) / named components ;
membrane (components) / named components ;
enzymes involved in cell division ;
enzymes involved in, respiration / chemical reactions / production of new materials ;
AVP ; e.g. transcription factors / ribosomes
AVP ; e.g. regulatory proteins

3 max

[Total: 16]

Question	Expected Answers	Marks
2 (a) (i)	corpus luteum ; A yellow body	1
(ii)	negative feedback ; hypothalamus ; GnRH inhibited ; LH inhibited ; from <u>anterior</u> pituitary ; ovulation not stimulated / LH normally causes ovulation ; FSH inhibited ; no oestrogen surge ;	A FSH 3 max
(b)	<i>no credit given for questions</i> <i>relevant to any oral contraception</i> encourages, casual / underage, sexual intercourse / AW ; not approved by, Catholic Church / other religions ; does not protect from STIs ; possible health risks / specific risk ; AVP ; e.g. issues about prescription to underage girls	 1 max
	<i>relevant to emergency contraception only</i> used as alternative to planned contraception ; debate on whether it should be available over the counter ; potential human life may be destroyed / form of abortion ; AVP ;	 2 max
(c) (i)	can be effective up to, 3 days / 72 hours / 2 days / 48 hours / more than one day ;	1
(ii)	<i>award two marks if correct answer (150) is given</i> <i>incorrect answer (or no answer) but correct working = 1 mark</i> $\frac{100 - 85}{100} \times 1000$ 150 ;;	 2
(iii)	ovulation already occurred / ref to point in menstrual cycle ; unprotected sexual intercourse at other time in same cycle ; already pregnant / fertilisation already occurred / AW ; diarrhoea / vomiting / stomach upset / full stomach, so pill not absorbed ; AVP ;	 1 max
(d)	binds to progesterone receptors ; lowers progesterone, activity / effectiveness ; R less progesterone secreted progesterone needed to maintain, endometrium / uterus lining ; endometrium shed / (menstrual) bleeding ; (implanted) embryo lost ; AVP ;	 2 max

[Total: 12]

44

3 (b) *similarities, needs indication that these apply to both structures*

- S1** large surface area ;
S2 network of capillaries / many capillaries ; **R** good blood supply
S3 transfer / diffusion (through), single layer of cells / short distance ;
S4 (mechanism to give) high rate of diffusion / concentration gradient ;
S5 gases removed rapidly ;

*features of placenta**all independent marks*

max 4

large surface area

- P6** chorionic villi ;
P7 microvilli (cause further increase) ;

capillaries

- P8** network of fetal vessels ;

short diffusion distance

- P9** only three membranes / membranes named ;
P10 maternal blood spaces / lacunae

mechanism to give high rate of diffusion

- P11** gradient maintained by, circulation / counter-current ;
P12 ref to role of fetal haemoglobin ;

removal of gases

- P13** O₂ into fetal vessels / CO₂ into maternal vessels ;
P14 AVP ; e.g. O₂ transported despite low partial pressure in maternal blood

*features of alveoli**all independent marks*

max 4

large surface area

- A15** relevant detail of structure of alveoli ;

capillaries

- A16** network from pulmonary vessels ;

short diffusion distance

- A17** 0.5µm between air and blood ;
A18 capillaries embedded in walls ;

mechanism to give high rate of diffusion

- A19** high O₂ concentration in alveolar air / high CO₂ concentration in capillaries / ora ;
A20 ref to role of haemoglobin ;

removal of gases

- A21** O₂ into pulmonary vein / CO₂ into air and exhaled ;
A22 AVP ; e.g. surfactant / moisture prevents complete deflation
 e.g. gases dissolve in moisture

7 max

QWC – clear, well organised using specialist terms ;**1**

award QWC mark if one P mark and one A mark awarded plus two specialist terms from this list:

chorionic villi

microvilli

umbilical / fetal / maternal

pulmonary

haemoglobin

diffusion

capillaries

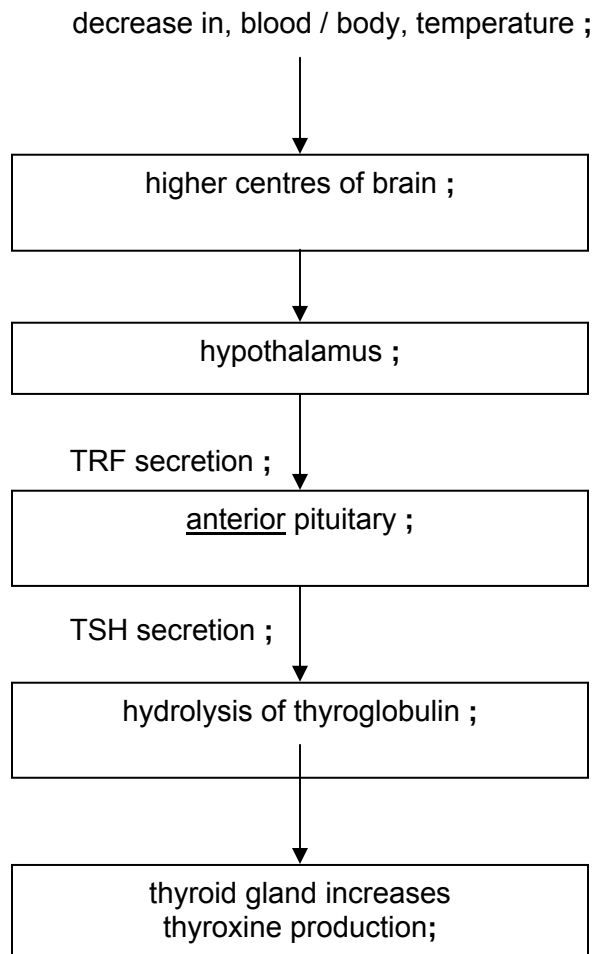
[Total: 17]

Question	Expected Answers	Marks
4 (a)	X nucellus ; A seed coat / testa Y root / radicle ; Z cotyledons ;	3
(b)	maintains, genetic diversity / genetic variation / species diversity / large gene pool / biodiversity ; preserves species which could have medicinal benefits ; preserves alternative species of crops if others diseased ; preserves species which could be grown if climate changed ; AVP ; e.g. preserves attractive species / duty of humans to preserve other species AVP ; e.g. for genetic engineering	2 max
(c)	testa, swells / ruptures / softens ; stimulates gibberellin production ; washes out growth inhibitors ; solvent ; chemical reactions in solution ; mobilises / transports, nutrients / food store / hormones ; to growing embryo ; hydrolysis of, food stores / nutrients ;	4 max
(d) (i)	germinate when conditions favourable / survive harsh conditions ; R right conditions suitable temperature / sufficient rainfall / other example of suitable conditions ; prevents germination in short warm spell ; allows (time) for dispersal ; prevents pre-germination ;	3 max
(ii)	overcome inhibition ; by ABA ; switch on genes ; stimulate, enzyme / (α) amylase, synthesis ; from aleurone layer ; (enzymes) hydrolyse / digest, food stores / named nutrient(s) ;	3 max
(iii)	prechilling / vernalisation / stratification / freezing / described ; scarification / described ; ref to fire ; ref to light ; through gut of animal / part digestion ; treat with enzymes ; soak in weak acid ; AVP ;	2 max

[Total: 17]

Question	Expected Answers	Marks
5 (a)	G1 no initial change ; <i>can apply to any graph</i> G2 (in A) BMR increases, to over 100% / until day 10 ; G3 decreases, to 86% / until day 26 ; G4 (in B) pulse rate rises, to 90 beats min⁻¹ / until day 6 ; G5 decreases, to 68 beats min⁻¹ / until day 26 ; G6 (in C) mass decreases to 57 kg ; G7 initially body mass falls as BMR increases ; G8 AVP ; e.g. other correct ref to figures from graph e.g. ref to treatment not starting until after two days T9 thyroxine transported in blood plasma ; T10 attached to (plasma) proteins ; T11 to target organs ; T12 binds to (protein) receptors, in cells / nucleus ; R on membrane T13 attaches to DNA ; T14 switches on, transcription / production of mRNA ; T15 enzymes produced ; T16 stimulates / increase in, chemical reactions / metabolism of named chemicals ; T17 increased rate of respiration / stimulates respiration ; T18 increase energy usage causes loss of body mass / stored fat used for energy / AW ; T19 increases (resting) heart rate ; T20 thyroxine broken down by liver ; T21 AVP ; e.g. ref to other factors affecting body mass e.g. direct stimulation of heart	4 max from graph 6 max 8 max
	QWC – legible text with accurate spelling, punctuation and grammar ;	1
(b)	detection by, sensory receptors / thermoreceptors / receptors in skin ; conversion to action potential / transduction ; decrease in, blood temperature / temperature of body ; higher centres of brain ; stimulate hypothalamus ; secretion of TRF ; A TRH stimulation of <u>anterior</u> pituitary ; secretion of TSH ; stimulates thyroid gland, to increase thyroxine production ; hydrolysis of thyroglobulin ; AVP ; e.g. blood flow from hypothalamus to pituitary <i>Example of acceptable flow chart on next page</i>	5 max

e.g. of marking from flow chart



[Total: 14]

Question	Expected Answers	Marks
6 (a)	meiosis ; growth ; mitosis ;	3
(b) (i)	P 1 / haploid / monoploid / n ; Q 2 / diploid / $2n$;	2
(ii)	8 nuclei in embryo sac ; <i>following in correct position and labelled</i> polar nuclei ; antipodal cells ; ovum ; synergid cells ;	A 7 if 2 shown to have fused 3 max 4 max
(c)	double fertilisation ; two male gametes ; one fuses with ovum ; produces diploid ; zygote ; one fuses with, diploid nucleus / polar nuclei ; produces triploid nucleus ; forms endosperm ; AVP ; e.g. ref to correct mechanism by which male gametes reach embryo sac	5 max

[Total: 14]

Mark Scheme 2805/02

June 2006

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
	R	=	reject
	()	=	words which are not essential to gain credit
	—	=	(underlining) key words which must 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>parents</i> Mm male x mm female / M^hm hermaphrodite x mm female ; <i>gametes</i> M m x m / M^h m x m ; <i>offspring</i> 1 Mm male/ M^hm hermaphrodite, 1 mm (female) ;	3
(ii)	<i>parents</i> M^hm hermaphrodite x M^hm hermaphrodite / M^hm hermaphrodite x Mm male ; <i>gametes</i> M^h m x same / M^h m x M m ; <i>offspring</i> 1 M^hM^h dead 2 M^hm hermaphrodite 1 mm female / 1 M^hM dead 1M^hm hermaphrodite 1 Mm male 1mm female ; A 'non-viable v. viable' as phenotypes	3
(iii)	<i>parents</i> M^hm hermaphrodite x M^hm hermaphrodite ; <i>gametes</i> M^h m x same ; <i>offspring</i> 1 M^hM^h dead 2 M^hm hermaphrodite 1 mm female ;	3
(b) (i)	to maintain genetic diversity / prevent genetic erosion ; A maintain, genetic variation / gene pool for, future / unknown / potential, use ; for changed environmental conditions ; A climate change e.g. of such change ; to counteract, inbreeding / extinction ;	3 max
(ii)	use, emasculated hermaphrodite / female plant ; cross with, male / hermaphrodite, with resistance ; A female resistant and male not offspring, grown in presence of disease / challenged ; select offspring with resistance and commercial traits ; cross to commercial plant for alleles of background genes ; idea of many generations ;	3 max

[Total: 15]

Question	Expected Answers	Marks
2 (a)	estimate of role of genotype in phenotypic variation / AW ; heritability = V_G / V_P ; when heritability high much of variation is, genetic / not environmental / ora ; high heritability will result in successful selective breeding / ora ;	2 max
(b)	single / major / Mendelian, gene ; large effect ; little environmental effect ; dominant allele T expressed in homo- and heterozygote ; not polygenic ; not additive ; discontinuous variation / not continuous variation ; qualitative / not quantitative ;	2 max
(c) (i)	triplet of bases that does not code for an amino acid ; ATT / ATC / ACT ; code to mark end of gene ; code to stop transcription / ref to disengagement RNA polymerase ;	2 max
(ii)	transcription halted early / AW ; protein will, be smaller / have fewer amino acids ; tertiary structure / 3D shape different ; binding / affinity, different ; protein inactive ;	3 max
(iii)	ref to <i>lac</i> operon ; ref to, promoter / operator / 'on' switch ; allele T is regulator ; (protein) binds to DNA ; (protein) binds to repressor and prevents it binding to DNA ; allows RNA polymerase to bind ; AVP ; e.g. enzyme affecting transcription	2 max
(d) (i)	tt + T / AW , increases number of tillers per plant ; and number of branches per tiller ; ref to comparative figures ;	2 max
(ii)	inserted into genome randomly / cannot choose where it is inserted ; may be within a frequently expressed gene ; may be after an 'on' switch ; lacks normal controls ; AVP ; e.g. no other alleles affecting it different promoter	max 2

[Total: 15]

- 3 (a) (i) mating success decreases with degree of inbreeding / ora ;
 number of males surviving (mating) decreases with degree of inbreeding / ora ;
 ref to comparative figures ;
figures from either table or graph – must compare any two, e.g. A with B **2 max**
- (ii) inbreeding depression ;
 loss of alleles *or* decreased, genetic diversity / genetic variation / gene pool ;
 loss of, fitness / viability ; **R** fertility
 e.g. related to butterflies ;
 different behaviour ;
 increased homozygosity / decreased heterozygosity ;
 increased expression of deleterious recessive alleles ;
 AVP ; **4 max**
- (b) 1 both result from changes in allele frequencies ;
 2 selective breeding often faster than evolution / ora ;
 3 both require selection of parents ;
 4 to pass alleles to offspring ;
 5 selective breeding involves artificial selection ;
 6 v. evolution involves natural selection ;
 7 man selective agent in selective breeding ;
 8 v. whole environment selective agent in, natural selection / evolution ;
 9 selective breeding for benefit of man ;
 10 may be detrimental to organism / e.g. detriment ;
 11 v. fitness for environment ;
 12 single / few, trait(s) in selective breeding ;
 13 v. whole, phenotype / genotype ;
 14 AVP ;
 15 AVP ; **8 max**
- QWC – legible text with accurate spelling, punctuation and grammar ; 1**

[Total: 15]

Question	Expected Answers	Marks
4 (a)	fertilisation, in a dish / 'in glass' ; fertilisation outside, the reproductive tract / the body / AW ;	1 max
(b)	reduce number of multiple births ; reduce number of premature births ; danger to babies ; danger to mother ; parental stress ;	2 max
(c) (i)	<i>single</i> IVF increases incidence of premature births ; increases mortality ; ref to comparative figures ; <i>of either</i> <i>twins</i> IVF increases incidence of premature births ; reduces mortality ; ref to comparative figures ; <i>of either</i>	4 max
(ii)	single less likely to be premature ; but effect IVF greater for single ; single less likely to die ; but for single IVF increases mortality and for twins decreases it ; ref to significance of difference in figures ;	3 max
(d)	selected / high quality / proven, sire ; increased choice of sire ; increased number of, offspring from chosen male / females inseminated ; speeds up selective breeding ; speeds up progeny testing ; saves, cost / problems, of keeping male ; saves cost / dangers, of transporting animals ; saves, stress / dangers, of mating ; quickly available / available when needed ; sperm, sexed / checked for genetic defects ; reduced inbreeding when different males used ; allows use after death of male ;	5 max

[Total: 15]

Question	Expected Answers	Marks
5 (a) (i)	depends on plant growth regulators ; A plant growth substances / plant hormones named plant growth regulator ; produced in a variety of tissues ; may have effect at a distance ; move, cell to cell / by diffusion / by active transport / via vascular tissue via a named vascular tissue / via plasmodesmata ; different effects in different tissues ; different effects when acting together ;	2 max
(ii)	coordinate, growth / development / activities, of different parts ; respond to internal changes ; respond to, external / environmental / e.g. environmental, change ; AVP ; e.g. comparison with animals	2 max
(b) (i)	economy of, materials / resources ; economy of energy ; saves unnecessary, transcription / translation ;	2 max
(ii)	random / chance / preexisting, mutation (for resistance) ; resistants survive / susceptibles die ; natural selection ; insecticide selective agent ; A selective pressure resistants pass, mutation / allele for resistance, to offspring ; R gene frequency of, mutation / allele for resistance, increases in population ;	5 max
(c)	plant signal used by earworms ; J switches on gene coding for E ; can then break down insecticide ; effect on transcription ; (x 5.5) reduces mortality ; even in absence of insecticide ; in absence of J , mortality, high / c. 87% ; ref to comparative figures ; e.g. 87 to 48% / almost halved, in presence of insecticide 16 to 7% / more than halved, in absence of insecticide slight expression of E in absence of J caused by insecticide ;	4 max

[Total: 15]

Question	Expected Answers	Mark
6 (a)	rDNA = DNA from two sources ; both DNAs cut with, restriction enzyme / named restriction enzyme ; giving sticky ends ; or giving blunt ends to which sticky ends added ; complementary binding of sticky ends ; H bonds / e.g. A to T / e.g. C to G ; nicks in (sugar-phosphate) backbone sealed by ligase ;	3 max
(b)	percentage / proportion, of, muscle fibres with central nuclei / dying muscle fibres, increases in control with time ; percentage / proportion, of, muscle fibres with central nuclei / dying muscle fibres, reduced by treatment ; ref to comparative figures with percentages and day ;	3
(c)	<i>advantages</i> 1 can identify presence of disorder ; 2 removes uncertainty ; 3 allows early treatment ; 4 which may improve, life expectancy / quality of life ; A avoid unnecessary suffering 5 allows, informed choice about having children / planning healthy family ; 6 allows IVF and, embryo screening / preimplantation genetic diagnosis (PGD) ; 7 allows fetal testing and termination ; 8 choice, re donation / adoption ; 9 AVP ; e.g. detail of donation: AI(D) / egg donation / embryo donation max 5 for advantages <i>disadvantages</i> 10 false, positives / negatives ; 11 may not be test for all mutations ; 12 only small number tests available / not available for all conditions ; 13 simple presence may not result in condition ; 14 confirmed presence gives stress / fear ; 15 problem re, telling / testing, rest of family ; 16 discrimination by, employers / insurers ; 17 ethics of termination ; 18 AVP ; e.g. detail of problem of test, risk of test procedure, diagnosis and elimination rather than treatment, increase in, intolerance / discrimination, of disabled, 'designer' problem max 5 for disadvantages	8 max
	QWC – clear, well organised using specialist terms ;	1
	<i>must include both advantages and disadvantages and two terms such as</i> life expectancy, quality of life, IVF, PGD, PGH, AI(D), amniocentesis, CVS, karyotype, false positive, false negative	

[Total: 15]

Mark Scheme 2805/03
June 2006

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 R = reject () = words which are not essential to gain credit <u> </u> = (underlining) key words which must be used to gain credit ecf = error carried forward AW = alternative wording A = accept ora = or reverse argument
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Question	Expected Answers	Marks
1 (a)	predation ; height above shore / depth of shore / AW ; slope / steepness of shore / shore shape / shape of rocks / AW ; salinity ; disease ; competition ; space qualified ; ability to withstand desiccation ; length of time covered by water ; availability of food / nutrients ; named nutrient e.g. calcium ; type(s) of, rock / substrate ; age of limpets ; ref to genetic qualities ; AVP ; e.g. tidal currents AVP ; R temperature and light	3 max
(b)	grid set out over the area / different shores <i>or</i> tape measures set out at right angles ; random numbers / AW, used to generate coordinates ; nearest limpet to coordinate chosen ; quadrat placed at these points ; ref to repetitions ; R line and belt transect	3 max
(c) (i)	reject ;	1 max
(ii)	18 degrees of freedom ; at the 5% confidence levels ; A alternative confidence limits p = 0.05 ; (95% certain) that difference is not due to chance ; t-test value at this level = 2.10 ; calculated value is greater than this (must state a value) ; <i>ecf applies</i> <i>(ecf refers to error from part (i) – candidates can still receive credit for correct identification of t-values and degrees of freedom)</i>	3 max

[Total: 10]

Question	Expected Answers	Marks
2 (a) (i)	increases ; at each trophic level / AW ; correct ref to data with units (mg kg^{-1}) included ;	2 max
(ii)	mercury, accumulates / stored, in (fatty) tissues ; not, digested / broken down / excreted ; ref to bioaccumulation / bioconcentration / described ;	2 max
(b)	pesticides, are harmful to other organisms / affect more than the target species / are non-specific ; may kill natural predators to the pest ; effects on pollinators ; reduce species diversity / disrupts food chains ; slow to biodegrade / remain in food chains / remain in food webs ; ref to bioaccumulation ; stored in fat deposits of organisms ; residues on food produce ; leaching / run-off ; ref to aquatic pollution ; ref to fungicide residues on seeds affecting animals ; ref to DDT and egg shell thinning ; AVP ; e.g. consequences for food chain	
	R eutrophication	5 max

(c) *advantages*

- 1 avoids use of chemical sprays / reduces chemical sprays ;
- 2 more economical than spraying / cheaper ;
- 3 safer for farmers / less potential health risks ;
- 4 directly kills wax moth larvae / pest-specific ;
- 5 not usually harmful to other organisms / maintains biodiversity / AW ;
- 6 no spray drift / leaching ;
- 7 less chance of resistant strains occurring ;
- 8 no chemical residues on food ;
- 9 allows food to be sold as organic ;
- 10 works well in closed environments ;
- 11 refs to 'deaths of populations' ;
- 12 AVP ; e.g. poly-tunnels, more value to crop
- 13 AVP ;

disadvantages

- 14 time lag problems ;
- 15 explanation ;
- 16 species may have to be bought and released ;
- 17 management and planning required ;
- 18 ref to research ;
- 19 pests not totally eradicated ;
- 20 inability of monoculture crops to support predators ;
- 21 therefore reintroduction needed ;
- 22 predator becomes the pest / affects other food chains ;
- 23 AVP – named example ;
- 24 AVP – unexplained consequence of point 22/23 ;

- 25 correct ref to data from graph up to 24 hours ;
- 26 correct ref to data from graph after 24 hours ;

8 max**QWC – legible text with accurate spelling, punctuation and grammar ;****1****[Total: 18]**

Question	Expected Answers	Marks
3 (a)	(i) natural change in species composition (in an area) ; ref to directional change ; ref to named examples in the diagram (either species or category) ; over a period of time ; a number of recognisable stages / seres / seral stages ; one sere changes the conditions for the next ; e.g. depth of soil increases / soil stabilisation ; leads to a climax community ; creation of niches ; ref to nitrogen fixation ; AVP ; e.g. pioneer species (ii) development of deeper soil ; soil, becomes rich in humus / has more nutrients / is more fertile ; dominant species change ; plant species get larger / shrubs to trees / increase in biomass / larger root systems ; R soil structure improves unqualified ; AVP ; (iii) biotic = animal species / number of soil organisms / decomposers / detritivores / decrease in biodiversity ; AVP ; abiotic = pH of soil / nitrogen or mineral content of soil / soil texture / wind speed / humidity / shading / light intensity / soil water retention ; AVP ; e.g. temperature	4 max 2 max 2 max
(b)	(i) weigh a sample of soil and burn / greater than 200 °C but less than 450 °C / use of Bunsen burner, reweigh ; constant mass obtained ; use of formula e.g. $(\text{initial mass} - \text{final mass} / \text{initial mass} \times 100)$; (ii) greater % of samples with more than 7% humus in 1980 / ora ; greater % of samples with 3.6 - 7.0% humus in both years ; greater % of samples with less than 3.6% humus in 1995 / ora ; ref to data ; 1980 32%, 46%, 22% 1995 40%, 50%, 10%	2 max 2 max
(c)	golf course / sports field ; grassland ; lawn / garden ; urban park ; managed moorland / heathland ; AW hedgerows ; man-made, ponds / lakes ; downland ; AVP ; e.g. footpaths R methods or descriptions of methods	2 max

- (d) human interference / farmers ;
prevent a natural climax occurring ;
by removing trees to create agricultural land ;
by burning ;
grazing / mowing ;
planting / ploughing / harvesting crops / sowing ;
use of, pesticides / herbicides ;
AVP ; e.g. named example or case study

3 max

[Total: 17]

Question	Expected Answers	Marks
4 (a) (i)	numbers have become low / habitat reduced, qualified ; population reached a critical level / AW ; there is a risk of extinction ;	2
(ii)	shot to prevent damage to farmland ; A other appropriate reason habitat destruction ; hunting ; poaching ; killed for horn ; A ivory killed, for meat / hides ;	2 max
(b)	signatory countries made it illegal to, kill / poach, rhinos ; ban placed on trade (in horns) ; increased cooperation between countries ; permits / licenses, issued ; education / raising awareness ; R ref to Appendix 1	2 max
(c)	area of national environmental significance, under governmental control / AW ; intensive changes in farming methods pose a threat ; farmers are paid to manage (land in a more traditional fashion) ; no application of, nitrate fertilisers / pesticides ; promotion of extensive farming ; no land drainage ; maintenance of hedgerows ; AVP ;	2 max

(d) *reasons for removal*

- 1 use of larger farm machinery ;
- 2 increased area for, growing crops / agricultural land ;
- 3 habitat for pests / disease ;
- 4 less maintenance / cheaper ;
- 5 amalgamation of farms ;
- 6 AVP ; e.g. motorways / road widening / space for houses

importance to wildlife

- 7 provide habitats / nesting sites ;
- 8 have a large species diversity / biodiversity ;
- 9 provide wildlife corridors / AW ;
- 10 provide, food sources / links in food chains *or* food webs ;
- 11 habitat for pollinating insects ;
- 12 roots provide soil stability / decreased soil erosion ;
- 13 provide barriers against the spread of disease ;
- 14 provide shelter / protection for wildlife ;
- 15 decreases wind speed qualified in terms of wildlife ;
- 16 increased water retention quality of the soil, qualified ;
- 17 AVP ;

7 max**QWC – clear, well organised using specialist terms ;****1***only award QWC mark if at least 3 of points 7 to 17 are discussed***[Total: 16]**

Question	Expected Answers	Marks
5 (a)	coolants ; inks / paints ; plastics ; electrical equipment ; fire retardants ; old fluorescent lighting ;	2 max
(b) (i)	mutations ; uncontrolled cell division ; tumours ; <i>any of the following for max 2</i> changes base sequences in DNA ; therefore changes DNA structure ; ref to amino acid sequencing ; ref to incorrect proteins being synthesised ; AVP ;	3 max
(ii)	immune system ; decrease in size of thymus gland / fewer antibodies produced / increased risk of disease / less resistance to infection ; reproductive system ; reduced birth rates / reduced conception rates / decreases gestation periods / egg shell thinning ; nervous system ; decrease in short term memory / learning difficulties ; endocrine system ; depressed thyroid hormone levels ; AVP ; AVP ;	2+2

(c) *description*

fluctuates / AW / decrease, increase, decrease ;
correct ref to data / data quotes (qualified) ; *units must be included*
2nd data quote (qualified) ;

criticisms

ref to reliability of data with respect to unequal sampling of eggs ;
ref to reliability of data with respect to missed years ;
ref to small group size ;
ref to testing / monitoring and destruction of eggs ;
ref to persistence in environment ;
ref to data means ;
ref to omission of, standard deviation / SD ;
AVP ;
AVP ;

5 max

- (d) ref to sustainable fishing ;
establishment of quotas ;
minimum mesh size on nets ;
regulating the, type of net / size of net ;
banning fishing in particular areas ;
banning fishing, at particular times / during breeding seasons ;
restricting fishing times ;
decreasing size of fishing fleets ;
aquaculture / fish farming ;
restocking ;

2 max

[Total: 16]

Question	Expected Answers	Marks
6 (a)	trees felled for wood (to sell / export) ; cleared for, agricultural land / cash crops ; cleared for building, villages / towns ; cleared for roads ; mining / industrial development ; AVP ;	3 max
(b)	<i>check graph for annotations</i> higher the population growth, the higher the rate of deforestation / ora ; ref to country and paired data quotes (x + y) ; ref to Cameroon and Republic of Congo with, paired data quote / use of data ; AVP ; e.g. use of other countries with data AVP ;	3 max
(c)	<i>mark up to a maximum of 3 for each section</i> <i>economic reasons</i> some species may be of use in the future ; for medical uses ; <i>accept in either section</i> example ; for, agricultural / silvicultural, purposes ; (eco)tourism ; prevention of natural disasters ; save local forest communities ; AVP ; <i>ethical reasons</i> <i>idea that</i> man has no right to cause the extinction of species, so must be prepared to help save them ; need to save them for future generations ; aesthetic reasons ; ref to indigenous people(s) ; AVP ; <i>both ethical and economic</i> sustainable use of resource ; ref to example of sustainable use ; ref to use of genetic material ; ref to gene pool ;	5 max
(d)	saves natural resources ; less pollution e.g. reduction in greenhouse gases / named greenhouse gas ; less use of landfill sites ; saves energy / reduction in fossil fuels ; less incineration ; AVP ;	2 max

[Total: 12]

Mark Scheme 2805/04
June 2006

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 R = reject () = words which are not essential to gain credit <u> </u> = (underlining) key words which must be used to gain credit ecf = error carried forward AW = alternative wording A = accept ora = or reverse argument
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Question	Expected Answers	Marks
1 (a) (i) autoclave ; (ii) capsomere ; (iii) thermophile ; (iv) stationary ; (v) biosensor ; (vi) gasohol ;	A thermophilic	6
(b)	<i>award marks if diagram clearly annotated</i> reservoir for storage of nutrients ; ref to method for addition of nutrients and removal, of waste / products ; A substrate ref to more detail of, nutrient addition / product removal, at a constant rate / continually / throughout fermentation period ; idea of rate of product removal equal to addition of nutrients ; A keep volume constant use of probes / sensors / monitors ; A thermometer (for temperature) (to monitor) any <u>two</u> of, temperature / pH / oxygen levels ; method to maintain pH e.g. use of buffers, tube to add acid / alkali ; addition of antifoam ; ref. to need to maintain sterility (to avoid contamination) ; method to maintain constant temperature e.g. (thermostatically-controlled) water bath, cooling jacket ; R heat exchanger AVP ; e.g. use of stirrer, method to avoid, clumping of cells / blocking of inlet or outlet pipe(s)	4 max

[Total: 10]

Question	Expected Answers	Marks
2 (a) (i)	use of <u>microscope</u> to observe ; <i>Lactobacillus</i> rod shape / <i>Streptococcus</i> spherical ; ref to observing shape / different shape of cells ; <i>max 2 for references to shape – if both shapes given correctly award 2 marks</i> (ii) <i>max 2 if not clearly justified</i> <i>dilution plating</i> gives numbers of, living (and growing) / viable (bacteria) ; <i>haemocytometry</i> total (cell) count ; includes dead cells / living and dead cells ;	A correct 2-D description 4 max
(b) (i)	choose plate C / 10^{-2} dilution / 280 colonies OR plate D / 10^{-3} dilution / 36 colonies ; (count colonies because) each colony represents a single original bacterium ; AW sufficient colonies, to make a valid estimate / AW ; <i>ora</i> (i.e. last plate – too few so random sampling errors) A 30 – 300 colonies not too many colonies to <u>count</u> ; <i>ora</i> e.g. first two plates – colonies merge / lawn or too many / too time consuming to count C (if D chosen) <i>max 1 if incorrect plate (E) chosen</i>	3 max
(ii)	<i>two marks for correct answer</i> <i>if incorrect answer allow one mark if idea of dilution factor or sample factor</i> <i>considered</i> (280 bacteria in 0.1 cm^3 in 10^{-2} dilution) (2800 bacteria in 1.0 cm^3 in 10^{-2} dilution) 280 000 bacteria in 1.0 cm^3 in undiluted sample ; ; A 2.8×10^5 / 0.28×10^6 OR (36 bacteria in 0.1 cm^3 in 10^{-3} dilution) (360 bacteria in 1.0 cm^3 in 10^{-3} dilution) 360 000 bacteria in 1.0 cm^3 in undiluted sample ; ; A 3.6×10^5 / 0.36×10^6 4 bacteria in 0.1 cm^3 in 10^{-4} dilution) (40 bacteria in 1.0 cm^3 in 10^{-4} dilution) 400 000 bacteria in 1.0 cm^3 in undiluted sample ; ; A 4.0×10^5 / 0.40×10^6	2
(iii)	sample taken in later stages of cheese, ripening / maturing ; <u>anaerobic</u> respiration ; lactic acid / other organic acid, production ; pH, low / decreases ; <i>Streptococcus</i>, inhibited / killed / does not survive (as well) ; <i>Lactobacillus</i>, more (strongly) tolerant to / proliferates in / AW, <u>acid</u> conditions ; AVP ; e.g. refs to slower growth / reproduction <i>or</i> longer generation time, effect of low pH (enzyme denaturation), competition ;	3 max

[Total: 12]

Question	Expected Answers	Marks
3 (a)	<i>classification in the plant kingdom - must be clear that feature shared with plants</i> 1 ref to, photosynthesis / photosynthetic pigments ; A autotrophic 2 presence of chloroplasts in green alga ; 3 presence of cell wall in, both / green alga and cyanobacterium ; 4 cell wall in green alga is made of cellulose ; <i>removal of green algae from plant kingdom to protoctist kingdom</i> 5 green alga unicellular, plants multicellular ; A green alga, filamentous / colonial A green alga not multicellular 6 green alga simple eukaryotes, plants complex ; 7 lack of vascular tissue in green alga, plants, are vascular / possess xylem and phloem <i>removal of cyanobacteria from plant kingdom</i> 8 cyanobacterium prokaryotic, plants eukaryotic ; 9 cyanobacterium unicellular, plants multicellular ; A cyanobacterium not multicellular <i>allow idea once - check mark point 5</i> 10 cell wall, contains murein not cellulose / similar to Gram negative bacteria ; <i>cyanobacteria and green algae different kingdoms</i> 11 cyanobacterium prokaryotic, green algae eukaryotic ; 12 cyanobacterium, no <u>true</u> nucleus / no nuclear envelope ; A membrane ora A valid ref to a difference e.g. 'naked' / free / circular DNA (only) 13 cyanobacterium, chlorophyll / photosynthetic pigments, in phycobilisomes / photosynthetic lamellae (green algae chloroplasts) ; 14 cyanobacterium, (much) smaller than green alga / 2-3 μm compared to 35-40 μm ; 15 AVP ; e.g. starch stored in alga and plant cells, 16 AVP ; shared eukaryotic feature green alga and plant, valid e.g. prokaryote, eukaryote differences (alga / plant v cyanobacteria), DNA analysis shows differences, no sexual reproduction shown, sexual reproduction in plants / AW slime layer in cyanobacteria, lack of slime layer in plant cells / slime layer qualified contractile vacuole in <i>Chlamydomonas</i>, plant cells (permanent) vacuole / contractile vacuole qualified cyanobacterium smaller than plant cell	7 max
	QWC – legible text with accurate spelling, punctuation and grammar ;	1

(b) (i) viruses ; **A** virus

any one difference, e.g.

lambda

HIV

DNA
non-enveloped / no envelope
no reverse transcriptase

RNA ;
enveloped ;
reverse transcriptase ;

complex structure / details of structure

or

presence of two capsids / AW ;

(ii) fungi ; **A** fungus

any one difference, e.g.

Saccharomyces

Penicillium

unicellular

filamentous / presence of hyphae ;
A mycelium

cell wall mannan and glucan /
mannoglucan

cell wall chitin ;

oval-shaped

thread-like / AW ;

4

[Total: 12]

Question	Expected Answers	Marks
4 (a) (i)	ref to prevents contamination / (plant) disease ; <i>ora</i> (maintains aseptic conditions / keeps culture disease free / sterile) (by) bacteria / fungi / fungal spores / (some) viruses ; ref to possibility of (smaller) viruses / bacterial spores being able to pass through ;	2 max
(ii)	<i>idea of</i> air flowing out, prevents / pushes back / AW, air / contaminants / microorganisms, from entering (through open front) ; <i>idea of</i> (prevents contamination of culture from) <u>worker</u> , breathing / sneezing / coughing / AW ;	2
(iii)	air flows out towards worker ; possibility of escape of, pathogen / <i>Mycobacterium</i> / AW , into, wider area / lab ; risk of contamination of worker / worker not protected from disease organism ;	2 max
(iv)	efficient in, removing / filtering, particles / dust in, rooms ; A AW vacuum also efficient in preventing, particles / dust, being blown out into room ; allergens / named allergen, cause allergic / immune response / asthma attack / AW ; reduces risk of attack / AW ; R easier to breathe	2 max
(b)	<i>any three acceptable e.g.</i> disease / virus, free ; genetically identical / clone ; maintain, favourable characteristics / advantageous phenotypes ; faster method ; produces many plants ; allows long-term storage of plant tissue ; easily genetically manipulated / example of genetic manipulation ; easier exchange between countries as no quarantine ; enables optimal production of useful secondary products (e.g. codeine from poppy) ; no external environmental influences ; no influence of seasonal variation ; AVP ; e.g. use for, sterile / infertile, plants, AVP ; named example of advantageous phenotype e.g. grow more vigorously use for rare or endangered plants relevant example of genetic manipulation	3 max

- (c) *award 1 mark for a valid feature, award second if explanation correct
allow ecf if refer to fermenter feature*

surfaces smooth / non porous / AW ;
for easy / efficient cleaning ;

walls / floors / surfaces, disinfected ;
kills, microorganisms / pathogens ; **A** AW

two doors / air locks ;
prevents mixing of fermenter area and external air ; **A** AW

AVP ;
AVP ;

2

(d) *answers referring to insulin production can also be credited in mp 2,3,4*

1 *Escherichia coli* ; **A** *E. coli*

genetic engineering

max 3

2 amino acid sequence (of HGH), known / analysed ;

3 gene coding for HGH synthesised ;

4 using, triplet code / genetic code ;

OR

2 mRNA (coding for insulin) from beta cells ;

3 use reverse transcriptase ;

4 synthesise cDNA ;

5 plasmid (vector) ;

6 cut using restriction (endonuclease) enzyme ;

7 ref to gene and plasmid mixed with (DNA) ligase ;

8 (recombinant) plasmid introduced into, bacterium / bacteria ; **AW**

large scale production

max 4

9 genetically engineered / recombinant bacteria ;

10 grown in fermenter / fermentation, qualified ;

11 reproduce / replicate / multiply / undergo binary fission / form a clone / large numbers
/ millions of bacteria / gene cloning ;

12 idea of gene expression / transcription and translation, for HGH, synthesis /
production ; **A** *insulin when relevant*

13 downstream processing ;

14 separation / purification, of growth hormone ; **A** *insulin when relevant*

15 AVP ; e.g. ref to screening using antibiotic resistance markers

16 AVP ; scaling up to determine optimum operating conditions

bacteria killed and separated (from proteins)

by centrifugation

growth hormone separated from other, proteins / molecules

(product separated by) large scale chromatography / ultrafiltration

other detail of fermentation e.g. pH 5.5 – 8.0, temperature 20 – 45 °C,

aeration, glucose

doubling time 20 minutes

6 max

QWC – clear, well organised using specialist terms ;

1

any three, used in context, from

amino acid sequence (beta cells for insulin) / triplet (mRNA for insulin) / genetic code

(reverse transcriptase for insulin), plasmid, vector, restriction enzyme, ligase,

recombinant, genetically engineered, binary fission, clone, transcription, translation,

downstream processing, screening, antibiotic resistance markers, centrifugation

[Total: 20]

Question	Expected Answers	Marks
5	(a) (i) C ; (ii) E ; (iii) A ; (iv) F ;	4
	(b) methane ;	1
	(c) (i) $(2600 \times 5/100)$ = 130 ; $(200 \times 5/100)$ = 10 ;	2
	(ii) 1 (pig sty) and 3 (cheese outflow) ;	1
	(iii) whey / lactose / sugars / carbohydrate ;	1

- (d) *max 3 marks if no arrow heads or arrow heads all point in wrong direction*
max 2 marks if arrow heads in both directions / mixed

insect larvae has arrows from

protozoa / protoctists / ciliates

OR

Paramecium

Vorticella

and

rotifers / *Euchlanis*

for one mark ;

rotifers / *Euchlanis* has arrows from

protozoa / protoctists / ciliates

OR

Paramecium

Vorticella

and

bacteria / *Pseudomonas*

and

dead cells + detritus

for one mark ;

bacteria / *Pseudomonas*

sludge worms / *Tubifex* has arrows from

and

dead cells + detritus

for one mark ;

bacteria / *Pseudomonas*

protozoa / protoctists / ciliates or *Paramecium* and *Vorticella* has arrows from

for one mark ;

organic matter of sewage

bacteria / *Pseudomonas* has an arrow from

for one mark ;

dead cells and detritus has any one arrow from any organisms, labelled 'death' ;

4 max

- (e)
- 1 different microorganisms have different requirements / AW ;
 - 2 ref to (high) levels of oxygen / aeration ;
 - 3 ref to anaerobic / microaerophilic, organisms unable to survive ; *ora*
 - 4 example of above e.g. gut microorganisms ;
 - 5 nutritional requirements not satisfied ;
 - 6 competition ;
 - 7 (for) resources / named resource in short supply ;
 - 8 some microorganisms better adapted to survive ;
 - 9 metabolic waste in the environment toxic to some ;
 - 10 unable to survive in temperatures (of process) ;
 - 11 ref to, predation / grazing ; AW
 - 12 unable to survive in crowded conditions ;
 - 13 AVP ; e.g. ref to light requirement for photosynthesis
 - 14 AVP ;
- 4 max
- (f)
- less light penetrates ;
 reduced depth for photosynthesis / decreases ability to photosynthesise ; AW
 decreased amount of oxygen produced ;
 ref to death of organisms ;
decomposition / respiration, by bacteria reduces oxygen content ;
 so BOD rises ;
 AVP ; e.g. less oxygen available for respiration by other organisms,
 increase in number of decomposers / bacteria **R** thrive
 reduced biodiversity / fewer species present
- 3

[Total: 20]

Question	Expected Answers	Marks
6 (a)	wort ;	1
(b)	health food / yeast extracts / 'Marmite' ; A used as cattle / animal feed A used to inoculate brew in whisky distilleries	1
(c)	15 °C ; A 12 – 20 °C moisture / water ; A humid, damp oxygen / aeration ; removal CO ₂ ;	2 max
(d)	1 water enters seed / AW ; 2 increased respiration ; 3 idea of embryo stimulated / stored enzymes activated ; 4 gibberellin / gibberellic acid, synthesised / produced / released ; 5 (gibberellin) stimulates/ AW, <u>aleurone</u> layer ; 6 (cells) synthesise / produce amylase ; 7 (some) starch, hydrolysis / converted to maltose ; 8 (and) dextrans ; 9 proteases / proteolytic enzymes ; 10 proteins to, peptides / amino acids ; 11 embryo / root / shoot, growth ; 12 ref to a link between new products and growth e.g. sugar production for ATP / energy for growth / amino acids to make proteins / more enzymes ; 13 AVP ; e.g. entry of water via micropyle glucanase / cell wall degrading enzymes 'switching on' genes coding for enzymes increased, transcription / translation diffusion of gibberellin / enzymes from site of production to site of action protein matrix (of endosperm) broken down (large) starch granules (in endosperm) released give credit (as 13) if candidates refer to conditions created in malt house e.g. switch to anaerobic respiration in steepes with long immersion periods abrasion of seeds / use of a seed cleaner to speed up germination addition of gibberellic acid by maltsters	5 max
(e)	prevents all sugars being used up (in respiration) / AW ; <i>ora</i> prevents, growth of embryo / seedling being produced / AW ; <i>ora</i> A plant growth sugars required for, brewing process / fermentation ; further detail of above e.g. yeast, respiration / alcohol production ;	2 max

- (f) (i) low moisture content makes enzymes less sensitive (to high temperature) ;
ref to structure making enzymes heat stable / extra bonds ; R ref to thermophilic
AVP ; e.g. ref to time **1 max**
- (ii) sugars / amino acids / nutrients (from grist), dissolve better ; AW
provides optimum conditions for (reactivated) enzymes / amylases / proteases ; AW
increased / additional, hydrolysis of starch / dextrins ; AW **1 max**
- (iii) for yeast / *Saccharomyces*, metabolism / growth / reproduction / population growth ;

increased monosaccharides
increased (anaerobic), respiration / fermentation ;
(results in) increased amount of alcohol ;

increased amino acids
increased protein ;
hence increased alcohol ; *allow once only*
AVP ; e.g. increased aerobic respiration (initially) for population growth
AVP ; e.g. increased enzymes (synthesised) **3 max**

[Total: 16]

Mark Scheme 2805/05
June 2006

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 R = reject () = words which are not essential to gain credit <u> </u> = (underlining) key words which must be used to gain credit ecf = error carried forward AW = alternative wording A = accept ora = or reverse argument
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Question	Expected Answers	Marks
1 (a)	breaks down large pieces of food into small ones ; R breakdown alone increases surface area ; ref to, chewing / stomach churning / emulsification by bile salts ;	2 max
(b)	<i>endopeptidases</i> (hydrolysis of peptide bonds) within, proteins / polypeptides ; to produce shorter lengths / AW ; <i>exopectidases</i> (hydrolysis of peptide bonds) at ends of chains ; produce individual amino acids ; AVP ; e.g. suitable named enzyme	3 max
		[Total: 5]

Question	Expected Answers	Marks
2 (a)	membrane, stability / fluidity ; impermeability to, hydrophilic substances / AW ; ora synthesis of, steroid hormones / named examples ; waterproofs skin ; synthesis of vitamin D ; synthesis of, bile salts / named bile salt(s) ; R bile alone AVP ; e.g. protects skin from absorbing (some) harmful chemicals	3 max
(b)	CHD / stroke / AW ;	1
(c)	1 (saturated) fats in diet ; 2 converted to cholesterol / cholesterol in meal ; 3 may affect concentration of, HDLs / LDLs ; 4 ref to reliability of reading / AW ; 5 AVP ;	2 max
(d)	0.39 : 1 ; 0.78 : 1 ;	2
(e)	<i>cholesterol</i> 1 A – (total blood cholesterol concentration) 4.0 mmol dm^{-3} compared to 5.9 mmol dm^{-3} for D ; A processed figs 2 D – outside desired range, greater health risk / ora ; <i>HDL / LDL</i> 3 A – HDL to LDL ratio 0.67 : 1, compared to D 0.39 : 1 ; 4 D – higher LDL / ora ; 5 HDL, removes cholesterol / takes cholesterol to liver ; <i>cholesterol = plaques</i> 6 LDL deposits cholesterol in artery walls ; <i>cholesterol = plaques</i>	4 max
(f)	increased uptake of cholesterol, from blood / by liver ; decreased absorption of, cholesterol / fat, from gut ; lowers LDL concentration ; AVP ; e.g. increases conversion of cholesterol to, bile salts / vitamin D / steroids	2 max

[Total: 14]

[Total: 15]

Question	Expected Answers	Marks
4 (a) (i)	A islet of Langerhans / α <u>and</u> β cells ; B (branch of pancreatic) duct ;	2
(ii)	<i>endocrine</i> ductless gland ; hormones / named hormone ; e.g. insulin / glucagon into blood ; <i>exocrine</i> enzymes / pancreatic juice / HCO_3^- ; amylase / trypsin / chymotrypsin / lipase / carboxypeptidase ; into duct ; <i>if answers are interchanged then mark to 2 max</i>	4 max
(b)	1 contact of food with (duodenal), wall / cells ; 2 (food) acidic ; 3 hormones released ; 4 secretin ; 5 stimulate (pancreas) exocrine cells ; 6 leads to release of hydrogencarbonate ions ; 7 CCK / PZ ; 8 leads to enzyme release ; 9 AVP ;	5 max
(c) (i)	hydrolysis ; lipids broken down to fatty acids and glycerol ; starch / amylose / amylopectin, (broken down) to maltose ;	3
(ii)	scan ; e.g. ultrasound / CT / MRI / CAT AVP ; e.g. endoscopy	1 max
(iii)	protease enzymes / named enzyme ; activated ; breakdown of, cells / tissues, of pancreas ; breakdown of proteins in pancreas ; AVP ; e.g. action of lipase in membrane	2 max

[Total: 17]

Question	Expected Answers	Marks
5 (a)	surrounded by meninges ; cerebrospinal fluid ; absorbs shocks ; brain protected by, cranium / skull ; spinal cord protected by vertebrae ;	3 max
(b)	1 ref to, medulla (oblongata) / cardiovascular centre (in brain) ; 2 sympathetic nervous system / accelerator nerve (to heart) ; 3 short preganglionic, neurone / fibre ; 4 (transmitter substance) noradrenaline ; 5 to sino atrial node (SAN) (in correct context) ; 6 heart rate increases ; 7 increased force of contraction ; 8 ref to adrenaline ; 9 parasympathetic nervous system / vagus nerve ; 10 (transmitter substance) acetylcholine ; 11 long preganglionic, neurone / fibre ; 12 heart rate decreases ; 13 AVP ; e.g. myogenic heart muscle / cardiac inhibitory centre	
	<i>if answers to sympathetic and parasympathetic are interchanged mark to 4 max</i>	7 max
	QWC – legible text with accurate spelling, punctuation and grammar ;	1
[Total: 11]		

Question	Expected Answers	Marks
6 (a)	<i>collagen</i> (good) tensile strength / withstand strong pulling forces ; detail of fibres ; e.g. staggering of 3 fibres / every third amino acid is glycine flexible / bends ; <i>calcium phosphate</i> hard ; (good) compressive strength / withstand pushing forces ; rigid ;	4 max
(b)	1 osteoblasts ; 2 synthesise <u>fibrous</u> protein ; 3 secreted, into matrix / out of cells ; 4 tropocollagen / triple helix ; 5 molecules link up ; 6 AVP ; e.g. detail of protein synthesis / occurs during ossification	3 max
(c)	synapse ; muscle contraction ; blood clotting ; AVP ; e.g. secondary messenger	2 max
(d)	A osteoblast ; B osteoclast ;	2
(e) (i)	no / less, calcitonin <i>or</i> calcitonin inhibited ; cell A / osteoblasts, not stimulated / are inhibited ; more parathormone / parathormone not inhibited ; cell B / osteoclast, activity increases / not inhibited ; ref to ratio of balance of, two hormones / cells A and B ;	2 max
(ii)	weight bearing exercise regularly ; to increase bone density ; eat, dairy product / food containing calcium ; take calcium supplements ; eat sufficient vitamin D / some sunbathing ; HRT ; avoid smoking ; avoid excessive alcohol consumption ; AVP ; e.g. avoid steroid use / avoid high caffeine intake AVP ; e.g. having children / excessive dieting	4 max

[Total: 17]

Question	Expected Answers	Marks
7 (a)	ref to insight learning ; use actions learned in unconnected situations / exploratory learning / AW ; to solve problems ; ref to planning ; AVP ; e.g. higher form of learning / description of activity	2 max
(b) (i)	time taken (to make choice) decreases ; as number of trials increases / AW ; ref to figures ; idea chamber B chosen more often towards end of investigation ;	2 max
(ii)	same, apparatus / conditions ; different experimental mouse ; <i>idea of</i> same species / same age / same gender, of (experimental) mouse ; no companion mouse / B and C empty ; same number of trials ; AVP ;	3 max
(iii)	time taken does not decrease significantly ; roughly equal choice of chamber B or C / AW ;	1 max
(iv)	trial and error learning / operant conditioning ; ref to associative learning ; companion animal is, reinforcer / reward ; no conditioned stimulus ; no conditioned response ; AVP ;	3 max
		[Total: 11]

Mark Scheme 2806/01
June 2006

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 R = reject () = words which are not essential to gain credit <u> </u> = (underlining) key words which must be used to gain credit ecf = error carried forward AW = alternative wording A = accept ora = or reverse argument
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Question	Expected Answers	Marks
1 (a)	<i>T. sillamontana</i> thicker / fleshier / succulent ; hairy ; more compact / AW ; ref to different leaf shape ; AVP ; e.g. petiole rolled round stem	2 max
(b) (i)	<i>T. sillamontana</i> 14, <i>T. fluminensis</i> 19 ;	1
(ii)	same magnification / AW ; several leaves ; leaves from similar parts of plants ; same (environmental / light / water / soil / fertiliser) conditions ; AVP ; e.g. same age	2 max
(c)	1 <i>T. sillamontana</i> drier / <i>T. fluminensis</i> wetter / AW ; <i>T. sillamontana</i> 2 <u>xerophytic</u> / <u>xeromorphic</u> ; 3 fewer stomata / ora ; 4 hairs ; 5 trap water vapour / water potential gradient lower ; R trap, water / moisture 6 (so) transpiration / evaporation, slower ; 7 white hairs qualified ; 8 fleshy, stem / leaves, store water ; 9 AVP ; ref surface area to volume ratio, ref to rolling qualified <i>T. fluminensis</i> 10 leaves further apart ; 11 so do not, trap air / shade each other ; 12 leaves, darker / have more chlorophyll ; 13 so improved photosynthesis ; 14 smooth / shiny, leaves allow water to drip off ;	5 max

- (d) *T. fluminensis* has, max / optimum, rate at, 7 a.u. / 42 (- 50) % ;
T. sillamontana rate increases with increasing light intensity ;
T. sillamontana data quote (x + y) ;
comparative statement re data ;
comparative statement re conditions ;

AVP ; e.g. *T. fluminensis* may be damaged by high light intensity

3 max

[Total: 13]

Question	Expected Answers	Marks
2 (a)	<i>plasmid DNA</i> nucleotides / sugar + phosphate + base ; 4 different subunits ; phosphodiester bonds ; A phosphoester contains P ; double-stranded / double helix ; circular ; <i>protein</i> amino acids ; 20 different subunits ; peptide bonds / polypeptide ; contains S / disulphide bonds ; may have 4° structure ; ref to, 2° / 3°, structure / AW ; AVP ; e.g. role of H bonds	3 max
(b) (i)	stimulates, immune response / production of antibodies / T or B cells ;	1
(ii)	stimulate, cell-mediated immunity / T cells ; antigen, remains in body longer / continuously produced ; antigens in blood only stimulate, humoral immune system / B cells ; antigens (in blood) lost in urine / broken down in liver ; ref to MHC ;	1 max
(c) (i)	binds RNA polymerase ; allows, transcription / production of mRNA ; switches gene on / allows gene expression ;	2 max
(ii)	(protect against) more than one, strain / disease / pathogen / AW ; stronger immune response ; less likely mutant form will escape immune response / AW ; AVP ; cheaper / reduces number of vaccinations	2 max
(iii)	Golgi modifies <u>protein</u> / <u>polypeptide</u> / AW ; forms glycoproteins / add sugars or carbohydrate ; Golgi forms vesicles ; incorporated into cell membrane ; R exocytosis AVP ;	2 max
(d)	<i>cells that take up DNA vaccine might</i> 1 function less well ; 2 be killed by immune system / trigger auto-immune response ; 3 have genes disrupted / mutation ; 4 new gene might be inherited / AW ; 5 plasmid could enter bacteria ; 6 superbug / create new disease / AW ; 7 effects unknown / new technology / no human trials ; 8 AVP ; ref ethics, ref irreversible	3 max

[Total: 14]

Question	Expected Answers	Marks
3 (a)	1 starch broken down to, maltose / glucose / sugars ; 2 maltose broken down to glucose ; 3 hydrolysis ; 4 ref to, enzymes / named enzyme ; 5 (glucose used for) glycolysis ; 6 (glucose) converted to, pyruvate / pyruvic acid ; 7 reduced NAD / NADH ₂ , produced ; 8 pyruvate / pyruvic acid, reduced ;	3 max
(b)	E1 bacteria / fungi / microorganisms, decompose (polylactic acid) cup ; E2 no organism (can produce enzymes to) break down polystyrene ; E3 heat, sterilises soil / kills microorganisms / denatures enzymes ; E4 therefore no decomposition / AW ; <i>max 2 suggestions</i> S1 polylactic acid biodegradable / ora ; R disintegrates S2 polylactic acid preferable (to polystyrene) ; S3 to avoid, rubbish / litter / landfill / incineration ; S4 starch is renewable resource ; S5 would conserve oil stocks ; S6 AVP ;	3 max
(c)	1 <u>decomposition</u> / <u>decay</u> / <u>rotting</u> (of grass) ; 2 (microbial) respiration ; 3 (releases) heat ; 4 temperature figures ; 5 uses up oxygen / aerobic ; 6 oxygen figures ; 7 produces carbon dioxide ; 8 carbon dioxide figures ; 9 grass cuttings provide insulation ; 10 AVP ;	5 max

[Total: 11]

Question	Expected Answers	Marks
4 (a)	<i>lugworm curve</i> steeper ; higher saturation at, low / same pp oxygen ; has max (saturation) at 2 kPa ; reaches 100% (saturation) ; <i>human curve</i> shallow / gentle / sigmoid ; max at 13.5 - 14 kPa ; (only) reaches 98% ; <i>(max 1 of above differences)</i> lugworm haemoglobin has a high affinity for oxygen ; low oxygen in, lugworm habitat / water / ora ; lugworm haemoglobin, stores oxygen / only releases oxygen when pp O₂ very low ; two haemoglobins have different, structures / amino acid sequences ;	2 max
(b)	<i>differences (max 5)</i> D1 ref to lugworm gills and mammal, alveoli / lungs ; D2 ref to internal and external, exchange surfaces ; D3 less oxygen in, water / sand ; A ora D4 lugworm haemoglobin adapted to, water / sand/ low O₂ environment ; A ora D5 lugworm has no red blood cells / ora ; D6 detail of mammalian red blood cells ; D7 lung ventilation tidal / lugworm, throughflow / unidirectional / AW ; D8 AVP ; e.g. ref. water loss from lungs <i>similarities (max 5)</i> S1 both (gas exchange surfaces have) large surface area ; S2 both, thin / have short diffusion distance ; S3 both well-vascularised ; S4 both moist ; S5 ref to diffusion of, oxygen / carbon dioxide / gases ; S6 (blood carries) oxygen to tissues ; S7 haemoglobin transports oxygen ; S8 both move medium over gas exchange surface ; S9 AVP ;	7 max
	QWC – legible text with accurate spelling, punctuation and grammar ;	1
[Total: 10]		

Question	Expected Answers	Marks
5 (a) (i)	genetically identical ; produced by mitosis ; ref to self-incompatibility ; AVP ; e.g. ref to S genes ref to pollen will not germinate on stigma ref to timing ref to outbreeders	1 max
(ii)	(promotes genetic) variation ; R variance recombination / crossing over / independent assortment ; ref to meiosis ; (better chance of) population surviving ; (better chance of) adapting to, change / example of change ; AVP ; e.g. to prevent, inbreeding / problems associated with inbreeding to promote hybrid vigour	2 max
(b) (i)	(sharp) crystal pierces membrane ; ice expands as it forms (crushing lysosomes) ; AVP ; e.g. ice formation withdraws water affecting membrane	1 max
(ii)	1 prevents oxidative phosphorylation in both ; 2 mitochondria common to both ; 3 enzymes / respiration pathway, common to both ; 4 prevents aerobic respiration ; 5 stops electron transport chain ; 6 stops oxidation of NADH_2 ; 7 less / no, ATP produced ; 8 e.g. of metabolic process prevented by lack of ATP ; 9 AVP ; e.g. only ATP from glycolysis cyanide binds to haemoglobin	3 max
(c)	as temperature increases ability to make HCN increases / ora ; below 0°C , most plants can't make HCN / few plants can make HCN ; A fig $< 0^\circ \text{C}$ above 2°C , most plants can make HCN / few plants cannot make HCN ; A fig $> 2^\circ \text{C}$ at $2\text{--}3^\circ \text{C}$, wide variation (in cyanogenesis) ; AVP ; criticism of, data / graph ref to threshold / critical temperature	2 max
(d)	decrease in plants that can't make HCN / ora ; cyanogenic / HCN, plants in warmer climate have selective advantage / AW ; HCN, kills herbivores / stops plants being eaten ; reproduce / pass on alleles ; frequency of HCN alleles increases ; unnecessary damage to clover from HCN due to ice reduced ; AVP ; e.g. ref to stabilising selection at 2°C ref to directional selection	3 max

[Total: 12]

Mark Scheme 2806/03
June 2006

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 R = reject () = words which are not essential to gain credit <u> </u> = (underlining) key words which must be used to gain credit ecf = error carried forward AW = alternative wording A = accept ora = or reverse argument
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Planning Exercise

The mark scheme for the planning exercise is set out on the next page. 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

The mark scheme for Questions 1 and 2 for the Practical Test are on the pages following the mark scheme for the Planning Exercise.

Throughout this mark scheme accept salicylic acid / salicylate as AW for aspirin

Checking Point	Descriptor	The candidate
A	P.1a	plans a suitable procedure that involves adding known concentrations / masses of (hydrolysed) aspirin / salicylic acid / salicylate to iron (III) chloride solution ;
B	P.1a	gives a prediction about concentration of aspirin in body or urine ; e.g. concentration of aspirin in body decreases with time after dose or concentration of aspirin in urine rises then falls
C	P.1b	chooses suitable materials and equipment to include, colorimeter / burette for titration ;
D	P.3a	uses SKU to explain how aspirin enters the blood stream or explains the nature of the relationship between aspirin and iron chloride / nature of purple substance ;
E	P.3a	identifies at least two key factors to control or take account of in making calibration ; e.g. pH, temperature, concentration of iron III chloride, volume of aspirin, volume of iron (III) chloride solution, time before sample tested
F	P.3b	decides on an appropriate range of measurements (minimum of five different concentrations/masses) with which to draw calibration curve ;
G	P.3b	decides on number of measurements to make - minimum of three with each concentration / mass ;
H	P.5a	uses appropriate SKU to explain how aspirin is eliminated ; e.g. ultrafiltration / reabsorption / ADH's effects on volume and on concentration <i>or</i> mass of aspirin in urine
I	P.5a	uses, information / results, from preliminary work or previous practical work in developing a plan ;
J	P.5a	refers to safety aspect (hazard and precaution) ; e.g. ref to adverse reaction to aspirin <i>and</i> ask if safe to administer, iron chloride is harmful <i>and</i> wear gloves/eye protection <i>or</i> label beaker A refs to health risks of handling urine
K	P.5b	describes a way of generating precise results ; e.g. measuring volumes precisely when making up calibration solutions A use of correct filter (orange/yellow/green)
L*	P.5b	<i>gives a clear account, logically presented with accurate use of scientific vocabulary (QWC) ;</i>
M	P.7a	uses information from an identified secondary source ;
N	P.7a	uses appropriate SKU to describe, mode of action / metabolism of aspirin ; e.g. enzyme inhibitor (COX inhibitor), fatty acid metabolism (prostaglandin), nature of transport in blood, metabolised to salicylic acid etc
O	P.7a	shows how data are to be presented as a table (concentration / mass of aspirin and colorimeter reading) ; A for table of results for urine samples
P	P.7a	explains / shows, how data are to be presented in a calibration curve ; x axis = concentration/mass of aspirin, y axis = colorimeter reading / optical density / absorbance / transmission or volume with units as appropriate
Q*	P.7a	<i>uses spelling, punctuation and grammar correctly (QWC) ;</i>
R	P.7b	shows how to use calibration curve to find the concentration / mass of aspirin in urine ;
S	P.7b	explains that percentage concentration should be converted to mg cm^{-3} (i.e. mg of aspirin per cm^3 of urine) ;
T	P.7b	explains the need to collect all the urine within the time of the investigation since dose and subtract mass / percentage of aspirin in urine from dose ;
U	P.7b	comments on constraints that affect validity ; e.g. aspirin could be metabolised so amount in urine is an underestimate, colour of urine (ref bile pigments) influences colorimeter reading, pH affects amounts of aspirin in urine, pH affects intensity of purple colour, urine already present in bladder at dose has dilution effect so amount in urine is an underestimate, sweating increases concentration of urine

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

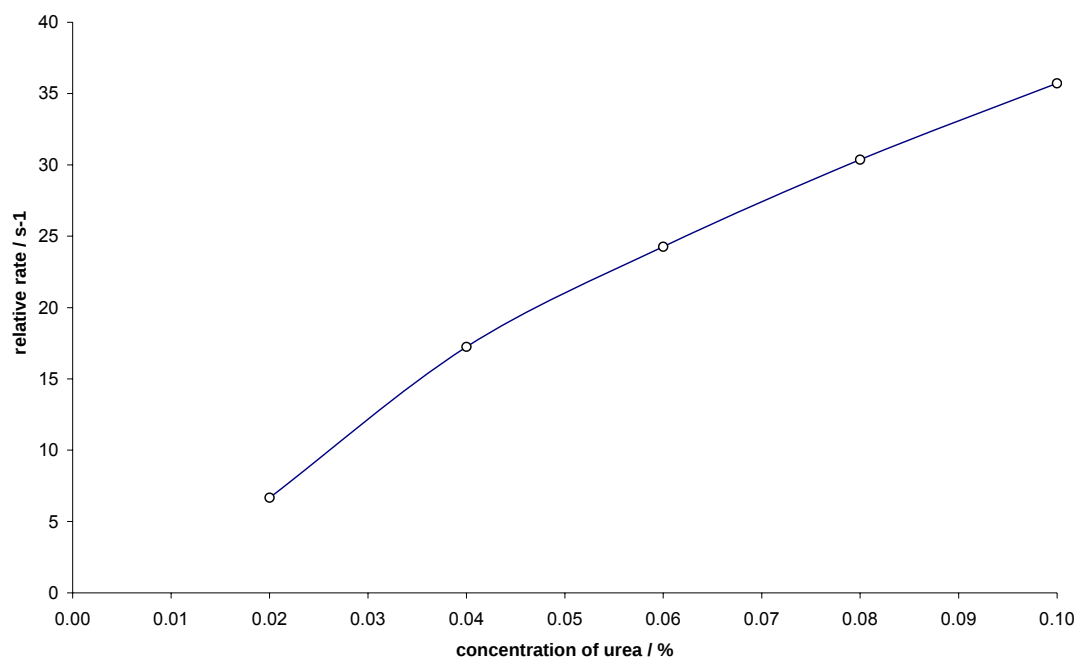
Then award **1** mark for each of **L** and **Q** (QWC).

Total: 16

Example of expected results for **(a)**

tube	concentration of urea / %	time t to match colour of control / s	rate / s^{-1} $1000/t$
1	0.10	28	35.7
2	0.08	33	30.4
3	0.06	41	24.3
4	0.04	58	17.2
5	0.02	150	6.7

Example of expected graph for **(b)**



Question	Expected Answers	Marks
1 (a)	table with min of three columns with, concentration of urea / tube number, in first column ; informative column headings including units - % and minutes / seconds ; units not in body of table ; results for all five tubes ; time recorded in seconds ; calculates rates correctly ; results for <u>timings</u> show correct trend ; i.e. tube 1 fastest, tube 5 slowest	5 max
(b)	axes round right way (x axis = concentration of urea, y axis = time / rate) ; axes labelled and scaled, units in ascending order ; <i>no need to start at 0,0</i> uses half or more of both axes ; points accurately plotted ; points joined clearly / neatly by straight lines (unless conform to line of best fit) ;	5
(c)	direct relationship <i>or</i> increase in rate / decrease in time, with increase in concentration ; <i>ora</i> rate of increase decreases / curve begins to level off as concentration of urea increases ; <i>ora</i> comparative data quote in support of pattern ; identifies any anomaly ;	3 max
(d)	records time taken / rate to end point ; A without unit urea concentration agrees with, time taken / rate on graph ; (look for intercepts) estimates urea concentration to be $0.07\% \pm 0.01\%$;	3
(e)	eating more protein ; kidney disorder ; A named kidney disorder starvation ; drinking less / dehydration / sweating ; AVP ; e.g. overproduction of ADH	2 max
(f)	<i>accept ora in this part</i> ref to attachment of ADH to receptor sites of cells ; <u>DCT</u> / <u>collecting ducts</u> ; (collecting ducts) impermeable / less permeable ; no, activation of / active, phosphorylase enzyme ; water permeable channels / aquaporins ; failure of vesicle to fuse with membrane lining <u>lumen</u> of duct ; water, continues down collecting duct / not reabsorbed ; large volumes of urine / dilute urine, produced ; <i>ignore lower concentration of urea</i> no negative feedback / AW ;	5 max

(g) *mark (i) and (ii) together to max 6*

- (i) so all tubes start at same pH ;
provides, pH range / observable colour change ; **A** AW
so rise in pH / course of reaction, can be monitored / AW ;
- (ii) acid, lowers pH / raises concentration of H^+ ;
 H^+ react with (basic), side chains / R groups ;
interferes with ionic bonding / side chains become charged repelling *or* attracting
each other ;
distorting, active site / tertiary structure ;
denaturing, urease / enzyme ;

6 max

(h) *limitations*

- 1 measuring volumes using syringes ;
- 2 initial pH not recorded ;
- 3 pH varies during course of reaction / change in pH affects rate of reaction ;
A pH not optimum
- 4 ref to variable size of indicator drops ;
- 5 temperature, not controlled / was not kept constant ;
- 6 judging colour changes ;
- 7 no repeats; **A** ora
- 8 delay between adding indicator and starting stop watch ;
- 9 colour of **C** changes over time ;
- 10 AVP ; e.g. cloudiness obscures colour, inconsistency judging end points,
anomalous result not identified

improvements

- 11 use, graduated pipettes / burette, to measure volumes accurately ;
- 12 use thermostatically-controlled water bath ;
- 13 use pH meter to judge end point ;
- 14 use colorimeter to judge, colour change / end point ;
- 15 use intermediate concentrations ;
- 16 two or more repeats ;
- 17 calculate means ;
- 18 calculate standard deviations ;
- 19 AVP ; add urease to **C** to make cloudy

10 max

[Total: 28 max]

Question	Expected Answers	Marks
2 (a)	<i>drawing</i> draws LS of whole or part of kidney ; clear continuous lines ; no shading ; <i>labels</i> capsule ; cortex ; medulla ; pyramids / ducts of Bellini ; pelvis ; ureter / renal artery / renal vein / blood vessel(s) ;	3 4 max
(b)	capsule visible as (fragmented) layer around kidney ; cortex contains, renal capsules / glomeruli ; A Malpighian bodies R nephrons (and) tubules / vessels, cut in different planes ; medulla / pyramids, contain, loops of Henlé / ducts / blood vessels / tubes mostly cut longitudinally ; pelvis, hollow / no cells ; ureter / renal vessels, emerge from kidney ; blood vessels containing blood cells ;	4 max
(c)	line goes through cortex and medulla ; <i>put the tick on the line</i>	1
(d)	<i>drawing</i> cross section of duct ; lumen wider than wall ; more than six nuclei ; <i>annotations allow ecf</i> comment on lumen e.g. smooth lining / large ; comment on cytoplasm e.g. pink / granular ; comment on nucleus e.g. round, large, blue/purple / darkly stained ; comment on nucleoli e.g. number / darkly stained ; AVP ; another descriptive comment	3 4 max

[Total : 16 max]

**Advanced GCE
June 2006 Assessment Series**

Unit Threshold Marks

Unit		Maximum Mark	a	b	c	d	e	u	Entry
2801	Raw	60	44	39	34	29	24	0	19368
	UMS	90	72	63	54	45	36	0	
2802	Raw	60	44	39	34	29	25	0	26750
	UMS	90	72	63	54	45	36	0	
2803A	Raw	120	89	78	67	56	45	0	13287
	UMS	120	96	84	72	60	48	0	
2803B	Raw	120	89	78	67	56	45	0	948
	UMS	120	96	84	72	60	48	0	
2803C	Raw	120	87	76	66	56	46	0	12375
	UMS	120	96	84	72	60	48	0	
2804	Raw	90	62	54	47	40	33	0	10685
	UMS	90	72	63	54	45	36	0	
2805A	Raw	90	68	59	51	43	35	0	2155
	UMS	90	72	63	54	45	36	0	
2805B	Raw	90	62	55	48	42	36	0	1462
	UMS	90	72	63	54	45	36	0	
2805C	Raw	90	69	63	57	51	46	0	1027
	UMS	90	72	63	54	45	36	0	
2805D	Raw	90	68	61	54	47	40	0	1178
	UMS	90	72	63	54	45	36	0	
2805E	Raw	90	66	57	48	39	31	0	9681
	UMS	90	72	63	54	45	36	0	
2806A	Raw	120	88	79	70	61	52	0	7525
	UMS	120	96	84	72	60	48	0	
2806B	Raw	120	88	79	70	61	52	0	371
	UMS	120	96	84	72	60	48	0	
2806C	Raw	120	89	80	71	62	54	0	6880
	UMS	120	96	84	72	60	48	0	

Specification Aggregation Results

Overall threshold marks in UMS (i.e. after conversion of raw marks to uniform marks)

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

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

	A	B	C	D	E	U	Total Number of Candidates
3881	17.1	33.4	51.5	69.6	84.7	100.0	19425
7881	23.8	45.9	67.2	84.6	96.0	100.0	15915

For a description of how UMS marks are calculated see;
www.ocr.org.uk/OCR/WebSite/docroot/understand/ums.jsp

Statistics are correct at the time of publication

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Information Bureau

(General Qualifications)

Telephone: 01223 553998

Facsimile: 01223 552627

Email: helpdesk@ocr.org.uk

www.ocr.org.uk

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OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553

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