



GCE MARKING SCHEME

**BIOLOGY/HUMAN BIOLOGY
AS/Advanced**

SUMMER 2011

INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2011 examination in GCE BIOLOGY/HUMAN BIOLOGY. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

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BIOLOGY - BY1

No. **Answer** **Mark**

1.

Feature	Prokaryotic	Eukaryotic
mitochondria	Absent (not: no organelles)	present;
Arrangement of DNA	circular/no chromosomes; (not: loop)	DNA forms chromosomes
Position of DNA	Free in cytoplasm	in nucleus/ bound by membrane;
Composition of cell wall if present	murein peptidoglycan (not: not cellulose)	cellulose/chitin;
Size of ribosomes	Small/70S; (not: other figures)	Large/80S;

1 mark per row

(Total 5 marks)

- 2. (a)** capable of immobilisation/fixed to inert matrix or named;
Stable/able to withstand changes in temperature or pH;
specific to test or substrate;
(not: ref. turn over number) **2 max**
- (b)** allows glucose through; (not: ref. small molecules)
prevents passage of other molecules/solutes
(not: ref. substances) **2**
- (c)** glucose broken down by enzyme;
Products/oxygen affect/detected by electrode;
(not: measured by)
electric signal generated/chemical to electrical;
greater conc. glucose the greater the signal; **2 max**
- (d)** enzyme activity/ rate of diffusion of glucose affected;
change rate of reaction;
unreliable result;
(not: ref. enzyme denaturation/fair experiment/control/false reading/confidence) **2 max**

(Total 8 marks)

3. (a) (i) fluid mosaic model;
 mosaic of protein molecules/irregularly or randomly
 arranged;
 lipid layer fluid/can move; **3**
- (ii) A = phospholipid bilayer/fatty acid tails; (not: ref.
 hydrophobic)
 B = extrinsic/surface protein/glycoprotein;
 C = transmembrane/carrier/intrinsic protein; **3**
- (iii) allows passage of polar/charged/ionic/hydrophilic
 molecules/facilitated diffusion; (allow: ref. water/non lipid
 soluble; not: named molecule) **1**
- (b) movement up/against a concentration gradient;
 requires energy/ATP; **2**
- (c) maintain water potential;
 obtain nutrients/metabolites or named e.g. glucose;
 obtain oxygen/remove carbon dioxide;
 secrete molecules;
 remove toxic substances or named;
 (not: waste products) **2 max**
- (Total 11 marks)**

4. (a) 5.8;
0.5
11.6 cm³ min⁻¹;
(allow: 5.8/30 x 60) correct answer + units =2;
correct answer - units =1; incorrect answer, correct working
= 1 2
- (b) Maximum/higher concentration of substrate;
all active sites occupied;
(not: ref. unoccupied at start) 2
- (c) (i) increase in rate from 20 - 100°C/up to 100°C;
fall from 100 - 130°C;
increase in kinetic energy;
molecules move faster; (not: more)
More successful collisions/more enzyme-substrate
complexes formed;
up to optimum; (not: 100°C unqualified)
above optimum increased vibrations;
hydrogen bonds break;
Loss/change of shape of active site; (not: ref. enzyme)
denature; 6 max
- (ii) enzymes have different optimum temperatures/
human amylase has optimum of 37°C, bacterial 100°C; 1
human amylase denatures at a lower temperature; 1
- (Total 12 marks)**
5. (a) (i) amino acid;
triglyceride; (not: lipid/triglycerol) 2
- (ii) nitrogen/sulphur; (not: chemical symbols) 1
- (b) condensation;
peptide; 2
- (c) (i) add Biuret to test solution; (not: if ref. to boiling) 1
blue changing to mauve/purple colour is positive result; 1
- (ii) little colour change/mauve colour may be masked; 1
- (Total 8 marks)**

6. (a) A = matrix;
B = crista/internal membrane; 2
- (b) E is the site of protein synthesis;
Polypeptide chains build up at ribosome;
transports polypeptides/proteins;
ribosomes read genetic code (allow: receive mRNA); 2 max
- F buds off vesicles/package proteins into vesicles;
these contain molecules for secretion;
transport protein molecules to cell surface/membrane;
synthesis of glycoproteins/modification of proteins; 2 max
- (c) secretory cell involved in active processes/metabolically active;
ATP/energy dependent;
ATP manufactured by C;
hormone synthesis requires ATP; 2 max
- (d) cut in different plane/AW; 1
- (Total 9 marks)**
7. (a) cell/plasma membrane; 1
- (b) 50% of cells plasmolysed/point of incipient plasmolysis/membrane just in contact with wall/at incipient plasmolysis $\Psi_P=0\text{KPa}$;
because cell left in solution for one hour;
equilibrium reached/no net movement of water;
solute potential inside equal to that outside;
outside solution is given as -600kPa ; 3 max
- (c) K is cell wall which is inelastic/won't stretch;
as protoplast/cell contents expand/swell; (not: ref. vacuole unqualified)
as water passes into cell;
pushes against expanding protoplast/cytoplasm/cell contents;
pressure potential is generated by resistance of cell wall; 3 max
- (Total 7 marks)**

8. (a) (i) A daughter cells exact copies/genetically identical cells;
 B same number of chromosomes as parents;
 C genetic stability;
 D important for growth;
 E replacement of missing tissue/parts;
 F repair to wounds/(damaged) tissue/cell replacement plus e.g. skin/hair/gut lining/blood cells;
 G asexual reproduction plus e.g. bulbs tubers runners/used by bacteria/yeast;
 H allows large numbers of offspring to be produced/ref. cloning/quick colonisation;
 I ref. to cancer i.e. proliferation of cells; **6**
- (ii) J haploid vs. diploid/mitosis maintains chromosome numbers, meiosis halves it; (not: just 23 vs 46)
 K two divisions involved;
 L chromosomes are different/crossing over occurs; (allow: ref. independent assortment)
 M meiosis produces gametes; (allow: examples e.g. sperm and egg cells; not: sex cells)
 N allows for variation;
 O allows sexual reproduction to take place; **4**
10
- (b) A polynucleotide/chain of nucleotides;
 B nucleotide consists of phosphate, sugar plus base;
 C sugar is deoxyribose;
 D base contains nitrogen; (allow: ref. nitrogenous)
 E four bases are adenine, guanine, cytosine and thymine; (not: letters/ref. uracil)
 F sugar phosphate backbone;
 G two polynucleotide chains linked;
 H antiparallel (stated, in context);
 I ref. polynucleotide chains/base pairs held together by hydrogen bonds;
 J complementary base pairing;
 K A-T, G-C;
 L pairing of purines and pyrimidines;
 M double helix;
 N purines double ring and pyrimidines are single ring;
 O ref. sequence of bases is genetic code; **10**

BIOLOGY - BY2

No.	Answer	Mark
1.	(a) (i) Incomplete metamorphosis	1
	(ii) 1 egg } 7 adult/imago } 1 mark for both (not: zygote) 2-6 nymphs (allow: instar)	2
	(b) (i) Complete metamorphosis	1
	(ii) A Egg B Larva (allow: maggot) C Pupa (allow: chrysalis / cocoon) D Adult/Imago (1 mark per pair) Any 2 per mark	2
Total 6 marks		
2.	(a) Chordata (allow: vertebrata) Mammalia/mammals <i>Acinonyx</i>	1 1 1
	(b) Phylum: vertebral column/backbone well developed brain/CNS enclosed in a cranium internal skeleton (any 1)	1
	Class: endothermic (not: warm blooded) Lungs Hair / fur Double circulation Internal gestation / mammary glands /feed young on milk (allow: give birth to live young / placenta)	
	Sweat glands (any 1)	1
	(c) (Genetic/population) bottleneck (not: low gene pool)	1
	(d) (i) Electrophoresis Genetic/DNA fingerprinting / DNA hybridisation / DNA profiling (not: DNA analysis) / protein sequencing (any 1)	1
(ii) That the DNA / sequence of bases/ genes/proteins shared between individuals is very high / closely match (allow: ref. banding patterns very similar)	1	
Total 8 marks		

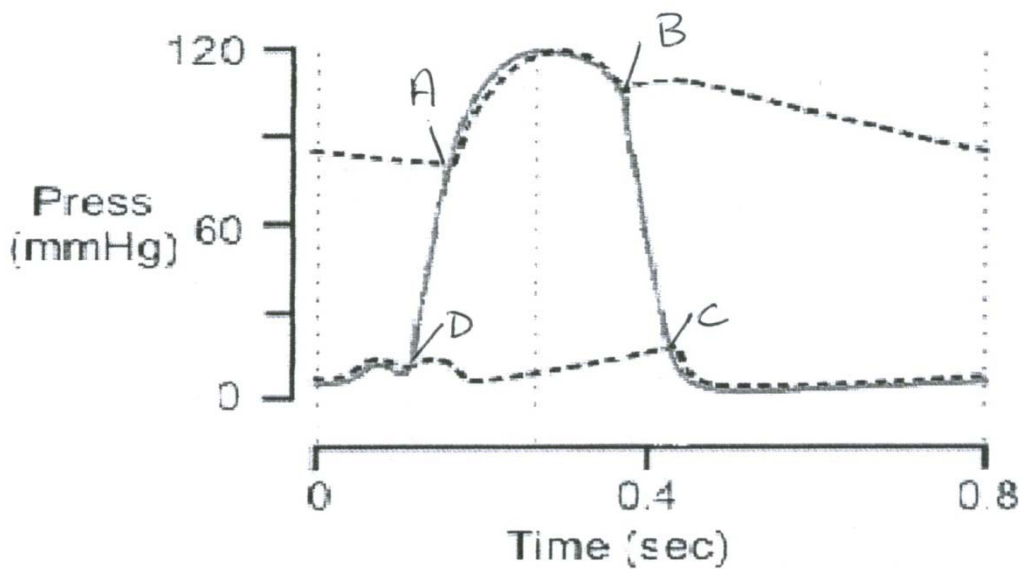
No.	Answer	Mark
3.	<p>(a) Eggs/faeces eaten by pigs/livestock</p> <p>Tapeworm eggs in <u>muscle</u></p> <p><u>Undercooked</u> meat eaten containing cysts/eggs / parasite/infected meat</p>	2
	<p>(any 2)</p> <p>(b) Suckers <u>and</u> hooks on (scolex/head)</p> <p>Thick cuticle (not: coat)</p> <p>Large numbers of embryos/eggs produced</p> <p>(not: reproduce in huge numbers; allow: ref. offspring)</p> <p>Resistant stages / secretion of chemicals to block the hosts digestive enzymes / immune system</p>	
	<p>No digestive system</p> <p>Hermaphrodite/eq</p> <p>Large surface area to volume ratio</p> <p>(any 3)</p>	3
	<p>(c) Ensure meat is well/thoroughly cooked/meat inspection (not: check the meat)</p>	1
	<p>Do not spread untreated sewage on land (not: sewage treatment unqual)</p>	1
	<p>(d) Prevents scolex/hooks/suckers from holding on(to intestine) (allow: ref. worm)</p>	1
Total 8 marks		

No.	Answer	Mark
4.	(a) A Guard cells	1
	B Epidermis/al cells (not: epithelium)	1
	(b) Allow gas exchange/CO ₂ / O ₂ to enter and leave the leaf	1
	Control water (vapour) loss (allow: prevents water loss qual. e.g. by closing at night not: allows transpiration)	1
	(c) Active transport/ pumping of K ⁺ ions into the guard cells and starch-malate	1
	conversion lowers Ψ	1
	Water flows in by <u>osmosis</u> or down a water potential gradient	1
	Guard cell becomes <u>turgid</u>	1
	<u>Inner</u> wall of guard cell is inelastic/thicker	1
	so guard cells curve /bends away from each other	
	(d) Cyanide stops respiration/is respiratory inhibitor/stops ATP synthesis	1
Stopping <u>active transport</u> (of K ⁺) into (guard) cell	1	

Total 10 marks

No.	Answer	Mark
5.	(a) Hydrophyte	1
	(b) Large <u>air spaces</u> in <i>Nymphaea</i> , smaller in <i>Ligustrum</i> (not: ref. thicker spongy mesophyll / thickness of epidermis / more air spaces)	
	Stomata on upper surface of leaf in <i>Nymphaea</i> , not in <i>Ligustrum</i>	
	(any 2) Comparison needed. Accept converse of points	2
	(c) Large air spaces for buoyancy/diffusion/floating	
	Stomata on upper surface so allowing gas exchange with the air	
	Thin cuticle as little water (vapour) loss (not: no cuticle)	
	Little support tissue as buoyed by water	
	Little xylem as surrounded by water	
	Air spaces in stems allowing diffusion of gases	
	(any 3)	3
	(d) Rolled leaves (not: curled) Hairs	
	Thick cuticle	
	Sunken stomata (allow: in pits not grooves)	
	Deep rooted	
	Extra support tissue in leaf	
	(any 1)	1

Total 7 marks



6. (a) (i) One mark for each correctly labelled point. 2
(ii) One mark for each correctly labelled point. 2
- (b) The (aortic) semi lunar valve closes
so preventing backflow of blood into the ventricle
(left) ventricle relaxing / diastole
2 from 3 2
- (c) One heartbeat takes 0.8 seconds
- Therefore $\frac{60}{0.8}$ seconds
- = 75 (beats per minute) 2
2 marks for correct answer, if incorrect could give 1 for correct figures and equation.
- (d) Correct ref. to wall/muscle thickness affecting pressure
Atrium pushes blood into the ventricle which is very close.
The ventricle has to push blood around the entire body.
The right ventricle has to push blood to the lungs which need a lower blood pressure/closer.
3 from 4. Points require qualification not just description
(not: ref. gravity) 3

Total 11 marks

No.	Answer	Mark
7.	(a) Lipase	1
	(b) (i) Hydrolysis of lipids/fats (not: digestion) Releasing fatty acids Causing a more acid pH/reducing pH (linked with previous point) (any 2)	2
	(ii) Presence of <u>bile salts</u> (in tube B) causes the <u>emulsifying</u> of lipids Increasing surface area For action of lipase (not: ref enzymes) Fatty acids are released more quickly/eq so pH becomes acidic more quickly/in less time (any 3)	3
	(c) Lipase/enzyme is denatured/tertiary structure altered Active site has changed shape Lipid/substrate will not fit into active site No hydrolysis of lipid/no fatty acids released (any 3)	3
	(d) More fatty acids/products Quicker change in colour/faster reaction (any 1) (not: high fat content)	1

Total 10 marks

8. (a) General re any examples

- A Large S.A. qualified e.g.
- B Moist surface for diffusion e.g.
- C Short diffusion pathway qualified e.g. thin walls etc.
- D Circulatory system with blood pigments/haemoglobin
- E Internal lungs minimise loss of water / heat (not: in reference to frogs)
- F Ventilation mechanism / or description e.g. ref insect abdominal movements
- G Ensures fresh oxygen is brought to /carbon dioxide removed from gas exchange surface/maintain concentration gradients.

Frogs

- H Inactive (frog) amphibian uses its moist skin for gas exchange
- I Active (frog) amphibian uses lungs
- J tadpole stage uses gills

Reptiles and birds

- K More efficient lungs than amphibians
- L Air sacs act as bellows

Insects

- M Have a branched chitin lined system / presence of tracheae
- N With openings called spiracles;
- O Gases exchange directly with tissues/No blood pigment/ haemoglobin present

10 of the 15 marks available

(b) Diagram

- A. With correct axes PPO₂
oxygen partial pressure (KPa) allow: oxygen tension
% Saturation of haemoglobin with oxygen
- B. Correct numbers
- C. Correct shaped curve for adult haemoglobin, labelled
- D. Correct position of curve for fetal haemoglobin, labelled
- E. Correct position of curve for Llama/lugworm, labelled or curve to left
labelled animal at light altitude
(note: Lines not to go over 100%)

Text

- F. Sigmoid / S shaped being more efficient
- G. More/easier O₂ loading in lungs/fully saturated at (relatively) low partial pressure
- H. Significance of this for living at altitude / low PPO₂
- I. More O₂ delivered to tissues
- J. Reduced affinity for O₂ at lower partial pressures
- K. Bohr Effect reduces haemoglobin affinity for O₂ / more O₂ is delivered to respiring tissues
- L. Correct biological explanation for this – acidity reduces affinity Hb for O₂
- M. Ref. myoglobin or position on graph
- N. Correct explanation for foetal haemoglobin curve position, i.e. ref. affinity
- O. Correct explanation for Llama/lugworm curve position i.e. ref. affinity higher
(Note: G+H in context of loading and marks transferable to different organisms;
I+J in context of unloading)

10 of the 15 marks available

HUMAN BIOLOGY HB2

No.	Answer	Mark
Q.1 (a)	Prokaryotae; Fungi; Plantae	3
(b)	Class - Mammalia	1
	Family - Hominidae	1
(c)	Not able to interbreed; to produce fertile offspring	1 1
(d)	DNA hybridisation/Genetic or DNA fingerprinting/(gel) electrophoresis (allow: DNA profiling).	1
(Total 8 marks)		
Q.2 (a) (i)	1 ingestion 2 digestion 3 absorption 4 egestion	
	4 correct	2
	3 correct	1
(ii)	The passage of digested/soluble food through the gut wall into the bloodstream.(allow: specific example)	1
(b) (i)	endopeptidase cuts in the middle of (polypeptide) chain/produces several (smaller) chains; producing many (free) 'ends' for exopeptidase to act on.	1 1
(ii)	APAK + SEGMAR + GAMF	1
	3 correct dipeptides + remaining free amino acids (i.e AP + A+K + SE + G + M +A +R + GA +M +F)	1
(c) (i)	Surface area reduced; Do not absorb substances so efficiently/reduced uptake.	1 1
(ii)	No or fewer microvilli/surface area reduced for enzyme attachment/catalytic surface reduced/enzymes adsorbed onto membranes of microvilli/inside epithelial cells.	1
(Total 10 marks)		

Q.3 (a) (i) Left ventricle (not: LV) **1**

(ii)

Valve	Open	Closed
1		/
2	/	
3		/
4	/	

All valves correct **2**

3 valves correct **1**

(iii) ON GRAPH peaks and troughs coinciding **1**
All lines at a higher pressure **1**

(b) (i) E **1**

(ii) Right atrium **1**

(iii) Muscle contracts and narrows vessel/arteriole/lumen; **1**
reduces blood flow to particular capillaries/organs/parts of
body/increases pressure to other parts of the body/diverts blood
flow (not: slows down) **1**

(iv) Arteries are dividing up (into arterioles) with a larger surface **1**
area/blood is distributed in larger number of blood vessels with
greater S.A/greater resistance due to larger S.A/larger total cross
sectional area

(v) Enables more time to exchange materials (with tissue fluid) **1**
(not: ref. bursting)

(Total 11 marks)

- Q.4 (a)** A (is Gram positive) and has a cell wall made of murein/peptidoglycan (not lipopolysaccharide) (which retains the purple stain.) **1**
- C (is Gram negative) and has a peptidoglycan/murein layer surrounded by an (outer) layer of lipopolysaccharide. (stains red/violet) **1**
 (allow: A has no lipopolysaccharide in the cell wall but C does = 1mark)
- (b) (i)** *Penicillium*/fungus has grown. (allow: ref. reproduction) **1**
- (ii)** *Penicillium* produces antibiotic/penicillin;
 which diffuses into the agar;
 stops/inhibits/kills bacteria/growth;
 B and D are more resistant/less affected as bands or streaks almost reach fungus;
 A and C are inhibited as bands are shorter/further away from fungus;
 'thicker bands' due to bacterial colonies growing/reproducing/dividing;
 C is more susceptible/affected/less resistant to bacteria than A;
 (Any three points) (not: ref. immunity). **3**

- (c) (i)** Prevents or slows down growth/cell division/reproduction
(not: ref. protein synthesis unqual.) **1**
- (ii)** All bacteria synthesise protein/possess ribosomes.
(not: ref. common pathway unqual.) **1**
- (iii)** Human cells do not have the same uptake mechanism as bacterial cells/membranes are not as permeable to tetracycline/do not have the necessary carriers/do not take up tetracycline by active support, by diffusion instead. **1**
- (iv)** A (section) of DNA/base sequence/a mutation (or since they have not encountered this yet) or a gene that prevents an antibiotic from working/able to produce an enzyme that breaks down the antibiotic. **1**
- (v)** Genes may be transferred to other harmful/pathogenic bacteria;
Which then become resistant to the antibiotic;
The antibiotic will then have no effect or cannot be used. **2**
- (d)** e.g. penicillin; Cell wall formation is affected;
Inhibit an enzyme/glycoprotein peptidase which links together the peptidoglycan chains;
Making cell wall weaker;
water enters (by osmosis);
cell undergoes lysis/bursts;
Kills bacteria so bactericidal. **4**
(Any 4)

Q.5 (a) A foreign or non-self surface marker/
protein/polysaccharide/glycoprotein/molecule/pathogen (on
surface membrane) 1
that triggers antibody production/immune response. 1

(b) component - glycoprotein 1
Explanation - located on outside surface of cell so
exposed/detectable owtte / has a specific shape/different shape to
recipient's body protein/body 1

(c) (i)

	A	B	AB	O
Anti-A	_____	X	/	X
Anti-B	_____	/	/	X

1 mark for each correct line across 2

(Total 6 marks)

Q.6 (a) memory cell; 1
Allows fast/greater production of antibodies/ secondary immune
response will be quicker when encountered again 1
(not: responds quicker unqual.)

(b) (i) Killer cells kill/destroy foreign cells/bacteria/cells infected with virus
(not-kills virus/attacks virus infected body cell) 1

(ii) Phagocytosis/engulf virus or ingests/digests/engulf pathogens 1

(iii) Stimulate phagocytosis/activity of cell Y/produces more
phagocytes (not: triggers....) 1

(c) Complementary shape of virus and (variable region of) antibody
enabling them to join/fit together/Any concept of binding sites 1

(d) (i) Increases slowly until 1997/eq. and then much more rapid increase 1

(ii) Not all cases of HIV develop into AIDS/time delay in onset of
AIDS; 1
Improved medical care/antiviral drugs that prevent/slow onset of
AIDS. 1

(Total 9 marks)

Q.7 (a)	A Alveoli have a thin wall/wall is one cell thick	1
	B (thin wall gives)short diffusion path/ ref. moisture and diffusion	1
	C have a large surface area (not: SA:Vol ratio unless qual.)	1
	D extensive capillary network(not: good blood supply)	1
	E to maintain diffusion gradient/movement of blood removing oxygen and returning with carbon dioxide	1
	F reference to presence of surfactant	1
	G Function of surfactant - reducing surface tension owtte	1
	(Any 5 out of 7)	
	H Cause – allergens in air/allergy to e.g. dust mites/fur/feathers/pollen	1
	I attacks of wheezing/difficulty in breathing (out)/ tidal volume decreased	1
	J spasms in (smooth) muscle walls of bronchioles	1
	K narrow airways/passageways close partially/flow of air restricted	1
	L inflammation of bronchioles/air passages (not: swelling)	
	M more effort required to deliver sufficient air to the lungs	1
	N Inhalant/aerosol relax muscles (lining bronchioles)/dilates airway	1
	O Steroids or named reduce inflammation	1
	(Any 5 out of 8)	
		(Total 10 marks)

Q.7 (b) A Both caused by bacterium or named

Cholera

- B diarrhoea (not: vomiting) (not: colloquial terms)
- C dehydration (and death)
- D water borne from infected person/human faeces/carriers
- E prevented by water treatment/provision of clean drinking water/hygienic disposal of human faeces
- F and good hygienic practices/or example - food hygiene
- G Treatment by rehydration
- H Possible use of antibiotics/vaccine may provide temporary protection.

Tuberculosis

- I Attacks lungs and lymph nodes in the neck
- J symptoms - persistent cough, fever/night sweats, coughing blood. (Any 2 from 3)
- K transmission - airborne droplets/coughing and sneezing
- L treatment - antibiotics for long period of time
- M prevention by vaccination
- N reference to skin test/Heaf test
- O BCG between ages 10-14 (n UK) (not: small children)

(Total 10 marks)

BIOLOGY - BY4

No.	Answer	Mark
1. (a) (i)	phosphate; pentose/ribose; adenine (all correct for 2; 1 error = 1) (not: adenosine/nitrogenous base)	2
(ii)	adenosine triphosphate (not: triose phosphate/ATP)	1
(b) (i)	ATP <u>drawn</u> as in part a in upper box; ADP two Ps attached <u>+ 1P</u> not attached in lower box.	1
(ii)	protein synthesis/biosynthesis/active transport/nerve conduction/cell division/avp (not: metabolism/growth/movement)	1
(c) (i)		2

Stage	Precise location in cell	Number of molecules of ATP	Number of molecules of NADH ₂	Number of molecules of FADH ₂
Glycolysis	cytoplasm	2 (net)	2	0
Link reaction	matrix of mitochondrion	0	2	0
Krebs cycle	matrix of mitochondrion	2	6	2

(1 mark for each correct row) (if only 'matrix' penalise once only)

(ii)	name of stage - electron transfer/transport chain/oxidative phosphorylation + location-inner membrane/cristae of mitochondrion (not: ETC)	1
(iii)	NADH ₂ -3 FADH ₂ -2	1
(d)	NAD, ethanol + carbon dioxide in correct places (not: alcohol)	1

Total 10 marks

2. (a)	they have increasing numbers of spots (not: the number of spots)	1
(b)	A - GP, B-malic acid, C-glycine (all 3 for 1 mark)	1
(c)	First - GP; second-Triose phosphate	2
(d)	Nitrogen (not: nitrate)	1
(e) (i)	Y - ATP to ADP (+P); X-NADPH ₂ to NADP	1 1
(ii)	light dependent reactions/(non cyclic) photophosphorylation; (not: Z scheme/cyclic photophosphorylation)	1
(iii)	grana/thylakoids	1
(f)	6	1
		Total 10 marks

3. (a) (i) general shape of spike including overshoot dip. 2
 accurate values -70 to +40 or +50 mV (width c.3ms)
 (allow: 68-80 + 30-60)
- (ii) correct labelling of depolarisation on upward and 1
 repolarisation on downward side of graph
- (b) (i) I proteins 1
 II phospholipids 1
- (ii) Ref. to pumps e.g. resting potential – Na⁺/K⁺ pump pumps 1
 Na⁺ out and K⁺ in;
 Ref. why difference between two sides e.g. organic anions 1
 inside create pd/K⁺ channels open;
 less permeable to Na⁺ (not: ref. concentration gradient)
 depolarisation - impulse opens Na⁺ channel/voltage gated 1
 channel;
 Na ions rush in/sudden increase in permeability to Na⁺ 1
- (c) transmitter substances synthesised in synaptic knob;
 impulse causes secretory vesicle to migrate to
 (presynaptic) membrane/Ca ions to rush in;
 vesicle fuses with membrane discharges transmitter
 substance/exocytosis;
 diffusion of transmitter substance across cleft;
 transmitter binds to post-synaptic membrane/stimulates
 depolarisation/reference to receptors.
 (Any 3 in correct sequence; no mention of transmitter
 substance=2 max)

3

Total 12 marks

4. (a) (i) rod shaped; 1
- (ii) retains (red) counter stain/stains red/pink in Gram test/do not retain crystal violet; 1
because of complex nature of cell wall/reference to lipopolysaccharide/does not contain as much merein/peptidoglycan. 1
- (iii) grow best with oxygen; (not: prefer/like oxygen) 1
but can grow with or without oxygen 1
(not: ref. aerobic/anaerobic)
- (b) (i) viable only counts living cells/cells which are reproducing/total count includes living and dead cells 1
- (ii) 9 cm³ of sterile distilled water in each tube; (not: tap water) 1
1 cm³ of sample transferred to tube 1; 1
mixed well or ref. 1 cm³ transferred next tube in sequence; 1
any reference to aseptic technique. (Any 3) 3
(labelled diagram=2max e.g. 9cm³ sterile distilled water + 1 cm³ sample)
- (iii) 4 1
- (iv) take/prepare 4 sterile nutrient agar plates; (idea of each dilution on a different plate needed) 1
transfer 0.5 cm³ /other specified volume of each to a separate plate; (allow: 0.1-1 cm³) 1
spread with sterile spreader; 1
incubate plates at suitable temp./25°C; (allow: 25-40°C) 1
count colonies; 1
1 colony=1 cell. 1
(any 4 in correct sequence) 4

Total 14 marks

5. (a)	W - lag, X-exponential/log, Y-stationary, Z-death (allow: decline) (all correct for 2, 1 error = 1)	2
(b) (i)	(arrow labelled D) pointing to or drawn on the down slope.	1
(ii)	the maximum size of population; (not: optimum size) that can be maintained/supported indefinitely/can be sustained (owtte)	2
(iii)	availability of/competition for food/living space/mates/light; predation; disease/parasitism; accumulation of toxins. (any 2; 1 only from competition; not: competition unequal.)	2
(iv)	temperature/weather (extremes)/flood/fire/natural disasters e.g. tsunami avp	1
(v)	dashed line continued in steep downward gradient (down to at least halfway between line and axis, no lag, no upward turn, down before dip in plotted line i.e. second cross over dotted line)	1
		Total 9 marks
6. (a)	nephron	1
(b) (i)	A-glomerulus, B-bowman's capsule, C-proximal convoluted tubule, D-loop of Henle, E-distal convoluted tubule, F-collecting duct. (all correct for 3, 1 error 2, 2 errors 1) (not: letters/ref. first and second convoluted tubule)	3
(ii)	create concentration gradient/low water potential in medulla owtte. (not: reabsorption of water)	1
(iii)	longer	1
(c) (i)	ADH/antidiuretic hormone	1
(ii)	pituitary	1
(iii)	I detector - hypothalamus Effector wall of collecting duct	1

- (iv) Effector:
left dotted line- makes more permeable
right dotted line- makes less permeable 1
- Concentration:
left dotted line- increase/ hypertonic
right dotted line- decrease/ hypotonic 1
- volume :
left dotted line- decrease
right dotted line- increase 1
- (d) (i) (I) freshwater fish release ammonia; 1
(II) insects release uric acid. 1
- (ii) requires less water for its disposal to allow them to survive
in dry places. /avp e.g. less toxic/less mass to allow flight 1

Total 15 marks

7. (a)	A	Nitrogen gas in air/atmosphere	1
	B	amino acids/protein in plants and or animals	1
	C	urea in urine/ammonia/nitrite/nitrate in soil	1
	D	Decomposition/putrefaction qualified	1
	E	Nitrifying bacteria/nitrification qual – produces nitrates in context	1
	F	<i>Nitrobacter</i> and <i>Nitrosomonas</i> , correctly linked to process	1
	G	ammonium compounds to nitrites	1
	H	nitrites to nitrates (G+H not: just arrows on diagram)	1
	I	denitrifying by <i>Pseudomonas</i>	1
	J	in anaerobic conditions	1
	K	Nitrogen fixing bacteria/nitrogen fixation	1
	L	convert nitrogen gas into soluble/organic nitrogen containing compounds. e.g. amino acids	1
	M	<i>Azotobacter</i> are free living	1
	N	<i>Rhizobium</i> in root nodules (of legumes)/symbiotic	1
	O	Decay bacteria release nitrogen compounds /ammonia from dead bodies faeces and urine	1
		(any 10 from 15)	
			Total 10 marks (max)

7. (b)	A	all materials are present at start/not added during the process	1
	B	sterile apparatus;	1
	C	pure (culture) of <i>Penicillium (notatum)</i> ;(not: if ref. bacteria)	1
	D	sterile nutrient medium;	1
	E	aeration method/oxygen for respiration;	1
	F	pH adjustment/buffer;	1
	G	filters for introducing sterile air/oxygen;	1
	H	method of mixing qualified e.g. to stop sedimentation/clumping;	1
	I	water jacket to control temperature/qualified	1
	J	allow growth phase to take place/glucose is depleted during growth phase;	1
	K	penicillin is secondary metabolite;	1
	L	penicillin is produced/harvested <u>after</u> growth phase/during stationary phase/after nutrient depletion;	1
	M	filter culture fluid/separate fungus;	1
	N	concentrate or extract penicillin/chemically modify antibiotic;	1
	O	AVP e.g. penicillin production in nature possibly to reduce competition/comparison with continuous culture;	1
		(any 10 from 15)	1
			Total 10 marks (max)

BIOLOGY - HB4

- | No. | Answer | Mark |
|------------|---|-------------|
| 1. (a) (i) | phosphate; pentose/ribose; adenine
(all correct for 2; 1 error = 1) (not: adenosine/nitrogenous base) | 2 |
| (ii) | adenosine triphosphate (not: triose phosphate/ATP) | 1 |
| (b) (i) | ATP <u>drawn</u> as in part a in upper box;
ADP two Ps attached <u>+ 1P</u> not attached in lower box. | 1 |
| (ii) | protein synthesis/biosynthesis/active transport/nerve conduction/cell division/avp
(not: metabolism/growth/movement) | 1 |
| (c) (i) | | 2 |

Stage	Precise location in cell	Number of molecules of ATP	Number of molecules of NADH₂	Number of molecules of FADH₂
Glycolysis	cytoplasm	2 (net)	2	0
Link reaction	matrix of mitochondrion	0	2	0
Krebs cycle	matrix of mitochondrion	2	6	2

(1 mark for each correct row) (if only 'matrix' penalise once only)

- | | | |
|-------|---|---|
| (ii) | name of stage - electron transfer/transport chain/oxidative phosphorylation + location-inner membrane/cristae of mitochondrion (not: ETC) | 1 |
| (iii) | NADH ₂ -3 FADH ₂ -2 | 1 |
| (d) | NAD, + lactic acid in correct places | 1 |

Total 10 marks

- | | | |
|------------|---|--------|
| 2. (a) (i) | Y - ATP to ADP (+P);
X-NADPH ₂ to NADP | 1
1 |
| (ii) | light dependent reactions/(non cyclic) photophosphorylation;
(not: Z scheme/cyclic photophosphorylation) | 1 |
| (iii) | grana/thylakoids | 1 |
| (b) | 6 | 1 |

Total 5 marks

3. (a)	sensory neurone from finger tip, cell body in root ganglion; relay neurone in grey matter; motor neurone same side of arc through ventral root to muscle.	1 1 1
(b)	sensitivity of nerve membrane lost during depolarisation/refractory period; in synapses transmitter substances diffuse from knob to post synaptic membrane	1 1
(c) (i)	general shape of spike including overshoot dip. accurate values -70 to +40 or +50 mV (width c.3ms) (allow: 68-80 + 30-60)	2
(ii)	correct labelling of depolarisation on upward and repolarisation on downward side of graph	1
(d) (i)	I proteins	1
	II phospholipids	1
(ii)	Ref. to pumps e.g. resting potential – Na ⁺ /K ⁺ pump pumps Na ⁺ out and K ⁺ in; Ref. why difference between two sides e.g. organic anions inside create pd/K ⁺ channels open; less permeable to Na ⁺ (not: ref. concentration gradient) depolarisation - impulse opens Na ⁺ channel/voltage gated channel; Na ions rush in/sudden increase in permeability to Na ⁺	1 1 1 1 1
(e)	transmitter substances synthesised in synaptic knob; impulse causes secretory vesicle to migrate to (presynaptic) membrane/Ca ions to rush in; vesicle fuses with membrane discharges transmitter substance/exocytosis; diffusion of transmitter substance across cleft; transmitter binds to post-synaptic membrane/stimulates depolarisation/reference to receptors. (Any 3 in correct sequence; no mention of transmitter substance=2 max)	3

Total 12 marks

4. (a) (i)	rod shaped;	1
(ii)	retains (red) counter stain/stains red/pink in Gram test/do not retain crystal violet; because of complex nature of cell wall/reference to lipopolysaccharide/does not contain as much murein/peptidoglycan.	1 1
(iii)	<u>grow</u> best with oxygen; (not: prefer/like oxygen) but can grow with or without <u>oxygen</u> (not: ref. aerobic/anaerobic)	1 1
(b) (i)	viable only counts living cells/cells which are reproducing/total count includes living and dead cells	1
(ii)	9 cm ³ of sterile distilled water in each tube; (not: tap water) 1 cm ³ of sample transferred to tube 1; mixed well or ref. 1 cm ³ transferred next tube in sequence; any reference to aseptic technique. (Any 3) (labelled diagram=2max e.g. 9cm ³ sterile distilled water + 1 cm ³ sample)	3
(iii)	4	1
(iv)	take/prepare 4 sterile nutrient agar plates; (idea of each dilution on a different plate needed) transfer 0.5 cm ³ /other specified volume of each to a separate plate; (allow: 0.1-1 cm ³) spread with sterile spreader; incubate plates at suitable temp./25°C; (allow: 25-40°C) count colonies; 1 colony=1 cell. (any 4 in correct sequence)	4
		Total 14 marks

5. (a) W-lag, X-exponential/log, Y-stationary, Z-death (allow: decline) 2
 (all correct for 2, 1 error = 1)
- (b) (i) (I) birth rate = death rate 1
 (II) birth rate is greater than death rate 1
- (ii) no stationary phase/longer lag phase/no death phase/doesn't flatten off 1
- (iii) can influence/build own environment; 2
 can reduce death rate with medical advances/e.g.;
 can increase food supply with intensive agriculture. (any 2)
- (iv) natural disasters e.g. earthquakes; 2
 man made disasters e.g. wars;
 climate change;
 contraception;
 AVP (any 2)

Total 9 marks

6. (a)	nephron	1
(b) (i)	A-glomerulus, B-bowman's capsule, C-proximal convoluted tubule, D-loop of Henle, E-distal convoluted tubule, F-collecting duct. (all correct for 3, 1 error 2, 2 errors 1) (not: letters/ref. first and second convoluted tubule)	3
(ii)	create concentration gradient/low water potential in medulla owtte. (not: reabsorption of water)	1
(iii)	longer	1
(c) (i)	ADH/antidiuretic hormone	1
(ii)	pituitary	1
(iii)	I detector - hypothalamus; II Effector wall of collecting duct	1
(iv)	Effector: left dotted line- makes more permeable right dotted line- makes less permeable	1
	Concentration: left dotted line- increase/ hypertonic right dotted line- decrease/ hypotonic	1
	volume : left dotted line- decrease right dotted line- increase	1
(d)	Haemodialysis - kidney machine blood passed through artificial membrane; peritoneal dialysis - uses peritoneum, a natural membrane lining abdomen; kidney transplant.	3

Total 15 marks

7. (a)	A	Nitrogen gas in air/atmosphere	1
	B	amino acids/protein in plants and or animals	1
	C	urea in urine/ammonia/nitrite/nitrate in soil	1
	D	Decomposition/putrefaction qualified	1
	E	Nitrifying bacteria/nitrification qual – produces nitrates in context	1
	F	<i>Nitrobacter</i> and <i>Nitrosomonas</i> , correctly linked to process	1
	G	ammonium compounds to nitrites	1
	H	nitrites to nitrates (G+H not: just arrows on diagram)	1
	I	denitrifying by <i>Pseudomonas</i>	1
	J	in anaerobic conditions	1
	K	Nitrogen fixing bacteria/nitrogen fixation	1
	L	convert nitrogen gas into soluble/organic nitrogen containing compounds. e.g. amino acids	1
	M	<i>Azotobacter</i> are free living	1
	N	<i>Rhizobium</i> in root nodules (of legumes)/symbiotic	1
	O	Decay bacteria release nitrogen compounds /ammonia from dead bodies faeces and urine (any 10 from 15)	1
			Total 10 marks (max)

7. (b)	A	correctly labelled actin (thin) and myosin (thick) filaments;	1
	B	correctly labelled sarcomere;	1
	C	correctly labelled A band (length of myosin including overlap), I band, and H zone (myosin only);	1
	D	when muscle receives an impulse sarcomeres shorten;	1
	E	H and I get shorter;	1
	F	A stays the same;	1
	G	Actin and myosin become linked by cross bridges;	1
	H	action of clubbed head of myosin/ratchet;	1
	I	actin and myosin slide over each other; (max 7 from 10)	1
	J	energy provided by ATP;	1
	K	slow twitch fibres more efficient at using oxygen;	1
	L	best for marathon runners;	1
	M	fast twitch fibres use anaerobic for rapid burst of energy;	1
	N	but can only do for short periods because of lactic acid;	1
	O	best for sprinters; (max 3 from 5)	1
			Total 10 marks

BIOLOGY - BY5

No.	Answer	Mark
1.	<u>Secondary</u> succession; Pioneer; Climax community; Seres; Gross primary productivity/GPP; Pyramid of energy/energy flow diagram;	6
2. (a)	Large petals, small insignificant petals/no petals; Brightly coloured, dull/brown/green; (not: not coloured) Scented, not scented; Nectar, no nectar; Small amount of pollen, large amount of pollen; Pollen sticky/sculpted, pollen smooth/not sticky/air sacs; Pollen large/heavy, pollen small/light; Anthers/stigma outside flower, enclosed within petals; (Large) feathery stigmas, small/round stigmas; Any 4. One comparison from each pair matched boxes.	4
(b)	lack of/less genetic variation/inbreeding/increased risk of <u>genetic</u> faults/ ref. homozygous recessive. (not: no variation)	1
(c)	pollen tube delivers male gametes to egg/ovule/do not need motile (gametes)/ no water needed/pollen grains transferred by wind or insects;	1
	stops risk of dehydration of gametes;	1
	Tough exine/outer wall;	1
(d)	<i>Fruit from fertilised ovary</i> ; (not: ref. ovary wall/pericarp)	1
	<i>Embryo plant from zygote</i> ; (not: fertilized egg cell)	1
	<i>Testa from integuments</i> ;	1
	<i>Seed from ovule</i> ; (not: ovum)	1

3. (a) (i)

Gametes	HW	HR	hW	hR
HW	HW HW	HR HW	hW HW	hR HW
HR	HW HR	HR HR	hW HR	hR HR
hW	HW hW	HR hW	hW hW	hR hW
hR	HW hR	HR hR	hW hR	hR hR

1 mark per column; if wrong- gametes-1, letters -1;

4

(ii) Phenotypes

Horn less roan 6

Horn less red 3

Horn less white 3

Horned roan 2

Horned red 1

Horned white 1

3 marks all phenotypes + 3 for all correct matching ratio

-1 per error, no ecf from (i)

6

(b) mutation;

Variation in population;

(Light coats and dark skins) advantage/better adapted;

Greater chance of survival/selective advantage(in context);

Passed on alleles to offspring; (not: genes)

Repeated over many generations/frequency of alleles increased.

Max 4

4. (a) Wolf, dingo, coyote, golden jackal;
Interbreed producing fertile offspring; **2**
- (b) share same gene pool;
Similar physiology;
Similar behaviour;
Similar genetic makeup/ref DNA;
Similar proteins;
Similar morphology
Similar genetic profile (not: same/same number of chromosomes) **Max 2**
- (c) (i) Black backed and side striped jackal
(not: jackals/golden jackal) **1**
- (ii) reproductive cycles different;
Difference in reproductive/courtship behaviour
/pheromones;
Changes in chromosome numbers/ploidy;
Different activity times;
Mechanical isolation;
Any sensible suggestion e.g. gamete attack by immune system. **Max 1**
- (d) Chromosomes not homologous; (not: ref. number)
Cannot pair/form bivalents;
During prophase 1 (of meiosis);
Meiosis does not take place;
no gametes produced; **Max 4**

5. (a) Each strand of DNA used as a template to make a new DNA strand;
New DNA (mols) made of an old/original strand linked to a new strand; (not: if ref. to new DNA strand) 2
- (b) (i) nitrogenous bases/organic bases/purines and pyrimidine bases/ all four named
(not: bases/letters only/nucleotide) 1
- (ii) spin (at same) speed;
(Same) time;
(Same) density/concentration of gel;
(Same) temperature
(not: pH/ref. volume or mass) Max 2
- (c) (i) Tube A all heavy/ N^{15} ;
Tube B DNA mixture of heavy and light (so intermediate position)/ $N^{15} + N^{14}$;
DNA in B must be made from one strand of heavy and one light;
If conservative would get two bands in light and heavy position. Max 3
- (ii) C intermediate and light equal amounts;
(touching dotted lines)
D intermediate and light more light than intermediate
e.g. shown as thicker or wider line;

- 6. (a) (i)** X transcription;
Y translation; **2**
- (ii)** 8 marks on diagram **8**
S- to line between anticodon/codon; T – to solid line not dotted line; R not if just labelled to black circle
- (b)** CCT ACA GCA CGT
All correct 2 marks
2/3 correct 1 mark
- 7. (a) (i)** A Spermatogonia
B Primary spermatocytes
C Secondary spermatocytes
D Spermatids
2 correct for 1 mark
- (ii)** Sertoli cell. (not: nurse cell) **1**
- (iii)** nutrition of sperm cells/supplies oxygen/removes waste products; not protection unqualified. **1**
- (b) (i)** Mitosis (correct spelling only) **1**
- (ii)** 4 cells produced (from each/B) during meiosis

8. (a)
- A. Less carbon dioxide removed from air;
 - B. Ref global warming; (not: greenhouse effect)
 - C. ref one consequence of global warming e.g. melting ice caps/flooding/climate change/greenhouse effect qual.;
 - D. destruction/loss of (natural) habitats;
 - E. leads to reduction in biodiversity;
 - F. Extinction of some species (not: ref. destroys).
 - G. Some plants may have clinical/medicinal properties, lost before investigated;
 - H. some species may have alleles which could be introduced into gene pool of related species;
 - I. Soil erosion or desertification/localised flooding;
 - J. ref less protection of soil from drying/wind helps to increase desertification;
(I+J in context of removal of roots)
 - K. effect climate, ref transpiration/water cycle/rainfall patterns;
 - L. replanting;
 - M. allow (natural) regeneration;
 - N. coppicing/selective cutting;
 - O. ref to efficient forestry, planting trees of correct/endemic/local species/correct distance apart;
 - P. control pests and diseases;

Max 7 for A-K

- (b)
- A. Cells from Islets of Langerhans;
 - B. gene for insulin located;
 - C. gene/DNA probe;
 - D. (cut gene) restriction endonuclease /enzyme;
 - E. mRNA for insulin;
 - F. reverse transcriptase qual.; (e.g. make DNA from RNA)
 - G. DNA polymerase qual.;(e.g. make DNA double stranded)
 - H. sticky ends on gene;
 - I. bacterium/*E.coli* (is source of);
 - J. plasmids;
 - K. same restriction endonuclease;
 - L. sticky ends with complementary bases;
 - M. DNA ligase;
 - N. ref marker/tracer genes/antibiotic resistance;
 - O. recombinant DNA.
 - P. introduced back into bacterium/ *E. coli*;



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