



# **GCE MARKING SCHEME**

## **BIOLOGY AND HUMAN BIOLOGY AS/Advanced**

**SUMMER 2010**

## **INTRODUCTION**

The marking schemes which follow were those used by WJEC for the Summer 2010 examination in GCE BIOLOGY AND 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

Question			Mark Scheme	
1	<b>Feature</b>	<b>Bacterium</b>	<b>Virus</b>	3
	Possess nucleic acid	✓	✓	
	Surrounded by a protein coat	X	✓	
	Ribosomes in cytoplasm	✓	X	
	(not: hybrid ticks ✕ )			
2	(a)	(i) Fibrous;		1
		(ii) Polypeptide chains; (not: proteins) Three chains; (not: strands) (Three) alpha helices; Tightly/closely bound; Held together by hydrogen bonds:		(3 max)
		(iii) Structural/relevant example e.g. tendons or named tissue strengthened. (not: strength or name of tissue unqual./tensile strength)		1
	(b)	(i) Four chains vs. three; Iron/prosthetic/haem group vs. none; Compact vs. non-compact/long fibres vs spherical; 3 polypeptide chains the same vs 2 different polypeptide chains; Secondary structure vs. quaternary structure: (not: more complex)		(3 max)
		(ii) Hormones/enzyme/ antibodies/plasma proteins. (not: specific examples)		1

**9 MARKS**

<b>Question</b>		<b>Mark Scheme</b>
3	(a) (i) At higher temperature/60° enzyme/substrate has more kinetic energy/vibrates more; (not: ref. movement) More Enzyme substrate complexes formed/ more <u>successful</u> collisions; More product formed/greater rate of reaction.	3
	(ii) At 60°C enzyme reacts rapidly; (Gradual) denaturation of enzyme occurs or description; All substrate not reacted;	3
	(b) All substrate converted to product. (not: active sites full)	1
	(c) Lower temperature, less kinetic energy/fewer vibrations; Fewer enzyme substrate complexes formed/fewer <u>successful</u> collisions; Some substrate remains after 60 minutes; (not: reaction has not ended) Maximum product formation not yet achieved.	(3 max)

**10 MARKS**

<b>Question</b>	<b>Mark Scheme</b>
4 (a) (i) Can be re-used; Greater stability; Despite variations in temperature/pH; Easy to remove product/product not contaminated with enzyme; More than 1 enzyme can be used/enzymes added or removed easily. Can be used in a continuous production system	(2 max)
(ii) Colour change only/can only indicate if its present or absent; Subjective nature of judgement of colour/qualitative rather than quantitative.	2
(b) (i) Measures metabolite/named substance; By converting chemical signal/energy into an electrical signal/energy.	2
(ii) Combines with substrate/glucose; At active site; To produce product.	(2 max)
(iii) Glucose from blood diffuses into gel; Acted on by glucose oxidase; Amount of product released proportional to glucose concentration; Electrode activated by product; Generates electrical potential/signal; Size of potential directly proportional to mass of product.	(4 max)

**12 MARKS**

Question		Mark Scheme
5	(a) <b>Cell X</b>	(3 max)
	Large number of vesicles (not: lysosomes)	No/small number vesicles;
	Large amount of RER/ribosomes	Little RER/ribosomes;
	Few mitochondria	Large number of mitochondria;
	No microvilli	Microvilli; (not: villi /membrane folds)
	More nuclear pores (not: ref. cell size)	Fewer nuclear pores.
(b)	A = Transport substances to plasma/cell membrane; B = Protein synthesis; C = <u>ATP</u> synthesis (not: produce energy/ref. respiration).	3
(c)	Exocytosis; Transport vesicle fuses with plasma membrane; Break in membrane to allow expulsion of secretion.	(2 max)

**8 MARKS**

<b>Question</b>			<b>Mark Scheme</b>
6	(a)	Mitochondrion.	1
	(b)	(i) Advantage: *Higher energy yield <u>per unit mass</u> /higher yield <u>per g</u> . Disadvantage: More oxygen required for respiration.	2
		(ii) Heat/thermal/electrical insulation; (not: insulation unequal.) *Better source of metabolic water; Buoyancy; Protection against knocks (not: protection unequal.)  (points marked * are interchangeable and could be credited in either (i) or (ii) but not credited in both)	(2 max)
	(c)	(i) New tissue manufacture/growth qualified/repair; Enzyme manufacture.	2
		(ii) Breaking a bond; (not: molecule broken down) Insertion of a molecule of water/chemical addition of water (not: adding water)	2
		(iii) Glucose; (not: beta glucose) Amino acids.	2

**11 MARKS**

<b>Question</b>			<b>Mark Scheme</b>
7	(a)	(i) Blood clots/infection.	1
		(ii) Water has highest water potential/0 compared with -476/-896kPa; Water passes down water potential gradient/from high to low water potential; Passes into cell by osmosis.  (not: ref. water concentration)	3
	(b)	Diagram showing <u>crinkled</u> cells; (not: showing plant cell or nucleus) Higher water potential inside cell; Water passes out of cell (causing shrinkage/distortion).	3

**7 MARKS**



**Question****Mark  
Scheme**

- 8 (a)
- A Interphase, replication of DNA; (not: DNA doubles)
  - B Also replication of organelles;
  - C Synthesis of rRNA/proteins/ATP; (not: metabolic activity)
  - D Prophase chromosomes appear as two chromatids/ ref, condensation;
  - E Joined at centromere;
  - F Nuclear membrane disappears;
  - G Chromosomes line up at equator during metaphase;
  - H Spindle formation;
  - I Centromere divides at anaphase;
  - J Chromatids/chromosomes to opposite poles at anaphase;
  - K Contraction/shortening of spindle fibres;
  - L Nuclear membrane reforms during telophase;
  - M Cytokinesis/cell division occurs by furrowing of membrane/cleavage;
  - N Cytoplasm splits/divides;
  - O Centrioles replicate / move to poles.

Note: ref. to each event must take place in correct stage

**10 MARKS**

**Question****Mark  
Scheme**

- 8 (b) A Both contain the elements CHON;
- B Both can link to form larger molecules/polymers/ref. monomers;
- C Nucleotides consist of nitrogenous base;
- D plus pentose and phosphate; (not: 5C sugar)
- E bases are pyrimidines and purines;
- F Amino acids possess an amine/NH<sub>2</sub> group/carboxylic group;
- G Variable R group;
- H More/20 types of amino acid;
- I Amino acids link together by peptide bond formation/sugar phosphate backbone;
- J Five different bases in nucleotides/5 named; (not: letters only)
- K Bases can undergo complementary base pairing;
- L Adenine with thymine or uracil and guanine with cytosine;
- M By hydrogen bonds;
- N Nucleotides carry genetic information;
- O Sulphur containing vs. phosphate containing.

**10 MARKS**

## Biology BY2

		Question	Mark Scheme
1	(a)	(i) Species.  (ii) Ventilation.  (iii) Hydrophytes.  (not: aquatic / hygrophytes)	1  1  1
	(b)	[For 'distinguish' must refer to both terms]. Apoplast is pathway (for water) via cell walls, symplast via living protoplast / cytoplasm / plasmodesmata / cell membrane 1 mark each pathway, no mark if only 1 mentioned (not: ref. gaps between cell walls) allow: between cell walls	2
			<b>5 MARKS</b>
2	(a)	(i) Drawing showing 2 guard cells curved and pore open AND drawing showing guard cells inner edge straighter and pore closed (1); Wall adjacent to pores thicker (1). Touching top + bottom	2
	(ii)	Chloroplasts. (right + wrong = 0)	1
	(b)	Stomata will be open to allow carbon dioxide in / gas exchange for photosynthesis.  closed at night to avoid water loss. / transpiration reduced	1  1
	(c)	1. $K^+$ / Potassium <u>ions</u> pumped into <u>guard cell</u> (by active transport) (not: diffused) 2. Starch to malate. 3. Solute/ water potential in the (guard cells) lowered. (not: WP)  4. Water moves in by <u>osmosis</u> / down a water potential gradient 5. (Turgor increases) as cells expand they curve/bend (because inner walls are thicker than outer walls)  [4/5]	4
			<b>9 MARKS</b>

Question		Mark Scheme										
3	(a) linked marks	(i) <u>B</u> iconcave (discs)/no nucleus. (allow: no organelles / labelled diag) allow: full description (not: diagram alone)	1									
		(ii) Biconcave (discs) - increase SA:vol/flexibility/no nucleus-room to pack in haemoglobin.	1									
	(b)	<table border="1"> <thead> <tr> <th></th> <th>A</th> <th>B</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td>96</td> </tr> <tr> <td></td> <td></td> <td>20</td> </tr> </tbody> </table>		A	B			96			20	1
	A	B										
		96										
		20										
	(c)	(i) Increased carbon dioxide/increased acidity/lower pH (not: ref. oxygen/temperature)	1									
		(ii) Bohr shift/effect.	1									
		(iii) Makes more oxygen available (during increased activity)/dissociates more easily/owtte/lowers affinity for oxygen (not: ref speed/taking up O <sub>2</sub> )	1									
	(d)	(i) Curve drawn to left of A. (start + end at same point as A + B)	1									
		(ii) At low levels of oxygen/low partial pressures; Hb has greater affinity/will become fully saturated/Hb will be able to absorb more oxygen from environment. (not: lower amount/ref. llamas having affinity)	1									
		(iii) More red blood cells/higher Hb concentration/more Hb (Not: ref. affinity/viscous)	1									

**10 MARKS**

Question		Mark Scheme
4	(a) Chordata/chordates (accept vertebrata/vertebrates).	1
	(b) (i) Pentadactyl (limb).	1
	(ii) B.	1
	(ii) Phoca.	1
	(c) (i) Homologues/homologous. (not: analogous/adaptive radiation)	1
	(ii) They suggest the existence of shared/common ancestors (not: similar ancestors)	1
	(d) (i) 6.	1
	(ii) Macroderma gigas.	1
(e)		1

**9 MARKS**

<b>Question</b>			<b>Mark Scheme</b>
5	(a)	(i) Meiosis (correct spelling). (ii) Fertilisation. (iii) Zygote. (allow: mitosis) (iv) Mitosis. (correct spelling)	2
		[4 correct = 2, 3 correct = 1]	
	(b)	X - haploid, Y - diploid. Colonise area quickly/reduce parasite transmission	1
	(c)	(i) <u>Rapid</u> increase in <u>numbers</u> /energy for mating is saved/where environment is stable/ useful features maintained. (not: its quicker/one parent needed/clones)	1
		(ii) Variation/variety in offspring needed to <u>adapt</u> to new conditions or example/survival advantage;	1
		(sexual reproduction) leads to <u>variation</u> .	1
	(d)	(i) Joining together gametes/ <u>fusing</u> of <u>sperm</u> and eggs (sperms introduced) inside (female's) body/reference to intromittent organ. (not: zygote formation)	1
		(ii) Reduced number of gametes produced/more chance of gametes meeting/fertilisation/less chance of gametes being wasted; allows (male) gamete to become independent of water ref. prevent dehydration; embryo/zygote can be better protected; (not: it/offspring/baby) resistant stage in life cycle/ref. shelled egg. (any 3)	3
		(iii) Embryo can receive nutrition during development.	1

**10 MARKS**

Question		Mark Scheme
6	(a) (i)	P - herbivore, Q - carnivore. [Both for 1] 1
	(ii)	P <u>incisors</u> in lower jaw only (with horny pad) for cutting plants/interlocking (W-M) <u>molars</u> for <u>grinding</u> (tough fibrous material) /enamel ridges/tooth continues to grow/diastema/bolus formation/ tongue action/AVP (not: large molars) 1
		Q - sharp incisors to grip and tear flesh from bone/large canines for seizing or killing prey/tearing flesh/carnassials for shearing flesh/ slicing/crushing bones 1
	(b) (i)	Short gut in carnivore reflects ease with which <u>protein</u> is digested compared with <u>cellulose</u> . (or reverse argument). (not: meat/plant material) 1
	(ii)	(cud mixed with) cellulose digesting bacteria/cellulase produced by bacteria; (allows cud to be) regurgitated and (chewed again); allows water to be <u>re</u> -absorbed; correct use of term rumen; i.e. presence of bacteria/first chamber some absorption e.g. of fatty acids/keratinised lining [Any 4] 4
	(iii)	Carnivores catch prey only periodically and can use stomach to store catch until next time they make a kill/diet mainly protein and stomach is where protein is digested/can take in large quantities in one go. (not: ref. chewing) 1
	(iv)	P has a longer colon. (allow: ref. large intestine) (not: small intestine) 1
	(c) (i)	One layer (has fibres) arranged <u>longitudinally</u> , one has <u>circular</u> fibres. 1
	(ii)	Peristalsis. 1
	(iii)	S - sub-mucosa, T - mucosa. [Both for 1] 1

(iv)

Structure	Function
Blood vessels/capillaries.	Carry/transport dissolved, products of digestion (to liver) or specific example
Lymph vessels/lymphatics.	Transport lipids.
Nerves.	Co-ordinate muscular Control secretion contractions in peristalsis.
Glands/gastric/brunners	Secretion of enzymes or named/alkali/acid secrete mucus/gastic juice/intestinal juice

[Any 2, 1 for each structure and 1 for each corresponding correct function]

**17 MARKS**

(not: lacteals/goblet cells/crypts of lieberkuhn/elastic fibres/absorption)



Question		Mark Scheme
7	(a)	
A	Leaves (are flat) and have large surface area to <u>absorb</u> maximum light/CO <sub>2</sub> /gas exchange	1
B	Leaves can grow towards/orientate with light/sun to expose maximum area.	1
C	Leaves thin to allow light to penetrate to lower layers.	1
D	Cuticle and/or epidermis are transparent to allow light to penetrate to mesophyll.	1
E	Palisade cells elongated to reduce number of cross walls to absorb light.	1
F	Palisade cells packed with chloroplasts to increase photosynthetic capacity/light absorption.	1
G	Chloroplasts can move/circulate inside cells to gain best positions for absorbing light.	1
H	Spongy mesophyll cells are moist/wet surface or have large surface area for gas exchange/absorption of gases.	1
I	Xylem to supply water and/or phloem to remove sugar.	1
J	Leaves thin (i.e. overall thickness) to reduce distance for diffusion.	1
K	Air spaces in spongy mesophyll allow circulation of gases/ cut down distance for diffusion into cells/gradient for uptake.	1
L	Stomatal pores permit entry and exit of gases/sub stomatal/intercellular spaces in spongy mesophyll allow supply of carbon dioxide and removal of oxygen/gas exchange between outside and inside leaf.	1
M	Waxy cuticle on upper surface reduces water loss (by evaporation) or waterproofs the leaf.	1
N	Stomatal pores in <u>lower</u> epidermis reduce water loss (by evaporation).	1
O	Guard cells can close stomatal pores/control opening to reduce water loss.	1

(allow: ecf for ref. 'traps' light or 'stops/prevents' water loss)

**10 MAX**

Question		Mark Scheme
7	(b)	
A	Xylem transports water (and mineral salts) (from the roots to leaves).	1
B	Phloem transports the soluble products/sucrose/sugars/organic molecules/amino acids/source to sink of photosynthesis from leaves to other parts of the plant. (not: glucose)	1
C	Xylem is made of vessels and tracheids.	1
D	Xylem vessels form continuous tubes/ lose end walls (to carry water throughout the plant).	1
E	Their (secondary) wall is lignified to waterproof and/or strengthen/or support them/stop them (collapsing under suction/tension).	1
F	Mature Xylem vessels are dead and cytoplasm has gone so there is nothing to impede flow.	1
G	Tracheids have tapered ends that fit together and/or pits to allow transfer of water between cells.	1
H	Phloem is made of sieve tubes and companion cells.	1
I	Sieve tube cells lose most of their organelles/are still alive when mature.	1
J	Sieve tube cells have perforated sieve/end plates that allow solutes/sugar to pass through.	1
K	(Sugar solution) flows in both directions.	1
L	Companion cells have all the organelles/communicate by plasmodesmata/are responsible for keeping sieve tube cells alive/provide ATP	1
M	Any reference to fibres or parenchyma in either.	1
N	Cohesion-tension/capillarity/adhesion in xylem. Correct use of terms with ref. water molecules.	1
O	Correct use of terms in correct context: Reference to mass flow/cytoplasmic streaming/protein filaments in phloem.	1

**10 MAX**

## Biology BY4

- 1 (a) (i) X ATP  
Y ADP 1 mark for both (1)
- (ii) Active transport; Nerve impulse;  
Muscle contraction; Light independent stage of p/s;  
Glycolysis;  
Protein synthesis / cell division; (Any 2)
- (iii) ATP synthetase / ATPase (1)
- (b) (i) Electron transport (chain) (1)
- (ii) A Proton pumps (1)  
B stalked particle / ATP synthetase / ATP ase (1)
- (iii) High energy electrons/eq;  
Fuel (eq) the proton pumps;  
Which pumps protons into the inter-membrane space;  
This creates an electrochemical gradient/eq;  
Which causes H<sup>+</sup> to flow through a stalked particle;  
Synthesising ATP;  
Correct reference to chemiosmosis;  
Any 4 but in THE CORRECT SEQUENCE (4)

**Total: 11 MARKS**

- 2 (a) 1 Obligate aerobes; (1)  
at the top of the test tube in order to absorb maximal oxygen/eq; (1)
- 2 Obligate anaerobes; (1)  
gather at the bottom to avoid oxygen/eq. (1)
- 3 Facultative anaerobes; (1)  
gather mostly at the top, since aerobic respiration is the most  
beneficial/but as lack of oxygen does not inhibit them, they can  
be found all along the test tubes. (1)
- (b) *C. perfringens* is an obligate anaerobe;  
More/high pressure oxygen (is forced) into the wound;  
*C. perfringens*/bacteria cannot metabolise / is inhibited in the presence  
of O<sub>2</sub>; (not: respire)  
Bacteria stop dividing / producing toxin;  
Allows antibiotics/immune system time to destroy bacteria. (Any 2)
- (c) Suitable temperature (not heat);  
Suitable pH;  
Carbon source/glucose\*;  
Nitrogen source/eq\*;  
Vitamins\*;  
Mineral salts\*; (1)  
[or nutrients instead of \*]  
Water; Any 3 for 1 mark

**Total: 9 MARKS**

3 (a) Ribosomes are not involved in respiration/eq; (1)

Mitochondria cannot metabolise glucose/have no enzymes for glucose breakdown / have no carrier for glucose in the membrane;

Pyruvate is broken down in the/Link reaction/Krebs cycle producing CO<sub>2</sub>;

No lactate with either substrate as mitochondria are not involved in anaerobic respiration; (Any 2)

CR breaks down glucose anaerobically to lactate;

Enzymes for pyruvate breakdown are in mitochondria/Link or Krebs occurs in mitochondrial matrix;

Cytoplasmic residue cannot metabolise pyruvate (Any 2)

(No source of reduced NAD)

(b) Cyanide must stop Krebs cycle/Link reaction (since no CO<sub>2</sub> is produced);

Non competitive inhibitor;

Of the ETC/(last) proton pump;

Cyanide is a respiratory inhibitor / inhibits respiration; (Any 2)

**Total: 7 MARKS**

4 (a) Ultrafiltration;  
 High hydrostatic pressure/high pressure in glomerular capillary/glomerulus;  
 Forces small molecules through the capillary (walls) into capsule;  
 through basement /dialysing membrane; (Any 3)

(b) (i) podocytes, (1)  
 (ii) Capillary shows pores/fenestrations/small gaps; (1)

(c) (i) Selective reabsorption (1)  
 (ii)

Transport mechanism

Molecule	Facilitated Diffusion	Active Transport	Osmosis
Glucose	✓	(✓)	
Amino Acids	✓	(✓)	
Water			✓
Sodium Ions		✓	

One mark per column (3)

(d) Short length (in fresh water mammals)  
 Because water is readily available so low  $\Psi$  not needed; (1)  
 Medium length (in terrestrial mammals)  
 Water reasonably available; (1)  
 Long length (in desert mammals)  
 Water needs to be conserved so medulla with low  $\Psi$  required; (1)

(e) ADH is not being secreted;  
 Collecting duct cells are not responsive to ADH;  
 So reduced water uptake into the medulla; (Any 1)  
 Collecting duct cells less permeable.

**Total: 13 MARKS**

- 5 (a) Decay/putrefaction/decomposition/ammonification; (1)
- (b) *Nitrosomonas/nitrococcus* (1)  
*Nitrobacter* (1)
- (c) Denitrification (1)  
 Anaerobic/eq (1)
- (d) (i) *Rhizobium* (1)
- (ii) Hb absorbs/has an affinity for O<sub>2</sub> (1)
- (e) Respiration would demand high use of O<sub>2</sub>;  
 O<sub>2</sub> is the final electron acceptor in the ETC;  
 (And so rapidly) converts O<sub>2</sub> to water (Any 2)
- (f) Waterlogged soil/bogs are anaerobic;  
 Have low nitrate content/denitrification occurring;  
 Insect's protein is digested;  
 Releasing *amino acids/ammonium* ions;  
 Which can be used for plant protein/nucleic acid synthesis; (Any 2)  
 (not: nitrates or growth)

**Total: 11 MARKS**

- 6 (a) Sunlight/Red light is absorbed during daylight;
- Pr/ P660 is converted to Pfr/ P730;
- Pfr is active and inhibits flowering (in short day plants);
- In Exp1 lots of light/high Pfr so no flowering (inhibited);
- In Exp2 not enough Pfr/low Pfr (no inhibition) so flowering;
- In Exp3 the Pr is (rapidly) converted back to Pfr; so inhibition of flowering; (Any 3)
- (allow: converse points)
- (b) Short day plant (1)
- (c) Allows plant breeders to cross pollinate flowers which would not usually flower at the same time
- Preparation of flowering plants for known dates – Christmas/Easter/Mothers' Day/eq (1)

**Total: 5 MARKS**

- 7 (a) Large/intense/dark spot of G3P indicating a lot has been synthesised;
- First product after  $^{14}\text{CO}_2$  added is G3P;
- Smaller quantity of sugar phosphates produced later; (Any 2)
- (b) More sugar phosphates produced;
- More triose phosphate produced;
- Presence of amino acids indicate other compounds being synthesised;
- Presence of citric acid;
- Any comment on Krebs cycle intermediates being used to synthesise amino acids; (Any 3)
- Sucrose present.



(c) Presence of nucleic acids/ATP/ADP/eq.;  
Starch;  
Proteins;  
Lipids/glycerol/fatty acids; (Any 2)  
Cellulose.  
(not: RUBP/ glucose/fructose/ethanol)

(d) Reduced NADP/NADPH/NADPH<sub>2</sub>  
ATP 1 mark for both (1)

(e) *Cyclic*  
Light absorbed/harvested by PS 1/P700;  
High energy electrons used to fuel proton pump;  
Creating EC gradient/eq.;  
Allowing ATP synthesis/ATP as a product;  
Electrons return to PS1/P700/same PS (I); (Any 2)

*Non Cyclic*

Light harvested/absorbed by both PS;  
High energy electrons passed to carriers;  
Replaced in PS2/P680 by photolysis of water/eq.;  
Electrons replaced in PS1/P700 from PS2/P680;  
Electrons from PS 1/P700 passed to NADP;  
Products are reduced NADP and ATP (Any 4)

**Total: 14 MARKS**

8 (a) Chemical control

*Advantages*

- A. Very effective/quick/cheap means of control
- B. Chemicals can be applied on a small area (e.g. Market gardening) /  
Application does not require a high level of skill/knowledge

*Disadvantages*

- C. Chemicals are not specific/may eradicate useful insects
- D. Resistance may occur (not: immunity)
- E. Killing of fish/birds/mammals/bioaccumulation;
- F. Risk to human health/contamination of rivers.

Biological control

*Advantages*

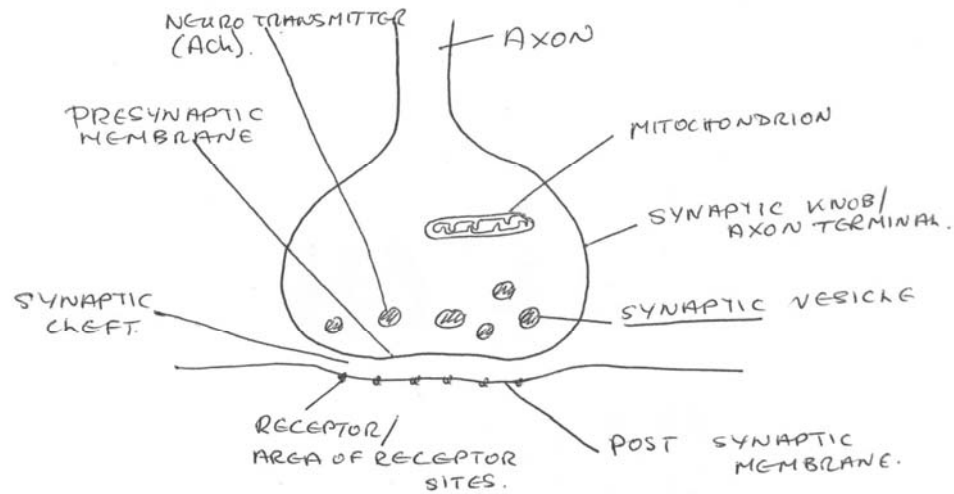
- G. Highly specific to one pest
- H. Long term control if predator: prey balance / Use in glasshouses
- I. May be inexpensive in long term
- J. No environmental contamination

*Disadvantages*

- K. Slow build up/have to accept some damage to crop/'not perfect'/pest  
not totally eradicated;
- L. Few successful examples
- M. Skill and research is expensive/detailed life cycle knowledge is  
needed
- N. Frequent input of predator needed / may only be of use in closed  
systems (greenhouses)
- O. Predator may become a pest itself/suitable e.g. (cane  
toads/hedgehogs on Uist)

*Any 10 from the 15 marks available*

(b) A. Decent drawing of a synapse.



/Na channels

B.C.D. With 6 labels (2 correct labels per mark)

- E. When action potential arrives at axon terminal  $Ca^{2+}$  moves into synaptic knob
- F. Synaptic vesicles fuse with presynaptic membrane
- G. Neurotransmitter/Ach/eq released by exocytosis
- H. Diffuses over synaptic cleft
- I. ACh binds to receptors on post synaptic membrane
- J. Causing the protein channels to open/Na gates open
- K.  $Na^+$  flows in through channels
- L. So depolarising the post synaptic membrane
- M. With sufficient depolarisation, an impulse/action potential is generated in the post synaptic neurone
- N. Some comment on the breakdown of ACh by (A)Ch-esterase
- O. Diffusion back into axon terminal through presynaptic membrane/Use of ATP for re-synthesis and packaging

Any 10 from the 15 marks available

## Biology BY5

Question	Mark Scheme
1 (a) A = Seminal vesicle	1
B = Vas deferens (not: sperm duct)	1
C = Prostate (gland) (not: Prostrate)	1
D = Urethra (correct spelling required)	1
E = Epididymis	1
F = Seminiferous tubule	1
(b) Seminiferous tubules (A. Germinal epithelium)	1
Spermatogenesis; (not: spermiogenesis)	1
<u>Primary</u> spermatocytes;	1
<u>Secondary</u> Spermatocytes;	1
Spermatids;	1
Sertoli. (not: nurse)	1

**12 MARKS**

Question		Mark Scheme
2	(a) Shaded on diagram	1
	(b) B + D (both needed)	1
	(c) Haploid kangaroo C (not: if more than 1 letter)	1
	Diploid mosquito A	1
	(d) (i) Diploid means <u>a pair</u> (of each) chromosome (not: 2 chromosomes present) because meiosis could not take place/ because haploid can't be less than 1 or equiv.	1
	(ii) Mitosis. (correct spelling required)	1
	(e) (i) Q S M N P R	1
	(ii) Q	1
	P	1
	Q	1
	S	1
	R	1
	(If words used minus 1 mark)	

**12 MARKS**



Question			Mark Scheme
4	(a)	(i) A A U A G A A A G C C C U A C	1
		(ii) tyr, arg, ala, ser, leu. (abbreviation or full name)	1
		(iii) Start codon / AUG (allow: ref. 5-3 direction) (not: punctuated/stop codon)	1
		(iv) Mutation (not: chromosome mutation).	1
		(v) Amino acid sequence different/one less/ thr, glu, his, arg/alters primary structure/different polypeptide chain. (not: sequence is wrong/different protein/ref. reading frame)	1
	(b)	(i) 4	1
		(ii) Switches on gene which codes for gamma chain; (not: fetal haemoglobin/HbF)  mRNA made;  Transcription or description;  mRNA translated or description;  Ribosomes;  Ref <u>role</u> tRNA;  Ref formation of <u>peptide</u> bonds.  Max 4	4
		(iii) Reduced oxygen supplied to tissues/haemoglobin doesn't carry as much oxygen (not: no oxygen/ref. affinity)	1
		(iv) Foetus would not be provided with sufficient oxygen/ Oxygen would not be supplied to tissues until pp of oxygen low/affinity for oxygen too high. (not: higher)	1

**12 MARKS**

**Question**

**Mark  
Scheme**

5 (a) Egg taken;  
  
Nucleus/DNA removed;  
  
Nucleus/DNA (from adult dog Trakr) taken from a body cell (skin)  
  
placed into enucleate egg/2 cells fused.  
  
Stimulated to divide;  
  
Placed/implanted into uterus of surrogate/bitch (allow:dog);  
  
(Who is at) correct stage of reproductive cycle.

Somatic cell nuclear transplant/transfer (not: embryo cloning)

Max 4

(b) (Somatic) mutation;  
  
Environmental influence or description;

Different ages. (not: cloned at different times)

Max 2

(c) a. More offspring produced than can survive, overproduction;  
b. Numbers in a species remain constant;  
c. Large number die;  
d. Struggle for survival/competition;  
e. Variation or description of coat colour;  
f. Selection pressures favour one phenotype  
g. Those with beneficial alleles better chance of survival/selective advantage;  
h. Reproduce/breed;  
i. Pass on beneficial alleles to offspring.

Max 4

**10 MARKS**



Question		Mark Scheme
6	(a) <i>Restriction endonuclease</i> , cuts DNA into smaller segments/at specific base sequences. (not: cuts genes/removes gene from DNA)	1
	<i>DNA ligase</i> , joins sections of DNA together/splices genes. (not: joins sticky ends)	1
	<i>Reverse transcriptase</i> , enzyme which uses RNA as a template for making a DNA mol. (not: converts RNA into DNA).	1
	<i>Marker gene</i> , a gene which enables the detection of a bacterium which has taken up a genetically modified plasmid/with the gene.	1
	<i>PCR</i> , (in vitro) replication of <u>DNA</u> molecule, to give multiple <u>copies</u> (amplify DNA)	1
(b)	(i) Determine sequence of bases throughout all human DNA; Identify genes formed by bases; Find location of genes; Produce database of genes. Max 2	2
	(ii) Identification of carriers/allow genetic counselling; Checking embryo before implantation; Pre/post natal testing; Checking to see if there is a risk of a condition developing; Extra screening/regular health checks/life style advice; Drug targeting; Possibly gene therapy/forensic/identity. Max 2	2
	(iii) Cause anxiety; Should a line be drawn between medical treatment and enhancement; Ref problems if information gets into wrong hands, insurance, employment/discrimination, etc. (not: designer babies) Max 1	1

**10 MARKS**

**Question**

**Mark  
Scheme**

- 7 (a) A = Energy (in form of organic mols) passing from one trophic level to another.  
(not: through food chain/between consumers)
- B = Photosynthesis/light energy to chemical energy.
- C + D = Energy loss, not all wavelengths of light absorbed/some reflected/transmitted;  
Latent heat of evaporation;  
Loss as heat/ by radiation/convection.
- (Any 2 marks from 3 for C + D energy loss from plant)
- E = Loss of energy from plant by respiration.
- F = Ref NPP and GPP.
- G = Calc of efficiency = 1% or 0.8%
- H = some parts of plant not eaten / enter decomposition pathway.
- I = Respiratory loss by consumers/heterotrophs.
- J + K = Examples of what energy produced by respiration used for.
- 2 Examples from movement/anabolic / catabolic reactions/ maintaining temp/active transport.
- L = Consumers lose energy by egestion/ref. cellulose not digested.
- M = Consumers lose energy by excretion.
- O = Secondary and tertiary consumers more efficient than primary consumer/  
Calc primary to secondary or secondary to tertiary (comparison 10% to 20%).
- P = reason for difference in efficiency – more egested waste in primary consumers

**10 MARKS**

**Question****Mark  
Scheme**

- (b) A = Pollination transfer of pollen from anther to stigma.
- B = 2 examples of pollinating mechanisms from wind, insect, self, bird, water, bat, mammal. (not: specific example e.g. bee/ cross pollination unless qualified)
- C – (*After landing on stigma*) pollen grain absorbs water/ref. sucrose.
- D = Pollen tube.
- E = Tube nucleus controls growth.
- F = Enzymes/pectinase released/secreted.
- G = Digest route along ovary wall/through style/carpel.
- H = Passes through micropyle.
- I = Male gamete fuses with egg cell.
- J = Forms zygote which develops into embryo plant.
- K = Embryo plant consists of plumule and radicle,
- L = Radicle is embryo root/plumule is embryo shoot .
- M = Cotyledon, embryo/seed leaf, food store.
- O - Product of (fertilised) ovule is seed.
- P = Product of (fertilised) ovary is fruit.

**10 MARKS**

## Human Biology – HB2

1. antigens;  
bone marrow;  
antibodies;  
memory cells.

**Total 4 marks**

2. (a) (i)

Structure	Plant cell	Animal cell	Prokaryote cell
mitochondrion	✓	✓	×
ribosome	✓	✓	✓
cell wall	✓	×	✓
membrane bound nucleus	✓	✓	×

1 mark per correct row across (4)

- (ii) Protoctista and Fungi (must have both) (1)

- (b) phylum class order family genus

1 mark for size i.e. phylum at start and genus at end

Additional mark for class, order and family in correct sequence. (2)

**Total 7 marks**

3. (a) Bactericidal kills / destroys bacteria. (1)

Bacteriostatic slows / stops bacteria growing / multiplying / cell division /  
reproducing / stops metabolism/protein synthesis (1)

- (b) (i) Antibiotic has diffused/spread/moved into the agar;  
killing / inhibiting growth of bacteria. (2)

(ii) ampicillin (1)

(iii) largest clear area / zone of inhibition / most bacteria killed  
in this area (1)

- (c) (random) mutations;  
 Selection pressure favours the resistant bacteria / selective advantage /  
 resistant bacteria survive;  
 bacteria reproduce; form a clone to give a resistant population / pass on  
 resistant genes. (3)
- (d) MRSA, *Clostridium difficile* / *C.difficile* /TB /*E.coli* (1)

**(Total 10 marks)**

4. (a) (i) It takes time for sufficient bacteria to multiply; (1)  
 (ii) Bacteria produce toxins; irritate/affect gut lining (2)
- (b) (i) Bacteria may be picked up on the cloth and be transferred  
 elsewhere/bacteria grow/multiply (in food solution) on cloth (1)  
 (ii) Bacterial reproduction is slowed (not stopped) in fridge  
 (normally around 5°C). (1)  
 (iii) Exudate/blood from raw meat containing bacteria could fall  
 onto cooked food. (1)

**(Total 6 marks)**

5. (a) (i) A – leucocyte / agranulocyte / lymphocyte (1)  
 B – erythrocyte / red blood cell / red blood corpuscle (1)
- (ii) produce antibodies; in presence of antigens / attach to antigens;  
 reference to memory cells. (2)
- (iii) bi-concave disc increases surface area for oxygen uptake; (not  
 flattened)  
 No nucleus leaves more space for haemoglobin;  
 Contains haemoglobin which combines with/has an affinity for  
 oxygen;  
 Flexible shape / elastic membrane allows cells to squeeze through  
 capillaries. (not thin membrane) (2)

- (b) (i) 4.5 (kPa) (1)
- (ii) Sigmoid curve has a higher percentage saturation than a straight line;  
 Making haemoglobin more efficient at loading/or eq. oxygen in the lungs  
 /easier to saturate/higher saturation over a wide range of  $pO_2$ . (2)
- (iii) As the partial pressure of carbon dioxide increases, the saturation of  
 haemoglobin with oxygen decreases/haemoglobin has a lower affinity for  
 oxygen;  
 curve shifts to the right/figures demonstrating shift. (2)
- (iv) haemoglobin has a greater affinity for carbon dioxide / lower affinity for  
 oxygen; (1)  
 makes haemoglobin more efficient at unloading oxygen/unloads oxygen  
 more readily / oxygen dissociates from the haemoglobin more readily. (1)
- (v) hydrogen carbonate /  $HCO_3$  (1)

**(Total 14 marks)**

6. (a) (i) left ventricle has a thicker / more muscular wall / left ventricle  
 (muscle) contracts with more force. (1)
- (ii) pressure is greater / higher in atria / lower in ventricles;  
 Valves between atria and ventricles / atrioventricular valves are open.  
 (not just valves). (2)
- (b) X = atrioventricular node  
 Y = bundle of His / Purkyne tissue / Purkynje tissue (2)

- (c) (i) Allows blood to pass into ventricles / from atria / so that atria can empty;  
Before ventricles contract/so can't contract at same time. (2)
- (ii) So that ventricle contracts from the base / upwards;  
So more blood is forced out / ventricle empties completely (2)
- (d) (Since contraction of muscle starts at the base) if heart muscle at S was affected there would be no contraction but if muscle at T was affected there would be a contraction of some of the muscle resulting in a reduced force. (1)

**(Total 10 marks)**

7. (a) (i) *Taenia*:  
Suckers/hooks for attachment to gut wall  
Thick cuticle to prevent digestion / acid pH  
Inhibitors on surface of segments to prevent digestion by enzymes.  
(Any two 2 marks)
- Plasmodium*:  
Lives inside host cells so avoids attack by host /drugs/ antigens not exposed;  
Rapidly changing surface antigens / different antigenic types. (2)
- (b) (i) The higher the rainfall the greater the incidence of malaria. (1)
- (ii) High rainfall linked to water in pools / ponds / swamps / lakes;  
Mosquitoes breed in aquatic environment;  
Malaria is spread by mosquitoes / act as secondary host / mosquito is vector (Any two 2 marks)
- (c) (i) Biological control, fish / guppies feed on mosquito larvae;
- (ii) Larvae are killed when oil clogs breathing tubes (2)

**(Total 9 marks)**

8. (a) Monitoring
- A Measuring blood pressure / using a sphygmomanometer (1)
  - B Indication of healthy B.P. 120/75 (1)
  - C lower figure / diastolic pressure indicates high resistance in the arteries to the flow of blood (1)
  - D build up of material / atheroma increases resistance to blood flow/ atherosclerosis (1)
- Diagnosis
- E Electrocardiogram/ECG (1)
  - F shows electrical activity taking place in the heart muscle (1)
  - G irregularities (compared with normal activity) indicates cardiac disorders (1)
  - H e.g. arrhythmia (1)
- Treatment
- Preventative
- I reduce blood pressure by lifestyle changes – reducing body weight and taking regular exercise/stopping smoking (1)
  - J other high risk factors –high salt intake, excess alcohol (1)
  - K daily dose of aspirin – reduces ability of blood to clot (1)
- Heart attack
- L Clotbusting drugs / streptokinase (1)
  - M angioplasty (1)
  - N Inflation of balloon to restore lumen to "normal" diameter (1)
  - O open heart surgery / coronary by-pass (1)

**Any 10 from 15 marks**



8. (b) A protein breakdown by pepsin in stomach  
B proteins broken down to polypeptides  
C role of HCl/acid in activating pepsinogen to pepsin  
D polypeptides also produced by trypsin/chymotrypsin in pancreatic juice  
E intestinal juice contains endo-peptidases which cleave the middle of a peptide  
F and exo-peptidases which remove the end amino group  
G di (and tripeptides) are digested intracellularly/ on the cell surface of the ileum epithelium  
H amino acids absorbed across the epithelium by a combination of diffusion and active transport.  
I amino acids which enter the capillaries in the villi

Award mark I and any five from A – I (6)

- J caused by the presence of the protein, gluten  
K found in wheat/rye/barley  
L an enzyme in the body modifies the protein causing the immune system to react with the bowel tissue causing inflammation  
M villi of small intestine are flattened / interferes with absorption  
N symptoms range from mild; tiredness and lethargy to severe, loss of weight and acutely ill  
O treatment (lifelong) gluten-free diet.

Award any four marks (4)

### Human Biology – HB4

1. (i) B (ii) E (iii) C (3)

**(Total 3 marks)**

2. (i) phosphate  
base / adenine  
ribose / pentose sugar (3)

- (ii) protein synthesis / muscle contraction / active transport /  
nerve transmission. (Not movement or growth) (2)

**(Total 5 marks)**

3. (a) A. photosynthesis  
B. respiration  
I. combustion (3)

- (b) H (1)

- (c) (i) underline – the bacterium takes nitrogen from the air, splits it,  
and then combines it with hydrogen to form ammonium ions. (1)

- (ii) (ATP is broken down to ADP)  
but in mitochondria ADP combines with phosphate to make  
ATP. (1)

- (iii) decomposition breaks down *Azolla* into  $\text{NH}_4^+$  ions (in the soil);  
 $\text{NH}_4^+$  ions are converted to nitrites;  
nitrites are converted to nitrates. (3)

**(Total 9 marks)**

4. (a)

			Products			
	Starting point	End point	ATP	Reduced NAD	Reduced FAD	CO <sub>2</sub>
Glycolysis	glucose	pyruvate	✓	✓		
Link reaction	pyruvate	Acetyl CoA		✓		✓
Krebs cycle	Acetyl CoA	4 carbon compound	✓	✓	✓	✓
Electron transport chain (oxidative phosphorylation)	Reduced NAD or reduced FAD	water	✓			

(1 mark per row across = 4 marks)

(b) electron transport chain / oxidative phosphorylation (1)

(c) in oxidative phosphorylation chemical reaction provides energy but in photosynthesis the energy comes from light. (1)

(d) (i) animals – (pyruvate) is directly reduced to lactate by NADH<sub>2</sub> (1)

yeast – (pyruvate) converted to ethanal by removal of CO<sub>2</sub>  
then reduced to ethanol by NADH<sub>2</sub> (2)

**(Total 9 marks)**

5. (a) 5 3 3 6 (1)

(b) (i) GP increases  
TP decreases  
RuBP decreases (Must have all 3) (1)

(ii)  
I GP cannot be converted to TP, since no ATP/CO<sub>2</sub> can combine with RUBP to form GP.  
II TP can be converted to hexose /reduced NADP required to make TP from GP.  
III RuBP can be converted to GP/TP cannot be converted to RuBP since no ATP (3)

(c) water is split by light/photolysis;  
into protons and electrons;  
electrons replace those lost from chlorophyll/transferred to PSII;  
protons reduce NADP. (Any 3) (3)

**(Total 8 marks)**

6. (a) (i) single bacteria/a bacterium reproduced/clone (1)
- (ii) I dishes 1, 2 and 4 chosen as clumping has taken place in 3 & 5. (1)
- II work out mean = 32;  
dilution factor 100 x 2;  
correct answer = 6400 (3)
- (b) (i) to avoid contamination by other microorganisms (1)
- (ii) (although 37°C is the optimum) at 25°C it is less likely that harmful bacteria will reproduce (1)
- (c) (i) to prevent contamination of/from the environment (due to spillage) (1)
- (ii) to destroy bacterial spores (1)

**(Total 9 marks)**

7. (a) (i) B or C or both
- (ii) D
- (iii) E
- (iv) A
- (v) F (5)
- (b) (i)  $\frac{2 \times 100}{180} = 98.9\%/98.89\%$  (1)
- (ii) R (1)
- (iii) Q (1)
- (c) (i) increase in solute/sodium chloride/urea/less water (1)
- (ii) 1. (osmoreceptors in) hypothalamus (1)
2. (posterior lobe of) pituitary gland (1)
- (iii) decrease/lower/more negative water potential (1)

**(Total 12 marks)**

8. (a) (i) X – myelin sheath  
Y – node of Ranvier (2)
- (ii) insulation (1)
- (iii) lipid/fat (1)
- (iv) speeds rate of transmission of impulses;  
since impulses jump from node to node/ref. saltatory (2)
- (b) (i) sodium channels/gates open (in the cell surface membrane);  
Sodium ions flood/diffuse in; ATP is used up to re-establish  
the sodium-potassium pump. (Any two) (2)
- (ii) (this requires ATP) as more active neurones generate more  
action potentials/  
so more ATP is needed to provide energy for the pumps/  
ATP required for resynthesis of neurotransmitter/acetylcholine  
(Any one) (1)
- (iii) Effect – slope of action potential would be less steep;  
Explanation – diffusion gradient would be less steep / takes  
longer for sodium ions to diffuse in/ so would take longer to  
generate impulse; (2)
- (c) (i) curare blocks the receptor molecule;  
so the neurotransmitter cannot stimulate the muscle (2)
- (ii) organophosphates combine with the enzyme, cholinesterase  
which normally breaks down the transmitter;  
the neurotransmitter continues to stimulate the muscle (2)

**(Total 15 marks)**

9. (a)
- |   |   |     |
|---|---|-----|
| A | All materials are added at start/not during the process   | (1) |
| B | Sterile apparatus   | (1) |
| C | Pure (culture) of <i>Penicillium (notatum)</i>  | (1) |
| D | Sterile nutrient medium   | (1) |
| E | Aeration method/oxygen for respiration  | (1) |
| F | pH adjustment/buffer  | (1) |
| G | Filters for introduction of sterile air/oxygen  | (1) |
| H | Method of mixing qualified  | (1) |
| I | Water jacket to prevent overheating (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/harvest after growth phase/during stationary phase/after nutrient depletion          | (1) |
| M | Filter culture fluid/separate fungus  | (1) |
| N | Purify filtrate/chemically modify antibiotic  | (1) |
| O | AVP e.g. penicillin production in nature possibly to reduce competition/comparison with continuous culture. | (1) |

**(Total 10 marks)**



- (b) Marks can be obtained using well annotated diagram
- |   |  |     |
|---|--|-----|
| A | Fibre made up of myofibrils  | (1) |
| B | Sarcolemma, sarcoplasm, large numbers of mitochondria, sarcoplasmic reticulum, multinucleate, T tubules ( <i>Any 3</i> )   | (1) |
| C | Sarcomere qualified (e.g. length between Z lines, repeating units)   | (1) |
| D | Thin actin/thick myosin  | (1) |
| E | Correct reference to Z line qual. Position/start of sarcomere  | (1) |
| F | Correct reference to A band/myosin length/overlap with actin   | (1) |
| G | Correct reference to I band – actin only   | (1) |
| H | Correct reference to H zone – myosin only  | (1) |
| I | Correct reference to M line – middle of H zone / A band  | (1) |
| J | Evidence of sliding of protein   | (1) |
| K | Evidence shown by changes in width of bands – A stays the same, I band / H zone smaller  | (1) |
| L | Cross <u>bridges</u>   | (1) |
| M | Myosin heads attach / bind to actin  | (1) |
| N | Details of ratchet mechanism / description – attach, contract, release, reattach, repeat.  | (1) |
| O | Function of ATP – breaks bond between actin and myosin   | (1) |
| P | Role of calcium – binds to troponin and alters its shape.<br>Troponin is now able to displace tropomyosin which had been blocking its binding site on the actin. | (1) |

**(Total 10 marks)**



WJEC  
245 Western Avenue  
Cardiff CF5 2YX  
Tel No 029 2026 5000  
Fax 029 2057 5994  
E-mail: [exams@wjec.co.uk](mailto:exams@wjec.co.uk)  
website: [www.wjec.co.uk](http://www.wjec.co.uk)