



GCE MARKING SCHEME

**BIOLOGY/HUMAN BIOLOGY
AS/Advanced**

JANUARY 2011

INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 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

- Q.1** needed for / found in / used in /component of chlorophyll;
(allow: middle lamella / enzyme co-factors)
component haemoglobin; enzyme Co factors
component nucleic acids/DNA/RNA/ATP/ (plasma) membrane/ phospholipids/
hardens bone / nucleotide;
hardens/deposited in bones/teeth/ossification/synaptic transmission
enzyme co-factors/middle lamella (not: strengthen bones) [4]
- Q.2** cell wall;
beta/ β ;
glycosidic;
180;
hydrogen;
microfibrils; (not: microfibrines) [6]
- Q.3** (a) (i) higher water potential outside rbc/lower inside;
(not: ref solute concentration / ref water concentration)
water moves in by osmosis;
down water potential gradient;
ref. no cell wall to prevent bursting/cell
membrane unable to withstand pressure. [3]
- (ii) 4g dm^{-3} ; [1]
- (iii) different concentration/solute/ water potential of contents;
requires different concentration of external salts/water potential, for
movement of water/ to burst the cell [2]
- (b) (i) temperature/pH;
change enzyme activity/reaction rate/diffusion rate/respiration rate
(not: time/root/ref fair test) [2]
- (ii) active transport; [1]
is energy/ATP dependent;
aerobic respiration/oxygen required, to liberate energy/for ATP prod;
greater oxygen concentration produces greater uptake; [2]
- (c) * all would be 7au; [1]
cyanide inhibits aerobic respiration/ inhibits cytochrome oxidase/
stops/ reduces prevents ATP production;
when no oxygen is present there is still some uptake;
by diffusion;
which is a passive process; [2]
must have *. Plus 2 others

(Total 14 Marks)

Q.4 (a) [4]

Role	Mitosis	Meiosis
	✓	X
	X	✓
	X	✓
	✓	✓

(not: hybrid ticks)

(b) joined pair of chromatids;
chromatid labelled and centromere labelled; [2]

(c) centromere splits;
chromatids pulled to (opposite) poles;
by shortening/ contraction of spindle fibres; [3]

(d) centrioles; [1]

(Total 10 Marks)

Q.5 (a) (i) glycerol;
(3) fatty acids; [2]

(ii) ester; [1]

hydrolysis;
chemical insertion of water/water added to bond [2]

(iii) energy storage / respiratory substrate/source of energy
waxy cuticle/leaf waterproofing;
membrane structure; [2]

(Total 7 Marks)

Q.6 (a) (i) mitochondrion; [1]

(ii) aerobic respiration / production / manufacture of ATP;
(not: make ATP for respiration) [1]

(ii) A = cristae;
B = matrix; [2]

(b) metabolically active/ many chemical reactions or specified eg active transport
large amount of ATP produced/required; [2]

(Total 6 Marks)

Q.7 (a)

	DNA	m-RNA
Name of sugar	deoxyribose	ribose;
Number of carbon atoms in sugar	five	five;
Number of polynucleotide chains in molecule	two	one;
Location in cell	nucleus	nucleus + cytoplasm; (allow: RER/ ribosomes)

[4]

(b) (i) base pairing;
Complementary/ adenine with thymine;
not identical because of experimental error;

[3]

(ii) passed on from parents/during fertilization/inherited/zygote formation;
from same cell/mitosis;
DNA replication;
genetically identical / same base sequence/ all body cells have same DNA

[3]

(iii) half as much; DNA (not: ref chromosomes)
variation/ genetically different
produced by meiosis;

[3]

(Total 13 Marks)

Q.8 (a)

- A. polar molecule/dipole;
- B. uneven distribution of charges/ H^+O^- ;
- C. forms hydrogen bonds (between molecules);
- D. dissolves ionic/polar substances; (not: ref glucose/solvent unequal)
- E. used for transportation of molecules;
- F. high latent heat of evaporation / vapourisation / large amount of heat energy needed to make water evaporate
- G. has a role in cooling body;
- H. high specific heat / large amount of heat energy needed to raise temp
- I. helps maintain stable/constant environmental temperature; (not: Internal)
- J. (transparent) to allow light through for photosynthesis

- K. molecules of water stick together / (high) cohesion (not: adhesion)
- L. allows movement through xylem/ adhesion (not: ref capillarity)
- M. surface tension allows insects to walk on water or example
- N. reactant in photosynthesis/hydrolysis or description (not: used in Photosynthesis)
- O. ice less dense than water so floats on surface therefore insulation of pond life when ice forms / correct ref to buoyancy qual
- P. chemical reactions occur in solution

(Points F and H only in correct context of explanation)

[Total 10 marks]

- (b) (i) A. two types, competitive and non-competitive;
- B. both types of inhibitors reduce rate of reaction;
- C. competitive inhibitor complementary to active site / structurally similar to substrate;
- D. competes with substrate for active site of enzyme;
- E. blocks active site/prevents substrate from binding to active site
- F. fewer/ no enzyme substrate complexes formed;
- G. increase substrate concentration reduces effect of inhibitor;
- H. non-competitive binds away from active site/ binds at allosteric site
- I. changes shape/conformation of enzyme molecule;
- J. shape/conformation of active site changed;
- K. increasing substrate concentration has no effect on rate of reaction **[7]**

- (ii) L. enzymes tolerate wider range of conditions/temp/pH/thermostable/ Owtte (not: stable unqual)
- M. enzyme easily reused;
- N. several enzymes can be used together;
- O. product not contaminated / easier purification of product
- P. greater central of reaction achieved/ enzymes easily added or Removed qual. **[3]**

(Total 10 Marks)

Biology BY2

- Q.1**
- (a) apoplast [1]
 - (b) surface area:volume [1]
 - (c) autotroph [1]
 - (d) move ribs/enlarge thorax [1]
 - (e) reduces heat loss;
reduces water loss;
protection (by ribs)
(any 2) [2]

Q.2

	Mouth	Stomach	Duodenum	Ileum	Large Intestine
Villi present			*	*	
Site of mechanical breakdown of food	*	*			
Connects with bile duct			*		
Microorganisms secrete vitamins					*
Carbohydrate digestion takes place	*		*	*	
pH 2-3		*			
Brunner's glands secretes alkaline fluid			*		
Main region of water absorption					*
Protein digestion begins		*			

1 mark for each correct line

[Total 9 marks]

- Q.3** (a) Segmented body [1]
 Jointed limbs [1]
- (b) Water proof – terrestrial adaptation [1]
 Limits growth / necessitates moulting [1]
- (c) Class [1]

[Total 5 marks]

- Q.4** (a) Haemoglobin line is S-shaped;
 Actual line rises much more steeply between 2kPa and 7kPa/is steeper in the middle;
 Theoretical line shows no flattening at top;
 Haemoglobin shows higher saturation throughout.
 (Any two) [2]
- (b) (i) Only haemoglobin is fully saturated at pp in lung [1]
- (ii) Haemoglobin carries much more oxygen for the muscle than the theoretical situation. [1]
- (iii) Compared with theoretical, haemoglobin gives up its oxygen much more readily as oxygen pp falls. [1]
- (c) Accumulation of carbon dioxide / carbonic acid. [1]
 causes fall in pH / increased acidity. [1]
 which releases oxygen from oxyhaemoglobin. [1]
- (d) Myoglobin is saturated/has high affinity for oxygen at very low pp [1]
 acts as an oxygen store [1]
 used when muscle is exercising heavily/working hard [1]

[Total 11 marks]

- Q.5** (a) An organism that lives on, in or off a host [1]
The host is harmed. [1]
- (b) Possession of hooks / suckers/ thick cuticle (any 2) [2]
- (c) (i) Digestive system (allow: circulatory/respiratory system) [1]
- (ii) Absorption of host nutrients [1]
over the parasite's body surface [1]
- (d) (i) 1. Large number of embryos [1]
2. Male and female organs present (hermaphrodite) [1]
- (ii) 1. High offspring mortality/difficult to reach new host. [1]
2. Fertilises its own eggs/mating impossible. [1]

[Total 11 marks]

- Q.6** (a) Time to travel 63 cm = $5 - 2 \frac{1}{2} = 2 \frac{1}{2}$ hours or 150 minutes [1]
Rate = $63 \times \frac{2}{5}$ or $63/150$ [1]
= 25.2 cm/hr or 0.42 cm/min [1]
(Correct answer showing no working =3, units missing or incorrect= -1)
- (b) (i) Source – region where photosynthate/sugar/carbohydrate is produced [1]
and exported. [1]
Sink – region where photosynthate is used/stored. [1]
- (ii) Source – leaves [1]
Sink – roots (accept aphid colony) [1]
- (c) (i) Sucrose [1]
- (ii) Translocation [1]
- (d) Phloem and sieve tubes (allow: mesophyll and palisade cells) [2]

[Total 11 marks]

- Q.7** (a) Thoracic spiracles open first / just before abdominal spiracles
Abdominal spiracles open as thoracic spiracles close.
Abdominal spiracles close just after the thoracic spiracles.
Abdominal spiracles open for the same length of time as thoracic spiracles
(Any 2) [2]
- (b) (i) Thoracic spiracles open when the abdomen expands [1]
Abdomen is compressed before abdominal spiracles open [1]
- (ii) Acting as a pump to draw air in via the thoracic spiracles, [1]
through the system and forces it out via the abdominal spiracles. [1]
- (c) Excessive water loss prevented / rapid dehydration if spiracles left
open. [1]

[Total 7 marks]

- Q.8** (a) A. Double circulation / left and right sides of heart completely separated. **[1]**
- B. RHS atrium connected to ventricle through tricuspid valve. **[1]**
- C. LHS atrium connected through bicuspid or mitral valve. **[1]**
- D. Vena cava brings deoxygenated blood from body to right atrium. **[1]**
- E. Pulmonary artery carries blood from right ventricle to lungs. **[1]**
- F. Pulmonary vein brings blood from lungs to left atrium. **[1]**
- G. Aorta carries blood from left ventricle to general body circulation. **[1]**
- H. Backflow is prevented by semi lunar valves **[1]**
- I. Heart is a pump driven by muscle which is thickest in left ventricle. **[1]**
- J. The coronary artery, supplies the heart muscle. **[1]**
- K. Aorta then branches into arteries and smaller arterioles supplying all body tissues. **[1]**
- L. Arteries - small lumen; thick layer of elastic tissue/muscle; endothelial lining. **[1]**
- M. Veins - wide lumen; little elastic tissue/thin muscle layer; endothelial lining; **[1]**
- N. Veins have (pocket) valves along their length. **[1]**
- O. Capillaries – endothelium only/ one cell thick; connection between arteries and veins. **[1]**

[Ten marks can be awarded from the fifteen available]

- (b)
- A. Leaf is flat and thin / large surface to volume ratio. [1]
 - B. Large surface area for light trapping. [1]
 - C. Thin to give short diffusion distance into leaf. [1]
 - D. Transparent epidermal layer. [1]
 - E. Covered by cuticle. [1]
 - F. Prevents water loss. [1]
 - G. Palisade mesophyll - vertically arranged packed cells or contain abundant chloroplasts. [1]
 - H. Arrangements gives maximum light absorption. [1]
 - I. Spongy mesophyll with large intercellular spaces. [1]
 - J. Allows room for movement of respiratory gases and water vapour. [1]
 - K. Diffusion of gases in and out of leaf through stomata. [1]
 - L. Stomatal pore surrounded by two guard cells. [1]
 - M. Change in water potential / pressure bends guard cells to open stomata. [1]
 - N. This change is related to photosynthetic activity so gas exchange only occurs when it is required. [1]
 - O. Closure at other times prevents water loss. [1]

[Ten marks can be awarded from the fifteen available]

Biology - HB2

1. (a) Prokaryotae, Any of the bacterial diseases. [1]
Protoctista, Malaria, Accept others if correct [1]
Fungi, Athletes foot, ringworm, thrush etc. [1]
- (b) (i) Humans, chimps, gorilla, orang-utans. [1]
- (ii) $\frac{1.6}{0.7} = 2.28$, 2.28×3 ; [1]
6.84 million years (variance allowed due to differing use of decimal places) [1]
- (iii) Proteins/enzymes/mRNA (not: amino acids/hormones) [1]
- (c) Could not interbreed; [1]
To produce fertile offspring. [1]
2. (a) Beat/waft/sweep/brush (NOT carry/move) [1]
Move mucus (bacteria upwards) [1]
- (b) (i) Prevent trachea closing/keep shape [1]
During inspiration/low pressure [1]
- (ii) allow expansion of oesophagus when swallowing or wouldn't allow [1]
dilation of oesophagus when swallowing (rev) owtte [1]
- (c) (i) Concentration of carbon dioxide in alveoli would increase; [2]
Reducing concentration gradient between blood and alveoli;
Build up of carbon dioxide in blood/toxic concentrations/faster breathing
- (ii) drugs increase flow rate; [3]
Figs from graph;
Does not affect lung capacity;
- (iii) house dust (mites), animal fur, feathers, pollen. Any 2 for 1 mark [1]
- (iv) Steroids reduce inflammation/reduces mucus (not: clears mucus) [2]
Relaxation of (smooth) muscles.
- (v) irreversible/ no change after drugs given/alveoli damage not muscular [1]

3. (a) [4]

Blood group	A	B	AB	O
Antibodies Produced and found in blood plasma	b	a	none	a and b

(b) (i) [4]

	A	B	AB	O
A	/	x	x	/
B	x	/	x	/
AB	/	/	/	/
O	x	x	x	/

(ii) Universal donor - Blood group O [1]
 Universal recipient - Blood group AB [1]

(c) (i) 17% [1]

(ii) 83% [1]

(d) Destroyed by immune system, not present in large enough numbers. Owtte. [1]

4. (a) B; B; A D; C. 1 mark each. [4]

(b) (i) lacteal, absorption of fats [1]

(ii) absorption small molecules/glucose/amino acids [1]

(iii) Smooth muscle, move villus to change materials in contact with it (not: peristalsis) [1]

(c) reduced surface area;
 Reduced absorption of materials;
 Digestive enzymes adsorbed or part of membrane;
 Reduced digestion;
 Bacterial activity in large intestine increases/Undigested food in colon
 Auto-immune response
 Reaction to gluten [4]

(d) water absorbed from colon. [1]

5. (a)

[4]

	Atrial systole	Atrial diastole	Ventricular systole	Ventricular diastole
Bicuspid and tricuspid valves open	✓			✓
Semi lunar/ aortic valves closed	✓			✓
Initiated by SAN	✓			
Initiated by Purkyne fibres (Purkinje fibres)			✓	

- (b) SAN / pacemaker in wall of right atrium;
Wave of (depolarisation passes/stimulation) from here across atria; [2]
- (c) Prevents depolarisation in atria passing to ventricles(not: Bundle of HIS)
Therefore stopping ventricles contracting downwards; [2]
- (d) Increased oxygen;
Increased glucose/nutrients;
Remove carbon dioxide;
Remove lactic acid;
Aerobic respiration;
Prevent arrhythmia [4]

6. (a) Salmonella,

- A Food contaminated with (bacteria)
- B Any two methods to prevent infection;
- C Ref. Eggs;
- D Ref treatment with antibiotics;

(Max 2)

Cholera,

- E Contaminated water;
- F Prevention of faecal contamination of water, treatment drinking water, sewage system;
- G Antibiotics;
- H rehydration;
- I vaccination;

(Max 4)

Tuberculosis,

- J airborne;
- K milk;
- L Ref overcrowding, immigration, AIDS;
- M TB tested cows;
- N long term, several different antibiotics used;
- O Vaccination; BCG

(Max 4)

(b)

- A Natural barrier
- B Natural barrier (Any 2 named)
- C WBC/macrophage
- D ref PHAGOCYTOSIS
- E Modification /presentation of antigen by cells/ named cells
- F lymphocytes
- G Ref T cells qual / destroy antigen on contact / mature in thymus
- H B cells qual;
- I Antigen stimulates lymphocyte cell division, ref cytokines;
- J Plasma cells produce antibodies
- K Carried in blood/description of structure
- L Agglutination / lysis / precipitation
- M Memory cells
- N Immunity, antibodies produced in larger quantities, quickly;
- O Ref vaccination qual/ placenta / maternal milk

(Max 10)

Biology – BY4

- Q.1** Integrated control / integrated pest management [1]
- (b) facultative anaerobes [1]
 - (c) osmoreceptors (not: osmoregulators) (not: if ref to pituitary) [1]
 - (d) nerve net [1]
 - (e) photoperiodism [1]

[Total 5 marks]

- Q.2**
- (a) (i) day 10 [1]
 - (ii) day 2 to day 14 [1]
 - (b) (i) interspecific [1]
 - (ii) 240 (unit needed) [1]
 - (iii) adding more nutrients / food / *B. pyocyaneus* / more food for *B. pyocyaneus* / remove waste / adding bacteria
increasing amount of culture
(not: more space) [1]
 - (iv) increase; [1]
Less competition for food / more food available [1]
 - (c) (i) dependent – effect on population depends on population size
independent – effect on population is the same whatever the size of
the population [2]
[not: population affecting factors]
 - (ii) temperature / pH (not: O₂ concentration) (not: fire / flood) [1]

[Total 10 marks]

- Q.3**
- (a) (i) glomerulus [1]
 - (ii) urea or amino acids, fatty acids / glycerol / small proteins /
inorganic ions or Na⁺ or minerals or salts (not: vitamins / salt)
(name two for 1 mark) [1]
 - (iii) ultrafiltration [1]
 - (iv) Hydrostatic/ blood pressure decreased; [1]
less filtrate formed / less rate of filtration [1]
 - (b) (i) loop of Henle (not: ascending limb) [1]
 - (ii) increased length / longer [1]
(not: larger)

- (c) (i) fish – ammonia
bird – uric acid
mammal – urea [3]
- (ii) uric acid (allow: e.c.f) [1]
- (iii) little mass (for storage) / reduces body mass / light for flight / less storage space for eggs (not: less toxic/ less water unqual) [1]

[Total 12 marks]

- Q.4** (a) absorbs light energy / of specific wavelength / wavelengths of light / light at red and blue end of spectrum / photons [1]
- (b) (i) 440 nm (435 – 440) [1]
- (ii) any pigment / chlorophyll absorbs or uses a limited part of the spectrum / light wavelength;
additional pigments increase range of wavelengths;
from which energy can be obtained / or increase efficiency of photosynthesis (any two) [2]
- (c) all wavelengths except green are absorbed / green wavelength is reflected or transmitted. (not: ref to light; allow: ref to spectrum / frequency) [1]
- (d) since they follow a similar trend / pattern / shape / close correlation / peaks correspond (not: similar unqual) [1]
it suggests that the pigments / wavelengths responsible are used in light absorption are then used in photosynthesis. [1]
- (e) (i) R – light harvesting unit / complex / centre / antenna complex [1]
S – reaction centre [1]
- (ii) cross in circle of reaction centre [1]
- (iii) thylakoid membrane / granal membrane / intergranal membrane [1]

[Total 11 marks]

- Q.5** (a) carbon dioxide / CO₂ [1]
- (b) ATP;
Reduced NADP / NADPH / NADPH₂ [2]
- (c) D;
G (any order) [2]
- (d) energy source / cellulose / lipids / food store / starch /
amino acids / proteins / pentose sugar / disaccharide / release energy in
respiration (accept: named sugars; not: carbohydrates / respiration
unqual) [1]

[Total 6 marks]

- Q.6** (a) pyruvic acid / pyruvate is converted to (two carbon) acetyl / acetate;
(two molecules) of reduced NAD formed (by dehydrogenation)
(allow: NADH etc)
loss of (two molecules) of carbon dioxide / decarboxylated
acetate combines with coenzyme A (to form acetyl coenzyme A) [3]
(pyruvate converted to acetyl Co A = 0)
- (b) (i) cytoplasm;
- (ii) matrix of mitochondrion [2]
- (c) (i) (Decarboxylation) is the removal of carbon dioxide / carboxyl group;
(Dehydrogenation) is the removal of hydrogen [2]
- (ii) P and Q [1]
- (d) (i) one [1]
- (ii)

	In the link reaction using NADH	In the Krebs Cycle using NADH	In the Krebs Cycle using FADH
Number of Molecules of ATP Formed	3	9	2

All 3 = 2 marks any 2 = 1 mark. 1=0 [2]

- (iii) carrier system involving NAD has three pumps FAD has two pumps.[1]
(not: ref carriers)

[Total 12 marks]

- Q.7**
- (a) (rapid) reaction/ response to a stimulus; [1]
 automatic / involuntary / not under conscious control /
 brain not involved (not: cannot be controlled / automated without thinking) [1]
- (b) A – motor;
 B – relay / intermediate / connector;
 C – sensory
 (all three) [1]
- (c) (i) X – myelin sheath / Schwann cell
 Y – node of Ranvier [2]
- (d) (i) Na⁺ or sodium ions are actively removed / pumped out /
 faster than K⁺ ions are moved in; [1]
 K⁺ or potassium ions diffuse out more rapidly than Na⁺ /
 membrane has a higher permeability to K⁺ than Na⁺. [1]
 or Na / K pumps 3Na⁺ out and 2K⁺ in = 2 marks
 (Ref. to ions needed at least once; 1 mark if no number)
- (ii) Sudden change /increase in the permeability of the membrane to Na⁺/
 sodium gates / channels open;
 sodium ions diffuse in or ref. concentration gradient
 (not: move in) [2]
- (e) (i) As the axon diameter increases the speed of conduction increases
 (ref. linear/proportional needs direction allow: positive correlation) [1]
- (ii) Speed of transmission (of the action potential) depends on [1]
 resistance (of axoplasm)
 (This resistance is related to the diameter of the axon). The greater /
 larger the diameter of the axon the less the resistance. [1]
Or increased diameter means increased surface area (of axon)
 over which exchange of ions can take place.
- (iii) ATP is required for active transport / ref Na/ K pumps;
 Na⁺ ions (actively) moved out only at nodes in myelinated;
 Na⁺ ions (actively) moved out along whole length of
 axon in non-myelinated. (Any 2) [2]

[Total 14 marks]

- Q.8 (a)**
- A. Glucose is phosphorylated / ATP is added. [1]
 - B. to form hexose (di) phosphate. [1]
 - C. this is split into (two) 3C triose phosphate molecules.
(not: abbreviations) [1]
 - D. which are converted to pyruvate. [1]
 - E. and (2) reduced NAD or eq e.g. NADH [1]
 - F. takes place in the cytoplasm / glycolysis [1]
 - G. in the absence of oxygen, (the Krebs cycle and) ETC cannot occur / no oxygen to act as the final electron acceptor at the end of the ETC. [1]
 - H. Pyruvate is converted to lactate / lactic acid in animal cells / humans. [1]
 - I. using the reduced NAD to reduce the pyruvate / transferring the hydrogen to pyruvate (in the process) [1]
 - J. in plants / fungi there is a loss of carbon dioxide / decarboxylation [1]
 - K. ethanal / acetaldehyde is produced [1]
 - L. ethanal is reduced by NADH to ethanol [1]
 - M. anaerobic respiration yields a total of 2 ATP [1]
 - N. (because) a lot of energy is still tied up / contained in the lactate / ethanol (i.e. ethanol high in calories) [1]

[Total 10 marks]

- (b)**
- A. All materials are added at start / not during the process [1]
 - B. Sterile apparatus. [1]
 - C. (Pure (culture) of) ref *Penicillium (notatum)*. [1]
 - D. Sterile nutrient medium. [1]
 - E. Aeration method as oxygen is required for respiration / for aerobic conditions [1]
 - F. pH adjustment / buffer. [1]
 - G. introduction of sterile air / oxygen. to prevent contamination (by airborne organisms) [1]
 - H. Method of mixing (qualified). (eg paddle) to mix nutrients (and culture / oxygen) [1]

- I. Water jacket to prevent overheating to remove excess heat produced during respiration / metabolism or maintain optimum temperature qual / prevent enzyme denaturation [1]
- J. nutrients / 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 / purify culture fluid / separate fungus. [1]
- N. AVP e.g. penicillin production in nature possibly to reduce competition / comparison with continuous culture. [1]

[Total 10 marks]

Human Biology – HB4

- Q.1**
- (i) E [1]
 - (ii) H [1]
 - (iii) F [1]
 - (iv) B [1]
 - (v) I [1]

[Total 5 marks]

- Q.2**
- (a) (i) spherical / round / circular [not: oval] [1]
 - (ii) Contains peptidoglycan / murein / glycoprotein
Do not have (or little) outer layer with lipopolysaccharide /
lipoprotein [Reference to dye retention = 0] [1]
 - (iii) Respires aerobically but can switch to anaerobic/ Grow better in
the presence of oxygen but can survive in its absence. [1]
(allow: can respire aerobically or anaerobically)
 - (b) (i) each cell produces one colony [1]
 - (ii) underestimate / doesn't allow for clumping [1]
 - (c) includes dead bacteria [1]
 - (d) serial dilution [1]

[Total 8 marks]

- Q.3.**
- (a) (i) glomerulus [1]
 - (ii) urea, amino acids, fatty acids / glycerol / small proteins /
inorganic ions or Na⁺ or minerals or salts or NaCl
(name two for 1 mark; not: salt or 2 inorganic ions or vitamins) [1]
 - (iii) ultrafiltration [1]
 - (iv) blood pressure / hydrostatic decreased;
less filtrate formed/decreased rate of filtration [1]
[1]
 - (b) (i) microvilli provide a large surface area for absorption;
many mitochondria for active transport [1]
[1]
 - (ii) loop of Henle (not: ascending limb) [1]

- (c) (i) blood is taken from a vein;
dialysate passes in opposite direction / countercurrent;
dialysis fluid has the same water potential/concentration/ isotonic with
ions and glucose as blood of patient;
urea/excess water/ salt diffuses from blood into dialysate
(not: waste products diffuse out)
Constant replacement of dialysis fluid to maintain the concentration gradient
(any four points) **[4]**
- (ii) glucose would diffuse out of the patient's blood and would lead
to a shortage of glucose. **[1]**
- (iii) cheaper in the long term /
No frequent hospital visits or confined to machine for periods. **[1]**
- (iv) shortage of donors/ref. illegal sale of kidneys;;
Organ rejection / immunosuppressant drugs
Matching tissue type / blood group **[2]**

[Total 16 marks]

- Q.4** (a) pyruvic acid / pyruvate is converted to acetyl/acetate;
reduced NAD or eq formed; (not just dehydrogenation)
decarboxylation/release of carbon dioxide;
acetate/acetyl combines with coenzyme A **[3]**
Any 3 (pyruvate converted to acetyl coenzyme A= 0)
- (b) (i) cytoplasm/cytosol
- (ii) matrix of mitochondrion **[2]**
- (c) (i) (Decarboxylation) is the removal of carbon dioxide / carboxyl group
(Dehydrogenation) is the removal of hydrogen **[2]**
- (ii) P and Q **[1]**

- (d) (i) one [1]
(ii)

	In the link reaction using NADH	In the Krebs Cycle using NADH	In the Krebs Cycle using FADH
Number of Molecules of ATP Formed	3	9	2

(3 correct = 2 marks, 2 correct = 1 mark) [2]

- (iii) (carrier system involving) NAD has three pumps and FAD has two pumps. [1]

[Total 12 marks]

- Q.5.** (a) carbon dioxide [1]
(b) ATP; [1]
Reduced NADP / NADPH / NADPH₂ [1]
(c) D; [1]
G (any order) [1]
(d) energy source /energy release or ATP in respiration/ starch/ cellulose / lipids / food store / amino acids / proteins / pentose sugar /named disaccharide/ nucleic acids. [1]
(not: carbohydrates/glucose/respiration unequal)

[Total 6 marks]

- Q.6** (a) (rapid) response to a stimulus; [1]
automatic / involuntary / not under conscious control / brain not involved. [1]
(not: without thinking/ cannot be controlled/automated)
(b) A – motor; [1]
B – relay / intermediate / connector; [1]
C – sensory.
(all three)
(c) (i) X – myelin sheath/Schwann cell [1]
Y – node of Ranvier [1]
(d) (i) Na⁺ or sodium ions are actively removed / pumped out / faster than K⁺ ions are moved in; [1]
K⁺ or potassium ions diffuse out more rapidly than Na⁺ / membrane has a higher permeability to K⁺ than Na⁺. [1]
(Na / K pump pumps 3Na⁺ out and 2K⁺ in = 2 marks
Or 1 mark if no numbers)

- (ii) Change/ increase in the permeability of the membrane to Na⁺ / Sodium gates/ channels open; [1]
Sodium ions diffuse in/or moves in if reference to concentration gradient. [1]
- (e) (i) acts as a neurotransmitter / transmits impulse across synapse; synaptic vesicles fuse with pre-synaptic membrane; releasing acetylcholine; acetylcholine diffuses across synaptic cleft; attaches to receptor site on post-synaptic membrane; sodium channels open and Na⁺ diffuse in; membrane is depolarised; action potential is generated. (any 5 points) [5]
- (ii) fewer branches in Alzheimer's patient / B; shorter branches in Alzheimer's patient / B; fewer synaptic knobs in Alzheimer's patient / B; [2]
- (iii) acetylcholine in the knobs, fewer knobs less acetylcholine / fewer action potentials. [1]
(allow: ref. to enzymes in the knobs)

[Total 17 marks]

- Q.7** (a) (i) sarcomere (not: sacromere) [1]
- (ii) J – H zone and K – A band [not: zone or region] [1]
- (iii) J shorter / decrease and K same length. [1]
- (b) A band remains unchanged as the myosin filaments are in a fixed position; actin slides over myosin; Z-lines to move closer/sarcomere decreases in width; H zone gets smaller/shorter/disappears when actin filaments move closer together. Any 3 [3]

[Total 6 marks]

- Q.8** (a) A. Glucose is phosphorylated / ATP is added. [1]
- B. to form hexose phosphate. [1]
- C. this is split into triose phosphate/glycerate phosphate molecules. [1]
- D. these are converted to pyruvate. [1]
- E. with a net gain of 2 ATP. [1]
- F. and 2 reduced NAD. [1]
- G. takes place in the cytoplasm /glycolysis/no oxygen to act
as final electron acceptor. [1]
- H. Pyruvate is converted to lactic acid. [1]
- I. using reduced NAD
(any 7 out of 9) [1]
- J. build-up of lactic acid in muscles causes cramp [1]
- K. lactate broken down in the liver [1]
- L. where it is converted back to pyruvate when oxygen becomes
available [1]
- M. oxygen debt – the extra oxygen needed to repay the
discrepancy between supply and demand. [1]
- N Heart rate /breathing rate continue at a high level after
exercise to repay the debt. [1]
- (any 3 out of 5)

[Total 10 marks]

(b) Parkinson's disease

- A. caused by the death of brain cells [1]
- B. that produce dopamine/ lack of dopamine [1]
- C. a neurotransmitter / involved in synaptic transmission [1]
- D. affects part of the brain that controls movements. [1]
- E. symptoms include repetitive shaking, slowness of movement, muscle stiffness. [1]
- F. early stage treatment drug / levodopa that is converted to dopamine in the brain [1]
- G. longer term treatment – physiotherapy / therapy to help manage condition. (any 5 from 7) [1]

Stroke

- H. caused by a blood clot/haemorrhage forming in a blood vessel supplying blood to the brain. [1]
 - I. part of the brain becomes starved of oxygen and neurones in that area die. [1]
 - J. causing loss of function associated with that part of the brain [1]
 - K. paralysis on one side of body [1]
 - L. speech / memory loss [1]
 - M. immediate/within 6hrs treatment – clot busting drugs/streptokinase. [1]
 - N. longer term treatment – aspirin daily / rehabilitation therapy [1]
- (any 5 from 7) **[Total 10 marks]**



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