GCE MARKING SCHEME

GCE BIOLOGY/HUMAN BIOLOGY
AS/Advanced

JANUARY 2014

INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2014 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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Question		Marking details	Marks Available
1	*(a)*	Base clearly circled;	1
	(b)	(The pentose in) RNA is ribose <u>and</u> in DNA is deoxyribose; the base thymine is only found in DNA <u>and</u> the base uracil is found in RNA; NOT: ref. helix/strands/uracil and thymine unqualified	2
	(c)	Adenine with thymine <u>and</u> cytosine with guanine; Appropriate use of {data/ratios} for {human/sea urchin/wheat}; Need data on both A T and C G NOT 'they are the same' or reference to ratio the same in all organisms	2
		Question 1 total	**[5]**

Question			Marking details	Marks Available
2	*(a)*	(i)	B, D, C, F, E;	1
		(ii)	Cytokinesis;	1
	(b)	(i)	4 cells are produced compared with 2 / cells are haploid as oppose to diploid/only contain one set of chromosomes compared with two sets of chromosomes; NOT 2 chromosomes (can be neutral) As a result of two (consecutive) divisions;	2
		(ii)	(Meiosis produces haploid gametes which) allows the diploid state to be restored {at fertilisation/in the zygote} / prevents doubling of the chromosome number at fertilisation; Meiosis produces <u>genetically</u> different {gametes/cells} / results in <u>genetic</u> variation (in the offspring);	2
			Question 2 Total	**[6]**

Question			Marking details	Marks Available
3	*(a)*	(i)	Ester;	1
		(ii)	Hydrolysis;	1
		(iii)	Glycerol and fatty acid drawn correctly; Glycerol and fatty acid named;	2
		(iv)	Glycerol and fatty acids have different structures / OWTTE; (not just reference to monomers)	1
	(b)	(i)	(Oleic acid is) unsaturated; It contains at least one C=C double bond (in the hydrocarbon chain) / is not fully saturated with hydrogen (atoms); NOT hydrogen bonds/ fewer hydrogens	2
		(ii)	Any 2 protection of internal organs against impact; <u>thermal</u> insulation; buoyancy; waterproofing skin/fur; source of metabolic water;	Max 2
			Question 3 total	**[9]**

Question			Marking details	Marks Available
4	*(a)*	(i)	Activation energy;	1
		(ii)	Line starting and finishing at the same point but with a lower activation energy;	1
	(b)		The <u>active site</u> (of succinate dehydrogenase) has a <u>specific shape</u>; Succinate has a <u>complementary</u> shape; (and therefore) {fits/ binds/ bonds to} into the active site; NOT attaches	Max 2
	(c)	(i)	I The concentration of succinate/ substrate; II As the concentration of the {succinate/substrate} increases {the rate of reaction/production of fumarate increases};	1 1
		(ii)	The concentration of succinate dehydrogenase/ enzyme; all of its active sites are occupied (at any given moment);	2
	(d)	(i)	Malonate has a similar {shape/structure} to {succinate/ substrate} / malonate has a complementary {shape/structure} the active site; NOT same shape Malonate {binds/ competes} to the active site; Prevents succinate binding / fewer enzyme-substrate complexes are formed; (MP3 must be in context of competitive inhibition)	3
		(ii)	Curve rising at a lower rate and plateaus at the max rate at a higher concentration; Accept max rate may not be reached	1
			Question 4 Total	**[12]**

Question			Marking details	Marks Available
5	*(a)*		(see table below)	6

Organelle	Name	Function
K	nucleus;	contains DNA which {codes for / controls} protein synthesis;
L	ribosomes ;	synthesise proteins;
M	Golgi apparatus/body;	packaging of proteins (for secretion from the cell) / (chemically) modifies proteins / produces glycoproteins / produces lysosomes;

Question			Marking details	Marks Available
	(b)	(i)	They have been cut in different plane/ angle;	1
		(ii)	(Loop of) DNA; (70S) ribosomes; Both possess plasma membranes; NOT double membrane	Max 2
		(iii)	Mitochondria: (statements should be comparative) Has a double membrane; No cell wall; No capsule; No flagellum/ pili; No mesosome; No plasmids;	Max 2
			Question 5 Total	**[11]**

Question			Marking details	Marks Available
6	*(a)*	(i)	Allows the glucose molecules to pass through (to the enzyme layer); Prevents the passage of other solutes ; so they can't {affect results / affect enzyme / reduce enzyme activity};	2 max
		(ii)	glucose broken down by enzyme; the {hydrogen peroxide/oxygen} is {detected/absorbed} by electrode; an electric signal is generated/ changes chemical to electrical signal; the greater the concentration of {glucose/hydrogen peroxide/oxygen} the greater the signal;	3 max
	(b)	(i)	The enzyme converts glucose into it's isomer fructose / glucose and fructose are isomers;	1
		(ii)	Add Biuret solution / sodium hydroxide solution & copper sulphate; (reject if reference to heat) The solution would remain blue / no colour change would occur;	2
		(iii)	can be re-used; has greater stability/denature at higher temperatures; can catalyse reactions/greater stability over a wider range of pH; More than one enzyme can be used/enzymes added or removed easily/ greater control over process/ can be used in a continuous process; (Reference to cost is neutral)	2 max
			Question 6 Total	**[10]**

Question			Marking details	Marks Available
7	*(a)*	(i)	-700(kPa);	1
		(ii)	I arrows drawn from F to G, F to E and from G to E; (allow ecf)	1
			II Water molecules move down a water potential gradient / from a{high<u>er</u> /less negative} water potential to a{low<u>er</u> /more negative} water potential; By osmosis; (in correct context)	2
	(b)	(i)	50% of the cells were plasmolysed;	1
		(ii)	-430kPa; (At incipient plasmolysis) {the pressure potential equals zero/ the solute potential = water potential};	2
			Question 7 Total	**[7]**

Question			Marking details	Marks Available
8	*(a)*	A	polysaccharides {are polymers/ formed during condensation reactions};	10 max
		B	(monomers are) joined by glycosidic bonds;	
		C	starch is made up from <u>alpha</u> glucose;	
		D	starch is composed of amylose and amylopectin / contains both 1,4 & 1,6 bonds;	
		E	glycogen is made from (alpha) glucose;	
		F	{Starch/glycogen} are insoluble and therefore osmotically inert/ OWTTE;	
		G	{Starch/glycogen} are storage molecules because {glucose can be added or removed easily / they have a compact structure};	
		H	cellulose is composed of <u>beta</u> glucose;	
		I	alternate glucose molecules are rotated by 180^{o}/ head up head down structure;	
		J	this form long <u>straight</u> chains (of beta glucose)/ only contains 1-4 bonds;	
		K	{hydrogen bonds / cross links} form between the chains;	
		L	forming microfibrils;	
		M	cellulose provides {strength/rigidity} to <u>plant</u> cell walls / cellulose prevents osmotic lysis in plant cells;	
		N	in chitin some OH groups are replaced with amino acids / amine groups / glucose amine;	
		O	chitin provides strength to <u>fungal</u> cell walls / (arthropod) exoskeletons;	

Question			Marking details	Marks Available
8	*(b)*	A	globular proteins show tertiary / quaternary structure;	
		B	they have a <u>{specific/precise} 3D</u> shape;	
		C	their shape is maintained by bonds between (atoms within the) R-groups;	
		D	disulphide bridges / ionic bonds / hydrogen bonds / Van der Walls forces / hydrophobic interactions; (any 2) NOT peptide	
		E	intrinsic proteins span the membrane;	
		F	extrinsic proteins are {embedded in one half of the membrane / on the surface of the membrane};	
		G	correct reference {made to the distribution of charge / polar and non-polar groups} on the {intrinsic/extrinsic} proteins;	
		H	channel proteins have a hydrophilic pore;	
		I	this allows {polar molecules/ions} to pass through the membrane;	
		J	by (facilitated) diffusion; NOT active transport	
		K	carrier proteins allow the passage of molecules {with a complementary shape/ by the protein changing shape ;	
		L	by (facilitated diffusion and) <u>active transport</u>;	
		M	Glycoproteins contain a carbohydrate chain attached to a protein;	
		N	{Glycoproteins/ extrinsic proteins} act as hormone receptors / are involved in cell recognition;	
		O	enzymes may be located in the membrane / catalyse reactions / carry out digestion / synthesise ATP;	
			Question 7 Total	**[10]**

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Question	Marking details	Marks Available

1

Characteristic	**Plant;**	**Animal;** Accept animalia	**Prokaryote;** Accept prokaryotic	**Protoctista;** NOT protozoa/ fungi
Eukaryotic	✓	✓	✗	✓
Chloroplast	✓	✗	✗	Some species
Cell wall	✓	✗	✓	Some species
Nucleus	✓	✓	✗	✓

4

Question 1 total **[4]**

Question			Marking details	Marks Available
2	*(a)*	(i)	*atrio-ventricular node (max 2)* {<u>collects/ receives</u>} {wave of excitation/ impulses} <u>from SAN</u>; NOT signal passes on to{Purkyne fibres/Bundle of His}; allows delay before wave passed to ventricles/ stops atria and ventricles contracting at the same time;	2
				2
		(ii)	*Bundle of His and Purkyne fibres* conducts wave to {base/ apex} of ventricles/ heart; ensures contraction (from base) upwards;	
	(b)	(i)	11;	1
		(ii)	7;	1
		(iii)	1;	1
		(iv)	6;	1
		(v)	4;	1
		(vi)	2;	1
		(vii)	12;	1
		(viii)	10;	1
			Question 2 Total	**[12]**

Question			Marking details	Marks Available
3	*(a)*	(i)	24/ 25/26%;	1
		(ii)	Any two from (vigorous) exercise/ OWTTE; high levels of (aerobic) <u>respiration</u>; oxygen used/ needed (by muscle cells);	2 max
	(b)		C/mouse;	1
	(c)	(i)	curve to right of C;	1
		(ii)	Any three from (move to right) lowers affinity of <u>haemoglobin</u> for oxygen; <u>more</u> oxygen released/ oxygen <u>more</u> readily dissociates; at the same partial pressure of oxygen; for (aerobic) respiration;	3 max
	(d)		Any three from curve shows haemoglobin has high affinity for oxygen; can{ pick up/ absorb} oxygen at {low partial pressure/ high altitude}/ can be become saturated with oxygen {more easily/ lower partial pressure/ at altitude}; Llama lives at high altitudes where oxygen is scarce; small change in partial pressure results in a large change in % saturation;	3 max
	(e)		Curve A;	1
			Question 3 total	**[12]**

Question			Marking details	Marks Available
4	*(a)*	(i)	organism that lives {on/in} another {organism/ host}; causes {harm/ damages} to host/ at the expense of the host;	2
		(ii)	Any three from {suckers/hooks} (for attachment to host gut); <u>large surface area to volume ratio</u>; {thin/ flattened}{proglottids/ segments}; covering resistant to host's digestive enzymes; NOT immune system hermaphrodite/ OWTTE; produces large number of eggs; no digestive system;	3 max
		(iii)	Any three from Carnivorous/ carnivore; {Large/ pointed} canines for {tearing/grasping flesh/ killing prey}; molars/premolars for {cutting/ slicing} meat; NOT tearing (small) incisors for {gripping/ stripping} flesh; <u>carnassials</u> teeth for {crushing/cutting}; vertical movement of jaws;	3 max
	(b)	(i)	obtains {food/ nutrients} from another organism/heterotrophic;	1
		(ii)	**A** {requires food digested by host/ no digestive system}, **B** {digests food itself/ has digestive system}; **A** absorbs food {externally/at surface}, **B** internal absorption;	2
			Question 4 Total	**[11]**

Question			Marking details	Marks Available
5	*(a)*	(i)	Change in mass = 11.2 - 13.6 = -2.4; % change in mass (-2.4/13.6) x 100 = 17.6/ 17.65 %; NOT 17.7	2
		(ii)	{greater percentage of water lost/ largest change in mass} when upper surface <u>only</u> is covered/ when lower surface is covered there is less change in mass; more stomata on lower surface; some water is lost through upper surface as{some/ few/ less} stomata present;	3
		(iii)	to ensure that {all of the / maximum loss of} water was lost from the leaves;	1
	(b)	(i)	xerophytes/xerophytic;	1
		(ii)	{lower density of/ less} stomata; (rolling causes) upper epidermis to face inwards/ stomata are on the inside of (rolled) leaf; <u>no</u> stomata on {lower/exposed} surface/ <u>all</u> stomata on the {upper/ inner} surface;	3
		(iii)	Any two waxy cuticle on lower surface; reduced leaf surface area; sunken stomata; hairs; long roots;	max 2
			Question 5 Total	**[12]**

Question		Marking details	Marks Available
6	*(a)*	lamellae/gill plates;	1
	(b)	water {forced/ flows} over gill (filaments); by pressure changes/ OWTTE; (pumping) action of mouth and operculum/ OWTTE; water flows in opposite direction to blood/counter-current mechanism; maintains {diffusion/ concentration} gradient across {entire/ whole} gill (filament); as blood always meets water with a higher oxygen concentration/ equilibrium is never reached;	max 4
	(c)	Any four <u>large</u> surface area; {(dense) network/ large number} of <u>capillaries</u>; NOT good blood supply {thin/permeable} <u>epithelium</u>; moist; short diffusion pathway;	max 4
		Question 6 Total	**[9]**

Question			Marking details	Marks Available
7				
	(a)	A	plants have well established root system/ OWTTE;	10 max
		B	leaves are thin/ large SA for photosynthesis/ gas exchange;	
		C	{waxy cuticle/ shed leaves in winter} to <u>reduce</u> water loss;	
		D	{stomata/ guard cells} to {control/ reduce} water loss;	
		E	xylem transport water;	
		F	phloem transports organic solutes/ amino acids;	
		G	xylem/ tracheids provide structural support;	
		H	brightly coloured {flowers/ petals/ scent/ nectar} to attract insects;	
		I	Adaptation of pollen to insect pollination e.g. sticky/ hooks;	
		J	large amounts and small sized pollen grains for wind pollination	
		K	pollen grains have hard coats to prevent desiccation;	
		L	no requirement for gametes to travel through water/ fluid;	
		M	resistant {coat/shell} around the seed to {withstand adverse conditions/ protect};	
		N	food store in seeds;	
		O	embryo develops in seed until {germination/ leaves are produced} (above ground);	
		P	seed dispersal adaptations/ appropriate example	

Question			Marking details	Marks Available
7	*(b)*			
		A	reproduce by mitosis;	10 max
		B	<u>genetically</u> identical/clones;	
			advantages	
		C	less chance of mutation;	
		D	adapted to same conditions as parents/ owtte;	
		E	parent can provide support until independent;	
		F	example of asexual reproduction: strawberry/other appropriate named example;	
		G	no need for (second organism for) fertilisation/ only one parent is needed;	
		H	no wastage of gametes/ less energy wasted;	
		I	rapid increase <u>in numbers</u>/ large numbers produced;	
		J	no special mechanisms required;	
			disadvantages	
		K	lack of genetic variation {means more susceptible to wiping out/ less able to adapt};	
		L	(means more susceptible to wiping out) by disease;	
		M	(less able to adapt) environmental changes;	
		N	no chance of evolution/natural selection;	
		O	less chance of dispersal/ restricted to one niche;	
		P	more competition for resources;	
			Question 7 Total	**[10]**

BY4 January 2014

Question		Marking details	Marks Available
1	*(a)*	There more {microorganisms/ bacteria/ fungi} in indoor air than outdoor air samples;	1
	(b)	(Different) pH; (Different) C {source/ concentration}; (Different) N {source/ concentration}; (Different) growth factors: {Different/ different concentration} Vitamins/minerals; NOT nutrients Any 4 1 mark per pair	max 2
		Question 1 total	**[3]**

Question		Marking details	Marks Available
2	*(a)*	Legumes/ leguminous;	1
	(b)	Contain nitrogen fixing bacteria/ OWTTE; (must be correct context, not plant fixing nitrogen) Such as *Rhizobium;* (Some) {nitrogenous compounds/ ammonium ions/ ammonia/ amino acids} pass to the <u>plant</u>; NOT nitrate/ nitrogen Allows the plant to grow in poor soil/ used for {amino acid/ proteinsynthesis};	max 3
	(c)	*Nitrosomonas* converts <u>ammonia to nitrites</u>; *Nitrobacter* converts <u>nitrites to nitrates</u>; *Accept diagram/equation* Which the plant can {absorb/take up} (from the soil); And use for {nucleic acid/eq or protein synthesis};	max 3
		Question 2 total	**[7]**

Question			Marking details		Marks Available
3	*(a)*		milliVolts/mV; NOT microvolts milliseconds/msec/ ms;		2
	(b)		A	Resting potential;	4
			B	Depolarisation	
			C	Repolarisation;	
			D	Hyperpolarisation/ refractory ;	
	(c)	(i)	Threshold (potential);		1
		(ii)	Failed to reach threshold potential; All or nothing response; -55; So (too few) sodium gates opened/not enough depolarisation;		max 2
			Question 3 Total		**[9]**

Question			Marking details	Marks Available
4	*(a)*		• Low water levels in blood/high osmotic potential/low Ψ; • Detected by osmoreceptors; • In hypothalamus; • (More) ADH secreted from (posterior lobe of) pituitary; • {Into/travels in} blood to; • {collecting duct/distal convoluted tubule}{ becomes more permeable/more aquaporins/ more water channels in membranes}; • Water absorbed; • Because of low Ψ in medulla;	max 6
	(b)	(i)	As plasma solute concentration increases to 282 there is no increase in ADH/ the concentration of ADH remains constant; After 282 there is {a proportional/ rapid} increase in ADH; (increase must be qualified)	2
		(ii)	(Up to 293 au) ADH can achieve sufficient water reabsorption/ OWTTE; After this point {water needs to be taken in/ by drinking} to avoid dehydration;	2
	(c)		Blood loss/vomiting; NOT dehydration/ anaemia	1
			Question 4 Total	**[11]**

Question		**Marking details**	**Marks Available**
5	*(a)*		8

	Name of stage	*Precisely what is happening in the culture*
A	Lag;	Cells are rehydrating/ Yeast is synthesizing enzymes/ gene activation; NOT adapting/ acclimatizing/DNA replication
B	Log/Exponential;	Cells are {dividing/budding/ replicating/ fission} (at maximum rate) eq; NOT rapid growth
C	Stationary;	Cells are dying in equal numbers to those produced by division; NOT births=deaths
D	Decline/death;	There is a build up of ethanol which is killing the cells;

(b) Pyruvate is converted to ethanal/acetaldehyde; — 4

With the removal of CO_2/ by decarboxylation;

Ethanal/acetaldehyde is reduced to ethanol;

Using the $NADH_2$/ reduced NAD/ NADH. ;

Or correct diagram for 3max

Accept Pyruvate is converted to ethanol = 1 mark (alternative to MP 1 and 3)

Question 5 Total **[12]**

Question			Marking details	Marks Available
6	*(a)*		<u>Similarities</u> (Both contain) a 5 carbon sugar; Both have two phosphate groups; Both contain (two) nitrogenous bases/ adenine/ organic base; Dinucleotide; Accept adenosine for 1 mark if MP1 and 3 not awarded	max 2
			<u>Differences</u> FAD only contains one (ring form) sugar <u>**and**</u> NAD contains 2/ One 5C sugar is in its linear form in FAD <u>and</u> both 5C sugars are in ring form in NAD/ NAD contains nicotinamide and FAD contains flavin/ FAD has a three ring base and NAD has one ring base;	1
	(b)	(i)	The bond between the {terminal/last two} phosphate groups on ATP;	1
		(ii)	Does not involve the ETC/complex series of carriers and pumps; Does not need stalked particles/ATP synthetase; Does not need an electrochemical gradient/eq; Does not require oxygen; Accept 'Does not require mitochondria' as alternative to MPs 1, 2,3	Max 2
		(iii)	Arrows showing In the conversion of triose phosphate to pyruvate; After the 5C compound in the Kreb's cycle;	2
		(iv)	4; 2;	2
	(c)	(i)	In the mitochondrial matrix;	1
		(ii)	Dehydrogenase AND decarboxylase;	1
			Question 6 Total	**[12]**

Question			Marking details		Marks Available
7	*(a)*		It stops electrons from PS II being moved to PS I; So blocking the reduction of $NADP^+$ to NADPH; Cyclic Photo Phosphorylation only involves PSI; is not stopped as the electrons pass from PSI and return to PSI/ eq; And the carrier involved in this is not affected;		4
	(b)		Plant cannot generate {$NADPH_2$/ NADPH/ reduced NADP} {so Calvin cycle cannot work/ description of part of process which is prevented}; {No glucose/ hexose sugar} will be formed; For respiration;		3
	(c)	(i)	1. Ribulose bisphosphate; 2. Glycerate(-3-)phosphate; 3. Glyceraldehyde(-3-)phosphate/triose phosphate;		3
		(ii)	<u>Catalyses</u> {the reaction between RuBP and carbon dioxide/ to fix carbon dioxide} ;		1
		(iii)	X	ATP;	2
			Y	NAD**P**H_2;	
		(iv)	A	CO_2 Fixation/ 6C intermediate/ RuBP binds to CO_2;	3
			B	Regeneration/resynthesis of RuBP;	
			C	Reduction;	
			Question 7 Total		**[16]**

Question			Marking details	Marks Available
8	(a)		**Viable count mark scheme**	
		A	Viable count is counting living cells;	
		B	As opposed to a direct count which counts both living and dead cells;	
		C	One cell gives rise to one colony/so N^o of colonies = N^o of viable cells;	
		D	Use of aseptic technique + example; (eg flaming neck of bottle etc)	
		E	Sterilisation of equipment and media + example; (eg autoclave/ oven/ radiation)	
		F	Serial dilution;	
		G	Culture needs diluting by ten-fold steps;	
		H	1cm^3 of original sample added to;	
		I	9cm^3 of (sterile) water;	
		J	(Mixed and) process repeated;	
		K	Known volume(or eg such as 1cm^3/0.5 cm^3) of microorganisms are added to agar plates;	
		L	Incubated at 25^{o}C (up to 37^{o}C) for 24-48 hours; Must state a temperature and time	
		M	Count N^o of colonies in {appropriate plate/appropriate number of colonies};	
		N	Multiply by dilution factor to calculate No of cells per cm^3 in original sample;	
		O	Some comment on unreliability eg reference to clumping of cells;	
			Question 8a Total	**[10]**

Question			Marking details	Marks Available
8	*(b)*		**Synapse mark scheme**	
		A	A synapse occurs between neurones;	
		B	The impulse across a synapse is chemical (rather than electrical);	
		C	Neurotransmitter;	
		D	Acetylcholine/noradrenaline;	
		E	Is enclosed in synaptic vesicles;	
		F	Arrival of an action potential at the;	
		G	Axon terminal/(pre) synaptic knob;	
		H	Causes Ca^{2+} ions to flow into the axon terminal;	
		I	This causes synaptic vesicle to fuse with the presynaptic membrane;	
		J	Neurotransmitter is released by exocytosis and;	
		K	Diffuses across the synaptic cleft;	
		L	Where it binds with receptors on the post synaptic membrane;	
		M	Which open sodium channels;	
		N	allowing Na^{+} to enter;	
		O	The membrane is depolarised;	
			Question 8b Total	**[10]**

HB2 January 2014

Question			Marking details	Marks Available
1	*(a)*			4

PHYLUM	**CHORDATA;**
CLASS	**MAMMALIA;**
ORDER;	primates
FAMILY;	Hominidae

	(b)	(i)	DNA profiling / DNA base sequencing / protein gel electrophoresis/ amino acid sequencing;	1
		(ii)	(absence of fossils suggests that) *H.sapiens* and *H.neanderthalensis* were unable to interbreed to produce fertile offspring;	1
			Question 1 total	**[6]**

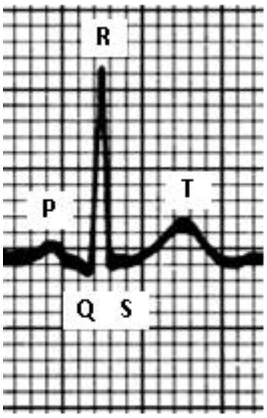
Question		Marking details		Marks Available
2	(i)	**Humoral:**	(B lymphocytes) produce antibodies against (specific) antigens;	1
	(ii)	**Cell-mediated:**	(T lymphocytes) carry out immune response through direct contact with the antigen;	1
	(iii)	**Natural active:**	immune response / antibodies produced in response to actual infection; Reject reference to vaccination produce memory cells / long-term immunity;	2
	(iv)	**Natural passive:**	antibodies produced in another person; transferred through the placenta / breast milk; no memory cells produced/ short-term immunity;	max 2
		Question 2 Total		**[6]**

Question			Marking details		Marks Available
3	*(a)*	(i)	{Protein/ molecules/ substances} that stimulates {the production of a (specific) immune response/ production of antibodies};		1
		(ii)	proteins {produced in response to / bind to}presence of antigen;		1
	(b)	(i)	**Person A:**	**Blood Group O -;**	2
			Person B:	**Blood Group A+;**	
		(ii)	**Person A**:	{no haemagglutination/ negative result} (with any of the antibodies)/ all negative results; (rbcs) do not have antigens A, B or D/rhesus;	max 3
			Person B:	{haemagglutination/ positive result} with anti- A and anti-D; (rbcs) must have antigens A and D/rhesus;	
		(iii)	prove that blood does not haemagglutinate on the card alone / prove that the antibodies have caused the haemagglutination; Reject fair test/ for comparison		1
			Question 3 total		**[8]**

Question			Marking details		Marks Available
4	*(a)*		Villus/ villi;		1
	(b)		**Duodenum**	digestion;	2
			Ileum	absorption;	
	(c)	(i)	secretions neutralise stomach {acid /contents} / raise pH to alkaline / suitable pH above 7;		1
		(ii)	inactivated / denatured/ not optimum conditions;		1
	(d)	(i)	Increased / larger surface area for absorption;		1
		(ii)	wall of ileum folded + to increase surface area; microvilli (on epithelial cells) + to increase surface area; ileum is long + increase time for absorption; (extensive) capillary network + remove absorbed substances; lacteals + remove absorbed substances; large number of mitochondria in epithelial cells + for active transport;		max 2
	(e)		(villi would be){ shorter / smaller}/{less surface area/ flattened}; NOT short/ small few<u>er</u> nutrients absorbed / <u>less</u> food digested; (weight loss) body uses stored carbohydrate / fats; (fatigue) lack of{carbohydrates / fats} for {energy/ respiration};		max 3
			Question 4 Total		**[11]**

Question		Marking details	Marks Available
5	*(a)*	organism{ that causes damage to its host/ is disease causing};	1
	(b)	Bacillus;	1
	(c)	thin (inner) wall of {murein / peptidoglycan / proteoglycan}; (thick) outer layer of {lipoprotein/ lipopolysaccharide};	2
	(d)	{outer / lipoprotein / lipopolysaccharide} layer prevents penicillin reaching {murein / peptidoglycan / proteoglycan}/ {acts as a barrier/ protective layer}; Reject references to pencillin breaking bonds or destroying cell wall/ resistant or immune to penicillin so penicillin cannot stop formation of cross-linkages / cell wall formation;	2
		Question 5 Total	**[6]**

Question			Marking details	Marks Available
6	*(a)*	(i)	surface area : volume;	1
		(ii)	metabolic / oxygen demands proportional to volume; ability to absorb oxygen proportional to surface area; surface area:volume ratio large enough to meet metabolic / oxygen demands / enough oxygen can be absorbed through cell membrane to meet metabolic needs; diffusion distance to centre of cell short;	max 3
	(b)	(i)	to minimize heat / water loss;	1
		(ii)	3 from: large number of alveoli + to give large surface area; alveoli folded / lobed + to increase surface area; thin alveoli walls + decrease diffusion distance; extensive capillary network + maintain concentration gradient for gas exchange; layer of moisture in alveoli + for gases to dissolve; Accept ref to ventilation mechanism + to maintain diffusion gradient	max 3
	(c)		breathing in airborne droplets/ aerosol transmission/owtte; under overcrowded conditions;	2
			Question 6 Total	**[10]**

Question			Marking details	Marks Available
7	*(a)*	(i)	5 beats in 4 seconds x (60 / 4) or 15; 75 beats per minute ; (if an alternative method is shown eg., time between two R peaks = about 0.8 / 0.75 s, then accept a heartbeat between 75 and 80)	2
		(ii)	trace for each heartbeat (would stay same size but) more frequent / filling time reduced / time between T and next P shorter; Reject peaks	1
	(b)	(i)	 P Q R S T clearly labelled on a single heart beat ;	1
		(ii)	**P** atria contracting / atrial systole; **QRS** impulse passing to base of ventricles / just before {ventricles contract / ventricular systole}; **T** ventricles relaxing / ventricular diastole; reject heart	3
	(c)	(i)	**Left atrium** Z; **Left ventricle** Y;	2
		(ii)	atrio-ventricular CLOSED and aortic valves OPEN; both needed for 1 mark	1
		(iii)	ventricle contracts from base up; blood pressure in ventricle higher than atrium + AV valve closed; blood pressure in ventricle higher than in aorta + aortic valve forced open;	3
			Question 7 Total	**[13]**

Question			Marking details	Marks Available
8	*(a)*		**Describe and explain how knowledge of the life cycles of the parasite *Plasmodium* and of its vector, the *Anopheles* mosquito, is important in controlling the transmission of malaria.**	
		A	prevent transmission of parasite by disrupting mosquito life cycle;	
		B	by preventing mosquitoes biting;	
		C	through use of netting/clothing / repellants;	
		D	insecticide/synthetic pyrethroids to kill adults or insects; (Ignore references to DDT)	
		E	introduce: {predatory/ named} fish to eat larvae / pupae;	
		F	bacteria to infect larvae / pupae;	
		G	sterilise male mosquitoes;	
		H	{drain /cover} standing water + to remove sites for larvae to develop/ drain breeding grounds;	
		I	spray {oil /detergent} on water + to prevent {larvae / pupae} getting oxygen/ owtte;	
		J	*Plasmodium* is an intracellular parasite;	
		K	can only be attacked when free in the bloodstream;	
		L	drugs used reduce chances of infection;	
		M	drugs used to kill parasite in host cause damage to host;	
		N	*Plasmodium* mutates / undergoes antigenic variation / many antigenic types ;	
		O	therefore vaccine difficult to develop because of different antigenic types;	
			Question 8(a) Total	**[10]**

Question			Marking details	Marks Available
8	*(b)*		**Describe how immunisation against diseases such as Rubella can protect people against infection.** **Explain why immunisation against influenza provides only partial protection and should be repeated annually.**	
		A	vaccine contains a {non-pathogenic forms / attenuated strain/ products / antigens/ toxoids/ killed microbe} of microorganisms;	
		B	latent period;	
		C	followed by the primary (immune) response;	
		D	memory cells developed;	
		E	{booster shots/ second injection} {stimulate a secondary immune response / memory cells stimulated};	
		F	booster needs lower levels of antigen;	
		G	secondary response is faster / shorter latent phase + lasts longer;	
		H	secondary response produces {higher concentration of antibodies/ more antibodies};	
		I	Influenza {has a high rate of mutation strains/ mutates frequently};	
		J	Influenza antigens constantly changing;	
		K	three main sub-groups of influenza virus;	
		L	Influenza virus has many {antigenic types / serotypes/ strains} (in each sub-group);	
		M	Memory cells do not recognise the new strain of antigen;	
		N	influenza transmitted by airborne droplet infection which is difficult to control;	
		O	new strains of the virus can develop in {animals / pigs / chickens} ;	
			Question 8(b) Total	**[10]**

Question			Marking details	Marks Available
1	*(a)*	(i)	Any 4 from	max 4
			Increased levels of urea in blood;	
			Increased levels of {ions / named ion/ salt} in blood;	
			Increased water levels in blood / swelling legs / shortness breath;	
			Increase in water potential of blood;	
			Reduced volume of urine;	
			Blood in urine;	
			Nausea;	
			Itching (caused by high levels phosphate);	
			Bone damage/ slow bone healing;	
			Muscle cramps/ abnormal heart rhythm/ muscle paralysis;	
			Decreased numbers RBC / tiredness/ dizziness;	
		(ii)	Fall in blood pressure;	2
			Ultrafiltration no longer takes place;	
	(b)		High blood pressure;	2
			Ref. vein not having a thick muscular wall;	
	(c)	(i)	Maintain {diffusion gradient/ concentration gradient};	1
			Accept prevent urea diffusing back	
		(ii)	Countercurrent maximise concentration gradient along length of tube/ stop equilibrium;	1
			Accept blood and dialysis fluid do not reach same urea concentration	

Question		Marking details	Marks Available
	(iii)	High conc. calcium in blood - diffuses from blood to dialysate, Low conc. in blood - from dialysate to blood./ maintain constant level in blood;	1
(d)		Any 2 from Risk to living person, surgery, one kidney only; Ethics of using kidney from cadaver; Ethics of removing kidney from brain dead person; Ethics of using fetal material; Increased risk of people selling kidneys; Ethics of giving transplant to elderly person; Rejection / infection/ surgical risks; Use of immunosuppressant's increase risk of infection / cancer;	max 2
(e)		Secretes hormones *(erythropoietin/ calcitriol*)into blood;	1
		Question 1 total	**[14]**

Question			Marking details	Marks Available
2	*(a)*		A = myosin; B =actin;	2
	(b)		Any 4 from Z line; I band; A band; H zone / M line; Actin and Myosin;	max 4
	(c)	(i)	Any 2 from; Cause movement of synaptic vesicles towards presynaptic membrane; Fusion with presynaptic membrane; Exocytosis;	max 2
		(ii)	Any two from Binds to troponin changes shape; causes tropomyosin to change shape / position; myosin binding sites exposed; cross bridges form; power stroke;	max 2
			Question 2 total	**[10]**

Question			Marking details	Marks Available
3	*(a)*	(i)	Population growth rapid;	2
			Enzymes do not need to be supplied / less cost;	
			Low temperatures , cheaper production costs;	
			Accept can be genetically modified	
		(ii)	Batch culture;	1
		(iii)	Pure culture;	2
			Fermenter sterilised; Reject cleaned	
			Air / oxygen filtered;	
			Sterile medium;	
			2 for 1mark	
			3 for 2 marks.	
		(iv)	Competition for nutrients;	max 2
			Toxic substances produced / contaminant{toxic/ harmful} to humans;	
			Destroy useful microorganism;	
			Max 2	
		(v)	Heat produced by {respiration/ metabolic activity};	2
			Denature enzymes;	

Question		Marking details	Marks Available
(b)	(i)	Any two from Penicillin production increases as carbohydrate levels drop and P. notatum biomass increases; Highest production of penicillin when carbohydrate lowest and biomass P. notatum highest; Correct figures quoted;	2
	(ii)	reduce competition; when nutrient levels are depleted;	2
		Question 3 Total	**[13]**

Question		Marking details	Marks Available
4	(a)	Any three from	max 3
		Sodium/ potassium pumps;	
		ATP / active transport;	
		3 Na^+ out 2 K^+ in;	
		Organic anions, -ve charged molecules/proteins;	
		Pd across membrane -60mV / -70mv;	
		Membrane leakage, more permeable to K^+ than Na^+;	
	(b)	A. Threshold reached;	max 5
		Sodium voltage gated channels open;	
		Sodium ions diffuse into {cytoplasm/ cell};	
		Depolarised;	
		B. Sodium voltage gated channels close;	
		Potassium voltage gated channels open;	
		Potassium diffuses out;	
		Ref. to Sodium/potassium pumps;	
		Repolarised;	
		Max 3 for A or B.	

Question	Marking details	Marks Available
(c)	Any three from	max 3
	Myelin sheath electrical insulation;	
	Ion exchange only at nodes of Ranvier/ depolarisation only at nodes;	
	Action potential jumps from one node of Ranvier to next;	
	Saltatory conduction;	
	If no myelin sheath local circuits;	
	Saltatory conduction much faster than local circuits;	
(d)	Increase: Mimic action of normal transmitters / bind to receptors; Prevent breakdown of transmitter; Stimulate release of transmitters; Reduce threshold for excitation of post synaptic membranes; Accept; more calcium ions diffuse in	max 2
	Decrease: Block receptors on post synaptic membrane; Prevent Ca^{2+} being released; Prevents exocytosis; Prevents recycling of neurotransmitter/ active transport back across presynaptic membrane; Raises threshold; changes shape of neurotransmitter;	max 2
	Question 4 Total	**[15]**

Question	Marking details	Marks Available

5

	Glycolysis	Link reaction	Krebs cycle	Oxidative phosphorylation
Substrate level phosphorylation takes place	✓		✓	
NAD is reduced	✓	✓	✓	
FAD is reduced			✓	
Dehydrogenation takes place	✓	✓	✓	
Decarboxylation takes place		✓	✓	
Oxygen is used				✓
ATP is produced	✓		✓	✓
Takes place in the cytoplasm	✓			
Takes place in the mitochondrial matrix		✓	✓	
Takes place in the inner mitochondrial membrane				✓
Coenzyme A is used as an acceptor		✓		

One mark per row

Question 5 Total **[11]**

Question		Marking details	Marks Available
6	*(a)*	Any three from	max 3
		Blood clot in blood vessel to brain;	
		Blood vessel brain rupturing;	
		Brain starved of oxygen;	
		Neurones in affected area die;	
		High blood pressure;	
		Smoking;	
	(b)	Any three from	max 2
		numbness/ weakness/ paralysis/ description eg drooping arm, eyelid droops, dribbling;	
		Slurred speech;	
		Blurred vision;	
		Confusion / unsteadiness;	
		Severe headache;	
	(c)	Any two from	max 2
		Clot busting drugs;	
		Aspirin;	
		Rehabilitation therapy	
		Introduction of stent;	
		Question 6 Total	**[7]**

Question			Marking details	Marks Available
7	*(a)*			
		A	PS II;	
		B	Splits water into oxygen. Protons and electrons;	
		C	Electrons replace electrons lost from chlorophyll to replace electrons of PS1;	
		D	Cyclic photophosphorylation;	
		E	H^+ combines with electrons from PSI to reduce NADP;	
		F	Oxygen used for aerobic respiration;	
		G	Light independent stroma;	
		H	RUBP;	
		I	Fixation of CO_2/ combines with CO_2 qualified;	
		J	GP reduced to TP;	
		K	ATP and reduced NADP;	
		L	Glucose;	
		M	TP used to make other carbohydrates, lipids, amino acids; ;	
		N	“ “ “ “ “ “ “	
		O	Food source for man;	
		P	Reduce CO_2 ;	
			Question 8a Total	**[10]**

Question			Marking details	Marks Available
7	*(b)*			
		A	Decomposition, ammonium ions;	
		B	Nitrosomonas, ammonium compounds nitrites;	
		C	Nitrobacter, nitrites to nitrates;	
		D	Nitrification, qualified;	
		E	Nitrogen fixing, qualified;	
		F	Azotobacter free living;	
		G	Rhizobium;	
		H	Root nodules, legumes/eg.;	
		I	Proteins;	
		J	Nucleic acids;	
		K	ATP/ NAD;	
		L	Ploughing aerobic conditions nitrification;	
		M	Drainage aerobic conditions nitrification;	
		N	Prevent denitrification;	
		O	Grow leguminous crops;	
		P	Chemical fixation of nitrogen/ ploughing in green crops/ manure;	
			Question 8b Total	**[10]**

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