

Pure Biology Prelims 2019 Answer key

Paper 1

1	2	3	4	5	6	7	8	9	10
B	D	C	D	B	A	D	C	D	D
11	12	13	14	15	16	17	18	19	20
B	A	C	D	C	C	C	D	C	D
21	22	23	24	25	26	27	28	29	30
B	D	C	B	D	A	C	C	B	B
31	32	33	34	35	36	37	38	39	40
B	C	C	D	C	A	B	B	C	C

Paper 2 (Section A)

Q1	a	i)	<u>DNA / Deoxyribonucleic acid / nucleotides;</u>	1
		ii)	- Enzyme A is a <u>restriction enzyme / endonuclease;</u> - It <u>cuts the plasmid at specific nucleotides</u> to create <u>sticky ends</u> which are <u>complementary to the insulin gene;</u>	2
		iii)	<u>TGG, CGT;</u>	1
		iv)	- More <u>rapid / efficient;</u> <u>Lowered rejection/immune reaction</u> as it is human insulin; - Less ethical issues; - Less manpower required (max 1m)	1
	b		- Insulin <u>increases the membrane permeability of liver and muscle tissues</u> to glucose; - This <u>increases rate of absorption of glucose/promotes conversion of glucose to glycogen</u> for storage; - Thus <u>reducing overall blood glucose level;</u>	3

Q2		a	i)	Stage 2;	1
			ii)	- to form gametes with half the number of chromosomes as the parent cell ; - to ensure that the diploid number of chromosomes will be restored after fertilisation ; - meiosis give rise to genetic variation through crossing over and independent assortment ; - give rise to genetic variation through <u>random</u> fusion of gametes produced ; (Any 2)	1 1 1 1
		b	i)	Anaphase I	1
			ii)	<u>Homologous chromosomes</u> are being separated and <u>pulled to opposite ends of the cell</u> ;	1
			iii)	Centrioles would be <u>absent/cell plate is formed</u>	1
Q3	a	i)	light energy carbon dioxide + water → glucose + oxygen chlorophyll		1
		ii)	- As <u>temperature increases</u>, rate of <u>oxygen production increases</u> because <u>enzyme activity in photosynthesis increases</u>; <u>Beyond</u> optimum temperature, rate of oxygen production <u>drops drastically</u> as <u>enzymes are denatured</u>;		1 1

		ii)	- The couple's children have a <u>high risk of contracting cystic fibrosis</u>; - As the expected phenotypes of their children are <u>1 CF : 1 Carrier / 50% CF to 50% Carrier</u>;	1 1
	b	i)	Duodenum;	1
		ii)	- Reduction in enzymes (lipase)/ bile entering duodenum, leading to reduced digestion/emulsification of fats; - Less nutrients absorbed for growth / storage;	2
5	a	i)	Any answer from <u>0.18s - 0.2s</u> <i>(R: answers without units)</i>	1
		ii)	- From <u>0.1s to 0.3s</u>, <u>pressure</u> in the ventricle <u>increases</u> - From <u>1 kPa to 16 kPa</u>; - As the <u>muscles</u> of the ventricle <u>contract</u>; <i>(-1m if no data quoted)</i> <i>(R: ventricle contracts)</i>	1 1 1
		iii)	- The right ventricle only pumps blood <u>to the lungs</u> over a <u>shorter distance</u>; - Has <u>thinner muscular walls</u> compared to left ventricle;	1 1
	b		- The left ventricle is <u>unable to relax</u> and <u>fill with sufficient blood</u> / <u>smaller volume</u> in left ventricle; <u>Less blood / oxygen</u> is pumped around the body;	1 1

Q6	a	i)	 (1m for correct shape; 1m for labelling in correct order)	2
		ii)	- A trophic level represents the <u>feeding position</u> of an organism in a <u>food chain / food web</u> ; - The <u>first</u> trophic level refers to <u>producers</u> like the <u>phytoplankton</u> which <u>produce their own food</u>; - The <u>second</u> trophic level refers to <u>primary consumers</u> such as the <u>zooplankton</u> that <u>feed on producers</u> like phytoplankton; - The <u>third</u> trophic level refers to <u>secondary consumers</u> such as mackerel that <u>feed on primary consumers</u> like zooplankton ; - The fourth trophic level refers to <u>tertiary consumers</u> like the <u>seal</u> that feed on secondary consumers; (Max 1m out of the above 3) (-1m if no reference is made to any organism in Fig. 6.1)	1
	b		- Microplastics <u>cannot be excreted</u> and is thus <u>passed along in food chains</u>; <u>Concentration</u> of microplastics <u>increases</u> with each trophic level/<u>Bioamplification</u> with each trophic level; - Resulting in <u>bioaccumulation</u> of microplastics <u>in top consumers</u>;	1 1 1

Q7	a	• The concentration of urine <u>increases</u> as concentration of ADH increases;	1
		• <u>ADH increases the permeability of collecting ducts to water</u> ;	1
		• More <u>water re-enters the blood</u> from the urine/filtrate;	1
		<i>(R: ADH “changes” permeability of collecting ducts)</i>	
	b	• Profuse <u>sweating</u> from vigorous exercise would cause <u>water loss</u> ;	1
		• <u>Water potential of the blood drops</u> ;	1
		• Hypothalamus is stimulated to <u>release more ADH</u> into the bloodstream;	1

Paper 2 (Section B)

Q8	a	<table><tr><td>Aerobic respiration</td><td>Anaerobic respiration</td></tr><tr><td>Takes place in the presence of oxygen</td><td>Takes place in the absence of oxygen</td></tr><tr><td>Oxidises glucose OR Uses oxygen and glucose as substrates</td><td>Does not oxidise glucose OR Glucose is the only substrate</td></tr><tr><td>Produces carbon dioxide and water</td><td>Produces lactic acid</td></tr><tr><td>Releases a large amount of energy</td><td>Releases an additional small amount of energy</td></tr><tr><td>Takes place in mitochondria</td><td>Takes place in cytoplasm</td></tr></table>	Aerobic respiration	Anaerobic respiration	Takes place in the presence of oxygen	Takes place in the absence of oxygen	Oxidises glucose OR Uses oxygen and glucose as substrates	Does not oxidise glucose OR Glucose is the only substrate	Produces carbon dioxide and water	Produces lactic acid	Releases a large amount of energy	Releases an additional small amount of energy	Takes place in mitochondria	Takes place in cytoplasm	(1m for every valid point-to-point comparison)	4
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	b	- At first, the <u>muscle cells</u> of the legs <u>respire aerobically</u>; <u>Breathing rate increases</u> from <u>12 to 42 breaths</u> per minute to <u>take in more O₂</u> and <u>remove CO₂ faster</u>; <u>Heart rate also increases</u> to transport <u>glucose and O₂</u> to respiring cells <u>faster</u>; - However, there is a <u>limit</u> to <u>heart rate</u> & <u>breathing rate</u>, - At <u>~5mins</u> the athlete's breathing rate has reached a <u>maximum/plateau</u> of <u>42 breaths per minute</u>; - To continue the exercise, muscle cells have to start <u>respiring anaerobically</u>, releasing a <u>small amount of energy</u> and <u>lactic acid</u> as a by-product. <u>Accumulation</u> of <u>lactic acid</u> to high concentrations leads to muscle aches (any 6) (-1m for no data/insufficient data quoted)		6												

Q9	ai	• <u>Pain receptor in skin</u> stimulated and produce <u>impulses</u>; • Nerve impulses travel along <u>sensory neurone to spinal cord</u> (central nervous system) • Nerve impulses transmitted across synapse to <u>relay neurone</u> and then across another synapse to <u>motor neurone</u>; • Nerve impulses travel along motor neurone to <u>leg muscle</u> (effector); • Leg <u>muscle contracts</u> and <u>withdraws foot</u> from nail (action) <i>(max 4m; -1m if no mention of keywords in pattern A)</i>	4
	a ii	• Blood glucose concentration increases (stimulus) • <u>Islets of Langerhans</u> (receptor) in pancreas stimulated and release <u>insulin</u> into bloodstream • Insulin carried by blood to <u>liver</u> (effector) • Liver <u>converts glucose into glycogen</u> / <u>Uptake of glucose by cells / usage of glucose in respiration</u> (action) • Blood glucose concentration returns to normal levels <i>(max 4m; -1m if no mention of keywords in pattern B)</i>	4
	b	• Endocrine control can have <u>long-lived or short-lived</u> responses while nervous control has only short-lived responses; • Endocrine control <u>can affect more than one target organ</u> while nervous control is usually localised; • <i>Medical conditions under endocrine control can be more easily treated by medication which alter hormone levels</i> • <i>(or any other reasonable answer)</i>	2

Q10 E	ai	• Progesterone <u>inhibits FSH secretion</u> by the <u>anterior pituitary gland</u> by negative feedback; • When FSH is low, <u>primary follicles are not developed</u> in the ovary and thus <u>ovum will not be released, preventing fertilisation</u>;	2
	aii	• The pill is a chemical contraceptive that <u>does not prevent the exchange of bodily fluids</u> during sexual intercourse; • Males could wear condoms/ practice <u>abstinence / fidelity</u> to one partner	6
	bi	• High blood <u>pressure</u> of the mother would <u>kill</u> the foetus; • Maternal and foetal blood may be incompatible, i.e. <u>different blood group</u> when mixed, would lead to <u>agglutination</u>;	
	bii	• Allows <u>useful substances</u>, e.g. oxygen and glucose, to <u>diffuse from the mother's blood to foetus' blood</u>; • Allows metabolic <u>waste products</u>, e.g. urea and carbon dioxide, to <u>diffuse from foetus' blood to mother's blood</u>; • Allows <u>protective antibodies</u> to diffuse from mother's blood to foetus' blood that would <u>protect</u> the baby against disease-causing organisms; • <u>Produces progesterone</u> to <u>maintain the thickness of the endometrium</u> during pregnancy;	

Q10 Or	ai	• A <u>gene</u> found on the DNA <u>codes for the antibody protein</u>; • Every <u>3 DNA nucleotides / codon</u> codes for <u>an amino acid</u>; • The <u>template strand</u> of the gene is used to make <u>mRNA</u>; • Which is transported <u>out of the nucleus into the cytoplasm</u>; • The mRNA attaches to a <u>ribosome</u>; • Which <u>translates</u> the message in mRNA into a <u>sequence of amino acids</u>; • By recruiting <u>tRNAs containing anti-codons</u> that are <u>complementary</u> to the mRNA; • Amino acids are joined by <u>peptide bonds</u> to form <u>polypeptide chains</u>; (any 6)	6
	b	• <u>Ribosomes</u> on the RER <u>synthesise</u> the antibodies / <u>vesicles</u> containing the antibodies <u>pinch off from the RER</u>; • To <u>fuse with the Golgi apparatus</u> which <u>stores and modifies</u> the protein/antibody; • <u>Secretory vesicles</u> containing the protein/antibody <u>pinch off from the Golgi apparatus</u>; • And move to <u>fuse with the cell surface membrane</u>, releasing the antibody outside of the cell;	4

