

**2021 Biology 6093
Suggested Answers**

Paper 1

1	2	3	4	5	6	7	8	9	10
C	B	D	D	A	D	C	A	D	A

11	12	13	14	15	16	17	18	19	20
B	A	B	B	A	D	C	A	C	D

21	22	23	24	25	26	27	28	29	30
A	A	D	D	D	C	B	C	C	C

31	32	33	34	35	36	37	38	39	40
B	C	C	B	A	C	D	B	A	D

Paper 2

Section A			
Q No	Suggested Answers	Marks	Feedback
1(a)	P: vena cava Q: right atrium	1 1	Some candidates confused the vena cava with pulmonary vein.
1(b)	Transport blood rich in oxygen and glucose from aorta to muscles of the heart	1 1	Many correctly summarised the role of the coronary arteries
1(c)	Oxygenated blood from pulmonary vein; enter heart through the left atrium; passes through bicuspid valves / AV valve into left ventricle; ventricular systole, pushing blood out of left ventricle, passes through the semi-lunar valves to the aorta; enters the kidney via the renal artery	1 1 1	Many candidates included unnecessary detailed info abt the oxygenation of the blood in the lungs as an intro Describe route to the kidney, ref to renal artery
1(d)	platelets and damaged tissue release thrombokinase; thrombokinase converts prothrombin to thrombin thrombin converts soluble fibrinogen to insoluble fibrin threads, which entrap RBCs, forming a mesh to plug the wound	1 1	Blood clotting was well understood by most candidates, with many demonstrating extensive knowledge not required for answering the question. Many candidates had a good knowledge of the role of platelets and the role of fibrin in forming the clot.
2(a)(i)	energy used for growth = 6×2.5	1	

	= 15 au / year		
2(a)(ii)	heat	1	
2(a)(iii)	20 x 2.5 = 50 au / year	1	
2 (b)	percentage = $15 / (15 + 25 + 50) \times 100\%$ = 16.7%	1	
2(c)	For animals to move, they have to break down more digested food to release more energy through respiration. By reducing movement, less energy is used by the animal and hence lost as heat to the environment. There will be more excess energy to be used for growth → increase in mass increases profit for farmers.	1 1 1	
3(a)	B, salivary amylase C, lipase A, pepsin	2 2 2	The vast majority of candidates demonstrated an excellent knowledge of enzymes in different parts of the digestive system. Occasional errors occurred when trypsin and pepsin were ascribed to the incorrect areas, or ligase enzyme was confused with lipase enzyme.
3(b)	Enzyme acts as a lock while the substrate acts as a key. The substrate has a complementary shape to the <u>active site of the enzyme</u> .	1	A significant number of candidates did not follow the instruction to 'explain the mode of action' of enzymes and instead listed a range of digestive enzymes including their associated substrates and products with

	Substrate binds to the active site, forming an <u>enzyme-substrate complex</u>. This allows the enzyme to break the bonds in the substrate easily, lowering the activation energy for the reaction. Substrate which the large, complex food molecule e.g. protein is broken down by protease into products which are small, simple food molecules e.g. amino acids.	1 1	occasional references to optimal pH values and possible denaturation. Candidates who did correctly address the question demonstrated a good level of understanding
4(a)	Nn X Nn N n N n NN Nn Nn nn normal normal normal affected	1 1 1 1	Most candidates correctly completed the genetic cross. Candidates who performed less well used the term 'carrier' for the phenotype of 'Nn', which is a genotype not a phenotype.
4(b)	25% / 0.25	1	The majority of candidates gave the correct probability, although some candidates who correctly completed the genetic cross went on to give an incorrect probability of 0.5 or gave a ratio answer of 3:1.
4(c)	The mother does not have PKU and thus can produce the enzyme to break down phenylalanine. Mother will not accumulate phenylalanine in the blood, which will not be passed to the foetus in excess through the placenta.	1 1	Many candidates identified that the mother possessed the enzyme that would break down phenylalanine, but they did not develop their answer fully to describe the consequences of this. Candidates who performed less well referred to the mother's enzyme diffusing to the baby.
4(d)	Down syndrome	1	The vast majority of candidates provided a correctly

			named disease. Incorrect suggestions included 'cancer' or 'autism'.
5(a)	Excretion is the removal of <u>metabolic waste products, toxic substances and excess substances</u> from the body. For example, carbon dioxide from respiration is excreted via lungs, urea from deamination of excess amino acids is excreted via kidneys.	1 1	This question was well answered. a very large proportion of candidates could describe the origin of the waste products.
5(b)(i)	From glomerulus to Bowman's capsule	1	Most candidates knew the site of ultrafiltration and drew their arrow in the correct vicinity. Some, however, only indicated the position (usually within the glomerulus) of the process and did not indicate the direction of ultrafiltration.
5(b)(ii)	From proximal convoluted tubule to peritubular capillaries	1	Origin of their arrow showing reabsorption within the nephron, sometimes did not reach the capillaries. Others only drew arrows along the nephron or within the tubule showing the direction of flow.
5(c)	ADH causes walls of V to be more permeable to water Increases reabsorption of water from V into surrounding blood capillaries	1 1	
5(d)(i)	Both similarities and differences required	3	

	Similarities: 1. Both contain digested food substances e.g. amino acids, glucose. 2. Both contain mineral salts 3. Both contain dissolved gasses e.g oxygen, carbon dioxide. 4. Both are maintained at body temperature Differences 1. Unlike plasma, dialysis fluid contains no metabolic waste products e.g. urea. 2. Unlike plasma, dialysis fluid contains no hormones e.g. insulin, glucagon.		
5(d)(ii)	Dialysis fluid is a medium that creates a steep concentration gradient for a high rate of diffusion of metabolic waste e.g. urea and excess substances e.g. salt, water, from blood. This effectively removes metabolic waste and excess substances from the patient's blood.	1 1	
6	Isolation idea: Scientists isolate the human DNA containing insulin gene from a pancreatic cell, and a bacterial plasmid. Restriction enzyme: Insulin gene is cut using a suitable restriction enzyme. The plasmid is cut using the same restriction enzyme. This produces complementary sticky ends on the human DNA fragment and the bacterial plasmid.	1 1	

	DNA ligase: The human DNA fragment containing insulin gene is mixed with the bacterial plasmid and inserted into it using DNA ligase forming recombinant plasmid. Transformation: Recombinant plasmid/DNA is inserted into <u>bacterial cell</u> after weakening the cell membrane with heat → bacteria is transformed (now considered a transgenic organism) and now contains and can express the gene to make the insulin protein	1 1	
Section B			
7(a)(i)	size is at least 50% of grid provided axes labelled, with units points accurately plotted, allow 1 misplot line of best-fit	1 1 1 1	Most responses generally showed good graphical skills. Some responses did not draw a correct line of best fit. A common error was not having a balance of data points on either side of the line.
7(a)(ii)	0.3 mol/dm ³		
7(a)(iii)	+0.5%		
7(b)	As concentration increases from 0 - 0.4 mol/dm³, percentage change in length decreases, but value is still positive due to water entering the cell Water potential in distilled water, sucrose 0.2 - 0.4 is higher than water potential in potato cells When sucrose concentration increases further, percentage change is negative as water leaves the cell, as water potential in cell is higher than surrounding → water moves out of cells	1 1	detailing the pattern in the results in terms of water potential. .

	Water potential of sucrose from 0.5 - 1.0 is lower than cells so water moves out via osmosis → causing the cells to shrink, hence decreasing in length	1	
7(c)	drawing of a plasmolysed cell	1	
8(a)	Hair - traps layer of air, poor conductor of heat → reduce heat loss Thermoreceptor - detect drop in temperature on skin, generates nerve impulse Sensory neurone - transmit impulses from thermoreceptor to hypothalamus Adipose tissue - layer of insulation to prevent too much heat loss to surrounding Capillary - less blood flow, reduce heat loss at surface of skin by RCC, due to vasoconstriction of skin arterioles	1 1 1 1 1	Some candidates mistakenly described capillaries as being able to constrict, some misidentified the hair as the hair follicle or the sensory neurone as a nerve or relay neurone. Some candidates correctly named structure 2 but did not go on to describe its role in thermoregulation.
8(b)	Maintenance of a relatively constant internal environment within narrow limits Stimulus that deviates from the normal condition of the internal environment is detected → Corrective mechanism is activated → Returns body back to the normal condition through negative feedback	1 1	Many knew that negative feedback is involved. Fewer candidates were able to describe the way that the return to the normal point is achieved, and consequently did not always fully explain the role of a corrective mechanism. Candidates who performed less well referred only to specific examples and not the general principles of homeostasis.
8(c)	Hypothalamus is both a detector and control centre.		Several candidates recognised that receptors detect the

	Hypothalamus has thermoreceptors which monitor and detect any change in body temperature. Nerve impulses are generated if a stimulus is detected. Hypothalamus sends nerve impulses to the effectors e.g. sweat glands, skin arterioles, hair erector muscles. Corrective mechanism is activated to oppose the stimulus. Hypothalamus detects if the body has returned to normal levels.	1 1 1	temperature change but did not develop their answer further to include nerve impulses. Only candidates that performed well overall, noted the role of the hypothalamus in detection of blood temperature. Some candidates recognised the role of the hypothalamus in transmitting nerve impulses, although the role of the motor neurone was not often described.
9E(a)	Either of the points whether both graphs intersect	1	
9E(b)	1. No photosynthesis before 6am → absence of light 2. 6am to noon - rate of photosynthesis rises sharply by 50au, due to increased light intensity 3. Max light at noon → max photosynthesis at 50au 4. Noon to 6pm → photosynthesis decreases sharply by 50au, due to decreased light availability 5. Past 6pm, no light → no photosynthesis	1 1 1 1 1	Most candidates described the rate of photosynthesis along the timeline of the graph. Most gave an appropriate data quote, usually for the rates at 06.00 and 12:00. A significant number of candidates referred to the 'Sun rising and setting' or to there being 'more or less sunlight', rather than describing changes in light intensity or light energy. Many candidates correctly described the maximum rate of photosynthesis and linked this to when most light is available. Candidates who performed less well described the shape of the curve rather than describing and explaining the changes in the rate of photosynthesis.

9E(c)	When rate of photosynthesis exceeds rate of respiration, overall mass will increase, when rate of respiration exceeds rate of photosynthesis, overall mass will decrease Photosynthesis makes glucose, excess is stored as starch which add to the overall protoplasm → increase biomass; while respiration uses glucose to release energy, decreasing biomass From graph, time 8am to 4pm is when $P \gg R$ and before 8am and after 4pm, $R \gg P$ The overall area is similar hence net increase in mass → growth is zero (show with calculation)	1 1 1 1	Many candidates correctly described processes involved in the production of, and uses of, glucose. Some candidates were not specific about when photosynthesis occurred over the 24-hour cycle. candidates who performed less well referred to 'food' being formed.
9O(a)	Produce hormone oestrogen and progesterone; Helps to maintain menstrual cycle Production and release of mature ova, released once in each menstrual cycle	1 1	Most candidates gave details of the functions of named reproductive hormones, although some did not identify them as hormones. The production or release of ova was also recognised.
9O(b)	Not pregnant Progesterone level increases and then decrease to original due to non-pregnancy while pregnant level will increase but remain high throughout pregnancy Pregnant and non-pregnant have similar levels up till end of fertile period (20) which is about 25au	1 1	Although the question asked for a comparison, many candidates answered by giving detailed descriptions of the data for a pregnant woman but did not make clear comparisons with the nonpregnant woman. Only stronger responses made clear comparisons not only of the raw data, but also of trends in the data.

	Pregnant woman level will increase by 4x after 3 months and increase to max of 250 (x10), while the max amount for non pregnant is 25 units Non pregnant will drop after fertile period which is halfway through the 28-day cycle, and rises again at the beginning of the cycle for the next 9 months, pregnant increases (describe) and is maintained	1 1	
9O(c)	pollen grain germinates; pollen tube emerges; tip of pollen tube releases enzymes to digest tissue of stigma and style; male gamete reaches ovary; enters ovule via micropyle; pollen tube absorbs sap and bursts; releasing male gamete for fertilisation;	1 1 1	This question was usually well answered with some very detailed accounts. Candidates who performed less well referred to the ovary in general rather than including specific details about the role of pollen tubes and the micropyle.