MAYFLOWER SECONDARY SCHOOL
2020 SECONDARY 4 PRELIMINARY EXAMINATIONS MARK SCHEME
BIOLOGY 6093

Paper 1

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

1a [3]

	name of organelle	function
A	Cell surface membrane	Controls movement of substances into and out of cell
C	Mitochondrion	Release energy through aerobic respiration
E	Rough endoplasmic reticulum	Involved in the transport of synthesized proteins by ribosomes
F	Golgi apparatus	Involved in the chemical modification and packing of substances into vesicles for export

1bi [1]

Compact and branched – can be used to pack large numbers of glucose molecules for storage

Insoluble – does not affect the water potential of cell cytoplasm and hence affect osmosis within the cell

1bii [1]

When the blood glucose concentration is above the norm, insulin can be secreted by the Islets of Langerhans to be transported to the liver.

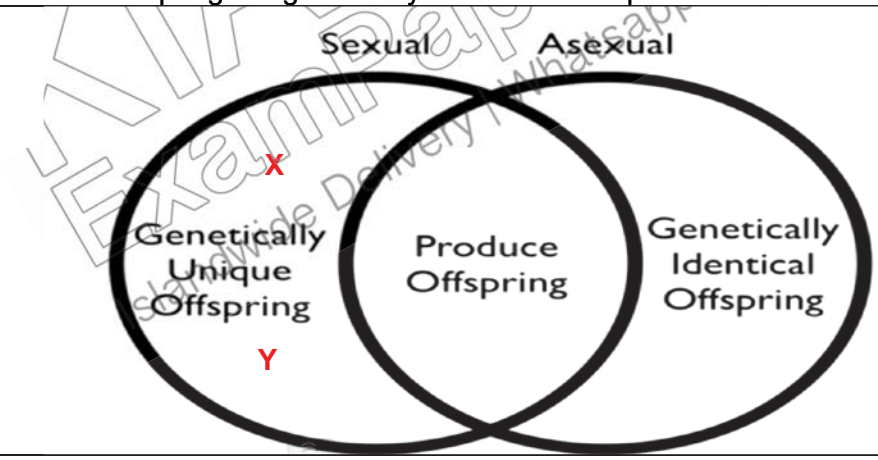
[1]

The liver cells will then absorb the glucose molecules from the bloodstream, converting the glucose into glycogen in the presence of insulin. This would lower the concentration of blood.

[1]

When the blood glucose concentration is below the norm, glucagon can be secreted by the Islets of Langerhans to be transported to the liver.

	Glucagon then converts glycogen to form glucose to raise the blood glucose concentration back to the norm.	[1]
2a	Carbon dioxide + water → glucose + oxygen + water In the presence of sunlight and chlorophyll	[1]
2b	Any two of the following: 1. At low light intensity, the shade leaf took in carbon dioxide at a higher rate than the sun leaf. 2. As light intensity increases, the shade leaf does not take in more carbon dioxide but the sun leaf continues to take in more carbon dioxide. 3.The sun leaf is able to take in twice as much of carbon dioxide compared to the shade leaf at high light intensities.	2[1]
2c	As the light intensity increases, light intensity no longer is a limiting factor for the shade leaf.	[1]
2d	Glucose is formed as a product of photosynthesis. Any 2 of the following: • It can be converted to cellulose, a polysaccharide used for the production of cell walls of plant cells. • Glucose can be converted to sucrose to be transported via translocation through the phloem to other parts of the plant for storage. • Glucose can be converted to starch to be stored within the plant cells (as granules) to be used as an energy store.	2[1]
2e	• When the leaves of a tree wilt, the rate of photosynthesis will decrease as the stomata close, taking in less carbon dioxide. Any one of the 2 points: • Hence, the rate of carbohydrate production will decrease, reducing the plant's increase in biomass. • Also, the plant will be using up its carbohydrate stores in the form of starch, and hence decreasing the biomass within the plant.	2[1]
3a	Homeostasis is the maintenance of a constant internal environment independent of external changes in the external environment.	[1]
3b	Receptor: Osmoreceptors in hypothalamus Effector: Collecting duct	2[1]
3c	• With the intake of large amounts of concentrated sodium chloride solution, the water potential of blood decreases below the norm. • Hence, the decrease in water potential of blood is detected by the (osmoreceptors) in the hypothalamus and the (anterior) pituitary gland secretes more Anti-Diuretic Hormone (ADH)	4[1]

	• The increase in ADH secretion causes the increase in selective reabsorption of water at the collecting duct by osmosis. • Producing low volumes of concentrated urine/high in concentrations of salt.	
4a	• By using a restriction enzyme to cut the herbicide-resistant gene (rej: gene of interest NSE) from the chromosome of a cell of the mature plant • And using the same restriction enzyme to cut the plasmid of a vector like E.coli • Form a recombinant plasmid using DNA ligase and the herbicide-resistant gene and the plasmid • Using heat shock at 42^{O}C in the presence of Ca^{2+} ions or electroporation, allow the E.coli cell to go through transformation to take in the recombinant plasmid to become a transgenic bacteria cell.	4[1]
4b	Any one of the following: • Introduction of other genes into the plant that can lead to allergies or toxic reactions in humans when consumed. • Changes in the ecosystem when consumers consume such herbicide-resistant plants – possibility of bioaccumulation of toxins • Widening of rich-poor divide when wealthier countries are able to make use of such technology to improve their crop yield.	[1]
4c	• Production of genetically varied gametes during meiosis in addition to random fertilisation in sexual reproduction causes the production of genetically unique offspring. • In asexual reproduction, there is no fusion of gametes involved and henc, the offspring are genetically identical to the parental cells.	2[1]
4d		2[1]
5a	**U:** phosphate group **W**: deoxyribose sugar **X**: cytosine (rej: nitrogen-containing base)	3[1]
5b	Any 2 of the following: 1. The bonds found within a polypeptide are peptide bonds but the bonds found within a DNA molecule are phosphodiester bonds.	2[1]

	2. The polypeptide is made of repeating units of amino acids but the DNA molecule is made of repeating units of nucleotides. 3. The DNA molecule is a a double-helix shape but the polypeptide is a linear chain of amino acids. 4. Complementary bp exist between the 2 polynucleotide chains in DNA but no complementary bp exist within a polypeptide chain.	
5c	• The sequence of bases control the sequence of amino acids within a polypeptide synthesized. • 3 bases code for one amino acid in a triplet code.	2[1]
5di	• At K, the mass of DNA doubles due to DNA replication in Interphase. • At L, the mass of DNA doubles due to cytokinesis splitting the contents of the cell into two cells.	2[1]
5dii	2^3=8 cells produced 3 blood cells produced	1
5diii	• Remains the same at 46 chromosomes	1
6a	• Dominant allele • Individual 4 and 5 are heterozygous for the condition, having inherit one recessive allele from 2 but express the condition. • Individual 5 and 6 are both able to produce offspring 7 and 8 who do not have the condition as 7 and 8 inherit a recessive allele from each parent.	3[1]
6b	• 0% • Individual 11 is homozygous recessive for the condition and marrying an unaffected male who is also homozygous recessive for the condition means that there is no dominant allele inherited by their children that can cause this condition	2[1]
6ci	• Gene mutation	1
	• The mutation leads to the photoreceptors/cones not being able to be stimulated under low light intensity. • Hence, the sensory neurones cannot be triggered properly to send nerve impulses to the brain. • No or little imagery can then be intepreted under low light as the brain lacks the sensory input.	3[1]

Section B

7a	Axes correctly labelled with units – 1 Scale (start from pH 5) – 1 Plotting – 1 Best Fit Curve – 1	4[1]
7b	• D1: The optimum pH for catalase activity is pH 7, where the volume of gas produced in 5 minutes is the highest at 88cm^3 • D2: As pH decreases from pH 7 to pH 2 (pH becomes increasingly acidic), the volume of gas produced in 5 minutes decreases from 88 to 12 cm^3. • D3: As pH increases from pH 7 to 9 (pH becomes increasingly alkaline), the volume of gas produced in 5 minutes decreases from 88 to 8cm^3.	2[1] – description of trend 2[1] - explanation

	• E1: At pH 7, the 3D conformation of the catalase is at its optimum and the activte site is able to fit the shape of the hydrogen peroxide molecule to form the highest rate of e-s complex. Hence, the highest rate of enzyme activity occurs at pH 7. • E2: As the pH deviates from optimum/becomes more acidic and alkaline, the 3D-conformation of catalase is altered as the bonds maintaining the 3D structure become disrupted. The catalase is said to be denatured and the active site is lost. The formation of e-s complex decreases and hence, the rate of enzyme activity decreases.	
7c	Any 2 of the following • Volume of hydrogen peroxide • Concentration of hydrogen peroxide • No of potato discs/tissue used • Source of potato	2[1]
8a	28 days[1] Explanation (any one of the following) – 2[1] **Data to be quoted for full credit to be given** 1. The peak of estrogen occurs at day 13 and day 41 and since there is only 1 peak of estrogen per cycle, each menstrual cycle has a duration of 28 days. 2. The level of progesterone drops to basal level by day 28 and it resumes the same trend as day 1 to 13 from day 28 to day 41.	3[1]
8b	• D1: From day 1 to day 13, the level of estrogen increases from 8 to 176pg cm^{-3} • D2: From day 13 to day 22, the level of estrogen decreases from 176 to 96 pg cm^{-3} • E1: The level of estrogen increases as the production of estrogen occurs in the follicle cells of the growing follicle. This is to enable the repair of the uterine lining to prepare for implantation. • D3: From day 1 to day 13, the level of progesterone remains at a low of 3 ng cm^{-3} • D4: From day 13 to day 22, the level of progesterone increases from 3 to 22.5 ng cm^{-3} • E3: The level of progestrone increases after ovulation occurs on Day 13 as the corpus luteum remaining in the ovary produces progesterone. The function of progesterone is to maintain the thickening and vascularisation of the uterine lining for implantation and placenta development.	Max 3 – Data 2[1] – explanation
8c	• If the woman is pregnant, the level of progesterone will remain high after day 22 instead of dropping to basal levels. • This is to allow for the continued thickening of the uterine lining to allow the pregnancy to be viable.	2[1]

9a	State the changes in the table without explanation – 1m max • The breathing rate increases from 11 to 22 breaths per minute. • The ventilation rate increases from 6 to 90 dm3 per minute. • The heart rate increases from 65 to 170 beats per minute. Explanation: 1. As a person exercises, vigorous muscular contractions require large amounts of energy and hence a higher rate of aerobic respiration needs to occur. 2. With a higher rate of aerobic respiration, the demand for oxygen increases and hence breathing rate and ventilation increases to bring in more oxygen into the body. 3. The rate of production of carbon dioxide also increases as a result of respiration and hence, the higher breathing rate and ventilation helps to remove carbon dioxide from the body more quickly. 4. The rate of ventilation increases also to increase the efficiency in which gaseous exchange occurs at the alveoli and bloodstream (respiratory surface) 5. The heart rate increases in order to circulate oxygenated blood to all parts of the body more quickly to support aerobic respiration.	5[1]
9b	• When the race started, the athlete uses aerobic respiration for his energy demands. • As the race continues, the heartrate and breathing rate cannot continue to increase further to supply more oxygen to the respiring muscle cells. • The muscle cells go into oxygen debt and hence, utilise anaerobic respiration, in addition to aerobic respiration, to release more energy in the absence of oxygen. • Lactic acid is produced as a result of anaerobic respiration. • When the race stops, the demand for energy decreases as the muscles are no longer contracting vigorously and hence, the additional oxygen take in is used to convert lactic acid to glucose. • Hence, the oxygen debt is repaid when all the lactic acid is fully converted back to glucose for aerobic respiration.	5[1]