4E Biology Prelims 2022 (6093)
Answers

Paper 1

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

Paper 2

Mark schemes will use these abbreviations:

;	separates marking points
/	alternatives
()	contents of brackets are not required but should be implied
R	reject
A	accept (for answers correctly cued by the question, or guidance for examiners)
I	ignore (for incorrect but irrelevant responses)
AW	alternative wording (where responses vary more than usual)
AVP	alternative valid point (where a greater than usual variety of responses is expected)
ORA	or reverse argument
underline	actual word underlined must be used by candidate (grammatical variants excepted)
max	indicates the maximum number of marks that can be given
+	statements on both sides of the + are needed for that mark

Section A

Qn	Answer	Mark	Remarks
1ai	**Xylem** ;	1	
1aii	Xylem is **long and hollow**, without **crosswalls**. ; Allows **water and dissolved mineral salts** to be **transported** from roots to other parts of the plant **without obstruction**. ; OR **Cell wall thickened with lignin**. ; A: lignified cell wall To provide mechanical support for the plant. ;	2	Common mistakes: Not specifying long, hollow and no crosswalls. Not specifying cell wall. Not specifying how the lack of crosswalls allowed water and dissolved mineral salts to be transported without obstruction Not including dissolved mineral salts.
b	The **concentration of mineral ions** is higher in the soil than in the **cell sap of root hair cells.** ; **ORA** Mineral ions **diffuse** from the soil into the cell sap of root hair cell by **diffusion.** ; **A**: dissolved mineral salts OR The **concentration of mineral ions** is lower in the soil than in the **cell sap of root hair cells.** ; **ORA** Mineral ions **diffuse** from the soil into the cell sap of root hair cell by **active transport**.	2	A number of students did not refer to the cell sap when comparing concentration of mineral salts. A small number of students did not address question properly, and included comparison of water potential and movement of water via osmosis.
2a	Excretion is the process by which **metabolic waste products** and **toxic substances** are removed from the body of an organism. ;	1	Most students were able to answer this question.
2b	Patient **A**: Glucose/reducing sugar is present (in the urine) ; the patient is diabetic ; Patient **B**: protein are present (in the urine) ; patient has kidney disease/problems ;	4	Misconception: protein present in urine due to problems with protein digestion by the stomach. Some students were careless, and referred to the bloodstream instead of urine.
2c	**Protein:** - **Protein molecule** is **too large** to pass through the partially permeable membrane **from the blood in glomerulus** into the **Bowman's capsule** during **ultrafiltration.** ; - Hence, proteins **stay in the blood** capillaries and is transported out of the kidney and would not be found in urine.; **Glucose:**	4	A number of students gave irrelevant answers about the role of insulin in glucose regulation. A number of students showed misconception, and related to the digestion of proteins. A large number of students did not name the process of ultrafiltration in their answers.

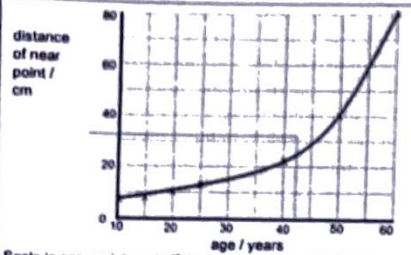
	- Glucose is a **small molecule** that would be forced out of the glomerulus during **ultrafiltration**. ; However, **all** the glucose is **selectively reabsorbed** back into the **blood capillaries at the proximal convoluted tubule**, resulting in the absence of glucose in urine.;		
3a	**Gene-of-interest** for Savinase can be cut off from the chromosomes of one organism using a **restriction enzyme**. ; Obtain plasmid / chromosome of the recipient organism/ bacterium, and **cut with same restriction enzyme**. ; Mix gene of interest with recipient's plasmid / chromosome and **add DNA ligase** to join them together. ; The plasmids / chromosome with the gene-of-interest can be introduced into the cells of the recipient using **heat treatment or electric shock**. ; **Transgenic bacteria** is able to express the production of **Savinase protein/ polypeptide**;	5	Common errors: Failure to relate to questions (RTQ) Misconception that enzyme or bacteria is cut by the restriction enzyme, instead of gene-of-interest. Not stating that Savinase is a polypeptide/protein.
3bi	The **optimum temperature** of Savinase is 60°C while the **optimum temperature of pepsin/ protease in human stomach** is around **37°C**. ; **A**: rate of Savinase activity is **highest** at 60°C while rate of pepsin activity is **highest** at 37°C Savinase only begins to **denature after 60°C** while pepsin denatures after 37°C ; **AW**	2	Many students were not able to compare point-to-point. Some students compared optimum temperature to denaturation. A small number of students gave irrelevant answers pertaining to: - pH - explaining denaturation
3bii	The **rate of Savinase activity is highest at pH 9.** ; The alkaline solution provides **optimum pH** for Savinase to break down protein at the highest rate. ; OR The alkaline solution **prevents denaturation** of Savinase ; **AW**	2	

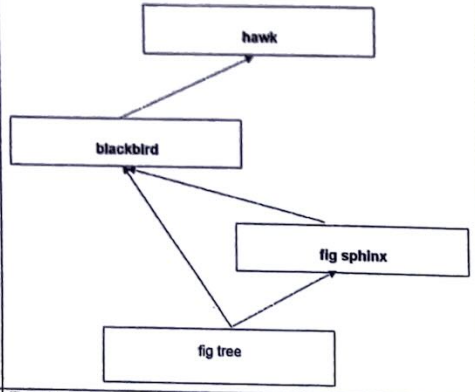
3c	Phosphates in waste water **encourage rapid growth of algae and water plants** on the **surface** of the water. ; **Submerged plants die due to lack of sunlight.** ; Bacteria **decompose** the dead plants and **use up oxygen** in the water. ; **Lack of oxygen leads to death of aquatic life.** ;	4	Need to remind students that 'aquatic life' is not restricted to fish. Misconception that algae use up all the oxygen.'
4a	<table><tr><td>cell</td><td>name of cell</td></tr><tr><td>**A**</td><td>**guard cell ;**</td></tr><tr><td>**B**</td><td>**lower epidermis cell ;**</td></tr></table> Both correct for 1m	2	Most students were able to answer this question correctly. A number of students did not read the question, and gave irrelevant answers such as palisade mesophyll, spongy mesophyll cells, cuticle Some students did not specify that it is the lower epidermis
4b	**Carbon dioxide is required for photosynthesis.** ; Blockage of pore C/stomata **reduces the intake of carbon dioxide, reducing the rate of photosynthesis ; AW** **less glucose produced and converted into starch ;**	3	
4ci	As the temperature at which the leaves were kept **increases from 4°C to 25°C**, final mass as a percentage of the initial mass **decreases gradually from 90% to 85%.** ; As the temperature at which the leaves were kept **increases from 25°C to 38°C**, final mass as a percentage of the initial mass **decreases sharply from 85% to 73%.** ; Award only 1 mark if only overall trend is described.	2	Need to distinct the two rates of decrease A number of students are still not able to distinct between describe and explain, and provided an explanation of the graph.
4cii	humidity; light intensity; wind speed; Max 1	1	**Most students are able to answer this questions.** **A small handful of students do not understand the question, and gave irrelevant answers such as, 'rate of transpiration', 'photosynthesis', 'respiration'.**

5a	**A allele/ gene** **C polypeptide** **A: Protein** **D ribosome** 0 correct: 0 1-2 correct: 1m All 3 correct: 2m	2	Most students are able to identify the ribosome. Very few are able to identify A and C. Many identified A as nucleotides and C as amino acids.
b	AUGUUUCCGGCUUAU	1	
5c	mRNA / a copy of the, gene or **A** ; moves out of, the nucleus (to the cytoplasm) ;	2	

6a	Sexual reproduction is the **process** involving the **fusion of nuclei of male and female gametes** to form a **zygote**, producing **genetically dissimilar** offsprings ;	1	Most students are able to give the definition, some students left out keywords.
6b	Gametes ; R: sex cell, sperm, egg	1	Generally well answered.
6c	**M is haploid/contains 23 chromosomes** while **N is diploid/ contains 46 chromosomes/ 23 pairs of chromosomes** **OR** **M only has one X chromosome,** while **N has XX or XY chromosomes ;** Max 1	1	Generally well answered.
6d	**Naming K and O (2m)** **K is meiosis ;** **O is mitosis ;** **Comparison of K and O (3m)** In meiosis, **chromosome number is halved/ reduced from 46 to 23**, while in mitosis, **chromosome number is maintained/ 46.** ; **Haploid** daughter cells are produced in meiosis while **diploid** daughter cells are produced in mitosis. ; Meiosis produces **4 daughter cells** while mitosis produces **2 daughter cells.** ; Meiosis produces daughter cells which are **genetically different** while mitosis produces daughter cells which are **genetically identical**.; Meiosis takes place in **testes / ovaries / gonads** while mitosis takes place in **body cells/autosomal cells.** ; Max 3 for comparison	5	A number of students mixed up the identity of K and O. Generally well answered. Need to remind students to present answers in the form of point-to-point comparisons.
6e	Only **one** parent is required/ Fusion of gametes is **not** required ; Offspring are **genetically identical** to parent, so, **all the beneficial qualities** of parent can be passed on to offspring. ; **Faster** method of producing offspring ; Max 2	2	Generally well answered.

Section B

Qn	Answer	Mark	Remarks
7a	 Scale is appropriate, > half the grid, multiples of 1/2/5/10; Line is best-fit; Axes labelled with units, markings at regular intervals; Points are plotted accurately;	4	Common errors: • irregular scales (intervals of 8s, 15s) • not indicating the value at origin for 1 of the axis • errors in drawing line of best-fit
7b	As age increased from **10 to 40 years**, the distance of near point increased **gradually** from **7.0 cm to 22.0 cm**. ; As age increased from **40 to 60 years**, the distance of near point increased **sharply** from **22.0 cm to 80.0 cm**. ; Award only 1 mark if only overall trend is described	2	Generally well answered. A number of students did not describe the two different gradients, and just described the overall trend.
7c	**46 ± 2**; Award ECF based on graph	1	All students are able to show workings on their graphs. Need to remind students to present their answers as it is on their graph. Some students round up their answers. A number of students did not read the question carefully, and mixed up 32.0 cm with 32 years old.
7d	As the man walks closer to the poster, light rays from near object is detected by the photoreceptors. The **ciliary muscles of the eye contract**, causing the **suspensory ligaments to slacken**. ; This cause the lens to become **thicker and more convex**. ; The light rays are **refracted** by the lens and the image is **focused** sharply on the yellow spot / **fovea** of the retina. ;	3	Poorly answered. Common errors: • mix up with pupil reflex • stating that suspensory ligaments relaxes (only muscles can contract/relax) • 'concave' lens • Giving irrelevant details on nervous response

8a	all organisms correct ; all arrows correct ;  	2	Generally well answered. Errors: - Arrows in wrong direction - Missing arrows from fig tree to blackbird
8aii	Fig sphinx/caterpillar take in the insecticide when they consume the fig, and insecticide is **absorbed** but **cannot be broken down**, and they are **stored** in the fats **in their bodies**. This is known as **bioaccumulation**. ; insecticide is **passed along food chains**, from Fig sphinx to the blackbird, and to the hawk by **feeding**. ; The **concentration of insecticide increases at each successive trophic level**. This is known as **bioamplification**, ; **where highest concentration of** insecticide **accumulated in the bodies of the hawks** at the **highest trophic level**. ;	4	Common errors: Not stating that the insecticide cannot be broken down. Not relating the increasing concentration of insecticide with each successive level, and the species' position in the food chain. Long-winded answers showing prey-predator relationship, but failed to point out how the insecticide is passed on via feeding.

8b	Since **large amount of energy** (about 90%) **is lost at each trophic level**, (as heat lost during respiration, or in uneaten and undigested materials) ; less and **less energy is available** for organisms at **each successive level** of the food chain. ; **Shorter food chains will mean less energy is lost to the environment** and **more energy is available to the final consumer**. ; Shorter food chains are thus **more energy-efficient than long food chains**. ;	4	Common errors: Answers that do not address the question directly. E.g. talking about the disadvantages of long food chains. Instead of stating directly why short food chains are more energy efficient. Misconception that energy lost = energy wasted. Need to take note of word choices.
9Ea	Alleles are **alternative forms** of the **same gene** ; which occupy the **same relative position/locus** on a pair of **homologous chromosomes** ;	2	Only half the students were able to correctly provide the definition of alleles.
9Eb	number of individual in Fig. 9.2 / genotype of individual 1 — **bb** ; 2 — **Bb** ; 4 — **Bb** ; 14 — **bb** ;	4	Mostly well answered. Some students did not read the question carefully to identify the dominant and recessive alleles, and mixed up the answers.

9Ec	Parental phenotype Parental genotype Gametes Fertilisation Offspring genotypes Offspring genotypic ratio Offspring phenotypic ratio	bar pattern (individual 11) X barless pattern ; Bb X bb ; B b b b ; parent with bar pattern Parent with barless pattern B b b Bb bb b Bb bb ; Bb Bb bb bb Bb : bb ; 1 bar pattern: 1 barless pattern Probability : 0.5 OR ½ OR 50% ;	4	For fertilisation, students may use punnet square or crosses Generally well answered. Need to remind students to include genotypic ratio, and the phenotypic ratio.

9Oa	During intense exercise, body **experiences stress, adrenaline secreted by the adrenal glands ;** **Stimulates conversion of glycogen to glucose in liver cells** • **Increases blood glucoses concentration** • So **more glucose is available for muscle contraction ;** **Increases breathing rate and depth** • **Increases rate of oxygen uptake by lungs ;** **Increases heart rate and blood pressure** • So **oxygen and glucose transported to muscles faster ;** **Increases metabolic rate** • **More energy released** from **respiration** Leads to **constriction of arterioles to the gut and in the skin** • Decreases digestive activities, and cause paleness in skin • **More blood channelled to skeletal muscles** (in the limbs) ; Leads to **dilation of pupils to enhance vision** ; Max 5	5	Generally well answered. Common errors: - Stating that adrenaline converts glycogen to glucose - Not stating the role of liver - Stating that capillaries can carry out vasodilation and constriction
9Ob	When a person enters the sauna, the **body temperature rises above 37 °C.** This change **detected by thermoreceptors in the skin.** ; **Sweat glands** become **more active, more sweat is secreted** onto the surface of the skin. ; **Water** in sweat **evaporates, removing** the **latent heat of vaporisation,** thus **cooling down** the surface of the skin. ; **Arterioles vasodilate** bringing in an **increased blood flow towards the capillaries** near the surface of the skin. ; **Heat** in blood in the **capillaries** is lost to the surroundings **via conduction, convection and radiation.** ; **metabolic activity decreases, to reduce heat released** by the body. ; Max 5	5	Generally well answered. Common errors: - Not stating stimulus - Stating that capillaries can carry out vasodilation and constriction