

2024_6093 Biology

Paper 1

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

Feedback for Paper 1

Qn No	Ans	Comments
5	B	candidates were aware that glycogen is composed of glucose units but were unaware that glucose units can combine in other ways to produce cellulose.
6	B	heating Benedict's solution to 37 C for four minutes will not result in a positive result with glucose.
8	D	These candidates either mis-identified the named blood vessels, did not understand liver functions or did not realise that maltose would not be present in the blood stream.

11	A	When X (bicuspid) valve closes, the AV-valve on the right closes as well - what happens on one side of the heart, happens on the other side too. - eliminating D When AV valve closes, blood cannot flow from atria to ventricles, eliminating B. X closes when ventricular pressure exceeds atrial pressure during ventricular systole to prevent backflow of blood. Soon after, aortic valve open (not closes) during ventricular systole. - eliminating C Blood flows out of heart to lungs via pulmonary artery and to rest of body via aorta
14	A	glucose is necessary for the alveolar cells to function.
16	A	glucose will reduce while blood passes through the kidney. The kidney needs energy for the functions it performs, in particular for the reabsorption of substances from the glomerular filtrate.

18	B	if the skin temperature reduces then less heat must be reaching the skin and so the blood flow must have been restricted.
28	D	Arrow A: Carbon dioxide → plants → This is photosynthesis, where plants take in CO₂. This happens on a huge scale, so a lot of carbon moves here. Arrow B: Plants → herbivores → This is feeding (plants being eaten). Many herbivores eat plants, so again, a large amount of carbon is transferred. Arrow C: Herbivores → carnivores → This is also feeding (herbivores being eaten). Less energy and biomass pass on to carnivores compared to herbivores, so the carbon transferred here is smaller than A or B. Arrow D: Carnivores → decomposers → This is when carnivores die and decomposers break them down. But remember: there are far fewer carnivores than herbivores or plants, so the total carbon flowing here is very small.

32	B	Meiosis does not occur in haploid cells. Haploid cells are produced from meiotic division. Meiosis, aka reductive division, results in halving of chromosome number in cells, forming haploid cells. When the haploid gametes fuse (during fertilisation), diploid number of chromosomes is restored
38	A	Heterozygous - one dominant and one recessive allele. Based on the genetic cross of heterozygotes (individual 4 and 5), there's a 50% chance that individual 7 is heterozygous. Each birth event is independent of the previous.

Paper 2

Qn	Answer	Marks	Remarks
1(a)	Root hair cells are usually found underground where sunlight is absent ; Because of this, root hair cells, do not require chloroplasts to absorb light for photosynthesis to occur ;	1 1	Most candidates understood why root hair cells do not require chloroplasts. A significant proportion of candidates described the root hair cell as being 'underground' without reference to light. Weaker responses simply stated that the function of root hair cells is to absorb water and mineral ions.

1(b)(j)	Mitochondrion ;	1	This question was answered correctly by almost all candidates. Take note of the singular form and not plural form.
1(b)(ii)	Organelle A is used to convert glucose into energy ; Which is released during respiration ; For protein synthesis which is required for cell growth and repair that helps with growth of plants ; OR Energy released is for active transport of stored manufactured food substances for translocation of substances from roots to leaves for cell growth during periods of absence of lights OR For active transport of ions into the root hair cells, which may be used for plant growth OR For active transport of ions into root hair cells, to lower the water potential in the root hair cells, for water to enter via osmosis and is	1 1 1	Many candidates recognised the role of mitochondria in the growth of plants and referred to energy in their answer. A common incorrect answer was to describe the uptake of water by active transport. Weaker responses indicated that energy could be used for photosynthesis or respiration.

	eventually used by leaves as a raw material for photosynthesis ;		
1(b)(iii)	Endoplasmic reticulum; Golgi body ;	1 1	A common incorrect response was ribosome instead of endoplasmic reticulum.

2(a)	When the student looks away from the boat (far away object) and looks at the book (near object), his ciliary body in the eyes will contract ; This will cause the suspensory ligaments to slacken ; This reduces the tension on the lens causing the lens to be thicker and more convex ; As a result, focal length decreases, causing the light rays from the book to bend and focus sharply on the retina ;	1 1 1 1	Suspensory ligaments will relax is rejected as they are not muscles. Students have to remember that the question is testing on accommodation reflex and they have to take note of the keywords of what happens when the lens becomes thicker. Many candidates described the eye when the student was looking at the boat or the detail of nervous coordination to bring about the changes, which were not required.
2(b)(i)	Percentage decrease = $(5.8-2.5)/5.8 \times 100 \%$ = 56.9 % (3sf)	3	1 mark for correct working 1 mark for the correct calculation 1 mark for correct number of sf Since the question states calculate, if there is no calculation, students would not get the mark for this question and students may miss out the number of sf stated in the qn.

2(b)(ii)	To allow less light to enter the eye preventing over-exposure to light that would cause damage to the retina. ;	1	Many candidates could correctly suggest why it is important for the pupil diameter to decrease in bright light. Weaker responses only referred to allowing less light to enter the eye.
2(b)(iii)	Radial muscle of iris relaxes and circular muscle of iris contracts ; Constricting the pupil, reducing the amount of light entering the eye. ;	1 1	Students may use words like contracting pupil. However, pupil is a gap which can only dilate or constrict in size. Weaker responses referred to muscles constricting rather than contracting, referred to the radial muscle as the longitudinal muscle or referred to the circular muscle as the ciliary muscle.
3(a)(i)	Differences in phenotypes or traits between individuals of the same species ;	1	Many responses needed more detail, often referring to differences without specifying between what.
3(a)(ii)	Height, skin colour ; AVP	1	
3(a)(iii)	Blood type, presence of dimples, ability to roll tongue ; AVP	1	
3(b)(i)	P has a bigger dome-shaped shell, compare to Q which has a flatter shell. ; P has has scales that looks sharper / it protrudes out of the leg whereas Q has scales that protrudes less / looks smoother on the surface of the leg ;	1 mark per difference	Some candidates talked about the overall size of the tortoises which could not be determined from the photographs without a scale. Weaker responses attempted to describe

			features that were not sufficiently visible to be compared.
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3(b)(ii)	1. Variation exist in population of the tortoises in the island due to random mutations. 2. Due to constraints in availability of food, variants with the longer neck have better access to food than the shorter-necked variants. 3. Longer-necked variants enjoy selective advantage over the shorter-necked variants OR nature selection would select for the longer-necked variants 4. Lived longer, to reproductive age + pass down beneficial genes of long-necked to their offspring. Resulting in increased frequency/population of longer-necked variants. 5. Over time (many generations), and with reproduction in isolation the longer-necked variants replace the population.	1 1 1 1 1	Many candidates demonstrated a good understanding of the principles of natural selection, although many did not use this scientific term in their response. Stronger responses began with a reference to 'mutation' and 'variation', as the basis for the evolution of the long-necked tortoise. Stronger responses described the passing of favourable alleles to the offspring and the increased frequency of these alleles in the population.
4(a)	Oxygen ;	1	
4(b)(i)	17 bubbles per minute ;	1	

4(b)(ii)	Measure the volume of gas produced using a gas syringe ;	1	Some lacked precision and referred to measuring the amount of gas rather than its volume or did not mention measurement at all. Weaker responses used a datalogger to count bubbles or attempted to measure the quantity of manufactured starch using iodine solution.
4(b)(iii)	Carbon dioxide is the limiting factor ; There is no change in number of bubbles of 27 bubbles produced	1 1	Students need to explain both light intensity and carbon dioxide concentration. If student only

	despite an increase in light intensity from 6 to 7 arbitrary units and when carbon dioxide concentration increased to 0.1% when light intensity remained at 6 and 7 arbitrary units, number of bubbles increased by 30. ;		considered at 0.01% carbon dioxide concentration and number of bubbles did not increase, there could be another factor that is limiting. By using 0.1% carbon dioxide concentration, and there is an increase in the number of bubbles, it is clear that carbon dioxide is the limiting factor here.
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4(c)	Rate of photosynthesis will be lower ; Enzymes involved during photosynthesis is inactive / has low kinetic energy, therefore, reducing the rate of effective collisions and enzyme substrate complexes formed. ; Rate of photosynthesis will be 0 ; Enzymes would have denature. There would be no enzyme-substrate complex formed. ;	1 1 1 1	Some students may use the idea of transpiration. For example, in high heat, plants may transpire more to lose heat, hence, increasing the rate of photosynthesis. Even though it is logical, the enzymes will denature. Hence, even with water reaching the leaves, photosynthesis would not occur. Many candidates realised that photosynthesis would stop completely at 80 C. Weaker responses incorrectly described changes in turgidity and stomatal opening or chlorophyll denaturation. Some responses incorrectly stated that the rate would increase due to higher kinetic energy of both enzyme and substrate.
5(a)(i)	Mitosis results in the formation of genetically identical daughter cells ;	1	Students need to be aware that

	Which is important for replacing of damaged or dead cells ; R: genetically similar cells R: enabling growth of cells [A: growth of tissue/organism] R: cell repair [A:tissue repair]	1	mitosis is similar to the idea of asexual reproduction but it shouldn't be an example of asexual reproduction. Mitosis involves the nucleus whereas asexual reproduction may not. One example is asexual reproduction of bacteria during budding. Another common error was to refer to mitosis enabling the repair of cells instead of tissue repair. A small minority of candidates confused the process of mitosis with meiosis.
5(a)(ii)	Meiosis results in the formation of haploid gametes that are not genetically identical ; Ensures that upon fertilization there will be the only diploid number of chromosomes in zygote OR Ensures variation in gametes and thus, variation in offsprings ;	1 1	Weaker responses showed lack of specificity, such as referring to 'haploid' cells' rather than to 'gametes' or to 'reproduction' alone without qualification. Some referred to the production of genetically different cells without going on to state how this results in genetically different offspring (leading to variation).
5(b)	Mitosis produces daughter cells with diploid number of chromosomes, 46 chromosomes while meiosis produces daughter cells with haploid number of chromosomes, 23 chromosomes. OR Mitosis produces daughter cells with two times the number of	1	

	chromosomes compared to daughter cells produced during meiosis ;		
6(a)	Carbon, hydrogen and oxygen ;	1	
6(b)	Bile released from liver and gall bladder to the small intestine will <u>emulsify fats</u> in the small intestine ; This <u>increases the surface area to volume ratio</u> of fat molecules ; <u>Lipase</u> from intestine and pancreas will be able to <u>catalyze the break down of fat molecules</u> ; Into <u>fatty acids and glycerol</u> which will be absorbed into <u>lacteal of</u> the small intestine as <u>minute fat globules</u> which will be transported in the <u>lymphatic system</u> ;	1 1 1 1	Most students should be able to describe the processes for digestion. However, they need to take note how and where fats are absorbed into the small intestine.
6(c)	Insulation to prevent excessive heat loss ; Secondary source of energy ; Important component of cell membrane ; Protection / Cushioning of organs from injuries ; Solvent for fat-soluble vitamins	Any 2 points	Weaker responses used imprecise language such as 'keeping us warm'.
7(a)	From the diagram in Fig. 7.1, only 10 % of biomass is transferred from one trophic level to another ; This is because, not all parts of the organisms were consumed by the consumer of the next trophic level + Examples includes, uneaten body parts, bones, faeces and excretory products of organisms which will be decomposed. ; biomass is a <u>measure of the stored chemical energy</u> within living organisms	1 1 1	Students may mistake this question to be related to transfer of energy but not biomass. Many candidates demonstrated an understanding of how energy can be lost at each trophic level, explaining why energy transfer is inefficient. Some candidates only described the loss of biomass or percentage energy losses at each level, <u>rather than explaining the ways in which energy was lost.</u> Weaker

			responses mixed up excretion and egestion, e.g. excretion of faeces.
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7(b)(i)	There is a general increase of 95 parts per million (ppm) carbon dioxide concentration from 1960 to 2020 ; With small fluctuations of about a few ppm within each year ;	1 1	Students must remember to use processed data for this question. Many candidates described fluctuations in the data with stronger responses specifying that they were annual fluctuations.

7(b)(ii)	Combustion of fossil fuels will increase amount of carbon dioxide released into the atmosphere ; Deforestation results in removal of forests, therefore lesser carbon sinks ; Deforestation by burning of trees etc, could also increase amount of carbon dioxide released into the atmosphere ; Industrial activities that involves burning or manufacturing of chemicals may release carbon dioxide as a by-product ; AVP	3	Any three valid points that would result in either lesser carbon dioxide absorbed or more carbon dioxide is being released will be accepted. Deforestation was also often stated but the explanation for the effect of deforestation was sometimes not clear. Some candidates incorrectly stated that merely cutting down trees would release carbon dioxide. Weaker responses referred to greenhouse gases or carbon emissions rather than carbon dioxide release, described the release of methane by livestock, or described the respiration of increased populations as a cause of carbon dioxide release.
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			Eutrophication was also incorrectly given as a reason for increased carbon dioxide release.
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8(a)(i)	S - Size has to cover more than 50 % of space provided L - Best fit curve A - Axes plotted accurately with lines drawn and relevant units P - Points plotted correctly	1 1 1 1	Students may draw point to point but since the question did not state so, it is to draw either best fit line or best fit curve. In this case, it should be a best fit curve.
8(a)(ii)	Lactic acid concentration stayed constant for the first 10 minutes before it peaked and increased by 720 mg per dm ³ in the next 10 minutes. ; And it dropped back by 720 mg per dm ³ to 90 mg per dm ³ for the remaining 40 minutes ;	1 1	
8(a)(iii)	Rate at which lactic acid was produced = $(810 - 90) / (20 - 10) = 72$ mg per dm ³ / min	1 1 1 for units	
8(a)(iv)	Lactic acid is only produced during anaerobic respiration which may not be the same time as when the individual starts exercising ;	1	
8(b)	Oxygen debt refers to the amount of oxygen required to remove lactic acid ; To remove oxygen debt is to have deep and rapid breathing rate even after exercise and increased heart rate to increase transport of oxygen to muscle cells and the liver ;	1 1	Many candidates correctly explained what oxygen debt is. Some candidates went on to explain how oxygen debt can be removed. Weaker responses described why the body undergoes anaerobic respiration during vigorous exercise and how the lactic acid is transported to the

			liver to be broken down. Students may miss out increased heart rate.
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9(a)	Weaker form of the influenza virus OR Structural components of virus such as antigens OR Inactivated form of the influenza virus ;	1	Some candidates gave a correct description of what the vaccine contained. Weaker responses confused the disease (influenza) with the pathogen or virus.
9(b)	Influenza virus mutates easily ; This changes the structure of the antigens which may not be identifiable by the antibodies created based on the previous vaccine ;	1 1	A common incorrect answer was the virus becoming resistant or immune to the vaccine. Explanations often described that new vaccines would be needed for the new variants which might have different antigens. Stronger responses recognised that the antibodies that were currently in the bloodstream, or the cells that produced them, would be ineffective against the new variant
9(c)	Antibody concentration peak after an infection is about 2.5 times more than the peak due to vaccination ; Vaccination may have a small quantity of weakened pathogen, compared to after an infection where there could be a high quantity of the influenza virus ; Antibody concentration took approximately 2 times the amount of time to peak after a vaccination compared to after an infection ; It takes time for white blood cells to recognize the pathogen and produce	2 difference s required for 2 marks 2 marks for relevant	Students need to realize that there are two parts to this question. One part for difference and the other for explanation. Hence, they should not be writing 4 differences or 1 difference with 3 explanations. Stronger responses described

	antibodies to counter the pathogen after a vaccination. However, this results in production of memory cells that will be able to produce the antibodies quicker after an infection ; Antibody concentration decreased to close to 0 within 2 weeks after vaccination however, after approximately 3 weeks, antibody concentration did not decrease to close to 0 ; Vaccination may have a small quantity of weakened pathogen, compared to after an infection where there could be a high quantity of the influenza virus OR Because of the high amount of antibodies produced, it may take a long time for the body to remove the antibodies after the person is fully cured from the virus as compared to after a vaccination where only a small amount of antibodies is produced ; OR Viral load from infection is large, thus a longer time is needed to completely neutralise/ obliterate the virus.	explanation to the 2 differences written.	how it took time for the triggering of the immune response and production of antibodies after vaccination, whereas after infection there was a much shorter delay. Weaker responses referred to the antibody concentration not being as high after vaccination because the vaccine contained a weaker form of the virus or had fewer viruses, so less antibodies were needed. They also stated that the antibodies remained in the blood after vaccination to respond after infection.
9(d)	Antibiotics target the synthesis of cell of bacterial cell. Without the cell wall, bacteria will burst. However, cell wall is absent in viruses ; Antibiotics target the ribosomes of bacterial cell hence, the bacterial cell does not have proteins to produce enzymes and for cell repair. However, viruses do not have ribosomes ; Antibiotics target the cell membrane of the bacterial cell hence, the bacterial cell is not protected from the external environment. However, viruses do not have cell membrane ;	1 1 1	Students would not receive the marks if they only stated that viruses do not have certain structures which are found in the bacterial cell. This is because question stated to explain.
10(a)(i)	Fish-eating birds ;	1	
10(a)(ii)	Planktons absorb the DDT they are exposed to and since DDT cannot be broken down, there will be bioaccumulation of DDT in planktons ; Small fish would then consume the plankton which is eventually consumed by the large fish ;	1 1	Most students would miss out on the results. The results are required to show the extent of biomagnification as the

			question
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	At each trophic level, organisms consume more due to only 10 % of energy transferred to each trophic level ; Therefore, leading to more DDT present for organisms at the higher trophic level which shows biomagnification ; This is seen in the results where there is a 12.5 times increased for DDT, 50 times increase and eventually 625 times increase in DDT levels in trophic level 2, 3 and 4 respectively in comparison to planktons ;	1 1 1	said to explain the results. Weaker responses just described the order of the food chain and quoted data from the table without an explanation.
10(b)(i)	An organism that has a foreign gene inserted into its genome or DNA ;	1	
	The gene of <i>Bacillus thuringiensis</i> that produces toxins is first isolated and cut out using a restriction enzyme to produce sticky ends ; The same restriction enzyme is used to cut the plasmid of the bacteria to produce complementary sticky ends ; The gene of interest and plasmid are mixed where they will join together due to the complementary sticky ends and form hydrogen bonds ; DNA ligase is used to seal the sticky ends thus forming a recombinant plasmid ; Heat or electric shock is applied on Agrobacterium so that the recombinant plasmid can enter the Agrobacterium ; As Agrobacterium is known to insert its genome into plants ; OR The gene of <i>Bacillus thuringiensis</i> that produces toxins is first isolated ; This gene of interest is then mixed with necessary metal particles ; Using a gene gun, the gene of interest is inserted into the plant cells to form a transgenic plant ;	2 points 1 m 1 1 1	Students would likely misread the question and use the standard steps to form a genetically modified bacteria. However, in this situation, the plant is genetically modified. Hence, there is a need to add the entire bacteria into the plant and let the bacteria insert the gene of interest into the plant cells. The use of gene gun is not in the syllabus. Stronger responses described inserting the bacterial gene into the cotton plant but did not go on to describe its incorporation into the DNA of the plant cell. Weaker responses placed

			a recombinant plasmid into E. coli and placed this in a fermenter.
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