## ADMIRALTY SECONDARY SCHOOL



PRELIMINARY EXAMINATION 2024					
SUBJECT	:	Biology			
CODE/PAPER	:	6093/2			
LEVEL/STREAM	:	Secondary 4 Express			
DATE	:	22 August 2024			
TIME	:	0800h – 0945h			
DURATION	:	1 hour 45 minutes			

#### **READ THESE INSTRUCTIONS FIRST**

Write your name, class and register number on all the work you hand in. Write in dark blue or black pen.

You may use an HB pencil for any diagrams, graphs, tables or rough working. Do not use staples, paper clips, glue or correction fluid.

#### Section A

Answer **all** questions. Write your answers in the spaces provided.

#### Section B

Answer **one** question. Write your answers in the spaces provided.

The use of an approved scientific calculator is expected, where appropriate.

The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use				
Section A / 70				
Section B	/ 10			
Total	/ 80			

## DO NOT TURN OVER THIS PAPER UNTIL YOU ARE TOLD TO DO SO.

#### Section A

Answer all questions.

1 An experiment was set up to investigate the effect of different sodium chloride concentrations on the volume of animal cells. The final volume of the animal cells was compared with the original volume of animal cells and the results are shown in Fig. 1.1



(a) With reference to Fig. 1.1, state the concentration of sodium chloride solution which has the same water potential inside the cells. Explain your answer.



(b) Describe and explain the appearance of the animal cells placed in a concentration of sodium chloride solution of 40 mmol/dm<sup>3</sup>.

(c) (i) Predict an observation when these animal cells are placed in a concentration of sodium chloride solution less than 10 mmol/dm<sup>3</sup>.
 (ii) Explain your answer in (c)(i).

2 In an experiment, four starch agar plates were prepared.

Plates 1, 2 and 3 were treated with a filter paper disc soaked with liquid Y at different pH values.

In plate 4, liquid Y was boiled and cooled before being placed on the agar starch as shown in Fig. 2.1.



The experiment set-ups were left for 30 minutes at 40 °C before iodine solution was added to each agar plate. The observations were recorded in Table 2.2.

plate	condition of liquid Y	pH of liquid Y	observation when tested with iodine solution
1	without boiled and cooled	3	blue-black only
2	without boiled and cooled	7	presence of brown patches
3	without boiled and cooled	9	blue-black only
4	boiled and cooled	7	blue-black only

#### Table 2.2

(a) With reference to Fig. 2.1 and Table 2.2, state two conclusions that can be drawn and support your answer from the evidence of the experiment.

Conclusion 1

.....

Evidence from the experiment

.....

	Conclusion 2
	Evidence from the experiment
	[4]
(b)	Identify the part of the human body that liquid Y is produced naturally.
	[1]
(c)	Using the 'lock-and-key' hypothesis, explain the action of liquid Y on starch.
	[3]

3 (a) Fig. 3.1 shows a section through the heart where a catheter is used to measure the pressure changes in the pulmonary artery. Fig. 3.2 shows the graph of pressure changes in the pulmonary artery.



- (i) State the part of the heart labelled X on Fig. 3.1.
- [1] (ii) There are three valves shown in Fig. 3.1 labelled 1, 2 and 3. State the valve(s) that will open at time A marked on the graph in Fig. 3.2.

.....

[1] 

- (iii) On Fig. 3.2, sketch and label a graph to show the expected pressure changes in aorta if it is measured at the same time. [1]
- Balloon angioplasty is a method to compress blockage in the artery due (b) to fatty deposit so that the lumen in the artery can be enlarged again. The procedure is carried out as shown in Fig 3.3.



	(i)	State a possible cause of occlusion in the artery.	
			[1]
	(ii)	Describe the structural characteristic of an artery wall when the balloon is inflated and removed for it to give rise to what is shown in stage 2 and 3.	
			[2]
	(iii)	Explain what would happen in blood circulation if the artery wall does not have the characteristic mentioned in <b>(b)(ii)</b> .	
			[2]
(a)	Defir	ne type 2 <i>diabetes mellitus</i> .	
			[1]
(b)	Iden	tify one risk factor and one way to manage type 2 diabetes mellitus.	
			[2]

**5** Fig. 5.1 shows a cross-section of a mammalian eye.





(a)	State the structures labelled P, Q, R and S.			
	P:		Q:	
	R:		S:	[2]
(b)	(i)	When a person enters a dimly lit roo pupil reflex occurs. Describe how st in the pupil reflex.	m from a bright environment, a tructures R and S are involved	l I
				[2]
	(ii)	Suggest why this reflex mentioned in	n <b>(b)(i)</b> is important.	
				[2]
	(iii)	State one other reflex action in the b	oody.	
				[1]

(c) As a person ages, the vitreous humour liquefies and exerts an abnormal pull on the retina causing it to tear. The vitreous humour would seep through the tear and separate the retina from the tissue beneath it. Suggest why the seperation of the retina may cause blindness.

.....[2]

6 Haemoglobin is a large protein molecule found in red blood cells. The structure of each haemoglobin molecule is controlled by a gene that has two alleles:

Hb<sup>A</sup> codes for the normal form of haemoglobin Hb<sup>S</sup> codes for the abnormal form of haemoglobin

Red blood cells containing the abnormal form of haemoglobin became a stiff, sickle shape in conditions of low oxygen concentration. This gives rise to sickle cell anaemia.

(a) Sickle cell anaemia is an example of a disease caused by mutation. Explain what is meant by a *mutation* and state one factor that increases the rate of mutation.

(b) Describe and explain how having red blood cells which become sickleshaped can have a harmful effect on the body.

.....[2]

(c) A father and a mother have 4 children. Two children have blood group B and two have blood group O. Complete the genetic diagram below using relevant symbols for alleles.

parental genotype					
gametes	$\bigcirc$	X	lo	lo	
space for working					
genotypes of offspring					
phenotypes of offspring					
phenotypic ratio					[4]
Explain whe codominance	ether inheritar e.	nce of blood	l group is	an example	of
					[3]

(d)

7 Discuss the validity of the statement. "*The placenta performs the function of the small intestines, lungs and kidneys for the growing fetus*".

[4]

8 A student set up the apparatus shown in Fig. 8.1 to investigate the effect of light intensity on the rate of photosynthesis of a pond plant.



The student maintained the temperature at room temperature and measured the distance travelled by the air bubble in the capillary tube for a period of five minutes on three occasions for each light intensity. (a) State the word equation of photosynthesis.

(b) The result of the experiment is recorded in Table 8.2.

The result of the experiment is recorded in Table 8.2.

distance of lamp from pond plant / mm	rate of photosynthesis / mm per minute
10	6.0
20	6.0
30	5.2
40	2.8
50	1.4
60	0.6

Table 8.2

(i) Draw a graph of best fit of the data in Table 8.2 on the grid provided below.



**9** Fig. 9.1 shows the relationship between the ovarian hormones A and B and the thickness of the uterine lining.



Fig. 9.1

(a) With reference to Fig. 9.1, state the identity of hormones A and B. Describe how these hormones affects the thickness of the uterine lining.

(b) (i) With reference to Fig. 9.1, suggest the fertile period. (1) (ii) Describe what will happen if a couple has sexual intercourse during the fertile period. (c) State three ways by which the spread of HIV may be controlled.

[3]

Answer one question from this section.

- **10** Pneumococcal disease is caused by a bacterium called streptococcus pneumoniae.
  - (a) Describe two features of a bacterial cell that are different from an animal cell.

......[2]

(b) Fig. 10.1 shows the annual hospitalization rate for pneumococcal disease by age group in Singapore between 1998 and 2004.



Fig. 10.1

Using Fig. 10.1, describe the differences in the hospitalisation rate for people aged 75 and above with people aged 15 to 74. Suggest a reason for the differences.

[3]

(c) Vaccines and antibiotics are used in different ways to reduce the number of deaths from pneumococcal disease. Explain the ways in which vaccines and antibiotics are used.

[5]

- 11 Urea is the main nitrogenous waste product excreted by the kidneys in urine. The kidneys regulate the water potential of body fluids. This is known as osmoregulation and involves a negative feedback system.
  - (a) Define *excretion* and explain its importance.

..... ..... [2] ..... With reference to (a), explain negative feedback and outline its role in (b) osmoregulation. ..... ..... ..... ..... ..... -----[5] A person with kidney damage needs to undergo the process of dialysis (C) several times each week. (i) State one way in which blood returning from the dialysis machine back into the body will differ from blood leaving the body to enter the dialysis machine. [1] ..... Suggest and explain how the efficiency of dialysis is affected if the (ii) dialysis fluid contains a small amount of urea. ..... ..... [2] 

# Admiralty Secondary School Marking Scheme 4E Pure Biology Preliminary Examination 2024

# SECTION A [70 marks]

Qn.	Description	Mark	Remarks	Marker's report
1a	MP1: 20 mmol/dm <sup>3</sup> MP2: When the <u>water potential of the cells is the same as the</u> <u>solution</u> , there will not be an increase or decrease in volume.	[1] [1]		Well done.
1b	MP1: The <u>water potential in the cells is higher</u> than in the sodium chloride solution <u>so water molecules move out of the cells across a partially permeable membrane via osmosis.</u> MP2: Causing the cells to <u>shrink</u>	[2]		Not well done. Handful of students wrote water molecules entering the cell. However, at 40mmol/dm3, the water potential of the cells will be higher than sodium chloride solution. Instead of shrink, handful of students wrote plasmolysed.
1ci	No intact cells can be seen/only fragments of cell membranes can be found	[1]		Not well done. Many students wrote that the cells will burst, not understanding that the question is asking for an observation.
1cii	MP1: <u>More water molecules move into</u> the animal cells which causes the animal cells to <u>increase in size greatly</u> MP2: Animal <u>cells do not have cell wall</u> and eventually <u>burst.</u>	[2]		MP1 was well answered while MP2 was not well done. Students only wrote that the cell will burst but did not explain that it is due to absence of cell wall.

2a	Conclusion 1: Liquid Y works best at pH 7 (neutral solution)/ Liquid Y is sensitive to pH/ Liquid Y does not work in acidic/alkaline conditions. Evidence The presence of brown patches indicates that starch is digested in plate 2 only Conclusion 2 Liquid Y works best when it is unboiled/ Liquid Y is sensitive to temperature Evidence Starch is not digested in plate 4 even when it has the same pH as plate 2 as there are no brown patches observed	[4]	1m each (evidence must correctly support conclusion to be awarded the mark)	Well done. Students were able to correctly identify the two conclusions and supporting evidences.
2b	Salivary glands	[1]	Reject: mouth	A few students wrote ileum.
2c	<ul> <li>MP1:The lock is the enzyme in liquid Y and the key is starch.</li> <li>MP2: The substrate (starch) has a shape that is complementary to the active site of the enzyme (salivary amylase/amylase)</li> <li>MP3: to form an enzyme-substrate complex that catalyses a chemical reaction to form products.</li> </ul>	[3]		Well done.

3ai	Right ventricle	[1]	Well done.
3aii	Valve 1	[1]	Well done.
3aiii	pressure time	[1]	Poorly done. Students did not understand the concept of aorta having a higher pressure. Many draw another graph at the same level of pressure.

3bi	Smoking/stress/high-cholesterol diet	[1]	Well done.
3bii	MP1:The artery wall is able to stretch MP2: due to the presence of elastic muscles/tissue/fibre	[2]	Poorly done. Handful wrote having a big lumen as a characteristic and explained so that the balloon can be fitted in.

3biii	MP1: Blood circulation will be at a <u>low speed/energy/impeded</u> MP2: as the artery wall lacking of elastic muscles will <u>not be</u> <u>able to withstand the high pressure</u> and will rupture.	[2]	Many were able to answer correctly for MP1 but fail to support their answers with the correct explanation.
4a	Type 2 diabetes mellitus is a condition where the <u>blood</u> glucose level is persistently higher than normal.	[1]	Fairly well done. There is still a handful of students who did not get the definition correct.
4b	Risk factors include obesity (due to high consumption of sugar rich food), age, family history, sedentary lifestyle, high blood lipid levels Ways to manage include using oral medication/changes to diet/ have a more active lifestyle.	[2]	Well done.

5a	P: cornea		All	Poorly done. Many students were
	Q: lens		correct-2m	unable to identify the features of
	R: iris	[0]	2-3	the eye correctly. Most common
	S: optic nerve	[2]	correct-1m	mistake is R being suspensory
			1	ligaments/ciliary body, P being iris
			correct-0m	and S being retina/fovea.
5bi	MP1: Structure R (iris) contains 2 muscles radial muscle and			Poorly done. Students fail to read
	circular muscle. When entering a dim room, the radial muscle			the question properly, instead of
	contract while circular muscle relax			describing the reflex actions when
		[2]		a person enters a dimly-lit room,
	MP2: Structure S (optic nerve) transmits nerve impulses from			students went on to describe the
	photoreceptos/receptors in retina to brain.			reflex actions when a person
				enters a bright room.
5bii	MP1: Response is rapid/instant/automatic			None of the students were able to
				state the importance of the reflex
	MP2: Important as it allows more light to enter the eve to be	[2]	Accept ECF	action as being instant/rapid.
	able to see in the dark to prevent possible injury		•	Most of the students were able to
	is k is the state of the			answer correctly for MP2.
5biii	Knee reflex/ any other valid example			Well done. Some students
	, , , , , , , , , , , , , , , , , , ,	[1]		incorrectly state sweating as a
				reflex action or being too vague
				by stating spinal reflexes.
5c	MP1:Detached retina separated from optic nerve			Poorly attempted. Majority of the
				students were not able to
	MP2: Nerve impulses cannot be transmitted to the brain and	101		conclude that retina is separated
	this result in blindness	[2]		from optic nerve. Many went on to
				describe the loss of vision due to
				damage to retina from the tear.
6a	MP1: Mutation is change in sequence of the gene or in the			MP1 was not well done even
	chromosome number that results in formation of an abnormal			though it is a recall question.
	protein.	[2]		Students did not mention both
				change in sequence of gene and
	MP2: Chemical mutagens/Ionising radiation as factors that			chromosome number. Some only
	increases the rate of mutation.			mentioned change in sequence of
				nucleotides (but nucleotides does
				not necessarily refers to gene).
				· · · · · · · · · · · · · · · · · · ·
				MP2: students like to write
				UV-light without spelling out in full
				what UV is. Some students wrote
				radiation only (without knowledge
				that not all radiation are ionising)

6b	<ul> <li>MP1: The sickle-shaped red blood cell has a <u>decreased</u> <u>surface area:volume ratio</u>, leading to <u>less efficient</u> <u>diffusion/transport of oxygen</u>,</li> <li>MP2: resulting in <u>fatigue/breathlessness</u>.</li> <li>OR</li> <li>MP1:The sickle-shaped red blood cell <u>clog up capillaries</u> <u>leading to blood clot that caused reduced oxygen supply</u></li> <li>MP2: resulting in <u>death of tissues/death</u></li> </ul>	[2]		Well done. Students who did not do as well for this question fail to mention decreased surface area:volume ratio.
6c		[4]	MP1: Correct parental genotype MP2: Correct gametes MP3: Correct crossing and offspring genotype MP4: Correct offspring phenotype and phenotypic ratio	Well done.
6d	MP1: Both alleles are expressed MP2: I <sup>A</sup> and I <sup>B</sup> are co-dominant MP3: I <sup>A</sup> is dominant over I <sup>O</sup> and I <sup>B</sup> is dominant over I <sup>O</sup>	[3]		Well done. Many forgot to mention MP3.

7	MP1: The placenta acts as a small intestine as it allows	[4]	A handful of students were able
	diffusion of nutrients from the mother's blood across the		to answer correctly.
	placenta into the foetus's blood.		MP1: Majority of the students
			were able to describe the
	MP2: The placenta acts as the lungs as oxygen carried in the		diffusion of nutrients.
	umbilical vein diffuses from the mother's blood across the		
	placenta into the foetus's blood.		MP2: Many only wrote oxygen
			without mention of umbilical vein
	MP3: Carbon dioxide carried in the umbilical artery diffuses		
	from the foetus's blood into the mother's blood.		MP3: Many only wrote carbon
			dioxide without mention of
	MP4 <sup>-</sup> The placenta acts as a kidney as nitrogenous waste		umbilical artery
	products in the umbilical artery diffuses from the foetus's		
	blood into the mother's blood across the placenta		MP4: Many did not talk about
			waste products diffusing from

L

8a	light carbon dioxide + water> glucose + oxygen chlorophyll MP1: word equation of correct reactants and products MP2: Light and chlorophyll as conditions are stated	[2]	Most of the students only got 1 mark for correct word equation while a handful write chemical equation. Many fail to write both 'light' and 'chlorophyll' as the conditions for photosynthesis. Some wrote
8bi	MP1: Both axes labelled with units MP2: Appropriate scaling and graph occupying ¾ of grid MP3: Correct plotting of points MP4: Graph of best fit	[4]	chloroplast. Well done.
8biii	MP1: As distance of lamp increases from 10mm to 20mm (decrease in light intensity), the rate of photosynthesis remained the same at 6 mm per minute. MP2: As distance of lamp increases from 30mm to 60mm (decrease in light intensity), the rate of photosynthesis decreases from 5.2 mm per minute to 0.6 mm per minute/ As distance of lamp increases, the rate of photosynthesis decreases.	[2]	Many fail to mention the constant rate of photosynthesis even when distance of lamp increases.
8biv	MP1: The rate of photosynthesis remained constant (6mm per minute) when light intensity decreases (distance of lamp increases from 10mm to 20mm) <u>because light intensity is not</u> <u>the limiting factor</u> , hence rate of photosynthesis is affected by <u>other factor such as carbon dioxide concentration</u> . MP2: <u>Light intensity is the limiting factor</u> on the rate of photosynthesis at distance above 30mm.	[2]	MP1 was not well done, many could not identify that light intensity is not the limiting factor, and for those who could, fail to mention the other limiting factors. MP2 was well done.

9a	<ul> <li>MP1: Hormone A is oestrogen and hormone B is progesterone.</li> <li>MP2: As oestrogen increases, the thickness of uterine lining increases from 2mm to 4mm.</li> <li>MP3: As progesterone level increases, the thickness of uterine lining increases from 4mm to 8mm</li> <li>MP4: Quotation of value from figure.</li> </ul>	[4]		MP1 was generally well done, although, there was a handful who identified wrongly. MP2 and MP3: 'Growth' of uterine lining can be accepted while 'repair' of uterine lining does not necessarily mean increase in thickness of uterine lining. Students need to read carefully the demand of the question in order to phrase their answers accordingly. MP4: Poorly attempted, majority of the students did not quote values for thickness of uterine lining. Instead, many students quote the number of days which
				the question did not ask for.
9bi	Day 11 to day 17	[1]	Accept if answers include day 14.	There was a wide range of answers. Some mentioned an exact day when the question was asking for a period. Some did not include day 14 within their range of days.
9bii	MP1: There will be a <u>higher probability of fusion of nuclei of</u> the male gamete and female gamete to form a zygote./Higher probability of fertilisation. MP2: Hence, the zygote will further divide to form a ball of cells <u>(embryo) and gets implanted</u> in the wall of uterus	[2]		MP1 was generally well done except for a few who fail to mention fusion of nuclei of both female and male gametes. Some wrote terms that contradicted themselves such as "fusion of nuclei of the sperm in the male gamete". MP2 was not well done. Many only wrote leading to pregnancy without mentioning the implantation of embryo.
9c	MP1: Keep to one healthy sex partner MP2: Use of condom during sexual intercourse MP3: Avoid sharing of needles MP4: Practise abstinence	[3]		Not well done. Many wrote do not share intimate items/ do not share toothbrushes and razors with no further elaboration.

## Section B

10a	<ul> <li>MP1: A bacterial cell has plasmid while animal cell does not.</li> <li>MP2: A bacterial cell has flagella which animal cell does not</li> <li>MP3: A bacterial cell does not have a membrane bound nucleus while animal cell has a membrane bound nucleus.</li> <li>MP4: A bacterial cell has cell wall while animal cell does not.</li> <li>MP5: A bacterial cell does not contain mitochondria while animal cell does.</li> </ul>	[3]	Any 2	Well done.
10b	<ul> <li>MP1: People aged 75 years and above have a higher annual hospitalisation rate than people aged 15 to 74.</li> <li>MP2: This is shown in the year of 2000, people aged 75 and above have 160 out of 100 000 people hospitalised while people aged 15 to 74 have a total of 40 out of 100 000 people hospitalised.</li> <li>MP3: One of the reason for such observation is due to the decreased immunity level of people aged 75 years and above / as people ages, they have more illness as their body accumulates more toxins.</li> </ul>	[3]	MP2: any reasonable quote of data from the graph MP3: any reasonable explanation	Well done. Need to be more careful on the units for number of people.
10c	<ul> <li>MP1: Vaccines contains <u>an agent that resembles</u> <u>streptococcus pneumoniae</u>. When a person is vaccinated, the agent that resembles the pathogen will <u>stimulate our white</u> <u>blood cells to produce specific antibodies</u> against them.</li> <li>MP2: These <u>antibodies will destroy the pathogen</u>. In future, if the live pathogen enters the bloodstream, the white blood cells will <u>quickly recognise it and produce antibodies</u> to destroy the pathogen.</li> <li>MP3: Antibiotics can kill bacteria by <u>inhibiting synthesis of bacterial cell wall</u>, allowing water to enter the bacterial cell to <u>cause expansion and eventually burst</u>.</li> <li>MP4: Antibiotics can kill bacteria <u>by inhibiting cell membrane function</u> such that <u>any substances from the environment can enter</u> the bacterial cell.</li> <li>MP5: Antibiotics can kill bacteria cell by <u>inhibiting protein synthesis of folic acid</u>. therefore inhibiting growth.</li> </ul>	[5]	MP1, MP2 have to be included. MP3-MP6: Any 3	Students were able to describe the properties of antibiotics correctly. Students seemed to face some challenge in describing how vaccines work.

11a	MP1: Excretion is the process by which <u>metabolic waste</u> <u>products are removed</u> . MP2: It is important to remove as these waste products are <u>harmful and toxic to the body</u> if left to accumulate	[2]		Well done. Some students fail to mention 'metabolic' in their answer.
11b	<ul> <li>MP1: Negative feedback refers to when there is a stimulus resulting from a change in the internal system that leads to a sequence of events to restore the system to its original state</li> <li>MP2: In osmoregulation. When the water potential of the blood increases above normal, hypothalamus in the brain detects this and the pituitary gland releases less anti-diuretic hormone (ADH) into the bloodstream</li> <li>MP3: Walls in the collecting duct become less permeable to water</li> <li>MP4: Less water is reabsorbed back into the bloodstream</li> <li>MP5:More water is excreted, urine is more diluted/increase in volume/less concentrated</li> <li>MP6: Water potential in the blood returns to normal</li> </ul>	[5]	MP1, MP2 and MP6 have to be mentioned. MP3-MP5: Any 2 Accept: descriptions of water potential decreasing below normal	MP1 was badly done. Students did not mention a stimulus causing a change and the system restoring it back to its original state. MP2 to MP5 are well done. Students are good at describing the process of osmoregulation. MP6: Only a handful of students relate it back to negative feedback hence returning water potential back to normal/original state.
11ci	MP1: The blood returning from the dialysis machine back into the body will have less/no urea/lower pressure/less metabolic waste products.	[1]		Well done.
11cii	<ul> <li>MP1: The efficiency of dialysis will have <u>lower efficiency in</u> removing urea</li> <li>MP2: because there is a <u>less steep concentration gradient of</u> <u>urea</u> between blood and dialysis fluid/<u>slower rate of diffusion</u> <u>of urea</u> from blood into dialysis fluid.</li> </ul>	[1] [1]		Well done.