



SINGAPORE CHINESE GIRLS' SCHOOL Preliminary Examination Secondary Four

CLASS 4 REGISTER NUMBER INDEX NUMBER	CANDIDATE NAME						
	CLASS	4		REGISTER NUMBER			
NUMBER	CENTRE NUMBER			INDEX NUMBE	ER		

BIOLOGY

5158/02

Paper 2 Theory

Tuesday

1 August 2017

1 hour 45 minutes

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.Write in dark blue or black pen.You may use a soft pencil for any diagrams or graphs.Do not use staples, paper clips, highlighters, glue or correction fluid/tape.

Section A

Answer **all** questions.

Section B

Answer **all** questions, the last question has a choice of parts to answer. The use of an approved scientific calculator is expected, where appropriate.

At the end of the examination, fasten all your work securely together. The number of marks is given in brackets [] at the end of each question or part question.

Marker	Qn (marks)
Vivian	2,3,4,6,9,10,13E/O [total 40m]
Jo	1,5,7,8,11,12 [total 40m]

For Examiner's Use		
Section A	50	
Section B	30	
Total	80	

This question paper consists of <u>29</u> printed pages.

Section A Answer all the questions. Write your answers in the spaces provided.

1	(a)	Name	a constituent of a diet that is	Water / mineral salt / vitamins,	
		(i)	absorbed without digestion, .		
		(ii)	never absorbed.	fibre / roughage / cellulose / fruits / seeds	

Fig. 1.1 is a diagrammatic representation of the small intestine containing three types of food molecules, **A**, **B** and **C** before they have been fully digested.

Fig. 1.1 also shows a lacteal and a capillary, both not drawn to scale.



Fig. 1.1

(b) On Fig. 1.1, draw and label the molecules as they would appear after they have been fully digested and then absorbed by the lacteal and by the blood capillary. [1]

(c) Some of these molecules travel directly to the liver.

Name two molecules and explain how they are transported to the liver. [2]

 Glucose and amino acids;]
 In plasma / solution / blood via hepatic portal vein	

(d) Describe how **A** is completely digested by named enzymes in the small intestine. [2]

 A (starch) is digested by pancreatic amylase to maltose,]
 Maltose is digested by intestinal maltase to glucose.	

[Total : 6m]

2 Fig. 2.1 shows a large jar in which plants are growing.





This jar provides an environment in which plants can carry out photosynthesis without adding water or removing the tightly-fitting cork to allow air to enter.

State the word equation for photosynthesis in the space below.		
Carbon dioxide + waterLight energy chlorophyll		
Describe how the plants in Fig. 2.1 obtain water in the jar		

•	water from transpiration AW / water from soil evaporates /	
	respiration releases water;	
1	returned to <u>soil</u> / <u>condenses;</u>	
	absorbed from soil AW by plants	
'		

(c) Suggest a reason, apart from limited carbon dioxide, why the plants in the jar show only very limited growth compared with similar plants growing under natural conditions. [1]

 Iimited nitrates /fertiliser / nitrates not topped up OWTTE, or
 Iimited space / volume / area.

 Iimited space / volume / area.
 Iimited space / volume / area.

.....

[Total : 5m]





(a)	Between which times is the left atrium contracting?	[1]
	0.1 to 0.6s	
(b)	Using information from Fig. 3.1, calculate the number of heart beats minute. Show your working.	s per [1]
	60 / 0.8 = 75	

(c) On Fig. 3.1, label the point 'X' where the 'lub' sound of the heart is produced. [1]

3 Fig. 3.1 shows changes in the volume of blood in the left ventricle.

Table 3.1 shows the rate of blood flow to some organs when a person is at rest and during a period of vigorous exercise.

Organ	Rate of blood flow / cm ³ minute ⁻¹			
Organ	at rest	during exercise		
Skeletal muscles	1 000	16 000		
Kidney	1 200	1 200		
Brain	750			
Heart muscle	300	1 200		

Tabl	е	3.	1
Tabl	e	ა .	

(d) Suggest a value for the rate of blood flow to the brain during exercise. [1]

 750 to 800 (max)	

(e) Using information from Table 3.1, calculate the ratio of the rate of blood flow into the coronary arteries during exercise to the rate flowing into these arteries at rest. [1]

••••	4 : 1	
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[Total : 5m]

4 Table 4.1 shows the relative thickness of layers in the walls of an artery and a vein.

	Thickness / μm		
Layer in waii	artery	vein	
Endothelium	20	20	
Smooth muscle	490	240	
Elastic tissue	370	240	
Connective tissue	120	120	

Table 4.1

(a) Using information from Table 4.1, explain why a vein may be described as an organ. [1]

 made of different tissues (must name at least two : elastic,	
smooth muscle and connective tissues)	

- (b) Use information from Table 4.1 to suggest the thickness of a capillary wall. [1]
- (c) Explain how the elastic tissue in the wall helps to even out the pressure of blood flowing through the artery. [1]
 - stretches
 as a result of high pressure/surge of blood +

 then recoils;





Fig. 4.1

(d) Describe the transfer of materials between Fluid X and Fluid Y. Identify X and Y in your answer. [2]

	X : plasma, Y : tissue fluid;	
	Waste products such urea and carbon dioxide diffuse	
• • • • •	from cells to Y to X;	
	Useful materials such as oxygen and glucose diffuse from	
	X to Y and then to cells.	

[Total : 5m]

5 Fig. 5.1 shows how the branch of a small apple tree varied in diameter over a 24-hour period.



Fig. 5.1

Using the data given in the table below, draw a curve on the grid above to show how rate of transpiration of the apple tree varied over the same 24-hour period.

Time / h	Rate of transpiration / arbitrary units (AU)
0	24
6	5
12	30
18	40
24	25

10

(b) Suggest a reason for the changes in the rate of transpiration between the 6th and 18th hour period. [1]

••••	Increase in temperature / light intensity / wind OR decrease in	
	humidity during daytime]

- (c) With reference to Fig. 5.1, describe the effect of transpiration on the diameter of the branch. [1]
 - When transpiration increases, diameter of branch decreases [with quote data]

[Total : 3m]

6 Fig 6.1 is a micrograph of a section of the pancreas responsible for the secretion of hormones.



Fig 6.1

- (a) Suggest the identity of the cells in circle A. [1] Islets of Langerhans
- (b) With reference to Fig. 6.1, describe in detail how these cells carry out a function in maintaining a constant, internal environment. [3]

 •	when blood sugar increases OR decreases; secretes MORE	
	insulin OR MORE glucagon in minute amounts;	
•	directly into bloodstream;	
 •	insulin stimulates the conversion of excess glucose to	
	glycogen in liver OR glucagon stimulates the conversion of stored glycogen to glucose in liver	

(c) Some forms of diabetes are caused by an inability to secrete insulin and can be controlled by regular injections of insulin. Most of this insulin is now produced using genetically modified *Escherichia coli*.

List two advantages of using this type of insulin, rather than the insulin obtained from animal sources. [1]

 less chance of rejection / use of immno-suppressant drugs less chance of inheritance of cross species disease 	
 purity of insulin guaranteed more humane method 	[Total : 5m]
faster production ANY TWO	

7 Before birth, the baby's temperature is maintained by the amniotic fluid.

Premature babies have the following characteristics :

• smaller in size

method keeps the baby warm.

- have thin skin with prominent blood vessels
- have a poorly developed shivering response

In cold climates, it is necessary to keep the premature baby warm in an incubator.

(a) Explain how each characteristic makes it necessary for the baby to be kept warm in an incubator.

	(i)	smaller size	[1]
		<pre>small size = larger SA: V ratio; more heat lost AW</pre>	
	(ii)	thin skin with prominent blood vessels	[1]
		blood vessels closer to surface of thin skin, so more heat lost by CCR	
	(iii)	poorly developed shivering response	[1]
		less shivering = less heat is generated	
(b)	In a	iddition, the baby may be wrapped in aluminium foil. Suggest how	 this



[Total : 4m]

[1]

8 Fig. 8.1 shows drawings of a cell at various stages in mitosis.



Fig. 8.1

(a) List the letters shown in Fig. 8.1 in the order in which these stages occur during a mitotic cell cycle. [1]

 ACEDB	
]

(b) With reference to Fig. 8.1, explain what is happening in stage

(i)	A ,	[1]
	·· Replication of DNA / doubling of chromosomes	
(ii)	D.	[1]
	sister chromatids pulled /migrate to opposite / respective poles;]

(c) State the importance of mitosis in the growth of a multicellular organism, such as a flowering plant or a mammal. [1]

production of genetically identical cells/genetically uniform cells/ identical DNA/maintains genetic stability/same number and kind of c-somes/no genetic variation;

Fig. 8.2 is a diagram drawn from a photomicrograph of an animal cell undergoing meiosis.



Fig. 8.2

(d) Identify the stage of meiosis shown in Fig. 8.2. [1]

(e)	Explain briefly how meiosis leads to variation within species.	[2]
	independent assortment of homologous chromosomes during	
	<u>metaphase I</u> , h chromosomes will move to opposite poles	
	crossing over of homologous chromosomes during prophase I	
	• random <u>fertilisation</u>	
	[3 points = 2m]	

[Total : 7m]

9 Certain flowering plant species, such as the violet (*Viola odorata*), produce some flowers that are never open and are self-pollinated.

(a)	Suggest two advantages of plants having flowers that self-pollinate.				
		ensures a higher probability of pollination (higher success rate OWTTE)			
	•••	reduces wastage / saves energy in producing pollen		• • • • •	
		reduce need for agent of pollination (eg. wind / insect)			
		ANY TWO			

Some species of orchids practise mimicry as their flowers look like female bees or wasps. These flowers release a scent that attracts males which then attempt to mate with the flowers.

Fig 9.1 shows *Ophrys scolopax* which is an example of such species.



Fig. 9.1

(b)

Explain an advantage of mimicry.

Insect will deposit / pick up pollen among same type of species / help topollinate AW

[1]

(c) Describe the sequence of events which occur after the pollen lands on the stigma, until the formation of a fruit. [3]

 •	pollen grain germinates;]
 •	a pollen tube grows out + secretes enzymes which digest the	
 •	<u>style;</u> at the <u>micropyle, pollen tube bursts open</u> to release the male	
	gamete;	
 •	nucleus of male gamete fuses with nucleus of female gamete to form zygote	

[Total: 5m]

10 Fig 10.1 shows the carbon cycle. Each arrow represents a process in the cycle.





- (a) On Fig. 10.1, label arrows with suitable letters (provided below) that represent the following processes : [2]
 - (i) combustion letter **C**,
 - (ii) decomposition letter **D**,
 - (iii) photosynthesis letter P,
 - (iv) respiration letter R.
- (b) State what is meant by the term *carbon sink*.

[1]

 •	[example given] a natural environment such as oceans and forests	
 •	area which is able to store large amounts of carbon dioxide indefinitely	
•	stores more carbon than it releases	
		• • • • •

• • •	reduced photosynthesis because of less plants
•	decreased removal from / increased carbon dioxide levels in atm
	from burning / increased rotting

[Total : 5m]

Section B

Answer three questions.

Question 13 is in the form of an **Either / Or** question.

Only one part should be answered.

11 Two experiments were carried out to investigate the effect of the removal of liver and kidneys from rats on blood urea concentration.

Experiment A	kidneys removed at start of experiment	liver removed eight hours later
Experiment B	liver removed at start of experiment	kidneys removed eight hours later

The blood urea concentration of the rats was measured from 0 hour to 16 hours. The results are shown in Table 11.1.

Table 11.1

Time /	blood urea concentration / mg per 100 cm ³ blood		
hours	Experiment A	Experiment B	
0	10.0	10.0	
4	17.0	5.0	
8	22.0	2.5	
12	21.0	2.0	
16	21.0	2.0	

(a) Plot a graph of these data in the grid provided on the next page.

[3]

Correct axes with labels/units - 1m

Plotting points – 1m

2 lines with best fit - 1m



(b) Explain the change in blood urea concentration of the rats used in:

	Urea is produced in liver as deamination of excess amino	
	acids still occurs	
•	blood urea concentration remains relatively constant from	
	8h to 16h as no urea was produced once liver was removed.	

(ii) Experiment B

[2]

 •	when liver was removed, no more urea was produced	ŀ
•	kidneys continuously excretes urea in urine until they were	
	removed.	ľ

.....

(c) Outline the mechanism of dialysis in the case of kidney failure. [3]

 Blood from patient from VEIN	
 Composition of Dialysis fluid	
 Direction of dialysis fluid OPPOSITE to blood flow	
 Nature of tubing : highly coiled + ppm 	
]

[Total : 10m]

- **12** An optometrist tested a patient's eyesight. The first test was a Visual Acuity Test to measure how the patient sees in near and far distances.
 - (a) Describe how the eye is able to see objects clearly at different distances. [5]

Looking at distant objects: 1. Ciliary muscles relax, pulling on the suspensory ligaments. 2. Suspensory ligaments become taut, pulling on the edges of the lens 3. the lens becomes thinner and less convex, increasing its focal length 4. Light rays from the distant object are sharply focussed on the retina. 5. photoreceptors are stimulated, nerve impulses are transmitted by the optic nerve to the brain and 6. the brain interprets the impulses and the person sees the distant object. Looking at near objects: 1. Ciliary muscles contract, relaxing their pull on the suspensory ligaments. 2. Suspensory ligaments become loose, relaxing their pull on the edges of the lens 3. the lens becomes thicker and more convex, decreasing its focal length 4. Light rays from the near object are sharply focussed on the retina. photoreceptors are stimulated, nerve impulses are transmitted by the optic nerve to the brain and the brain interprets the impulses and the person sees the near object.

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Another one of the tests performed by the optometrist was a field test. This test examines the sensitivity of the patient's retina to light in different areas of the field of vision.

An optometrist carried out a field test on the patient as follows:

- With one eye covered, the patient stared at the centre of a screen.
- Points of light of varying intensities then appeared briefly on the screen, each in a different area, **A**, **B** or **C**, of the patient's field of vision.
- Each time the patient saw a point of light, she pressed a button to record this using an event-recorder.

The patient did not see every point of light.

Table 12.1 shows the results for one of the patient's eyes.

Each of the areas **A**, **B** and **C** of the patient's field of vision corresponds to an area of her retina. These areas are shown in the photograph of her retina in **Fig 12.1**.

intensity of point	Number of times out of 5 that the patient detected point of light				
units	Area A	Area B	Area C		
1 (dim)	0	5	0		
2	0	4	0		
3	2	5	0		
4 (bright)	4	5	0		

Table 12.1





(b) Explain the results for Area C.



 point of attachment of the optic nerve / point where blood vessels enter or leave / blind spot no photoreceptors in this area 	

(c) Area **B** detected points of light at all of the light intensities tested.

Suggest one reason why, at light intensity of 2 units, one of the points of light was not detected. [1]

 patient blinked / looked in wrong direction	

(d) The optometrist advised the patient on the importance of using sunglasses with UV protection when he is out in the sun. Suggest an explanation why UV protection in sunglasses is important. [2]

 Blocks UV / harmful / excessive sunlight/ rays ; prevents damage to retina / prevents cancer / prevents cataract]

[Total : 10m]

13 Either

Wolfram syndrome is a genetic disorder caused by the mutation of the CISD2 gene. Children with Wolfram syndrome develop early-onset diabetes and deafness.

27

(a) Describe how mutation of the CISD2 gene is responsible for Wolfram syndrome.

 Results in a <u>different gene sequence</u> AW; Which will result in <u>different polypeptide</u> / <u>protein</u> ; phenotype / trait AW	
 · · · · · · · · · · · · · · · · · · ·	[2]

Wolfram syndrome is caused by a recessive gene, \mathbf{n} . The gene for normal condition can be represented by \mathbf{N} .

A family consisted of two young parents who are normal and three daughters who have the genetic disorder.

(b) Using a genetic diagram, discuss the probability that the next child is a boy without the disorder. [5]



[Total : 10m]

13 Or

The picture below shows the white-backed vulture, Gyps benganalensis.



Photo credit courtesy of Krzysztof Blachowiak, The Internet Bird Collection

In India, the population of *Gyps benganalensis* has fallen by 97% to an estimated 4000 vultures. This species is now considered to be "critically endangered".

An explanation for the decline in numbers of the species is as follows :

- Vultures feed on carcasses from farm animals which may have been treated with a particular painkiller drug. This drug is known to cause kidney failure in the vultures.
- Farmers continue to use up their stocks of the drug although its sale is to be phased out by authorities.
- The drug is non-biodegradable and will remain in the environment.
- (a) Calculate the original population of the white-backed vulture. Show your working.

[1]

(4000 / 100) x 3 = 133 333 * penalise if no working shown * ignore if answer given in decimal place

.....

(b) With reference to the explanation on the previous page, explain what is meant by the term *'bioaccumulation'* and *'bioamplification'*. [3]

		7
	[Bioaccumulation] Pain killer / chemicals accumulate in the tissues	
	because it is <u>non-biodegradable [1]</u> or it is absorbed into the <u>body of the</u>	
	organism such as into the fatty tissues [1], so may not be excreted. When	
	vultures feeds on the carcasses, the level of insecticide just builds up	
	(accumulates);	
	[Bioamplification] IDEA OF NBC INCREASING ACROSS TROPHIC	
	LEVELS [1] Vultures need to feed on a relatively large amount of	
	carcasses to obtain sufficient energy, resulting in the increased quantity	
	of insecticides in their bodies:	
••••	,	
		1

In an effort to save the vultures, a captive breeding programme has been set-up.

Three centres have been built in India so far, each housing up to 40 vultures. These vultures have been collected from different areas of the Indian subcontinent.

(c) Explain why the decision was made to conserve the species in captivity (*ex situ*) rather than in the wild (*in situ*). [3]

	pain killers still being used [1]]
	In captivity – allow for reverse argument for in the wild	
	 health of individuals monitored / treated for disease 	
• • • • •	 eggs (artificially) incubated / young hand reared; reduced mortality of young provision of male / female breeding can be manipulated 	
	 protecting from hunting / predators competition reduced (between individuals/species) 	
	ANY TWO [2]	

(d) Outline three reasons why conservation of the white-backed vulture is important. [3]

•	maintain / increase genetic variation / gene pool	
•	reducing the risk of inbreeding / breeding between related birds	
•	less likely all contaminated with painkiller	
•	less risk to losing all individuals due to disease / natural disaster /	
	human action	

End of paper