St. Stephen's Girls' College
Final Examination 2016-2017

Biology Paper 1 (SECTION B) KFL, LYL

Form 6 __ Class No.: _____ Name: _____

SECTION B (Question-Answer Paper B)

INSTRUCTIONS FOR SECTION B

1. Write your class, class number and name in the space provided on this page.
2. The questions in this Question-Answer Paper carry 84 marks. Answer ALL questions.
3. Write your answers to Section B in the spaces provided in this Question-Answer Paper.
4. Supplementary answer sheets will be provided on request. Write your class, class number and name on each sheet. Tie them loosely but securely with a string INSIDE this Question-Answer Paper.
5. Present your answers in paragraphs wherever appropriate.
6. The diagrams in this section are NOT necessarily drawn to scale.

Section	Marks
A	
B	
Total	
Percentage (%)	

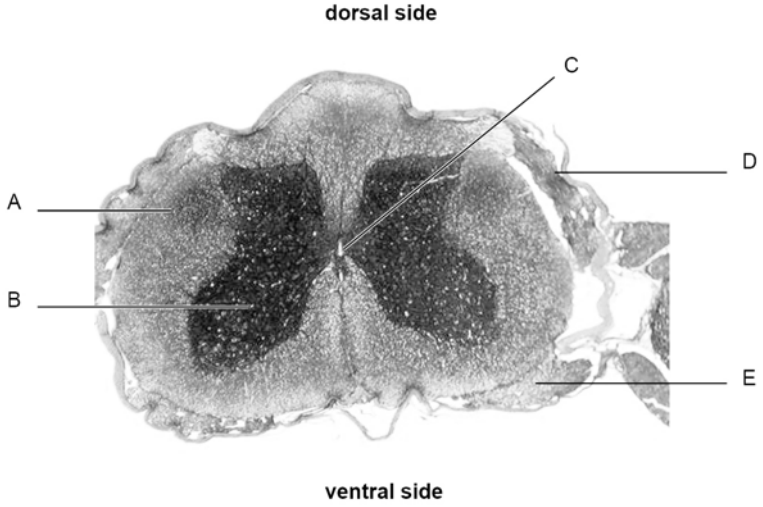
SECTION B

Answer ALL questions. Put your answers in the spaces provided.

1. Select the appropriate substance from Column 2 to match with the description in Column 1. Put the appropriate letter in the space provided. (3 marks)

Column 1		**Column 2**
Substances produced by the carbon fixation which are used to form glucose	_____	A. NADH B. NADPH
A reducing agent donates hydrogen to the carbon fixation	_____	C. Triose phosphate D. Pyruvate
Substances can be converted to form acetyl-CoA after removal of one carbon dioxide molecule.	_____	E. FADH F. Coenzyme A

2. The photomicrograph below shows the transverse section of a human spinal cord.



(a) Structures A and B differ in their physical appearance. Explain the difference in appearance with respect to their composition. (4 marks)

(b) State the types of neurones found in D and E respectively. (2 marks)

D: _____

E: _____

3. Breast-feeding and vaccination both can offer immunity to babies.

(a) What are the types of immunity offered by breast-feeding and vaccination respectively? (2 marks)

Breast-feeding:_____

Vaccination:_____

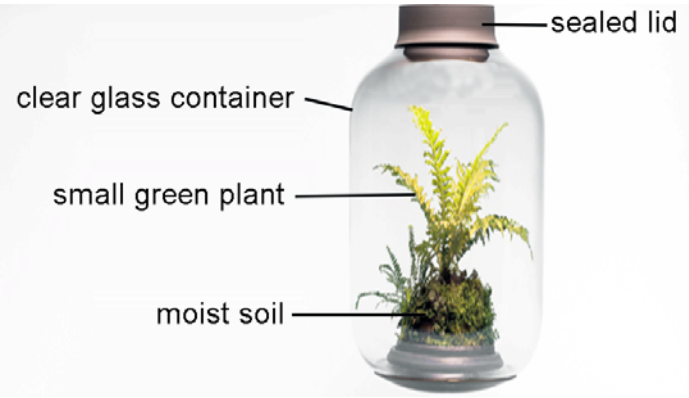
(b) Babies receive antibodies from breast milk. Why do they need vaccines even though they get antibodies from their mothers? (2 marks)

(c) There are many types of hepatitis. If a child received hepatitis B vaccine, will he be protected from all the other types of hepatitis? Explain your answer. (3 marks)

(d) Hepatitis B is transmitted through contact with the body fluid of an infected person. Apart from vaccination, suggest two measures that can prevent the transmission of this disease. (2 marks)

(e) Suggest a possible reason why the digestion of fat would be impaired in the patients with hepatitis B. (3 marks)

4. The diagram below shows small green plants growing inside a sealed glass container. The plants inside can live for several months without any addition of water or nutrients, as long as they receive enough sunlight.



(a) Explain why the plants can live and grow even without a continuous supply of fresh air. (2 marks)

(b) Suggest why it is not necessary to add water or fertilizer to the soil once the container is sealed.
(i) Water (2 marks)

(ii)Fertilizer (2 marks)

(c) This ecosystem can only support two trophic levels. Suggest a possible explanation for this. (2 marks)

5. Sickle-cell anaemia is caused by a mutation in the gene that codes for one of the polypeptide chains of haemoglobin. ***Table 1*** shows part of the base sequence of the allele for normal haemoglobin to be transcribed into an mRNA strand, which is then translated into a sequence of amino acids. ***Table 2*** shows the mRNA codons for all amino acids.

Table 1

Template DNA strand	T	G	A	G	G	A	C	T	C	C	T	C	T	T	C
mRNA codons															
Amino acid sequence															

Table 2

UUU	Phe	UCU	Ser	UAU	Tyr	UGU	Cys
UUC		UCC		UAC		UGC	
UUA	Leu	UCA		UAA	Stop	UGA	Stop
UUG		UCG		UAG		UGG	Trp
CUU		CCU	Pro	CAU	His	CGU	Arg
CUC		CCC		CAC		CGC	
CUA		CCA		CAA	Gln	CGA	
CUG		CCG		CAG		CGG	
AUU	Ile	ACU	Thr	AAU	Asn	AGU	Ser
AUA		ACC		AAC		AGC	
AUC		ACA		AAA	Lys	AGA	Arg
AUG	Met/Start	ACG		AAG		AGG	
GUU	Val	GCU	Ala	GAU	Asp	GGU	Gly
GUA		GCC		GAC		GGC	
GUC		GCA		GAA	Glu	GGA	
GUG		GCG		GAG		GGG	

(a) Using the information in Table 2, ***complete Table 1*** to show the base sequence of the mRNA transcribed from the template DNA strand and the sequence of amino acids coded.(2 marks)

(b) The base thymine (T) in the shaded box in the template DNA strand is replaced by the base adenine (A) in the allele for the abnormal haemoglobin. What is the amino acid that will be found at the corresponding position in the abnormal haemoglobin? (1 mark)

_____

(c) If the base cytosine (C) in the shaded box in the template DNA strand was replaced by the base thymine (T), there would be no effect on the haemoglobin produced. Explain why. (2 marks)

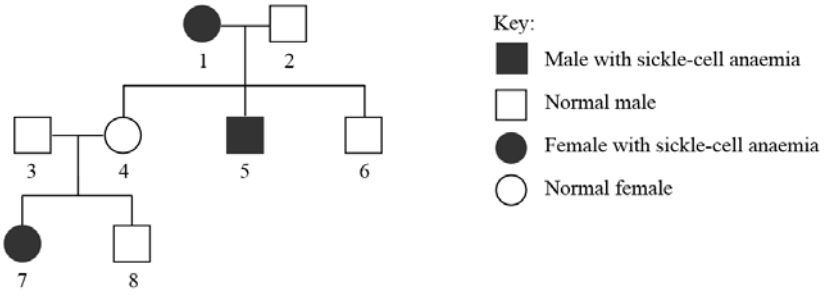
_____

_____

_____

_____

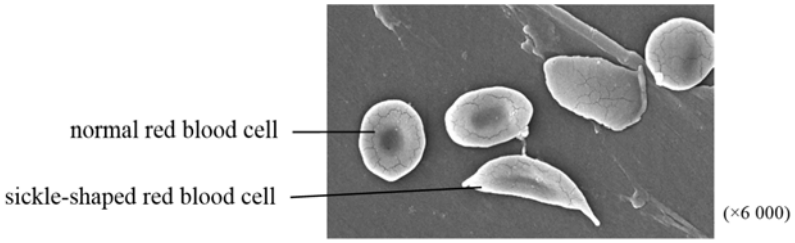
The inheritance of sickle-cell anaemia is controlled by a pair of alleles. The pedigree below shows the inheritance of sickle-cell anaemia in a family over three generations.



(d) Deduce, with reasons, whether the allele for sickle-cell anaemia is dominant or recessive. (Marks will not be given for genetic diagrams.) (4 marks)

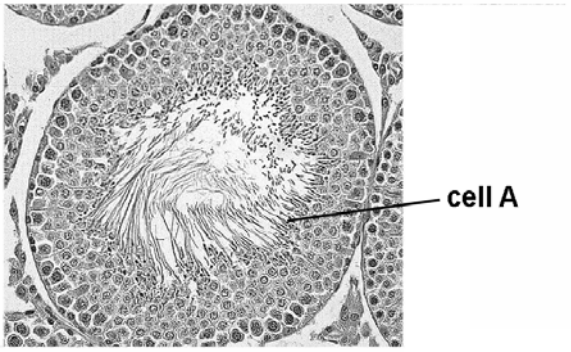
(e) State the possible genotype(s) of individual 2. Define the symbols you use. (2 marks)

People with sickle-cell anaemia produce abnormal haemoglobin molecules which make red blood cells distort into a sickle shape. The following photomicrograph shows some normal and sickle-shaped red blood cells:

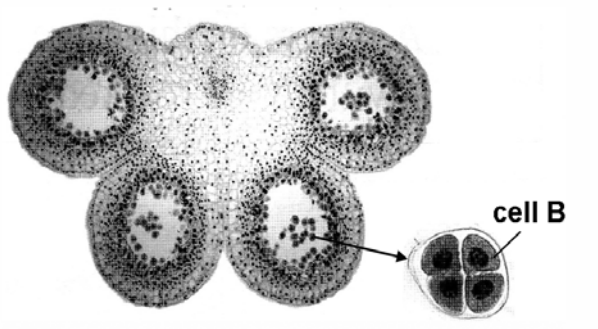


(f) With reference to the photomicrograph, explain, with ***two*** reasons, why the body cells in patients with sickle-cell anaemia often fail to obtain enough oxygen. (2 marks)

6. The two photomicrographs below show parts of the male reproductive organs in a human being and a flowering plant respectively.



Photomicrograph 1



Photomicrograph 2

(a) Name cells A and B. (2 marks)

A:_____ B:_____

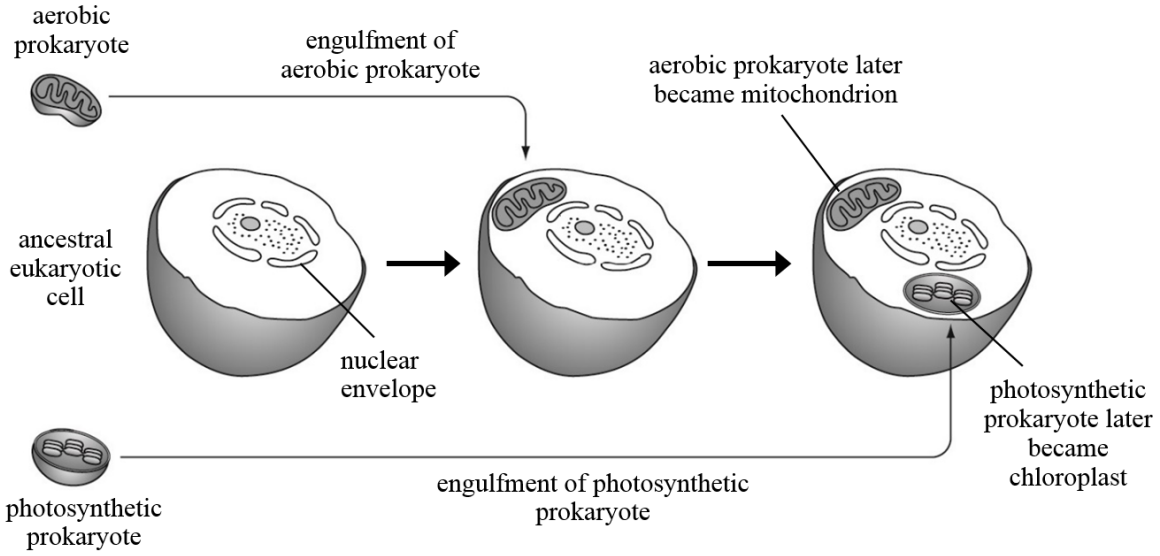
(b) Name the type of nuclear division involved in the production of cell B. (1 mark)

(c) Contrast the methods by which cells A and B are released from the male reproductive organs after maturation in a human being and a flowering plant respectively. (2 marks)

(d) State the differences for cells A and B to achieve fertilization (4 marks)

7. Symbiogenesis, or endosymbiotic theory, is an evolutionary theory that explains the origin of organelles in eukaryotic cells. It proposes that several key organelles of eukaryotes originated from symbiosis between single-celled organisms. According to this theory, mitochondria, chloroplasts and some other organelles were once free-living bacteria (or prokaryotes), and were taken in by an ancestral eukaryotic cell as endosymbionts around 1.5 billion years ago.

   The simplified diagram below shows the endosymbiotic theory.



The table below shows some of the major contributions made by scientists to the development of endosymbiotic theory.

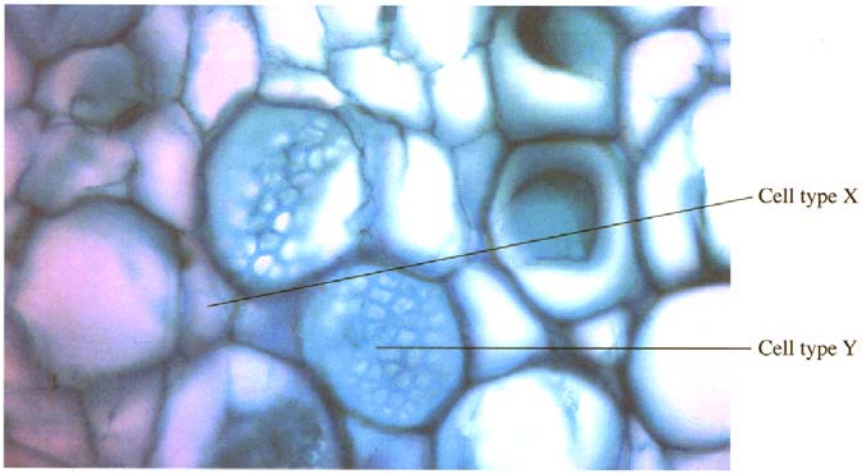
Year	***Scientist***	***Contribution***
1883	Andreas Schimper	He observed that the division of chloroplasts in green plants closely resembled that of free-living cyanobacteria; he tentatively proposed that green plants had arisen from a symbiotic relationship between plants and cyanobacteria.
1910	Konstantin Mereschowsky	He proposed the theory of symbiogenesis based on the findings of Andreas Schimper.
1918	Paul Portier	He published the book *Les Symbiotes* in which he claimed that the mitochondria originated from a process of symbiosis.
1920	Ivan Wallin	He extended the idea of an endosymbiotic origin to mitochondria.
1961	Hans Ris	He observed the structures of chloroplast under an electron microscope. He found out that the chloroplasts contain DNA which is similar in appearance to that in cyanobacteria.
1967	Lynn Margulis	She proposed the modern endosymbiotic theory: organelles such as mitochondria and chloroplasts were once independent bacteria.
2011 2014	J. Cameron Thrash, Ochoa de Alda	They conducted molecular and biochemical studies on prokaryotes and organelles, and provided evidence for the modern endosymbiotic theory.

(a) State ***one*** aspect about the nature of science that can be demonstrated by the proposal of an endosymbiotic origin of mitochondria by Ivan Wallin. Give a reason to support your answer. (2 marks)

(b) How did the technological development of microscopes lead to the deduction that the chloroplasts had originated from cyanobacteria? (3 marks)

(c) The modern endosymbiotic theory has been refined in recent years as scientists, Thrash and Alda, discovered that mitochondria evolved from proteobacteria and chloroplasts from nitrogen-fixing filamentous cyanobacteria. Other than microscopic examination, suggest ***one*** way that scientists might use to discover the endosymbiotic origins for organelles. (2 marks)

8. The photomicrograph below shows a transverse section through the vascular tissue of a stem in a dicot plant.



(a) Identify cell type Y. Give one piece of evidence to support your answer. (2 marks)

Identification: _____

Evidence: _____

_____

(b) A type of insect, aphids, uses their mouthparts to penetrate into cell type Y. Suggest why this kind of insect feeds on cell type Y. (3 marks)

_____

_____

_____

_____

_____

_____

(c) Suggest two reasons why some of the fruits have no sweet taste even after the carbohydrates in cell type Y are transported into them. (2 marks)

_____

_____

_____

_____

9. Blood stains on clothing are often difficult to remove once they have dried. The protein haemoglobin causes the stains. To study the effectiveness of different washing powders in removing blood stains, six pieces of cloth with identical blood stains were washed. All variables other than the washing powder were kept the same. After washing, the percentage of the blood stain that remained was recorded. The results are shown in the table below:

Brand of washing powder	**Type of washing powder**	**Percentage of the blood stain remaining**
A	Non-biological	50
B	Non-biological	60
C	Non-biological	35
D	Biological	25
E	Biological	20
F	Biological	5

(a) Apart from the stain, state one variable that should have been kept the same. (1 mark)

_____

(b) What conclusions can be drawn from the results? (2 marks)

_____

_____

_____

_____

(c) Biological washing powders contain enzymes to digest blood stains.
(i) What is/are the products formed by the digestion of blood stains? (1 mark)

_____

(ii) Design a further experiment to show that Brand D washing powder contains enzymes. (2 marks)

_____

_____

_____

_____

10. Both the biochemical pathways of the Krebs cycle and the Calvin cycle involve a cyclic transformation of metabolites. How do these cycles differ in their occurrence and in the nature of the biochemical reactions involved? (13 marks)

END OF SECTION B
*****END OF PAPER *****

St. Stephen's Girls' College
Biology Final Examination 2015-2016
Suggested Solutions

SECTION A

1	2	3	4	5	6	7	8	9	10
C	D	A	A	A	A	C	C	B	D

11	12	13	14	15	16	17	18	19	20
D	B	D	A	B	D	C	D	D	B

21	22	23	24	25	26	27	28	29	30
B	C	A	B	C	B	C	A	C	D

31	32	33	34	35	36				
C	B	D	C	B	A				

SECTION B

1. C B D

2.

(a) Structure A mainly consists of nerve fibres. (1)
The myelin sheaths surrounding the nerve fibres give rise to a lighter appearance. (1)
Structure B mainly consists of the cell bodies. (1)
The nuclei of the cell bodies give rise to a darker appearance. (1)

(b) D: sensory neurone (1)
E: motor neurone (1)

3.

(a) Breast-feeding: natural passive immunity (1)
Vaccination: artificial active immunity (1)

(b) Through breast-feeding, the babies get the antibodies against diseases that the mother has had or has been vaccinated in the past. There may be some diseases that the mother doesn't have immunity against.(1)
This type of passive immunity is short-lived as the babies do not develop memory cells. The blood concentration of the antibodies will gradually fall as the antibodies are used up or broken down. The child will soon be left without protection. (1)

(c) No. The memory cells produced after receiving Hepatitis B vaccine are specific to the Hepatitis B virus only. (1)
Other types of influenza are caused by other influenza viruses whose antigens are different. (1)
The memory cells for Hepatitis B virus cannot recognise other Hepatitis viruses. (1)

(d) Wear gloves when handling wounds)
Do not share toothbrush/ nail cutter/ razor etc.) any TWO 1,1

Use condom during sexual intercourse)
Screen the blood used in blood transfusion)

[The following is NOT accepted : Don't eat together/wash hand/ sweat/ isolation education/ cure]

(e) Hepatitis causes inflammation of liver tissues / damage to liver cells, thus the production of bile by the liver is greatly reduced. (1)
There is less bile salt to emulsify fat into oil droplets. (1)
The surface area of fat for lipase to carry out chemical digestion decreases. (1)
Hence, the efficiency of fat digestion is lowered.

4.

(a) Green plants and decomposers in the soil carry out respiration and produce carbon dioxide. (1)
Carbon dioxide is absorbed by the green plants for photosynthesis (2) while oxygen is released in photosynthesis as a by-product, (1)
which replenishes the oxygen content in the container.

(b) (i) Water is lost through the surfaces (mainly leaves) of the green plants via transpiration as water vapour. (1)
The water vapour condenses on the inner wall of the container and is eventually returned to the soil. (1)

(ii) Decomposers / saprophytic fungi / bacteria in the soil (1) break down the organic matter in fallen leaves into inorganic nutrients (1)
which are returned to the soil.

(c) The biomass of algae is limited in the ecosphere (1)
Energy is lost along food chain (1)
and cannot support more trophic levels

5.

(a)

DNA bases	*T*	*G*	*A*	*G*	*G*	*A*	*C*	*T*	*C*	*C*	*T*	*C*	*T*	*T*	*C*
mRNA bases	A	C	U	C	C	U	G	A	G	G	A	G	A	A	G
Amino acids	Thr			Pro			Glu			Glu			Lys		

(1)

(1)

(b) Val (1)

(c) TTT in DNA are transcribed into AAA in mRNA. (1)
Both AAG and AAA code for the same amino acid, Lys. (1)

(d) Individual 7 has sickle-cell anaemia, therefore she must have at least one allele for sickle-cell anaemia which (1)
must come from individual 3 and/or individual 4. (1)
Since individuals 3 and 4 have normal phenotype, (1)
the allele for sickle-cell anaemia must be recessive otherwise it will be expressed in individual 3 and/or individual 4. (1)

(e) Let **T** represent the allele for normal condition, and **t** represent the allele for sickle-cell anaemia. (1)
The genotype of individual 2 is Tt. (1)

(f) Sickle-shaped red blood cells have a smaller surface area to volume ratio for the diffusion of oxygen. This results in a reduced oxygen-carrying and delivery capacity of the blood. (1)
Sickle-shaped red blood cells form blockage in arterioles / blood capillaries and slows / reduces blood flow. (1)

6.

(a) Cell A: Sperm 1
Cell B: Pollen grain 1

(b) Meiosis 1

(c) Cell A is moved by the muscle contraction of the epididymis in the male reproduction organ of human body. (1)
Cell B is moved by the explosive force caused by breaking open the anthers / is carried away by attaching to an insect's body. (1)

(d)

Cell A	Cell B	
• with a tail to swim and reach the female gamete.	• No tail to swim	1
• No further growth of cell A	• by growing a pollen tube to carry the male gamete to the female gamete.	1
• active movement of male gametes involved	• passive transfer of male gametes by pollen tube	1
• no digestion of tissues during the movement of cell X up the female tract	• tissue of style is digested during the growth of the pollen tube from cell Y	1
• Cell X fused with female gamete directly	• male gametes are transferred by pollen tube grow into the ovule (1) containing the female gamete	1

Any 4 pairs

7.

(a) Ivan Wallin developed his idea based on previous findings of other scientists (e.g. Paul Portier) / ideas from other scientists (e.g. Konstantin Mereschowsky). (1)
This illustrates the principle of NOS that scientists develop their theories based on the works of other scientists. (1)

(b) Electron microscopes have a very high magnification and resolution (1)
which enable scientists to observe the detailed structure of chloroplasts, (1)
and find out that the chloroplasts contain DNA which is similar in appearance to that in cyanobacteria. (1)

(c) Compare the genetic compositions / biochemical compositions (1)
between certain prokaryotes and organelles. (1)

Total: 7 marks

8.

(a) Companion cell 1
It controls the cellular activities of sieve tube. 1

(b) Sieve tube of phloem 1
It has a sieve plate. 1

(c) Cell type Y contains sucrose. 1
Aphids use their mouthparts to suck in sugary solution from cell type Y. 1
They break down sugar obtained for releasing energy by respiration. 1

(d) Cell type Y has thin cell wall while xylem vessel has thick cell wall. 1
Cell type Y has cytoplasm while xylem vessel has no cytoplasm. 1

Cell type Y has sieve plate while xylem has no sieve plate. 1
Cell type Y has no deposition of lignin in cell wall while xylem has lignin deposition in cell wall. 1 Any three

(e) Carbohydrates are immediately converted into starch for storage. 1
Carbohydrates are immediately broken down to release energy by respiration. 1
Carbohydrates are converted to cellulose for making cell walls. 1 Any two

9.

(a) Concentration of the washing powder solutions / water temperature / material of the cloth / time of washing (1)

(b) Any two of the following:
Biological washing powders are more effective than non-biological ones in removing blood stains. (1)
Brand F is the most effective washing powder in removing blood stains. / Brand B is the least effective washing powder in removing blood stains. (1)
No washing powder can completely remove the blood stains. (1)

(c) (i) Peptides / amino acids (1) (1)
(ii) Repeat the experiment using boiled solution of Brand D washing powder. (1)
The percentage of blood stain remaining will be greater /
The washing powder becomes less effective / loses its ability to remove blood stains after boiled, showing that it is heat sensitive / denatured at high temperatures. (1)
Therefore, it probably contains enzymes.

10.

Krebs cycle	Calvin cycle	
• occurs in mitochondria (1) / all living cells	• occurs in chloroplasts (1) / photosynthetic cells	1+1
• involves decarboxylation (1) / CO2 is removed from the substrate	• involves carboxylation (1) / CO2 is fixed by a 5-C compound	1+1
• catabolic reactions (1) / organic substrate is broken down into inorganic CO2 in the cycle	• anabolic reactions (1) / inorganic CO2 is built up into organic molecules of triose phosphate	Max. 6 1+1
• oxidative in nature (1) / generates reducing power such as NADH and FADH2 (1)	• reductive in nature (1) / uses reducing power in the form of NADPH (1)	1+1 1+1
• ATP is produced (1)	• ATP is consumed (1)	1+1

Max. 10

Communication (C) max.3

Mark award for communication:

Mark	Clarity of expression and relevance to the question	Logical and systematic presentation
3	• Answers are easy to understand. • They are fluent showing good	• Answers are well structured showing coherence of thought and

	command of language. • There is no or little irrelevant material.	organisation of ideas.
2	• Language used is understandable but there is some inappropriate use of words. • A little relevant material is included, but does not mar the overall answer.	• Answers are organised, but there is some repetition of ideas.
1	• Markers have to spend some time and • effort on understanding the answer(s). • Irrelevant material obscures some minor ideas.	• Answers are a bit disorganised, but paragraphing is evident. Repetition is noticeable.
0	• Language used is incomprehensible. • Irrelevant material buries the major ideas required by the question.	• Ideas are not coherent and systematic. Candidates show no attempt to organise thoughts.