METHODIST COLLEGE
FIRST MOCK EXAMINATION (2022-2023)
SECONDARY VI BIOLOGY
ANSWER

Paper 1 Section A

Question no.	Answer	Question no.	Answer	Question no.	Answer
1	D	**13**	A	**25**	A
2	C	**14**	B	**26**	C
3	C	**15**	D	**27**	B
4	D	**16**	B	**28**	A
5	B	**17**	D	**29**	C
6	C	**18**	B	**30**	A
7	D	**19**	C	**31**	B
8	B	**20**	C	**32**	D
9	C	**21**	D	**33**	C
10	D	**22**	A	**34**	A
11	A	**23**	C	**35**	C
12	A	**24**	D	**36**	C

Paper 1 Section B

1 E 1m

B 1m

A 1m

C 1m

2 **a** Capillary 1m

b Cell Q has a biconcave disc shape. 1m

This provides a large surface area to volume ratio / a short distance for the diffusion of oxygen into and out of the cell. 1m

c pancreatic vein → (posterior) vena cava → heart → pulmonary artery → lung → pulmonary vein → heart → aorta → hepatic artery → liver 2m

3 **a** The water potential of the cell sap of the epidermal cells is higher than that of the salt solution. 1m

There will be net water movement out of the cell by osmosis. 1m

The vacuole/ cytoplasm shrinks in size, 1m

pulling the cytoplasm / cell membrane away from the cell wall. 1m

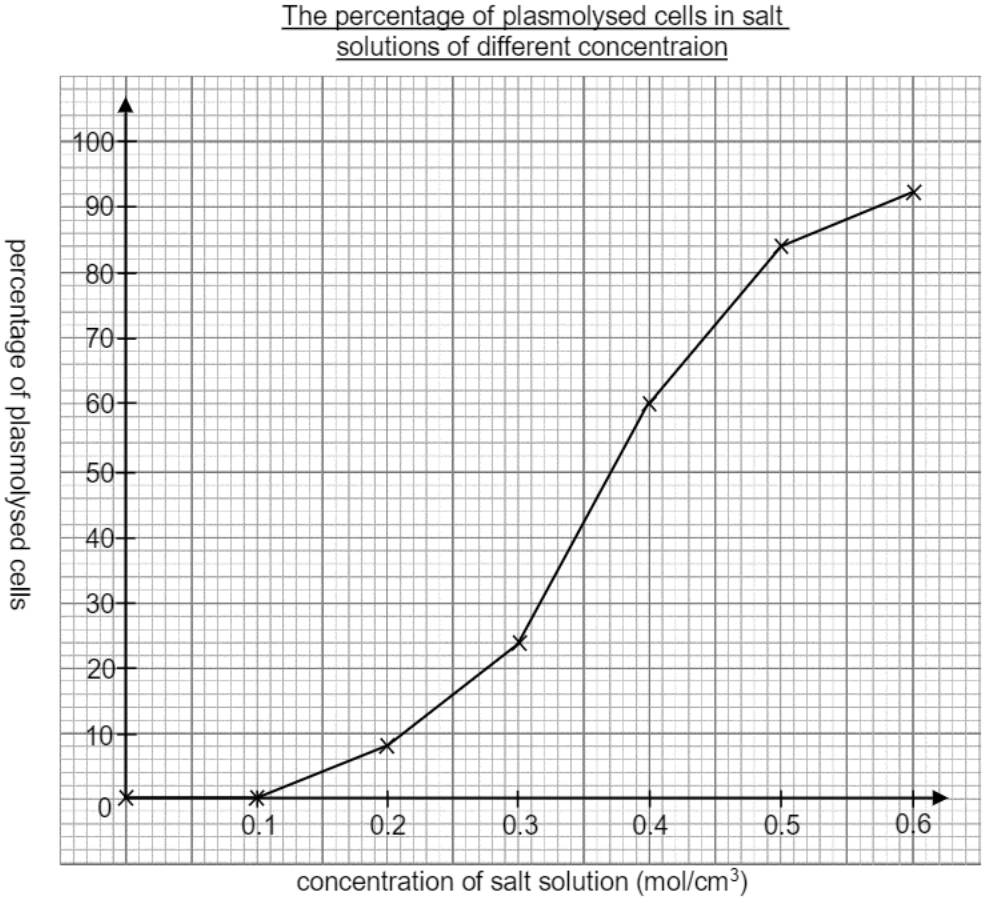
b The epidermal cells have different water potential. 1m

c **i** Correct title 1m

Correct choice of axes 1m

Axes with labels 1m

Correct plotting and joining of lines 1m



ii 0.37 mol/cm^3 1m

d Obtain more strips of epidermis from different parts of the onion /
include more pieces of epidermis in each salt solution /
count more cells in each piece of epidermis
to calculate a mean. 1m

This is to minimize the individual differences of water potential between different parts of the onion / the epidermal cells. 1m

(or other reasonable answers)

4 **a** Translocation 1m

b The radioactive carbon dioxide diffuses into the air space of the leaf. It dissolves in the water film on the surfaces of mesophyll cells and then diffuses into the cells. 1m

The mesophyll cells use the radioactive carbon dioxide to carry out photosynthesis, producing glucose with radioactivity. 1m

The radioactive glucose is converted to a radioactive sugar (sucrose), which is then transported to the roots via the phloem. 1m

c The radioactive sugar is actively used to synthesize other substances for growth (e.g. cellulose for making new cell walls) in the bud, 1m

whereas the radioactive sugar (sucrose) keeps on flowing in the stem. 1m

d More carbohydrates is transported from the leaf to the nearest growing region / region of storage. 1m

The radioactivity in the root of plant A is much higher than that in the root of plant B as the leaf treated with radioactive carbon dioxide in plant A is closer to the root. 1m

5 **a** Primary succession 1m

b **i** Each year, collect the above-ground parts of all the plants in a designated sample area of 1 m^2 (or using a quadrat). 1m

Dry all the harvested plants in an oven at around 100 °C 1m

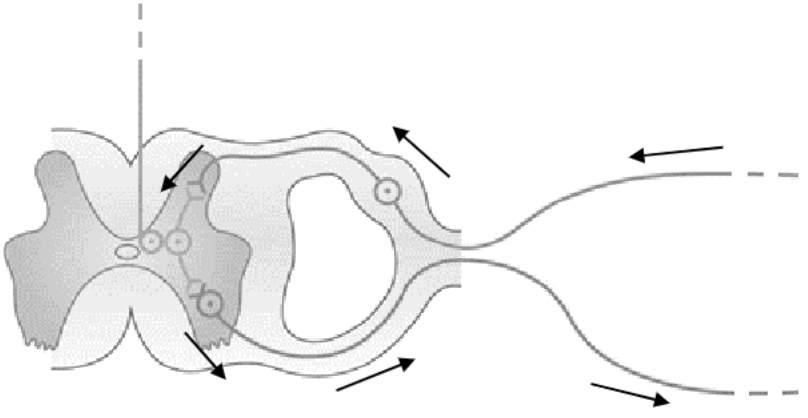
until a constant mass is obtained upon repeated weighing. 1m

ii The rate of increase in plant biomass during the first 20 years is higher than that after 100 years. 1m

It is because during the first 20 years, the area was occupied by herbaceous plants and shrubs, while after 100 years, trees became the dominant species. 1m

Herbaceous plants and shrubs are fast-growing, while trees grow at a slower rate. 1m

6 **a** Correct drawing of arrows 1m



b Synaptic vesicles containing neurotransmitter are present only in the endings of axons. 1m

Receptors of the neurotransmitter are present only in the endings of dendrons. 1m

c **i** The hand would withdraw 1m

but the person would not feel the pain. 1m

ii The hand would not withdraw 1m

and the person would not feel the pain. 1m

d When the person decided to straighten his arm, the motor areas of the cerebrum generated nerve impulses. 1m

The nerve impulses were transmitted to the muscles on the upper arm along motor neurones. 1m

Upon stimulation by the nerve impulses, the triceps contracted 1m

while the biceps relaxed, 1m

causing the straightening of the arm.

7 **a** The tying of the pancreatic duct resulted in the backflow of pancreatic juice to the pancreatic tissues that secrete the juice. 1m

Digestive enzymes (e.g. proteases) in the pancreatic juice broke down the pancreatic tissues. 1m

It can be deduced that the islets of Langerhans did not degenerate as the dog did not develop diabetes. 1m

b The pancreatic extract contained insulin. 1m

Since Banting and Best were not diabetics / their pancreas could secrete insulin normally, the injection caused their blood insulin level to reach a higher than normal level. 1m

As insulin stimulates the conversion of more blood glucose into glycogen by the liver / uptake of more blood glucose by body cells, the extra insulin would reduce the blood glucose to a low level. 1m

As a result of insufficient blood glucose supply to the brain, Banting and Best felt dizzy. 1m

c

Nature of science	Elaboration
Science is affected by the technology and the types of equipment available at the time.	The development of microscope allowed Langerhans to discover the islets of Langerhans. 1m
Scientists build on the work of other scientists.	Banting and Best knew that the removal of pancreas from a dog can make it diabetic. 1m

8 **a** FAP is not a sex-linked genetic disease 1m

because the gene (*APC*) is not located on a sex chromosome / is located on an autosome. 1m

b Individual 7 / 10 is normal, so he / she must have received at least one normal allele from either of his / her parents (individual 3 or 4). 1m

Individuals 3 and 4 have FAP, so each of them must carry at least one FAP-causing allele. 1m

Thus, at least one of the individuals 3 and 4 is heterozygous. 1m

In heterozygous condition, only the dominant allele is expressed. 1m

Therefore, the FAP-causing allele is dominant. 1m

c These genes would direct the cell to produce certain proteins 1m

which inhibit cell division / cause the destruction of the cells with mutated DNA. 1m

d The development of polyps into malignant tumours takes time for mutations to accumulate. 1m

Having colonoscopy every year allows the early detection and removal of polyps, ensuring that polyps do not have the chance to accumulate mutations. 1m

9 **a** P, Q and S 1m

b Both Q and S contacted the COVID-19 virus before 1m

but Q cannot / has not yet produced antibodies against the virus while S can form antibodies to destroy the virus. 1m

c **i** No. The antigen of the COVID-19 virus is different from that of the MERS virus. 1m

The immunity / memory cell produced is specific to the antigen of the COVID-19 virus. 1m

ii Measles / tuberculosis / smallpox / poliomyelitis / influenza 1m

(Or other acceptable answers)

10 How gases are exchanged in the placenta:

- Oxygen diffuses from the maternal blood to the embryo's blood. 1m
- Carbon dioxide diffuses from the embryo's blood to the maternal blood. 1m

Adaptations of lung and placenta to gas exchange:

- Numerous air sacs in the lungs and the large number of finger-like embryonic villi in the placenta provide a large surface area for diffusion of gases. 1m 1m
- The epithelia making up the walls of the air sacs are only one-celled thick. The walls of the embryo's capillaries and the embryonic villi are also very thin. 1m

  These features provide a short distance for the diffusion of gases. 1m
- There are numerous capillaries surrounding the air sacs. In the placenta, there are a lot of blood vessels. 1m

  The blood in these blood vessels transports the gases away readily. A steep concentration gradient can be maintained for efficient diffusion of gases. 1m

Communication 3m

Paper 2

1 a i The thick, sticky mucus impairs the beating action of the cilia on the epithelium of the airway / is not easily cleared from the lungs. 1m

Pathogens would be trapped in the thick mucus and they multiply, causing infections. 1m

ii When the same viral vectors enter the patients ' bodies again, memory cells readily recognise the viral vectors and produce a more rapid immune response. 1m

The memory cells divide and differentiate quickly into large numbers of plasma cells, killer T cells and memory cells. 1m

Plasma cells secrete large amounts of antibodies which quickly act against the viral vectors. The large amount of killer T cells quickly destroy the infected cells. 1m

iii 1 The phospholipid bilayer of liposome can fuse with the cell membrane of the cells in the lungs, 1m

releasing the normal CFTR gene into the cells. 1m

The normal CFTR gene expresses inside the cells / directs the production of a functioning protein, 1m

compensating for the function of the defective gene.

2 The nonnal CFTR gene will be lost when the lung cells inserted with the gene die. 1m

New lung cells do not have the nonnal CFTR gene. 1m

1 b i Each type of protein is composed of a specific sequence of amino acids and has a specific shape or conformation. 1m

The antigen binding sites of each type of monoclonal antibodies have a specific shape which only protein molecules with a complementary shape can bind. 1m

ii ATTCGG 1m

iii RTase attaches to the primer and free nucleotides pair up with the bases on the viral RNA by complementary base pairing. 1m

The enzyme catalyses the formation of bonds between nucleotides, joining adjacent nucleotides together and synthesizing a cDNA strand 1m

iv The PCR products are DNA fragments which are negatively charged, so they migrate through the gel to the positive pole. 1m

The shorter DNA fragments migrate at a faster speed than the longer DNA fragments. 1m

The viral specific sequence is of a certain length and would appear at a certain position on the gel. 1m

v Strength of rapid antigen tests:

Require no laboratory equipment / can be performed by people with relatively little training / provide a result within minutes. 1m

Weakness of rapid antigen tests:

Relatively low sensitivity / may give false negative result if the amount of proteins specific to SARS-CoV-2 in the sample is lower than the threshold value. 1m

1. c i EcoRI 1m

EcoRI cuts the plasmid and cuts at both ends of the DNA fragment. 1m

SmaI cuts within the gene of interest. Using SmaI will interrupt the gene of interest. 1m

ii During transformation, only some of the bacteria picked up the plasmid. The bacteria with the plasmid carried the ampicillin resistance gene. 1m

The agar plate contains ampicillin. Only the bacteria carrying the ampicillin resistance gene survived and grew on the agar plate. 1m

iii 6677 bp 1m

iv The agar plate contains arabinose. In the presence of arabinose, araC protein promotes the binding of RNA polymerase to the GFP gene. 1m

The GFP gene, together with the gene of interest, is expressed. GFP linked to the protein produced from the gene of interest is synthesized. 1m

GFP glows when it is exposed to ultraviolet light. 1m

1. d i The substitution of base does not create nor destroy the cutting sites of the restriction enzyme. 1m

The length of the DNA fragments containing the normal allele and the diseased alleles obtained after cutting the DNA samples with the restriction enzyme is the same. 1m

Therefore, the positions of the DNA bands formed in the gel after gel electrophoresis are the same. 1m

ii The single base can be found at many other locations in the genome. A DNA probe containing only one base will bind to other locations in the genome. 1m

The chance of having the same sequence of 20 bases at other locations in the genome is lower. 1m

iii The DNA probe complementary to the normal allele bound to a DNA fragment in the husband's DNA, but the DNA probe complementary to the diseased allele did not. This indicates that he is homozygous normal. 1m

Both the DNA probe complementary to the normal allele and the DNA probe complementary to the diseased allele bound to a DNA fragment in the wife's DNA. This indicates that she is heterozygous. 1m

iv The number of DNA copies containing the diseased allele in the reaction mixture increases exponentially when PCR is carrying out. 1m

As the number of copies increases, the number of DNA probes binding to the target sequence increases, and so the intensity of green light given out by the dye increases exponentially. 1m

v Individual X has two copies of the diseased allele while individual Y has only one copy. 1m

Therefore, in the reaction mixture containing the DNA sample of individual X, the amount of DNA probes binding to the target sequence is doubled, and so the intensity of green light detected is doubled. 1m