

Section I: Part A

Multiple Choice Answers – Overlay Grid

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1.	A ☐	B ☒	C ☐	D ☐
2.	A ☐	B ☐	C ☐	D ☒
3.	A ☒	B ☐	C ☐	D ☐
4.	A ☐	B ☐	C ☐	D ☒
5.	A ☐	B ☒	C ☐	D ☐
6.	A ☐	B ☐	C ☒	D ☐
7.	A ☐	B ☒	C ☐	D ☐
8.	A ☐	B ☐	C ☒	D ☐
9.	A ☐	B ☒	C ☐	D ☐
10.	A ☒	B ☐	C ☐	D ☐
11.	A ☐	B ☒	C ☐	D ☐
12.	A ☐	B ☒	C ☐	D ☐
13.	A ☐	B ☐	C ☒	D ☐
14.	A ☐	B ☐	C ☐	D ☒
15.	A ☒	B ☐	C ☐	D ☐

Multiple Choice Answers – Descriptive Answers of Correct Choices

1. B Enzymes are made up from the more complex protein molecules
2. D $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3$ (or ions of this)
3. A ADH is a hormone that slows the movement of water from the blood stream at the kidneys. Helps retain water in the body.
4. D Osmosis will move the water into the more concentrated environment, hence water is lost from the cube.
5. B Amino acid is transported to the liver where it is converted to the less toxic urea. It is then filtered from the body by the kidneys.
6. C This can happen, but convergent evolution also happens.
7. B Genes and chromosomes were not discovered until much later.
8. C The double helix structure was not discovered until the 1950's.
9. B AT and GC are complementary and they attach to sugar not phosphate.
10. A U replaces T in RNA.
11. B They cause growth and division, while the suppressor genes balance this by slowing the process down.
12. B None are linked to microorganisms.
13. C This is enough to kill most organisms without destroying the food.
14. D Viruses are basically nuclear and not cellular. They need a host cell to enter and reproduce. All the others are cellular.
15. A The differentiation occurs at the B-cell clone stage.

Section I: Part B Answers

Question 16

- (a) Metabolism is the general term for the chemical reactions that are carried out in the organisms. It involves the formation and breaking up of molecules in a controlled environment (ie pH and temperature). Enzymes regulate the rate of chemical reaction.

(b)

Exercise
Increased body temperature from muscle action
Body receptors (nerves) register the temperature increase
Message sent to the hypothalamus and brain receptors
Hypothalamus controls cooling process through the endocrine system.
Response:
Dilation of skin capillaries
Sweating
Stop exercise
Decrease metabolism
Increase blood circulation
Cooling takes place.

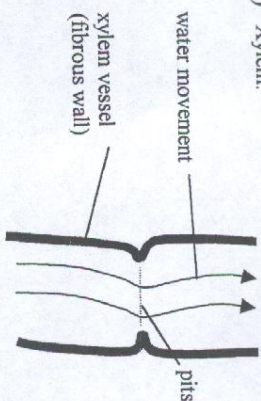
Question 17

- (a) The ectotherm could be chosen from such examples as: fish, amphibians, reptiles or plants. Endotherms from: birds, placental mammals, monotremes, marsupials. The main differences are that endotherms generate most of their own warmth and so need a lot more food for energy. Mammals for instance need up to five times more food than a reptile of similar size. Ectotherms often spend time looking for radiant energy or hiding from too much energy in order to control internal temperature. They require a lot less food.
- (b) There are a wide range of examples that can be discussed, from the fluffing up of bird feathers to humans putting on heavier clothes in the winter.
- (c) Oxygen enters through the lungs, alveoli and into the bloodstream to be transported as oxyhaemoglobin in the red blood cells. At the cell it is released so that the haemoglobin can recycle. Glucose enters as molecules from the small intestine and the liver and travels in this molecular form along with the blood plasma to the body cells.

Question 18

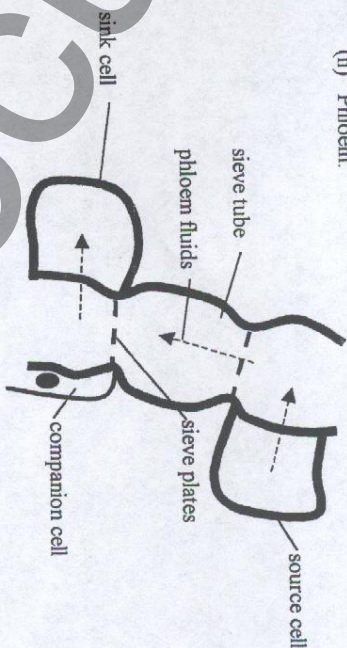
- (a) Artificial blood is often used in cases where large amounts of normal blood have been lost and pressure needs to be maintained before a blood transfusion can be organised. It is usually administered through a vein and comes in two main forms.
1. Saline solution containing 0.5% NaCl concentration (same as the body)
 2. Dextrose, containing 4% glucose and 0.18% NaCl mixture in water.

(b) (i) Xylem:



Xylems are basically long tubes

(ii) Phloem:



- (c) The xylem brings fluids (water, salts, some nitrogen products) from the roots to the active parts in the plant ie. leaves. This is often against gravity and depends on:

1. transpiration stream resulting in pressure differences due to the evaporation at the stomates.
 2. capillary action of water molecules moving along narrow tubes
 3. the adhesive attraction of water to cellulose.
- These all add up to significant water movement along the xylems. Phloem fluids (sugars, hormones etc.) are transported by the phloem from the source cells to the sink cells where active uptake due to growth is occurring. The water moves with the sugars etc. into the sink cell reducing pressure in the sieve tube and more fluid then flows due to the pressure difference.

Question 19

- (a) In the kidney the blood is brought into the glomerulus where fluids (not blood cells) pass into the Bowman's capsule. As the fluid moves along the tubule some substances are reabsorbed depending on body needs. The final filtrate eventually passes through to the bladder. The purpose of this is to balance the composition of the blood and remove wastes like urea. Renal dialysis works in a similar way. There are two basic types.

1. Peritoneal. A dialysis solution flows into the abdominal cavity where the lining acts as a semi permeable membrane to allow wastes to pass through to the solution. The solution is replaced regularly.
2. Haemodialysis. This was the original system where a patient goes to a medical centre and their blood is pumped from a vein through semi permeable membrane tubing to remove the wastes. The blood cells are too large to be removed and cycle back to the body. With prolonged use the blood cells can be damaged, also anti clotting agents are needed in this process. The main similarities are they both filter and remove wastes. The main difference is that kidneys are continuous and automatic and part of the balance process in the body.

- (b) Hormones are chemical messengers usually transported around the body in the blood to stimulate responses in particular areas.
- Aldosterone comes from the adrenal gland and is responsible for the relative concentrations of sodium and potassium ions in the body. It causes the reabsorption of sodium ions in the Loop of Henle in the kidney, leaving potassium ions behind. It also promotes absorption of sodium ions by the alimentary canal. This allows for the K^+ concentration to fall and Na^+ to rise, helping with the regulation of body fluids.
- ADH (antidiuretic hormone) is secreted by the pituitary gland. It causes uptake of water in the kidney nephrons and thus regulates water volume in the blood and urine.
- They work together as part of the overall process of maintaining balance for the body by keeping concentrations and volumes within safe levels.

Question 20

- (a) It would be very hard to make a judgment unless you knew the species very well and also had details on their specific environment. You would need to know seed type, camouflage etc.
- (b) Briefly:
1. There are variations within species populations
 2. Offspring that don't reach maturity and reproduce have their characteristics removed from the population
 3. The organisms that do survive to reproduce are well adapted to that environment
 4. Therefore favourable variations are passed onto offspring and these become more common in the population.
- (c) Some points that could be discussed:
1. Australia is a large isolated island with a wide range of environments
 2. This means there is the possibility of an original species spreading out over the island and filling in the many different niches.
 3. They are similar enough in appearance, eating habits and flocking to suggest they may have come from a single ancestral group.
 4. The variations suggest that each area favoured slightly different traits in the group over time

5. Speciation (splitting into different species) suggests possible isolation from each other.

Question 21

- (a) Taking the example of the tall/short plants. He first bred pure-breed tall (homozygous) and pure short plants by controlling the fertilisation of the plants over several generations. He then crossed them, stopping the possibility of self fertilisation by removing the anthers, and hand pollinating. (He used the same basic procedure for other variations in the pea plants and bred hundreds of plants to reach his famous ratios.)
- In the first generation (F_1) he discovered they were all tall. This can now be explained with

T	T
Tt	Tt
Tt	Tt

T tall gene
t short gene
Tt tall

In the second generation (F_2) he allowed self pollination and found the 3:1 ratio:

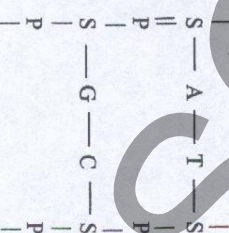
T	T	T
Tt	Tt	Tt
Tt	Tt	tt

TT tall
Tt tall
Tt tall
tt short
Tt tall

Although he did not understand genetics, by methodical experimentation he discovered the underlying ratios.

Question 22

- (a) (i) C is Cytosine
T is Thymine
G is Guanine
A is Adenine
- (ii) A sequence could look like this:



(iii) This is a mutation where the DNA sequence has changed. This is possibly a displacement or inversion mutation. Causes could be many and varied:

1. Natural (spontaneous) changes during replication
2. Radiation damage
3. Chemical damage from mutagens

Question 23

(a) Points that could be discussed:

1. A healthy organism has a regulated environment for growth and also for the repair of damaged cells.
2. Genes are copied through mitosis and can be affected (mutated) in this process.
3. Genes control the production of proteins and these contribute to healthy growth and some regulate the cell cycle.
4. The speed of cell production is controlled by two types of genes:
 - a. proto oncogenes, produce proteins that speed up cell growth
 - b. suppressor genes, produce proteins that slow cell growth down
5. If suppressor genes are damaged then cancerous cells (fast growing cell masses) can develop.

(b) (i) They are capable of infecting and causing disease.

(ii) Influenza is usually passed on via the air or direct contact. It needs a host cell to reproduce in.

Bacteria has many means of entering our bodies: food, direct contact, sneezing etc. Bacteria are independent cellular organisms. Protozoan can come from ingesting contaminated foods or water, mosquito bites etc.

Question 24

(a) Viruses are not made from cells. They are very small (less than 100 nm) and made primarily of nuclear material (DNA or RNA) covered in a protein layer. They can only reproduce inside a host cell using its cellular material. Diseases caused by viruses are generally hard to treat but can be reduced in the population by vaccinations. They are so small that it wasn't until the advent of the electron microscope that they were seen.

Bacteria are independent cells that have a life cycle much like other cells. They contain a nucleus, cytoplasm and a cellular membrane. Disease causing bacteria can be treated with antibiotics, although resistant strains have developed requiring more sophisticated approaches to treat them.

(b) (i) Koch's postulate:

1. The microorganism must be present in every case of the disease
2. The microorganism must be isolated from the diseased organism and grown in a culture
3. The disease must be reproduced when a pure culture is reintroduced to a non diseased, susceptible host
4. The microorganism must be present in the new host.

(ii) Skin cancer is caused by environmental factors like overexposure to ultra violet light, so Koch's postulate would not apply. AIDS is viral so the postulate would work.

Question 25

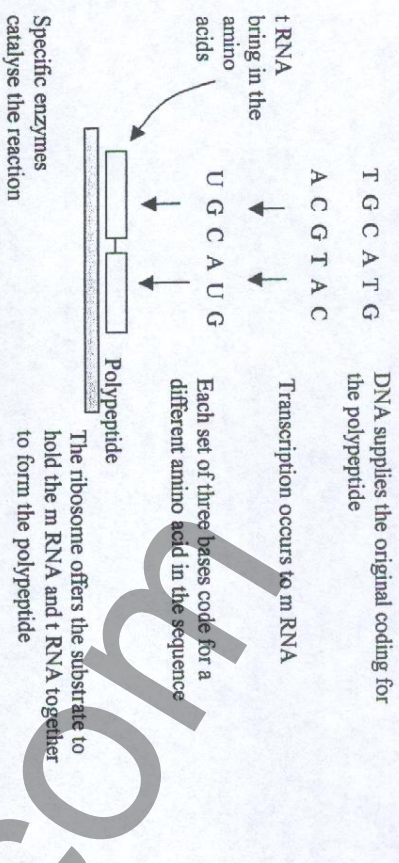
(a)	Entry	Defence
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- | | |
|---------------------------------------|---|
| 1. Stomach and digestion | Acidic environment |
| 2. Mucous membranes (mouth, nose etc) | Thick fluid that kills microorganisms and washes them away |
| 3. The skin | Keratin in the outer layers seals the body from microorganisms. Sebum is secreted and as it breaks down produces an acidic environment. Wounds are quickly healed |

(b) As tissues become damaged, histamine and other chemicals are released to promote inflammation. The area swells, blood flow increases and white blood cell concentrations increase. This slows the movement of the pathogen so it can be contained.

The white blood cells (phagocytes) move into the damaged area for the purpose of enveloping, ingesting and removing invading materials. Short term inflammation involves mainly neutrophils and longer term (days) involves macrophages.

(d) As an example



(e) Scientists in general are meticulous researchers and a lot of work is done in ensuring that there is no harmful impact on the environment and society as a whole. This attitude will be particularly important in the new genetic research areas because of the publicity involved and possible harm to humans. Scientists are also human beings with a wide variety of backgrounds, cultures and beliefs. Therefore a broad statement as quoted is too general to be applied to all scientists.

Some alternate points of view that could be discussed include:

1. The lawyers and the complex legal issues involved
2. Companies looking to develop new products for profit
3. Religious and cultural beliefs centred around the wish not to disturb natural processes
4. Politicians and law makers trying to balance progress with the wishes of society
5. The patient looking for a cure
6. Farmers looking for better drought or pest resistant crops.
7. Consumer concerns

Question 28 Genetics-The Code Broken?

(a) (i) They are amino acids and derived from the digestion of proteins.

(ii) The complementary sequence of bases from the DNA:

G	T	A
G	A	C
T	C	C
A	T	C

(iii) t-RNA is the general term for a range of ribonucleic acids that bring specific amino acids to the ribosome for the formation of polypeptides. They each contain an anticodon that recognises, and is complementary to, the coding of the m RNA.

(iv) The stop codon signals the end of the polypeptide sequencing and then the molecule is released into the cytoplasm.

(v) The leucine and histidine have swapped places. This happens because the DNA has changed. This suggests a type of mutation. Mutations can be caused by ultraviolet light, chemicals, some pathogens and also by random changes without a cause.

(b) Blood type A can have genotypes of AA or Ao, where A is dominant over o. If the parents are AA, then the offspring will all be A type. If one parent is Ao and the other AA then the offspring will still be A type. If both parents are Ao then one quarter will be O type with an oo genotype. Therefore it is a very low possibility.

(c) The work of Mendel was monogenic. This means that only one gene or only a couple of genes were expressed as tall or short etc.. Many characteristics, however, are determined by a large number of genes with each adding its own particular expression to the mix. Examples include body height and weight of humans, length of wool and colour of some hair types. Any characteristic that has a range of sizes, shapes or colours will be based on many (poly) genes.

(d) (i) This means YYTT are crossed with yytt. The ratio will be approximately:

9 yellow and tall
3 yellow and short
3 white and tall
1 white and short

(ii) With linkage the ratio changes to:

3 yellow and tall
1 white and short

Genes can be linked if they occur on the same chromosome. This means that they stay together during gamete formation and can be expressed as if they are one. Independent genes are on different chromosomes and can be separated during gamete formation and therefore expressed separately. Thus, depending on the phenotype ratio, there are clues to the position of the genes.

(e) The aim of the project is to map the genes in our chromosomes. Some of the benefits that could be expected to come from this include:

1. A better understanding of our genetics
2. It could lead to cures in some diseases
3. Help in the search for our evolution
4. DNA marking for forensic purposes
5. Could help develop a range of new drugs
6. and many others

(f) Items that could be noted include

- 1. Homologue genes
- 2. Similar genes are used to produce heads and limbs in a wide variety of animals
- 3. Studies into blood types
- 4. The impact of the Human Genome Project
- 5. Comparative embryology

Question 29 The Human Story

(a) (i)

Kingdom	Animal
Phylum	Chordata
Class	Mammalia
Order	Primate
Family	Hominidae
Genus	Homo
Species	Sapien

(ii) Features: Nails are flat and not claws

- Binocular vision
- Opposable thumb
- Relatively large brain
- Reduced sense of smell
- Short nose

(iii) A species is a group of organisms which at the very least is capable of breeding freely but not with other species.

(b) The criteria for ideal conditions for producing fossils include:

- 1. Early burial before scavengers or decomposition occurs
- 2. Burial in soft materials like muds, ash or sand
- 3. Lack of disturbance after burial ie. quiet ponds, under volcanic ash
- 4. Hard parts last a lot longer in general than soft tissue
- 5. Eventually it is exposed again so that we can study it

Under this criteria, the kangaroo at the billabong has more chance of being a fossil than in the desert, unless buried by an unforeseen occurrence like volcanic ash.