Answers

Chapter 1

Level 1

1. **B**
   A typical animal cell has mitochondria but not chloroplasts.
2. **A**
   Both red blood cells and root hair cells are specialised for transport.
3. **D**
   High surface area-to-volume ratio maximises absorption in root hair cells.
4. **B**
   Only the nucleus and chloroplasts are large enough to be visible under a light microscope.
5. **D**
   An organ consists of a group of different tissues working together for a similar function.
6. **B**
   The cell membrane is not permeable to large molecules such as starch.

Level 2

7. **B**
   Mitochondrion is the site of aerobic respiration. Nucleus is needed for cell division.
8. **D**
   Part **X** is a chloroplast, an organelle in a leaf cell.
9. **B**
   R is the nucleus. So, it controls all the cell activities including protein synthesis, which takes place in **S**.
10. **A**
    1 (chloroplast) produces food, and 4 (large central vacuole) stores it.
11. **B**
    Root cells are underground and do not photosynthesise. So, they do not have chloroplasts.

Level 3

12. **C**
    A nucleus, ribosomes, mitochondria and a cell membrane are organelles that can be found in either a plant cell or an animal cell.
13. **D**
    Mitochondria produce energy for muscular contraction.
14. **D**
    High surface area-to-volume ratio maximises the rate of absorption.
15. **D**
    Muscle cells require oxygen for aerobic respiration to produce energy for contractions. So, myoglobin has a greater tendency to bind with oxygen than haemoglobin.
16. **A**
    Since there is no nucleus, cell activities such as protein synthesis and cell division are not possible. Hence, there will not be any ribosomes, centriole or chromatin. Vacuoles store substances within the cell. So, they would most likely be present.

Chapter 2

Level 1

1. **B**
   Diffusion is the movement of substances (except water) from a region of higher concentration to a region of lower concentration.
2. **A**
   Osmosis involves water only.
3. **D**
   Water vapour diffuses out through the stomata.
4. **C**
   A plasmolysed plant cell has its cell contents shrunken away from the cell wall. Its central vacuole has also shrunk.
5. **C**
   Osmosis requires a partially permeable membrane for it to occur.
6. **C**
   Water moved from the solution with higher water potential into the red blood cells. This caused the red blood cells to expand and burst.

Level 2

7. **A**
   The diagram shows a partially permeable membrane. A cell wall is fully permeable.
8. **B**
   The cell is plasmolysed. This indicates that water left the cell for the surrounding solution with lower water potential via osmosis.
9. **D**
   Potato strip **P** increased in length due to water entering it via osmosis. The other potato strips became progressively shorter with increasing sucrose solution concentration due to more water leaving the potato strip.
10. **C**
    Water will move from a solution of higher water potential (5 % sucrose solution) to a solution of lower water potential (10 % sucrose solution). So, the liquid level in **A** will become higher than that in **B**.
11. **B**
    Gas **X** is higher in concentration in the alveolus and diffuses into the blood capillary. Gas **Y** is higher in concentration in the blood capillary and diffuses into the alveolus.

12. **C**
Diffusion is the movement of substances from a region of higher concentration to a region of lower concentration.

Level 3

13. **C**
Iodine diffuses from a region of higher concentration in the Visking tubing to a region of lower concentration in the test tube. This causes the difference in the concentration to decrease.

14. **C**
The presence of soil is not necessary. Mineral ions will still diffuse into the root hair cells down a concentration gradient.

15. **D**
The organism lives mostly in water, so its skin should not be fully permeable. Otherwise, water and other substances would be leaving or entering its body through its skin all the time. When on land, it breathes through its skin. So, the skin should be moist. Hence, oxygen in the surroundings can dissolve on its skin and diffuse into its body.

16. **B**
Osmosis exclusively involves the movement of water, but not water vapour. Water vapour moves via diffusion.

17. **C**
The percentage change in mass of the Visking tubing in solution **X** is greater than the one in solution **Y**. This means more water enters the Visking tubing that is in solution **X**. So, solution **X** has a higher water potential than solution **Y**.

18. **C**
Red blood cell **C** is crenated. This indicates that water moved out of the cell via osmosis into the surrounding more concentrated solution.

19. **A**
There are more K^+ ions inside the cell than outside.

20. **D**
During dialysis, there should not be any loss of mineral salts from the blood into the dialysis fluid.

Chapter 3

Level 1

1. **D**
A mammal stores the polysaccharide glycogen in its liver and muscles.

2. **C**
Hormones help to control and coordinate body activities, and proteins are used to synthesise some hormones.

3. **D**
Glucose is a carbohydrate. It is highly soluble in water and is a monosaccharide, which is a reducing sugar.

4. **B**
Glucose is a monosaccharide, not a polysaccharide.

5. **D**
Amino acids join together to make up a polypeptide chain.

Level 2

6. **A**
The food sample tested positive for the presence of proteins (biuret test) and starch (iodine test).

7. **B**
The nutrients dissolve in the water present in the blood and are transported around the body.

8. **C**
X is starch, which is being broken down into maltose. **Y** is a polypeptide, which is being broken down into amino acids. **Z** is a fat molecule, which is being broken down into glycerol and fatty acids.

9. **A**
The food sample contained fats, protein, starch and no reducing sugar. Sucrose is not a reducing sugar.

10. **C**
Glycogen is stored in the liver and muscles of mammals. Starch is easily digested into glucose and glucose is used for respiration.

Level 3

11. **C**
Although fats contain more energy, it is much faster to metabolise carbohydrates. This is essential in an energy drink which is supposed to provide energy quickly.

12. **B**
The amylase digested the starch into maltose, which is a reducing sugar. So the Benedict's test was positive. Since there was no more starch left, the iodine test was negative.

13. **D**
Carbohydrates are the main source of energy for the body.

14. **D**
Water helps plants to stay upright by making plant cells turgid. Water is a solvent for many substances, such as digested food, that are transported around the body. Water in saliva helps to soften the food.

15. **A**
Sucrose is a disaccharide that is not a reducing sugar. Hence, the Benedict's test was negative and the solution remained blue. Sucrose is made up of its monosaccharides, glucose and fructose. Maltose and lactose are reducing sugars.

16. **D**
The food samples might have contained different nutrients and hence had different amounts of energy stored.

17. **C**
Sodium hydroxide and copper(II) sulfate are the reagents used to conduct the biuret test for proteins. A positive test would give a violet solution.

Chapter 4

Level 1

1. **C**
   Before the reaction starts, there is no enzyme-substrate complex. When the reaction starts, the concentration of enzyme-substrate complex increases. As the reaction proceeds, less substrate is left, so the concentration of enzyme-substrate complex decreases.
2. **C**
   All enzymes remain chemically unchanged at the end of the reaction they catalyse. Enzymes are made of protein. Some enzymes work at optimum temperatures of 40 °C and above. Some enzymes catalyse the building of new molecules from smaller ones.
3. **C**
   The lock is the enzyme, and the key is the substrate. Lipase breaks down a fat molecule.
4. **C**
   Enzymes are highly specific. Only the substrate that is complementary to an enzyme's active site can bind to the enzyme. An enzyme-substrate complex is then formed.

Level 2

5. **A**
   Enzymes are made of protein.
6. **C**
   Extreme temperatures may cause enzymes to denature and lose their active sites and enzyme activity.
7. **A**
   P is the enzyme amylase. **Q** is the substrate starch. **R** is the product maltose.
8. **B**
   Enzyme concentration remains the same as they are chemically unchanged after a reaction. As the reaction proceeds, the product concentration will increase, while the substrate concentration will decrease.
9. **B**
   Substrate **B** is complementary to the enzyme's active site. So, it will be able to fit into the active site.
10. **C**
    The rate of reaction is at its highest at point **C**. This means the enzyme activity is at its highest. So, the greatest amount of products is produced at point **C**.

Level 3

11. **C**
    Amylase is an enzyme that breaks down starch. Boiled amylase is denatured. Amylase in hydrochloric acid has been through extreme pH changes, so it is also denatured.
12. **D**
    The enzymes were denatured when they were boiled at 100 °C and the process was irreversible. Hence, there was no enzyme activity after denaturation.
13. **C**
    The enzyme concentration is decreased but the amount of substrates remains the same. There are fewer enzymes to catalyse the reaction. So, it takes a longer time for all the substrates to be acted on. The final amount of products should be the same as previously.
14. **D**
    When more potato discs are used, there is more catalase present. The catalase in the boiled potato discs would have been denatured.
15. **A**
    The optimum pH for protease from the stomach is pH 2. Hence, protease will digest the most egg white in the pH 2 solution. The boiled protease in **D** is denatured, so there is no enzyme activity.
16. **D**
    Thermophilic bacteria live in very hot places, so their enzymes have higher optimum temperatures.
17. **C**
    Enzyme **P** has a higher enzyme activity at lower temperatures. Enzyme **Q** has a higher enzyme activity at higher temperatures.

Revision Paper 1

1. **B**
   The vacuole, cytoplasm and cell membrane are variously involved in the transport and/or storage of substances in a cell.
2. **A**
   Only the cell membrane can be found in all plant and animal cells.
3. **C**
   The presence of a single vacuole indicates that it is likely a plant cell and not an animal cell.
4. **A**
   A vacuole stores substances but is not actively required for protein synthesis.
5. **C**
   Proteins are found in **Y** as it is the site of protein synthesis. The enzymes and antibodies found in **Z** are proteins. DNA is not a protein.
6. **B**
   The stomach produces digestive enzymes, which are proteins. Ribosomes are involved in protein synthesis. So, they are expected to be present in abundance.
7. **D**
   The nucleus is needed for cell replication. The cytoplasm is where chemical reactions occur. Mitochondria are required to provide the energy for metabolic activities to be carried out.
8. **B**
   The presence of chloroplasts indicates that the organism carries out photosynthesis. So, the organism is likely to be found near light sources.
9. **A**
   Water vapour is in the gaseous state, so it diffuses.
10. **A**
    Water will move via osmosis from the test tube into the Visking tubing. Since the water potential gradient is steep, water will keep entering until the Visking tubing bursts.

11. **A**
After 24 hours, the water molecules would have reached an equilibrium. So, there will be no net movement of water molecules.

12. **C**
Osmosis and diffusion are passive processes. They do not require energy produced by aerobic respiration in mitochondria. Root hair cells do not photosynthesise.

13. **A**
The plant cell was plasmolysed. This indicates that water left the cell for the surrounding saline solution. So, the saline solution had a lower water potential.

14. **A**
Olive oil does not contain starch. Thus, it will test negative for starch.

15. **C**
Lipase digests lipids into fatty acids and glycerol.

16. **D**
Amino acids are the basic units of proteins.

17. **A**
The blue solution was copper(II) sulfate solution, also known as Benedict's solution. Since the solution remained blue, there was no reducing sugar. So, the clear solution was sucrose solution.

18. **B**
Steamed chicken with fresh lime juice provides protein, vitamin C and water. Protein will help the wounds to heal faster. Vitamin C will help reduce gum bleeding. Dehydration is due to lack of water.

19. **A**
Being insoluble in water prevents starch and glycogen from being easily transported out of cells instead of being stored.

20. **D**
Bones and connective tissues are mostly made up of proteins.

21. **A**
The healthier choice is the one with a lower fat content. Since they are sports drinks, they should contain carbohydrates. The carbohydrates are needed to replenish the depleted glycogen stores in the body after exercising.

22. **D**
Both glucose and glycogen are present in a human. Glycogen is not present in a plant.

23. **A**
Maltase digests maltose into glucose.

24. **B**
Salivary amylase is secreted in the mouth. It functions optimally at around pH 7.

25. **C**
Not all enzymes are denatured at temperatures above 100 °C. Some examples are the enzymes found in microorganisms living near hydrothermal vents. Most of these hydrothermal vents emit water that is at least 200 °C.

26. **C**
In a strong acid, the gas pressure remains unchanged after rising only slightly. This indicates that catalase cannot work well in a strong acid.

27. **C**
By adding an endoenzyme first, the large molecules are digested from within. This increases the surface area-to-volume ratio. So, it becomes easier for the exoenzyme to digest the molecules later.

28. **C**
X is secreted by the pancreas into the small intestine. The small intestine has a pH of about 7. So, the optimum pH for **X** should also be about 7.

29. **B**
If the enzyme changes its shape, it cannot convert glucose to alpha-ketoglutarate. So, alpha-ketoglutarate production will stop. Succinate production will also stop when there is no more alpha-ketoglutarate. However, succinate is still being converted to fumarate. So, the amount of succinate stored in the body will gradually decrease.

30. **D**
The optimum temperature of the human digestive enzyme would be around 37 °C. Increasing the temperature of the mixture to 37 °C would have increased the rate of reaction. So, the reaction time would have been shortened.

Chapter 5

Level 1

1. **C**
Emulsification of fats is by bile, which is not an enzyme.

2. **C**
X are the villi, which increase the surface area-to-volume ratio, thus increasing the rate of absorption of nutrients.

3. **B**
The liver deaminates excess amino acids into urea.

4. **B**
Excess glucose is converted into glycogen in the liver by the hormone insulin.

5. **C**
The small intestine is the only organ that absorbs digested nutrients.

Level 2

6. **B**
The pancreas secretes pancreatic juice which contains enzymes that are essential for chemical digestion.

7. **D**
Starch is digested in the mouth. Saliva mixes with food to soften it. Chewing cuts the food into smaller pieces.

8. **B**
Amylase breaks down starch into maltose, a reducing sugar.

9. **A**
Liver produces bile. Protein is digested in both the stomach and small intestine. Lipase breaks down fats into fatty acids and glycerol.

10. **D**
Glucagon is released when there is low glucose level in the blood. Glycogen in the liver is then converted to glucose and transported out through the hepatic vein.

Level 3

11. **C**
The layer of thick mucus prevents pepsin from digesting the wall of the stomach.

12. **B**
In the mouth, the starch would have been broken down into maltose. In the stomach, the proteins would have been broken down into polypeptides, but the fats are still undigested.

13. **B**
Carbohydrate digestion starts in the mouth. Protein digestion starts in the stomach. Fat digestion starts in the small intestine.

14. **B**
The pancreas releases alkaline pancreatic juice that contains digestive enzymes into the small intestine.

15. **A**
There will be no bile released into the small intestine, so the fats will not be emulsified into smaller fat droplets. Therefore, fat digestion will be much slower and reduced.

16. **B**
Secretion **W** is bile and secretion **Z** contains lipase. Bile emulsifies fats but does not digest them. Lipase digests fats into fatty acids and glycerol. When bile and lipase are mixed, fat digestion is much faster, so there will be large amounts of fatty acids produced.

Chapter 6

Level 1

1. **D**
Deoxygenated blood flows from the right side of the heart to the lungs for gaseous exchange. Oxygenated blood flows from the lungs back to the left side of the heart. Then, it is being distributed to the rest of the body.

2. **D**
White blood cells protect the body against disease-carrying organisms. Calcium ions are required for the conversion of fibrinogen to fibrin threads.

3. **A**
Oxygenated blood from the lungs enters the left atrium **P** of the heart. Then, it flows through the left ventricle **Q** before being pumped out to the rest of the body.

4. **D**
There are two types of white blood cells. The lymphocytes produce antibodies that bind to pathogens. The phagocytes ingest pathogens.

5. **D**
X has the thickest muscular wall, so it is an artery. **Y** has a thinner muscular wall than **X** and a large lumen. So, it is a vein. **Z** has a one-cell thick wall, so it is a capillary.

6. **A**
A is a red blood cell that contains haemoglobin, which binds to oxygen.

Level 2

7. **B**
Hepatic portal vein transports blood from the small intestine to the liver. The blood vessel that transports blood from the liver towards the heart is the hepatic vein.

8. **C**
X is an artery, while **Y** is a vein. The blood pressure in the veins is low, so they have valves to prevent the backflow of blood. The blood pressure in arteries is higher and they do not have valves.

9. **B**
The closing of the atrio-ventricular valves and semi-lunar valves produce the sounds of the heart.

10. **C**
The blood vessel is a vein. It carries blood that is at low pressure. So, it has valves to prevent blood from flowing backwards.

11. **B**
Oxygen binds to haemoglobin in the red blood cells. It is not found in the blood plasma.

Level 3

12. **A**
Coronary arteries receive oxygenated blood from the aorta and bring it to the heart muscles. They do not carry deoxygenated blood away from the heart.

13. **D**
A diet rich in cholesterol can result in fats being deposited in the coronary arteries. Over time, the fat deposits can cause blockages in the arteries.

14. **C**
The components of blood separate according to their densities when blood is spun at high speed. Plasma has the lowest density, so it will be found in the top layer. Red blood cells have the highest density and will be found in the bottom layer.

15. **C**
Individual **M** has a low white blood cell count. White blood cells are responsible for fighting infections.

16. **B**
Aorta is the blood vessel with the highest blood pressure. Next are the arteries which branch into arterioles and then capillaries. Capillaries then join to form veins to transport blood back to the heart.

17. **B**
The blood sample from **R** contained more carbon dioxide than oxygen. So, **R** is the pulmonary artery because it brings deoxygenated blood to the lungs. The blood sample from **S** contained more oxygen than carbon dioxide. **S** is the hepatic artery, which carries oxygenated blood to the liver.

Chapter 7

Level 1

1. **C**
The alveolus is more convoluted. The blood capillary wraps closely around the one-cell thick wall of the alveolus.

2. **A**
During anaerobic respiration, no oxygen is present, and only lactic acid and energy are released.

3. **C**
Inhaled air enters the trachea and then the bronchi. It then enters the bronchioles and lastly the alveoli.

4. **A**
X is a gland cell which secretes mucus.
5. **D**
Aerobic respiration still occurs even when the body uses anaerobic respiration to release more energy.

Level 2

6. **B**
Tar and irritant particles paralyse the cilia lining the trachea. So, dust particles trapped in the trachea cannot be removed and this causes coughing. Violent and persistent coughing can lead to the partition walls in the alveoli breaking down.
7. **B**
Cilia and gland cells are present only in the trachea.
8. **A**
The control should not contain any yeast. It is because it should show that the gases produced are from the yeast.
9. **D**
The concentration of carbon dioxide is the highest in the blood before it reaches the alveolus. When the blood flows by the alveolus, the carbon dioxide diffuses from the blood into the alveolus. So, there is much less carbon dioxide in the blood after it flows pass the alveolus.
10. **A**
Anaerobic respiration occurs when there is insufficient oxygen in the muscles. When muscles start respiring anaerobically, an oxygen debt is incurred.

Level 3

11. **A**
Exhaled air has more carbon dioxide and less oxygen than atmospheric air. Hence, the candle will extinguish faster as oxygen is required for the candle to burn.
12. **B**
The yeast in **X** respire aerobically in the presence of oxygen to produce carbon dioxide. The yeast in **Z** respire anaerobically in the absence of oxygen to produce carbon dioxide and ethanol. The yeast in **Y** have been boiled, so they are denatured and do not respire.
13. **D**
At point **X**, the lactic acid concentration rises, indicating that anaerobic respiration occurred to release energy.
14. **A**
Z exhaled the smallest volume of air, so he has emphysema. Having emphysema leads to smaller amounts of gases being exchanged compared to a healthy individual. **X** exhaled a greater volume of air in a shorter time than **Y**. This indicates that **X** has the healthiest lungs.
15. **C**
The stimulus to inhale air is the high concentration of carbon dioxide in the blood. Carbon dioxide exists as hydrogen carbonate ions in the blood plasma, which increases the acidity.
16. **D**
The cilia in the trachea of a heavy smoker would have been paralysed by the chemicals in the tobacco smoke. This causes mucus to accumulate in the airway. The coughing is to get rid of the accumulated mucus.
17. **B**
Since potassium hydroxide solution absorbs carbon dioxide, there is no carbon dioxide entering test tube **X**. So, the limewater in test tube **X** remains clear. The animals respire aerobically using the oxygen in the air. They produce carbon dioxide, which enters test tube **Y**. So, the limewater in test tube **Y** turns cloudy.

Chapter 8

Level 1

1. **B**
Coronary heart disease is non-infectious. It may be caused by an unhealthy diet rich in cholesterol and trans fats.
2. **D**
Disease-causing organisms are also known as pathogens. Pathogens include bacteria, viruses and other microorganisms.
3. **D**
Respiratory droplets may contain bacteria or viruses causing infectious diseases.
4. **B**
Food and water can be contaminated with pathogens when not properly stored or handled.
5. **B**
Influenza causes body aches, chills, fever, headache, cough and sore throat.
6. **D**
HIV can be transmitted through sexual intercourse. Hepatitis B and syphilis can be transmitted through breastfeeding.

Level 2

7. **D**
Face masks should be worn whenever in public and hands washed as frequently as possible to protect both oneself and others.
8. **D**
Cotton masks and surgical masks do provide some protection against infectious viral droplets. The masks restrict their spread during talking, sneezing or coughing.
9. **A**
Houseflies may spread bacteria that cause cholera which contaminate food and water.
10. **D**
An asymptomatic person may not be aware that he/she is infected. Wearing a mask even when not ill reduces others' exposure to the pathogen.
11. **C**
The symptoms of pneumococcal disease do not include a low heart rate.
12. **A**
Antibiotics are effective against only bacteria and not viruses.

Level 3

13. **D**
The influenza virus can be transmitted when a person touches a contaminated surface. The virus enters the body when he/she touches his/her own mouth, nose or eyes.

14. **D**
Meningitis refers to an inflammation of the spinal cord membrane or brain membrane caused by *Streptococcus pneumoniae*.

15. **A**
"Memory cells" in the body may decrease and cease to exist over time. Thus, a booster shot is needed to stimulate the immune response anew to produce new "memory cells".

16. **A**
The bacteria continue to grow around the antibiotic without being killed or affected.

17. **D**
The number of people potentially infected may be determined through proximity to an infected person. The infected person can also be quarantined as soon as possible.

18. **D**
The viral genes mutate over time. So, the surface antigens change and our white blood cells cannot recognise them.

19. **B**
The antibody must be complementary in shape to the surface antigen of the pathogen.

20. **C**
Vaccinated children do not harbour the pathogen. Thus, the number of possible instances where a cluster may develop from an infected child is reduced.

Revision Paper 2

1. **C**
The food sample tested positive for proteins and fats. Egg white has protein, while the yolk has fats.

2. **D**
Starch is digested in the mouth and slightly digested when it enters the oesophagus. It is completely digested in the small intestine.

3. **A**
The stomach produces enzymes that digest proteins. The layer of thick mucus in the stomach protects the stomach. It prevents the stomach from being digested by the enzymes.

4. **D**
The churning of the stomach is part of physical digestion. Pepsin in the stomach will digest proteins into polypeptides. The stomach has hydrochloric acid that kills ingested bacteria.

5. **D**
Q stores bile. **P** has an alkaline environment. **O** and **Q** are organs that aid digestion but are not parts of the alimentary canal. Structure **O** secretes insulin and glucagon which control the blood glucose concentration.

6. **B**
The glucose concentration in the blood rises. So, insulin is secreted and the cells increase their glucose uptake.

7. **B**
Emulsification of fats is carried out by bile, which is not an enzyme.

8. **B**
The large intestine absorbs water and mineral salts from the undigested food before egestion.

9. **C**
Absorption of amino acids occurs in the small intestine.

10. **D**
Amylase works best at body temperature. So, it breaks down the most amount of starch at about 37 °C.

11. **A**
The liver deaminates excess amino acids into urea. Urea leaves through the hepatic vein to be excreted.

12. **A**
Nicotine that is inhaled into the lungs is transported along the pulmonary vein. It enters the left atrium of the heart.

13. **D**
D is a phagocyte. It fights against a bacterium by engulfing and digesting it. **B** is a lymphocyte, which produces antibodies against bacteria.

14. **B**
Platelets help prevent excessive blood loss by promoting blood clotting. This prevents pathogens from entering the body through the wound and causing an infection.

15. **D**
M is a lymphocyte that produces antibodies. **O** is a phagocyte that ingests foreign particles.

16. **D**
The coronary arteries transport oxygenated blood to the heart muscles. **A** is the superior vena cava. **B** is the pulmonary artery. **C** is the aortic arch.

17. **C**
Oxygen is carried in the red blood cells. Large molecules like glycogen are not carried in the blood plasma.

18. **A**
Coronary heart disease can run in families, indicating that it can be inherited. Some causes of coronary heart disease are high stress, smoking and a high fat diet.

19. **C**
Some of the glucose is used by the lungs and heart tissues for respiration. So, there is less glucose at **Y** than at **X**.

20. **C**
Exhaled air has a high concentration of carbon dioxide. It will enter the limewater in **Y** and cause it to turn cloudy.

21. **D**
Blood that flows from the pulmonary artery has the most amount of carbon dioxide. The concentration gradient at region **D** is the steepest. So, the rate of diffusion of carbon dioxide is the highest there.

22. **A**
Irritant particles in tobacco smoke paralyse the cilia in the trachea.

23. **B**
Lactic acid produced during anaerobic respiration builds up in the muscles and causes fatigue.

24. **A**
Lactic acid is produced during anaerobic respiration. Lactic acid production started at 10 minutes.

25. **A**
Sodium hydroxide absorbs carbon dioxide. So, the movement of the indicator fluid depends on the amount of oxygen present. The germinating seeds will respire and take in oxygen. So, the indicator fluid will move to the left.

26. **D**
Cholera is a bacterial disease that is spread through contaminated water.

27. **B**
Antibiotics can be used to kill only bacteria.

28. **B**
Antibiotics should be used as prescribed by the doctor. This is to prevent bacteria from developing resistance to antibiotics.

29. **D**
Antibiotics like streptomycin kill bacteria. However, now there are many strains of the tuberculosis bacteria that are drug resistant.

30. **B**
Antibodies do not trigger the immune system to produce an allergic reaction.

Chapter 9

Level 1

1. **B**
Epidermal cells do not contain chloroplasts.

2. **B**
Water is absorbed into a root hair cell via osmosis.

3. **D**
The waxy cuticle is waterproof. It prevents excessive water loss through evaporation from the leaves.

4. **A**
Bubbles of oxygen are observed when the plant is photosynthesising. The highest rate of photosynthesis will occur when there is a high concentration of carbon dioxide in the water, high light intensity and the temperature is 35 °C.

5. **B**
Plants do not contain glycogen. Glycogen is found in animals.

Level 2

6. **D**
Evaporation rate is high when humidity is low with very little water vapour in the air. High light intensity causes the stomata to open and lose more water. High temperature causes water around the stomata to evaporate faster.

7. **D**
Translocation of sucrose occurs in the phloem of the vascular bundle.

8. **B**
Oxygen is produced by mesophyll cells during photosynthesis. The oxygen dissolves in the film of moisture on the cells. Then it enters the intercellular air space and leaves through the stomatal pore.

9. **B**
Potassium hydroxide solution absorbs the carbon dioxide in the air. Carbon dioxide is required for photosynthesis. So, the plant in set-up **X** could not photosynthesise. Hence, no starch was present in its leaves.

10. **B**
When the lamp is placed further away, the light intensity is lower. So, the rate of photosynthesis is lower. Ice lowers the temperature, so the rate of photosynthesis is lower.

Level 3

11. **C**
When the ring of bark was removed, the phloem was also removed. Removing the phloem prevents sugar from reaching the part of the tree below the ring. So, the sugar will accumulate in the fruits above the ring. It will also cause the swelling of the bark above the ring.

12. **C**
Both chlorophyll and light are required for photosynthesis. So, only the parts that had chlorophyll and received light tested positive for starch.

13. **D**
The plant starts to wilt when the transpiration rate is higher than the water absorption rate.

14. **B**
The plant used the radioactive carbon dioxide to make sugar. The sugar was then transported in the phloem.

15. **B**
Carbon dioxide is given out during respiration. When the rate of photosynthesis is higher than the rate of respiration, carbon dioxide is taken into the leaves. So, the amount of carbon dioxide leaving through the stomata should be the least at around noon.

Chapter 10

Level 1

1. **C**
A population consists of organisms of the same species living in a particular habitat. It includes the young and old.

2. **C**
The caterpillar is a primary consumer. The sparrow is a secondary consumer. The owl is a tertiary consumer.

3. **C**
Photosynthesis is not a mode of energy loss from an ecosystem.

4. **C**
Primary consumers feed on producers, which are green plants.

Level 2

5. **C**
Parasites generally outnumber organisms they are parasitic upon.

6. **A**
Being at the top of the food chain, the amount of energy available to an owl is the least. So, the owl population is the smallest. Biomass is the dry mass of all the owls at any one time. So, the biomass for the owl is the smallest among the organisms in the ecosystem.

7. **B**
Diseases cause the carnivores to become sickly and weak, and eventually die. A decrease in the biomass of producers means less food for the herbivores. So, the herbivore population will decrease, and this means less food for the carnivores.

8. **B**
During respiration, both plants and animals give out carbon dioxide into the atmosphere.

Level 3

9. **B**
To sustain this food chain, the biomass of the lower trophic level is larger than that of the next trophic level.

10. **A**
Krill feeds on both producers and other consumers, so it is an omnivore. Zooplankton is not an omnivore. There are two types of zooplankton — herbivorous and carnivorous.

11. **C**
The pyramid of numbers has a narrow base. So, it depicts a food chain present on a single tree.

12. **D**
If the flowers are not pollinated, fruits, which are the main source of food for the monkeys will not develop. There are six food chains present as the producer is the mango tree.

13. **D**
The ocean, vegetation, fossil fuels and sedimentary rocks all store carbon for an indefinite period.

14. **A**
$(33\,000 \times 100) \div 1\,050\,000 = 3\,\%$

Revision Paper 3

1. **D**
The spongy mesophyll cells contain fewer chloroplasts than the palisade mesophyll cells.

2. **D**
At 12 00, the aquatic plants are photosynthesising. So, they absorb the dissolved carbon dioxide present in the water. This causes the water to become less acidic and the pH increases.

3. **D**
The rate of photosynthesis will be the lowest among the three.

4. **A**
Lowering the temperature decreases the rate of photosynthesis.

5. **D**
Amylose is unbranched. So, starch synthesis in Sweet Grain would involve the debranching of amylopectin for a high concentration of amylose to be present.

6. **B**
Starch is insoluble in water. So, the shrinking of the Sweet Grain seeds after drying indicates that less starch and more water were present originally. This allows the seeds to look similar to those of wild rice.

7. **C**
Cuticle is found on the outside of the upper epidermis and lower epidermis.

8. **D**
The floating leaves of a water plant would have stomata on the upper surface instead.

9. **B**
The pores in the sieve plates allow sucrose to flow through rapidly.

10. **C**
The water molecules interact with the inner surface of the narrow xylem vessel. This interaction is known as capillary action. It helps the water to move up the xylem vessel.

11. **B**
Transpiration rate is inversely proportional to relative air humidity.

12. **C**
The hollow lumen allows substances to flow through the structure.

13. **D**
The petroleum jelly blocked the stomata and hence minimised transpiration. This resulted in the least volume of water absorbed.

14. **D**
Low temperature and high relative humidity decrease the rate of transpiration. This, in turn, slows down the movement of water up the stem of a plant.

15. **C**
The water molecule enters the vacuole of a root hair cell. Then it moves up the lumen of a xylem vessel. Next, it passes through the spongy mesophyll tissue of a leaf. Lastly, it passes out through the stoma in-between the guard cells. It does not pass through the guard cells.

16. **C**
The movement of water up through the xylem vessel requires transpiration pull.

17. **B**
There is no partially permeable membrane present, so osmosis cannot occur. Water diffuses out of a stoma as water vapour. Transpiration is the loss of water vapour from a plant. Translocation is the transport of food substances.

18. **A**
The plant will take in the carbon dioxide containing the radioactive carbon ^{14}C when it is photosynthesising. So, the radioactive carbon will be built into the glucose. The glucose will later be transported as sucrose in the phloem. Thus, the x-ray film will darken at where the phloem is.

19. **A**
The rat feeds on the grasshopper, which is the primary consumer.

20. **D**
Photosynthesis converts inorganic carbon (carbon dioxide) into organic carbon (glucose).

21. **B**
A pyramid of biomass is usually broadest at its base. However, phytoplankton can reproduce quickly enough to replace those that are consumed by the zooplankton.

22. **A**
Feeding and decomposition transfer carbon from one organism to another. Photosynthesis removes carbon in the form of carbon dioxide from the atmosphere. Respiration releases carbon in the form of carbon dioxide into the atmosphere.

23. **B**
(7700 ÷ 77 000) × 100 = 10 %

24. **A**
The finch is a prey of the eagle, and a predator of the caterpillar and snail.

25. **C**
The least energy is transferred from the primary consumers to the secondary consumers. The most energy is lost when the producers respire or die.

26. **D**
Decomposers break down dead organic matter, such as plants and animals, into simpler nutrients.

27. **A**
Plants are producers. When herbivores feed on plants and digest plant material, carbon compounds are transferred to them.

28. **B**
The producer converts carbon from an inorganic form to an organic form. The carbon compounds are then transferred from one trophic level to another. They are also released into the atmosphere as carbon dioxide.

29. **A**
Producers are at the bottom of every food chain. They are the organisms that can convert carbon from an inorganic form to an organic form.

30. **B**
Algal bloom results from water pollution by fertilisers, which speed up plant growth.

Chapter 11

Level 1

1. **A**
The basic unit of DNA is the nucleotide. It consists of a deoxyribose sugar, a phosphate group and a nitrogenous base.

2. **A**
RNA contains uracil instead of thymine.

3. **C**
Translation, or decoding and synthesis, occurs in the cytoplasm.

4. **C**
There are two polynucleotide chains. They form a double helix, not an alpha helix, which is a spiral.

5. **B**
Adenine pairs with thymine or uracil. Guanine pairs with cytosine.

6. **B**
Each set of three bases forms a codon, which codes for one amino acid.

7. **D**
A gene is a small segment of DNA. It stores information used to make a single polypeptide.

Level 2

8. **C**
Process **X** is the transcription of DNA into mRNA and it occurs in the nucleus. Process **Y** is the translation of mRNA into amino acids and it occurs in the cytoplasm.

9. **B**
The synthesis of polypeptides is translation and it occurs in the cytoplasm.

10. **D**
The sequence of the mRNA is complementary to the DNA template strand. However, in mRNA, thymine is substituted by uracil.

11. **D**
DNA will still be transcribed into mRNA but the mRNA sequence will be altered. As a result, the polypeptide produced may be different.

12. **C**
The basic unit of DNA is the nucleotide. It consists of a five-sided deoxyribose sugar, a phosphate group and a nitrogenous base.

Level 3

13. **D**
Each amino acid is coded for by a codon consisting of three nitrogenous bases.

14. **C**
CCU codes for proline, followed by ACU for threonine, and GAG for glutamate.

15. **D**
The sequence for arginine can be inferred based on TCT being repeated four times in the base sequence. GGT appears twice, so it can be inferred that GGT codes for proline. CAA appears only once, so it can be inferred that CAA codes for valine. Thus, the correct sequence is Val Arg Arg Arg Pro Arg Pro.

16. **C**
The percentages of thymine, cytosine, and guanine in DNA strand 2 are the same as the percentages of adenine, guanine and cytosine respectively in the mRNA. This shows that DNA strand 2 is the template.

17. **A**
A gene occupies a segment of a double-stranded DNA. Since the gene has 900 nitrogenous bases altogether, there are 450 nitrogenous bases on each DNA strand of the gene. 450 nitrogenous bases code for 150 amino acids.

Chapter 12

Level 1

1. **D**
A zygote is formed during fertilisation. Fertilisation takes place in the oviduct.

2. **D**
A sperm cell is smaller than an ovum. A testis produces millions of sperm cells each time.

3. **B**
A gamete has 23 chromosomes. A cell in the uterus is not a gamete, so it has 46 chromosomes. When a sperm fertilises an ovum, the zygote formed has 23 + 23 = 46 chromosomes.

4. **C**
Implantation of an embryo occurs in the uterus.

Level 2

5. **D**
   Part **X** is the prostate gland. It secretes fluid containing nutrients for the sperms.
6. **B**
   HIV can be transmitted through blood transfusion, sharing of needles and sexual intercourse.
7. **A**
   Progesterone is needed to thicken the uterine lining. This is in preparation for the implantation of an embryo if there is one.
8. **C**
   A testis produces sperms. The scrotum is outside the main body cavity. So, the lower temperature allows sperms to develop properly. The prostate gland provides sperms with nutrients for survival.
9. **D**
   Part 3 is the uterine lining, and part 4 is the vagina. During sexual intercourse, sperms are released in the vagina. They swim to the oviduct and fertilise the ovum there, forming a zygote. The zygote develops into an embryo, which implants itself in the uterine lining.
10. **A**
    The testes would still produce sperms. However, the sperms would not be able to leave the body after the surgery.
11. **B**
    Fertilisation can occur only after an egg is released during ovulation. If fertilisation occurs, there will not be menstruation.

Level 3

12. **B**
    In a 28-day menstrual cycle, ovulation happens on the 14th day, which is 10 March.
13. **B**
    The left ovary is still functioning and will release a mature egg during ovulation. Menstruation will occur when the egg is not fertilised.
14. **A**
    The uterine lining starts to thicken before ovulation occurs. The woman is most fertile a few days before and after ovulation. After ovulation, the uterine lining continues to thicken and remains thick, which is **B**. **C** indicates menstruation. **D** indicates the repair of the uterine lining.
15. **C**
    Use condoms that have not expired for protection. Keep to only one sexual partner, not a few.
16. **A**
    Sperms can survive for five days and an ovum can survive for one day. So, the longest possible fertile period is six days.
17. **A**
    An ovum is released during ovulation. Fertilisation occurs in an oviduct, where a zygote is formed. The zygote then develops into an embryo.

Chapter 13

Level 1

1. **A**
   The two alleles in each chromosomal pair segregate during gamete formation. Each allele enters a different gamete.
2. **C**
   The effect of a dominant allele can be seen when an organism is homozygous dominant or heterozygous.
3. **A**
   The organism is heterozygous if half the offspring shows the dominant trait and half shows the recessive trait.
4. **C**
   Somatic cells are cells in the body that are not gametes.
5. **A**
   In humans, the cells contain 22 pairs of autosomes and one pair of sex chromosomes.

Level 2

6. **C**
   X is formed from the fusion of two gametes, each bearing the t allele. Since it is homozygous recessive, **X** is dwarf.
7. **A**
   Since the allele for red flower is dominant, **X** is red.
8. **B**
   Two out of four possible combinations are "XY". So, there is a 50 % chance of having a male offspring.
9. **B**
   The parents are heterozygous given the 3:1 genotypic ratio of the offspring.
10. **B**
    A gene mutation occurs within a gene. A chromosomal mutation occurs within a chromosome.

Level 3

11. **D**
    P has no cleft chin, so she must be homozygous recessive. **Q** has a cleft chin. However, her father has no cleft chin and is homozygous recessive. So, she must be heterozygous.
12. **A**
    Since the allele for white flower is recessive, the two parent plants are homozygous recessive. Hence, all the offspring will be homozygous recessive and white.
13. **D**
    Discontinuous variation is controlled by one or a few genes with distinct expression and no additive effect.
14. **D**
    Individuals with the genotypic ratio 1 TT : 2 Tt : 1 tt will be produced. This results in a 3:1 ratio of tall to dwarf individuals.
15. **D**
    Red eyes mask the effect of having one allele for orange eyes. So, orange eyes must be a recessive trait. Thus, fruit flies with red eyes can have offspring with either red (homozygous or heterozygous for the red eye allele) or orange eyes.

16. **C**
Graph **X** shows continuous variation which applies to height. Graph **Y** shows discontinuous variation which applies to eye colour.

17. **A**
S and his spouse must be heterozygous since their offspring has sickle cell anaemia. Thus, the probability of **S** having offspring who are homozygous recessive is one out of four.

18. **B**
A chromosome from the female failed to separate during cell division. As a result, there is an extra chromosome in the zygote.

Revision Paper 4

1. **A**
Transcription uses one DNA strand as the template to make the mRNA. mRNA contains uracil instead of thymine.

2. **D**
DNA is made up of a sequence of nucleotides.

3. **D**
A sequence of nucleotides forms a gene. There are many genes in a chromosome, which is found in a nucleus.

4. **C**
Since adenine and thymine are complementary bases, their percentages are the same in a DNA molecule.

5. **A**
A nucleotide has a phosphate group, a deoxyribose sugar and a nitrogen base.

6. **C**
Glycine, alanine and glutamine are all amino acids.

7. **B**
A gamete has half the number of chromosomes present in a non-reproductive cell.

8. **C**
Ovulation occurs on day 14. By then, the uterine lining has thickened in preparation for embryo implantation.

9. **C**
Mitochondria carry out respiration and release energy for the sperm to swim towards the egg.

10. **C**
A sperm can survive up to five days in a female reproductive system. So, if a woman has sexual intercourse five days before ovulation, the egg can still get fertilised.

11. **D**
Sperms are produced in the testes. During sexual intercourse, a sperm travels through the sperm duct and out through the urethra into the vagina. It swims through the cervix and uterus, up into an oviduct.

12. **A**
Ovulation occurs on day 14. A menstrual cycle usually lasts 28 days.

13. **D**
Progesterone concentration starts to increase just after ovulation. If no fertilisation occurs, the progesterone concentration will decrease and menstruation will start again.

14. **D**
The prostate gland secretes a fluid which contains nutrients and enzymes. The fluid nourishes the sperms and stimulates them to swim actively.

15. **B**
A gamete has 23 chromosomes. When two gametes fuse, there are 46 chromosomes in the zygote.

16. **C**
Progesterone is produced to maintain the thickness of the uterine wall after ovulation to prepare for pregnancy.

17. **D**
Eggs are found in the ovaries. A zygote is formed after fertilisation takes place in the oviduct.

18. **B**
The sperm ducts are cut to prevent the release of sperms into the urethra.

19. **C**
Urine and sperms pass through the urethra.

20. **C**
There are many intermediate masses. So, the masses of the tomatoes show continuous variation.

21. **C**
Down's syndrome is caused by the presence of an extra chromosome 21 in a person.

22. **A**
Alleles are different forms of the same gene. A gene may have different alleles on their homologous chromosomes.

23. **D**
Hybrid plants are heterozygous plants. When heterozygous plants are crossed, the ratio of black beans to brown beans offspring will be 3:1.

24. **D**
Traits that show discontinuous variation have clear cut phenotypes.

25. **B**
A snail with a thin shell is heterozygous. When two heterozygous snails mate, the probability of the offspring having the genotype S^tS^t is 0.25.

26. **C**
When two heterozygous plants cross, a 3:1 ratio of the phenotypes is observed among the offspring.

27. **B**
The likelihood of having a girl is 50 % for each pregnancy.

28. **A**
Sexual reproduction produces offspring that inherits the genes from both parents.

29. **A**
A mutation in a gamete can be passed down to the offspring.

30. **C**
Homologous chromosomes have the same genes on their chromosomes.

Trial Examination 1

1. **D**
Almost all the epidermal cells were plasmolysed when they were immersed in the 0.3 mol/dm^3 sucrose solution. So, the water potential of the cell sap was higher than that of the 0.3 mol/dm^3 sucrose solution.

2. **D**
Antibodies are made up of proteins and do not contain fats.

3. **C**
Many substances can dissolve in water and so be transported by blood. Water is also a solvent for various metabolic reactions. When the water in sweat evaporates, the skin is cooled down.

4. **B**
Since the concentration of **X** remains unchanged, it is an enzyme. Enzymes remain chemically unchanged at the end of a reaction.

5. **B**
Proteins are digested in the stomach and small intestine. The oesophagus does not secrete any enzymes. However, salivary amylase may continue to digest the food as it passes through the oesophagus. The large intestine absorbs water from undigested food. The small intestine and pancreas release digestive juices that are alkaline in nature.

6. **B**
The liquid extracted from part **P** contains protease. It breaks down the protein in the cooked egg white. So, it causes the mixture to turn from cloudy white to clear.

7. **D**
It takes at least 30 minutes to digest carbohydrates. So, after 30 minutes, the small intestine will start to absorb glucose. The glucose is transported to the liver by the hepatic portal vein. The sudden rise in the blood glucose concentration causes the liver to convert glucose into glycogen. Thus, the blood sugar concentration in the hepatic vein decreases.

8. **A**
The presence of a nucleus and genetic material allows the cell to synthesise proteins such as enzymes and antibodies. No other properties of the cell can be deduced from the diagram.

9. **B**
The superior vena cava and inferior vena cava transport deoxygenated blood to the right atrium of the heart.

10. **A**
The bicuspid valve is found between the left atrium and left ventricle. When the left ventricle contracts, the bicuspid valve closes to prevent the backflow of blood into the atrium. The semi-lunar valves open to allow blood to flow into the aorta.

11. **B**
A vaccine may result in the development of certain signs and symptoms of the disease. For example, the vaccine for COVID-19 may cause fatigue and/or a fever.

12. **C**
The greatest number of bubbles is produced when red light is used. So, chlorophyll absorbs more red light than green light for photosynthesis.

13. **A**
Only part **Y**, which contains the phloem, contains cells that are involved in translocation.

14. **B**
Transpiration pull is the suction force that pulls water up a xylem vessel.

15. **D**
A food web shows the feeding relationships between organisms of different species within an ecosystem.

16. **A**
Cytosine and guanine are complementary bases. So, they are always present in a 1:1 ratio in a DNA.

17. **D**
Phosphorus is a key building unit of the phosphate backbone in the DNA.

18. **C**
The quadruplet codon system can code for ($4^4 - 4^3$ = 256 – 64 = 192) more types of amino acids. With more types of amino acids, it can possibly synthesise protein molecules that are more complex.

19. **B**
The female has three copies of chromosome 21, an autosome, instead of two.

20. **D**
To display the recessive phenotype, an individual must be homozygous recessive.

Trial Examination 2

1. **B**
A root hair cell is a plant cell and has a large central vacuole. A xylem vessel is hollow with no cross wall.

2. **B**
The potato strip in solution **X** increased in mass. So, the water potential of solution **X** was higher than that of the potato strip. The potato strip in solution **Y** did not increase in mass. This indicates that solution **X** had a higher water potential than solution **Y**.

3. **C**
Iodine molecules are small enough to pass through the partially permeable membrane of the Visking tubing. The iodine then reacts with starch to give a blue-black colour.

4. **C**
Carbohydrates include starch and reducing sugars. The iodine test is used to detect starch. The Benedict's test is used to detect reducing sugars.

5. **D**
Pepsin is an enzyme that works well at low pH levels like in hydrochloric acid. Hence, pepsin in hydrochloric acid will digest the egg white in the agar jelly the fastest.

6. **A**
Bile emulsifies fats, and this helps increase the rate of digestion of fats. When the bile duct is blocked, there is no bile to emulsify fats.

7. **B**
Platelets are involved in blood clotting, which helps prevent excessive bleeding when there is an open wound.

8. **C**
The pulmonary vein transports blood from the lungs to the heart. The hepatic artery transports blood from the heart to the liver. The hepatic portal vein transports blood from the small intestine to the liver.

9. **D**
Carbon monoxide is a poisonous gas that binds to haemoglobin in red blood cells. Thus, it prevents the transport of oxygen.

10. **D**
Air enters the trachea, then the bronchus, and lastly into the bronchiole.

11. **C**
HIV can be transmitted through blood and sexual intercourse.

12. **B**
During photosynthesis, only glucose and oxygen are produced. **B** is the part where only oxygen and glucose overlap each other.

13. **C**
Stomata are found at the bottom of the leaves. When the stomata are blocked by the petroleum jelly, less water is lost. So, after three hours, there will be more water in plant **N** than in plant **M**. Therefore, plant **N** will be heavier.

14. **D**
Translocation is the transport of manufactured food substances in plants. It occurs in the phloem of a leaf and stem.

15. **A**
There is one tree, many caterpillars and a few swallows.

16. **D**
When petrol is burnt, it produces carbon dioxide, which is a greenhouse gas. So, it contributes to global warming.

17. **D**
The sugar-phosphate backbone is made up of the deoxyribose sugar and the phosphate group.

18. **C**
The mRNA has a base sequence complementary to that of the DNA template. The DNA template contains thymine instead of uracil.

19. **A**
Ovulation occurs after the uterine lining is repaired after menstruation.

20. **B**
Individuals **6** and **7** are heterozygous since they have offspring that are affected and are homozygous recessive.

Trial Examination 3

1. **B**
Chloroplasts are not found in an animal cell.

2. **C**
A villus is specialised to absorb nutrients in the small intestine. So, its epithelial cells have finger like structures to increase the surface area for absorption. An epithelial cell is an animal cell. So, its vacuoles are small, not large. It has a nucleus.

3. **D**
The skin of the potato acts as a water barrier. So, no water can enter the potato through its skin. The centre of the potato has no skin, so there is osmosis of water into the potato.

4. **B**
A teenage athlete is active and is still developing physically. So, the diet should comprise mostly carbohydrates for energy, proteins for growth, and a little fats.

5. **B**
Ethanol is used to test for fats. Iodine solution is used to test for starch. Benedict's solution is used to test for reducing sugars. Starch and reducing sugars are carbohydrates.

6. **B**
The "lock" represents the enzyme, and the "key" represents the substrate.

7. **C**
The enzyme is totally denatured at **X**. The shape of its active site is irreversibly changed and the substrate can no longer bind to it.

8. **B**
Proteins are digested in the stomach and small intestine. The oesophagus does not secrete any enzymes. However, salivary amylase may continue to digest the food as it passes through the oesophagus. The large intestine absorbs water from undigested food. The small intestine and pancreas release digestive juices that are alkaline in nature.

9. **D**
The rate of lipid digestion can be increased by adding intestinal enzymes. Intestinal enzymes include intestinal lipase.

10. **B**
The liquid extracted from part **P** contains protease. It breaks down the protein in the cooked egg white. So, it causes the mixture to turn from cloudy white to clear.

11. **C**
The stomach produces dilute hydrochloric acid, which kills harmful microorganisms such as bacteria.

12. **A**
The blood pressure in **Q** is moderate, so it is likely to be a capillary. A capillary has a wall that is one cell thick.

13. **D**
The aorta can withstand the most stress. This is because the blood pressure in the aorta is the highest. The vena cava can withstand the least stress. This is because the blood pressure in the vena cava is the lowest.

14. **B**
During vigorous exercise, the muscles do not receive enough oxygen and they incur an oxygen debt. After the exercise, this oxygen debt must be repaid. Oxygen must be quickly supplied to the muscles. So, a person cannot hold his/her breath for long after vigorous exercise.

15. **A**
The oxygen concentration in the alveolus is high. The concentration of oxygen is the lowest in the blood before it reaches the alveolus. So, the concentration gradient at region **A** is the steepest. Thus, the rate of diffusion of oxygen at region **A** is the highest.

16. **D**
P. falciparum is the only species endemic to Japan.

17. **C**
Light intensity is highest at noon. So, the rate of photosynthesis is highest when there is much water at noon.

18. **A**
Glucose is a product of photosynthesis. The highest concentration of glucose can be found in the palisade mesophyll. This is because the cells in the palisade mesophyll contain the greatest number of chloroplasts.

19. **A**
The phloem is involved in translocation. Only part **Y** contains the phloem.

20. **B**
Transpiration pull is the suction force that pulls water up a xylem vessel.

Trial Examination 4

1. **B**
   A root hair cell is a plant cell and has a large central vacuole. A xylem vessel is hollow with no cross wall.
2. **B**
   The potato strip in solution **X** increased in mass. So, the water potential of solution **X** was higher than that of the potato strip. The potato strip in solution **Y** did not increase in mass. This indicates that solution **X** had a higher water potential than solution **Y**.
3. **C**
   When the sugar solution and potato strip had the same water potential, there was no net movement of water molecules. So, there was no change in length of the potato strip.
4. **C**
   Iodine molecules are small enough to pass through the partially permeable membrane of the Visking tubing. The iodine then reacts with starch to give a blue-black colour.
5. **C**
   Carbohydrates include starch and reducing sugars. The iodine test is used to detect starch. The Benedict's test is used to detect reducing sugars.
6. **D**
   Intestinal lipase works best at pH 9.
7. **D**
   Pepsin is an enzyme that works well at low pH levels like in hydrochloric acid. Hence, pepsin in hydrochloric acid will digest the egg white in the agar jelly the fastest.
8. **A**
   Bile emulsifies fats, and this helps increase the rate of digestion of fats. When the bile duct is blocked, there is no bile to emulsify fats.
9. **B**
   The left ventricle must pump blood to the rest of the body. So, it pumps blood at the highest pressure.
10. **B**
    Platelets are involved in blood clotting. Blood clotting helps prevent excessive bleeding when there is an open wound.
11. **C**
    The pulmonary vein transports blood from the lungs to the heart. The hepatic artery transports blood from the heart to the liver. The hepatic portal vein transports blood from the small intestine to the liver.
12. **D**
    Carbon monoxide is a poisonous gas that binds to haemoglobin in red blood cells. Thus, it prevents the transport of oxygen.
13. **D**
    The alveoli are damaged, so it is emphysema. In asthma and bronchitis, the air passages are affected. In lung cancer, cells grow uncontrollably to form tumours in the lungs.
14. **D**
    Air enters the trachea, then the bronchus, and lastly into the bronchiole.
15. **C**
    HIV can be transmitted through blood and sexual intercourse.
16. **B**
    During photosynthesis, only glucose and oxygen are produced. **B** is the part where only oxygen and glucose overlap each other.
17. **D**
    Translocation is the transport of manufactured food substances in plants. It occurs in the phloem of a leaf and stem.
18. **C**
    Stomata are found at the bottom of the leaves. When the stomata are blocked by the petroleum jelly, less water is lost. So, after three hours, there will be more water in plant **N** than in plant **M**. Therefore, plant **N** will be heavier.
19. **C**
    Translocation is the transport of sucrose in the phloem of plants.
20. **B**
    The stomata increase in size with increasing light intensity. Sucrose instead of glucose is transported in the phloem. Transpiration pull moves water up the xylem vessels.