FORM 2 BIOLOGY ANSWERS

TRANSPORT IN PLANTS

1. a) To investigate the effect of light on the rate of transpiration.

   b) More water was lost in the light than in the dark. Rate of transpiration was greater in light than in the dark. This is because the stomata are fully open in light but less open or closed in the dark. In light, photosynthesis takes place hence no water used.

2. The leaves exposed a smaller surface area to the sun thus reducing transpiration.

   Excessive water loss.

3.

- Temperature- high temperature increase transportation. Low temperature lower transpiration.
- Light intensity-more light increase transpiration, dim light lower transpiration.
- Wind – strong wind increase transpiration, calm weather lower transpiration.
- Humidity – High humidity lower transpiration, low humidity increase transpiration.
- Atmospheric pressure- High atmospheric pressure increase transpiration.
- Water availability-more water increase transpiration due to opening of stomata while little water lowers transpiration.

4. a) A - Epidermis

   B - Pith

   b) C- Transport manufactured food/translocation

   D - Produce new cells/divide giving new cells

   E - Transport mineral salts and water.

   c) -Xylem in centre/star shaped.

-Phloem in arm of xylem

-No pith in root

-Roots hairs present in root

5 a) K - Root hair

L - Xylem vessel

b) Water moves from the soil into the root hair by osmosis. Because concentration of cell sap is higher than water in the soil; the cell sap of the root hair is diluted thus making it less concentrated than neighbouring cells; therefore water moves into the neighbouring cell. It is then actively secreted into L.

c) Active transport/diffusion.

6.

- Lignified/thickened to prevent collapsing.
- Narrow to facilitate capillarity
- No cross wall for continuous flow of water.
- Side walls pitted to allow lateral movement of water and mineral salts.

7.

- Turgidity
- Presence of xylem vessels
- Presence of collenchyma

8. a) R- sieve pore/plate

S-Cytoplasm strand

T- Companion cell

b) Translocation

c) Thickened, - Lignified

9. a) Lignin,

b) Phloem

10. They are strengthened by lignin hence supporting the stem.

11. - Xylem - Transports water and mineral salts to photosynthesizing cells

- Phloem - Transports manufactured foods from the leaves creating high concentration gradient.

- Veins - Supports the leaf to be upright for maximum absorption of light for photosynthesis.

12. a) Ovule

b) Ovary

13 a) -Xylem vessels

-Sclerenchyma

b) -Turgidity of parenchyma cells

-Presence of collenchyma cells

14.

a) Dicot root

b) i) Presence of root hairs

ii) Phloem between rays of xylem (star shaped xylem).

c) J - Epidermis

K - Phloem

L - Xylem

d) Absorbs water and mineral salts from soil.

15. - Adhesion- force of attraction between unlike molecules

- Due to the force of adhesion water tends to stick to the walls of vessels containing it.

- Cohesion- forces of attraction between like molecules
- Cohesion between water molecules prevents the water column from breaking.
- Root pressure- due to pressure generated by the root's endodermis
- Capillary due to narrowness of xylem.
- Transpiration pull- as water evaporates from the leaf's surface more is absorbed
- After the water reaches the leaves cells, it passes the cells by osmosis from the xylem. Water vapour diffuses out through stomata.

16.
- Absence of cuticle to allow diffusion of water.
- Thin walled to reduce distance of diffusion.
- Elongated to increase surface area for absorption of water and mineral salts.
- Presence of large vacuole to increase concentration gradient between cell sap and soil water.

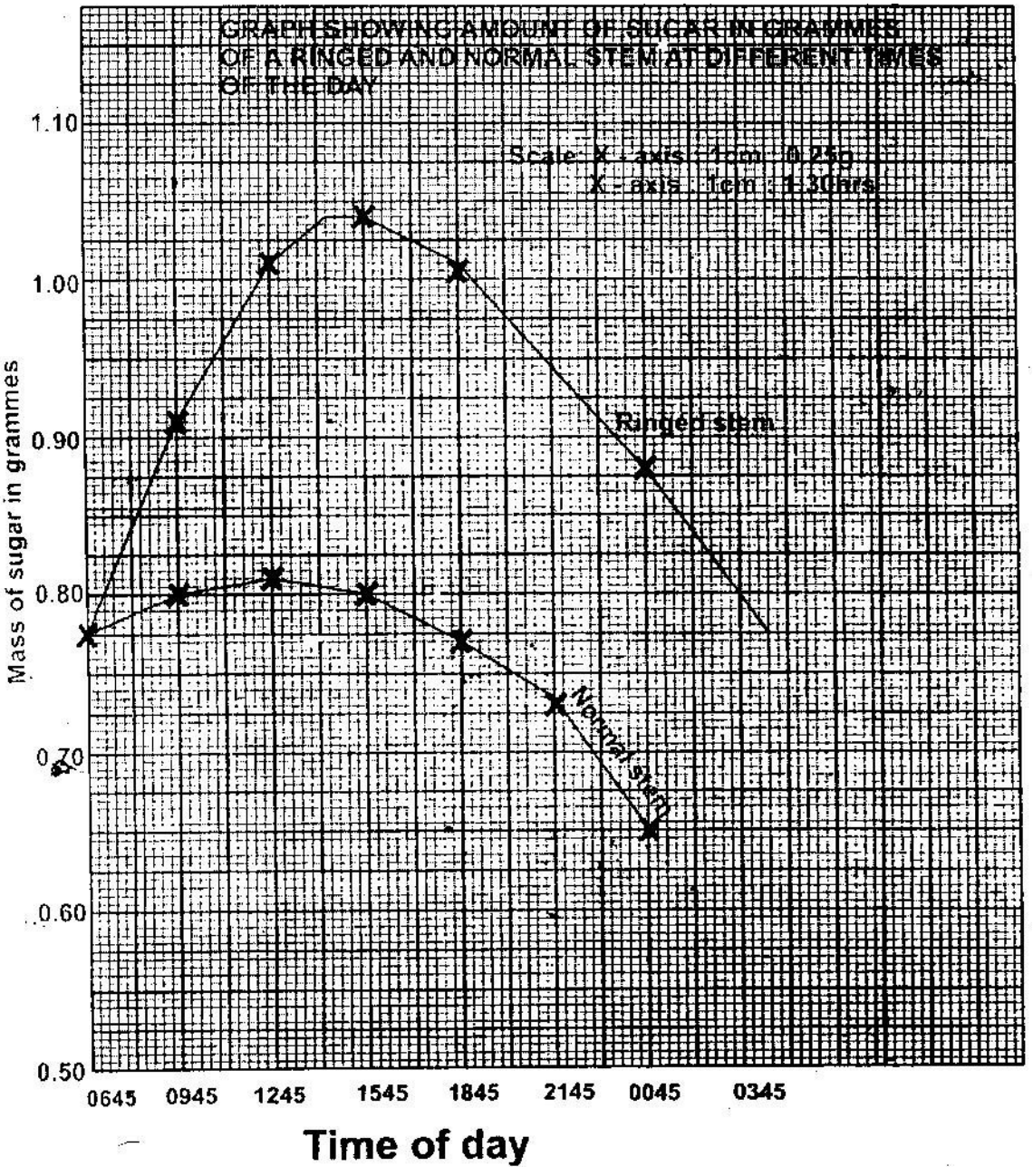
17.

a) Phloem tissues

b) K- Companion cell

c) Supply nutrients and energy to the sieve tubes.

18. a) Graph


GRAPH SHOWING AMOUNT OF SUGAR IN GRAMMES OF A RINGED AND NORMAL STEM AT DIFFERENT TIMES OF THE DAY
Scale: X - axis 1cm : 0.25g
X - axis 1cm : 1:30hrs
Mass of sugar in grammes
1.10
1.00
0.90
0.80
0.70
0.60
0.50
Ringed stem
Normal stem
0645
0945
1245
1545
1845
2145
0045
0345
Time of day

b) i) 15:45

ii) 12:45

c) 0.79 ± 0.02 grammes

d) The food that had been manufactured the previous day had been converted to soluble sugars and was being translocated to other parts of the plant.

e) i) 06 45 hours and 15 45 hours.

- There was low concentration of sugar early in the morning as there was little translocation.
- As day progresses the light intensity increases and more food is manufactured thus more translocation increasing concentration of sugars.

ii) 15 45 and 00 45

- The light intensity is decreasing reducing rate of photosynthesis. Less food is manufactured, hence less is translocated.
- As it turns dark there is no photosynthesis reducing concentration of sugar translocated.

iii) Sieve plates

- Cytoplasmic strands

f) - Amino acids

- Soluble fats/lipids.

19. i) Reduce transpiration

ii) Eliminate excretory wastes on the leaf

20. a) - Maintain transpiration stream

- Cool the plant
- Remove excess water
- Enhance absorption and distribution of water and mineral salts.

b) - Few and small leaves

- Reduced leaf size
- Sunken stomata
- Thick cuticle.

TRANSPORT IN ANIMALS

1. Carboxyhaemoglobin
2. Blood group **A** has antigens **A** on red blood cells and antibodies **b** in plasma. Recipient's blood group **B** has **B** antigens and **a** antibodies. When blood group **A** from donor is transferred antigen **A** will react with antibody **a** in the recipient's blood. Clumping or agglutination of the red blood cells will take place: the clumped red blood cells block capillaries and this hinders the flow of blood and may result in death.
3. In a closed circulatory system, blood flow is confined to enclosed vessels while in open circulation blood is not confined to vessels but flows in cavities (sinuses) and is in direct contact with tissues.
4. a) i) Arthropoda

   ii) Chordata

   b) When blood is confined within vessels, it generates high pressure. This results in a faster rate of circulation, over long distances, ensuring efficient transportation of material e.g nutrient to all parts of the body, which renders the animals more active than those with open circulatory system.
5. i) They contain haemoglobin, a molecule that readily combine with oxygen.

   ii) They are biconcave discs without a nucleus, allowing more haemoglobin to be packed in cells so that each cell can carry more oxygen.
6. a) i) - Capillaries

ii) - They are thin-walled (one cell thick), thus allowing diffusion of materials.

b) - Have a small diameter to increase pressure thus allow materials to diffuse out.

- They are intimately associated with tissues in order to allow exchange of materials
- They are numerous- to provide a large surface area for exchange of materials.

c) i) Pulmonary arterioles contain more carbon dioxide than pulmonary venules.

ii) Pulmonary arterioles contain less oxygen than pulmonary venules.

7. It does not dissociate easily hence leads to suffocation

8. i) They contain haemoglobin, a molecule that readily combine with oxygen.

ii) They are biconcave discs without a nucleus, allowing more haemoglobin to be packed in cells so that each cell can carry more oxygen.

9. i) Platelets (Thrombocytes)

ii) Calcium, Ca^{2+}

iii) Fibrin.

10. a) Anemia/low blood volume/low haemoglobin leading to low oxygen, loss of nutrients and dehydration.

b) Blood clotting

c) Transfusion, taking fluids/eating iron in foodstuff/taking iron tablets.

11. a) - Thrombosis

- Arteriosclerosis

- Varicose veins

b) - Regulate body temperature

- Regulate pH of fluids

- Regulate osmotic pressure

12. a) Presence of valves

b) - Have biconcave shape to increase surface area for absorption of gases.

- Absence of nucleus and other organelles

- To increase packaging of haemoglobin.

- Presence of red pigment haemoglobin that has high affinity for oxygen.

13. - During birth

- Breast feeding

14. - Red blood cells have a biconcave shape, which increases the surface area for gaseous exchange. They have a thin plasma membrane, which allows rapid diffusion of gases. They contain haemoglobin, which readily combines with oxygen in areas of high oxygen tension (lungs) and releases it readily in areas of low oxygen tension (other body tissues). They have no organelles with whole internal space being filled with haemoglobin. They contain the enzyme carbonic anhydrase which help in the transport of carbon dioxide.

- Some white blood cells are phagocytic which enables them to engulf and destroy invading micro-organisms. They are also capable of amoeboid motion, which enables them to squeeze between cells of the capillary wall and into infected tissues where they proceed to engulf invading micro-organisms other white blood cells called lymphocytes are able to recognize antigens of invading micro-organism and to form antibodies against them.

- Platelets are able to aggregate at the site of a damaged blood vessel

forming a temporary platelet plug which stops blood loss. They also produce the substance called thromboplastin which initiates the blood clotting mechanism.

- Plasma is composed mainly of water which is a solvent for a large variety of substance. This enables it to act as a medium for transport of a large number of water soluble substances. It has a high heat capacity that enables it to transport heat from highly active tissues to the rest of the body.

15. Blood: Tissues which consist of a liquid part called plasma in which several types of cells are suspended.

Plasma: Liquid part of the blood

Serum: Plasma from which the blood clotting protein called fibrinogen has been removed. It does not clot.

Tissue fluid: Liquid part of blood without plasma proteins. It is derived from the blood by the process of ultra filtration.

Lymph: is a tissue fluid, which drains into lymphatic vessels instead of going back into the blood vessels.

16. a) The patient's red blood cells have antigen A on their membrane and his plasma has anti-b antibodies .

The donor's red blood cells have antigen B on their membrane and his plasma has anti-a antibodies. After transfusion, the anti-b antibodies in the patient's plasma reacted with B antigens on the donor's red blood cell membrane. This led to clumping together of the donor red blood cells a process called haemagglutination. This may have caused blockage of capillaries in a vital organ like the heart or brain leading to death.

b) i) A,B,AB,O

ii) He is universal recipient. His plasma' lacks antibodies.

17. Active immunity-that is produced when an animal's body reacts to an antigen by producing antibodies.

    Passive immunity- Immunity that is produced when antibodies are transferred from one individual to another.

18. Antibodies formed against common cold viruses remain in the body and provide immunity for only a few days. Therefore, once a person has recovered from cold, he/she is only protected for a few days. Those antibodies formed against measles virus remain in the body and provide immunity throughout the person's life. Therefore, once a person has recovered from measles, he or she is protected for life.

19. PH of blood plasma is not altered homeostasis is maintained. Within the red blood cells, there is an enzyme (carbonic anhydrate) which help in fast loading/combination and offloading/dissociation of carbon dioxide.

20. Through tissues fluid, Oxygen and other food substance pass from the blood to the cells. Carbon dioxide waste substance passes from the cells to the blood through it

GASEOUS EXCHANGE

1. a)
   - Air enter into tracheal system through spiracles
   - It moves onto the tracheoles then moves on to the tips of tracheoles.
   - Air rich in oxygen dissolves in a fluid at the tip of the tracheoles. There is low concentration of oxygen in tissues as compared to the fluid.
   - Oxygen diffuses into the tissues due to concentration gradient. It is used in metabolic activities.

- In tissues there is high carbon dioxide concentration than in the fluid in tracheoles.
- Carbon dioxide diffuses from tissues into tracheole due to concentration gradient. It moves into trachea then out of the body through spiracles.

b) - Water enters through the mouth when it opens its mouth. When it closes the floor is raised and water flows over the gills.
- Oxygen diffuses into the gills blood capillaries while carbon dioxide diffuses from the blood capillaries along concentration gradient.
- Flow of water and blood in gill filaments is by counter current flow.

2. a) - Large number of alveoli-increase surface area.
- Alveoli moist-dissolve diffusing gases.
- This walls- allow quick diffusion of gases
- Rich blood supply- transport oxygen and carbon dioxide.

b) i) Carbon dioxide diffuses into the cells. It moves in the plasma or red blood cells.
- Carbonic acid in plasma or carbamino haemoglobin in red blood cells or hydrogen carbonate.
- At the lungs hydrogen carbonate, carbonic acid and carbomino haemoglobin dissociates releasing cavity due to concentration gradient.

ii) Due to metabolic activities carbon dioxide is released from mesophyll cell. It diffuses into the intercellular spaces.

- Due to concentration gradient the gas diffuses into the sub-stomatal air spaces.

- When stomata open carbon dioxide is released into the atmosphere.

3. a) Carbon dioxide diffuses into the tracheoles then into the trachea and out into the atmosphere through spiracles.

b) - Stomata.

- Lenticels

- Cuticle

4. - To facilitate transportation of gases/exchange of gases i.e. oxygen and carbon dioxide.

- Create high concentration gradient.

5 a) - External intercostals muscle contract while internal intercostals muscles relax.

- Diaphragm contract flattening. Volume in thoracic cavity

- Air rushes into the lungs.

b) Opening During the day photosynthesis takes place and sugar is formed in guard cells

- Osmotic pressure increases and water is drawn from neighbouring cells by Osmosis.

- The guard cells become turgid, bulge outward causing opening of stomata.

Closing During the night there is no photosynthesis and sugar is converted to starch.

- Osmotic pressure decrease and water is lost to the neighbouring cell osmosis.

- Guard cells become flaccid, closing the stomata.

6. - Stomata
   - Lenticels
   - Cuticle

7. - High number of stomata on the upper surface of the leaf.
   - Absence of cuticle to allow diffusion of carbon dioxide and oxygen.

8. a) - Pneumatophores
   - Aerenchyma tissues
   - Cuticle

   b) - The diaphragm flattens.
   - Volume in thoracic cavity increase.
   - Pressure decreases compared to atmospheric pressure. Air rushes into the lungs through the nostrils.

9. a) K- Pleaural membranes
   L - Alveolus
   M- Intercostals muscles

   b) - Has c-shaped cartilage rings that support it, preventing it from collapsing and allow free flow of air.
   - Inner lining has mucus secreting cells that trap fine dust particles and micro-organisms.
   - Inner lining has hair like structures called cilia that enhance upward movement of the mucus to the larynx.

   c) Diffusion

   d) Mycobacterium tuberculosis

10 - Highly folded to increase surface area.

- High network of blood capillaries
- Thin walled
- Moist

11. The trachea are strengthened by rings of cartilage which prevent them from collapsing.

12. - The epidermis of the root hair cells do not have cuticle and gaseous exchange takes place.
    - When soil is water logged oxygen cannot diffuse into the root tissues hence no respiration. Metabolic activities stop leading to death.

13. - Air is cleaned by the cilia in nostrils
    - Controlled amount of air is taken in through nose
    - Individual is able to detect the smell of air breathed in.

14. - Spongy mesophyll cells are loosely packed allowing diffusion of gases.
    - Spongy mesophyll cells have a film of moisture on the surface to dissolve diffusing gases.
    - Large sub-stomatal air space in order to create high concentration gradient of diffusing gases.
    - Presence of stomata where gases enter or leave the leaf.

15. - Carbon dioxide
    - Water vapour
    - Oxygen

16. - Skin
    - Mouth

17. - Mammals –alveoli
    - Fish – gill filaments

- Leaves – spongy mesophyll cells
- Amoeba – cells membrane

18. Diffusion

19. Support the trachea and prevent it from collapsing when there is reduced pressure.

RESPIRATION

1. a) To derive off air or oxygen
   b) To avoid killing yeast/Denaturing enzymes in yeast
   c) To prevent air from getting into the yeast and glucose mixture.
   d) Lime water turn to white precipitate
   e) Use boiled yeast/glucose without yeast/yeast without glucose
2. - Lactic acid is toxic to tissues and must be removed from muscles to liver.
   - To increase supply of oxygen to tissues
3. a) Anaerobic respiration
   b) Brewing/Beer making
4. - Ethanol
   - Energy (ATP)
5. - Lactic acid
6. a) Adenosine triphosphate (ATP)
   b) i) Beer brewing/wine making
   ii) Baking using yeast.
7. - Have thin epithelium/wall to reduce distance of diffusion of the gases.
   - Moist to dissolve the diffusing gases
   - Highly folded to increase surface area for diffusion of gases.

- Well supplied with blood or vascularized to help maintain high concentration gradient.

8. a) A mouse has high surface area to volume ratio and tends to lose heat faster. It required more energy to replace it.

A dog has low surface area to volume ratio and lose less heat. Less energy is required to replace it

b) Lactic acid

9. a) i) Ethanol and carbon (IV) oxide.

ii) Lactic acid

b) It is the state when human body undergoes anaerobic respiration producing lactic acid. Oxygen has to be taken into the body to break the lactic acid.

10. a) Ratio of carbon dioxide produce to oxygen used up during breakdown of a food substrate.

b) R.Q = $\frac{CO_2 \text{ produced}}{O_2 \text{ used up}}$

R.Q = $^{102}/_{145}$

R.Q = 0.7

c) Fat/ Lipid

11.

Aerobic respiration	Photosynthesis
• Take place in both plants and animals • Takes place in all body cells • Takes place during the day and night • Oxygen is taken up while carbon dioxide is removed.	• Only takes place in plants. • Takes place in cells containing chloroplast • Takes place during the day only. Carbon dioxide used up while oxygen is given off.

12. a) Mitochondrion

b) A - Outer membrane

B - Inner membrane

C - Matrix

D - Cristae

c) Increase surface area over which respiration takes place:

d) ATP

EXCRETION AND HOMEOSTASIS

1. Pancreatic juice containing digestive enzyme is prevented from reaching food. Insulin (and glucagons), which regulates sugar, is released directly into the blood stream.

2. a) Heat from the body metabolism is not lost to the surrounding through sweating because evaporation of sweat will be low; as air is already saturated with moisture.

b) Hypothalamus

3. a) Sweat produces does not evaporate due to high humidity and the body does not cool, hence more sweat produces leading to accumulation

b) Hypothalamus

4. - Elimination of uric acid requires less water than ammonia, hence (more) water is conserved.

- Uric acid is less toxic than ammonia hence safer to excrete where there is less water.

5. a) Regulation of blood sugar lowers blood sugar level/controls the conversion of blood sugar to glycogen/maintain correct blood sugar level (90-100mg/100cc of blood)

b) Controls the absorption of water in the kidney (tubules) nephron/regulation of water in the body/osmotic pressure in the blood.

6. More water will enter the amoeba (by osmosis) rate of water discharge by contractile vacuole will increase. Contractile vacuoles will be formed to discharge the excess water.

7. i) Proteins/plasma; protein/fibrinogen; albumin, globulin, prothrombin.

ii) Blood cells, RBC/white blood cells/Platelets.

8. - Tests/React/Boil urine with Benedicts/Fehlings: positive results/Orange red precipitate is an indication of the disease diabetes mellitus.

- Brick red instead of orange, use of Benedict's solution with boiling/heating.

9. After vigorous activity when blood glucose falls below normal.

10. a) Diabetes insipidus

b) Anti-diuretic Hormone/ADH/ vasopressin

11. Maintenance of constant level of water, salts, osmotic pressure for optimum conditions for metabolism, suitable condition for cellular functions.

12. Converted into fats and stored as adipose tissue.

13. a) - Most enzymes in the body function with a narrow range of temperature
- High temperature denatures enzymes
- Low temperature inactivates/inhibit enzymes

b) Sugar is a raw material for respiration therefore less sugar leads to low rate of respiration hence less energy available to the body/low rate of metabolism.

14. a) Heat loss by conduction/convection from the blood vessels, the skin enters general circulation cooling the body.

b) Vasoconstriction, thus less blood flowing to the skin surface thus reducing heat loss. Sweating ceases. Heat produced by shivering through metabolism is retained in the body.

15. a) Sebum

b) - Cooling the body when water content evaporates.

- Excrete excess salts, lactic acid and urea.

16. - Regulates the blood sugar level in the body by converting glucose into glycogen.

17. - Adhesion- force of attraction between unlike molecules

- Due to the force of adhesion water tends to stick to the walls of vessels containing it
- Cohesion – forces of attraction between like molecules.
- Cohesion between water molecules prevents the water column from breaking.
- Root pressure-due to pressure generated by the root's endodermis.

- Capillary due to narrowness of xylem
- Transpiration pull-As water evaporates from the leaf's surface, more is absorbed.
- After the water reaches the leaves cells, it passes the cells by osmosis from the xylem.
- Water vapour diffuses out through stomata.

18. a) i) Maintenance of a constant internal environment of cells.

ii) Regulation of the concentration of water and salts in the body fluid.

b) - Insulin - Glucagon

19. a) - The amino acids are broken into amino group (NH_2) and carboxyl group (COOH). The amino group combines with hydrogen forming highly toxic ammonia. It immediately carbines with carbon (IV) oxide forming urea that is less toxic.

- The carboxyl group are converted to carbohydrates and then oxidized or converted into neutral fats and deposited on parts of the human.

b) - Bowman's capsule

- Proximal convoluted tubule
- Distal convoluted tubule

c) i) Less water reabsorbed in the blood stream and dilute urine is produced.

ii) Diabetes insipidus

20. a) Excretion is the removal of metabolic waste products from the body of an organism.

b) Secretion is the removal of a substance from a cell where it is formed and its transfer to another part of the body where it serves a useful function

c) Egestion is the removal of undigested food material from the body of an organism.

21. Blood cells and plasma proteins

22. a) Ultra filtration

b) Selective reabsorption

c) Because the pores in the glomerular capillaries are too small for plasma protein to pass through.

d) Blood cells

e) Most of the water in the glomerular filtrate is reabsorbed by the urine is formed whereas very little urea is reabsorbed.

23. As moisture from the urine or saliva evaporates from the surface of the skin, it reabsorbs latent heat of vaporization from the body thus cooling it.

24. Being exothermic, fish do not spend any part of their food intake in the maintenance of body temperature. This is unlike the case with mammals which spend a significant part of their food on temperature maintenance. Therefore fish are able to spend more of their food intake on growth.

25. During hot dry weather, the humidity difference between the surface of the skin and

atmospheric between air is high. Under such conditions, sweat evaporates easily from the skin surface. This cools the body due to absorption of latent heat of vaporization. When the weather is hot and humid the humidity difference between the surface of the skin and atmospheric air is low. Evaporation of sweat takes place slowly with the result that sweat accumulates on the person's skin. Therefore the cooling effect of sweat on the body is greatly reduced.

26. Negative feedback refers to a regulatory mechanism whereby a deviation of the entity being regulated above or below the normal range triggers a sequence of event to bring it back to normal.

27. a) A- Hepatic artery

B - Hepatic portal vein

C - Hepatic vein

b) i) B

ii) B

iii) C

iv) A

v) C

c) During fasting there is no glucose from the alimentary canal making glucose concentration in vessel B low. Vessel C obtains glucose derived from the hydrolysis of glycogen in the liver.

The blood circulatory system - answers

1 (a) White cells have nuclei, red cells do not have nuclei. Some white cells can change their shape, red cells cannot.
(b) White cells ingest bacteria or make antibodies. Red cells carry oxygen.

2 Blood cells are made in the red bone marrow, e.g. in the ribs, sternum or vertebrae.

3 Fibrinogen, albumin and globulin (any two) are plasma proteins.

4 In addition to proteins, plasma contains salts (ions), glucose, lipids and amino acids, hormones, carbon dioxide and urea.

5 (1) Atria fill with blood, (2) ventricles relax, (3) semi-lunar valves close, (4) atria contract, (5) tricuspid and bicuspid valves open, (6) ventricles contract, (7) bicuspid and tricuspid valves close, (8) semi-lunar valves open.
Note: The order of semi-lunar valves and bicuspid and tricuspid valves may be reversed as their action is virtually simultaneous.

6 The missing words are: (A) left, (B) pulmonary, (C) left, (D) aorta, (E) deoxygenated, (F) vena cava, (G) right, (H) pulmonary, (I) lungs.

7 (d) Capillaries are thin-walled, not thick-walled.

8 Arteries carry blood ***from*** the heart. Veins carry blood ***to*** the heart.

9 There are valves in the heart (between each atrium and ventricle, in the aorta and pulmonary artery), in some of the large veins and in some of the lymphatics.

10 Tissue fluid is plasma (minus its proteins) which has leaked out of the capillaries. Lymph is tissue fluid which has entered the lymphatics.

11 Some of the larger lymphatics are able to contract, otherwise the lymph is propelled by body muscles which contract and 'squash' the lymphatics.

12 Lymph nodes contain white blood cells which ingest bacteria and prevent them from reaching the circulation.

13 Oxygen is transported from the lungs (A) to the whole body. Carbon dioxide (B) is transported from the whole body to the lungs. Urea (C) is transported from the liver to the kidneys. Digested food (D) is transported from the intestine to the whole body (E) (via the liver). Heat is transported from active muscles (F) to the whole body (G).

14 (d) Blood leaving a muscle will have more carbon dioxide, less oxygen and less glucose as a result of respiration.

15 (d) Blood from the alimentary canal returns to the heart by way of the hepatic portal vein, hepatic vein and vena cava.

16 Platelets release a substance which, indirectly, causes fibrinogen to be converted to fibrin. The fibrin forms a network which traps red cells to form a clot.

17 A blood clot forms a barrier to entry by bacteria. White cells ingest and kill bacteria. Antibodies from lymphocytes inactivate bacteria or make them easier to ingest. White cells in lymph nodes trap bacteria.

18 (b) The anti-bacterial substances produced by lymphocytes are called antibodies.

19 (b) If your immunity is acquired, natural and active, it must result from having recovered from a disease.

20 (a) Diphtheria and tetanus vaccines are prepared from the inactivated toxins (toxoids).
(b) Whooping cough vaccine is prepared from the dead bacteria.
(c) Temporary immunity to tetanus, rabies and chicken pox can be produced by injecting antibodies to these diseases.

21 (d) Group AB persons have neither anti-A nor anti-B antibodies in their plasma, so red cells from any donor will not be clumped.

22 The four main risk factors for coronary heart disease are thought to be (i) smoking, (ii) high blood pressure (possible accentuated by stress), (iii) high blood cholesterol (possibly aggravated by a fatty diet), (iv) lack of exercise.

Breathing – answers

1 (a) Energy is obtained from food by a process called *respiration* (A).
(b) The intake of oxygen and output of carbon dioxide at a respiratory surface is called *gaseous exchange* (B).
(c) The process of renewing air in the lungs is called *ventilation* (C).
(d) The processes B and C are included in the term 'breathing'.

2 From the nasal cavity the air would pass through the (pharynx, glottis), larynx, trachea, bronchi and bronchioles to reach the alveolus.

3 The cartilage rings hold the air passages open.

4 The lining of the air passages produces *mucus* which traps dust particles. *Cilia* in the lining flick to and fro to carry the mucus up and out of the passages.

5 (b) When we inhale our diaphragm muscles contract and the ribs move up.

6 Blood in the pulmonary artery will contain less oxygen and more carbon dioxide than blood in the pulmonary vein.

7 Breathing becomes deeper and more rapid, thus exposing the capillaries to a greater volume of air in a given time.

8 Exhaled air contains approximately 16% oxygen.

9 (i) vital capacity: 5000 cm^3, (ii) tidal Volume: 500 cm^3, (iii) residual air: 1000 cm^3.

10 Four characteristics of an efficient respiratory surface are: thin epithelium, large surface area, abundant capillaries, ventilation mechanism.

11 *Diffusion* is the process by which oxygen passes from the alveoli to the lung capillaries.

12 (b)Tuberculosis and (d) colds are unlikely to be caused by smoking (but it doesn't help).

Digestion – answers

1 (c) The liver is not part of the alimentary canal.

2 Salivary gland, gastric gland, pancreas (any two).

3 Peristalsis.

4 Digestive enzymes dissolve food, make food soluble, break large insoluble food molecules into smaller, soluble molecules.

5 (a) Proteins are digested to amino acids, (b) fats are digested to fatty acids and glycerol, (c) starch is digested to glucose.

6 Chewing reduces food to portions small enough to be swallowed and increases the surface area of the food for digestive enzymes to act on.

7 The enzyme in saliva is salivary amylase and it acts on starch.

8 (a) The stomach contents are acid.

9 Proteins are partially digested in the stomach.

10 The enzyme in gastric juice is pepsin.

11 The pancreas produces enzymes which act on proteins (proteases), starch (amylase) and fat (lipase).

12 The pancreas releases pancreatic juice into the duodenum.

13 Bile emulsifies fats (breaks fats into small droplets).

14 The absorbing surface of the small intestine is increased by (a) being very long, (b) having internal folds, (c) having villi, (d) micro-villi on the epithelial cells.

15 (a) Glucose and (c) amino acids enter the blood stream, (b) fatty acids and glycerol may enter the blood or the lymph.

16 The blood from the intestine goes first to the *liver* before entering the general circulation. If the glucose concentration in the blood is above a certain level, it is changed to *glycogen* and stored. Glucose which passes into the general circulation is taken up by the body cells and used to provide *energy*.

If there are excess amino acids in the blood from the intestine, the liver converts them to

glycogen which is stored, and *urea* which is excreted by the kidneys.

17 The liver (a) converts hormones to inactive compounds, (b) oxidises alcohol to carbon dioxide and water, (c) stores vitamin A.

18 (A) gullet (oesophagus), (B) stomach, (C) liver, (D) pyloric sphincter, (E) bile duct, (F) gall bladder(G) pancreatic duct, (H) duodenum, (I) pancreas.

Excretion and the kidneys – answers

1 Carbon dioxide, urea, uric acid, spent hormones, excess water and salts (any four) have to be excreted from the body.

2 The kidneys, lungs and liver have an excretory function.

3 The missing words are (A) renal, (B) cortex, (C) blood pressure, (D) proteins, (E) Bowman's capsule (or renal capsule), (F) renal tubule, (G) glucose, (H) salts, (I) water, (J) urine, (K) ureter, (L) bladder.

4 (b) In hot weather, urine becomes more concentrated and darker in colour.

5 (c) You would not normally expect to find glucose in a urine sample.

6 (a) Blood in the renal vein will have less oxygen and more carbon dioxide (as a result of the kidney's respiration) and less urea, than blood in the renal artery.

7 Water is lost from the body by evaporation (lungs and skin), urination and defaecation (faeces always contain water).

8 (a) If the concentration of solutes in the blood rises, more water is reabsorbed in the kidney tubules. (This helps to reduce the concentration of the blood.)

9 (c) Water, urea and uric acid can pass through the dialysis tubing into the bathing solution. (You could argue that, if the patient's blood contained excessive salts or glucose, these too would escape.)

10 Drugs are used to suppress the patient's immune response to foreign tissue. The donor is as closely related as possible to the patient (or the tissue types are very similar).

11

Organ	Substances regulated
Lungs	oxygen, carbon dioxide
Liver	glucose, amino acids
Kidneys	urea, uric acid, water, salts

Food and diet – answers

1 The body uses food (i) for energy, (ii) for growth (making new cells), (iii) repairing or replacing tissues.

2 Fats and carbohydrates both provide the body with *energy* but fats can provide *twice* as much as carbohydrates. Excess fats can be stored in the body but carbohydrates must be changed into *glycogen* or *fat* before they can be stored. The main types of carbohydrates are *starch*, *sugar* and *cellulose*. Examples of food rich in starch are (e.g.) *potatoes* and *bread*. Foods rich in fats are (e.g.) *butter*, *cheese* or *fatty meat*.

3 Most carbohydrate is taken in as starch.

4 Proteins are made up of about 20 different *amino acids*. One example of a plant product rich in protein is *beans* (or *wheat or maize*). An animal product rich in protein is *meat* (or *eggs* or *cheese* or *fish*). When a protein is digested, it is broken down into its constituent *amino acids* and these are later built up in the body to make new *cytoplasm* (or *cells* or *tissues*). Excess proteins which are not used for making new cells or tissues are converted to *glycogen* which can be stored or used to provide *energy*.

5 Fish, meat and lettuce contain little or no carbohydrate.

6 (a) Carbohydrates contain the elements *carbon* , *hydrogen* and *oxygen*.
(b) Proteins contain these elements but also *nitrogen* and *sulphur.*

7 (a) (i) Bones need calcium, (ii) red blood cells need iron, (iii) the thyroid gland needs iodine.
(b) (i) Milk contains calcium, (ii) milk is deficient in iron.

8 Vegetable fibre retains water (keeping the faeces soft and bulky), prevents constipation, reduces the chance of disease of the large intestine (*any one*).

9 (a) Vitamin A (retinol) helps maintain resistance to infectious disease.
(b) Liver, cheese, butter, margarine, milk, eggs, green vegetables, carrots (*any two*) are a good source.

10 (a) Vitamin D (calciferol) is necessary for the healthy development of the skeleton.
(b) Butter, milk, cheese, egg-yolk, liver, oily fish (*any two*) are a good source.

11 In addition to sufficient energy, a balanced diet must contain proteins, carbohydrates and fats in the right proportion, and water, vitamins, mineral salts and fibre.

12 It should be possible to survive without carbohydrate as energy can be obtained from fats and proteins.

13 Western diets are often unhealthy because they contain too much *sugar* and *fat*, and not enough *fibre*.

14 The low temperature of refrigeration slows down bacterial reproduction and enzyme reactions.

15 Pasteurisation may involve heating milk to 72°C for 15 seconds, or 60°C for 30 minutes.

16 (a) Preservatives such as sodium nitrite (cured meat) or sulphur dioxide (fruit juice) may be needed to stop bacteria growing in food.
(b) Artificial colouring and flavouring are not necessary, nor are additives which simply cause the food to retain more water.

17 (a) Heating a food sample with Benedict's solution is a test for *sugar*. (Strictly, it is a test for a reducing sugar.)
(b) A test for starch is to add *iodine* solution to the food.
(c) In the biuret test for protein, *sodium hydroxide* and *copper sulphate* solutions are added to the sample. A *mauve* colour indicates the presence of protein.

The skin, and temperature control – answers

1 (a) Our skin protects us against bacteria (A) and ultraviolet light (B).
(b) Our skin helps to control body temperature (C) and evaporation of water (D).

2 The two main layers of the skin are the epidermis and dermis.

3 (a) The basal (Malpighian) layer produces new skin cells and the pigment, melanin, which protects against ultraviolet light.
(b) The cornified layer reduces evaporation from the skin and resists entry of bacteria.

4 In the dermis you would expect to find sensory nerve endings, nerve fibres, capillaries, arterioles and venules, sweat glands and ducts, sebaceous glands and hair follicles.

5 The extremities of the body (hands and fingers, feet and toes, ears and nose) are likely to be the coldest parts. The internal organs (particularly the brain and active muscles) are likely to be the warmest parts.

6 The approximate range of normal body temperature is 36-38 °C.

7 The body loses heat by conduction, convection, radiation and evaporation (from skin and lungs).

8 (a) Respiration in the tissues, particularly in the brain and active muscles, is the main internal source of body heat.
(b) Direct sunlight, a hot environment and hot food and drink are external sources of body heat.

9 (a) Vaso-constriction is the reduction in diameter of small arterioles and capillaries.
(b) Vaso-constriction in the skin makes the skin look paler and reduces heat Joss.

10 Respiration in the spasmodically contracting muscles produces heat.

11 (a) Vaso-dilation is an increase in diameter of small arterioles and capillaries.
(b) Vaso-dilation makes the skin go more pink and increases heat loss.

12 For sweat to have a cooling effect, it must evaporate. In doing this it takes heat from the body.

13 Hypothermia is a lowering of the 'core' temperature of the body to below 35°C.

14 Eating well before going out and wearing warm, wind-proof clothing can reduce the chances of hypothermia.