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Specimen Paper 2024 (ThatBioTutor Edition)

Question	Ans	**Question**	Ans
1	**D**	21	**D**
2	**B**	22	**C**
3	**A**	23	**A**
4	**B**	24	**B**
5	**D**	25	**C**
6	**C**	26	**B**
7	**B**	27	**B**
8	**B**	28	**D**
9	**B**	29	**D**
10	**C**	30	**C**
11	**C**	31	**C**
12	**A**	32	**B**
13	**D**	33	**A**
14	**D**	34	**C**
15	**B**	35	**B**
16	**D**	36	**A**
17	**A**	37	**C**
18	**A**	38	**C**
19	**D**	39	**A**
20	**A**	40	**B**

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Q1.

ai) Protease

aii)

- The stomach has a highly **acidic environment**, due to presence of **hydrochloric acid**, which is at pH 2, the optimum pH for the protease in the stomach,
- while the small intestine has a slightly **alkaline environment** due to **higher pH** of **bile** and **pancreatic juice** and **intestinal juice**.

bi) **Liver** and **muscle** cells.

bii) **Glycogen**

c)

- **Deamination** occurs at the liver, where **amino groups** are removed from **excess amino acids** and converted into **urea**.
- **Urea** leaves the liver via the **hepatic vein**, enters a **kidney** via the **renal artery**, where it is forced out along with most of the **blood plasma** during **ultrafiltration** from **glomerulus** into the **Bowman's capsule.**
- **Urea** travels through the **proximal convoluted tubule, loop of Henle, distal convoluted tubule, collecting duct.**
- It is transported in **urine** to the **bladder** via a **ureter**, then **excreted** when **urine** leaves the body via the **urethra**.

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Q2.

ai)

- The **net** movement of particles from a region of higher concentration to a region of lower concentration,
- **down a concentration gradient**.

aii)

- There is a **higher concentration** of oxygen in the **alveolar air space** than in the **blood capillaries** which carry **deoxygenated** blood, creating a **concentration gradient**.

aiii)

- Deoxygenated blood from the body flows into the **right atrium**, then past the tricuspid valve into the **right ventricle.**
- It is pumped out of the **pulmonary artery** to the lungs, which branches into **capillaries** surrounding **alveoli**.
- Oxygenated blood then returns to the heart via the **pulmonary vein**, entering the **left atrium**.

bi)

- The lower oxygen concentration in the air would lead to a **gentler concentration gradient** between air in the **alveoli air space** and the **blood plasma**,
- **Diffusion rate** of oxygen decreases, hence there would be **reduced oxygen uptake** from the alveoli into the blood.

bii)

- More red blood cells would increase the rate that **oxygen** can be transported from **lungs** to **muscles,**
- so muscles can undergo **higher rates** of **aerobic respiration**, releasing **more energy** for **muscular contractions**, allowing athletes to sustain longer periods of intense activity with **less fatigue**, enhancing their performance.

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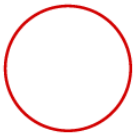
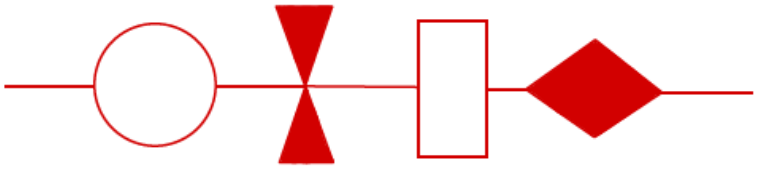
Q3.

ai) (Choose any one of the shapes)



aii) (Choose either top or bottom strand)



bi) **Mutation**

bii) (Any one)

- **Ultraviolet radiation/Nuclear radiation/Gamma rays/Tar**

c)

- To have the blood group O **phenotype**, one must have the **genotype I^OI^O**, and must have **inherited** a recessive **I^O allele** from each parent.
- An individual with blood group AB has **I^A** and **I^B alleles** which are **codominant**, and does not have an **I^O** allele.
- They would not be able to pass on an **I^O allele** to their offspring, hence their offspring can never be blood type O.

Q4.

ai) **Water vapour**

aii) **Aerobic respiration**

b)

- From the graph:
- Water from food = 1300 cm^3
- Water from drink = 1360 cm^3
- Water produced in the body = 320 cm^3
- Total water gain = 1300 + 1360 + 320 = **2980 cm^3**.

c) Choose 2:

- In cold climate, the body will not need as much water intake to compensate for water lost through **sweat**,
- decreasing one's **thirst**, hence **water intake from drinks would decrease.**

- **Water lost through the skin** would **decrease**.
- In a cold climate, **sweat glands** become **less active** and secrete less **sweat**, less water in sweat **evaporates**, less **latent heat** is lost, in order to keep the body warm.

- Due to an increase in **metabolic rate** in response to **internal body temperature** being too cold,
- higher rate of **aerobic respiration** produces more water as a **by-product**, hence **more water is produced in the body**/hence **more excess water** will be **excreted** in urine.

- Cold air is less **humid** than warm air, increasing the **evaporation** rate of water from the **thin film of moisture** of the **alveoli**,
- so **more water is lost at the lungs** during **exhalation** as **water vapour**.

d)

- **190dm^3 = 190,000cm^3** of water is filtered through the kidneys each day. From Fig. 4.1, **760cm^3** of water is excreted from the body through urine each day.
- This demonstrates that most water filtered through the kidney is **reabsorbed** back into the blood at the **proximal convoluted tubule, loop of Henle, distal convoluted tubule,** and **collecting duct**. Only a small amount of water stays in the **filtrate** and becomes **urine**.

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Q5.

ai) **Hormones**

aii) **Target** organs

bi)

Person without diabetes: J

Reason: From Fig. 5.1, person J's blood glucose levels were stable and kept **within the normal range** at approximately **5 units**, showing their pancreas is **secreting sufficient insulin** and their **target organs** are responding to insulin.

Person who produces no insulin: H

Reason: From Fig. 5.1, person H had persistently high blood glucose, in the range of **9 to 19 units**, and **fluctuated greatly** compared to persons G and J. This shows their pancreas **produces no insulin** and is unable to bring down blood glucose concentration to regular levels.

c)

- After being breathed in to the **trachea**, **bronchi**, and into **bronchioles**, insulin molecules enter the **alveoli**,
- Where they **dissolve** into the **thin film of moisture** lining the **alveolar air space**, then **diffuse** into the **blood plasma**.

Q6.

a)

- For all of the five species, there are a **greater number** of **stomata per mm^2** on the **lower epidermis** compared to the **upper epidermis**.

bi)

- This is to ensure changes in **mass** due to **water loss** is only due to **transpiration** at the leaves of shoot A, and not by **evaporation** from the **water surface**.

bii)

- Total mass of water loss after 48 hours = 214.5g − 211.8g = 2.7g
- Total mass of water loss per day = 2.7g/2 = 1.35g
- Mass of water lost per cm^2 of leaf surface area per day = 1.35g/45cm^2 = **0.03g/cm^2/day**

biii)

Species: C

Explanation: From Table 6.1, species C has the highest concentration of stomata, **241 stomata per mm^3** on its leaves, allowing more **water vapour** to **diffuse** out per leaf area, **increasing transpiration rate**, hence losing the most water per cm^2 of leaf area per day.

biv) (Any one)

- **Hairs on leaf surface/Rolled leaf structure/Sunken stomata/Thickness of the waxy cuticle**

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Q7.a)

[4]

b)

- From 10°C to 35°C, as temperature increases, clotting time decreases steadily from 86 to 30s.
- Clotting time is the lowest at the **optimum temperature** of 35°C.
- From 35°C to 45°C clotting time increases sharply from 30 to 58s.

c)

- Platelets promote **blood clotting** at the site of injury, sealing the **wound** to prevent loss of blood and preventing the entry of harmful **microorganisms**.
- When blood vessels are damaged, **platelets** are activated, which trigger the conversion of **soluble fibrinogen** into **insoluble fibrin**,
- Forming **long insoluble fibrin threads** which trap **red blood cells**, forming a **clot** at the site of injury. Pathogens are unable to enter the body and cause infection.

Q8.

a)

- Chlorophyll **absorbs light energy** and **converts** it to **chemical energy**,
- which is used to **convert carbon dioxide** and **water** into **glucose** and **oxygen** during **photosynthesis**.

bi)

- Radioactive carbon dioxide in the plastic bag **diffused** into the **leaves** of the plant via **stomata**,
- And was **converted** into **radioactive glucose** at the **chloroplasts** during **photosynthesis**.
- This was converted into **radioactive sucrose**, and **translocated** through the **phloem** from **leaves** to **roots**, hence radioactive carbon was found in the **leaves** and **roots**.
- This sucrose was converted back into **glucose** at the **roots**, and **root cells** used this for **aerobic respiration**,
- Resulting in radioactive carbon dioxide being released into the **soil**, hence radioactive carbon was found in the **soil**.

bii)

- When the cow **consumes** the plant, it **ingests** the radioactive carbon which could be present in **starch**, **fats** and **proteins** of the plant.
- The ingested plant is **broken down** to **simpler molecules** such as **glucose, amino acids** and **fatty acids** and **absorbed** into the **bloodstream** as it moves through the digestive system of the cow.
- The cow will use these molecules for its own **growth** and **repair**, such as **synthesising muscle fibres**, storage of **fat** in **fat cells**, resulting in radioactive carbon being present in the tissue of the cow.

Q9.

a) (any two)

- Bacterial cells have **cell walls** but animal cells **do not have cell walls**.
- Bacterial cells have **no membrane-bound nucleus** but animal cells have a **membrane-bound nucleus**.
- Bacterial cells have **circular DNA** but animal cells have **linear DNA**.

b)

- Those aged 75 and above have a much higher annual hospitalisaiton rate per 100 000 thorughout 1998 and 2004 than those aged 15 to 74.
- The rate for those above 75 increased from 110 to 150 per 100 000 from 1998 to 2000, whilst that of those aged 15 to 74 is the same at 1998 and 2000, at 45 per 100 000.
- **Older** people generally have **weaker immune systems** than **younger** people, thus are more **susceptible** to **infection** and suffer **more severe symptoms** when infected, hence those 75 and above tend to be hospitalised more frequently**.**

c)

- Vaccines are a **preventive** measure, whilst antibiotics are a **treatment** approach in the way of reducing the number of deaths from pneumococcal disease.
- Vaccines contain an **antigen** resembling that of the real **pathogen's**, and vaccinations prevent infectious diseases by **stimulating white blood cells** to quickly produce **antibodies** when the same pathogen invades.
- After vaccination, some of these **white blood cells r**emain in the body for a long time.
- When the real **pathogen** enters the person, these white blood cells **recognise** it and **quickly** produce **large amounts** of **antibodies** to destroy the pathogen.
- Antibiotics are drugs that inhibit the growth of or kill bacteria, such as by inhibiting **synthesis** of bacterial **cell wall**, or breaking up the bacterial **cell membrane**.

Q10.

a)

- Energy is lost as **heat** to the surroundings due to **cellular respiration** of the wheat plant during its lifetime.
- Energy is lost as **chemical energy** trapped within **carbon compounds** in **excreted** substances from the wheat plant.
- Energy is lost as **chemical energy** trapped in **carbon compounds** in the parts of the wheat plant which are not used for making animal feed/discarded when making the feed.

b)

- Percentage = (380,000/2,000,000) x 100 = **19%**

c)

- Wheat receives **90,000,000 kJ** of energy from the Sun, and provides **140 kg** of animal feed, which contains **2,000,000 kJ** of energy.
- Animals that feed on **140 kg** of wheat only gain **50 kg** of mass in their bodies, which contains **380,000 kJ** of energy, which is only 19% of what humans could have gotten from the wheat if they ate it directly.
- It is thus more **energy efficient** for humans to gain their food from the first trophic level (wheat) rather than from the second trophic level (animals that feed on wheat) due to the **energy loss** at each level.

d)

- The **environmental conditions** could have been different, such as the **weather** or the **seasons**, resulting in a different amount of energy from the Sun reaching wheat crops.
- The animals in the second experiment could have different **metabolic rates**, that caused more or less **energy** to be lost through **aerobic respiration**.