**Chapter 3 - Respiratory System**

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**Multiple Choice Questions:**

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

**Short Answers:**

1. **How does the exchange of gases takes place in alveoli?** In the alveoli, gas exchange occurs through diffusion. Oxygen from the inhaled air, which is at a higher partial pressure in the alveoli, diffuses across the thin alveolar and capillary walls into the blood, where its partial pressure is lower. Simultaneously, carbon dioxide, which is at a higher partial pressure in the blood, diffuses from the blood into the alveoli to be exhaled.
2. **What is the effect of exercise on the rate of breathing?** During exercise, the body's demand for oxygen increases, and the production of carbon dioxide also rises due to increased metabolic activity in muscles. To meet these demands, the rate and depth of breathing increase significantly, allowing for more oxygen intake and efficient removal of carbon dioxide.
3. **Compare inspired and expired air.** Inspired air contains approximately 21% oxygen, 0.04% carbon dioxide, and about 78% nitrogen, along with varying amounts of water vapor. Expired air, on the other hand, has a lower oxygen content (around 16%), a higher carbon dioxide content (about 4%), the same percentage of nitrogen, and is saturated with water vapor.
4. **How viral infections like Covid-19 affect bronchi?** Viral infections like Covid-19 can cause inflammation and damage to the lining of the bronchi, leading to bronchitis. This inflammation can cause the airways to narrow, fill with mucus, and become irritated, resulting in symptoms such as coughing, wheezing, and difficulty breathing.
5. **What is the importance of breathing in fresh air?** Breathing in fresh air is crucial for optimal health as it provides a higher concentration of oxygen, which is essential for cellular respiration and energy production in the body. Fresh air also contains fewer pollutants and allergens compared to stale or polluted air, reducing the risk of respiratory issues and promoting overall well-being.
6. **What is the importance of keeping nasal and oral cavity clear?** Keeping the nasal and oral cavities clear is vital for unobstructed airflow and efficient respiration. The nasal cavity filters, warms, and humidifies incoming air, protecting the lower respiratory tract. Blockages or inflammation in these cavities can impede breathing, lead to discomfort, and increase the risk of infections.
7. **Differentiate between:**

**a. Respiration and Breathing:** Breathing is the mechanical process of inhaling and exhaling air, involving the movement of the diaphragm and rib cage. Respiration is a broader biochemical process that includes breathing, external respiration (gas exchange in lungs), internal respiration (gas exchange in tissues), and cellular respiration (energy production within cells).  
**b. Respiration and Photosynthesis:** Respiration is a catabolic process that breaks down glucose in the presence of oxygen to release energy (ATP), carbon dioxide, and water. Photosynthesis is an anabolic process carried out by plants that uses light energy to convert carbon dioxide and water into glucose and oxygen. They are complementary processes, with photosynthesis producing the glucose and oxygen used in respiration.  
**c. Inhalation and Exhalation:** Inhalation is the active process of taking air into the lungs, occurring when the diaphragm contracts and moves downward, and the external intercostal muscles contract, raising the ribs. Exhalation is typically a passive process of expelling air from the lungs, occurring when the diaphragm relaxes and moves upward, and the external intercostal muscles relax, lowering the ribs, increasing pressure inside the lungs.  
**d. Smoker and Passive Smoker:** A smoker is an individual who actively consumes tobacco products, directly inhaling the harmful substances. A passive smoker, also known as a second-hand smoker, is someone who involuntarily inhales smoke from another person's tobacco product. Both are exposed to harmful chemicals, but the direct smoker has higher and more direct exposure.  
**e. Bronchitis and Pneumonia:** Bronchitis is an inflammation of the bronchial tubes, often caused by viral infections, leading to coughing and mucus production. Pneumonia is an infection that inflames the air sacs (alveoli) in one or both lungs, which may fill with fluid or pus, causing more severe symptoms like fever, chills, and difficulty breathing.  
**f. Aerobic and Anaerobic respiration:** Aerobic respiration is the process of breaking down glucose in the presence of oxygen to produce a large amount of ATP, carbon dioxide, and water. Anaerobic respiration occurs without oxygen, breaking down glucose to produce a smaller amount of ATP and byproducts like lactic acid (in animals) or ethanol (in yeast).  
**g. Pharynx and Larynx:** The pharynx (throat) is a muscular tube that serves as a passageway for both air and food. The larynx (voice box) is located below the pharynx and contains the vocal cords, playing a crucial role in sound production and ensuring food doesn't enter the trachea.  
**h. Glottis and Epiglottis:** The glottis is the opening between the vocal folds in the larynx, which air passes through. The epiglottis is a flap of cartilage located at the base of the tongue that covers the glottis during swallowing, preventing food and liquid from entering the trachea.  
**i. Bronchi and bronchioles:** Bronchi are the two main large airways that branch off the trachea and lead into the lungs. Bronchioles are smaller branches of the bronchi that further divide and lead to the alveolar sacs. Bronchi have cartilage rings, while bronchioles are smaller and lack cartilage.  
**j. Air sacs and alveoli:** Air sacs generally refer to the clusters of alveoli at the end of the bronchioles. Alveoli are the tiny, individual air sacs within the lungs where the actual gas exchange between air and blood takes place.  
**k. Oxyhaemoglobin and carboxyhaemoglobin:** Oxyhaemoglobin is formed when oxygen binds reversibly to hemoglobin in red blood cells, primarily in the lungs, for transport to tissues. Carboxyhaemoglobin is formed when carbon monoxide binds to hemoglobin, displacing oxygen, as carbon monoxide has a much higher affinity for hemoglobin than oxygen, leading to reduced oxygen transport and potential carbon monoxide poisoning.

1. **Breathing through nose is healthier than breathing by mouth. Why?** Breathing through the nose is healthier because the nasal cavity acts as a natural filter, trapping dust particles, allergens, and microorganisms with its hairs and mucus. It also warms and humidifies the incoming air, preventing irritation and drying of the delicate lung tissues. The mouth lacks these protective mechanisms, making mouth breathing less efficient and potentially harmful.
2. **What are the conditions necessary for efficient gaseous exchange between an organism and the environment?** Efficient gaseous exchange requires several conditions: a large surface area for diffusion (like the numerous alveoli in lungs), a thin respiratory surface for quick diffusion, a moist surface for gases to dissolve, and a good blood supply (capillary network) to maintain concentration gradients. There also needs to be a significant difference in partial pressures of gases between the environment and the organism.
3. **The two steps of breathing are shown in the given diagrams. Which of the given diagrams, A or B, shows the process of exhalation? Support your answer with a reason.** Diagram B shows the process of exhalation. This is evident because in diagram B, the diaphragm is shown to be relaxed and has moved upwards, and the ribs are lowered. These actions decrease the volume of the thoracic cavity, increasing the pressure within the lungs, which forces air out. In contrast, diagram A shows inhalation with the diaphragm contracted and moved downward, and ribs raised, increasing thoracic volume.
4. **Describe the effects of cigarette smoking on the inner walls of trachea of human beings.** Cigarette smoking causes significant damage to the inner walls of the trachea. The harmful chemicals in smoke irritate and paralyze the cilia, which are tiny hair-like structures responsible for sweeping mucus and trapped particles out of the airways. This leads to a buildup of mucus and debris, increasing the risk of infections. Smoking also causes inflammation and can lead to a condition called smoker's cough, as well as increasing the risk of developing chronic bronchitis and lung cancer by damaging the tracheal lining.
5. **The diagram shows percentage of gases in inspired and expired air.** (This question refers to the diagram in image\_619dff.jpg, but the actual question parts are on image\_619da7.jpg, which has question 12 also related to gas percentages in inspired and expired air.) **a. Identify I, II, X, Y and Z.**

* I: Inspired Air
* II: Expired Air
* X: Carbon Dioxide (It's almost negligible in inspired air and increases significantly in expired air)
* Y: Nitrogen (78% - almost zero differences in inspired and expired air)
* Z: Oxygen (more in inspired than expired air)

**b. Why gas X is almost negligible in figure I?** Gas X is carbon dioxide. It is almost negligible in inspired air (Figure I) because carbon dioxide makes up a very small percentage (about 0.04%) of the atmospheric air that we inhale.  
 **c. How the percentage of X is increased in figure II?** The percentage of gas X (carbon dioxide) is significantly increased in expired air (Figure II) because it is a waste product of cellular respiration in the body's cells. The blood transports this carbon dioxide from the tissues to the lungs, where it diffuses into the alveoli and is then exhaled.

1. **The figure shows a healthy lung and a diseased lung**:

**a.** The diagram shows a comparison between a healthy lung (A) and a diseased lung (B). The disease shown in the diagram is **emphysema**, a type of chronic obstructive pulmonary disease (COPD). The affected part of the lung is the **alveoli**, which are the tiny air sacs responsible for gas exchange.

**b.** In diagram A, the alveoli appear as separate, rounded sacs, each with its own distinct wall, allowing a large surface area for gas exchange. In contrast, part B shows enlarged and damaged alveoli with broken walls, resulting in fewer, larger sacs. This structural change reduces the surface area available for gas exchange and impairs oxygen uptake, which is characteristic of emphysema.

**c.** Two common symptoms of emphysema are **shortness of breath** (especially during physical activity) and a **chronic cough**, often accompanied by wheezing. These symptoms occur due to the reduced surface area for oxygen exchange and the trapping of air in damaged alveoli.

1. **The diagram shows the structural and functional units of the lungs**
2. **Identify structure Z-** Alveoli
3. **Name gases X and Y-** X is carbondioxide, and Y is oxygen
4. **Name of blood-** The blood leaving the alveolus at point E is oxygenated blood. This blood has absorbed oxygen from the alveolar air and is now rich in oxygen, ready to be transported to the rest of the body via the pulmonary veins.

15. **How nose and nasal cavity function in filtering incoming air?**

The **nose and nasal cavity** play an important role in filtering incoming air. The inner lining of the nasal cavity has **cilia and mucus**, which trap dust particles, microbes, and other harmful substances, preventing them from entering the lungs. Additionally, the nasal cavity warms and moistens the air, making it safer and more suitable for the delicate lung tissues.

16**.** **What is the role of pharynx in human respiration**

The **pharynx** is a muscular tube that serves as a passage for both air and food. In human respiration, it acts as a **common pathway** for the movement of air from the nasal cavity to the larynx (voice box). It ensures that inhaled air is directed towards the trachea and lungs while also preventing food from entering the respiratory tract, thanks to the action of the epiglottis.

**Extensive Answer Questions:**

**1. Describe the structure of the human respiratory system.** The human respiratory system is composed of a series of organs and tissues that facilitate the process of breathing. It begins with the nose and **nasal cavity**, where air is filtered, warmed, and moistened. Air then passes through the **pharynx** and **larynx** into the **trachea**, a tube that conducts air to the lungs. The trachea divides into two **bronchi**, each entering a lung. Inside the lungs, the bronchi further divide into smaller **bronchioles** that end in tiny air sacs called **alveoli**. These alveoli are surrounded by a network of capillaries where the exchange of oxygen and carbon dioxide takes place. The **diaphragm**, a dome-shaped muscle below the lungs, plays a vital role in the process of inhalation and exhalation by changing the pressure within the chest cavity.

**2. Define breathing. Write the mechanism of breathing.** Breathing is the physical process of inhaling oxygen-rich air into the lungs and exhaling carbon dioxide-rich air out of the lungs. It is also called ***pulmonary ventilation***. The mechanism of breathing involves two main phases: inspiration and expiration. During inspiration, the diaphragm contracts and moves downward while the intercostal muscles between the ribs contract to lift the rib cage up and outward. This increases the volume of the thoracic cavity and decreases the pressure inside the lungs, causing air to rush in. During expiration, the diaphragm and intercostal muscles relax, decreasing the volume of the thoracic cavity and increasing the pressure inside the lungs, pushing air out. This cycle of breathing ensures a constant supply of oxygen and removal of carbon dioxide.

**3. Differentiate between the composition of inspired and expired air.** Inspired (inhaled) air and expired (exhaled) air differ significantly in their composition. Inspired air contains approximately 21% oxygen, 0.04% carbon dioxide, and 78% nitrogen, along with small amounts of other gases and water vapour. In contrast, expired air contains about 16% oxygen, 4% carbon dioxide, and 78% nitrogen, with a much higher percentage of water vapour. The ***decrease in oxygen and increase in carbon dioxide in expired air*** occur because oxygen is absorbed into the bloodstream from the alveoli for use in cellular respiration, while carbon dioxide, a waste product of metabolism, diffuses from the blood into the alveoli to be expelled from the body.

**4. State the symptoms, causes, and treatments of:**

**a. Bronchitis** Bronchitis is the inflammation of the bronchial tubes, which carry air to and from the lungs. **Symptoms** include persistent cough, mucus production, wheezing, shortness of breath, and chest discomfort. It is commonly **caused** by viral or bacterial infections or by exposure to irritants such as tobacco smoke and air pollution. **Treatment** includes rest, plenty of fluids, cough medicines, bronchodilators, and in bacterial cases, antibiotics.

**b. Emphysema** Emphysema is a chronic lung disease where the alveoli become damaged and lose their elasticity, leading to breathing difficulties. **Symptoms** include shortness of breath, chronic cough, and wheezing. The primary **cause** is long-term exposure to cigarette smoke and other airborne irritants. There is no cure, but **treatment** includes inhalers, medications, oxygen therapy, and lifestyle changes such as quitting smoking.

**c. Pneumonia** Pneumonia is an infection that inflames the air sacs (alveoli) in one or both lungs. These air sacs may fill with fluid or pus, causing **symptoms** like a cough with phlegm, fever, chills, and difficulty breathing. It is **caused** by bacteria, viruses, or fungi. Treatment depends on the cause and may include antibiotics, antiviral or antifungal medications, rest, fluids, and oxygen support in severe cases.

**d. Asthma** Asthma is a chronic condition in which the airways become inflamed and narrow, leading to difficulty in breathing. Common **symptoms** include wheezing, coughing, chest tightness, and shortness of breath. **Triggers** include allergens, exercise, cold air, and pollution. Although there is no permanent cure, asthma can be **managed** with inhalers (bronchodilators and corticosteroids), lifestyle adjustments, and avoiding known triggers.

**e. Lung Cancer** Lung cancer is a malignant growth of cells in the lungs. **Symptoms** include persistent cough, coughing up blood, chest pain, hoarseness, weight loss, and shortness of breath. The leading **cause** is smoking, although exposure to secondhand smoke, pollution, and harmful chemicals can also contribute. **Treatment** options include surgery, chemotherapy, radiation therapy, and targeted drug therapies, depending on the stage and type of cancer.



