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BIO · BIOLOGY

09. Respiration / Gaseous Exchange

Official PMDC Solved Past Paper Topical Booklet · High-Yield Examination Series

🎯 34 Solved Questions

📅 2014 to 2024 Archive

🏛️ Boards: BUMHS, DUHS, KMU, MDCAT, NUMS, PMDC

📊 Weightage: 34% of MDCAT (68 MCQs)

Curated by Ibrahim for fellow bees. Every question in this chapter has been verified against official UHS, NUMS, SZABMU, DUHS, and KMU answer keys. Propolis cognitive autopsies are provided at the end of this booklet to explain core concepts and break down common distractor traps.

OFFICIAL SOLVED EDITION

Q1.

UHS 2024

Range of normal total lung capacity in humans is:
[UHS-2024]

- (A) 8-9 liters
- (B) 10-11 liters
- (C) 5-6 liters
- (D) 12-13 liters

Q2.

SZABMU 2024

When the diaphragm muscle lowers and the ribs move outward and forward, the volume of _____ increases, and the pressure on _____ decreases respectively. [SZABMU-2024]

- (A) Abdominal cavity, lungs
- (B) Chest cavity, lungs
- (C) Lungs, chest cavity
- (D) Lungs, abdominal cavity

Q3.

SZABMU 2024

Lungs are enclosed in the double membranous sac called: [SZABMU-2024]

- (A) Pericardium
- (B) Peritoneum
- (C) Pleura
- (D) Connective tissue

Q4.

SZABMU 2024

Which type of the conjugated molecule is absent in respiratory distress syndrome? [SZABMU-2024]

- (A) Lipoprotein
- (B) Glycoprotein
- (C) Lipopolysaccharides
- (D) Glycolipids

Q5.

NUMS 2024

Most of the carbon dioxide in blood is transported as by bicarbonate ions. Choose the event not taking place during gaseous exchange at tissue level. [NUMS-2024]

- (A) Formation of HHb
- (B) Formation of sodium bicarbonate
- (C) Chloride shift
- (D) Formation of oxyhaemoglobin

Q6.

SZABMU 2024

Which of the following proteins are involved in the expansion and recoiling of alveoli during breathing? [SZABMU-2024-Reconduct]

- (A) Collagen and keratin
- (B) Collagen and elastin
- (C) Elastin and keratin
- (D) Collagens and squamous cells

Q7.

SZABMU 2024

The area between the two lungs is called: **[SZABMU-2024-Reconduct]**

- (A) Mediastinum
- (B) Ischium
- (C) Acetabulum
- (D) Hilum

Q8.

UHS 2023

Smooth muscles are found in all mentioned below except: **[UHS-2023]**

- (A) Trachea
- (B) Bronchi
- (C) Alveoli
- (D) Bronchioles

Q9.

UHS 2023

The method of bringing oxygenated air into contact with a gas exchange surface is called: **[UHS-2023]**

- (A) Photorespiration
- (B) Gas transport
- (C) Respiration
- (D) Ventilation

Q10.

KMU 2023

Which of the following statements is not correct about alveoli: **[ETEA-2023]**

- (A) Alveoli form the gas exchange surface
- (B) Alveoli has a dense network of capillaries
- (C) The wall of each alveolus is 0.1 cm thick
- (D) Collagen and elastin present in alveoli allow it to expand and recoil easily during breathing

Q11.

KMU 2023

Where does the Trachea lie in relation to the esophagus? **[ETEA-2023 Retake]**

- (A) Dorsal
- (B) Lateral
- (C) Medial
- (D) Ventral

Q12.

UHS 2022

The respiratory surfaces exhibit following characteristic: **[UHS-2022]**

- (A) It must be thick for low diffusion
- (B) It must be permeable
- (C) It should be non-vascularized
- (D) It should have low ventilation mechanism

Q13.

NUMS 2022

The following part is common in both digestive system and respiratory system of human beings: **[NUMS-2022]**

- (A) Trachea
- (B) Larynx
- (C) Pharynx
- (D) Esophagus

Q14.

SZABMU 2022

The area between the two lungs is called: **[SZABMU-2022]**

- (A) Periosteum
- (B) Infundibulum
- (C) Hilum
- (D) Mediastinum

Q15.

KMU 2022

Which of the following part of human respiratory system forms the gas exchange surface? **[ETEA-2022]**

- (A) Alveoli
- (B) Larynx
- (C) Bronchi
- (D) Trachea

Q16.

BUMHS 2022

Where does the trachea lie in relation to the esophagus? **[BUMHS-2022]**

- (A) Dorsal
- (B) Medial
- (C) Ventral
- (D) Lateral

Q17.

KMU 2022

The percentage of carbon dioxide carried as carboxyhaemoglobin is: **[ETEA-2022]**

- (A) 70%
- (B) 15%
- (C) 7%
- (D) 23%

Q18.

KMU 2022

The average adult human has a lung capacity of approximately: **[ETEA-2022]**

- (A) 5 liters
- (B) 2 liters
- (C) 9 liters
- (D) 12 liters

Q19.

DUHS 2022

The tidal Volume of lungs at rest or during normal breath is: [DUHS-2022]

- (A) 4 liters
- (B) 6 liters
- (C) 3 liters
- (D) 0.5 liters

Q20.

PMDC 2019

In the passageways of the respiratory system, mucus secreting cells are called: [NTS-2019]

- (A) Tracheal cells
- (B) Surfactant cells
- (C) Goblet cells
- (D) Pleural cells

Q21.

MDCAT 2019

During inspiration, the space inside the chest cavity is increased due to: [MDCAT-2019]

- (A) The contraction of the muscles of the diaphragm
- (B) The relaxation of the muscle of the diaphragm
- (C) Relaxation of the external intercostal muscle
- (D) Increased pressure

Q22.

MDCAT 2018

During breathing air from pharynx enters to: [MDCAT-2018]

- (A) Alveoli
- (B) Trachea
- (C) Bronchioles
- (D) Bronchi

Q23.

MDCAT 2018

The low levels of surfactant produced by alveolar epithelium causes: [MDCAT-2018]

- (A) Emphysema
- (B) Bronchitis
- (C) Respiratory distress syndrome
- (D) Asthma

Q24.

MDCAT 2018

Which of the following statement is correct about the respiratory pigments? [MDCAT-2018]

- (A) Myoglobin has more affinity for oxygen as compared to haemoglobin
- (B) Albumin, globulin and globular proteins are present in respiratory pigments
- (C) Myoglobin and haemoglobin has higher affinity for nitrogen
- (D) Cyanide and haemoglobin has low affinity for oxygen

Q25.

MDCAT 2017

Site of gaseous exchange in humans is: [MDCAT-2017]

- (A) Alveoli
- (B) Bronchus
- (C) Trachea
- (D) Nose

Q26.

MDCAT 2017

Respiratory tubules are termed as bronchioles when they attain the diameter of or lesser. [MDCAT-2017]

- (A) 1 mm
- (B) 1.2 cm
- (C) 1 cm
- (D) 1.2 mm

Q27.

MDCAT 2017

Label the prominent dome-shaped muscular boundary located at the base of the lungs separating the thoracic and abdominal cavities:

[MDCAT-2017]

- (A) Pleura
- (B) Chest cavity
- (C) Inter-coastal muscle
- (D) Diaphragm

Q28.

MDCAT 2017

Low partial pressure of oxygen in tissues favors ____ of oxyhaemoglobin. [MDCAT-2017]

- (A) Stability
- (B) Formation
- (C) Dissociation
- (D) Transformation

Q29.

MDCAT 2017

Gaseous exchange in animals takes place with the help of process called as: [MDCAT-2017]

- (A) Active transport
- (B) Cyclosis
- (C) Diffusion
- (D) Phagocytosis

Q30.

MDCAT 2017

Which of the following is a respiratory disorder related to malnutrition? [MDCAT-2017]

- (A) Cancer
- (B) Emphysema
- (C) Tuberculosis
- (D) Asthma

Q31.

MDCAT 2017

Breakdown of thin wall of alveoli occurs in: [MDCAT-2017, 2018, 2019]

- (A) T.B
- (B) Emphysema
- (C) Cancer
- (D) Asthma

Q32.

MDCAT 2016

Breathing consists of: [MDCAT-2016]

- (A) Two phases
- (B) One phase
- (C) Three phases
- (D) Four phases

Q33.

MDCAT 2016

Carboxyhemoglobin (10-20%) is formed when CO_2 combines with: [MDCAT-2016]

- (A) Haem portion of haemoglobin
- (B) Amino group of haemoglobin
- (C) Iron part of haemoglobin
- (D) Plasma proteins

Q34.

DUHS 2014

Mucus secreting goblet cells are present in: [KMDC-2014]

- (A) Larynx
- (B) Glottis
- (C) Epiglottis
- (D) Trachea

RAPID 5-COLUMN ANSWER KEY

Official PMDC verified answer keys for 09. Respiration / Gaseous Exchange.

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Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD
1	C	UHS 2024	8	C	UHS 2023	15	A	KMU 2022	22	B	MDCAT 2018	29	C	MDCAT 2017
2	B	SZABMU 2024	9	D	UHS 2023	16	C	BUMHS 2022	23	C	MDCAT 2018	30	C	MDCAT 2017
3	C	SZABMU 2024	10	C	KMU 2023	17	D	KMU 2022	24	A	MDCAT 2018	31	B	MDCAT 2017
4	A	SZABMU 2024	11	D	KMU 2023	18	A	KMU 2022	25	A	MDCAT 2017	32	A	MDCAT 2016
5	D	NUMS 2024	12	B	UHS 2022	19	D	DUHS 2022	26	A	MDCAT 2017	33	B	MDCAT 2016
6	B	SZABMU 2024	13	C	NUMS 2022	20	C	PMDC 2019	27	D	MDCAT 2017	34	D	DUHS 2014
7	A	SZABMU 2024	14	D	SZABMU 2022	21	A	MDCAT 2019	28	C	MDCAT 2017			

TOTAL
MCQS

34

CORRECT

INCORRECT

BLANK

ACCURACY

%

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autopsies.

PROPOLIS COGNITIVE ERROR AUTOPSIES

Step-by-step conceptual derivations, formula working, and distractor autopsies for every question.

Question #1 Key: (C)

UHS 2024

Range of normal total lung capacity in humans is: [UHS-2024]

CORE CONCEPT AND DERIVATION

Total Lung Capacity (TLC) encompasses every possible measurable volume within the human lung architecture.

Solution:

- TLC is mathematically the sum of Vital Capacity (VC) and Residual Volume (RV).
- In standard human physiology, the normal biological limit for a healthy adult's Total Lung Capacity falls strictly within the range of 5 to 6 liters.

Why other options are incorrect:

- 8-13 liters: These volumes are massive and far exceed the anatomical limits of the human thoracic cage. Such volumes are observed only in much larger mammals.

Question #2 Key: (B)

SZABMU 2024

When the diaphragm muscle lowers and the ribs move outward and forward, the volume of _____ increases, and ...

CORE CONCEPT AND DERIVATION

Inspiration is driven by Boyle's Law: an increase in container volume produces an immediate drop in internal pressure.

Solution:

- When the diaphragm contracts (lowers) and intercostal muscles elevate the ribs, the physical dimensions of the **chest cavity** expand.
- Because the chest cavity volume *increases*, the intrapleural pressure plummets.
- This vacuum-like effect pulls on the **lungs**, causing their internal intrapulmonary pressure to decrease below atmospheric levels, sucking air in.

Why other options are incorrect:

- **Abdominal cavity:** When the diaphragm lowers, it actually compresses the abdominal cavity, *decreasing* its volume and *increasing* abdominal pressure.
- **Lungs, Chest cavity (reversed):** The structural volume of the chest cavity dictates the pressure applied to the lungs, not vice versa.

Question #3 Key: (C)

SZABMU 2024

Lungs are enclosed in the double membranous sac called: [SZABMU-2024]

CORE CONCEPT AND DERIVATION

Vital thoracic and abdominal organs are protected and lubricated by specialized serous membranes.

Solution:

- The lungs are wrapped tightly in a double-layered sac known as the **pleura**.
- It consists of the visceral pleura (adhered to the lung tissue) and the parietal pleura (lining the chest wall).
- The tiny space between them holds pleural fluid, which eliminates friction during the continuous expansion and recoiling of breathing.

Why other options are incorrect:

- **Pericardium:** The specific double-membranous sac enclosing the *heart*.
- **Peritoneum:** The serous membrane lining the *abdominal* cavity and its organs.

Question #4 Key: (A)

SZABMU 2024

Which type of the conjugated molecule is absent in respiratory distress syndrome? [SZABMU-2024]

CORE CONCEPT AND DERIVATION

Surfactant is biochemically essential to prevent the collapse of alveoli by interfering with the hydrogen bonding of water.

Solution:

- Pulmonary surfactant is synthesized by Type II alveolar cells.
- Biochemically, it is a highly complex mixture composed predominantly of phospholipids combined with specific proteins—making it a **lipoprotein** complex.
- In Respiratory Distress Syndrome (common in premature neonates), the severe lack of this specific **lipoprotein** causes overwhelming alveolar surface tension, leading to lung collapse.

Why other options are incorrect:

- **Glycoprotein / Glycolipids:** Common components of cell membrane receptors, but not the primary functional surfactant molecule.
- **Lipopolysaccharides:** Found in the outer membranes of Gram-negative bacteria as endotoxins.

Question #5 Key: (D)

NUMS 2024

Most of the carbon dioxide in blood is transported as by bicarbonate ions. Choose the event not taking place d...

CORE CONCEPT AND DERIVATION

Gas exchange events differ completely based on the location: systemic tissues vs. pulmonary capillaries (lungs).

Solution:

- At the **tissue level**, oxygen is desperately needed for cellular respiration. Therefore, hemoglobin must *release* its oxygen.
- Because oxygen is being released, **oxyhaemoglobin (HbO₂) is breaking down, NOT forming**.
- The *formation* of oxyhemoglobin exclusively happens in the lungs where oxygen is abundant.

Why other options are incorrect:

- **Formation of HHb (reduced hemoglobin):** Occurs at the tissues as hemoglobin drops oxygen and buffers hydrogen ions.
- **Formation of sodium bicarbonate & Chloride shift:** Occur actively at the tissues as massive amounts of CO₂ enter the RBCs, convert to bicarbonate, and exit into plasma in exchange for Chloride.

Question #6 Key: (B)

SZABMU 2024

Which of the following proteins are involved in the expansion and recoiling of alveoli during breathing? [SZAM...

CORE CONCEPT AND DERIVATION

The lung parenchyma must possess both structural integrity to prevent tearing and extreme elasticity to drive passive exhalation.

Solution:

- The connective tissue walls of the alveoli are reinforced with two vital proteins:
- **Collagen:** Provides tensile strength, preventing the alveoli from over-inflating or tearing.
- **Elastin:** Acts like molecular rubber bands, allowing the alveoli to stretch easily during inspiration and snap back (recoil) effortlessly during exhalation, pushing air out.

Why other options are incorrect:

- **Keratin:** A tough, waterproof protein found in hair, nails, and epidermis. It has absolutely no place in the delicate alveoli.
- **Squamous cells:** These are epithelial cells, not proteins.

Question #7 Key: (A)

SZABMU 2024

The area between the two lungs is called: [SZABMU-2024-Reconduct]

CORE CONCEPT AND DERIVATION

The thoracic cavity is partitioned into distinct zones to isolate organs and prevent the spread of infection.

Solution:

- The specific anatomical region sandwiched securely between the right and left pleural cavities (lungs) is termed the **mediastinum**.
- This crucial space houses the heart, pericardium, major vessels, esophagus, and trachea.

Why other options are incorrect:

- **Ischium / Acetabulum:** These are bones/structures of the pelvis (hip joint).
- **Hilum:** The root of a single lung where bronchi and vessels attach; not the space between the lungs.

Question #8 Key: (C)

UHS 2023

Smooth muscles are found in all mentioned below except: [UHS-2023]

CORE CONCEPT AND DERIVATION

Form follows function in histology. The thickness of airway walls dictates their capability for gas exchange versus conduction.

Solution:

- The conducting zones (trachea, bronchi, bronchioles) contain layers of smooth muscle that allow the autonomic nervous system to control airway resistance (bronchodilation and bronchoconstriction).
- The **alveoli** represent the functional gas-exchange zone. They consist strictly of a single microscopic layer of squamous epithelium.
- If alveoli contained bulky smooth muscle tissue, the barrier would be entirely too thick for O₂ and CO₂ to diffuse. Thus, they lack smooth muscle completely.

Why other options are incorrect:

- **Trachea, Bronchi, Bronchioles:** All contain smooth muscle within their walls to regulate the diameter of the airway passage.

Question #9 Key: (D)

UHS 2023

The method of bringing oxygenated air into contact with a gas exchange surface is called: [UHS-2023]

CORE CONCEPT AND DERIVATION

It is vital to distinguish between the cellular, vascular, and purely mechanical aspects of breathing.

Solution:

- **Ventilation** (commonly called breathing) is strictly the physical, mechanical process of pumping fresh air into the lungs (inspiration) and expelling stale air (expiration).
- It acts purely as a delivery system to bring oxygenated air into physical contact with the alveolar gas exchange surface.

Why other options are incorrect:

- **Respiration:** Generally refers to the overall process including internal cellular respiration (ATP production) or the actual chemical diffusion of gases.
- **Gas transport:** The movement of gases through the bloodstream via hemoglobin, *after* they cross the exchange surface.
- **Photorespiration:** A wasteful metabolic pathway in plants.

Question #10 Key: (C)

KMU 2023

Which of the following statements is not correct about alveoli: [ETEA-2023]

CORE CONCEPT AND DERIVATION

The physics of diffusion demand that respiratory surfaces be phenomenally thin. Misunderstanding biological units reveals conceptual errors.

Solution:

- The wall of an alveolus is roughly $0.1\ \mu\text{m}$ (micrometers) thick, not $0.1\ \text{cm}$.
- $0.1\ \text{cm}$ is equal to $1\ \text{mm}$. A barrier $1\ \text{mm}$ thick would be an impenetrable fortress to gas diffusion, instantly causing asphyxiation.
- Therefore, the statement claiming a $0.1\ \text{cm}$ thickness is mathematically and biologically completely incorrect.

Why other options are incorrect:

- **Dense capillary network, Gas exchange surface, Collagen/elastin presence:** All of these are highly accurate biological facts regarding alveolar structure and function.

Question #11 Key: (D)

KMU 2023

Where does the Trachea lie in relation to the esophagus? [ETEA-2023 Retake]

CORE CONCEPT AND DERIVATION

The spatial orientation of organs is critical for understanding anatomy and physiological protections (like cartilaginous rings preventing collapse).

Solution:

- In the human anatomical position, the **trachea** (windpipe) is situated at the absolute front of the throat and upper chest.
- The term **ventral** denotes the front or anterior side of the body.
- The esophagus lies directly dorsal (behind) the trachea. The C-shaped cartilaginous rings of the trachea are open at the back specifically to allow the esophagus room to bulge when a large bolus of food is swallowed.

Why other options are incorrect:

- **Dorsal:** Means behind/rear. The esophagus is dorsal.
- **Lateral/Medial:** The organs are aligned front-to-back, not side-to-side.

Question #12 Key: (B)

UHS 2022

The respiratory surfaces exhibit following characteristic: [UHS-2022]

CORE CONCEPT AND DERIVATION

For a respiratory surface to be efficient, it must maximize the rate of diffusion as described by Fick's Law.

Solution:

- An ideal respiratory surface must have several key traits: large surface area, highly vascularized network, extremely thin walls, and **high permeability** to gases.
- Permeability allows O_2 and CO_2 to dissolve and effortlessly cross the cell membranes.

Why other options are incorrect:

- **Thick for low diffusion:** A thick surface severely impedes diffusion; it must be microscopically thin.
- **Non-vascularized:** Lack of blood supply means gases cannot be transported away, halting the concentration gradient.
- **Low ventilation:** High ventilation is strictly required to bring in fresh air and maintain steep partial pressure gradients.

Question #13 Key: (C)

NUMS 2022

The following part is common in both digestive system and respiratory system of human beings: [NUMS-2022]

CORE CONCEPT AND DERIVATION

The anatomical pathways for food and air briefly intersect in the throat before diverging.

Solution:

- The **pharynx** is a muscular tube located at the back of the mouth and nasal cavity.
- It acts as a dual-purpose thoroughfare: it funnels inhaled air toward the larynx (respiratory) and ingested food/liquids toward the esophagus (digestive).
- The epiglottis ensures that food correctly bypasses the airway during swallowing.

Why other options are incorrect:

- **Trachea & Larynx:** Strictly belong to the respiratory tract.
- **Esophagus:** Strictly belongs to the digestive tract.

Question #14 Key: (D)

SZABMU 2022

The area between the two lungs is called: [SZABMU-2022]

CORE CONCEPT AND DERIVATION

The thoracic cavity is partitioned into specific anatomical compartments housing vital organs.

Solution:

- The central compartment of the thoracic cavity, situated safely between the two pleural cavities (which house the lungs), is called the **mediastinum**.
- It acts as a protective housing for the heart, great vessels (aorta, vena cava), esophagus, and trachea.

Why other options are incorrect:

- **Periosteum:** A dense fibrous membrane covering the surfaces of bones.
- **Infundibulum:** A funnel-shaped cavity or structure, often referring to a part of the brain (pituitary stalk) or fallopian tube.
- **Hilum:** The specific depression on a single lung where bronchi and blood vessels enter and exit, not the entire area between the lungs.

Question #15 Key: (A)

KMU 2022

Which of the following part of human respiratory system forms the gas exchange surface? [ETEA-2022]

CORE CONCEPT AND DERIVATION

The respiratory system is divided into a conducting zone (bringing air in) and a respiratory zone (where actual gas exchange happens).

Solution:

- The **alveoli** are clustered, highly vascularized microscopic sacs that form the terminal ends of the respiratory tree.
- Their exceedingly thin squamous epithelium allows for the rapid diffusion of oxygen into the blood and carbon dioxide out of the blood.

Why other options are incorrect:

- **Trachea, Larynx, Bronchi:** These are thick-walled, cartilaginous tubes belonging to the conducting zone. Gas cannot diffuse through their thick structural layers.

Question #16 Key: (C)

BUMHS 2022

Where does the trachea lie in relation to the esophagus? [BUMHS-2022]

CORE CONCEPT AND DERIVATION

Understanding the anatomical positioning of the major cervical and thoracic tubes is crucial for medical science and emergency airway management.

Solution:

- The **trachea** (windpipe) is positioned anteriorly in the neck.
- In anatomical terminology, "anterior" is synonymous with **ventral** (toward the front/belly side).
- The esophagus sits directly behind (dorsal to) the trachea, resting against the cervical spine.

Why other options are incorrect:

- **Dorsal:** Means "towards the back." The esophagus is dorsal to the trachea.
- **Medial / Lateral:** Refer to midline positioning; the trachea and esophagus are stacked front-to-back, not side-by-side.

Question #17 Key: (D)

KMU 2022

The percentage of carbon dioxide carried as carboxyhaemoglobin is: [ETEA-2022]

CORE CONCEPT AND DERIVATION

Carbon dioxide is managed by the cardiovascular system through three distinct transport mechanisms to maintain acid-base balance.

Solution:

- CO_2 is distributed in the blood as follows:
- **1. As bicarbonate ions (HCO_3^-):** Approximately 70% is converted via carbonic anhydrase.
- **2. Bound to hemoglobin (carbaminohemoglobin):** Approximately 23% (often called carboxyhaemoglobin in older local syllabus).
- **3. Dissolved in plasma:** Approximately 7% remains as a dissolved gas in the blood fluid.

Why other options are incorrect:

- 70%: Represents the bicarbonate ion fraction.
- 7%: Represents the dissolved plasma fraction.

Question #18 Key: (A)

KMU 2022

The average adult human has a lung capacity of approximately: [ETEA-2022]

CORE CONCEPT AND DERIVATION

Total Lung Capacity (TLC) is the maximum volume of air the lungs can hold after a maximal forced inspiration.

Solution:

- TLC is calculated as the sum of Vital Capacity (VC) and Residual Volume (RV).
- In a healthy, average-sized adult, this total volume ranges between 5 to 6 liters (5000 - 6000 mL).

Why other options are incorrect:

- 2 liters: Far too low for total capacity; closer to isolated volumes like Functional Residual Capacity.
- 9 liters / 12 liters: Massively exceed biological human limits; these volumes are seen in large mammals like horses.

Question #19 Key: (D)

DUHS 2022

The tidal Volume of lungs at rest or during normal breath is: [DUHS-2022]

CORE CONCEPT AND DERIVATION

Respiratory volumes vary greatly depending on exertion. Tidal volume represents baseline, resting respiration.

Solution:

- **Tidal Volume (TV)** is the amount of air inhaled or exhaled during a single, normal, relaxed breath without any extra effort.
- In a healthy adult, this volume is precisely 500 mL, which translates to 0.5 liters.

Why other options are incorrect:

- 3, 4, and 6 liters: These are massive volumes representing forced vital capacities or total lung capacities, not a relaxed, resting breath.

Question #20 Key: (C)

PMDC 2019

In the passageways of the respiratory system, mucus secreting cells are called: [NTS-2019]

CORE CONCEPT AND DERIVATION

The respiratory epithelium utilizes specialized glandular cells to maintain moisture and trap debris.

Solution:

- The epithelial lining of the respiratory tract contains modified columnar cells shaped like a wine goblet.
- These **goblet cells** synthesize and secrete mucus directly onto the surface of the respiratory passageways.

Why other options are incorrect:

- **Tracheal cells:** A non-specific term; the trachea contains multiple cell types (ciliated, basal, goblet).
- **Surfactant cells:** Also known as Type II pneumocytes, these are found exclusively in the alveoli to reduce surface tension, not in the general passageways to secrete mucus.
- **Pleural cells:** Form the mesothelial lining of the pleural cavity.

Question #21 Key: (A)

MDCAT 2019

During inspiration, the space inside the chest cavity is increased due to: [MDCAT-2019]

CORE CONCEPT AND DERIVATION

Boyle's Law states that pressure is inversely proportional to volume. Inspiration requires a volume increase to drop internal pressure below atmospheric pressure.

Solution:

- During active inspiration, the nervous system signals the skeletal muscles of the respiratory pump.
- **The diaphragm contracts**, causing its dome shape to flatten and move downward.
- Simultaneously, the external intercostal muscles contract, lifting the rib cage. These combined muscle contractions dramatically increase the volume of the chest cavity.

Why other options are incorrect:

- **Relaxation of diaphragm / intercostals:** This occurs during expiration, reducing chest cavity volume.
- **Increased pressure:** Volume must increase to decrease pressure for inspiration to occur.

Question #22 Key: (B)

MDCAT 2018

During breathing air from pharynx enters to: [MDCAT-2018]

CORE CONCEPT AND DERIVATION

The pathway of airflow must be understood sequentially from the external environment to the site of gas exchange.

Solution:

- When air is inhaled, it travels through the nasal cavity → pharynx → larynx → **trachea**.
- From the trachea, it bifurcates into the left and right **bronchi**, which further subdivide.
- Because the larynx is not listed in the options, the **trachea** is the immediate next major respiratory structure the air enters after the pharynx.

Why other options are incorrect:

- **Alveoli, Bronchi, Bronchioles:** These structures are located much deeper in the respiratory tract and receive air only after it has passed through the trachea.

Question #23 Key: (C)

MDCAT 2018

The low levels of surfactant produced by alveolar epithelium causes: [MDCAT-2018]

CORE CONCEPT AND DERIVATION

Surfactant is a lipoprotein complex that decreases surface tension inside alveoli, preventing them from collapsing during exhalation.

Solution:

- If Type II pneumocytes fail to produce adequate surfactant (commonly seen in premature infants), the surface tension inside the alveoli becomes too high.
- This leads to alveolar collapse and severe breathing difficulty, a condition medically termed as **Respiratory Distress Syndrome (RDS)**.

Why other options are incorrect:

- **Emphysema:** Destruction of alveolar walls, not a lack of surfactant.
- **Bronchitis / Asthma:** Inflammatory diseases of the airways (bronchi/bronchioles), not directly caused by alveolar surfactant deficiency.

Question #24 Key: (A)

MDCAT 2018

Which of the following statement is correct about the respiratory pigments? [MDCAT-2018]

CORE CONCEPT AND DERIVATION

Different respiratory pigments are adapted for transport versus storage of oxygen.

Solution:

- **Hemoglobin** (in blood) is designed to transport oxygen; it binds it in the lungs and easily drops it off in tissues.
- **Myoglobin** (in muscle tissue) acts as an oxygen reservoir. It must be able to steal oxygen away from hemoglobin.
- Therefore, **myoglobin has a significantly higher binding affinity for oxygen** than hemoglobin, holding onto its O₂ tightly until the muscle experiences extreme hypoxia.

Why other options are incorrect:

- **Affinity for nitrogen:** Neither pigment actively binds or transports nitrogen gas.
- **Albumin/Globulin:** These are standard plasma transport/immune proteins, not oxygen-carrying respiratory pigments.

Question #25 Key: (A)

MDCAT 2017

Site of gaseous exchange in humans is: [MDCAT-2017]

CORE CONCEPT AND DERIVATION

Gaseous exchange requires a thin, moist, and highly vascularized surface to allow efficient diffusion of respiratory gases.

Solution:

- The **alveoli** are microscopic, balloon-like air sacs at the terminal ends of the respiratory tree.
- They consist of a single layer of squamous epithelial cells surrounded by a dense network of pulmonary capillaries.
- This creates an optimal, extremely thin barrier for the rapid diffusion of O_2 and CO_2 .

Why other options are incorrect:

- **Trachea, Bronchus, Nose:** These form the conducting zone of the respiratory system. Their thick walls and structural cartilage prevent any meaningful gas exchange. They only filter, warm, and humidify the air.

Question #26 Key: (A)

MDCAT 2017

Respiratory tubules are termed as bronchioles when they attain the diameter of or lesser. [MDCAT-2017]

CORE CONCEPT AND DERIVATION

The respiratory tree is classified based on structural changes, particularly the presence or absence of cartilage and overall diameter.

Solution:

- As the bronchi branch repeatedly, their diameter decreases and the cartilaginous rings are gradually replaced by irregular plates.
- Once a tubule reaches a diameter of 1 mm **or less**, it loses its cartilage entirely.
- At this specific structural threshold, the passage is officially termed a **bronchiole**.

Why other options are incorrect:

- 1.2 cm, 1 cm, 1.2 mm: These measurements are either too large (representing bronchi or the trachea) or slightly above the strict anatomical threshold for defining a bronchiole.

Question #27 Key: (D)

MDCAT 2017

Label the prominent dome-shaped muscular boundary located at the base of the lungs separating the thoracic and...

CORE CONCEPT AND DERIVATION

The mechanism of breathing relies heavily on muscular boundaries that alter the volume of the thoracic cavity.

Solution:

- In standard anatomical diagrams of the human respiratory system, the prominent dome-shaped structure at the very base of the lungs is the **diaphragm**.
- It is a thin sheet of skeletal muscle that completely separates the thoracic (chest) cavity from the abdominal cavity.

Why other options are incorrect:

- **Pleura:** The double membrane enclosing the lungs, not a muscular boundary at the base.
- **Inter-coastal muscle:** Muscles located between the ribs.
- **Chest cavity:** The entire space, not a specific muscular structure.

Question #28 Key: (C)

MDCAT 2017

Low partial pressure of oxygen in tissues favors ____ of oxyhaemoglobin. [MDCAT-2017]

CORE CONCEPT AND DERIVATION

The behavior of hemoglobin changes dynamically based on the partial pressures of gases in its surrounding environment (Oxygen-Hemoglobin Dissociation Curve).

Solution:

- In the lungs, where the partial pressure of oxygen (pO_2) is very high, hemoglobin's affinity for oxygen peaks, favoring the **formation** of oxyhemoglobin.
- Conversely, at the tissue level, cellular respiration heavily consumes oxygen, resulting in a very low pO_2 .
- This low pO_2 triggers hemoglobin to lose its affinity and release its bound oxygen. This process is called **dissociation**.

Why other options are incorrect:

- **Formation / Stability:** These are favored in high pO_2 environments (the lungs), ensuring oxygen gets securely loaded onto the RBCs.

Question #29 Key: (C)

MDCAT 2017

Gaseous exchange in animals takes place with the help of process called as: [MDCAT-2017]

CORE CONCEPT AND DERIVATION

The movement of gases across biological membranes is solely governed by kinetic energy and concentration gradients.

Solution:

- Gaseous exchange does not require ATP or carrier proteins.
- Oxygen and carbon dioxide are small, uncharged molecules that pass freely through the phospholipid bilayers of alveoli and capillaries.
- They move exclusively via **simple diffusion**, traveling strictly from areas of higher partial pressure to areas of lower partial pressure.

Why other options are incorrect:

- **Active transport:** Requires ATP and pushes molecules against gradients; gases never utilize this.
- **Cyclosis:** Cytoplasmic streaming inside cells.
- **Phagocytosis:** Cellular eating (engulfing large particles).

Question #30 Key: (C)

MDCAT 2017

Which of the following is a respiratory disorder related to malnutrition? [MDCAT-2017]

CORE CONCEPT AND DERIVATION

Nutritional status profoundly impacts immune competence, making the body susceptible to opportunistic respiratory infections.

Solution:

- **Tuberculosis (TB)** is a contagious bacterial infection caused by *Mycobacterium tuberculosis*.
- Historically and clinically, TB is strongly associated with poverty, overcrowding, and strictly **malnutrition**. A malnourished body lacks the immune strength (like macrophages) to contain the mycobacterium, allowing the infection to ravage the lung tissue.

Why other options are incorrect:

- **Emphysema / Cancer:** Strongly correlated with smoking and environmental toxins, not directly caused by malnutrition.
- **Asthma:** An allergic/inflammatory hypersensitivity disorder, often genetic or environmental.

Question #31 Key: (B)

MDCAT 2017

Breakdown of thin wall of alveoli occurs in: [MDCAT-2017, 2018, 2019]

CORE CONCEPT AND DERIVATION

Chronic respiratory diseases present with distinct structural damages to the lung architecture.

Solution:

- **Emphysema** is a form of Chronic Obstructive Pulmonary Disease (COPD) predominantly caused by long-term smoking.
- Toxins cause chronic inflammation, triggering enzymes that actively digest the elastin and collagen in the alveolar walls.
- This **breakdown of thin alveolar walls** merges many small alveoli into fewer, larger, floppy air sacs, drastically reducing the surface area available for gas exchange.

Why other options are incorrect:

- **Asthma:** Involves constriction and inflammation of the bronchioles, not the physical destruction of alveoli.
- **T.B:** Causes necrotic tubercles and granulomas.
- **Cancer:** Characterized by uncontrolled cellular proliferation and tumor masses.

Question #32 Key: (A)

MDCAT 2016

Breathing consists of: [MDCAT-2016]

CORE CONCEPT AND DERIVATION

Breathing (pulmonary ventilation) is a cyclic, mechanical process driven by pressure gradients.

Solution:

- Breathing strictly consists of **two distinct phases**:
- **1. Inspiration (Inhalation):** Active intake of air as thoracic volume increases and pressure decreases.
- **2. Expiration (Exhalation):** Passive (or forced) expulsion of air as thoracic volume decreases and pressure increases.

Why other options are incorrect:

- Breathing is fundamentally a binary cycle of air moving in and air moving out. There are no tertiary or quaternary mechanical phases in standard pulmonary ventilation.

Question #33 Key: (B)

MDCAT 2016

Carboxyhemoglobin ([Formula]) is formed when [Formula] combines with: [MDCAT-2016]

CORE CONCEPT AND DERIVATION

Hemoglobin acts as a dual-transport molecule. While oxygen binds to the heme iron, carbon dioxide binds to a completely different site to prevent competition.

Solution:

- About 20-23% of carbon dioxide is transported in the blood bound directly to hemoglobin.
- It binds to the terminal **amino groups** of the globin polypeptide chains, forming carbaminohemoglobin.
- *Note: Some older regional curricula erroneously refer to this as "carboxyhemoglobin", though modern medicine strictly reserves that term for Carbon Monoxide (CO) binding. Regardless of terminology, CO₂ targets the amino group.*

Why other options are incorrect:

- **Haem / Iron part:** These are the specific binding sites for Oxygen (O₂) and Carbon Monoxide (CO), not Carbon Dioxide.

Question #34 Key: (D)

DUHS 2014

Mucus secreting goblet cells are present in: [KMDC-2014]

CORE CONCEPT AND DERIVATION

The human respiratory tract is lined with ciliated epithelium interspersed with specialized secretory cells to protect the delicate alveolar surfaces.

Solution:

- **Goblet cells** are unicellular glands that secrete mucus.
- In the respiratory system, they are abundantly present in the lining of the **trachea** and bronchi.
- The secreted mucus traps incoming dust, microbes, and foreign particles, which are then swept upward by cilia.

Why other options are incorrect:

- **Larynx, Glottis, Epiglottis:** These structures are primarily cartilaginous and are involved in sound production and preventing food from entering the airway. While they have mucosal linings, the trachea is the classical primary site known for its rich distribution of goblet cells for air filtration.