Chapter 14. The Respiratory System

Exercise 1

Solution A.1.

1. (b) contracts
2. (a) alveoli
3. (b) loss in dry weight

Solution B.1.

(a) Diaphragm
(b) Ethyl alcohol
(c) Diffusion
(d) Diffusion
(e) Hypoxia
(j) Vocal cord

Solution B.2.

(a) Epiglottis
(b) Capillaries
(c) Diaphragm
(d) Bronchioles
(e) Ribs
(f) Alveoli or air sacs

Solution B.3.

COMPONENT	INSPIRED AIR	EXPIRED AIR
1. Oxygen	20.96%	16.40%
2. Carbon dioxide	0.04%	4.00%
3. Nitrogen	79.00%	79.60%

Solution B.4.

ATP or Adenosine Triphosphate is termed as "Currency of Energy" of the cell.

Solution B.5.

Column I	Column II
(a) Alveoli	(iii) diffusion of gases
(b) Bronchioles	(iv) small air tubes
(c) Nasal Chamber	(ii) lined with hair
(d) Bronchi	(v) an inverted Y shaped tube

Solution C.1.

(a) Alveoli and **gaseous diffusion**
(b) Mitochondria and **power house (respiration)**
(c) Epiglottis and **guard of entrance to trachea**
(d) Pleura and **lung covering**
(e) Diaphragm and **differentiate thoracic cavity and abdominal cavity**
(f) 'C' shaped cartilage rings and **support**

Solution C.2.

(a) Ciliated epithelium: It is the protective inner lining of the respiratory passage. It helps in motion, driving any fluid that is on them.
(b) Mitochondria: In mitochondria, pyruvic acid is further broken down step by step in a cyclic manner in the presence of oxygen.
(c) Diaphragm: Diaphragm contributes to the enlargement of the chest cavity lengthwise.
(d) Intercostal muscles: The muscles help the inward and outward movement of ribs enlarging the chest cavity all around.
(e) Pleural fluid: It provides lubrication for free movement of the expanding and contracting lungs.

Solution C.3.

Column A	Column B
Cartilaginous	Bronchi
Large surface area	Alveoli
Breathing movements	Diaphragm
Voice	Larynx
Complemental air	Extra inhalation
Swallowing	Epiglottis

Solution C.4.

Solution C.5.

During breathing, the air expelled out is always warmer or at body temperature. It can be felt by breathing out the air on our own hand. One can feel the warmth of the air expelled out during breathing.

Solution C.6.

The nasal cavity is lined by ciliated epithelium and mucous glands. The mucous glands secrete mucous. The ciliated epithelium is present on the entire lining of larynx, trachea, bronchi and bronchioles. The constant motion of cilia and mucous trap dust, micro-organisms, pollen and other minute particles present in the air. In this way, the respiratory passage is kept free of dust particles.

Solution C.7.

We inhale air which contains more of oxygen and less of carbon dioxide. We exhale air which contains more of carbon dioxide and less of oxygen. Therefore, the statement "We breathe in oxygen and breathe out carbon dioxide" is wrong.

Solution D.1.

(a) Aerobic respiration :- CO_2, H_2O, ATP, Heat energy
Anaerobic respiration :- Lactic acid, ATP, Heat energy

(b) Respiration :- CO_2
Photosynthesis :- O_2

(c) Photosynthesis :- CO_2 + sunlight + H_2O
Respiration :- Glucose (with or without oxygen)

(d) Inspired air :- 004%
Alveolar air :- 4.00%

(e) Respiration :- lungs, bronchi, alveoli
Breathing :- nasal cavity, trachea, diaphragm

(f) Tidal volume :- 1500 ml
Residual volume :- 500 ml

Solution D.2.

(a) Breathing through the nose is said to be healthier than through the mouth because the hair present in the nostrils prevent large dust particles from entering inside the respiratory system.

(b) Gaseous exchange continues in the lungs even during expiration because expiration is the result of reverse movements of the ribs and diaphragm. As consequence of the movements of the ribs and the diaphragm, the thoracic cavity is diminished and the lungs are compressed, forcing the air out into the atmosphere.

(c) At higher altitudes, the oxygen content of the air is low. So, a person feels breathlessness at higher altitudes.

Solution D.3.

(a) (i) Abdominal muscles (ii) Intercostal muscles

(b) (i) The ribs are moved inwards and outwards by the intercostal muscles stretched between them and thereby, enlarges the chest cavity.
(ii) The diaphragm flattens and presses the organs inside the abdomen. When the abdominal muscles relax, the abdominal wall moves outwards.

(c) The overall chemical equation for the process of respiration in humans:

$$C_6H_{12}O_6 + 6O_2 \xrightarrow{\text{Enzymes}} 6CO_2 + 6H_2O + 38ATP + 420\,kcal$$

(d)

1. Residual air: Some air is a1ways left in the lungs even after forcibly breathing out. This is the left over or residual air. This volume is 1500 mL.
2. Dead air space: Some tidal air is left in the respiratory passages such as trachea and bronchi, where no diffusion of gases can occur. This volume is called dead air space. It is 150 mL.

Solution D.4.

Path taken by the inspired air:
Nose → Pharynx → Larynx → Trachea → Bronchi

Solution D.5.

(a) Ribs: The ribs move inwards and outwards by the muscles stretched between them, thus enlarging the chest cavity all around.
(b) Diaphragm: On contraction, the diaphragm falls or flattens from the dome-shaped outline to an almost horizontal plane and thus, contributes to the enlargement of the chest cavity lengthwise.
(c) Abdominal muscles: Abdominal muscles help to increase the size of the thoracic cavity by the movement of diaphragm and therefore, aids in inspiration.

Solution E.1.

(i) 1: Thin walls of capillary; 2: RBCs (Red blood corpuscles);
3: Plasma; 4: Thin wall of the alveolus
(ii) 5: CO_2 diffuses out; 6: O_2 diffuses in

Solution E.2.

(a) Anaerobic respiration
(b) This reaction is applicable to animals only.
(c) This reaction may occur in muscular tissues (skeletal muscles).

Solution E.3.

(a) (i) Anaerobic respiration in plants: 5
(ii) End products in aerobic respiration: 4
(iii) Reaction occurring in liver: 2
(iv) Anaerobic respiration in animals: 1
(v) Storage in the liver: 3

(b) (i) Aerobic respiration: 4
(ii) Change taking place in the liver: 3
(iii) Anaerobic respiration in yeast: 5
(iv) Change taking place in a plant storage organ, e.g., potato: 2
(v) Anaerobic respiration in animals: 1

Solution E.4.

(a) **Tidal volume (TV):** Air breathed in and out, in a normal quiet breathing is called tidal volume. It is 500 mL.

(b) **Inspiratory reserve volume (IRV):** Air that can be drawn in forcibly over and above the tidal air is called inspiratory reserve volume. It is also known as complemental air. It is 3000 mL.

(c) **Expiratory reserve volume (ERV):** Air that can be forcibly expelled out after a normal expiration is called expiratory reserve volume. It is also called supplemental air. It is 1000 mL.

(d) **Vital capacity (VC):** Volume of air that can be taken in and expelled out by maximum inspiration and expiration is called vital capacity. It is 4500 mL.

(e) **Residual volume (RV):** Air left in the lungs, even after forcible expiration is called residual volume. It is 1500 mL.