YAKEEN NEET 2.0

2026

4.07.2025

BREATHING AND EXHANGE OF GASES

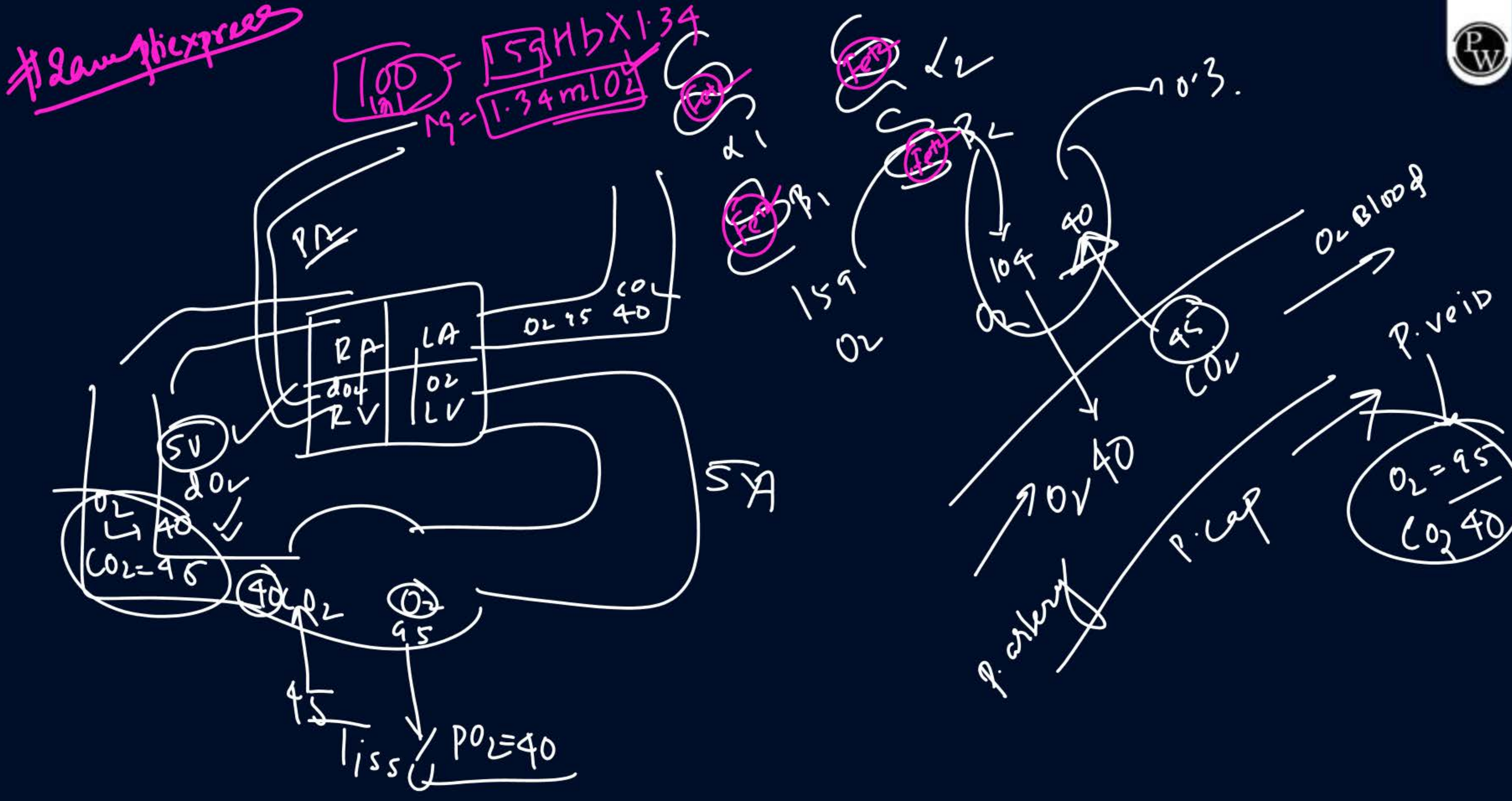
ZOOLOGY | Lecture – 5

By- SAMAPTI MAM

Topics to be covered

1. TRANSPORT OF GASES
2.
3.
4.

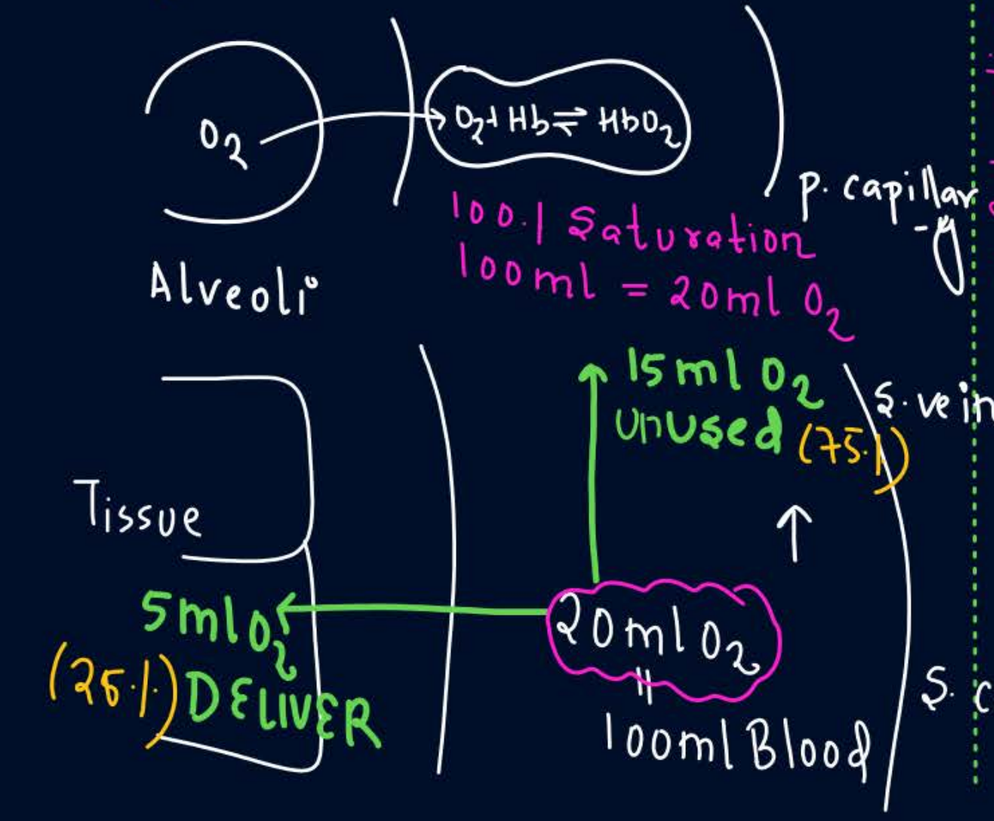
MY TELEGRAM

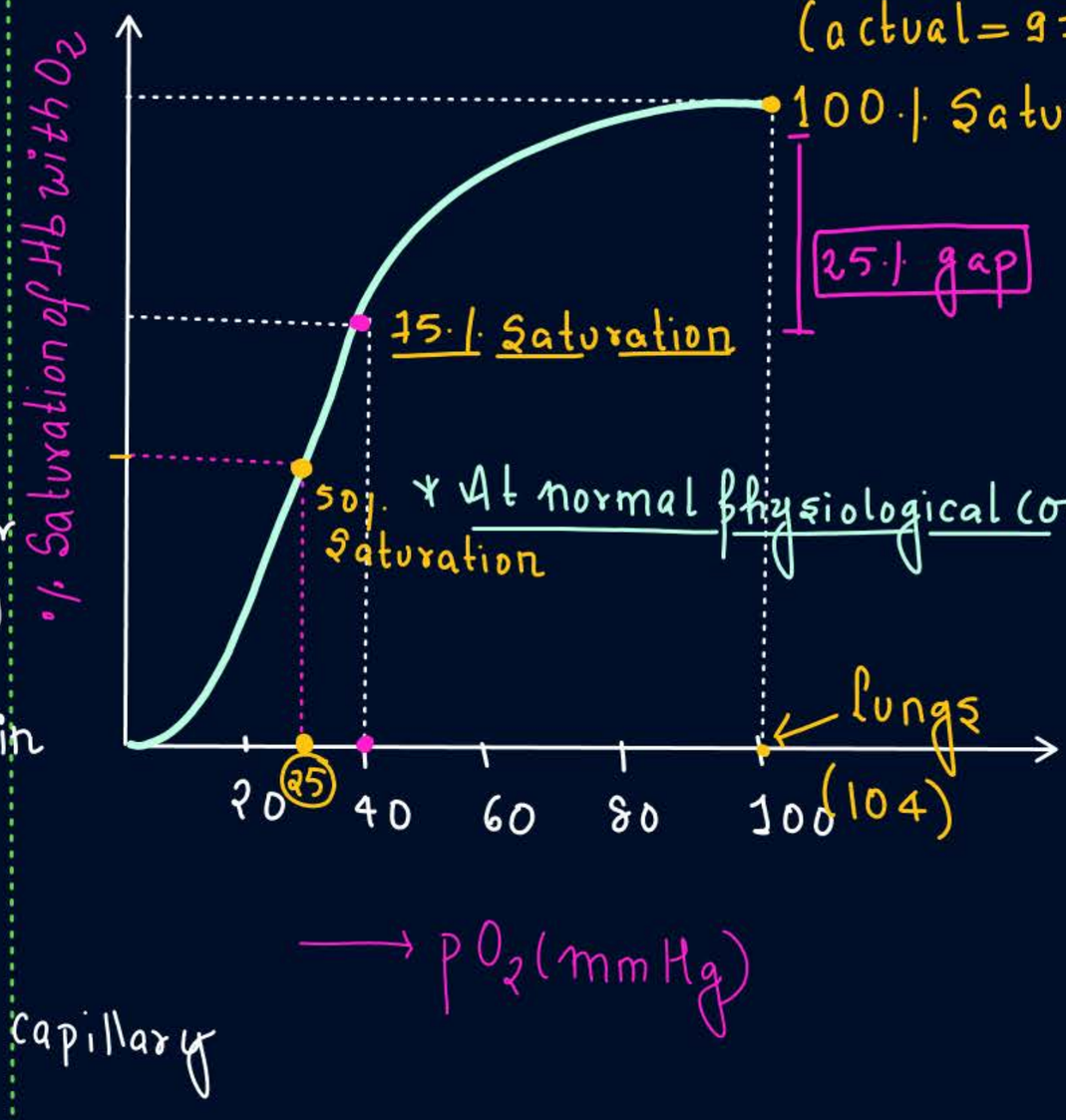


100 ml
15g Hb × 1.34
1g = 1.34 ml O2
PA
RA
LA
RV
LV
SV
SA
O2 95
CO2 40
CO2 = 45
Tiss
PO2 = 40
α1
α2
β1
β2
Fe
159
O2
104
40
95
CO2
0.3
O2 Blood
P. vein
P. cap
P. artery
O2 = 95
CO2 40

O_2- Dissociation Curve: A graph is plotted b/w % Saturation of 'Hb' with 'O_2' against pO_2 & 'SIGMOID' 'S' Curve is obtained.

* Binding of O_2 with 'Hb' is primarily related to pO_2.





→ At lungs: 100% Saturation: means: 100 ml O_2 Blood = 20 ml O_2

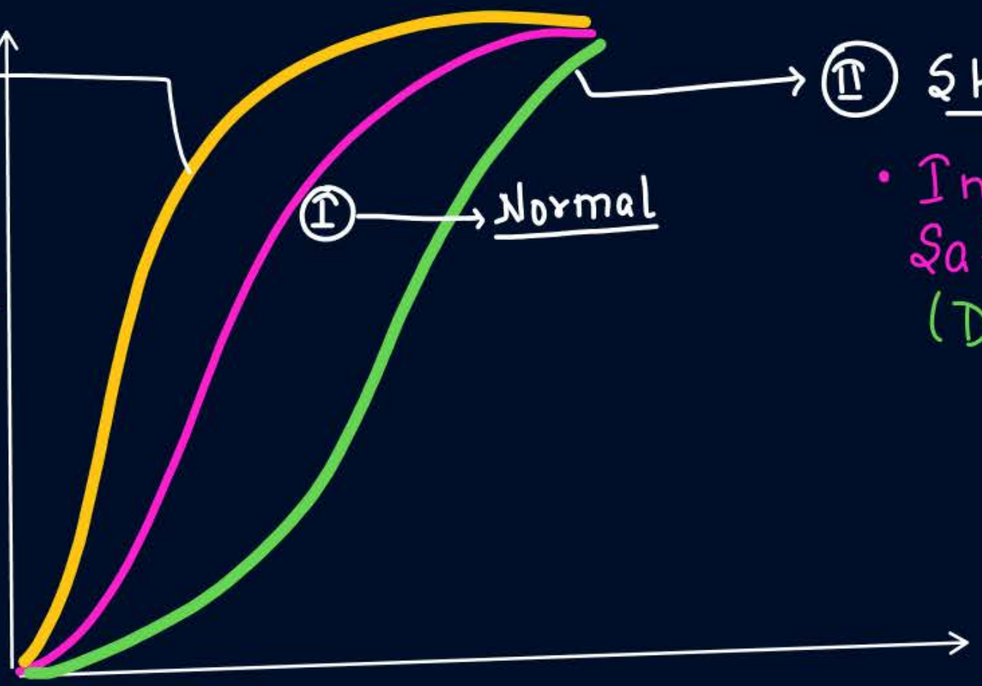
→ At normal physiological condition: 5 ml O_2 out of this 20 ml is delivered to tissue (25%) & 15 ml O_2 is still left (can be used in muscular exercise) (75% Blood still saturated).

→ $20\ ml\ O_2 \times \frac{75}{100} = \underline{15\ ml}$, $20\ ml\ O_2 \times \frac{25}{100} = \underline{5\ ml}$

Extraa gyan

p50 value: The partial pressure at which the 'Hb' is 50% Saturated.

* The Binding of O_2 with Hb primarily dependent on pO_2 but other factors can affect this binding: pCO_2, H^+, pH, temperature. & these can shift the graph either towards 'RIGHT' or 'LEFT'.



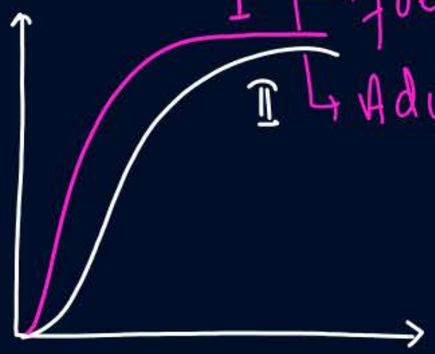
SHIFT TO LEFT (II)

- Indicates more saturation of Hb with O_2 (Association of HbO_2)
  - ↳ At Alveolar site
    - → pO_2 ↑
    - → pCO_2 ↓
    - → H^+ ↓
    - → pH = HIGH
    - → Temp ↓

(II) SHIFT TO RIGHT (Bohr's effect)

- Indication less Saturation of Hb with O_2 (DISSOCIATION of HbO_2)
  - ↳ At tissue level
    - → pO_2 ↓ (In FEVER, shift to RIGHT, more O_2 required by cell, more CO_2 Produce)
    - → pCO_2 ↑
    - → H^+ ↑
    - → pH = LOW
    - → Temp ↑

Note



I → foetal Hb: Shift to left ($\alpha_2\gamma_2$)

II → Adult Hb ($\alpha_2\beta_2$)

14.4 Transport of Gases

Blood is the medium of transport for O_2 and CO_2. About 97 per cent of O_2 is transported by RBCs in the blood. The remaining 3 per cent of O_2 is carried in a dissolved state through the plasma. Nearly 20-25 per cent of CO_2 is transported by RBCs whereas 70 per cent of it is carried as bicarbonate. About 7 per cent of CO_2 is carried in a dissolved state through plasma.

14.4.1 Transport of Oxygen

Haemoglobin is a red coloured iron containing pigment present in the RBCs. O_2 can bind with haemoglobin in a reversible manner to form **oxyhaemoglobin**. Each haemoglobin molecule can carry a maximum of four molecules of O_2. Binding of oxygen with haemoglobin is primarily related to partial pressure of O_2. Partial pressure of CO_2, hydrogen ion concentration and temperature are the other factors which can interfere with this binding. A sigmoid curve is obtained when percentage saturation of haemoglobin with O_2 is plotted against the

of haemoglobin with O_2 is plotted against the pO_2. This curve is called the Oxygen dissociation curve (Figure 14.5) and is highly useful in studying the effect of factors like pCO_2, H^+ concentration, etc., on binding of O_2 with haemoglobin. In the alveoli, where there is high pO_2, low pCO_2, lesser H^+ concentration and lower temperature, the factors are all favourable for the formation of oxyhaemoglobin, whereas in the tissues, where low pO_2, high pCO_2, high H^+ concentration and higher temperature exist, the conditions are favourable for dissociation of oxygen from the oxyhaemoglobin. This clearly indicates that O_2 gets bound to haemoglobin in the lung surface and gets dissociated at the tissues. Every 100 ml of oxygenated blood can deliver around 5 ml of O_2 to the tissues under normal physiological conditions.

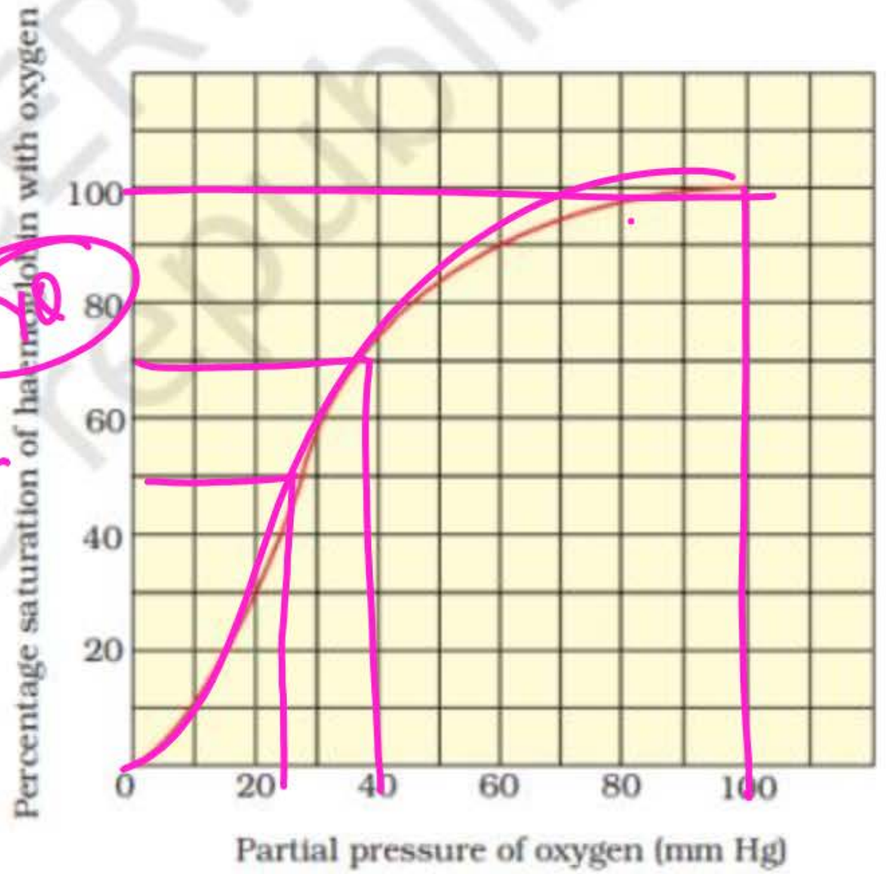


Figure 14.5 Oxygen dissociation curve

ii) Transport of CO_2 : 3 ways

i) Dissolved in Plasma (7·1)

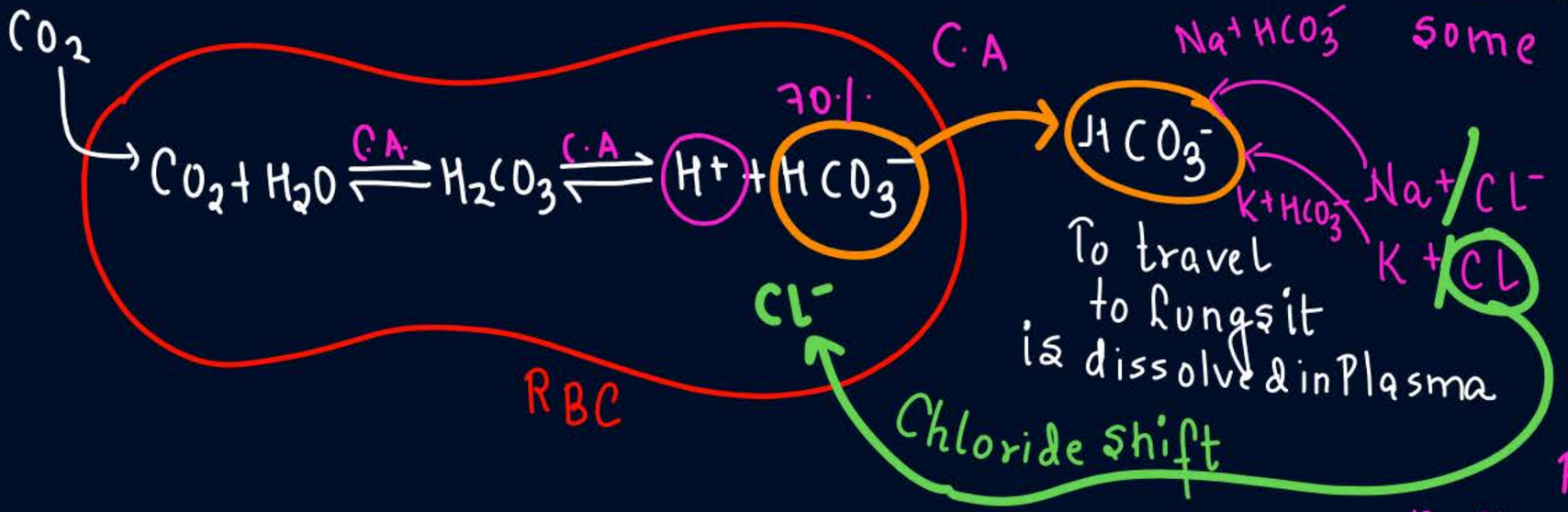
ii) Bound with Hb (20-25·1) ≃ 23·1

$$Hb + CO_2 \rightleftharpoons HbCO_2$$

→ CO_2 binds 'Globin' part

↳ 'Carbaminohaemoglobin'

iii) As HCO_3^- (Bicarbonate) ≃ 70·1



· C·A: Carbonic anhydrase

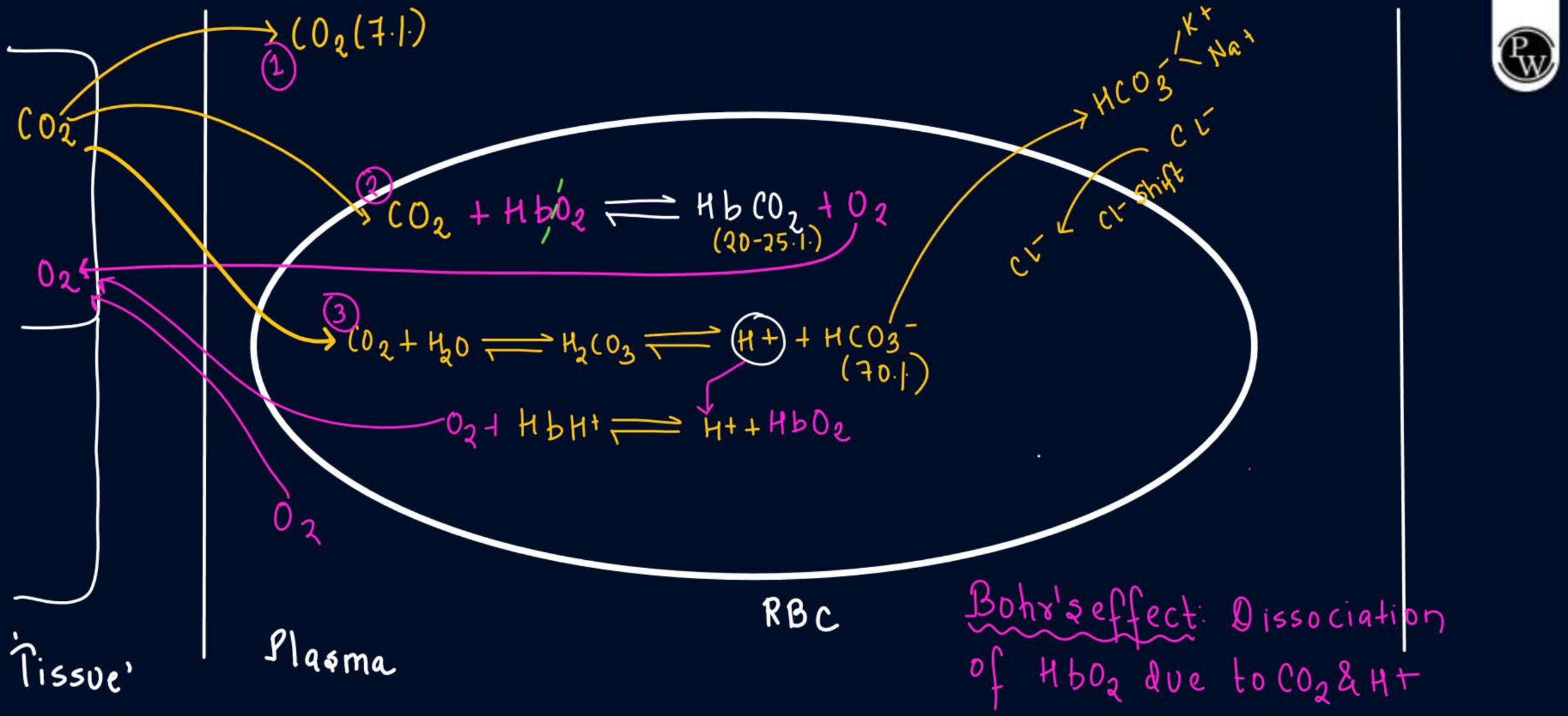
↓

Present mainly in RBC but some amount also in Plasma

· Cl^- Shift / hamburger's Phenomenon (3 idiots Gyaan)

Cl^- into RBC from Plasma to Balance movement of HCO_3^-

→ Every 100 ml dO_2 Blood 'DELIVERS' 4 ml CO_2 to Alveoli



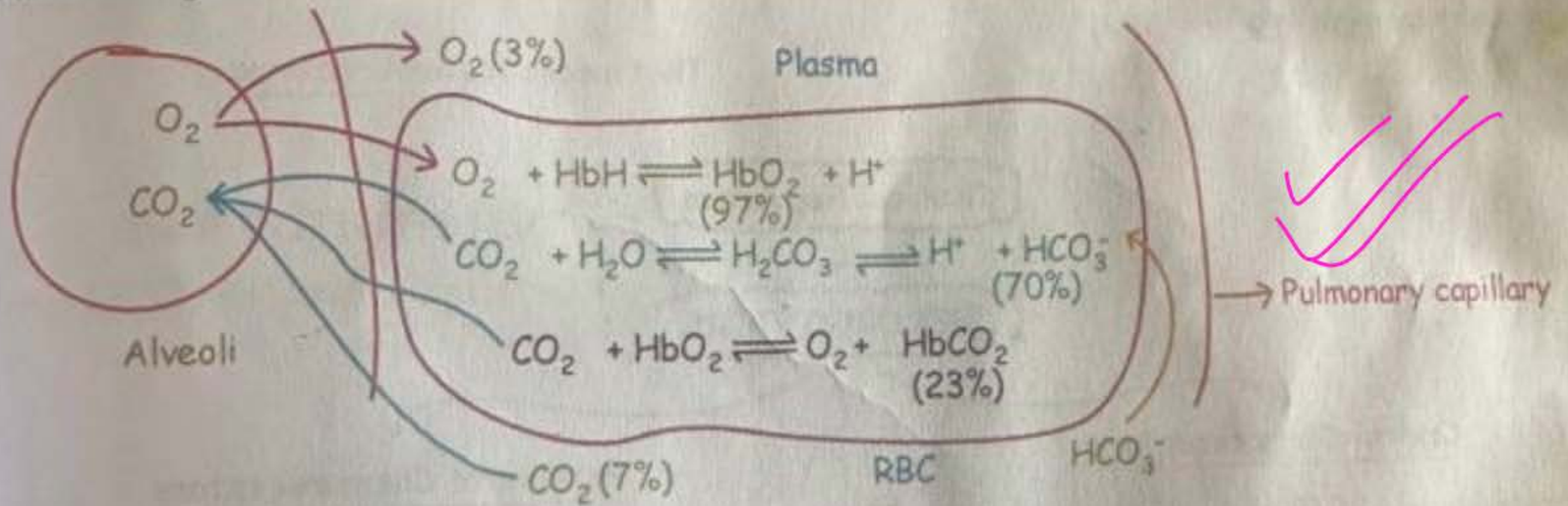
Bohr's effect: Dissociation of HbO_2 due to CO_2 & H^+

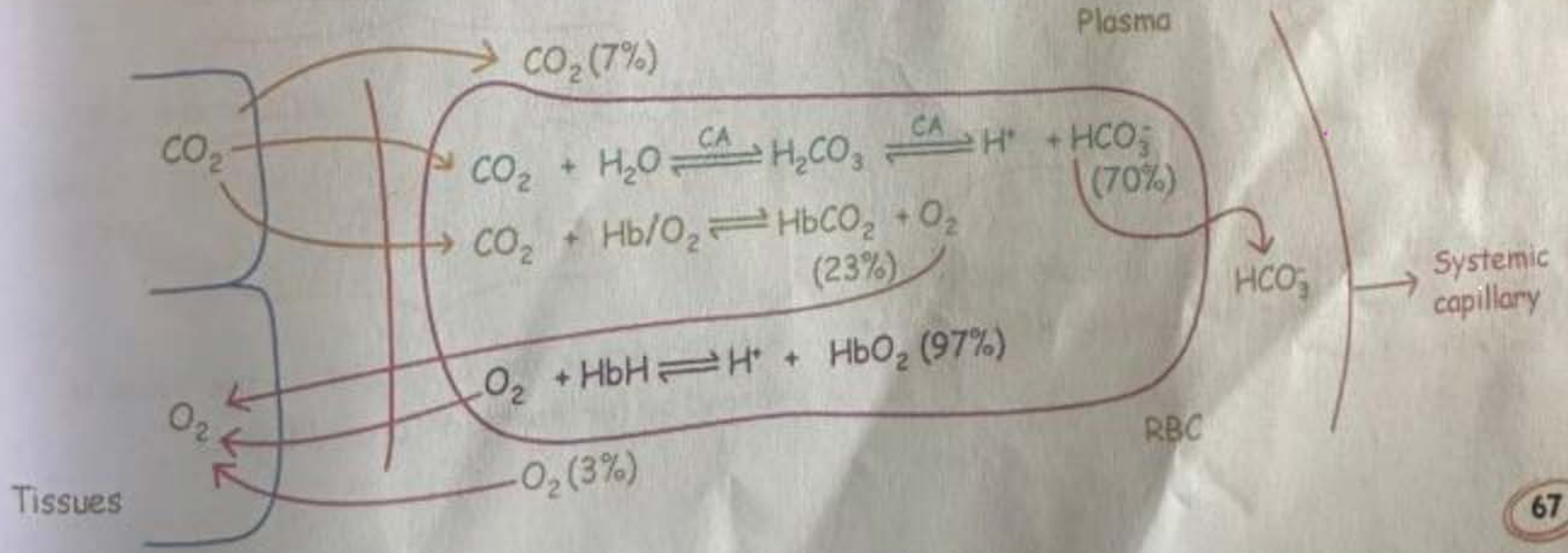
14.4.2 Transport of Carbon dioxide

CO_2 is carried by haemoglobin as **carbamino-haemoglobin** (about 20-25 per cent). This binding is related to the partial pressure of CO_2. pO_2 is a major factor which could affect this binding. When pCO_2 is high and pO_2 is low as in the tissues, more binding of carbon dioxide occurs whereas, when the pCO_2 is low and pO_2 is high as in the alveoli, dissociation of CO_2 from carbamino-haemoglobin takes place, i.e., CO_2 which is bound to haemoglobin from the tissues is delivered at the alveoli. RBCs contain a very high concentration of the enzyme, carbonic anhydrase and minute quantities of the same is present in the plasma too. This enzyme facilitates the following reaction in both directions.

$$CO_2 + H_2O \underset{}{\overset{\text{Carbonic anhydrase}}{\rightleftharpoons}} H_2CO_3 \overset{\text{Carbonic anhydrase}}{\rightleftharpoons} HCO_3^- + H^+$$

At the tissue site where partial pressure of CO_2 is high due to catabolism, CO_2 diffuses into blood (RBCs and plasma) and forms HCO_3^- and H^+. At the alveolar site where pCO_2 is low, the reaction proceeds in the opposite direction leading to the formation of CO_2 and H_2O. Thus, CO_2 trapped as bicarbonate at the tissue level and transported to the alveoli is released out as CO_2 (Figure 14.4). Every 100 ml of deoxygenated blood delivers approximately 4 ml of CO_2 to the alveoli.


O_2 (3%)
Plasma
O_2
CO_2
O_2 + HbH ⇌ HbO_2 + H^+
(97%)
CO_2 + H_2O ⇌ H_2CO_3 ⇌ H^+ + HCO_3^-
(70%)
CO_2 + HbO_2 ⇌ O_2 + $HbCO_2$
(23%)
Alveoli
Pulmonary capillary
CO_2 (7%)
RBC
HCO_3^-


Plasma
CO_2 (7%)
CO_2
CO_2 + H_2O ⇌ H_2CO_3 ⇌ H^+ + HCO_3^-
CA
CA
(70%)
CO_2 + Hb/O_2 ⇌ $HbCO_2$ + O_2
(23%)
HCO_3^-
Systemic capillary
O_2 + HbH ⇌ H^+ + HbO_2 (97%)
O_2
RBC
O_2 (3%)
Tissues

QUESTION

Assertion (A): At the tissue site, partial pressure of CO_2 is high
Reason (R): Catabolism causes increase in partial pressure of CO_2 at tissues

1. Both Assertion (A) and Reason (R) are the true, and Reason (R) is a correct explanation of Assertion (A).

2. Both Assertion (A) and Reason (R) are the true, but Reason (R) is not a correct explanation of Assertion (A).

3. Assertion (A) is true, and Reason (R) is false.

4. Assertion (A) is false, and Reason (R) is true.

QUESTION

Statement-I: O_2 gets bound to haemoglobin in the lung surface due to high pCO_2
Statement-II: Every 1000 ml of oxygenated blood can deliver around 5 ml of O_2 to the tissues under normal physiological conditions.

1. Statement I and Statement II both are correct.
2. Statement I is correct, but Statement II is incorrect.
3. Statement I is incorrect, but Statement II is correct.
4. Statement I and Statement II both are incorrect.

A large proportion of oxygen remains unused in the human blood even after its uptake by the body tissue. This O_2 :

A. helps in releasing more O_2 to the epithelial tissues

B. is enough to keep oxyhemoglobin saturation at 96%

C. raises the pCO_2 of blood to 75mm of Hg

D. acts as a reserve during muscular exercise

In lungs there is definite exchange of ions between RBC and plasma. Removal of CO_2 from blood involves

(1) Influx of Cl' into RBC
(2) Efflux of Cl' from plasma
(3) Influx of HCO_3' ions in RBC
(4) Efflux of HCO_3 ions from RBC

The oxygen - haemoglobin dissociation curve will show a right shift in case of

(A) High Pco2
(B) High pO2
(C) Low pCO2
(D) Less H+ concentration

Which statements are true/false"

(i) Blood transports CO_2 comparatively easily because of its high solubility
(ii) Approximately 8.9% of CO_2 is transported dissolved in plasma
(iii) CO_2 diffuses into blood, passes into RBCs and reacts with water to form H_2CO_3
(iv) Oxyhaemoglobin of erythrocytes is basic
(v) Chloride ions diffuse from plasma into erythrocytes to maintain ionic balance

(1) (i), (iii) and (v) are true, (ii) and (iv) are false
(2) (i), (iii) and (v) are false, (ii) and (iv) are true
(3) (i), (ii) and (iv) are true, (iii) and (v) are false
(4) (i), (ii) and (iv) are false, (iii) and (v) are true

QUESTION

What is the approximate partial pressure of oxygen (pO_2) in systemic arteries?

1. 40 mmHg
2. 45 mmHg
3. 80 mmHg
4. 95 mmHg

QUESTION

In the alveoli, which of the following factors is/are favourable for the formation of oxyhaemoglobin?

I. High pO_2
II. Low pCO_2
III. Lesser H^+ concentration
IV. Lower temperature
V. Low pH

Choose the correct option.

1. Only (I)
2. (I), (II), (III) and (IV)
3. (I), (II) and (III)
4. All of these

Homework

- REVISE CLAASNOTES / ZOOLOGY MED EASY

MODULE HW
Module -1
Prarambh exercise 1- 7-26

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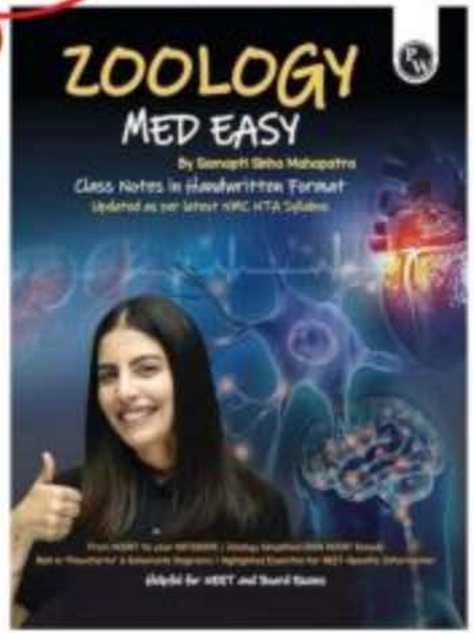

THANK YOU