CRFS Workshop

Exam question review – the tough ones

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Make the best use of practice exam questions

- Use the questions to identify key topics for further study
- Use the answer to explore a topic in more detail
- Use the wrong answers to help your study i.e. explain to yourself why each wrong answer is in fact wrong
- Some questions may have more than one ‘right’ answer, but one of them will be the ‘best’ answer in the context of the question
- Make sure you understand the concepts behind questions – relying on rote learning will not lead to success (or make you a good scientist!)

Question 1:
Using the data below, what is the O_2 content in arterial blood?

Hb-O_2 affinity	1.34 mL/g
O_2 solubility coefficient	0.0031 mL/dL/mmHg
PaO2	55 mmHg
SaO2	80 %
Hb	14 g/dL

A - 148 mL L^{-1}

B - 149 mL L^{-1}

C - 150 mL L^{-1}

D - 152 mL L^{-1}

Question 1:
Using the data below, what is the O_2 content in arterial blood?

Key concept: O2 is carried in blood in two forms

1. Dissolved in plasma
2. Chemically bound to Hb

So ……

Total O2 content = Dissolved + Hb bound

Question 1:
Using the data below, what is the O_2 content in arterial blood?

<u>The dissolved component</u> –

Henry's Law states - *At a constant temperature, the amount of a given gas dissolved in a given type and volume of liquid is directly proportional to the partial pressure of that gas in equilibrium with that liquid.*

Dissolved O2 ∝ PO2

Dissolved O2 = k x PO2 where k is the solubility coefficient

Hb-O_2 affinity	1.34 mL/g
O_2 solubility coefficient	0.0031 mL/dL/mmHg → 0.031 mL/L/mmHg
PaO2	55 mmHg
SaO2	80 %
Hb	14 g/dL → 140 g/L

Dissolved O2 content = 0.031 * 55 = 1.71 ml/L

Question 1:
Using the data below, what is the O_2 content in arterial blood?

<u>The Hb bound component</u> –

Hb-O_2 affinity	1.34 mL/g
O_2 solubility coefficient	0.0031 mL/dL/mmHg → 0.031 mL/L/mmHg
PaO2	55 mmHg
SaO2	80 %
Hb	14 g/dL → 140 g/L

Only include the Hb fraction that is carrying O2

Hb bound O2 content = amount of Hb * affinity
= 140 * 0.8 * 1.34
= 150.08 ml/L

Total O2 content = 1.71 + 150.08 = 151.79 ml/L

Question 1:
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Question 1:
Using the data below, what is the O_2 content in arterial blood?

Topic – Gas transport by the circulation

Some related aspects

- O2 and CO2 transport
- Oxyhaemoglobin dissociation curve
- Factors affecting the curve (pH, temp, 2-3 DPG etc)
- Implications of the curve shape eg loading (lung) and unloading (tissues) of O2
- O2 Content vs partial pressure vs Hb saturation
- Dissolved (Henry's law) vs Hb bound O2
- Hypoxaemia vs hypoxia
- SaO2 vs SpO2
- How the system fails i.e. pathophysiology
- Etc ……

Question 2:
If a small bolus of an inert gas is injected into the airstream of a normal upright patient at the onset of a slow inspiration commencing from RV, how will it be distributed?

A - Preferentially to the bases

B - Preferentially to the apices

C - Preferentially to the middle lobe

D - Homogeneously throughout the lung

Question 2:
If a small bolus of an inert gas is injected into the airstream of a normal upright patient at the onset of a slow inspiration commencing from RV, how will it be distributed?

A - Preferentially to the bases

B - Preferentially to the apices

C - Preferentially to the middle lobe

D - Homogeneously throughout the lung

Requires all lung regions to inflate uniformly
→ INCORRECT

Question 2:
If a small bolus of an inert gas is injected into the airstream of a normal upright patient at the onset of a slow inspiration commencing from RV, how will it be distributed?

A - Preferentially to the bases

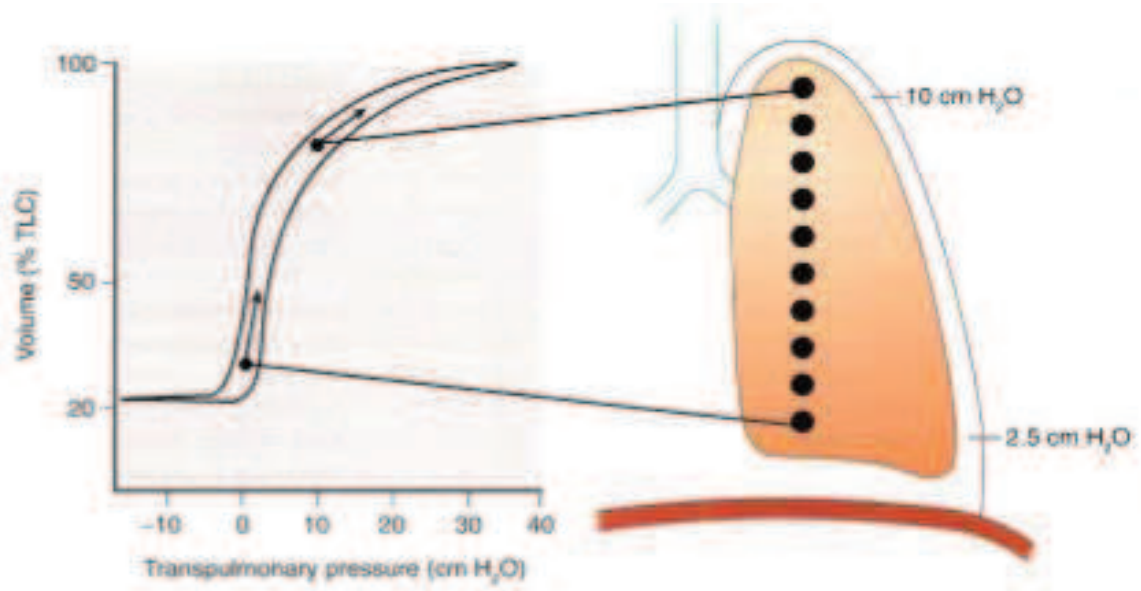
B - Preferentially to the apices

C - Preferentially to the middle lobe

D - Homogeneously throughout the lung

Requires vertical lung regions to inflate at different rates
→ CORRECT, BUT A, B or C?
AND WHY?

Question 2:



Pleural pressure (cmH2O)		
	Apex	Base
RV	-4	+3.5
FRC	-10	-2.5
TLC	-40	-32.5

- Vertical gradient of pleural pressure due to the weight of the lung
- Upper regions sit on a flatter section of the lung compliance curve
- For a given fall in pleural pressure (ie inspiration), basal regions inflate more than apical
- Therefore, ventilation goes preferentially to the lung bases during a (slow) inspiration.

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If a small bolus of an inert gas is injected into the airstream of a normal upright patient at the onset of a slow inspiration commencing from RV, how will it be distributed?

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Question 2:
If a small bolus of an inert gas is injected into the airstream of a normal upright patient at the onset of a slow inspiration commencing from RV, how will it be distributed?

Topic – Lung mechanics, regional lung function

Some related aspects

- Effect of gravity, upright vs supine
- Regional distribution of ventilation and perfusion
- Series vs parallel inhomogeneities
- Airway resistance vs parenchymal compliance inhomogeneities
- Normal vs disease
- Effect of inhomogeneities on gas exchange efficiency
- Etc ……

Question 3:
Pressure in the alveolar spaces is -

A - Sub atmospheric at the end of inspiration

B - Dependent upon airway dimensions and direction of airflow

C - Largely determined during airflow by the resistance of alveolar ducts

D - Less than atmospheric pressure during expiration as a consequence of elastic recoil

Question 3:
Pressure in the alveolar spaces is -

A - Sub atmospheric at the end of inspiration?

- Flow of air only occurs in response to a pressure gradient
  Ohms Law:
- 'end of inspiration' indicates that flow has ceased
- When there is no inspiratory flow, the pressure gradient must be zero, and therefore alveolar pressure must equal atmospheric pressure (assuming an open airway!)

Option A is incorrect

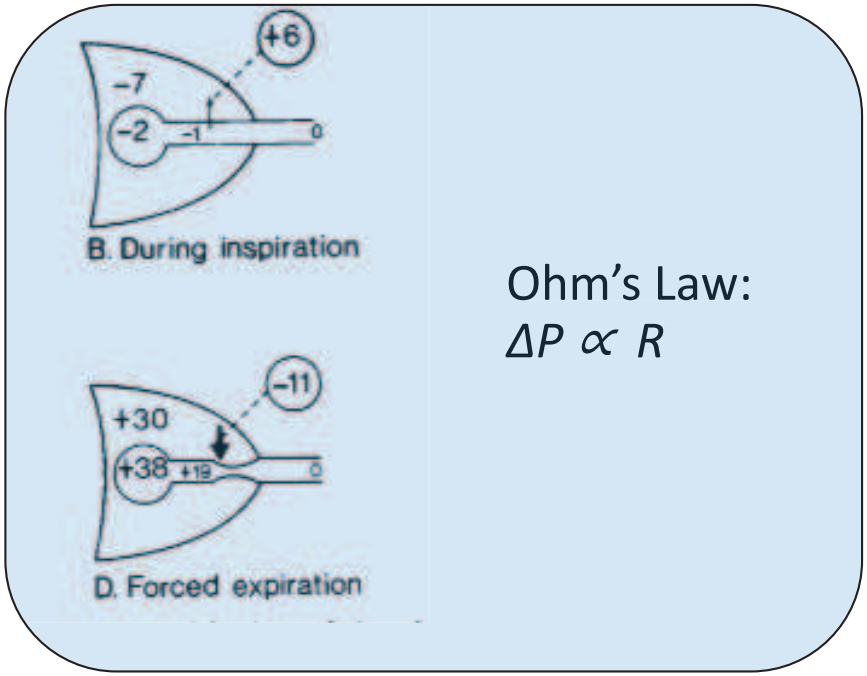
Question 3:
Pressure in the alveolar spaces is -

B - Dependent upon <u>airway dimensions</u> and <u>direction of airflow</u>

Poiseuille Equation:

$\Delta P \propto 1/r^4$

Option B is correct

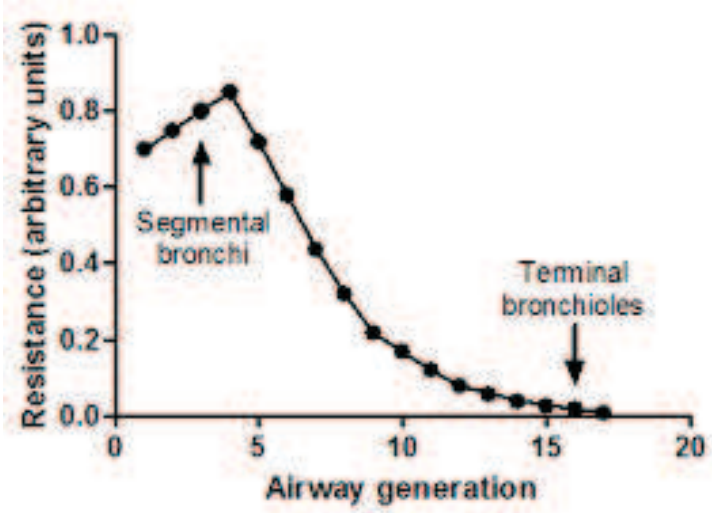


Ohm's Law:

$\Delta P \propto R$

Question 3:
Pressure in the alveolar spaces is -

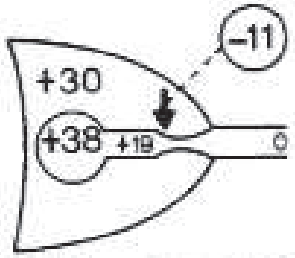
C - Largely determined during airflow by the resistance of alveolar ducts



Option C is incorrect

Question 3:
Pressure in the alveolar spaces is -

D - Less than atmospheric pressure during expiration as a consequence of elastic recoil



D. Forced expiration

Option D is incorrect

Question 3:
Pressure in the alveolar spaces is -

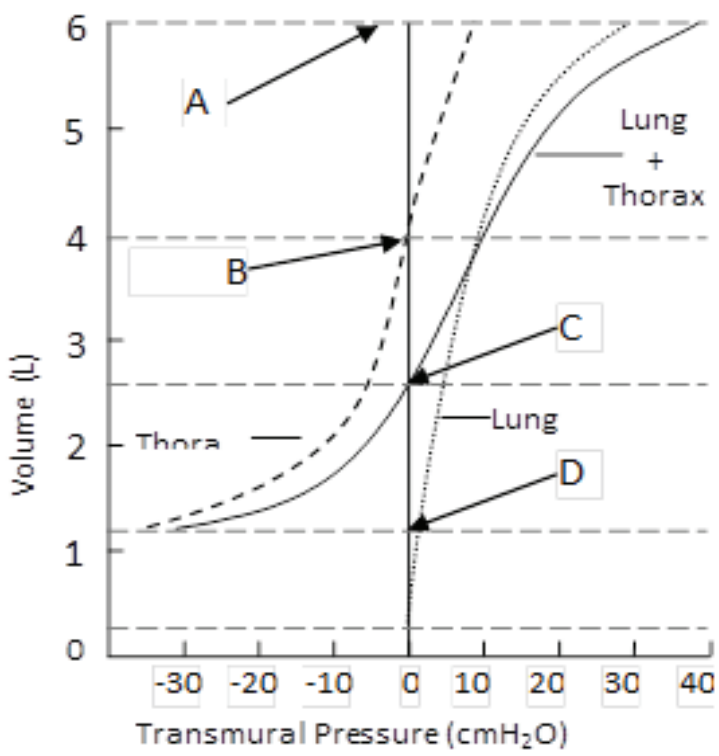
A - Sub atmospheric at the end of inspiration

B - Dependent upon airway dimensions and direction of airflow

C - Largely determined during airflow by the resistance of alveolar ducts

D - Less than atmospheric pressure during expiration as a consequence of elastic recoil

Question 4:
In the figure provided which arrow indicates the resting volume of the thorax-



- At rest, outward lung recoil will balance the inward lung recoil.
- When these two forces are equal and opposite, the thorax will achieve its rest volume
- Point C indicates where the net forces acting on the lung/thorax are zero

Question 5:
Which of the following are used to calculate Raw with a body plethysmograph?

A - Alveolar pressure and flow at the mouth

B - Mouth pressure and flow at the mouth

C - Alveolar pressure and box volume

D - Mouth pressure and box volume

Airway resistance = pressure drop along the airway / flow through the airway

Raw = (Palv - Pmouth) / Flow

Palv is the major source of the pressure drop.

Option A is correct

Question 6:
Which of the following analysing devices has a calibration point of zero mmHg on room air?

A - Nitrogen analyser

B - Capnography analyser

C - Clark electrode

D - Oxygen analyser

Option B is correct