



PTS Reading Week Question Series 2021

Respiratory

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1. John is a 65-year-old man with a 20-pack year history. He comes into the GP complaining of breathlessness on exertion and that he is no longer able to walk without resting every 1 minute. He is worried about his condition and wants to know more.

- a. Define vital capacity
- b. What would his predicted FEV_1 and FEV_1/FVC be?
- c. What stimulates the central chemoreceptors to increase respiratory rate?

2. During a microbiology lab session, Malcolm happened to chance upon some sample slides of cells obtained from the respiratory tract.

- a. State the type of cell present in the lower respiratory tract.
- b. Which week of gestation is Type 2 pneumocyte produced?
- c. Where does gas exchange occur in the respiratory tract?

3. Derrick is a retired old man who has recently discovered a tumor around his neck. He complains that he feels pain whenever he drinks alcohol and has also lost weight over the last few months. Only recently, he realised that his voice has become hoarse.

- a. What is the recommended alcohol intake?
- b. Why has his voice turned hoarse?
- c. State the cartilages of the larynx that are paired.
- d. What is the lowest surface marking of the lungs?

4. Molly was strolling in the park one lovely morning when she got stung by a bee. She developed an allergic reaction and was rushed into the hospital. She is currently hypotensive and has difficulty breathing.

- a. What type of hypersensitivity reaction is this?
- b. What is the cell responsible for the reaction? Describe the process by which this occurs?
- c. What medication should be given?

5. Ethan is an active and healthy 3 year old who likes to scream at his siblings when they irritate him. Unfortunately, he has accidentally inhaled a piece of Lego and has been brought into A&E by his concerned parents. He is currently crying and visibly distressed.

- a. Where is this piece of Lego most likely to end up?
- b. Which nerve innervates the diaphragm? What are its nerve roots?
- c. Name the structures that pass through the diaphragm at the following levels.
 - i. T8 (2 structures)
 - ii. T10 (3 structures)
 - iii. T12 (3 structures)
- d. Which nerve innervates the muscles of the larynx?

6. Getrude is a 87 year old lady with a past medical history of COPD and hypertension. She recently suffered from an exacerbation of her COPD and required non-invasive ventilation to help with her breathing.

COPD is known to cause both type 1 and type 2 respiratory failure.

- a. Describe the features of type 1 and type 2 respiratory failure.

Pulmonary blood vessels respond differently to hypoxia when compared to systemic blood vessels.

- b. How would pulmonary blood vessels respond to hypoxia? What about systemic blood vessels?

COPD is managed by a combination of beta-agonists and muscarinic-antagonists to induce bronchodilation and prevent bronchoconstriction.

- c. Which section of the autonomic nervous system is responsible for bronchodilation?
- d. Briefly describe the mechanism of bronchodilation.
- e. Which section of the autonomic nervous system is responsible for bronchoconstriction?
- f. Briefly describe the mechanism of bronchoconstriction.

Answers and Explanations

1a) Amount of air that can be exhaled with maximum effort after maximum inspiration.

1b) John likely has COPD which has an obstructive lung pattern. Hence, his FEV₁ would be reduced below 80% while his FVC would also be reduced but may not decrease as much as FVC. Therefore, FEV₁/FVC would likely be higher or normal

	FEV ₁	FVC	FEV ₁ /FVC
Obstructive	↓	↓ (but not as large)	↓ or ↔
Restrictive	↓	↓ (both FEV ₁ and FVC decrease proportionately)	↑ or ↔

1c) H⁺, Central chemoreceptors detect changes in H⁺ while peripheral chemoreceptors detect changes in H⁺ and also PaO₂

2a) Pseudostratified ciliated columnar epithelium with goblet cells

2b) Week 34. Premature labour before week 34 could result in respiratory distress syndrome where surfactant is not produced in the lungs.

2c)

Conducting zone	1. Bronchi 2. Bronchioles 3. Terminal bronchioles
Respiratory zone	1. Respiratory bronchioles 2. Alveolar ducts 3. Alveolar sacs

3a) Not more than 14 **units** a week.

3b) Recurrent laryngeal nerve

3c) Total of 9 cartilages in the larynx. Paired cartilages are cuneiform, corniculate and arytenoid. Unpaired cartilages are epiglottis, thyroid and cricoid. That makes a total of 9.

3d)

Lowest surface marking for lungs	Anteriorly	6th rib
	Mid-axillary	8th rib
	Posteriorly	10th rib

Lowest surface marking for pleura	Anteriorly	8th rib
	Mid-axillary	10th rib
	Posteriorly	12th rib

4a) Anaphylaxis is a Type 1 IgE hypersensitivity reaction.

4b) Basophils and Mast cells. Sensitizing agents elicit IgE antibody response. IgE binds to mast cells and basophils causing degranulation and the release of chemical mediators histamine, prostaglandins and leukotrienes. This results in vasodilation and bronchospasm.

4c) Adrenaline should always be given.

5a - Right main bronchus as it is shorter, wider and more vertically predisposed.

5b - The phrenic nerve with C3, 4 and 5 as its nerve roots.

5c - The mnemonic 'I ate 10 orens at 12' can help you remember the main structures that pass through the diaphragm (I ate = IVC at T8, 10 orens = oesophagus at T10, at 12 = abdominal aorta at T12).

Level	What passes through
T8	Inferior vena cava Right phrenic nerve
T10	Oesophagus Left and right vagus Left gastric vessels
T12	Abdominal aorta (between crura of diaphragm) Thoracic duct Azygos vein

5d - The recurrent laryngeal nerve. All muscles of the larynx, apart from the cricothyroid, are innervated by the internal branch of the recurrent laryngeal nerve. The cricothyroid is innervated by the external branch of the recurrent laryngeal nerve.

6a - Type 1 respiratory failure: low PaO₂ but normal or low PaCO₂ // Type 2 respiratory failure: low PaO₂ and raised PaCO₂

6b - Pulmonary vessels vasoconstrict in hypoxic environments while systemic vessels vasodilate in response to hypoxia.

6c - The sympathetic nervous system

6d - Adrenaline binds to beta-2 receptors that are coupled with Gs protein. This leads to adenylyl cyclase activation and increased cAMP. Increased cAMP levels cause a decrease in intracellular calcium which therefore leads to bronchodilation.

6e - The parasympathetic nervous system

6f - ACh binds to the muscarinic-3 receptors coupled to Gq protein. Phospholipase C is activated and catalyses the breakdown of membrane phospholipids into diacylglycerol (DAG) and inositol triphosphate (IP3). IP3 binds to ligand-gated calcium channels causing calcium release and bronchoconstriction.

We hope you have found these questions useful. Please fill out our feedback form so we can improve;

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