SOLUTIONS

9.1: The gas exchange system

1. **B**
   The labelled part T is a rounded structure embedded among ciliated cells, characteristic of a goblet cell, which secretes mucus in the trachea.
2. **C**
   Cartilage supports the bronchi and trachea but not bronchioles; smooth muscle is present in bronchi and trachea to control airway diameter.
3. **D**
   Oxygen crosses five cell membranes–two in the alveolar cell, two in the capillary cell, and one in the red blood cell?each with two phospholipid layers, totalling $5 \times 2 = 10$ layers.
4. **B**
   A steep concentration gradient ensures efficient gas exchange, while a short diffusion distance allows rapid oxygen and carbon dioxide movement across the alveolar membrane.
5. **A**
   Both the trachea and bronchi have cartilage for support, smooth muscle for airway regulation, and goblet cells for mucus secretion to trap particles.
6. **B**
   Cilia are hair-like structures in the respiratory tract that beat rhythmically **to move mucus**, which traps dust and pathogens, towards the throat for removal, preventing infections.
7. **A**
   The trachea contains epithelium with goblet cells to produce mucus and smooth muscle to regulate airflow. Alveoli lack goblet cells and smooth muscle, as their thin walls facilitate gas exchange. Thus, option A.
8. **B**
   Cartilage in the bronchus provides structural support, preventing airway collapse during breathing. It appears as a dense, rounded tissue in histological sections, as indicated by label B.
9. **C**
   Both the trachea and bronchioles contain smooth muscle (for airway constriction) and epithelial cells (for mucus secretion and cilia movement). Cartilage is present in the trachea but absent in bronchioles. Thus, option C is correct.
10. **D**
    The image shows alveoli, which are lined with squamous epithelium, allowing efficient gas exchange due to their thin walls. Other tissues like cartilage, ciliated epithelium, and smooth muscle are found in larger airways, not alveoli.
11. **C**
    Goblet cells secrete mucus (option C), which traps dust and pathogens in the airways. Ciliated cells then move the mucus out of the respiratory tract.
12. **B**
    To reach the alveolar air space, carbon dioxide must cross the red blood cell membrane, the capillary endothelial cell membrane, and the alveolar epithelial cell membrane, resulting in a minimum of three membrane crossings.
13. **D**
    The steep concentration gradient is maintained as blood entering the lungs has low oxygen and high carbon dioxide levels (statement 2), and constant blood flow brings fresh red blood cells to the lungs (statement 3). Airflow direction in the alveoli (statement 1) is not a key factor in maintaining this gradient.
14. **D**
    Cartilage tissue is found in both the trachea and bronchi, providing structural support to keep these airways open during breathing. It is not found in bronchioles.
15. **A**
    Alveoli are lined with squamous epithelium to reduce diffusion distance, facilitating efficient gas exchange between the alveoli and the blood.

16. D
Increasing the oxygen concentration inside the alveolus (X) and decreasing the thickness of the alveolar wall (Y) both enhance the diffusion rate by steepening the concentration gradient and reducing the diffusion distance.

17. A
The bronchi contain cartilage for support, ciliated epithelium for removing mucus, and smooth muscle to regulate airflow.

18. C
Both bronchi and trachea have cartilage for support and cilia to move mucus. Bronchioles typically lack cartilage but may have cilia, making only bronchi and trachea suitable for both features.

19. A
Elastic fibres help alveoli recoil during exhalation, and a continual supply of deoxygenated blood maintains the concentration gradient for efficient gas exchange.

20. D
The bronchi always contain cartilage, which provides support and prevents collapse. Other structures like alveoli and bronchioles lack cartilage.

21. B
Gas exchange occurs when CO_2 moves from high concentration in the blood (6.0 kPa) to lower concentration in the alveoli (5.3 kPa), and oxygen moves from high concentration in the alveoli (13.9 kPa) to lower concentration in the blood (5.3 kPa).

22. C
Oxygen diffuses through the squamous epithelium of the alveolus and the endothelium of the alveolar capillary, which are thin layers that facilitate efficient gas exchange.

23. D
Elastic fibers in the alveoli stretch and recoil during breathing, aiding in the expansion and contraction of the lungs. The other statements are incorrect, as collagen doesn't prevent bronchi collapse, and smooth muscle contraction in bronchioles decreases, not increases, airflow.

24. D
All bronchioles contain epithelial cells and muscle tissue, but not all have goblet cells, as these are found in larger airways.

25. A
Oxygen and carbon dioxide diffuse across the thin walls of the alveoli, which consist of a single layer of epithelial cells, allowing efficient gas exchange.

26. B
The trachea, bronchi, and bronchioles are lined with ciliated epithelium, which helps move mucus and trapped particles out of the airways, aiding in keeping the respiratory system clear of debris.

27. C
The photomicrograph shows a bronchus, identifiable by its thick walls and the presence of cartilage, which supports the airway and prevents collapse during breathing.

28. D
Efficient gas exchange requires a large surface area (2) and a short diffusion distance (3) between alveoli and blood to maximize the rate of diffusion. Clean and warm air (1) is not directly related to diffusion efficiency.

29. D
Squamous epithelial cells are found in the human gas exchange system specifically within the alveoli. The alveoli are tiny air sacs within the lungs where the actual gas exchange occurs. The thin, flat squamous epithelial cells that line the alveoli allow for efficient diffusion of gases, such as the exchange of oxygen from the inhaled air into the bloodstream and the removal of carbon dioxide from the bloodstream into the exhaled air. This thin structure is well-suited for facilitating gas exchange in the respiratory system.

30. C
The elastic fibres in the alveoli walls allow the alveoli to expand to increase the surface area available for diffusion into the pulmonary capillaries.
The elastic fibers in the alveoli walls provide flexibility to the alveoli, allowing them to expand during inhalation and contract during exhalation. This expansion and contraction increase the surface area available for gas exchange between the alveoli and the pulmonary capillaries. This structural adaptation enhances the efficiency of gas exchange in the lungs.

31. C

The molecule will have to cross the cell membrane of the alveolar cell as it enters the cell (5) this will then move through cytoplasm of alveolar wall cells (190) The molecule will then again cross the cell membrane of alveolar cell when it leaves (5). It will then pass through the tissues between alveolar wall and capillary wall (300). From here it will enter the cell membrane of endothelial cell (5), then the cytoplasm of the endothelial cell (90) and then again cross the cell membrane of endothelial cell as it leaves to enter the blood (5). It will then enter the RBC through its cell membrane (5) and finally combine with Hb.
Thus: 5 + 5 + 190 + 300 + 5 + 90 + 5 + 5 = 605 nm

32. D

The reduced diffusion rate of oxygen into the blood at rest compared to during activity, and the implications for carbon dioxide concentration, require an understanding of respiratory physiology and gas exchange dynamics.

33. B

The presence of epithelium and muscle tissue in bronchioles is a basic aspect of respiratory anatomy. The absence of goblet cells, which are found in larger bronchi, is a distinguishing feature of bronchioles.

34. C

First the molecule will pass through the single lining of alveolar cells of the alveoli. While passing a single cell, the molecule will pass from the cell membrane of that cell twice. Once when it enters the cell's cytoplasm and once when it leaves the cell's cytoplasm. The molecule will then enter the surrounding tissue fluid, followed by their entry into the endothelial cells of the capillaries. They will again pass through cell membrane twice. After this they will enter the cytoplasm of the RBCs by cross the cell surface membrane and bind to the RBCs. All this adds up to a total of 5

35. C

The correct row is:
C bronchiole: regulates the amount of air reaching the lungs
Here's the explanation:
Bronchioles are small, fine branches of the bronchi, and they play a role in regulating the amount of air reaching the lungs. They do this by controlling the diameter of their smooth muscle, which can change to adjust airflow.
The other options are not entirely accurate:
A bronchus is a larger airway, and while it does conduct air to the lungs, it is not primarily responsible for regulating the amount of air reaching the lungs.
The statement about the bronchus providing support and preventing collapse is more accurate.
Bronchioles, not bronchi, are primarily involved in regulating airflow.
The statement about bronchioles providing support and preventing collapse is less accurate compared to the primary function of bronchioles in regulating airflow.

36. C

For efficient gas exchange, alveoli must have a large surface area to allow for more gas to be exchanged, and a short diffusion distance to speed up the exchange process. The alveoli are indeed adapted to these requirements by being numerous and having a structure that creates a large surface area (C). Moreover, the alveolar walls are extremely thin (only one cell layer thick) and are closely associated with the capillary networks, providing a short diffusion distance for gases. These features enable the efficient exchange of oxygen and carbon dioxide between the air in the alveoli and the blood in the capillaries.

37. B

Statement 1 is correct as absence of cartilage allows the bronchioles to expand. Statement 2 is incorrect as alveoli walls are not made of cuboidal epithelium. Statement 3 is correct as alveoli secrete a chemical that reduced the surface tension of water preventing their collapse. Statement 4 is incorrect as trachea and bronchi are supported by incomplete cartilage rings. Hence, option B is the correct answer.

38. B

The alveolar wall consists of a thin layer of epithelial cells, a basement membrane, and capillaries. This structure facilitates efficient gas exchange between the air in the alveoli and the blood in the capillaries.

39. A

Cilia function primarily to move mucus across the epithelial surface. This mucus traps pathogens and dust particles, aiding in keeping the respiratory tract clear of contaminants.

40. A

In a cross-section through a bronchus, smooth muscle adjusts the diameter of the airway, elastic tissue helps the bronchus return to its original shape, cartilage provides structural support, and the bronchus is typically lined with ciliated pseudostratified epithelium.

41. C
Option C is the correct answer as 3 represents the goblet cells since they require many mitochondria, endoplasmic reticulum and Golgi bodies for the production of the mucus and its secretion. Then 1 and 2 represent the smooth muscle and the cilia since the contraction of the smooth muscle and the wave like action of the cilia both require many mitochondria.

42. D
Option D is the correct answer as the goblet cells are not visible in the photomicrographs. Statements 2 and 3 are correct as smooth muscle is visible and cartilage is visible in the left image which means that it cannot be from a bronchiole since they do not have any cartilage.

43. D
Option D is the correct answer as the epithelial cells of the alveoli secrete a chemical that reduces the cohesion of water with the walls preventing their collapse.

44. C
Option C is the correct answer as smooth muscle is sufficient for supporting the walls of bronchioles as they are required to expand and contract.

45. B
Option B is the correct answer as V shows the diameter of a bronchiole that is surrounded by the smooth muscle that is visible.

46. D
Option A is incorrect as each hemoglobin molecule can bind temporarily to 4 oxygen molecules not atoms. Option B is incorrect as carboxyhemoglobin is the complex of carbon monoxide and hemoglobin. Option C is incorrect as the binding of the first oxygen molecule increases the affinity of hemoglobin binding with the other molecules. Hence, option D is the correct answer as oxyhemoglobin formation increases the ability of red blood cells to transport oxygen.

47. C
Option C is the correct answer as the wall of the trachea and the bronchus contain smooth muscle and goblet cells but not squamous epithelium since alveoli contain that.

48. C
Option C is the correct answer as in an asthma attach the activity of the ciliated epithelium increases and the activity of smooth muscles increases as well which causes constriction of the airways. The exocytosis of goblet cells increase as more mucus is produced.

49. C
Option C is the correct answer as the inner layers are of ciliated epithelial cells and goblet cells and on top of them a layer of elastic fibers lies and this is covered by a layer containing blocks of cartilage.

50. A
Option A is the correct answer as tar contains carcinogens which come into contact with DNA resulting in the occurrence of mutations which lead to uncontrolled cell division forming a tumor.

51. A
Option A is the correct answer as nicotine causes the constriction of small arteries that results in a higher blood pressure. It also causes the heart rate to increase.

52. D
Option D is the correct answer as only the trachea and the bronchus in the respiratory system contain all three of the cartilage, goblet cells and ciliated epithelium.

53. C
Option C is the correct answer as 3 is a red blood cell containing high proportion of carbonic anhydrase. 5 is the cytoplasm contain hydrogen carbonate ions and 6 contains lysosomes.

54. D
Option D is the correct answer as the bronchiole, bronchus and the trachea collectively clean the inhaled air while only the alveoli are involved in gaseous exchange.

55. A
Option A is the correct answer as all the 3 statements are correct methods in which the steepness of the concentration gradient of oxygen is maintained.

56. A
Option A is the correct answer as the ribosomes will produce the mucus while the Golgi body packs it into vesicles and the mitochondria assists in the movement of those vesicles.

57. D
Option A is incorrect as carbonic acid dissociates into hydrogen carbonate ions and hydrogen ions. Options B and C are incorrect as the formation of carbaminohemoglobin conversion of carbon dioxide into hydrogen carbonate ions occurs in respiring tissues not in the blood capillaries of the lungs. Hence, option D is the correct answer as in the lung carbon dioxide is produced from hydrogen carbonate ions once again by the action of carbonic anhydrase.

58. B
Option B is the correct answer as in active tissues oxygen dissociates from hemoglobin to be provided to tissues. In active tissues the carbon dioxide combines with water in the presence of carbonic anhydrase to from carbonic anhydrase that dissociates into hydrogen carbonate ions and hydrogen ions and combine with hemoglobin to form hemoglobinic acid.

59. C
Option C is the correct answer as trachea and bronchus contain both cartilage and goblet cells but not squamous epithelium.

60. C
Option C is the correct answer as it is possible that most of the alveoli have collapsed and do not have enough alveolar capillaries that makes oxygenation of the blood inefficient. The rate of diffusion can also be slow due to the smaller surface area. The lower partial pressure of oxygen in the pulmonary artery than in the alveolar air should cause oxygen to flow into the blood causing an increase in partial pressure.

61. D
Option D is the correct answer the molecules passes through the top and bottom of the endothelium membrane and then the top and bottom of the alveolar epithelial cells and finally into the alveolus making it 4 membranes.

62. A
Option A is the correct graph as in the absence of carbon monoxide the graph has a typical S shape but in its presence the percentage saturation never increases past a particular point as carbon monoxide has greater affinity to hemoglobin as compared to oxygen and it displaces oxygen.

63. A
Option A is the correct answer as the bronchus is present with the complete cartilage ring and an artery and vein are present right next to it. There is no trachea or bronchioles visible.

64. D
Options A, B and C are all incorrect since there is no information in the graph related to carbon monoxide or nicotine. The graph just shows time against heart rate. So we cannot assume that nicotine causes the increase in heart rate etc. Hence, option D is the correct answer as the most logical conclusion is that smoking causes the heart rate to increase.

65. C
Option C is the correct answer as terminal bronchioles contain no cartilage but have cilia and smooth muscles.

66. C
Option C is the correct answer the molecules passes through the top and bottom of the alveolar epithelial cell and then the top and bottom of the endothelial membrane and finally passes through the membrane of the red blood cells making it 5 membranes in total.

67. C
Option C is the correct answer as the decrease in elasticity of the alveoli causes difficulties in breathing out as the alveoli cannot recoil properly.

68. D
Option D is the correct answer as bronchioles contain ciliated cells and smooth muscle tissue but no endothelium.

69. B
Option B is the correct answer as due to the high partial pressure of oxygen in the alveoli it will diffuse from the high partial pressure to the low partial pressure in the pulmonary capillaries.

70. D
Option D is the correct answer as all bronchioles have muscle tissue and ciliated cells but no goblet cells.

71. D
Option D is the correct answer as trachea and the bronchus is supported by the cartilage but not the bronchioles.

72. C
Option C is the correct answer as the stripes represent the smooth muscle layer.

73. B
Option B is the correct answer as smooth muscle, goblet cells and cartilage are all present in the bronchi.

74. B
Option A is incorrect as cartilage supports the airway. Option C is incorrect as elastic fibers help in recoil for proper respiration. Option D is incorrect as smooth muscle offer resistance to airways and control airway flow. Hence, option B is the correct answer as ciliated epithelium offers protection to the airway from suspended particles.

75. C
Option C is the correct answer as the trachea contain incomplete cartilage rings and the bronchus contains complete cartilage rings. Slide 3 is the alveolus since they contain only squamous epithelial cells and thus slide 1 is a bronchiole that doesn't contain any cartilage or glands.

76. A
Option A is the correct answer as X, Y and Z represent the goblet, ciliated and epithelial cells all of which are affected by tar in cigarette smoke. Goblet cells produce more mucus and epithelial and ciliated cells are destroyed.

77. C
Option C is the correct answer the molecules passes through the top and bottom of the alveolar epithelial cell and then the top and bottom of the endothelial membrane and finally passes through the membrane of the red blood cells.

78. B
Option B is the correct answer as the diagram shows ciliated cells as well as goblet cell which are not present in bronchioles but are present in the trachea and the bronchus.

79. B
Option A is incorrect as alveoli do not have goblet cells. Option C is incorrect as cartilage is not present in the bronchioles. Option D is incorrect as during exercise the muscles do not relax they contract as when to adjust the air flow. Hence, option B is the correct answer as the cartilage in the bronchi keeps its open and allows air to flow freely.

80. C
Option C is the correct answer as the trachea, bronchi and the bronchioles contain the ciliated epithelium.

81. C
Option C is the correct answer as bronchioles contain smooth muscle and ciliated epithelial cells but n goblet cells.

82. C
Option C is the correct answer as root hairs increase the surface area, cilia cannot be resolved with a light microscope, root hairs contain vacuoles and more than one cilia are present on a cell.

83. A
Option A is the correct answer as the high blood pressure forces red blood cells out of capillaries reducing the distance for gas exchange. The permeability of the epithelium allows gases to diffuse easily and since most of squamous epithelium is present it means the gases have to diffuse a small distance.

84. D
Option D is the correct answer as bronchioles contain smooth muscle and ciliated cells.

85. A
Option A is the correct answer as bronchus contains cartilage, ciliated epithelium and smooth muscle.

86. D
Option D is the correct answer as oxygen always has to diffuse through 5 membranes from the air while caron dioxide has to diffuse through 4 or 5 from the blood. 4 if it is present in the form of hydrogen carbonate ions in the blood and 5 if being carried as carbaminohemoglobin.

87. D
Option D is the correct answer as the trachea and the bronchus contain cartilage, ciliated epithelium and goblet cells. Bronchioles do not contain cartilage or goblet cells.

88. C
Option C is the correct answer as the trachea and the bronchi contain cartilage and cilia but bronchioles do not contain cartilage.

89. C
Option C is the correct answer as the trachea and the bronchus contain cartilage, ciliated epithelium and goblet cells. Bronchioles do not contain cartilage or goblet cells.

90. A
Option A is the correct answer as the blood flowing through the lungs means that oxygenated blood is continuously being replaced by deoxygenated blood. This helps to maintain the concentration gradient.

91. D
Option D is the correct answer as trachea and bronchus contain cartilage, ciliated epithelium and goblet cells but bronchioles contain only ciliated epithelium and no cartilage or goblet cells.

92. A
Option A is the correct answer as the addition of carbohydrate to the protein forms a glycoprotein. Then the vesicle separates from the Golgi body and fuses with the cell surface membrane and finally the glycoprotein is secreted.

93. C
Option C is the correct answer as loss of elasticity is specific to emphysema. This occurs due to loss of elastin as s result of excessive smoking.

94. C
Option C is the correct answer as the bronchus contains cartilage, cilia and goblet cells as wells.

95. C
Option C is the correct answer as the steepness of the diffusion gradient in dependent on the concentration of the substance. In this case the high percentage of oxygen in the air is what causes there to be a steep gradient.

96. A
Option A is the correct answer as the alveoli bursting will cause the surface area to decrease as well as the maximum volume to decrease since the number of alveoli decrease.

97. D
Options A, B and C are incorrect as bronchioles do not contain cartilage. Hence, option D is the correct answer as bronchioles contain elastic tissue and ciliated cells.

98. D
Option D is the correct answer as the X layer contains ciliated cells which waft dust and dirt upwards while Y is the muscle layer which dilates and constricts the airway.

99. C
Option A is incorrect as the ability to stretch and relax does not mean that there is a large surface area rather it increases the volume. Option B is incorrect as gases dissolving does not mean that there is a large surface area and squamous epithelium cells does not mean that there is a short diffusion distance. Option D is incorrect as red blood cells are in capillaries which are close to alveoli walls. Hence, option C is the correct answer as many alveoli are folded and connected together to form a sac in order to increase the surface area and the short diffusion distance is due to the capillaries right next to the alveoli wall.

100. A
Option A is the correct answer as the ventilation in the lungs makes sure that there is a steep gradient for diffusion of oxygen into the blood cells and removal of carbon dioxide from the capillaries.

101. B
Option B is the correct answer as the tar causes direct effects on X and Y by destroying the Y cells which are ciliated cells and causing Y cells which are goblet cells to secrete more mucus.

102. B
Option B is the correct answer as the trachea contain the cartilage, cilia and goblet cells.

103. B
Option A is incorrect as alveolus does not contain ciliated epithelium or goblet cells or smooth muscles. Option C is incorrect as bronchioles do not goblet cells but do contain smooth muscles. Option D is incorrect as trachea does contain smooth muscles as well. Hence, option B is the correct answer as bronchus contain cartilage, ciliated epithelium, goblet cells and smooth muscles.

104. B
Option B is the correct answer as bronchioles consist of ciliated epithelium, elastic fibers and smooth muscles as well.

105. C
Option C is the correct answer the oxygen molecules passes through the top and bottom of the alveolar epithelial cell and then the top and bottom of the endothelial membrane and finally into the plasma. This is the same for carbon dioxide but just in the reverse order.

106. C
Option C is the correct answer as P is the bronchus since both ciliated epithelial cells and goblet cells are present, but Q is bronchiole since they do not contain goblet cells or very small amounts of them.

107. C
Option C is the correct answer as 1 is the bronchiole due to the large lumen. 2 is the alveolus due to the thin epithelial walls and 3 is the small artery due to the narrow lumen and thick muscular walls.

108. A
Option A is the correct answer as 2 is the bronchiole since they contain very few goblet cells and a thick layer of smooth muscle relative to the wall thickness. 1 is the bronchus due to the irregular cartilage placement and folded layer. 3 is the trachea containing blood vessels, many goblet cells and smooth muscle tissue.

109. C
Option C is the correct answer as the mitochondria is needed for the movement of the cilia in the epithelial cells and for the exocytosis of mucus produced by goblet cells.

110. A
Option A is the correct answer as cartilage cells, ciliated cells and exocytotic vesicles from the goblet cells will all be seen in the cross-section of the bronchus wall.

111. D
Option D is the correct answer as only the alveolus might contain macrophages not trachea, bronchus or bronchioles.

112. D
Option D is the correct answer the molecules passes through the top and bottom of the alveolar epithelial cell and then the top and bottom of the endothelial membrane and finally passes through the membrane of the red blood cells making 5 membranes.

113. D
Option D is the correct answer the molecules passes through the top and bottom of the alveolar epithelial cell and then the top and bottom of the endothelial membrane and finally passes through the membrane of the red blood cells making 5 membranes and 10 phospholipid layers since each membrane contains 2 of them.

114. A
Option B is incorrect as ciliated epithelium is present in the trachea as well. Option C is incorrect as goblet cells are present in the bronchus as well. Option D is incorrect as alveolus do not contain smooth muscle. Hence, option A is the correct answer as the cartilage is present in trachea and bronchus but not in the alveolus.

115. D
Option D is the correct answer as statements 1, 2 and 3 describe reactions that take place in active muscles. In a capillary in the lungs carbon dioxide and water form from hydrogen carbonate ions and hydrogen ions so that carbon dioxide can be removed from the blood.

116. C
Option C is the correct answer as elastic fibers and smooth muscles are present in the tracheal wall but not an epidermis but rather cilia.

117. D
Option D is the correct answer as the cartilage is found in the trachea or the bronchi and the smooth muscle is found in the trachea, bronchi or the bronchioles.

118. A
Option A is the correct answer as the diffusion gradient is maintained by the blood continuously flowing past the alveoli and the breathing movement of exchanging air that allows oxygen to diffuse in and carbon dioxide to flow out.

119. B
Option B is the correct answer as hydrogen carbonate ions and hydrogen ions are converted into carbon dioxide and water so that carbon dioxide can be excreted from the body.

120. A
Option A is the correct answer as the dissociation of carbon dioxide from carboxyhemoglobin allows more hemoglobin to be available for binding to oxygen.

121. A
Option A is the correct answer as the cartilage always keeps the airways open by supporting them. The ciliated epithelium moves the mucus out of the airways. The smooth muscle helps to change the diameter of the bronchioles and the elastic fibers allow alveoli to expand during breathing in to increase their volume.

122. D
Option D is the correct answer as cartilage is present in only the trachea and the bronchus. Ciliated epithelium is present in the bronchus, trachea and the bronchioles. Goblet cells are present in the bronchus and trachea but not in the bronchioles. Smooth muscle is present in all of trachea, bronchus and bronchioles.

123. A
Option A is the correct answer as the elastic fibers help the alveoli to recoil during expiration. Options B and C are incorrect as the elastase decrease elastic fibers and they decrease in emphysema. Option D is incorrect as the surfactant released by the alveoli reduces the surface tension of water to make sure that the alveoli do not collapse.

9.2: Multiple topics

1. A
Insects exchange gases directly through tracheal walls, unlike humans. Chitin spirals support insect tracheae, whereas human airways lack this feature. Insects have multiple tracheae, while humans have a single trachea.

2. C
The data shows a positive correlation between goblet cell density and mucus density (statement 1). There is also an association between smoking and increased mucus density (statement 3), but lung disease does not increase goblet cell density (statement 2 is incorrect).

3. B
Option B is the correct answer as carbon monoxide has the highest affinity followed by oxygen and then finally carbon dioxide.

4. D
Option D is the correct answer as carbon monoxide in the cigarette smoke binds with hemoglobin forming carboxyhemoglobin causing the oxygen carrying capacity of the blood to decrease.

5. A
Option A is the correct answer as in coronary bypass surgery a healthy artery or vein is attached a one end to the aorta and a coronary artery to the other in order to restore blood flow in the coronary artery.

6. D
Option D is the correct answer as X shows a layer of cartilage that helps to support the airway and prevent its collapse.

7. B
Option B is the correct answer as nicotine decreases the diameter of the arterioles and increases the secretion of the adrenaline that causes the heart rate to increase.

8. A
Option A is the correct answer as coughing up blood is specific to lung cancer only. Options B, C and D are incorrect as these are all symptoms of COPD as well.

9. B
Option B is the correct answer as in asthma due to the constriction of the airways the diffusion gradient for oxygen will decrease as there is less air in the airways. There will be greater risk of developing lung infection due to the mucus tapping bacteria and it being unable to the removed due to the airways being narrow.