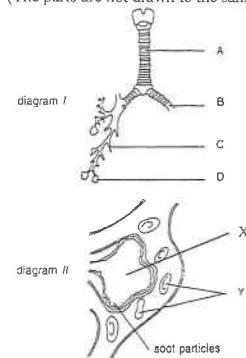


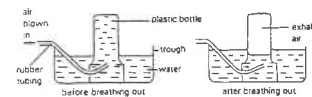
Past HKCEE Questions
Gaseous Exchange in Humans
Paper I

1. Diagram I below shows part of the human respiratory system, a portion of which is further magnified in diagram II to show greater detail. (The parts are not drawn to the same scale.)



- Using the letters from diagram I, indicate the region which corresponds to diagram II. What is the name of the region?
 - Under normal circumstances, a gas G₁ diffuses from X to Y during gaseous exchange.
 - What is G₁?
 - State the structures (in their correct sequence) through which G₁ passes as it goes from X to Y.
 - What immediate change would G₁ undergo after entering Y?
 - What is the gas that diffuses from Y to X during gaseous exchange?
 - The presence of soot particles may affect gaseous exchange.
 - State and explain the effect of the soot particles.
 - State a possible source of soot particles. (11 marks)
- (HKCEE 1983)

2. The diagram below shows an experiment which a person set up to measure the volume of air he breathed out:



The volume of the exhaled air was measured after adjusting the water levels inside and outside the bottle so that they were the same. A sample of the exhaled air was then taken

out and analysed. The results are shown in the table below:

Volume of sample taken out for analysis	10.0 cm ³
Volume of sample after the absorption of carbon dioxide	9.6 cm ³
Volume of sample after the absorption of both carbon dioxide and oxygen	8.0 cm ³

- Why is it necessary to adjust the water levels before measuring the volume of the exhaled air?
- Suggest a chemical substance that could be used in the above analysis for absorbing
 - carbon dioxide.
 - oxygen.
- In the sample of exhaled air taken out for analysis, what was the percentage of
 - carbon dioxide?
 - oxygen?
- If the person were to perform the above experiment again shortly after vigorous exercise, state the change, if any, in
 - the volume, and
 - the composition of the exhaled air.
 Explain your answer.
- What is the term used to describe the maximal volume of air that a person can breathe out?

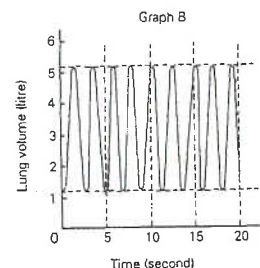
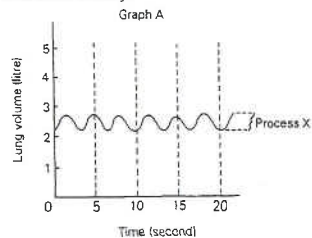
(HKCEE 1984)

3. The table below shows the different amounts of air breathed out by a young man:

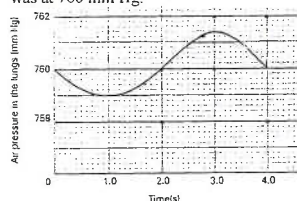
	Breaths per minute	Volume (cm ³) of a single expiration/exhalation
Before exercise	19	500
After exercise	36	1100

- From the above data, state two changes in breathing as a result of performing exercise.
 - In order to bring about the changes in (i), state
 - the part of the brain involved.
 - the stimulus concerned.
 - the two effectors responsible.
 - What is the volume of air breathed out per minute
 - before exercise?
 - after exercise?
 - If the percentage by volume of oxygen is 20% in atmospheric air and 16% in expired air, what is the volume of oxygen retained in the body per minute
 - before exercise?
 - after exercise?
- (HKCEE 1985)

4. Graph A shows the breathing pattern of a man at rest, while graph B shows that of the man doing a different activity.

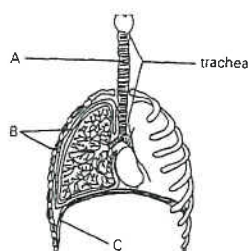


- (i)
- (1) Name process X (in graph A) which causes an increase in lung volume. (1 mark)
 - (2) How is process X brought about in man? (3 marks)
- (ii) From graph A, calculate the breathing rate of the man in number of breaths per minute. (2 marks)
- (iii) Suggest an activity undertaken by the man to account for the breathing pattern in graph B. (1 mark)
- (iv) State two differences in the breathing patterns shown in graph A and graph B. What is the significance of these differences? (4 marks)
- (HKCEE 1987)
5. The graph below shows the changes in air pressure in the lungs of a man measured during a single breath at rest. The atmospheric pressure was at 760 mm Hg.



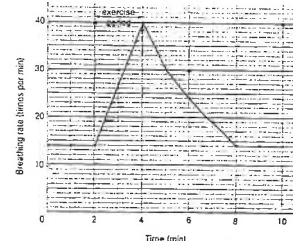
- (i) State the period of time during which the man was breathing out air? Explain how you arrive at your answer. (2 marks)
 - (ii) Describe how the actions of the respiratory muscles brought about the changes in air pressure in the lungs when the man was breathing out. (4 marks)
 - (iii) Deduce the rate of breathing of the man at rest. (1 mark)
 - (iv) Copy the axes of the graph above and sketch a curve showing the likely changes in the air pressure in his lungs when the man is exercising. (2 marks)
- (HKCEE 1990)

6. The diagram below shows part of the human respiratory system:



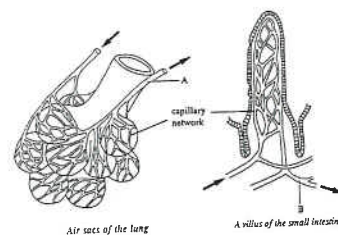
- (i) Name the ring-like structure A. State its function. (2 marks)
 - (ii)
 - (1) Name the structures labelled B. (1 mark)
 - (2) Explain why the lung will collapse if structure B is punctured in an accident. (2 marks)
 - (iii) What would happen to muscle C when a person tries to breathe out as much air as possible? (1 mark)
 - (iv) Explain how each of the following features of the alveoli facilitates gaseous exchange in the lungs:
 - (1) one-cell thick
 - (2) greatly folded
 - (3) moist
(3 marks)
 - (v) Cigarette smoke may inhibit the beating of the cilia in the respiratory tract. Explain how this could reduce the efficiency of the lungs in gaseous exchange. (2 marks)
- (HKCEE 1991)

7. A student was asked to perform a physical exercise. Before and after the exercise, he rested on a chair. His breathing rate was measured at intervals. The results are shown in the graph below:



- (i) What is the increase in the breathing rate as a result of the exercise? (1 mark)
 - (ii) Explain the significance of such an increase in the breathing rate. (3 marks)
 - (iii) Describe and explain the mechanism of inspiration (breathing in). (5 marks)
 - (iv) Besides becoming faster, what other change in the breathing movement would occur during exercise? (1 mark)
- (HKCEE 1992)

8. The diagrams below show a group of air sacs of the lung and a villus of the small intestine with their associated capillaries. The arrows indicate the direction of blood flow. (The two diagrams are not drawn to the same scale.)



- (i) Name one substance that is absorbed into the blood of
 - (1) the air sacs.
 - (2) the villus.
(2 marks)
- (ii) Both the air sacs and the villus are richly supplied with blood capillaries. State two reasons to explain how this feature can speed up the absorption of substances. (4 marks)
- (iii) By means of a flowchart, indicate the route by which blood in a person is transported from A to B. Indicate the major blood vessels and heart chambers involved. (2 marks)
- (iv) Explain the change in the carbon dioxide

content when the blood in A flows to B. (3 marks)

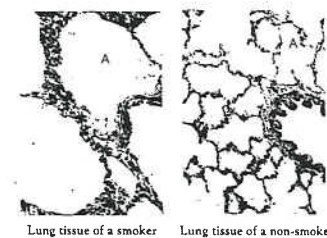
(HKCEE 1994)

9. The table below shows the breathing rate and the volume of air inhaled per breath of a healthy woman at rest and during exercise:

	At rest	During exercise
Breathing rate (times per minute)	18	36
Volume of air inhaled per breath (cm ³)	500	1000
Ventilation rate (cm ³ per minute)	9000	?

- (i) Calculate the ventilation rate of the woman during exercise. (2 marks)
 - (ii) Explain the significance of the increase in ventilation rate during exercise. (4 marks)
 - (iii) The air inhaled by the woman contains lots of dust particles but very few of them reach her lungs. Explain why. (3 marks)
 - (iv) Draw and label a set-up to estimate the volume of air exhaled in a breath. (3 marks)
- (HKCEE 1995)

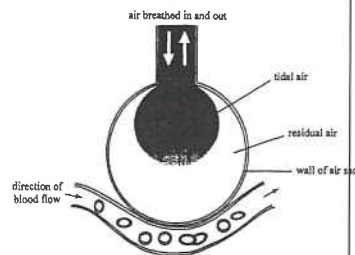
10. The photographs below show the sections of the lung tissues of a cigarette smoker and a non-smoker observed under the microscope with the same magnification:



- (i) What is structure A? (1 mark)
- (ii) Describe and explain the mechanism by which air from the atmosphere is drawn into structure A. (4 marks)
- (iii) With reference to the photographs, explain how the function of structure A is affected by cigarette smoking. (2 marks)
- (iv)
 - (1) State a disease which may be caused by tar in cigarette smoke. (1 mark)
 - (2) Draw a labelled diagram of a set-up used

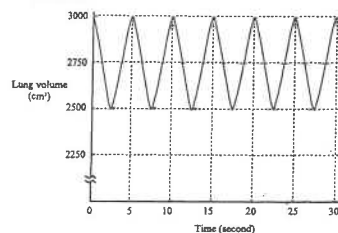
to show the presence of tar in cigarette smoke.
(3 marks)
(HKCEE 1997)

11. The diagram below shows the structure of an air sac of the human lung. The tidal air refers to the air that can be breathed in and out of the body in each breath. The residual air refers to the air that cannot be exchanged with the atmosphere during breathing.



- (i) Describe how oxygen in the tidal air reaches the blood. (3 marks)
(ii)
(1) If a person breathes deeply, how will the volume of tidal air inhaled be affected? (1 mark)
(2) Based on your answer to (1), explain the effect of deep breathing on the rate of oxygen uptake in the blood. (2 marks)
(iii) Explain one effect of smoking on the process described in (i). (2 marks)

12. The graph below shows the changes in lung volume of a boy at rest over a period of 30 seconds:



- (i) Determine the rate and depth of breathing of the boy at rest. (2 marks)
(ii) State the period of time in the first 5 seconds during which air was flowing out of the lungs. (1 mark)
(iii) Explain how the outflow of air from the lungs was brought about by the breathing mechanism. (4 marks)

- (iv) If the pleural membrane on the left side of the boy's thorax is punctured, his left lung will collapse while his right lung will not. What would be the change in
(1) his breathing movement, (1 mark)
(2) the air flow of his left and right lungs? (2 marks)
(HKCEE 2001)

13. To study the effect of concentration of oxygen and carbon dioxide on the breathing rate, a healthy person was asked to inhale different gas mixtures. The results are shown in the table below:

Gas mixture	Concentration of gas (%)		Breathing rate (breaths per min)
	Oxygen	Carbon dioxide	
P	21	0.03	17
Q	21	4.00	34
R	16	0.03	17
S	16	4.00	34

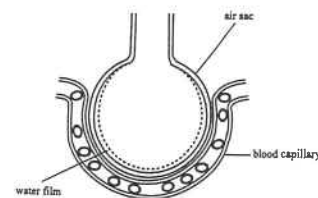
- (i) With reference to the above information, state the factor that affects the breathing rate of the person. Explain how you arrive at your answer. (3 marks)
(ii) Which of the four gas mixtures has similar concentrations of oxygen and carbon dioxide as exhaled air? (1 mark)
(iii) Mouth-to-mouth ventilation is a method for rescuing a person who fails to breathe but still has heartbeat. It involves blowing exhaled air into the patient's body through the mouth as shown below:



Based on the composition of exhaled air, explain why this method can help the patient stay alive before he can breathe again. (2 marks)

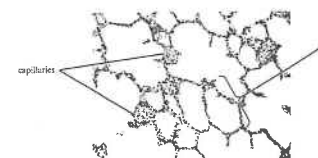
- (iv) Suggest why it is necessary to do the following when carrying out mouth-to-mouth ventilation
(1) Tilt the patient's head as shown in the diagram, instead of letting it lie flat. (1 mark)
(2) Observe whether the patient's chest rises when blowing air into the patient. (1 mark)
(v) Which part of the brain controls the breathing rate? (1 mark)
(HKCEE 2003)

14. The diagram below shows an air sac of the lung and its blood supply.



- (i) Explain the importance of the water film in gaseous exchange. (2 marks)
(ii) SARS patients may have fluid accumulated in the air sacs. Explain how the accumulation of fluid may affect the oxygen content of the blood of the patients. (3 marks)
(iii) One method to confirm whether a patient is infected with the SARS virus is to test for the presence of antibodies against this virus in the patient's blood. Explain why these antibodies will be produced by a SARS patient. (2 marks)
(iv) Suggest a method that can help the body develop immunity against SARS. Explain how the immunity is developed. (4 marks)
(HKCEE 2004)

15. The photomicrograph below shows a section of a mammalian lung:



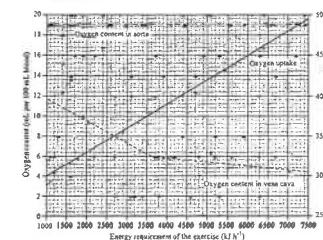
- (a) With reference to *two* features observable in the photomicrograph, explain how the lung tissue is adapted to gas exchange. (4 marks)
(b) Oxygen moves continuously from the air in A into the capillaries. However, the oxygen content in A remains relatively high. Explain how this is achieved. (2 marks)
(c) Eric wanted to compare the oxygen content of atmospheric air and exhaled air, so he prepared two jars of gas as shown below:



- (i) Draw a labelled diagram to show a set-up that can be used to collect the air exhaled from his lungs. (4 marks)
(ii) Describe what Eric should do in order to compare the oxygen content of the two air samples. (2 marks)

(HKCEE 2005)

16. The graph below shows the oxygen content of blood in the aorta and that in the vena cava, and the oxygen uptake of a person performing exercise of different intensities. The intensity of exercise is expressed as the energy requirement of the exercise.



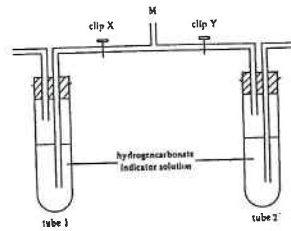
- (i) How does the oxygen uptake change with exercise of different energy requirements? (1 mark)
(ii) From the graph, find out the blood oxygen content in the aorta and the vena cava for boxing, which has an energy requirement of 4500 kJ h⁻¹. (1 mark)
(iii) The energy requirements for running and cycling leisurely are 3600 kJ h⁻¹ and 1800 kJ h⁻¹ respectively. Calculate the difference in the blood oxygen content between the aorta and the vena cava for each type of exercise. (2 marks)
(iv) How does the difference in blood oxygen content between the two blood vessels change with the intensity of exercise? Explain the significance of this change. (3 marks)
(v) As exercise intensity increases, there is a great change in the blood oxygen content in the vena cava, but that in the aorta remains constant and high. Explain how the constant and high blood oxygen content in the aorta can be achieved. (3 marks)

(HKCEE 2006)

Past HKCEE Questions
Gaseous Exchange in Humans and in Plants
Paper II

90-14

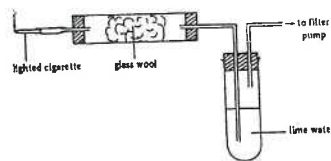
The following apparatus is used to compare the amounts of a certain component in exhaled and inhaled air:



When a student exhales air through M, which of the following combinations is correct?

Clip X	Clip Y	Colour of indicator	
		in tube 1	in tube 2
A. closed	open	yellow	red
B. closed	open	red	yellow
C. open	closed	yellow	red
D. open	closed	red	yellow

90-18



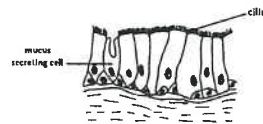
Using the above experimental set-up, which of the following substances present in cigarette smoke can be detected?

- (1) tar
- (2) nicotine
- (3) carbon dioxide

- A. (1) only
- B. (3) only
- C. (1) and (3) only
- D. (2) and (3) only

90.

Directions: Questions 20 and 21 refer to the diagram below which shows the inner lining of a certain part of the human body



90-20

This inner lining can be found in

- A. the trachea.
- B. the alveolus.
- C. the renal tubule.
- D. the small intestine.

90-21

The function of this lining is to facilitate

- A. the exchange of gases.
- B. the removal of dust particles.
- C. the absorption of food substances.
- D. the reabsorption of useful materials.

91-20

Cigarette smoking is hazardous to health because

- (1) cigarette smokers eventually die of lung cancer.
- (2) there is a high correlation between cigarette smoking and heart diseases.
- (3) tar from cigarette making is deposited on the surface of the alveoli thereby reducing the efficiency of gaseous exchange.

- A. (1) and (2) only
- B. (1) and (3) only
- C. (2) and (3) only
- D. (1), (2) and (3)

91-25

The table below shows the tar and nicotine content present in the cigarette smoke of 5 brands of cigarettes:

Brand of cigarette	With filter (+) or without filter (-)	Tar (mg/cigarette)	Nicotine (mg/cigarette)
P	+	15	1.0
Q	-	33	2.1
R	+	20	1.3
S	+	22	1.4
T	-	38	3.2

Which of the following statements is correct?

- A. Cigarette filters can reduce the tar content but increase the nicotine content.
- B. Cigarette filters can increase the tar content but reduce the nicotine content.
- C. Cigarette filters can increase both the tar content and the nicotine content.
- D. No conclusion can be drawn from the above results.

91-26

Vital capacity is the maximum volume of air breathed out

- A. during exercise.
- B. in a resting condition.
- C. after the deepest inspiration.
- D. after the deepest expiration.

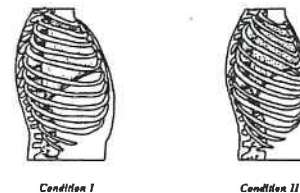
91-27

Which of the following shows the correct sequence of air passage into the lungs?

- A. trachea → larynx → air sacs → bronchi
- B. larynx → trachea → bronchi → air sacs
- C. air sacs → larynx → trachea → bronchi
- D. larynx → bronchi → trachea → air sacs

93.

Directions: Questions 18 and 19 refer to the two diagrams below which show the side view of the human thorax in two different conditions:



93-18

Which of the following occurs when the thorax changes from condition I to condition II?

- A. Intercostal muscle contracts and air flows into the lungs.
- B. Intercostal muscle contracts and air flows out of the lungs.
- C. Intercostal muscle relaxes and air flows into the lungs.
- D. Intercostal muscle relaxes and air flows out of the lungs.

93-19

Which of the following is correct when the thorax changes from condition II to condition I?

Diaphragm muscle	Pressure in lungs
A. contracts	increases
B. relaxes	increases
C. contracts	decreases
D. relaxes	decreases

93-20

What will happen when the pleural membrane is punctured?

- A. The air sacs are damaged.
- B. The lungs cannot expand.
- C. The diaphragm cannot contract.
- D. The ribs cannot be raised upwards.

93-21

Which of the following statements about cigarette smoking is correct?

- A. Nicotine causes lung cancer.
- B. Nicotine stains the lungs brown.
- C. Tar is the main factor that causes addiction to smoking.
- D. Carbon monoxide reduces blood oxygen content.

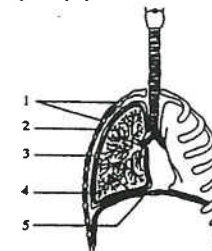
94-38

Which of the following sequences of events will occur when a person inhales while he is asleep?

- A. The diaphragm muscles contract → atmospheric air rushes into the lungs → the lungs dilate
- B. The intercostal muscles contract → atmospheric air rushes into the lungs → the lungs dilate
- C. The diaphragm muscles contract → the lungs dilate → atmospheric air rushes into the lungs
- D. The intercostal muscles contract → the lungs dilate → atmospheric air rushes into the lungs

95.

Directions: Questions 17 and 18 refer to the diagram below which shows the human respiratory system:



95-17

Which of the following are the functions of structure 1?

- (1) forming red blood cells
- (2) protecting the lungs
- (3) helping ventilation

- A. (1) and (2) only
- B. (1) and (3) only
- C. (2) and (3) only
- D. (1), (2) and (3)

95-18

Which structures contract rhythmically during breathing?

- A. 2 and 4
- B. 2 and 5
- C. 3 and 4
- D. 3 and 5

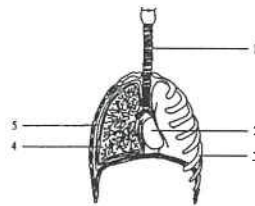
95-19

Which of the following may cause heart disease and damage of cilia in the trachea?

- A. alcohol drinking
- B. cigarette smoking
- C. too much fatty food in the diet
- D. too much salted fish in the diet

96.

Directions: Questions 19 to 21 refer to the diagram below which shows some of the structures in the human thoracic cavity:



96-19

Heavy cigarette smoking will affect the functioning of

- A. structures 1, 2 and 3.
- B. structures 1, 2 and 4.
- C. structures 1, 3 and 4.
- D. structures 2, 3 and 4.

96-20

Which of the following correctly describes the long-term effect of cigarette smoking on the body?

- A. The breathing rate decreases.
- B. Voluntary actions become faster.
- C. The blood pressure becomes lower.
- D. The oxygen level in the blood becomes lower.

96-21

Which of the following will occur if structure 5 is broken?

- A. The lungs will collapse.
- B. The ribs will stop moving.
- C. The air sacs will be filled with water.
- D. The diaphragm will not be able to contract.

96-58

The exhaled air from our body consists mostly of

- A. carbon dioxide.
- B. nitrogen.
- C. oxygen.
- D. water vapour.

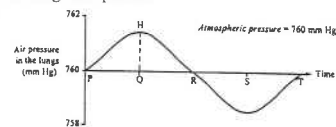
97-19

Which of the following changes will occur when a person is doing vigorous exercise?

	Depth of breathing	Rate of breathing	% O ₂ in inhaled air
A.	increases	increases	increases
B.	decreases	constant	increases
C.	increases	increases	constant
D.	decreases	constant	constant

98.

Directions: Questions 14 to 16 refer to the graph below which shows the change in air pressure in the lungs of a person:



98-14

Inhalation occurs from

- A. P to Q.
- B. P to R.
- C. R to S.
- D. R to T.

98-15

Which of the following correctly describes the state of the intercostal muscle and the shape of the diaphragm at Q?

	Intercostal muscle	Diaphragm
A.	contracted	flattened
B.	contracted	dome-shaped
C.	relaxed	flattened
D.	relaxed	dome-shaped

98-16

The shape of the curve above will change when the person is doing vigorous exercise. Which of the following correctly describes the changes?

	Distance between P and T	Distance between H and Q
A.	increases	increases
B.	increases	decreases
C.	decreases	increases
D.	decreases	decreases

99-36

Regular exercise may increase the vital capacity of a person. What is the advantage of having a larger vital capacity?

- A. The lungs can take in more air during exercise.
- B. The breathing rate can increase more during exercise.
- C. The lungs can take in air with a higher oxygen concentration during exercise.
- D. Normal activity can be maintained at a lower breathing rate.

01-15

Which of the following features of the respiratory tract helps to warm the inhaled air?

- A. The nasal cavity has a lot of hair.
- B. The lining of the trachea is covered with cilia.
- C. The lining of the respiratory tract is coated with mucus.
- D. The wall of the nasal cavity is richly supplied with capillaries.

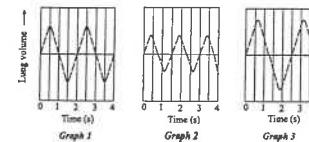
01-16

For a person who carries out physical exercise regularly, which of the following will not occur?

- A. His joints will become more flexible.
- B. He will have a lower heart rate at rest.
- C. He will breathe at a higher rate at rest.
- D. He will develop a larger vital capacity.

02.

Directions: Questions 30 and 31 refer to the graphs below, which show the rate and depth of breathing of three persons during a fitness test:



02-30

Referring to graph 1, what is the breathing rate of the person?

- A. 15 breaths per minute
- B. 30 breaths per minute
- C. 45 breaths per minute
- D. 60 breaths per minute

02-31

The three persons are a cigarette smoker, a non-smoker and a professional runner. Which of the following correctly identifies the person represented by each of the graphs?

	Graph 1	Graph 2	Graph 3
A.	smoker	non-smoker	runner
B.	non-smoker	runner	smoker
C.	non-smoker	smoker	runner
D.	runner	smoker	non-smoker

03-17

Which of the following correctly lists the sequence of events that follows the contraction of the intercostal muscles and diaphragm muscle?

- (1) Air enters the lungs.
- (2) The lung volume increases.
- (3) The pressure in the lungs decreases.
- A. (2), (1), (3)
- B. (2), (3), (1)
- C. (3), (1), (2)

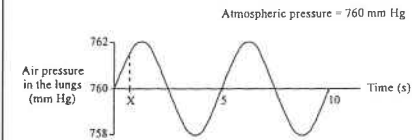
D. (3), (2), (1)

05-5

The lining of the nasal cavity is covered with a thin film of mucus. What is the importance of the mucus?

- A. It warms up the inhaled air.
- B. It helps remove dust from the incoming air.
- C. It lubricates the passage of air into the respiratory tract.
- D. It helps dissolve oxygen in the inhaled air for gas exchange.

The diagram below shows the changes in the air pressure in the lungs of a person when he is at rest:



05-17

What is the rate of breathing of this person at rest?

- A. 10 breaths per minute
- B. 12 breaths per minute
- C. 18 breaths per minute
- D. 24 breaths per minute

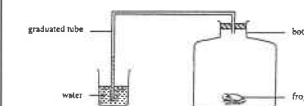
05-18

Which of the following correctly describes the state of the intercostal muscles and the diaphragm at time X?

	Intercostal muscles	Diaphragm
A.	contracting	dome-shaped
B.	contracting	flattened
C.	relaxing	dome-shaped
D.	relaxing	flattened

06.

Directions: Questions 19 and 20 refer to the diagram below, which shows a setup designed by a student to study the respiration of a frog:



06-19

The set-up failed to show a rise in water level in the graduated tube as expected. How should the student correct the set-up?

- A. The bottle should be filled with oxygen.
- B. The bottle should be wrapped with cotton

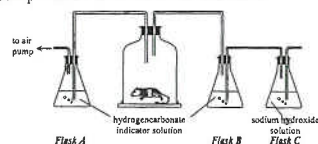
- C. A bag of soda lime should be placed inside the bottle.
- D. The water should be replaced by hydrogencarbonate indicator solution.

06-20

After the correction, the experiment was repeated. There was a rise in water level in the graduated tube showing a difference in readings of 4 cm³. Which of the following is the correct interpretation of the result?

- A. The amount of oxygen breathed in by the frog is 4 cm³.
- B. The amount of carbon dioxide breathed out by the frog is 4 cm³.
- C. The amount of oxygen breathed in is 4 cm³ more than the amount of carbon dioxide breathed out by the frog.
- D. The amount of oxygen breathed in is 4 cm³ less than the amount of carbon dioxide breathed out by the frog.

Directions: Questions 21 and 22 refer to the diagram below, which shows a setup used to investigate the respiration of a mammal. The air pump was switched on for 20 minutes.



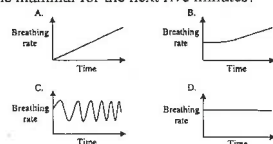
06-21

Which of the following correctly states the colour of the hydrogencarbonate indicator solution in flask A and flask B after 20 minutes?

- | | |
|----------------|----------------|
| Flask A | Flask B |
| A. red | purple |
| B. red | yellow |
| C. yellow | purple |
| D. purple | red |

06-22

If the air pump is switched off, which of the following graphs shows the breathing rate of the mammal for the next five minutes?



07-12

Which of the following correctly describes the functioning of the human breathing system?

- A. The bronchus cannot change its size.
- B. The nasal cavity has hairs to trap dust.
- C. The diaphragm contracts during inhalation.
- D. The lung expels air through its muscular contraction.

07-13

Cigarette smoking results in the deposition of tar on the inner surface of the air sacs. This would decrease

- A. the depth of breathing.
- B. the efficiency of gas exchange.
- C. the resistance for gas diffusion.
- D. the amount of oxygen that flows into the lungs.

07-41

The film of water on the surface of human air sacs serves to

- A. warm the incoming air.
- B. moisten the incoming air.
- C. trap dust in the inhaled air.
- D. dissolve the gases in the inhaled air.

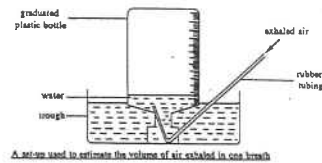
Past HKCEE Questions Gaseous Exchange in Humans and in Plants Suggested Answers

Paper I

- D (letter only)
alveolus / air sac
 - Oxygen/ O₂
 - X → alveolar wall (NOT for reversed direction) → capillary wall → RBC / Y forming oxyhaemoglobin
 - carbon dioxide / CO₂
 - slow down / decrease the rate reduce surface
 - smoking / car exhausts / polluted air / etc.
- to ensure that the volume of air is measured at atmospheric pressure / same pressure
 - potassium hydroxide / sodium hydroxide (solid or solution)
 - alkaline pyrogallol / pyrogallol acid solution
 - CO₂ % = 4%
 - O₂ % = 16%
 - | | (1) volume | (2) composition |
|-------------|----------------------------|-----------------|
| change | increase | no or little |
| explanation | causing depth of breathing | in |
- vital capacity
 - rate of breathing increased 1 depth of breathing / volume of exhaled air increased
 - medulla oblongata / breathing centre
 - increased CO₂ concentration in blood
 - intercostal muscles diaphragm
 - 9500 cm³
 - 39600 cm³
 - 380 cm³
 - 1584 cm³
- inspiration / inhalation / breathing in
 - intercostal muscles contract/ ribs move upward and outward diaphragm muscles contract / diaphragm becomes flattened thoracic volume increases / air pressure inside the lungs decreases

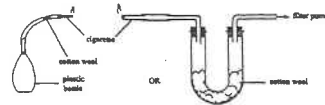
- 6/20 x 60 = 18 breaths per minutes
 - doing exercise
 - In graph B change in lung volume is greater / depth of breathing is greater breathing rate is faster [or vice versa for graph A]
Significance:
to remove more CO₂ / to remove CO₂ produced in exercise to supply more O₂ / to supply O₂ for the exercise
- from 2.0 s to 4.0s pressure in the lungs is greater than the atmospheric pressure
 - in intercostal muscles relax
 - to lower the ribs
 - diaphragm relaxes
 - to curve upward (any 3)
 - 15 breaths per minute (no unit, no mark)
 - showing a higher frequency showing a greater magnitude (no unit / reference point, no mark)
- ring cartilage to prevent collapse of the trachea / to allow free passage of air
 - pleural membranes / pleura
 - because air leaks in / increases pressure between pleura the lung recoils / collapses due to its own elasticity
 - muscle C relaxes
 - to provide a short distance for diffusion
 - to provide a large surface area for diffusion
 - to dissolve the respiratory gases for diffusion to occur
 - dust particles cannot be removed from the respiratory tract / more dust particles enter the lungs thereby reducing the surface area for gaseous exchange
- 26 times/minute (no unit, no mark)
 - An increase in breathing rate provides the body with more oxygen (1) and hence more energy is released (1) by respiration / oxidation of food (1) It also helps the body to get rid of carbon dioxide (product of respiration) more quickly (1) (any 3)

7. (iii) Intercostal muscle contracts to raise the rib cage
Diaphragm muscle contracts to make the diaphragm flattened
these 2 actions together increase the volume of thoracic cavity
thus decrease the thoracic pressure / pressure inside the lung
The greater atmospheric pressure forces air into the lungs
(iv) The amplitude / depth of breath is greater
8. (i) (1) oxygen
(2) glucose / amino acids / mineral salts / vitamins / water
(ii) With a rich supply of blood capillaries, substances absorbed can be transported away so as to maintain a steep concentration gradient across the wall of the air sacs / villus
The capillary network provides a large surface area
As a result, the rate of diffusion of substances increases
(iii) A → pulmonary vein → left atrium
→ left ventricle → aorta → B
N.B. 1/2 mark for each correct spelling of the heart chambers / blood vessels in the correct sequence. Deduct 1/2 mark for not showing arrow sign. No mark if the answer is not in the form a flow chart.
(iv) The blood CO₂ content increases because CO₂ is produced by respiration
by the cells in the villus (small intestine)
9. (i) Ventilation rate
= 1000 x 36 cm³ per minute
= 36000 cm³ per minute
(no unit, no mark)
(ii) To supply more oxygen to the skeletal muscles for faster respiration / for more energy supply
To remove CO₂ more rapidly
(iii) Dust particles are trapped by the hair in the nose and mucus along the lining of the air passage / nasal cavity / trachea
(iv) large, clear accurate diagram
labels and title (any 4)



A set-up used to estimate the volume of air exhaled in one breath

10. (i) air sac
(ii) The intercostal muscles contract to raise the rib cage
The diaphragm muscles contract to flatten the diaphragm
The volume of the thoracic cavity increases,
and hence the pressure inside decreases
so air rushes into structure A
Communication skill(c)
(iii) The number/surface area of structure A is reduced/the surface of structure A of the smoker is less folded
which greatly reduces the rate of gaseous exchange
(iv) (1) lung cancer
(2) Large and accurate diagram
Label and title: *cigarette, filter *pump, *cotton wool (No mark if the set-up is not workable)



A set-up to show the presence of air in alveolar ducts

11. (i) Oxygen in the tidal air diffuses through the residual air and dissolves in the water film lining the air sac
It then diffuses across the walls of the air sac and the capillary into the blood
Effective communication (C)
(ii) (1) The volume of tidal air will increase
(2) The oxygen uptake in the blood becomes faster:
because (any one below)
• the distance of diffusion of oxygen from the tidal air to the water film is reduced
• or because resurface area of the air sac for diffusion of oxygen is increased

- (iii) Particles / Tar deposit on the wall of the air sac
thus reduce the rate of diffusion of oxygen
(accept other correct answers)
12. (i) Rate of breathing = 12 breaths per minute
Depth of breathing = 500 cm³
between 0 and 2.5 second
(ii) Intercostal muscles relaxed, so that the ribs moved downward and inward
Diaphragm muscles relaxed, so that the diaphragm recoiled to the dome-shape
The thoracic / lung volume decreased
leading to an increase in air pressure in the lungs
Effective communication (C)
(iv) (1) The breathing movements would become faster
(2) In the left lung, air flow would decrease
In the right lung, air flow would increase
13. (i) • Concentration of carbon dioxide.
• Because the breathing rate increases / changes with the concentration of carbon dioxide,
• while it remains the same regardless of the change in oxygen concentration.
(ii) S
(iii) • Exhaled air still contains 16% oxygen.
• When blown into the patient's lungs, the oxygen can be supplied to the body cells for respiration.
(iv) (1) To ensure the entrance of the trachea is clear / free from obstructions.
(2) To ensure that air is blown into the lungs.
(v) medulla
14. (i) Oxygen in air dissolves in the water film,
so that it can diffuse readily through the wall of the air sac into the blood capillary.
- (ii) The accumulation of fluid increases the distance for diffusion / reduces the surface area for dissolving oxygen, thereby decreases the rate of diffusion of dissolved oxygen into the blood capillaries.
Thus the oxygen content of the blood decreases / becomes lower than normal.
(iii) The antigen of the SARS virus stimulates the white blood cells of the patient to produce the specific antibodies.
(iv) Injection of the weakened virus / the antigen into the body.
This will stimulate the white blood cells to develop memory for the antigen.
When the same virus enters the body,
a large amount of antibodies can be produced rapidly to kill the virus.
15. (a) Any one set below:
• The wall of A is very thin
• so as to reduce the distance of diffusion of respiratory gases
or
• A is richly supplied with blood capillaries
• This allows a rapid transport of gas to and away from the air sacs / can maintain a steep concentration gradient of gases between A and the blood
or
• The lung tissue is made up of numerous air sacs
• so that there is a large surface area for gas exchange / the diffusion of gases
16. (i) Oxygen uptake increases with exercise of increasing energy requirement
(ii) Oxygen content in aorta: 19 mL per 100 mL blood
Oxygen content in vena cava: 5.6 mL per 100 mL blood
(iii) Difference in oxygen content for running = 19 - 6 = 13 mL per 100 mL blood
Difference in oxygen content for cycling = 19 - 10 = 9 mL per 100 mL blood

- (iv) The difference in blood oxygen content between the aorta and the vena cava increases with increased exercise intensity
This is because that more oxygen is consumed by tissue
for respiration to release more energy for increased exercise intensity
- (v) During vigorous exercise, there is an increase in ventilation rate / rate and depth of breathing
The oxygen content in air sac increases
The diffusion gradient across alveolar wall increases / This increases the diffusion of oxygen into the blood thus maintaining the blood oxygen content of the aorta at a constant and high level

1
1
1
1
1
1
1

06-21	C
06-22	B
07-12	C
07-13	B
07-41	D

Paper II

90-14	D
90-18	C
90-20	A
90-21	B
91-20	C
91-25	D
91-26	C
91-27	B
93-18	D
93-19	C
93-20	B
93-21	D
94-38	C
95-17	D
95-18	B
95-19	B
96-19	B
96-20	D
96-21	A
96-58	B
97-19	C
98-14	D
98-15	D
98-16	C
99-36	A
01-15	D
01-16	C
02-30	B
02-31	C
03-17	B
05-5	B
05-17	B
05-18	C
06-19	C
06-20	A