On your answer sheet, write in or circle the correct letter for each question.

8Ca

1 What is released during respiration?

A energy **B** food

C air **D** glucose

2 Respiration is aerobic if it requires:

A carbon dioxide. **B** energy.

C oxygen. **D** lungs.

3 Which of these is a correct word equation for respiration?

A glucose + oxygen → carbon dioxide + water

B carbon + dioxygen → glucose + oxygen

C glucose → energy

D oxygen + carbon → carbon dioxide

4 The main difference between combustion and aerobic respiration is that:

A only combustion releases energy by heating.

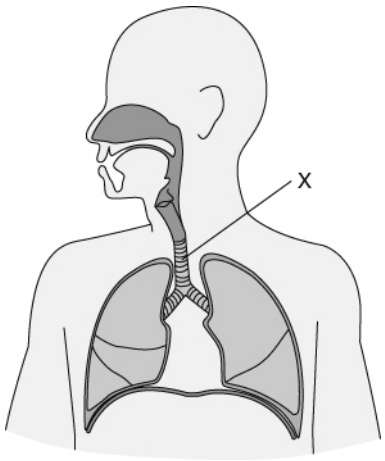
B only respiration produces carbon dioxide.

C only respiration produces water.

D combustion is much faster.

8Cb

1 On the diagram, the part labelled with the letter X is the:



A blood vessel. **B** oesophagus.

C trachea. **D** bronchus.

2 During gas exchange in the lungs, there is an overall diffusion of:

A carbon dioxide into the lung and oxygen into the blood.

B oxygen into the lung and carbon dioxide into the blood.

C oxygen and carbon dioxide into the blood.

D oxygen and carbon dioxide into the lung.

3 During inhalation, rib and diaphragm muscles:

A contract to increase the pressure inside the lungs.

B relax to reduce the pressure inside the lungs.

C contract to reduce the pressure inside the lungs.

D relax to increase the pressure inside the lungs.

4 Dust is prevented from getting into the lungs by a layer of mucus, which is swept away by:

A alveoli. **B** cilia.

C filaments. **D** flagella.

8Cc

1 Heart disease is caused by:

A the heart growing too big.

B blood vessels leading to the heart muscle becoming blocked.

C eating too much, which causes the stomach to push up on the heart.

D being allergic to a certain substance in food.

2 A poisonous substance in cigarette smoke stops red blood cells carrying oxygen. This substance is called:

A tar.

B nicotine.

C water vapour.

D carbon monoxide.

3 How is carbon dioxide transported around the body?

A carried on red blood cells

B as a gas

C carried on white blood cells

D dissolved in the plasma

4 During strenuous exercise:

A the pulse rate increases so that oxygen can get to cells faster for respiration.

B the pulse rate decreases to stop so much carbon dioxide getting to cells.

C the pulse rate increases so that carbon dioxide can get to cells for respiration.

D the pulse rate decreases so less carbon dioxide can get into the blood from respiring cells.

8Cd

1 Aerobic respiration in plants:

A is the same as in animals.

B does not occur (plants use photosynthesis).

C does not use glucose.

D does not use oxygen.

2 When carbon dioxide is added to limewater:

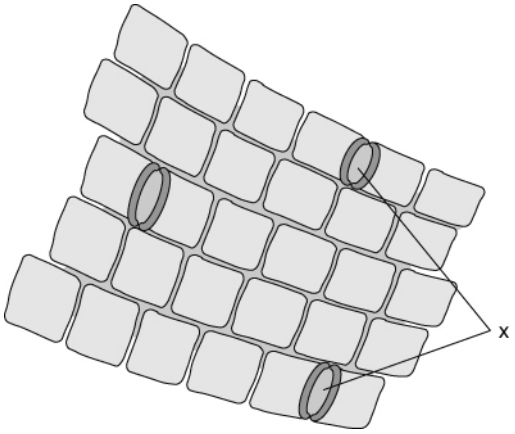
A the limewater turns from cloudy to clear.

B the limewater turns from clear to cloudy.

C the limewater turns green.

D nothing happens.

3 The drawing shows the underside of a leaf. What are the parts labelled X called?



A guard vessels **B** alveoli

C stomata **D** cilia

4 Which organ do fish use for gas exchange?

A lungs **B** skin

C gills **D** mouth

8Ce

1 Which substance does anaerobic respiration in humans produce?

A water

B lactic acid

C carbon dioxide

D carbon monoxide

2 Anaerobic respiration can occur in a cell if there is a lack of:

A oxygen. **B** water.

C glucose. **D** nitrogen.

3 Lactic acid is turned back into glucose, mainly in the:

A lungs. **B** small intestine.

C stomach. **D** liver.

4 One cause of excess post-exercise oxygen consumption is:

A an increased rate of anaerobic respiration after exercise.

B aching muscles.

C replacing stores of oxygen in the body.

D being thirsty.

Name _____ **Class** _____ **Date** _____

The Quick Quiz is to see how much you already know about a subject. It also gives you some idea of the things you will soon be learning about. Record your answers in the answers column. Shade in or tick the ones you get right.

Topic		Answers	I can already…
8Ca	1		Recall the purpose of respiration.
	2		Recall what happens in aerobic respiration.
	3		Model aerobic respiration using a word equation.
	4		Compare burning (combustion) and aerobic respiration.
8Cb	1		Recall the main organs in the gaseous exchange system.
	2		Describe gas exchange in the lungs.
	3		Describe how muscles cause ventilation.
	4		Explain how the lungs are adapted.
8Cc	1		Describe ways in which oxygen supply to tissues can be reduced, and their effects.
	2		Describe the effects of smoking tobacco.
	3		Describe the transfer of substances between blood and tissues.
	4		Explain the changes in pulse and breathing rate during exercise.
8Cd	1		Compare respiration in plants and animals.
	2		Describe ways in which respiration can be detected.
	3		Describe how gas exchange occurs in plants.
	4		Compare the human gaseous exchange system with those of other animals.
8Ce	1		Recall what happens in anaerobic respiration in humans.
	2		Explain when aerobic and anaerobic respiration take place.
	3		Describe how lactic acid is removed from tissues.
	4		Explain the cause of excess post-exercise oxygen consumption (EPOC).

Quick Quiz:	/20	At the start: 0–5 = I didn't know much; 6–10 = I knew something; 11–15 = I knew a fair bit; 16–20 = I already knew a lot

8Ca – Aerobic respiration

Word	Pronunciation	Meaning
aerobic respiration	*air-**O**-bick*	A type of respiration in which oxygen is used to release energy from substances, such as glucose.
carbohydrate	*car-bO-**high**-drate*	A nutrient that is used as the main source of energy. Examples include starch and sugars.
combustion		Burning, usually in air. The reaction usually gives out energy by heating the surroundings or by light.
glucose		An important sugar that is used as a reactant in respiration.
word equation	*eck-**way**-shun*	An equation in which the names of the reactant(s) are written on the left side, there is an arrow pointing from left to right and the names of the product(s) are written on the right side.

8Cb – The gas exchange system

Word	Pronunciation	Meaning
alveolus	*al-**vee**-O-lus*	A small pocket in the lungs in which gases are exchanged between the air and the blood. Plural is alveoli.
breathing		The movement of muscles that makes the lungs expand and contract.
bronchus	***bron**-kus*	The trachea splits into two tubes; one bronchus goes into the left lung and the other goes into the right lung. Plural is bronchi.
capillary		A thin-walled blood vessel that carries blood from arteries to veins.
cilium	***sill**-ee-um*	A small hair-like structure on the surface of some cells. Plural is cilia.
ciliated epithelial cell	***sill**-ee-ate-ted* *ep-ith-**ee**-lee-al*	A cell in the tubes leading to and from the lungs that has cilia growing on its surface.
diaphragm (biology)	***dye**-a-fram*	An organ containing a lot of muscle tissue, which diaphragm contracts and moves downwards to increase the volume of the chest when inhaling. This then causes the lungs to expand.
diffusion	*diff-**you**-zshun*	When particles spread and mix with each other without anything moving them.
gas exchange		When one gas is swapped for another. In the lungs, oxygen leaves the air and goes into the blood. At the same time, carbon dioxide leaves the blood and goes into the air in the lungs.
mucus	***mew**-kus*	A sticky liquid produced by certain cells in the body, including some cells found in the tubes leading to and from the lungs.
surface area		The total area of all the surfaces of a three-dimensional object.
trachea	*track-**ee**-a*	An organ in the shape of a tube that takes air to and from your lungs. Also called the 'windpipe'.
ventilation	*vent-ill-**ay**-shun*	The movement of air in and out of your lungs.

8Cb WS – Means and ranges

Word	Pronunciation	Meaning
anomalous result (outlier)	*uh-nom-uh-luh s*	A measurement that does not fit the same pattern as other measurements from the same experiment.
estimate		An approximate answer, often calculated from a sample or using rounded values.
mean		An average calculated by adding up the values of a set of measurements and dividing the total by the number of measurements in the set.
outlier		Another term for 'anomalous result'.
range		The difference between the highest and lowest values in a set of data (usually ignoring any anomalous results).

8Cc – Getting enough oxygen

Word	Pronunciation	Meaning
artery		A blood vessel that carries blood away from the heart.
asthma		A condition in which the tiny tubes leading to the alveoli become narrow and start to fill with mucus.
blood vessel		A tube that carries blood around the body.
carbon monoxide		A poisonous gas produced by carbon burning without enough oxygen. Found in cigarette smoke.
emphysema	*em-fee-**see**-ma*	A disease in which the lungs cannot take much oxygen out of the air because the walls of the alveoli have broken down.
haemoglobin	*hee-mow-**glow**-bin*	The substance that carries oxygen in red blood cells.
heart attack		When heart muscle cells start to die.
heart disease		A disease caused by narrowing of the arteries carrying blood to the muscles of the heart, so the heart muscles do not receive enough oxygen.
mitochondrion	*my-tow-**kon**-dree-on*	A small structure (organelle) in the cytoplasm of cells where aerobic respiration occurs. Plural is mitochondria.
plasma	***plaz**-ma*	The liquid part of the blood.
red blood cell		A blood cell that carries oxygen.
tissue fluid		The liquid formed when plasma leaks out of capillaries, carrying oxygen and food to cells.
vein	***vane***	A blood vessel that carries blood towards the heart.

8Cd – Other forms of gas exchange

Word	Pronunciation	Meaning
gills		A series of flaps of tissue with a good blood supply just behind the head of an organism and used to take oxygen out of water. Fish have gills.
hydrogen carbonate indicator		An indicator that is pink in water but turns yellow as carbon dioxide is added and the pH drops.
indicator	***in**-dee-kay-ter*	A substance that changes colour in solutions of different acidity and alkalinity.
limewater		A solution of calcium hydroxide. It is clear and colourless but turns 'milky' in contact with carbon dioxide.
pH		A numerical scale from 1 to 14 showing how acidic or alkaline a substance is. Acids have a pH below 7, neutral substances have a pH of 7 and alkalis have a pH greater than 7.
photosynthesis	*fO-tow-**sinth**-e-sis*	A process that plants use to make their own food. It needs light to work.
stoma	***stO**-ma*	A tiny hole in a leaf through which gases can diffuse into and out of the leaf. Plural is stomata.
tar		A sticky substance found in cigarette smoke, which contains harmful compounds including some that can cause cancer.

8Ce – Anaerobic respiration

Word	Pronunciation	Meaning
aerobic exercise	*air-**O**-bick*	An exercise in which all the energy needed can be supplied by aerobic respiration.
anaerobic respiration	*an-air-**O**-bick*	A type of respiration that does not need oxygen.
contract		To get smaller.
excess post-exercise oxygen consumption (EPOC)		The need for extra oxygen after exercise to break down lactic acid and replace the oxygen lost from blood and muscle cells.
oxygen debt		An older term for EPOC.

1 **a** The word equation for respiration may help you with this task, so write it down on a scrap of paper.

b Write the words ‘products’ and ‘reactants’ under the correct sides.

2 Cut out the cards and divide them between you and a partner.

3 Each person turns over one card from their pile at the same time.

4 Call out ‘snap!’ if one card shows a substance or energy and the other card correctly describes it as a ‘product’ or a ‘reactant’ or ‘released’. Remember, energy is released.

For instance, this is a ‘snap’:

glucose	reactant

This is *not* a ‘snap’:

oxygen	product

5 The person who calls ‘snap!’ first wins the two cards. These should be placed to one side.

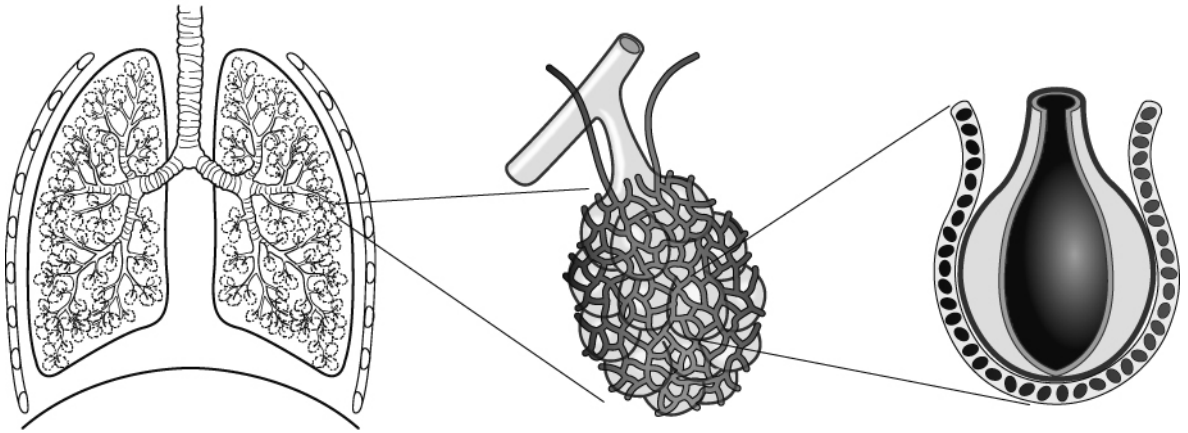
6 When all the cards have been used, turn over your pile and start again.

7 When no more ‘snaps’ can be made, each player should use all their cards to try to make the word equation for respiration. Draw in the ‘+’ signs and the arrow. The winner is the person with the most complete word equation.

glucose	glucose
reactant	oxygen
oxygen	water
water	carbon dioxide
carbon dioxide	reactant
reactant	product
product	product
energy	energy
released	released

Name _____ **Class** _____ **Date** _____

Add labels to the diagrams below to explain the functions of the organs in the gas exchange system and how they allow efficient gas exchange.



Name _____ **Class** _____ **Date** _____

Some students have been measuring the volume of air they breathe in each breath. Their results are shown in the table.

Name	1st try (cm^3)	2nd try (cm^3)	3rd try (cm^3)	4th try (cm^3)	5th try (cm^3)	Range	Mean
Dan	400						
Fletch	450	460	500	510	470		
Jaela	390	380	390	390			
Shona	140	410	420	410			

1 **a** Which person's results would you be least sure of? _____

b Explain your answer. _____

2 Calculate the ranges of Fletch's, Jaela's and Shona's readings. Show your working in the space below and fill in the values in the table.

3 **a** Which data is the most precise and of the best quality? _____

b Explain your answer. _____

4 **a** Calculate the means of Fletch's and Jaela's readings. Show your working in the space below and fill in the values in the table.

b Why do we calculate means? _____

5 Identify *one* anomalous result. Circle it in the table.

Name _____ **Class** _____ **Date** _____

1 Think up a question about one of these topics. Tick (✓) the *one* you choose.

☐ a question about the effects of exercise on the body

☐ a question about oxygen in the blood and smoking

Write your question below. A fully correct answer will get 3 marks.

_____

_____

2 Write a mark scheme in the boxes at the bottom of the page.

3 Cut out your mark scheme and keep it to one side. Give this top part of your paper to someone else to answer your question.

The answer to this question was written by: Name _____

_____

_____

_____

_____

_____

_____

_____

_____

Mark scheme for the question thought up by: Name _____

I will give one mark for each of these points:

Name _____ **Class** _____ **Date** _____

X In 1492, Rodrigo de Jerez was exploring what is now the beautiful island of Cuba and found local people smoking tobacco. He became the first European smoker. When he returned home to Spain, his smoking terrified people. He was put in prison!

Y Today, the NHS spends about £2.7 billion each year treating diseases caused by smoking. About £342 million a year is spent on clearing up mess due to smokers leaving cigarette ends in streets. Also, people miss work because of smoking (either for smoking breaks or by taking sick leave because of nasty illnesses caused by smoking).

1 Complete the second sentence: An opinion has not necessarily got any evidence to support it or to show that it is wrong. A fact _____

_____

2 Underline one fact in paragraph **X**.

3 Circle *one* opinion in paragraph **X**.

4 Draw circles around the words that link cause to effect in paragraph **Y**.

5 Add linking words to the sentences below to show cause and effect.

a Compounds in tar can _____ lung cancer.

b Smokers are often out of breath _____ lung damage.

c _____ inhaling carbon monoxide, smokers have less oxygen in their blood.

d Nicotine is addictive, _____ people find it very difficult to stop smoking.

e Arteries become narrower in smokers _____ the effects of nicotine.

6 Use the last two sentences in paragraph **X** to write one sentence showing cause and effect.

_____

_____

Name _____ **Class** _____ **Date** _____

1 What process does the summary below show? Tick (✓) the best answer.

oxygen + glucose → carbon dioxide + water

- ☐ respiration in plants
- ☐ photosynthesis in plants
- ☐ photosynthesis in plants and animals
- ☐ aerobic respiration in animals
- ☐ aerobic respiration in plants and animals

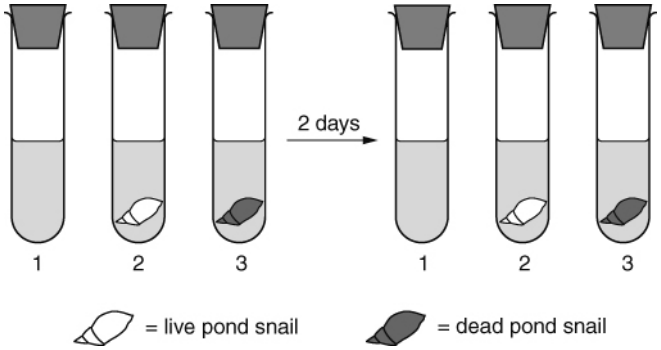
2 What process causes a container of germinating seedlings to get warmer? Tick (✓) the best answer.

☐ photosynthesis ☐ aerobic respiration ☐ growth ☐ germination

3 Complete this sentence: One test for carbon dioxide is that it turns _____ milky.

4 Tubes of pond water were taken and set up as shown.

After a day, the snails were removed from the tubes. Hydrogen carbonate indicator was added. This makes water pink, but it turns yellow if carbon dioxide has been added, and it turns purple if carbon dioxide has been removed.



a Write sentences to explain what would happen in each tube. One has been done for you.

The indicator in tube 1 will be pink because there has been nothing in the tube to add or remove carbon dioxide.

b What organs do pond snails use for gas exchange? _____

c Suggest one way in which these organs are similar to those used for gas exchange by humans.

5 **a** What is the main organ that plants use for gas exchange? _____

b How do gases get in and out of this organ? _____

1 Cut out the statements and sort them into true and false sets.

2 Use the true statements to help you to write summary paragraphs.

Anaerobic respiration means respiring without oxygen.	Anaerobic respiration uses glucose.
Anaerobic respiration uses oxygen.	Lactic acid is removed from muscles through the blood.
glucose → lactic acid + oxygen	Anaerobic respiration occurs in mitochondria.
Anaerobic respiration stops muscles getting tired too quickly.	Anaerobic respiration releases less energy than aerobic respiration.
EPOC is the need for additional oxygen after strenuous exercise.	Anaerobic respiration produces lactic acid.
One reason you breathe heavily after strenuous exercise is to fill up oxygen stores.	You can do 'anaerobic exercise' for long periods of time.
glucose → carbon dioxide + water	Aerobic respiration produces glucose.
Aerobic respiration uses carbon dioxide.	The word equation for combustion is different to the one for aerobic respiration.
When you inhale, muscle movements cause the pressure inside the chest to be reduced.	The movement of air in and out of the lungs is called respiration.
Aerobic respiration releases energy.	The pulse rate goes down when you exercise.
Aerobic respiration produces oxygen.	Aerobic respiration only occurs in animals.
Aerobic respiration uses oxygen.	Aerobic respiration produces carbon dioxide.
Gas exchange occurs by diffraction.	Oxygen is carried by haemoglobin.
Your breathing rate goes up when you exercise.	Carbon monoxide stops red blood cells carrying so much oxygen.
Your pulse rate goes up when you exercise.	Aerobic respiration uses up energy.
The air contains about 78% oxygen.	Carbon dioxide is carried by white blood cells.
Carbon dioxide turns limewater milky.	Fish use gills for gas exchange.

Name _____ **Class** _____ **Date** _____

Draw a ring around a number of stars for each statement. If you are very confident about a statement, draw your ring around all the stars. If you do not know anything about a statement do not draw a ring.

Topic	At the end of the unit:	
8Ca		
	Recall what happens in aerobic respiration.	* * * * *
	Model aerobic respiration using a word equation.	* * * * *
	Compare burning (combustion) and aerobic respiration.	* * * * *
8Cb		
	Recall the functions of the organs in the gas exchange system.	* * * * *
	Explain how the structure of the lungs allows efficient gas exchange.	* * * * *
	Describe how muscles cause breathing, and how this causes pressure differences that allow ventilation.	* * * * *
	Explain how the lungs are adapted for efficient gas exchange.	* * * * *
	Explain how specialised cells keep the lungs clean.	* * * * *
8C Working Scientifically		
	Calculate ranges and explain their use.	* * * * *
	Calculate means and explain their use.	* * * * *
8Cc		
	Describe ways that oxygen supply to tissues can be reduced, and the effect of this.	* * * * *
	Describe the effects of smoking tobacco.	* * * * *
	Describe the transfer of substances between blood and tissues.	* * * * *
	Explain the changes in pulse and breathing rate during exercise.	* * * * *
8Cd		
	Recall how to detect aerobic respiration.	* * * * *
	Describe how gas exchange occurs in different organisms including plants.	* * * * *
	Compare the human gaseous exchange system with those of other animals.	* * * * *
8Ce		
	Recall what happens in anaerobic respiration in humans.	* * * * *
	Explain when aerobic respiration and anaerobic respiration occur.	* * * * *
	Describe how lactic acid is removed from tissues.	* * * * *
	Explain the cause of excess post-exercise oxygen consumption (EPOC).	* * * * *

Types of respiration

All living cells **respire** to release energy. Organisms need energy for everything they do (for example, making new substances, moving).

Aerobic respiration is a series of **chemical reactions** that can be summarised as:

glucose + oxygen → carbon dioxide + water

Energy is released (but is not a chemical substance and so is not shown in the word equation).

Carbon dioxide can be detected using:

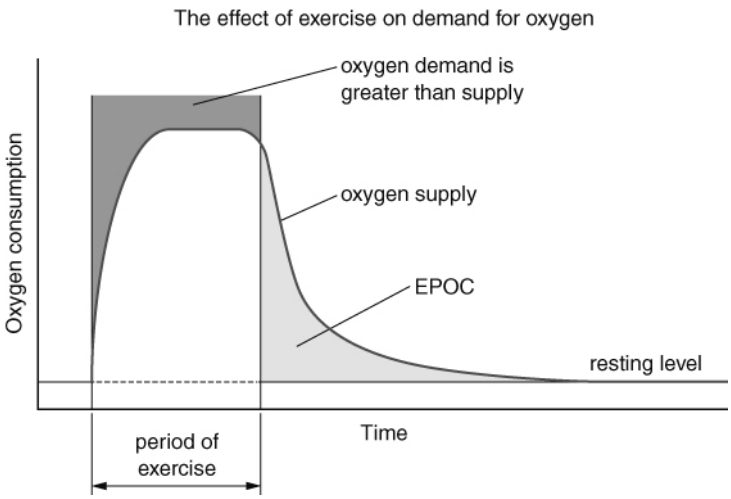
- **limewater** (which it turns cloudy)
- an **indicator** (such as hydrogen carbonate) because it is acidic.

Anaerobic respiration does not require oxygen. In humans it is used to release energy from glucose when more energy is needed than can be supplied by aerobic respiration (for example, during strenuous exercise).

glucose → lactic acid

Anaerobic respiration causes muscles to tire quickly and so cannot be used for extended periods. A lot of the lactic acid travels from the muscles to the liver, where it is converted back to glucose. Anaerobic respiration releases less energy than aerobic respiration.

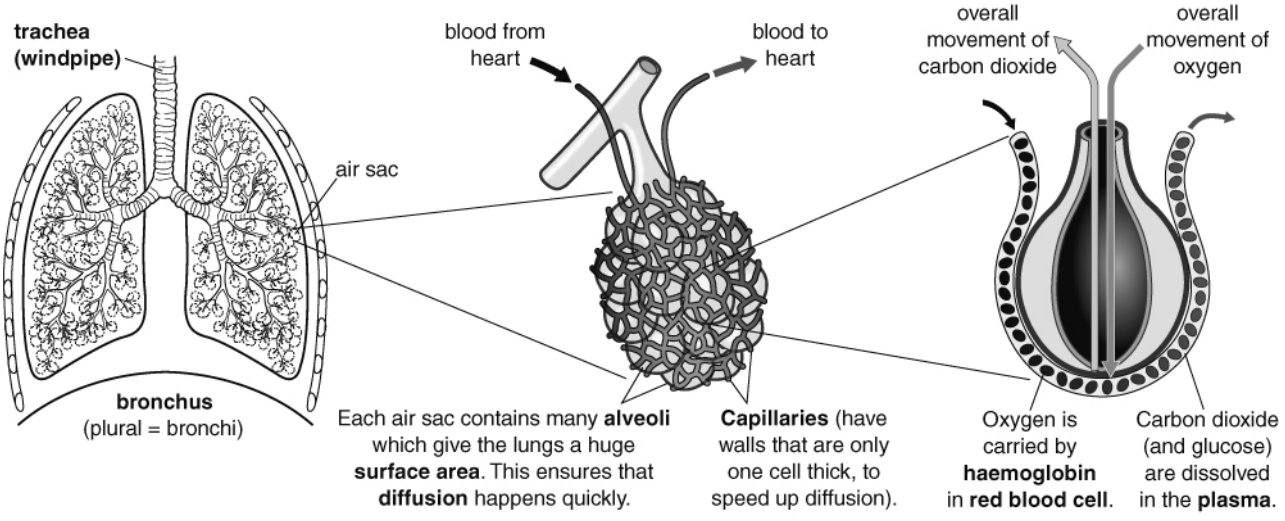
After strenuous exercise, the body needs extra oxygen. This **excess post-exercise oxygen consumption** (**EPOC**) (or 'oxygen debt') replaces oxygen lost from oxygen stores (in the blood and in muscles) and provides oxygen for increased levels of aerobic respiration (for example, to provide energy for removing lactic acid, for faster breathing, for faster heart rate).



Gas exchange

Different organisms use different organs for **gas exchange** (swapping one gas for another):

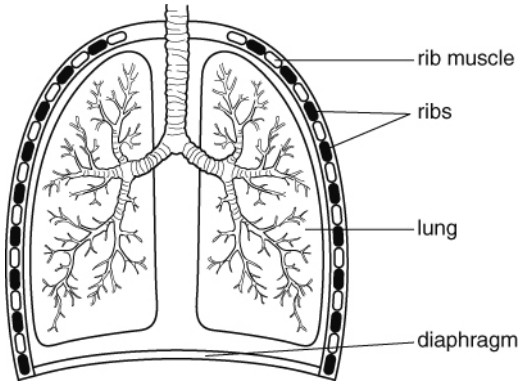
- **gills** (e.g. fish)
- **skin** (e.g. frogs)
- **stomata** in leaves (plants)
- lungs.

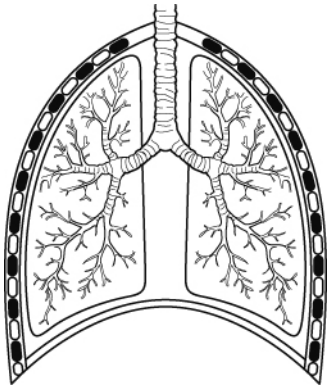


Ventilation and breathing

When you exercise, your **breathing rate** (number of breaths in one minute) and your **pulse rate** (number of times your heart beats in one minute) increase. This is because your cells need more oxygen and glucose for respiration.

Breathing is the movement of muscles in the **diaphragm** and attached to the ribs. These movements change the volume of the chest.





Breathing in (**inhalation**):

- Diaphragm contracts and moves downwards.
- Rib muscles contract and lift ribs up and outwards.
- Volume of the chest increases.
- Lungs expand.
- Pressure in lungs is reduced.
- Pressure outside is now higher than inside the lungs, so air flows into the lungs.

Breathing in (**exhalation**):

- Diaphragm relaxes and moves upwards.
- Rib muscles relax and move ribs down and inwards.
- Volume of the chest decreases.
- Lungs get smaller.
- Pressure in lungs is increased.
- Pressure inside the lungs is now higher than outside, so air flows out of the lungs.

Breathing **ventilates** the lungs. **Ventilation** is the movement of air into and out of the lungs.

Smoking

The chemicals in cigarette smoke are harmful.

Found in cigarette smoke:	Harm it causes:
nicotine	makes arteries narrower, causes heart disease
tar	can cause cancer, coats lungs reducing surface area, can cause alveoli to break apart (**emphysema**)
carbon monoxide	stops red blood cells carrying so much oxygen
high temperature of smoke	stops **cilia** working so lungs are not cleaned and **mucus** collects

Means, estimates and ranges

range = highest value – lowest value (with smaller ranges you can be more certain of your results)

$$\text{mean} = \frac{\text{total of all values}}{\text{number of values}}$$

Mean can be used to **estimate** a true value from repeated readings.

Swim training (Plenary P3 in Topic 8Ce)

In the table below, examples of how progression bands might be interpreted for this activity are given. It is suggested that a student needs to demonstrate work at a progression band in two different strands to achieve that band.

	Recalling	Explaining	Using knowledge	Using evidence	Applications and implications
Developing	Stated that humans need air and food.	Explained that since humans are living organisms they need to respire.	Described how swimming fast needs lots of energy.		
Developing+	Stated the gases involved in respiration. *Exemplar: respiration needs oxygen and makes carbon dioxide.*	Explained that we use lungs to get the air we need.		Described how to measure breathing rates. Described how to measure pulse rates.	Described how breathing rate changes during and after swimming. *Exemplar: when you swim hard you breathe faster.* Described how pulse rate changes during and after swimming. *Exemplar: when you swim hard your heart beats faster.*

	Recalling	Explaining	Using knowledge	Using evidence	Applications and implications
Securing	Stated the products and reactants involved in aerobic respiration. *Exemplar: respiration needs oxygen and glucose and produces water and carbon dioxide.* Recalled the major organs that make up the human gaseous exchange system. *Exemplar: lungs, trachea, bronchi, diaphragm.* Described the functions of the organs in the human gaseous exchange system. Stated what happens in gas exchange. Correctly use the terms: breathing, breathing rate, ventilation, inhalation, exhalation. Recalled some harmful chemicals in tobacco smoke. *Exemplar: tar, nicotine, carbon monoxide.* Recalled what happens in anaerobic respiration in humans. *Exemplar: in anaerobic respiration, glucose is turned into lactic acid and energy is released.*	Explained how muscles cause breathing. *Exemplar: muscles make your diaphragm go down and this makes the lungs bigger and air goes into them.*		Described ways in which respiration can be detected. *Exemplar: you can show that a swimmer is respiring because they produce carbon dioxide in their breath, which will turn limewater milky.*	

	Recalling	Explaining	Using knowledge	Using evidence	Applications and implications
Securing+	Modelled aerobic respiration using a word equation. Described the structure of the lungs. *Exemplar: the lungs have lots and lots of air sacs in them, made up of pockets called alveoli.* Described a way in which gas exchange in the lungs can be reduced. *Exemplar: smoking irritates the lungs and makes the alveoli collapse.* Described how muscles attached to ribs and the diaphragm produce breathing movements. *Exemplar: when muscles attached to the ribs contract the ribs are pulled up and out.* Described how lactic acid is removed from tissues. *Exemplar: lactic acid goes into the blood and is then converted back to glucose in the liver.*	Explained the changes in heartbeat and breathing rate during exercise. *Exemplar: when you exercise you need more energy and so you need to respire more. To get more oxygen into the blood you breathe faster and to get that oxygen to cells more quickly your heart pumps faster.* Explained some of the effects of reduced oxygen supply on the body. *Exemplar: if your cells cannot get enough oxygen they can die, and this is what happens in a heart attack.* Explained when aerobic and anaerobic respiration occur. *Exemplar: if your cells cannot release enough energy by aerobic respiration, they can use anaerobic respiration as well.*	Used a pressure model to explain ventilation. *Exemplar: when muscles make your chest expand, the pressure in the lungs is reduced and so air flows into them because there is higher pressure outside.* Explained how diffusion occurs in terms of movement of particles. *Exemplar: particles are always moving in all directions. This means that there will be an overall movement of those particles from an area where there are lots of them to an area where there are fewer of them.* Compared combustion with aerobic respiration. *Exemplar: you can think of aerobic respiration as being like a very slow form of combustion, with energy being released.*	Explained how measuring lactic acid levels in the blood allows monitoring of anaerobic respiration. *Exemplar: you can tell how much anaerobic respiration is happening by measuring the amount of lactic acid in the blood.*	Described the effects of nicotine, tar and carbon monoxide in tobacco smoke. *Exemplar: carbon monoxide stops the red blood cells carrying so much oxygen and so there is less oxygen in the blood for tissues to use.* Explained how anaerobic respiration makes the muscles tired and so cannot go on for too long.
Exceeding	Recalled some causes of excess post-exercise oxygen consumption. *Exemplar: replenishing oxygen stores, increased rate of aerobic respiration for breathing / heartbeat / lactic acid conversion in the liver.*	Explained how specialised cells keep the lungs clean. *Exemplar: some cells in the tubes of the lungs produce mucus, which traps dust and dirt. The dirty mucus is swept out of the lungs by hairs called cilia.*	Explained how the lungs are adapted for efficient gas exchange. *Exemplar: the alveoli give the lungs a huge surface area and so there is more space for diffusion to occur, and so more oxygen can get into the blood.*		

Name _____ **Class** _____ **Date** _____

A scout from the National Youth Swimming Team is coming to watch a school swimming gala to see if there are any students who might be able to train for the national team. The scout is also going to carry out some tests and measurements on some of the students. A letter needs to be written to parents to explain what the scout is going to do and why this is being done. Parents will need to sign the letter to give their consent for the children to be tested.

Write a letter to parents. Remember that parents probably don't know very much about respiration and so you will need to explain it to them.

Name _____ **Class** _____ **Date** _____

Now that you have completed the activity, circle the number of stars next to each of these sentences to describe how well you did.

I have…	
explained that humans are living organisms and so need to respire.	* * * * *
described how swimming fast needs lots of energy.	* * * * *
stated the gases involved in aerobic respiration.	* * * * *
explained that we use our lungs to get the air we need.	* * * * *
described how to measure breathing and pulse rates.	* * * * *
described how exercise changes breathing and pulse rates.	* * * * *
stated the products and reactants involved in aerobic respiration.	* * * * *
recalled the major organs in the gaseous exchange system.	* * * * *
described the functions of organs in the gaseous exchange system.	* * * * *
explained how muscles cause breathing.	* * * * *
described ways in which respiration can be detected.	* * * * *
recalled what happens in anaerobic respiration in humans.	* * * * *
correctly used the terms: breathing, breathing rate, ventilation, inhalation, exhalation.	* * * * *
explained why athletes don't smoke.	* * * * *
described the structure of the lungs (including air sacs and alveoli).	* * * * *
explained how exercise changes breathing and pulse rates.	* * * * *
used a pressure model to explain ventilation.	* * * * *
explained why the scout might measure blood lactic acid levels.	* * * * *
explained why anaerobic respiration cannot go on for too long.	* * * * *
recalled some causes of excess post-exercise oxygen consumption.	* * * * *
described how lactic acid is removed from tissues.	* * * * *
explained how the lungs are adapted for efficient gas exchange.	* * * * *

What could you do to improve? _____

_____

WSI Assessment: *Respiring organisms* (Exploring 3 in Topic 8Cd)

	Planning	Obtaining (DAPS)	Presenting	Considering	Evaluating
Developing	Students identify an aim (*e.g. to see if the more germinating cress seeds there are, the faster bromothymol blue indicator changes colour*). They identify a prediction or make a simple prediction (without a reason) (*e.g. this could be by selecting an appropriate prediction from a set of choices*). They outline a simple method to find out what happens (*e.g., 'I will put lots of seeds in one tube and only a few in the other. Then I will add indicator and leave the tubes'*). They identify at least one appropriate control variable from a list of choices (*e.g. amount of indicator*).	Following instructions, or with help, students make some observations.	Students record results clearly (*e.g. in a table given to them*).	Students provide a simple description of what was found, linking cause and effect (*e.g. 'the indicator only changed colour in the tubes that had seeds in them'*). They may use incorrect terminology.	Students make a simple suggestion as to how to improve the investigation (*e.g. 'I could use more differing amounts of seeds'*).

	Planning	Obtaining (DAPS)	Presenting	Considering	Evaluating
Developing+	Students make a prediction with a reason, and recognise that experimentation is an appropriate way of testing this prediction (*the reasoning may contain errors, e.g. 'the more seeds that are germinating, the more gas will be produced that changes the indicator colour and so it will turn a deeper colour'*). They plan to use simple, appropriate apparatus (*e.g. a stop clock for timings*). They decide on an appropriate approach including deciding whether to use a fair test. In fair tests, they plan to control at least one variable (*e.g. amount of indicator, type of indicator, type of seed*). They plan to change one variable and measure another (*e.g. change mass of seeds and measure the time taken for the indicator to change colour*). They write a method as a series of steps, including what they will look for. They state one way in which they and/or others around them will remain safe (*e.g. handling glassware with care*).	Students use simple apparatus appropriately (*e.g. measuring cylinders*). In fair tests, they vary one factor while keeping others the same (which may require some assistance). If questioned, they are able to state clearly the intervals between measurements (*e.g. different number of seeds used*) and the spread of measurements (*e.g. 0 g to 50 g of seeds*). Following instructions, they take action to control obvious risks to themselves (*e.g. to wash their hands after handling seeds*).	Students record their data using ordered tables or labelled diagrams or clearly laid out descriptions. Where appropriate, they clearly show the intervals between measurements and the range of measurements. They plot simple bar charts where possible (*bar charts may have small errors, such as missing units, axes incorrectly labelled and slightly inappropriate scales. However, the bars should be plotted accurately, e.g. amount of seed vs time taken for the indicator to change colour*).	Students draw a straightforward conclusion and identify the evidence that they have used (*e.g. 'the more seeds, the faster the colour change'*). They communicate their conclusions using appropriate scientific language (*e.g. using words such as 'evidence', 'conclusion', 'indicator'*).	Students suggest improvements to their work, giving simple reasons (*e.g. 'the indicator in all the tubes changed over one night apart from in the tube with no seeds, so we needed to use smaller quantities of seeds'*).

	Planning	Obtaining (DAPS)	Presenting	Considering	Evaluating
Securing	Students state a prediction with a reason using scientific knowledge (*e.g. 'seeds respire when germinating and so give out carbon dioxide. So, if I add more seeds to the tube, then more carbon dioxide will be formed and the indicator will change colour more quickly'*). They state what they will look for and explain why they will look for these things (*e.g. 'I record the time taken for the indicator to change colour. It is carbon dioxide that makes it change colour and so the more carbon dioxide produced by the seeds, the faster the indicator will change colour*). They plan a systematic approach, which includes the number of measurements that they will take and the overall range of measurements. They state some ways in which they will remain safe and how they will ensure that others stay safe (*e.g. recognising the hazards associated with sodium hydroxide solution and suggesting the wearing of eye protection, handling glassware carefully, mopping up spills, washing hands after handling seeds or living organisms*).	Students accurately record readings. They identify when measurements should be repeated and carry out those repeats (*e.g. they state that measurements often vary and so it is a good idea to take measurements several times as a check*).	Students use more complex bar charts, frequency diagrams, scatter graphs, pie charts or line graphs to present data, as appropriate (*e.g. any simple bar charts will be accurately drawn with all the appropriate features. Or a scatter graph may be attempted with seed mass on the* x*-axis and time taken for the indicator to change colour on the* y*-axis*).	Students analyse their findings and draw conclusions that clearly show how they have used their evidence (*e.g. 'carbon dioxide is acidic and dissolves in the indicator solution, changing its colour. There was a gradual reduction in the time taken for the bromothymol blue indicator to change colour with increasing mass of seeds. So, the more seeds there are the more respiration that is happening, and the more carbon dioxide that is being produced'*). They point out inconsistencies and anomalies in their data. They communicate their ideas using some scientific and mathematical conventions and terminology (*e.g. using words such as 'bromothymol blue'*).	Students evaluate their working methods to make practical suggestions for improvements, which are backed up with scientific reasons (*e.g. 'there might be other things in the tube that cause carbon dioxide to be released, such as microorganisms. So we should sterilise all seeds and equipment before starting'*).

	Planning	Obtaining (DAPS)	Presenting	Considering	Evaluating
Securing+	Students plan an appropriate approach, selecting and using secondary sources of information (*e.g. finding data from secondary sources on respiration in germinating seeds*). They take account of some less obvious variables that need to be controlled (*e.g. respiration of microorganisms*). They state the number and spread of measurements that they will make, justifying their choices (*e.g. they explain that repeating measurements may help them to spot anomalous results and/or yield data that they can be more sure is correct (providing the data is precise)*). They identify hazards and describe how to reduce the risks from those hazards, both to themselves and to others (*e.g. seeds being coated in a fungicide*).	Students collect data with an appropriate degree of accuracy (*e.g. mass of seeds recorded to nearest gram*).	Students present data using a wide range of neat and accurate charts and graphs (*e.g. they plot a scatter graph correctly with scales chosen to allow the graph to fill most of the graph paper*). They decide whether to include or ignore inconsistencies and anomalies in their charts and graphs, pointing these out where appropriate.	Students analyse findings to draw valid conclusions that are consistent with the evidence (*e.g. 'carbon dioxide is acidic and reduces the pH of the indicator, changing its colour. The amount of carbon dioxide required to change its colour is the same and so a fast colour change indicates that more carbon dioxide was produced. This was seen with the bigger masses of seeds'*). They use scientific concepts in their explanations (*e.g. pH reduction, the idea that carbon dioxide produces an acidic solution in water*). They account for any inconsistencies in the evidence (*e.g. the indicator in the tube without any seeds in it also eventually changed colour, which might have been due to the carbon dioxide in the air from all the students*). They communicate qualitative and quantitative data effectively using scientific conventions and terminology.	Students consider how good their evidence is in supporting their conclusion (*e.g. 'I can't say that all of the carbon dioxide in the tube came from the seeds and it may be that part of the colour change was due to respiring microorganisms. However, there was a very clear pattern and so I think that my conclusion is correct'*).

	Planning	Obtaining (DAPS)	Presenting	Considering	Evaluating
Exceeding	Students formulate scientific questions and hypotheses by synthesising information from a variety of sources (*e.g. using a combination of secondary source material and their own notes from a lesson*). They identify variables that cannot easily be controlled and plan appropriate ways to take account of this (*e.g. not breathing over the tubes as they are being set up*). They explain how their methods will allow them to account for potential sources of error that they have identified, so that they can collect good quality evidence that will allow them to be sure of a conclusion (*e.g. taking several repeat readings, or testing the same hypothesis with a different type of seed at the same time*).	Students collect data systematically and with precision and accuracy, using a range of apparatus (*e.g. balances, a lightmeter to detect colour change of the indicator*). They follow risk assessment procedures.	Students present graphical data using lines or curves of best fit (*e.g. a line of best fit is drawn on the scatter graph*).	Students communicate effectively using a wide range of scientific and technical conventions and terminology. This includes using a full range of appropriate symbols and terminology to represent abstract ideas. They decide whether to include or exclude anomalous results and explain their choice. They explain how data could be interpreted in different ways (*e.g. the more seeds, the faster the limewater went cloudy and so the more respiration was occurring. However, this could be due to respiring microorganisms on the seeds and not the seeds themselves. I need to set up a better control*).	Students evaluate their evidence to make reasoned suggestions about how their working methods could be improved (*e.g. explanations of why improved repeatability, reproducibility, accuracy and precision allow more confidence in a conclusion*). They describe how factors that they did not attempt to control may have affected the results, describe how these factors might be better controlled and explain the effects of better controlling them (*e.g. wearing face masks to avoid breathing directly into the tubes*). They consider whether their data is sufficient for the conclusions they have drawn. This includes describing how any identified limitations could affect the validity and certainness of their conclusions.

Name _____ **Class** _____ **Date** _____

1 Marta is running. Sam is sitting on a chair.

a Suggest two things Marta will need more of than Sam.

_____

_____

[2 marks]

b Suggest one way Marta's body will change when she runs.

_____

_____

[1 mark]

c Marta runs very fast at the end of her run but she cannot sprint for very long. Explain why.

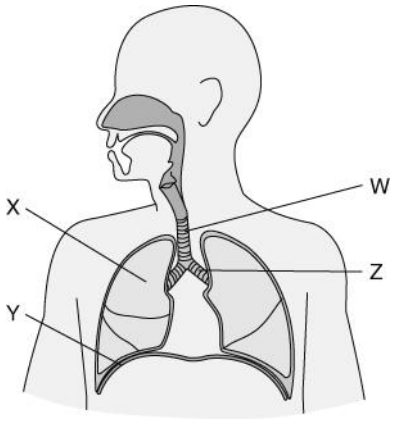
_____

_____

[1 mark]

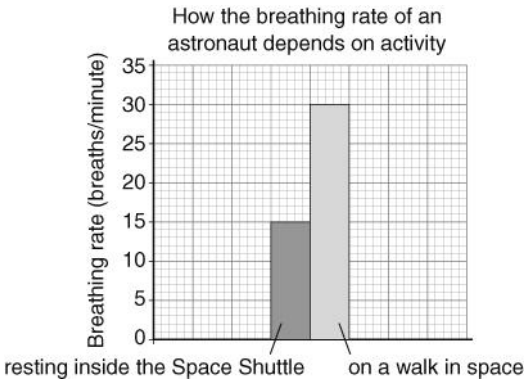
2 The diagram shows the human gas exchange system.

Name the organs, W, X, Y and Z. Write the correct name of the organ next to the letters.



[4 marks]

3 The breathing rate of an astronaut when resting inside the Space Shuttle and when walking outside the Space Shuttle are shown below.



a What sort of graph or chart is this? Tick one box.

☐ A line graph

☐ B scatter graph

☐ C bar chart

☐ D pie chart

[1 mark]

b How does the astronaut's breathing rate change when he goes for a walk outside the Space shuttle? Tick *one* box.

☐ A Breathing rate decreases.

☐ B Breathing rate increases.

☐ C Breathing rate stays the same.

☐ D Breathing rate stops.

[1 mark]

c Explain why his breathing rate changed when the astronaut was more active.

_____

_____

_____

[2 marks]

4 a Name *two* substances aerobic respiration produces in humans.

_____

_____

[1 mark]

b Describe the test for the acidic gas produced when people respire. List the equipment you would need and describe what would happen.

_____

_____

[2 marks]

c Which gas is needed for respiration in plants? Tick *one* box.

☐ A oxygen

☐ B nitrogen

☐ C hydrogen

☐ D carbon dioxide

[1 mark]

5 a Which organs get shorter and thicker to make the lung volume greater? Tick *one* box.

☐ A bronchi

☐ B bones

☐ C alveoli

☐ D muscles

[1 mark]

b Barney measures the volume of air in each breath before and after running on a treadmill for 5 minutes. He repeats the experiment five times. His results are shown in the table.

Test	Volume of air per breath
1	800
2	850
3	900
4	875
5	860

There are no units given in the table. Suggest suitable units for the volume of air.

_____

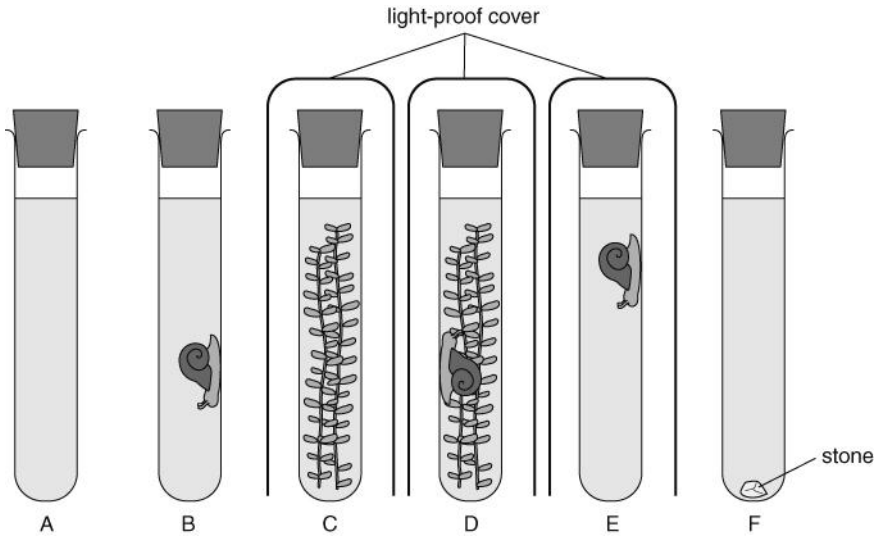
[1 mark]

c What is the range of Barney's results? Show your working.

Range = _____

[2 marks]

6 Hydrogen carbonate indicator is pink but changes to yellow when carbon dioxide is added. An experiment is set up as shown below. The tubes are left for two days.



a What does an indicator show?

_____

[1 mark]

b What colour will the liquid be in each tube after two days?

Complete the table using *one* tick (✓) in each row.

Tube after 2 days	Pink	Yellow
A		
B		
C		
D		
E		
F		

[2 marks]

7 a Which reactant is needed for aerobic respiration but not needed for anaerobic respiration? Tick *one* box.

- ☐ A oxygen
- ☐ B nitrogen
- ☐ C hydrogen
- ☐ D carbon dioxide

[1 mark]

b What chemical does anaerobic respiration produce in humans? Tick *one* box.

- ☐ A nitric acid
- ☐ B hydrochloric acid
- ☐ C lactic acid
- ☐ D oxygen

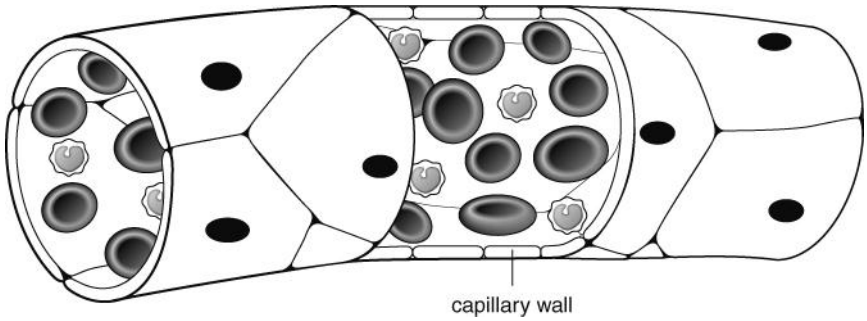
[1 mark]

c The cells of smokers often use anaerobic respiration more than the cells of non-smokers. Suggest *one* substance in cigarette smoke that may cause this.

_____

[1 mark]

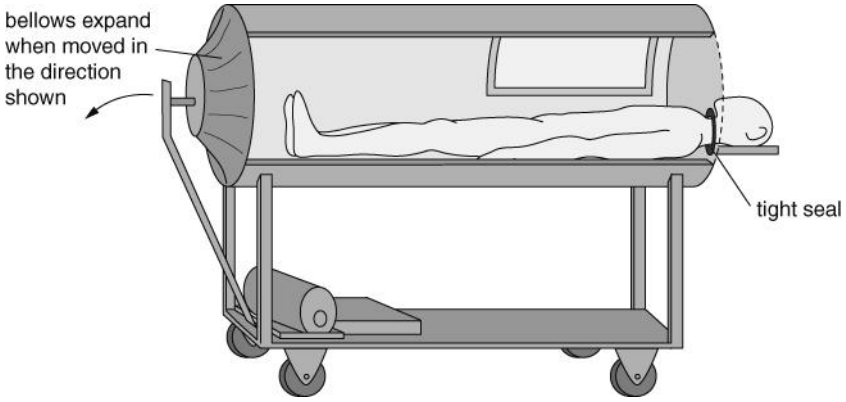
8 The diagram shows a capillary. Part of the capillary wall has been taken away to show the blood inside. The blood carries substances the cells need.



Explain how oxygen gets from the blood to the cells.

[2 marks]

9 The diagram shows an iron lung. If a person cannot breathe for themselves, the person has to lie in the machine and the iron lung will make the person breathe.



a Explain what will happen to the pressure inside the iron lung when the bellows move outward.

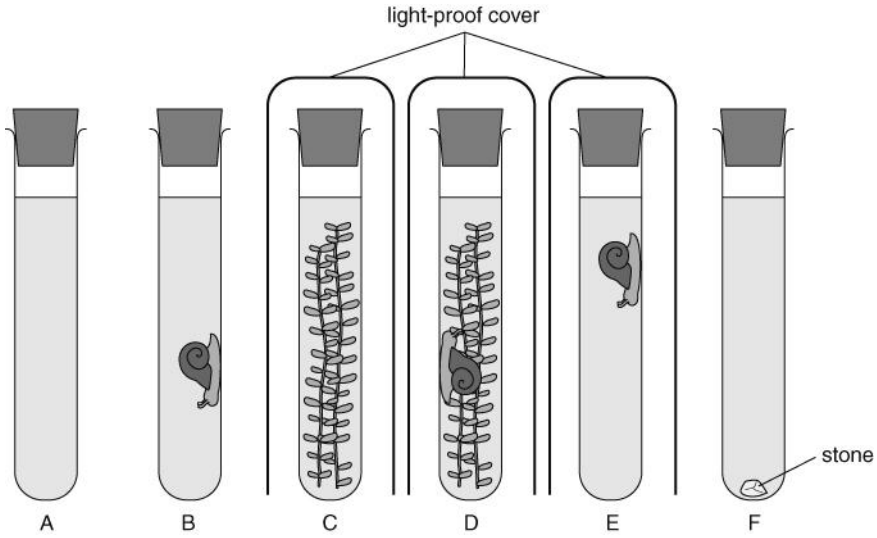
[1 mark]

b Describe the effect that this pressure change will have on the lungs.

[1 mark]

Name _____ **Class** _____ **Date** _____

1 Hydrogen carbonate indicator is pink but changes to yellow if the pH decreases. An experiment is set up as shown. The tubes are left for two days.



What colour will the liquid be in each tube after two days?

Complete the table using *one* tick (✓) in each row.

Tube after 2 days	Pink	Yellow
A		
B		
C		
D		
E		
F		

[2 marks]

2 **a** What chemical does anaerobic respiration produce in humans? Tick *one* box.

☐ A nitric acid

☐ B hydrochloric acid

☐ C lactic acid

☐ D oxygen

[1 mark]

b The cells of smokers often use anaerobic respiration more than the cells of non-smokers. Suggest *one* chemical in cigarette smoke that may cause this.

_____

[1 mark]

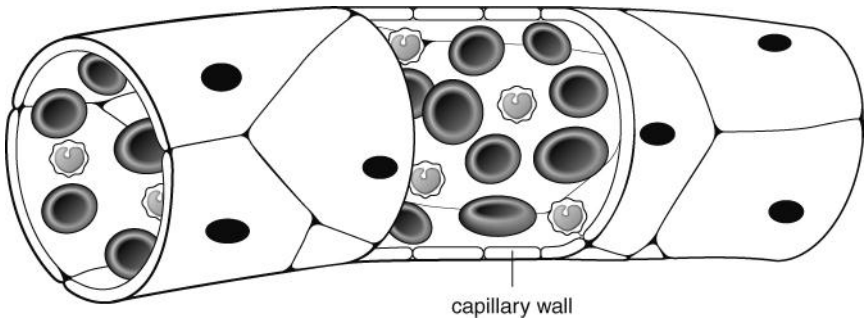
c Explain why this chemical causes more anaerobic respiration to happen.

_____

_____

[2 marks]

3 The diagram shows a capillary. Part of the capillary wall has been taken away to show the blood inside. The blood carries substances the cells need.



Explain how oxygen gets from the blood to the cells.

_____

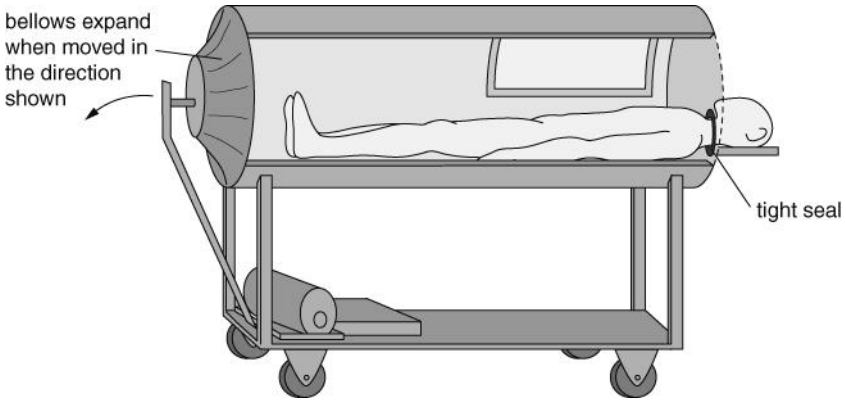
_____

_____

_____

[3 marks]

4 The diagram shows an iron lung. If a person cannot breathe for themselves, the person has to lie in the machine and the iron lung will make the person breathe.



Explain what will happen to the lungs when the bellows move outwards and the effect that this will have on the lungs.

[2 marks]

5 Describe the test for the acidic gas produced when people respire. List the equipment you would need and describe what would happen.

[2 marks]

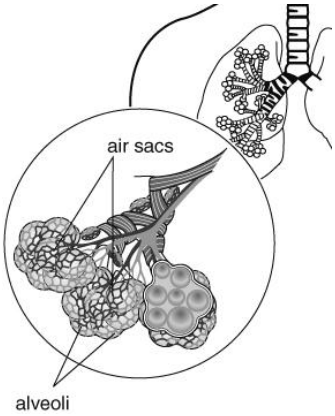
6 **a** Simon is running in a 1500 m race. Explain why his pulse rate changes when he runs?

[2 marks]

b Simon's breathing rate is faster during the race than before the race. Explain why his breathing rate remains high, even after he finishes the race? Give *two* reasons.

[2 marks]

7 Gas exchange happens in air sacs.



a Which *two* gases are exchanged in the air sacs? Tick *one* box.

☐ A oxygen and carbon dioxide

☐ B nitrogen and oxygen

☐ C hydrogen and carbon dioxide

☐ D carbon dioxide and nitrogen

[1 mark]

b Describe *two* features that increase the speed of gas exchange in air sacs.

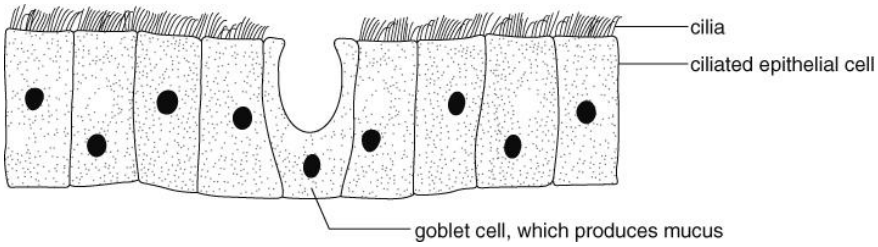
_____

_____

[2 marks]

8 The drawing shows some of the cells found in the tubes inside the lungs.

Explain how these different types of cells help to clean the air coming in to the lungs.



_____

_____

_____

_____

[2 marks]

9 **a** In the space below, write the word equation for anaerobic respiration.

[1 mark]

b The substance produced in anaerobic respiration is changed back to glucose.
Where does this process happen? Tick *one* box.

- ☐ A lung
- ☐ B stomach
- ☐ C brain
- ☐ D liver

[1 mark]

c When do cells use anaerobic respiration?

_____

_____

_____

[1 mark]

Quick Quiz

	Answers				Marks
Topic	**Q1**	**Q2**	**Q3**	**Q4**	
8Ca	A	C	A	D	4
8Cb	C	A	C	B	4
8Cc	B	D	D	A	4
8Cd	A	B	C	C	4
8Ce	B	A	D	C	4

End of Unit Test Mark Scheme Standard (S)

Question	Part	Step	Answer	Mark scheme
1	**a**	**3rd** **3rd**	Two of: oxygen/air, glucose/food, energy	**2 marks**
	b	**4th**	One of: she will get hotter/her breathing rate increases/her pulse rate (or heart rate) increases/she gets tired/her muscles ache	**1 mark**
	c	**4th**	it makes her muscles ache/she runs out of breath	**1 mark**
2		**2nd** **4th** **4th** **4th**	**W** trachea **X** lung **Y** diaphragm **Z** bronchus (Do not accept misspellings)	**1 mark** – for lungs **3 marks** – for others
3	**a**	**2nd**	**C** bar chart	**1 mark**
	b	**4th**	**B** Breathing rate increases.	**1 mark**
	c	**6th** **6th**	The astronaut needs more oxygen (from the air) for increased levels of aerobic respiration because he/she needs more energy.	**2 marks** – 1 mark for each point up to a maximum of 2
4	**a**	**5th**	water and carbon dioxide	**1 mark** – both substances needed for the mark
	b	**5th** **5th**	use limewater carbon dioxide turns it from clear to cloudy/milky OR use hydrogen carbonate indicator carbon dioxide turns it from pink/red to orange/yellow	**2 marks** – 1 mark for each point
	c	**5th**	**A** oxygen	**1 mark**
5	**a**	**4th**	**D** muscles	**1 mark**
	b	**4th**	centimetres cubed/cubic centimetres/cm^3 (Accept: ml, millilitres)	**1 mark**
	c	**5th** **5th**	Range = 900–800 Range = 100	**2 marks** – 1 mark for working showing knowledge that it is the difference between two numbers; 1 mark for correct answer

Question	Part	Step	Answer	Mark scheme
6	a	5th	change in pH/change in acidity/alkalinity	**1 mark**
	b	7th 7th	**A** pink **B** yellow **C** yellow **D** yellow **E** yellow **F** pink	**2 marks** – 1 mark for 3 to 5 answers correct, 2 marks for all correct
7	a	6th	**A** oxygen	**1 mark**
	b	6th	**C** lactic acid	**1 mark**
	c	6th	One of: nicotine, tar, carbon monoxide	**1 mark**
8		7th 7th	oxygen dissolves into the plasma plasma leaks out to become tissue fluid the oxygen diffuses from the tissue fluid into the cells	**2 marks** – 1 mark for each point up to a maximum of 2
9	a	6th	it is reduced	**1 mark**
	b	6th	Air flows into the person's lungs.	**1 mark**

Final Step Calculation

Marks	Step	Marks	Step
11–3	Below 2nd	16–20	5th
4–5	2nd	21–24	6th
6–9	3rd	25–30	7th
10–15	4th		

End of Unit Test Mark Scheme Higher (H)

Question	Part	Step	Answer	Mark scheme
1		7th 7th	**A** pink **B** yellow **C** yellow **D** yellow **E** yellow **F** pink	**2 marks** – 1 mark for 3 to 5 answers correct; 2 marks for all correct
2	a	6th	**C** lactic acid	**1 mark**
	b	6th	One of: nicotine, tar, carbon monoxide	**1 mark**
	c	8th 8th	nicotine – narrows arteries which causes reduced blood flow/oxygen supply OR tar – coats the lungs/irritates the lungs which causes reduction in surface area OR carbon monoxide – prevents red blood cells carrying so much oxygen which reduces supply of oxygen from blood	**2 marks** – 1 mark for cause and 1 mark for effect due to that cause, up to a maximum of 2

Question	Part	Step	Answer	Mark scheme
3		7th 7th 7th	oxygen dissolves in the plasma plasma leaks out to become tissue fluid the oxygen diffuses from the tissue fluid into the cells	**3 marks** – 1 mark for each point
4		6th 6th	the pressure inside the iron lung is reduced the pressure is higher outside the iron lung and so air flows into the lungs	**2 marks** – 1 mark for each point
5		5th 5th	use limewater carbon dioxide turns it from clear to cloudy/milky OR use hydrogen carbonate indicator carbon dioxide turns it from pink/red to orange/yellow	**2 marks** – 1 mark for each point
6	a	7th 7th	His cells have increased their (aerobic) respiration/he needs more energy. A faster flow of blood will deliver more oxygen to the cells.	**2 marks** – 1 mark for each point
	b	7th 7th	Two of: lactic acid being turned into glucose in the liver requires additional energy from aerobic respiration replenishing oxygen stores in blood replenishing oxygen stores in muscles additional aerobic respiration required to operate rib muscles and diaphragm at a faster rate (faster breathing rate) additional aerobic respiration required to heart muscles at a faster rate (faster pulse rate)	**2 marks** – 1 mark for each point to a maximum of 2
7	a	4th	**A** oxygen and carbon dioxide	**1 mark** – both gases needed for the mark
	b	5th 5th	Two of: large surface area good blood supply short distance and moist to aid diffusion high concentration gradient	**2 marks** – 1 mark for each point to a maximum of 2
8		8th 8th	Mucus produced by goblet cells traps dirt/dust/germs/microorganisms. Cilia sweep mucus out of lungs.	**2 marks** – 1 mark for each point to a maximum of 2
9	a	8th	glucose → lactic acid	**1 mark**
	b	6th	**D** liver	**1 mark**
	c	6th	When they need to release more energy than they can by using aerobic respiration alone.	**1 mark**

Final Step Calculation

Marks	Step	Marks	Step
1–2	Below 4th	10–14	6th
3–5	4th	15–18	7th
6–9	5th	19–25	8th

Quick Check answers

Topic	Step	Answers
8Ca	**5th–6th**	Student's own work.
8Cb	**4th–7th**	Student's own notes and annotations. They should clearly show the functions of the organs and how they allow efficient gas exchange.
8Cb WS	**4th–6th**	**1** **a** Dan's **b** He has not repeated his measurements. **2** Fletch: 60 cm^3; Jaela: 10 cm^3; Shona: 280 cm^3. Students should show their working. **3** **a** Jaela's **b** It has the smallest range. **4** **a** Fletch: 478 cm^3 (a better answer would round this to 480 cm^3); Jaela: 387.5 cm^3 (a better answer would round this to 390 cm^3) **b** To estimate the true value from a set of repeated readings. **5** Students circle 140 in Shona's results.
8Cc	**5th–7th**	Student's own work.
8Cc Lit		**1** [A fact] has been shown to be correct (many times). **2** Students underline any of the facts in the first paragraph. **3** 'the beautiful island' **4** 'caused by', 'due to', 'because of', 'because of', 'caused by'. **5** There will be many suggestions here. The ones below are the most likely. **a** cause **b** due to/because of **c** Due to **d** and so **e** because of/due to **6** For example: He was put in prison because his smoking terrified people.
8Cd	**5th–7th**	**1** aerobic respiration in plants and animals **2** aerobic respiration **3** limewater **4** **a** The indicator in tube 2 will be yellow as the aerobic respiration of the snail will have produced carbon dioxide. The indicator in tube 3 will be pink because there has not been a respiring organism in the water. **b** gills **c** one of: they both have a large surface area, they both have a rich supply of blood, they both have a small distance across which gases can diffuse **5** **a** leaf **b** through stomata

Topic	Step	Answers
8Ce	**5th–8th**	True: Anaerobic respiration means respiring without oxygen. Anaerobic respiration uses glucose. Lactic acid is removed from muscles through the blood. Anaerobic respiration releases less energy than aerobic respiration. EPOC is the need for additional oxygen after strenuous exercise. Anaerobic respiration produces lactic acid. One reason you breathe heavily after strenuous exercise is to fill up oxygen stores. glucose → carbon dioxide + water When you inhale, muscle movements cause the pressure inside the chest to be reduced. Aerobic respiration releases energy. Aerobic respiration uses oxygen. Aerobic respiration produces carbon dioxide. Oxygen is carried by haemoglobin. The breathing rate goes up when you exercise. Carbon monoxide stops red blood cells carrying so much oxygen. The pulse rate goes up when you exercise. Carbon dioxide turns limewater milky. Fish use gills for gas exchange. False: Anaerobic respiration uses oxygen. glucose → lactic acid + oxygen Anaerobic respiration occurs in mitochondria. Anaerobic respiration stops muscles getting tired too quickly. You can do ‘anaerobic exercise’ for long periods of time. Aerobic respiration produces glucose. Aerobic respiration uses carbon dioxide. The word equation for combustion is different to the one for aerobic respiration. The movement of air in and out of the lungs is called respiration. The pulse rate goes down when you exercise. Aerobic respiration produces oxygen. Aerobic respiration only occurs in animals. Gas exchange occurs by diffraction. Aerobic respiration uses up energy. The air contains about 78% oxygen. Carbon dioxide is carried by white blood cells.