Rosary School – Marj Elhamam
Chapter3: Breathing and Gas Exchange
Past paper mark scheme

Name: _____ Date: ___ / ___ / 2025

Grade: 9 (A, B, C, D) Subject: Biology IG

Question 1:

(a) The alveolus is adapted for efficient gas exchange as follows...

- Good blood supply / close to a capillary; [1 mark]
- To maintain/ensure a concentration gradient (between the air and the blood); [1 mark]

OR

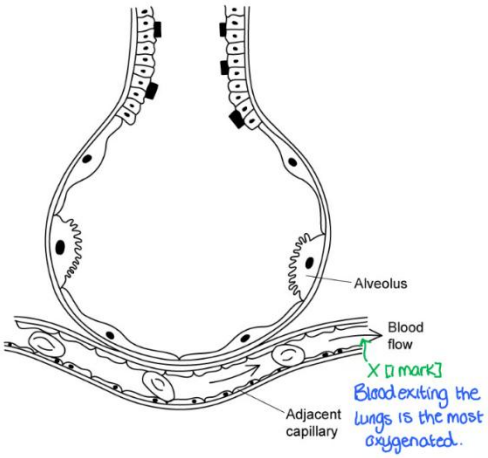
- Alveolar/alveolus wall is one cell thick; [1 mark]
- To minimise diffusion distance / reduce the distance for the diffusion of gases (between the air and the blood); [1 mark]

Reject references to the alveolar cell wall.

[Total: 2 marks]

Be careful with questions like this which request you to identify things that are **clearly visible**. There are other characteristics of the alveoli and breathing system which aid gas exchange, e.g. many alveoli increase the surface area, but we cannot see them in the image so no credit can be awarded.

(b) The oxygen content of the blood is highest at the position marked below...



(c) The surface area of a typical adult's lungs is calculated as follows:

- 4.2 (m^2) x 20 **OR** 4.2 (m^2) ÷ $^1/_{20}$; [1 mark]
- 84 m^2; [1 mark]

[Total: 2 marks]

(d) There is estimated to be a surface area of 4.2 m^2 in the overall lung system of a typical new-born baby, around one twentieth of the overall surface area of a typical adult's lungs.

Calculate the overall surface area of a typical adult's lungs.

[2]

Multiply by twenty: [1 mark]

4.2 x 20 = 84 m^2 [1 mark]

OR divide by $^1/_{20}$ [1 mark]

$\frac{4.2}{1/20}$ = 84 m^2 [1 mark]

(d) The sequence in which air passes through the structures during an exhalation is...

structure	order
bronchus	3
nasal cavity	5
alveolus	1
trachea	4
bronchioles	2

(e) The actions of the intercostal muscles and diaphragm during inhalation are as follows...

- The diaphragm contracts / moves downwards/flattens; [1 mark]
- The (external) intercostal muscles contract / pull the ribs up/out; [1 mark]

Question 2:

(a) Organ 1 is the...

- Diaphragm; [1 mark]

(b) Contraction of the diaphragm aids inhalation as follows...

Any **two** of the following:

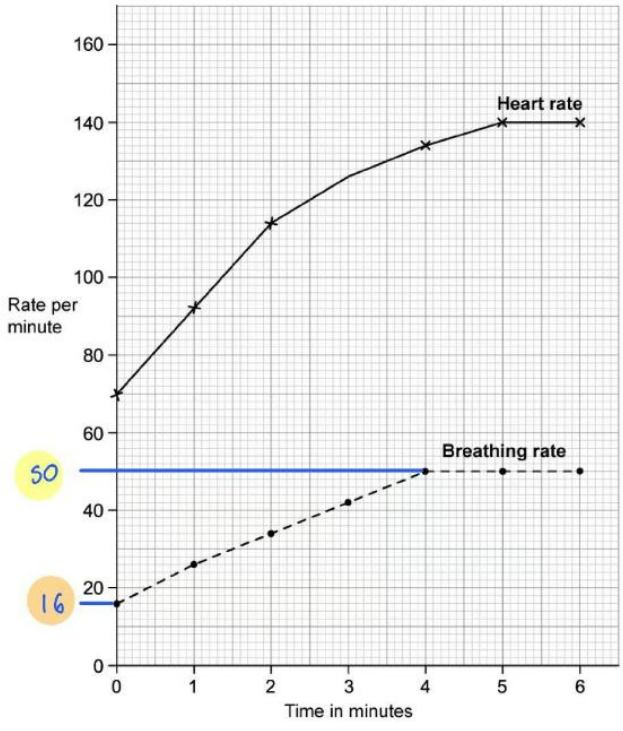
- (Organ 1/diaphragm) flattens / moves downwards; [1 mark]
- The thorax/chest/lung volume increases; [1 mark]
- The pressure in the thorax/chest/lung decreases; [1 mark]
- Air moves/is drawn into the thorax/chest/lungs from high to low pressure / down a pressure gradient; [1 mark]

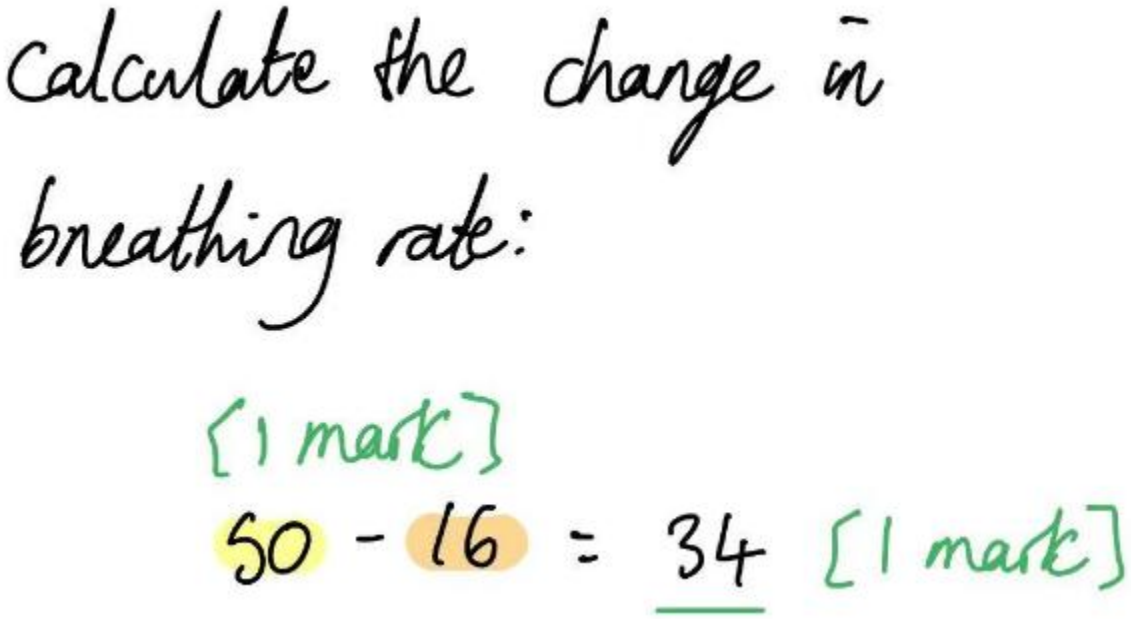
(c) One other antagonistic pair of muscles involved with ventilation is...

- The internal / external intercostal muscles; [1 mark]

(d) (i) The change in breathing rate between 0 and 4 minutes is...

- 50 - 16; [1 mark]
- 34; [1 mark]





(d) (ii) The change in breathing rate that occurs during exercise is due to...

Any **two** of the following:

- The muscles are respiring more; [1 mark]
- More oxygen is required / more carbon dioxide needs to be removed; [1 mark]
- Respiration requires oxygen / produces carbon dioxide; [1 mark]

(d) (iii) Stopping exercise would affect the line on the graph as follows...

- The line would remain at a higher/elevated level / would initially decrease slowly; [1 mark]
- The line will (eventually) return to the original level/breathing rate; [1 mark]

When exercise stops it takes time for the breathing rate to return to normal. This is because more oxygen is needed to pay of the 'oxygen debt' that has occurred, and because excess carbon dioxide still needs to be removed from the blood. Breathing rate will eventually return to normal once recovery has taken place.

Question 3:

(a) (i) The correct answer is **D** because...

Structure Q is the trachea and structure R is the bronchus.

(a) (ii) Structure S helps a person to exhale by...

Any **three** of the following:

- S/diaphragm/muscle relaxes;
- S/diaphragm moves up / becomes dome shaped;
- Volume (of the chest cavity) decreases;
- Pressure (in the chest cavity) increases;

[Total: 4 marks]

Remember to read the question carefully; if the question asks about exhalation make sure to only focus on this because any reference to inhalation would not gain any marks.

(b) The person with lung disease is often breathless and unable to exercise because...

Any **three** of the following:

- The (maximum) lung volume of people with lung disease is lower / less volume can be exhaled / less air exhaled; [1 mark]
- People with lung disease cannot exhale as rapidly; [1 mark]
- Less carbon dioxide removed / less oxygen taken in; [1 mark]
- Diffusion gradient (into the blood) is less steep; [1 mark]
- Less respiration (in cells) / more anaerobic respiration (needs to occur) / more lactic acid accumulation (as a product of anaerobic respiration); [1 mark]

Accept *reverse statement for marking point 1, e.g. " the maximum lung volume of people with healthy lungs is higher" / "a larger volume can be exhaled" etc.*

Question 4:

(a) (i) The flask exhaled air passes through is...

Any **two** of the following:

- (Flask B) as (mouthpiece is) connected to the long tube in flask B / (mouthpiece is) connected to flask A is shorter; [1 mark]
- (In flask B the) tube (from the mouthpiece is) in limewater / the tube is in liquid in flask B / causes bubbles (in limewater) in B / (the tube is) not in liquid / draws air in flask A; [1 mark]
- (The student) cannot inhale in flask B as the limewater would be sucked in / (they) would get a mouthful of liquid / Flask A is for inhalation as no liquid is drawn up; [1 mark]

No marks awarded if Flask A was identified at marking point 1.

(a) (ii) The changes that will happen in the limewater in flask A and B are...

Any **two** of the following:

- (Limewater in) flask A stays clear / no change / less cloudy / goes cloudy slowly; [1 mark]
- (Limewater in) flask B goes (more) cloudy / milky / cloudy quicker; [1 mark]
- (Because there is) less carbon dioxide in inhaled/atmospheric air **OR** (more) carbon dioxide in exhaled (air); [1 mark]
- (There is more carbon dioxide in exhaled air) due to respiration; [1 mark]

Allow 1 mark if it is stated that the limewater goes cloudy in both flasks (due to the presence of CO_2).

Ignore reference to no CO_2 in inhaled air.

(a) (iii) An alternative substance they could use to test the composition of inhaled and exhaled air is...

- Sodium hydrogen-carbonate / sodium bicarbonate (solution)/ hydrogen-carbonate / bicarbonate indicator; [1 mark]

(b) The role of the diaphragm and the intercostal muscles in inhalation is...

Any **four** of the following:

- Diaphragm contracts; [1 mark]
- Diaphragm flattens / moves down; [1 mark]
- (External) intercostal muscles contract; [1 mark]
- Rib cage is raised / moves out; [1 mark]
- Volume (of chest cavity/thorax) increases; [1 mark]
- Pressure in (chest cavity/thorax) decreases/reduces; [1 mark]
- Air drawn into lungs / lungs inflate; [1 mark]

Ignore reference to the volume of the lungs increasing at marking point 5.

Question 5:

(a) (i) The correct answer is **D** because...

The trachea is the main windpipe through which all inhaled and exhaled air flows during breathing.

(a) (iii) The correct answer is **A** because...

Both sets of muscles **contract**, which both have the effect of enlarging the thorax. This causes a drop in pressure within the thorax, so air is then forced in from outside due to the pressure difference between the outside air and the thorax.

When the diaphragm relaxes it moves back upwards into its dome shape, and in doing so pushes air *out* of the lungs. Similarly, the external intercostal muscles relax and that causes the ribcage to drop by gravity, again having the effect of pushing air *out*.

(b) The changes in the percentage of total blood flow in these body parts is...

Any **four** of the following...

- There is more blood supplied to muscles / less blood supplied to the intestine (during exercise) / blood is diverted to the muscles from the intestine; [1 mark]
- (Blood flow) supplies oxygen / oxygenated blood / glucose to organs/tissues/cells; [1 mark]
- (For aerobic) respiration / to avoid/prevent anaerobic respiration; [1 mark]
- To release energy / ATP; [1 mark]
- (So that) muscle contraction (can take place for running); [1 mark]
- (So there is) less absorption of food in the intestine when running / during exercise; [1 mark]

Accept *converse statements for marking point 1, e.g. "while* ***at rest*** *there is less blood supplied to muscles / more blood supplied to the intestine / blood is diverted to the intestine from the muscles".*

Accept *converse statements for marking point 6, e.g. "so that while* ***at rest*** *there is a high blood flow to the intestine to absorb food / maintain concentration gradient"*

(c) The horse continues to breathe faster and deeper for a period of time after it has stopped running because...

Any **two** of the following:

- To supply (more) oxygen / there was a shortage of oxygen; [1 mark]
- To allow the breakdown of / remove lactic acid; [1 mark]
- To repay oxygen debt; [1 mark]
- Because anaerobic respiration had occurred; [1 mark]

Question 6:

(a) (i) The percentage of mothers aged 19 years and under who smoked during pregnancy was...

- 356 / (356+1331) x 100; [1 mark]
- 21(.1)%; [1 mark]

(a) (ii) The ratio of non-smokers to smokers used in the study was...

- 85147 **AND** 7206; [1 mark]
- 12:1; [1 mark]

Allow full marks for the correct answer in the absence of calculations.

Age of mother in years	Data for mothers who did not smoke during pregnancy		Data for mothers who did smoke during pregnancy	
	Number of mothers	Percentage of babies with low birth mass	Number of mothers	Percentage of babies with low birth mass
19 and under	1331	11.5	356	16.0
20-24	11243	9.8	1677	13.2
25-29	24099	9.0	2211	13.3
30-34	28695	9.2	1847	14.5
35-39	16537	10.5	934	21.1
40 and over	3242	12.3	181	22.1
Total	85147		7206	

i) % of mothers age 19 and under who smoke $= \frac{\text{Number who smoke}}{\text{Total number of mothers}} \times 100$

$= \frac{356}{356 + 1331} \times 100$ [1 mark]

$= 21.1\%$ [1 mark]

2 marks for the correct answer with no working shown

ii) Ratio of smokers : non-smokers

Total number of non-smokers = 85147

Total number of smokers = 7206

Ratio = 85147 : 7206

÷7206 — Divide both sides by 7206

11.82 : 1 [1 mark]

Round to whole number

12 : 1 [1 mark]

2 marks for the correct answer with no working shown

(b) A comment on the conclusion is that...

Any **six** of the following:

The conclusion is correct because...

- (Smokers have a) higher % of low birth mass (at every age) / smokers have more low mass babies **OR** (there is a) correlation between smoking and low birth mass; [1 mark]
- Large numbers (of participants were used) in the study; [1 mark]

The conclusion is incorrect because...

- (There is a) big age effect / (there are) more (babies) with low birth mass (for mothers) at under 19; [1 mark]
- More (babies) with low birth mass (for mothers) over 35; [1 mark]
- (There is a) greater effect of smoking at older ages above 35; [1 mark]
- As older mothers may have smoked for many years / no information on the number of years mothers have smoked for; [1 mark]
- No information on mothers' mass / weight; [1 mark]
- No information on mothers' health care / medical condition / alcohol / diet / drugs; [1 mark]
- No information on premature birth; [1 mark]
- No information on frequency of smoking or when during pregnancy; [1 mark]

Use of own knowledge is...

- Smoking reduces oxygen (supply to baby/foetus); [1 mark]
- (This leads to) less respiration (in foetal cells); [1 mark]

Ignore mention of mother's lifestyle at marking point 8.

[Total: 6 marks]

Whenever you get asked to "comment on a conclusion" you must always discuss points that both agree and disagree with the conclusion.

Always make sure to refer to the data as well as your own knowledge.