2.4 Respiration and gas exchange

Name: _____ Class: _____ Date: _____ **Total: 27 marks**

Objective

Build the skills to answer exam questions on **respiration and gas exchange** : aerobic and anaerobic respiration, the structure of the thorax, breathing in and out, the alveoli, the effects of smoking and the effect of exercise on breathing.

You must be able to:

- write word equations for aerobic and anaerobic respiration
- explain how breathing in and out happens
- explain the effects of smoking on the lungs
- analyse breathing data before and after exercise

1 Key knowledge and worked examples

Respiration and breathing

idea	rule
respiration	releases energy (as ATP) from glucose in every living cell
aerobic	glucose + oxygen → carbon dioxide + water; releases a lot of energy
anaerobic	no oxygen; releases much less energy per glucose
gas exchange	oxygen and carbon dioxide move by diffusion across the alveolus walls
breathing rate	breaths ÷ time in minutes
volume per minute	breathing rate × volume of each breath

Worked example 1: breathing rate. A student takes 45 breaths in 3 minutes. Find the breathing rate.

1. Known: 45 breaths; 3 min.
2. Rule: breaths ÷ minutes.
3. Numbers: $45 \div 3$.
4. Result: 15 **breaths per minute**.

Worked example 2: volume per minute. Each breath is 0.5 dm^3 at 15 breaths per minute. Find the volume per minute.

1. Known: 15 per min; 0.5 dm^3.
2. Rule: rate × volume per breath.
3. Numbers: 15×0.5.
4. Result: 7.5 **dm^3 per minute**.

Answer shapes: in breathing, name the muscle, say whether it contracts or relaxes, then the change in volume and pressure.

2 Practice

2.1 Write the word equation for anaerobic respiration in human muscle. [2]



2.2 Describe a test for carbon dioxide in exhaled air, and give the result. [2]

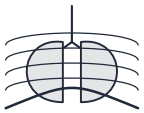


2.3 Give **two** features of the alveoli that make gas exchange fast. [2]



3 Exam-style questions

3.1 Describe how the intercostal muscles and the diaphragm cause air to enter the lungs. [3]



3.2 Explain **three** ways in which smoking damages the gas exchange system. [3]



3.3 A student measures her breathing rate at rest and for 5 minutes after running. She also measures the volume of each breath. The results are shown.

(a) Calculate the volume of air breathed per minute at rest and in the first minute after exercise. How many times greater is it after exercise? [3]



time	rest	1 min	2 min	3 min	4 min	5 min
breaths per min	14	30	24	18	15	14
volume per breath / dm^3	0.5	1.5	1.2	0.9	0.6	0.5

(b) Explain why the breathing rate stays high for several minutes after the exercise stops. [3]

(c) Calculate the percentage increase in breathing rate from rest to the first minute after exercise, and the time taken for the rate to return to the resting value. [3]

(d) Compare aerobic and anaerobic respiration in the student's leg muscles during the run. [6]