Measuring breathing – spirometry

Specification reference

- *3.1.1 (e)*

Learning outcomes

After completing the worksheet students should be able to:

- identify steps in the method for using a spirometer, and know the reasons for each step
- interpret the trace produced from a spirometer
- perform calculations based in a spirometer trace.

Introduction

Measuring lung volumes and breathing rates is an important technique, used by clinicians and sports physiologists amongst others. The principle piece of equipment used for measuring breathing is called a spirometer. Although there are many different designs for this piece of equipment, the basic functioning is the same.

Spirometry is technique which can present a number of issues. There are a number of points in the methods for spirometry that students tend to forget in any answer or description of the process. Secondly interpreting the trace produced from spirometry can cause problems.

The aim of this sheet is to help students reinforce the basic steps in the method for the use of a spirometer. In addition the sheet will offer support in analysing a trace.

Teacher notes

- The support sheet assumes that the topic of the structure and function of the human respiratory system has been taught. It does not support the basic physiology. Instead the support sheet focuses on the measuring of lung volumes. The first half of the support sheet deals with the structure of the method which students find difficult. The second half deals with calculations from the trace.
- Start by recapping the structure and function of the lungs and the process of ventilation.
- An image of the spirometer (or the actual spirometer) would be helpful whilst discussing the method for the technique of using the spirometer. Take students through the process, but ensure that they link a step in the method to the reason for that step.
- Now try question 1 in the task.
- Show a typical trace from a spirometer, or the actual trace students might have achieved in a practical lesson.
- First ensure that students know the names of the four main lung volumes, and how to recognise the volumes on a trace.
- Go through the calculations that are typical in exam questions. Use the worked example on the support sheet. If an actual trace is available, follow each example with a real calculation.
- Finally complete the questions.

Answers

Task

1 **a** Measure fitness/respiratory health/specific respiratory condition.

b Sterilise mouthpiece;
Check subjects health;
Fill spirometer with fresh air.

c Absorb carbon dioxide.

d Down.

Questions

1 **a** carbon dioxide (*1 mark*)

b stops air moving into spirometer through the nose; (*1 mark*)
allows valid measurements. (*1 mark*)

c ensure that the subject does not breath through the nose; (*1 mark*)
subject breaths normally; (*1 mark*)
measure the height/amplitude of waves from the trace; (*1 mark*)
measure a number of times between two lines to calculate a mean; (*1 mark*)
details of how spirometer works (e.g. movement of drum/use of kymograph, etc.) (*1 mark*)
(*maximum 3 marks*)

2 **a** tidal volume (*1 mark*)

b E placed on a line which is sloping downward. (*1 mark*)

c increased volume; (*1 mark*)
faster breathing rate. (*1 mark*)

d 16 breaths per minute. (*1 mark*)

e 0.9 dm^3 min^{-1} (*1 mark for working, 1 mark for correct answer*)