



**(b)** Explain why a person using the spirometer to measure their vital capacity should wear a nose clip.

.....  
.....  
.....  
..... [2]

**(c)** State **two** other precautions that should be taken when using a spirometer to measure vital capacity.

1 .....

.....

2 .....

..... [2]

**[Total: 9]**

2 Fig. 1.1 (a) is a diagram of a part of a mammalian lung.

Fig. 1.1 (b) is an enlargement of part of the lining of the bronchus.

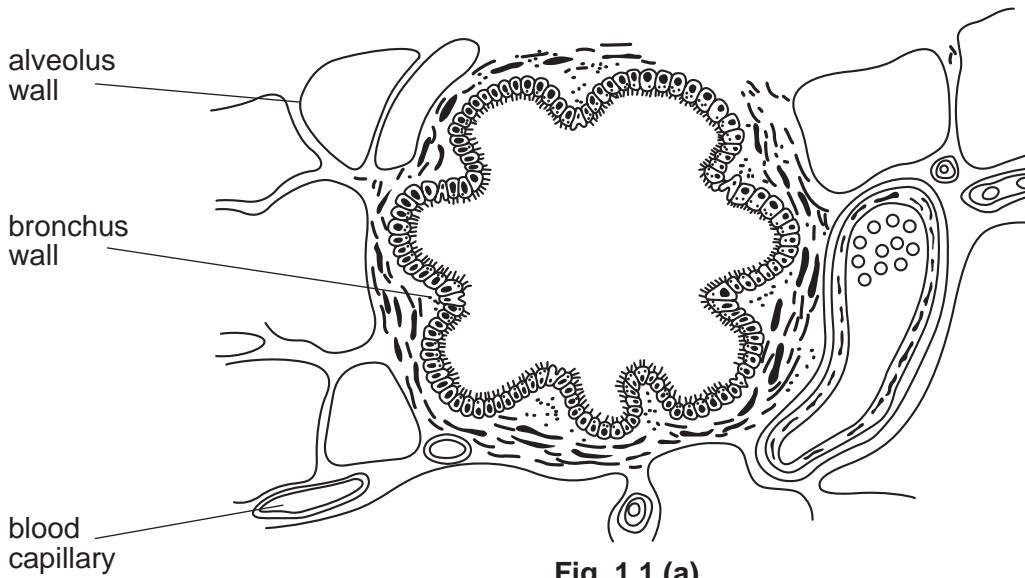


Fig. 1.1 (a)

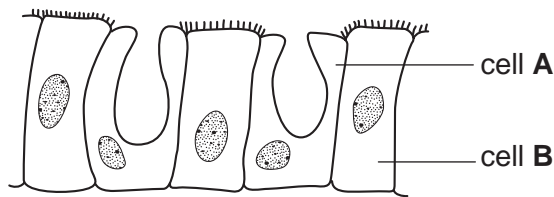


Fig. 1.1 (b)

(a) ( Name the two types of cell, **A** and **B**, shown lining the **bronchus**.

**A** .....

**B** ..... [2]

(ii) Describe how cell types **A** and **B** work together to keep the lung surface clear of dust and other particles.

.....  
.....  
.....  
.....  
.....  
..... [3]

**(iii)** The bronchus wall also contains smooth muscle fibres.

State the function of the smooth muscle fibres.

.....  
..... [1]

**(b)** ( Explain why blood capillaries and alveoli are very close together.

.....  
.....  
.....  
.....  
..... [2]

**(ii)** The walls of the alveoli contain elastic fibres.

State the function of these elastic fibres.

.....  
..... [1]

**[Total: 9]**





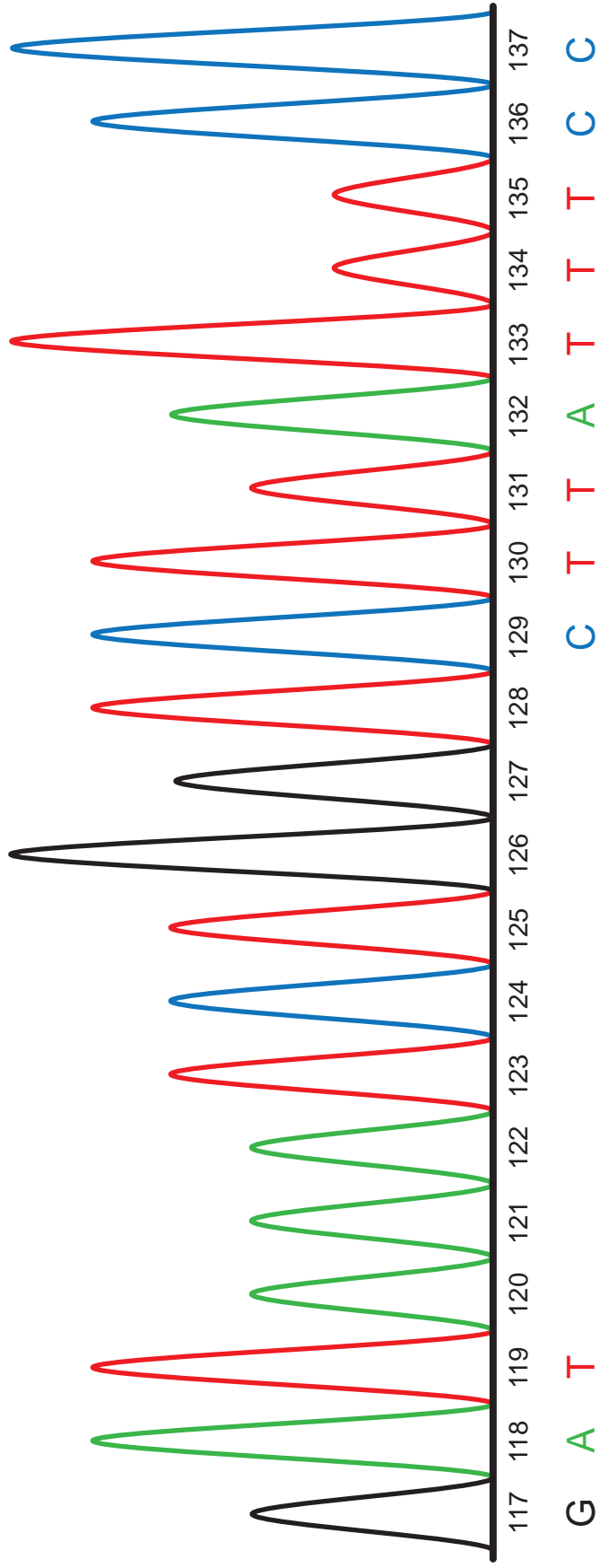


Fig. 3.1

4 Gene sequencing is an important technique in molecular biology.

Fig. 3.1, on page 3 of the Insert, shows part of a computerised graph obtained from an automated gene sequencing machine.

- The section of the DNA molecule represented in Fig. 3.1 is from base position 117 (on the left of the graph) to base position 137 (on the right of the graph).
- The bases in the DNA sequence are labelled with four different coloured fluorescent dyes.
- The identities of some of the bases (117 to 119 inclusive and 129 to 137 inclusive) are indicated below the graph.

(a) Use Fig. 3.1 to identify the order of bases from positions 120 to 128.

.....      .....      .....      .....      .....      .....      .....      .....      .....  
120      121      122      123      124      125      126      127      128      [1]

(b) To produce the type of graph shown in Fig. 3.1, the automated gene sequencing machine needs to be loaded with the following:

- the DNA to be sequenced
- short primer sequences specific to the DNA to be sequenced
- many normal DNA nucleotides
- some chain-terminating DNA nucleotides labelled with coloured dyes
- the enzyme *Taq* polymerase.

A regular cycle of temperature changes allows many DNA fragments of different lengths to be built up by the polymerase chain reaction (PCR).

Fig. 3.2 (on the next page) shows the end parts of the sequences of seven of these different length fragments, labelled 1 to 7. The end parts of the sequences for fragments 1 to 4 are complete but those for fragments 5 to 7 are not.

These seven fragments correspond to the **last seven peaks** on the right hand side of the graph in Fig. 3.1.

The letters in boxes represent labelled chain-terminating DNA nucleotides.  
The letters not in boxes represent normal DNA nucleotides.





- (c) Gene sequencing can help us to understand how an individual's genome affects their body's response to drugs.

One research study has looked at the effectiveness of drugs used to treat asthma in children. Asthma is a condition in which the bronchioles become reduced in diameter. This results in the child finding it difficult to breathe.

- (i) Using your knowledge of the structure of bronchioles, suggest how their diameter might become reduced.

.....  
.....  
.....  
..... [2]

- (ii) Explain why it is difficult to expel air from the lungs if the bronchioles become reduced in diameter.

.....  
.....  
..... [1]

- (d) Asthma in children may be treated with drugs. One of the most commonly used drugs is salmeterol.

Salmeterol acts by binding to protein receptors in the lining of the bronchioles. However, in approximately 14% of children with asthma, salmeterol is not very effective. This is thought to be the result of a genetic mutation in these children.

Suggest why this mutation reduces the effectiveness of salmeterol.

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
..... [3]

(e) In a recent medical trial, 62 children with this genetic mutation were studied.

- Their asthma was not controlled well by salmeterol.
  - 31 children continued using salmeterol and the remaining 31 were given an alternative drug, montelukast.
  - Montelukast is not routinely prescribed because salmeterol is far more effective for most children with asthma.
- (i) After one year, the children taking montelukast had better control of their asthma and were able to reduce their use of montelukast.

Suggest why these children responded better to montelukast than to salmeterol.

.....

.....

.....

.....

.....

.....

..... [2]

(ii) Comment on the reliability of the results of this medical trial.

.....

.....

..... [1]

(iii) It is proposed that a simple saliva test could identify those children who have the mutation.

What would be the source of the genetic material used in this test?

.....

..... [1]

[Total: 16]

5 (a) Fig. 1.1 is a diagram of a bacterium as seen under an electron microscope.

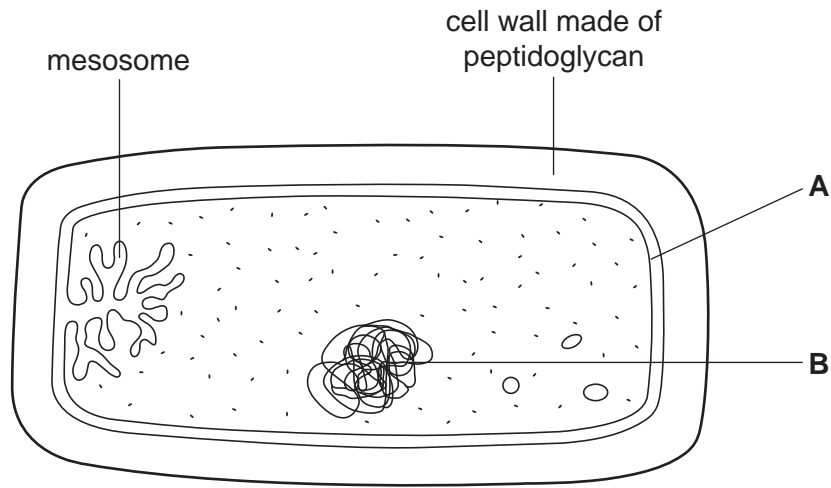


Fig.1.1

(i) Name the structures labelled **A** and **B**.

**A** .....

**B** ..... [2]

(ii) It has been suggested that the mesosome has the same role as mitochondria in eukaryotic cells.

Suggest the role of the mesosome in prokaryotic cells, such as bacteria.

..... [1]

(iii) Eukaryotic cells, such as *Euglena*, contain membrane-bound organelles. Each organelle has a specific function in the cell.

State the **process** that is carried out in each of the organelles listed below.

ribosome .....

chloroplast ..... [2]

(b) Explain why a single-celled organism, such as *Euglena*, does **not** need a specialised area to carry out gaseous exchange.

.....  
 .....  
 .....  
 .....

(c) The mammalian gas exchange system contains a variety of types of cells and tissues.

Complete Table 1.1, stating the function of each of the cells and tissues. The first row has been completed for you.

**Table 1.1**

cell / tissue	function
squamous epithelium	to provide a thin surface for a short diffusion distance
elastic tissue	..... ..... .....
ciliated epithelium	..... ..... .....
goblet cells	..... ..... .....
smooth muscle	..... ..... .....

[4]

[Total: 11]