5. Colorimetry was used to produce the standard curve below.
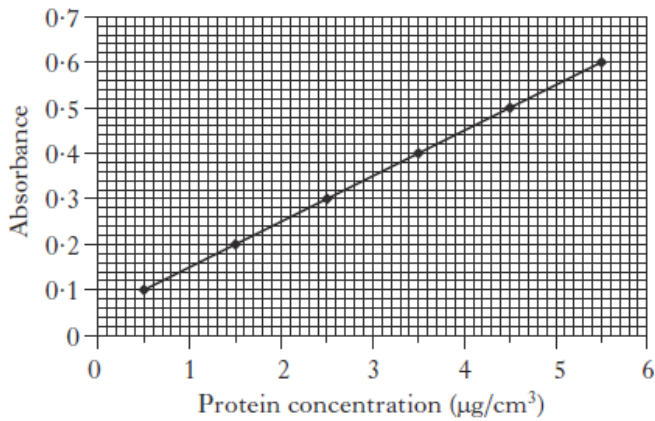

In an experiment to extract soluble protein from potato tubers, $25\,g$ tissue was ground with $50\,cm^3$ of buffer and centrifuged. The volume of extract produced was $65\,cm^3$. When $1\,cm^3$ of extract was tested, the absorbance was found to be $0\cdot5$.

Which of the following is the protein content of the potato tissue in $\mu g/g$ fresh tissue?

A $3\cdot9$

B $9\cdot0$

C $11\cdot7$

D $13\cdot5$

**1.** The diagram below shows a haemocytometer counting chamber containing animal cells.

The depth of the chamber is $0\cdot01$ cm.
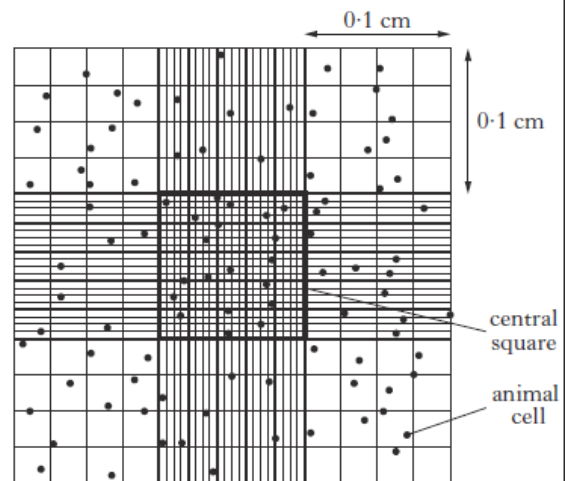
The concentration of animal cells, based on the cell count from the central square, is

A $2\cdot0 \times 10^4$ cells per cm^3

B $2\cdot0 \times 10^5$ cells per cm^3

C $2\cdot0 \times 10^6$ cells per cm^3

D $2\cdot0 \times 10^7$ cells per cm^3.

1. The bacterium *Escherichia coli* (*E. coli*) can use a variety of different sugars as an energy source during growth. The graph shows the typical growth curve obtained when *E. coli* is cultured in a medium containing both glucose and lactose.
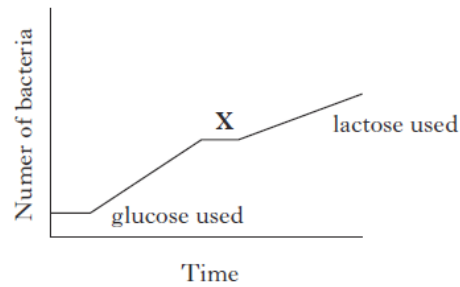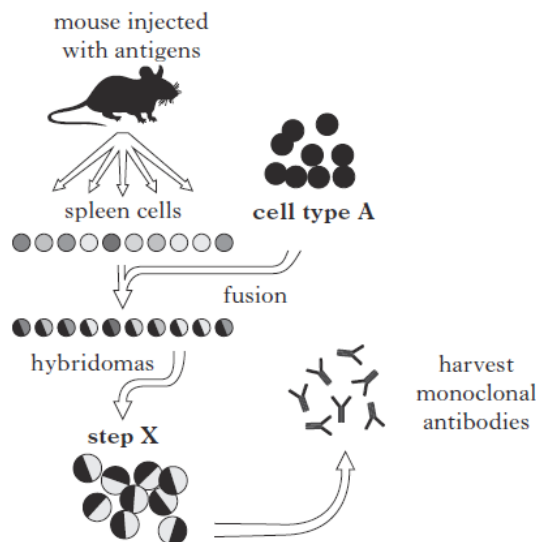

(a) Give **one** method that could be used to determine cell numbers in the production of a bacterial growth curve.
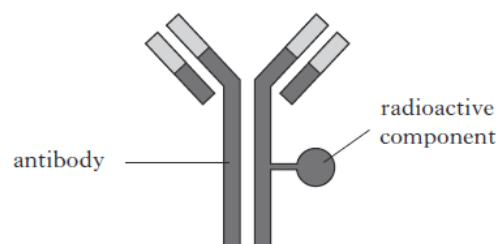
1

3. Figure 1 shows steps in the production of a monoclonal antibody.

Figure 1

In the treatment of disease, monoclonal antibodies can be attached to toxic components to create "magic bullets". One example of this, shown in Figure 2, uses a component that emits damaging radiation.

Figure 2

(a) (i) Name cell type A and explain the role of these cells in the production of monoclonal antibodies.

2

2. The table below shows data comparing some stages in the purification of an enzyme from a tissue sample. Total protein and enzyme activity are measured at the end of each stage.

	Stage	Total protein (mg)	Enzyme activity (units)
1	Liquidised tissue	10 000	2 000 000
2	Precipitation by salts	3000	1 500 000
3	Iso-electric separation	500	500 000
4	Affinity chromatography	30	42 000

(a) (i) By the end of the purification process, what percentage of the original protein has been removed? 1

(ii) Enzyme purity can be calculated from these values as the *activity per mg of protein*.

By how many times has the enzyme purity increased by the end of stage 4? 2

(b) Explain the principle of iso-electric separation. 2

(c) In affinity chromatography, a ligand specific to the enzyme was bonded to beads in a burette.

Explain how this method can improve purity. 2

(7)

A. Give an account of the procedures involved in producing transgenic plants. Use the following headings:

(a) plant production by tissue culture; 5