Biology

Year 12

Maths workbook
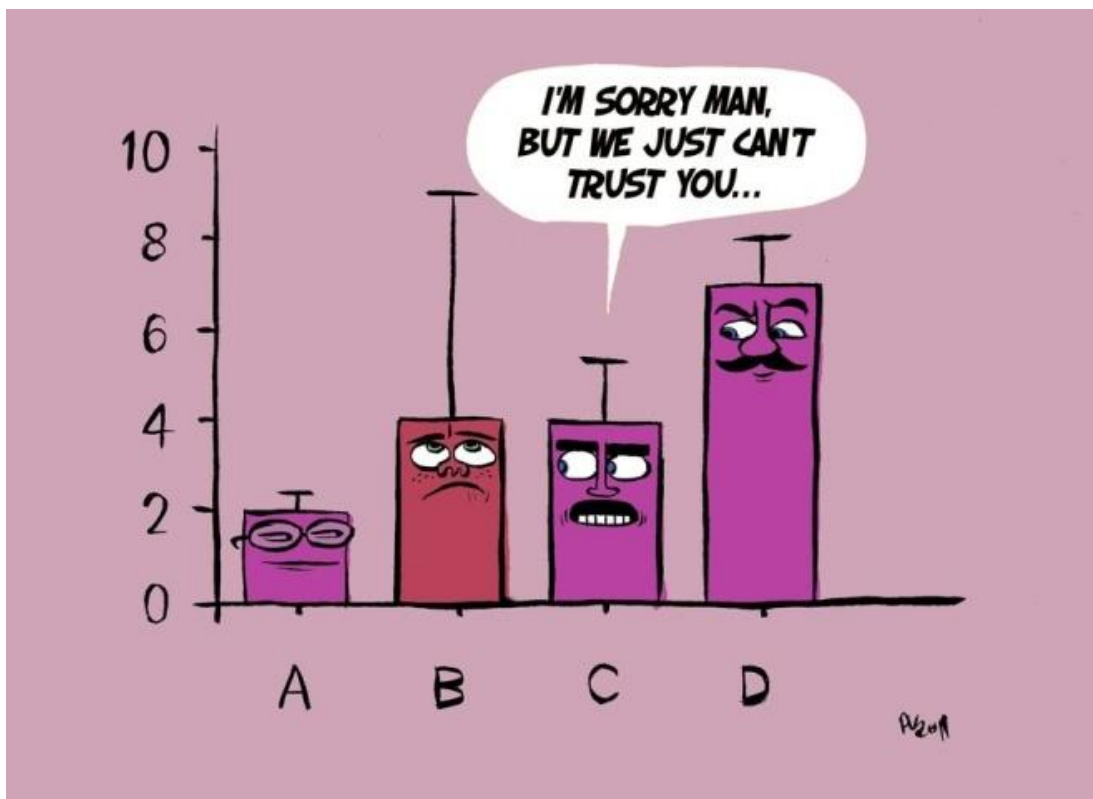
Name: _____

Biology set: _____

Tutor group: _____

Contents

1 FRACTIONS, DECIMALS AND PERCENTAGES

These are really all variations of the same thing. We use a fraction, a decimal (below 1.0) or a percentage to describe a quantity as **part of a whole**.

A percentage is a fraction of 100—this gives us an easy comparison. It is easy to convert a number between these three ideas.

For all of these, you will need to **divide one number by another**. The most common mistake is to use the wrong numbers.

Try thinking it through in words before you reach for your calculator.

e.g. In a class of 25, 3 students forget their calculator. This is **3 out of 25** or **3/25**.

To get a decimal, divide the number we're interested in (3) by the number of the whole we're comparing it to (25) to get **0.12**

To convert a decimal to a percentage, just multiply by 100 to get **12%** - this is the number of students who would have forgotten their calculators if there had been 100 in the class.

A   The results below were obtained from an experiment in which the number of cells in each phase of mitosis was determined. Work out the percentage of the total number of cells that were in each phase.

Phase of cycle	Number of cells	Percentage of cells in each phase/%
Interphase	26	
Prophase	5	
Metaphase	3	
Anaphase	4	
Telophase	2	

To calculate the percentage change, take the difference between the starting and final masses, divide this figure by the original starting mass, and then multiply by 100. For example:

mass at start   =   15.34 g

mass at end   =   17.35 g

difference   =   +2.01 g

percentage difference $\dfrac{2.01}{15.34}$ X   100   =   13.1%
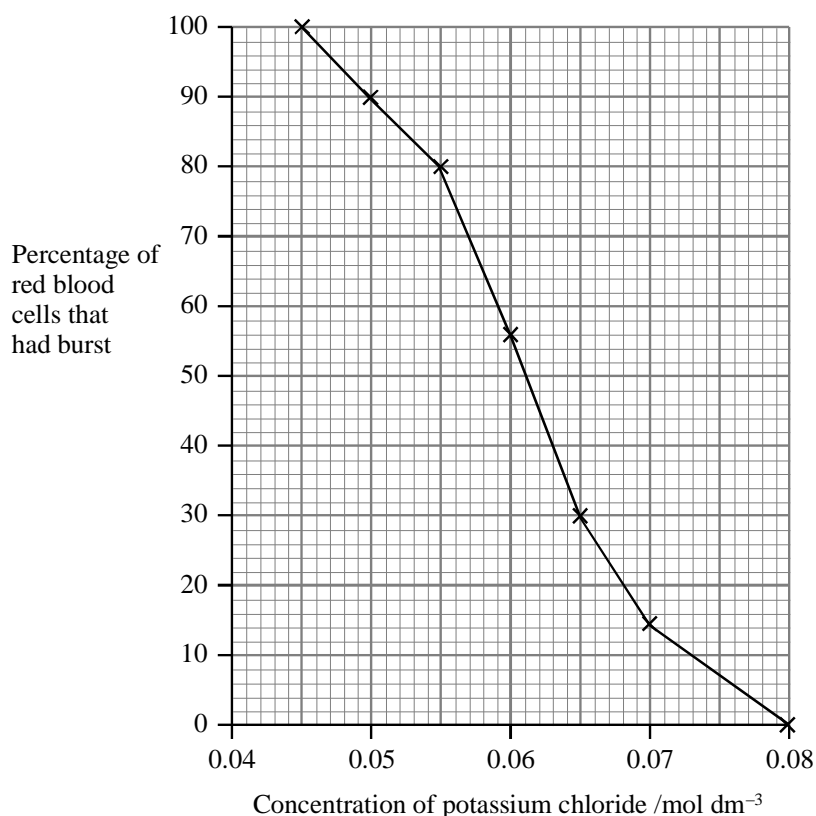
ie $\dfrac{final-original}{original}$ x 100

B   Sara took some samples of soil from a woodland ecosystem. She put them into labelled bags and returned them to the lab. Each sample was placed in a small paper box, which had been previously weighed. These boxes of fresh soil were then placed in an oven set at 70 _C, so that all the water could be evaporated off. After a day, Sara retrieved the soil samples and re-weighed them. She then calculated the loss in mass (equivalent to the water content) for each soil. Herresults are shown in the table below.

Sara concluded that sample C was the wettest soil. Was she correct? Calculate the percentage loss of water for each sample.

Soil sample	Soil A	Soil B	Soil C
Mass of fresh soil (g)	347.3	231.4	561.3
Mass after heating (g)	267.3	123.8	342.9
Change in mass = mass of water in soil (g)	80.0	107.6	218.4
Percentage loss			

/3

C   In an investigation into the effects of osmosis on red blood cells, seven samples of red blood cells were placed in potassium chloride solutions of different concentrations. After two hours, each sample was examined to find the percentage of cells that had swollen and burst (lysed). The results are shown in the graph below.

Calculate the difference between the percentage of red blood cells that burst in 0.05 mol dm^{-1} and 0.07 mol dm^{-1} potassium chloride solutions. Show your working.

Answer ....

(2)

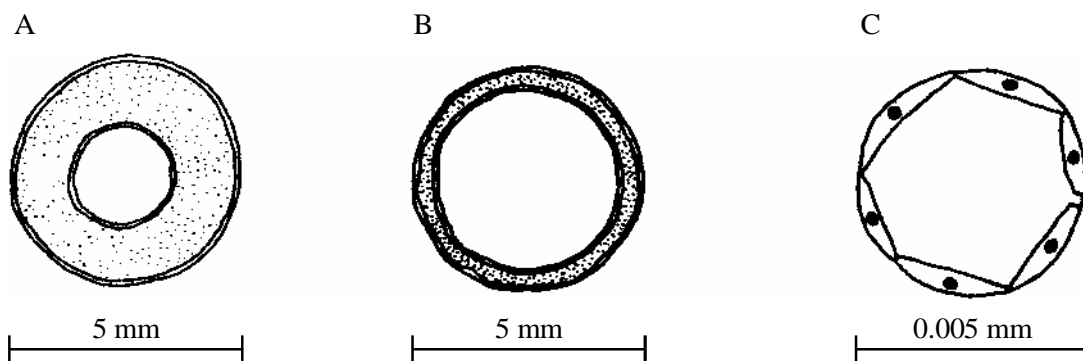**D**   Analysis of a molecule of DNA showed that cytosine accounted for 42 per cent of the content of the nitrogenous bases. Calculate the percentage of bases in the molecule which would be thymine. Show your working.

Answer ....

(3)

E   The diagram below shows cross-sections of three different types of blood vessel, A, B and C.

A	B	C
5 mm	5 mm	0.005 mm

i   Name the type of blood vessels   A _____

                                             B _____

                                             C _____

ii   Calculate the percentage decrease in size between vessel A and vessel C

Answer ....

(3)

F At rest, the total blood flow through the lungs is about 5 dm^3 per minute. During exercise, this increases to about 30 dm^3 per minute. Calculate the % increase in blood flow.

Answer ....

(3)

2   Standard form

Human faeces contains more than 10 000 000 000 000 bacteria cm^3. This is a very large number, and rather than write out all the zeros every time it is convenient to use a shorthand system: standard form. The sentence above would become: Human faeces contains more than 1 x 10^{13} bacteria cm^3.

Presenting numerical data in standard form
It is usual to use standard form when presenting numerical values that are very large or very small.
The number is written as the appropriate number between 1 and 10 followed by the correct power of 10, so, for example, 43 700 000 becomes 4.37 x 10^7 (7 being the number of places the decimal point has been moved to the left).

The value 0.000 192 becomes 1.92 x 10^{-4} (10^{-4} tells you that the decimal point has been moved four places to the right).

A Convert the following numbers into standard form.

   i 4370 _____ ☐

   ii 0.069 _____ ☐

   iii 11 900 _____ ☐

   iv 81 000 000 _____ ☐

/4

You might have to use standard form to work out magnifications for the size of organelles. Sometimes the values may be given to you in standard form and you have to convert them out of standard form to perform your calculations.

B   Convert the following numbers out of standard form

i 7.7×10^5 _____   ☐

ii 4.9×10^{-2} _____   ☐

/2

magnification = measured size ÷ actual size

| 1cm = 10mm |
| 1mm = 1000 μm |
| 1μm = 1000nm |

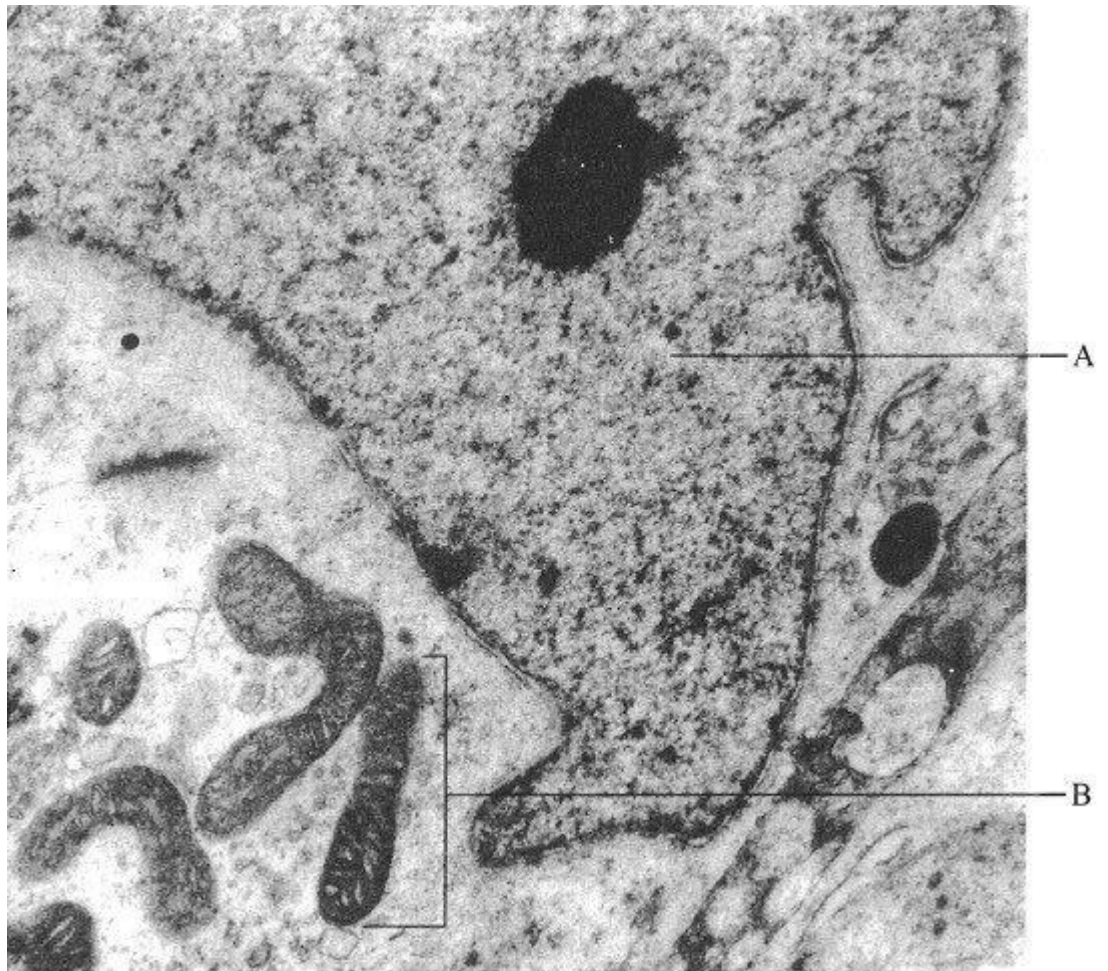| $1m = 1 \times 10^3$ mm |
| $1 μm = 1 \times 10^{-3}$ mm |
| $1nm = 1 \times 10^{-6}$ mm |

C   A nucleus with a diameter of 11 μm measures 55×10^4 μm on an electron micrograph.
Calculate the magnification of the electron micrograph using the equation above. Show your working and include correct units in your answer.

_____   **/3**

D

The photograph to the right shows part of an animal cell, as seen using an electron microscope. The magnification is ×5000.
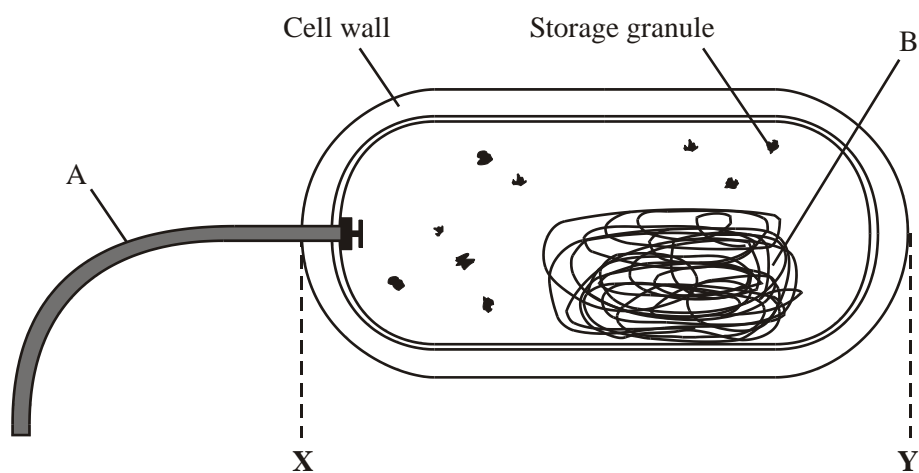
Calculate the actual length of the structure labelled B in µm. Show your working.

Actual length of B ....µ m

/3

E   The diagram below shows the structure of a bacterial cell as seen using an electron microscope.

The diagram has been magnified 6000 times. Calculate the actual length of the bacterial cell between X and Y. Show your working, and give your answer in micrometres.

Answer .... µm

/3

3 Graphs and Charts

The whole point of a graph is to show a pattern in data. We usually need to choose between a **line graph** and a **bar chart** by looking at the independent variable.
Line graphs are used if what we change could have any value in between the ones we used. Bar charts are for when the independent variable is in types or categories.
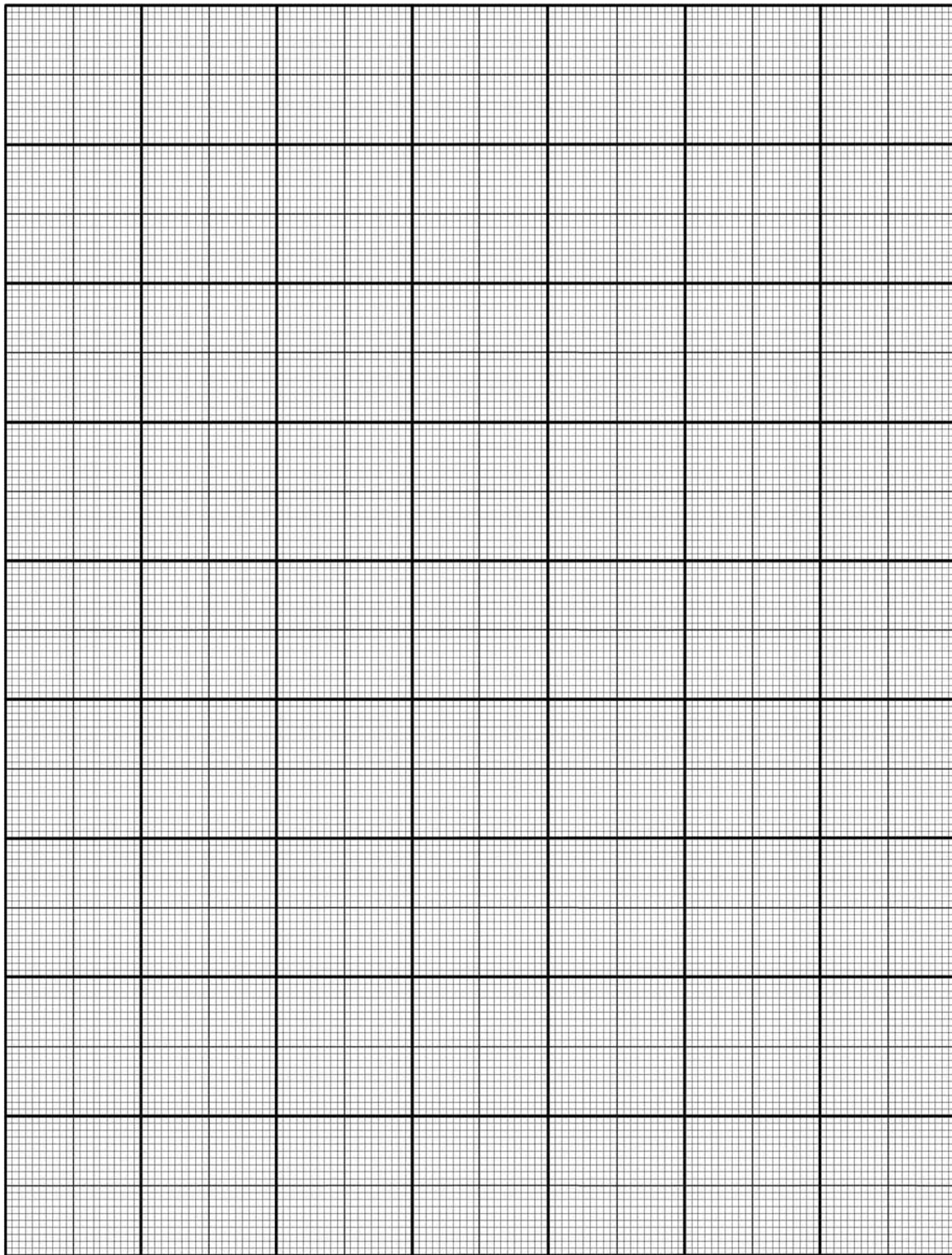
1 Use a sharp pencil and ruler.
2 Draw the independent variable along the bottom (the x axis).
3 Draw the dependent variable up the side (the y axis).
4 Use a regular, sensible scale with equal intervals for each axis.
5 Label both axes with the **quantity** (variable name) and **unit**.
6 Plot points carefully with a small cross.
7 Ask yourself if the origin (0,0) should be a point.
8 For bar charts, draw **equal width** bars, usually with a gap between them. For a line graph, join the points with a **best fit line**, which could be **straight** (with a ruler) or a **curve** (freehand).

Time s	Liver cm^3	Yeast cm^3	Potato cm^3
0	0.00	0.00	0.00
30	62.71	27.14	6.36
60	74.14	45.57	8.00
90	78.00	59.14	10.07
120	78.43	68.71	11.14
150	79.00	74.00	11.86
180	79.07	76.43	12.57
210	79.14	78.00	13.14
240	79.21	80.14	13.71
270	79.29	80.59	14.00
300	79.29	80.87	14.71
330	79.29	81.07	14.79
360	79.29	81.07	15.01
390	79.43	81.07	15.14
420	79.43	81.14	15.14
450	79.43	81.14	15.14
480	79.43	81.14	15.14
510	79.43	81.14	15.14
540	79.43	81.14	15.14
570	79.43	81.14	15.14
600	79.43	81.14	15.29

An experiment was carried out to investigate the effect on rate on changing concentration of enzyme.

The experiment used different catalase sources in animal cell (liver), plant cell (potato) and microbe cell (yeast) and a measure of volume was taken every 30s.

Plot the 3 average results for the 3 sources of catalase on the graph paper attached to show which source has the highest amount of catalase.

4 INTERPRETING GRAPHS

Graph Interpretation

Graph Interpretation is an important skill. You will find this to be especially true when one - or several - show up in your Biology Exam. Graphs are used to communicate information; it is important that you take the time to examine graphs critically so that the conclusions you draw are not flawed.
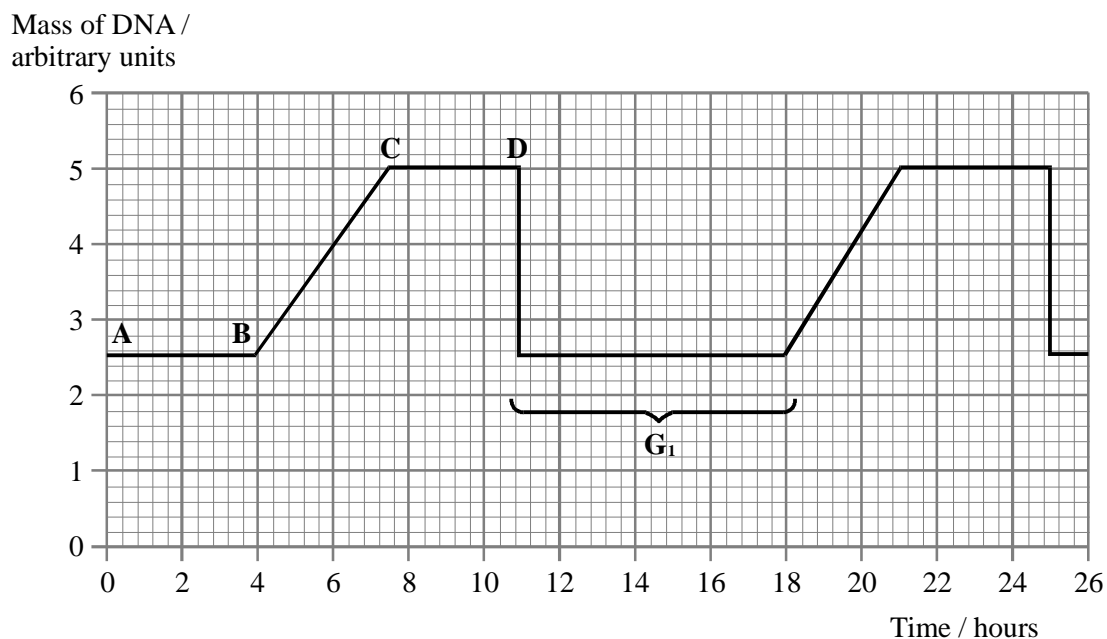
Examine ALL Information on the Graph!!!!

- **Recall the purpose of the type of graph used** and its advantages and disadvantages
- **Read the TITLE** The TITLE briefly describes the data represented in the graph.
- **Read the footer or summary** of the graph is included
- **Read the labels of the axes**. The independent or manipulated variable is usually on the x axis and the dependent or responding variable on the y axis
- **Read the units of the axes** Ensure you know the quantity measured and the multiple or submultiple of the units used. Understanding the units used helps you to quantify relationships between variables
- **Read the scales of the axes** is the range a small or large one? Many students take in the shape of the graph without first considering the scale. This of course leads to erroneous conclusions
- **Examine the symbols and the Key/Legend used** Sometimes the curves or columns are labelled

  For Describing Graph Questions:
- Make a statement highlighting the general trend - is it a positive correlation or negative and in relation to what (basically what the axis show). Don't forget that a correlation doesn't always mean that one factor causes the other. Stop and think about what the graph is telling you!
- Do some sort of manipulation of data. You are almost guaranteed a mark for finding percentage increase/decrease as opposed to just stating: between the year 2000 and 2001 there was an increase of 3 million people. Using percentages shows you have understood and are able to interpret data.
- Is there anomalous data? Perhaps indicating that one value is not in keeping with the general trend.
- You need to be able to also distinguish between describe and explain questions. In describe question just state a trend and give some figures from the graph but with the explain questions you need to back up your statement with evidence.

A The graph below illustrates the change in DNA content during the cell cycle

Mass of DNA /
arbitrary units

(i) Calculate the percentage of the cell cycle time spent in G_1.

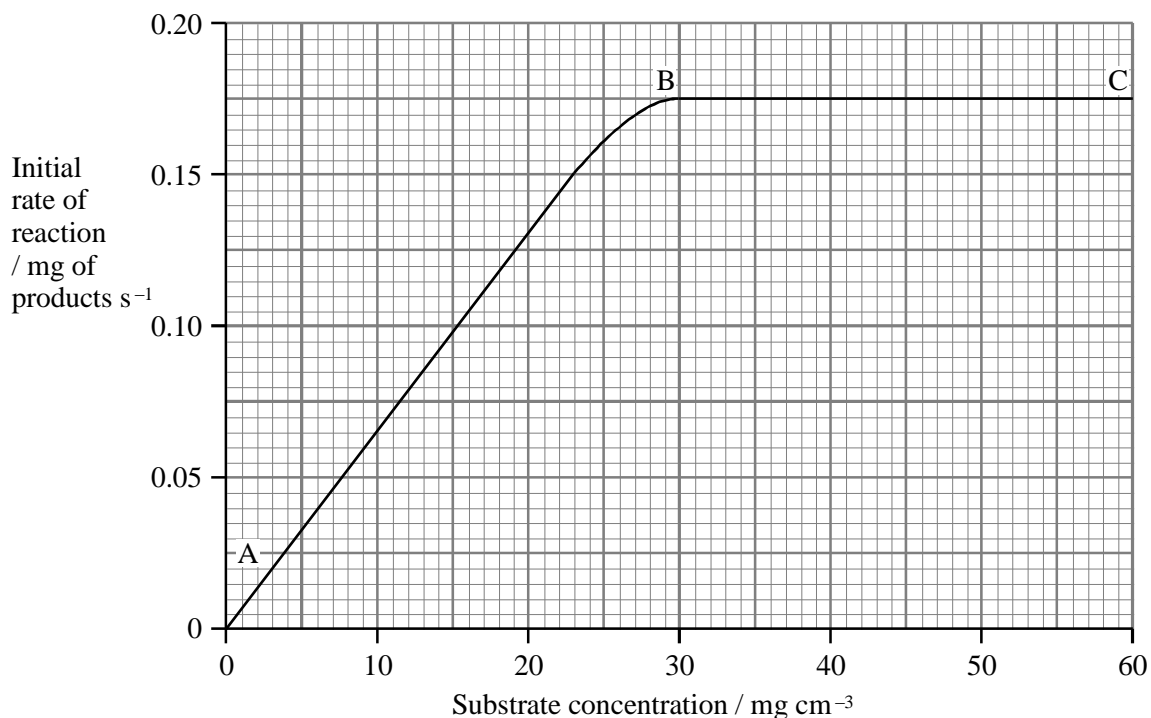Answer...

(3)

(ii) At which point, A, B, C or D, does chromosome replication (the S phase) begin? Explain your answer.

(2)

B   The graph below shows the results of an investigation into the effect of substrate concentration on the initial rate of an enzyme-controlled reaction.

(i)   Explain why changes in the substrate concentration cause an increase in the rate of reaction between points A and B on the graph.

(2)

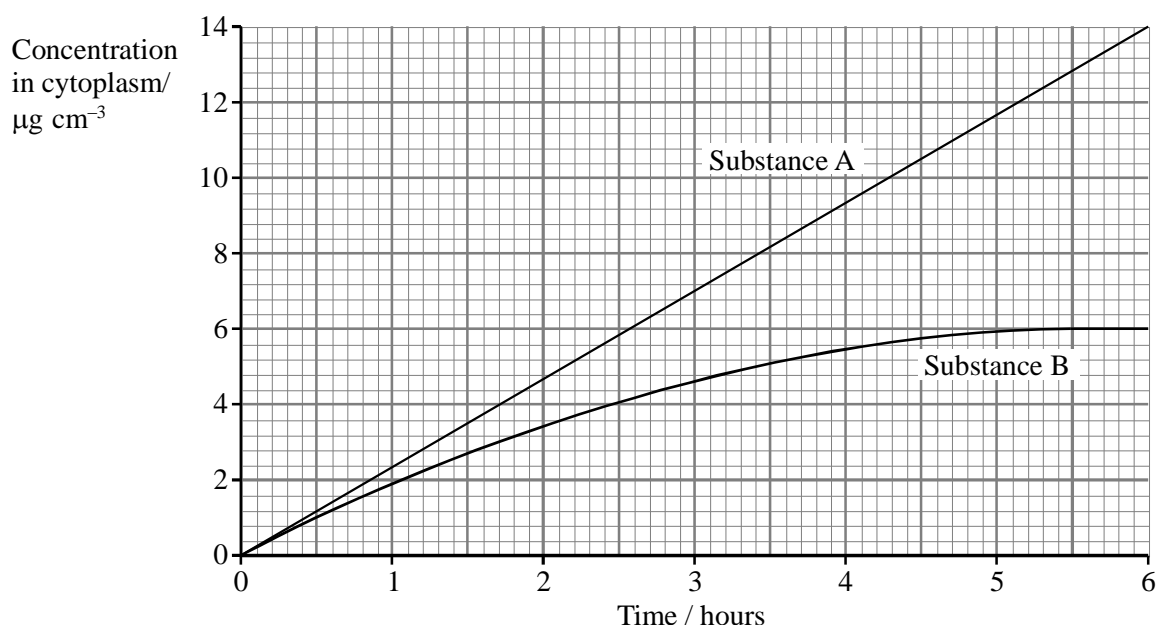(ii) Suggest why the curve levels off between points B and C.

(2)

(iii) On the graph on page 6, sketch a curve to show how the results for the investigation would change if it were repeated at a lower temperature. Explain any differences between the two curves.

(3)

C An experiment was carried out to compare the uptake of two substances, A and B, by Amoeba. Amoeba is a single-celled aquatic organism. Cells of Amoeba were placed in a solution containing equal concentrations of both substances and kept at 15 °C. The concentration of each substance in the cytoplasm of the cells was measured every 30 minutes over a period of 6 hours.

The results of this experiment are shown in the graph below.

(i) Compare the uptake of substance A by the cells with the uptake of substance B during the period of 6 hours.

(3)

(ii) Substance B enters the cells by diffusion. Describe and explain how the results of this experiment support this statement.
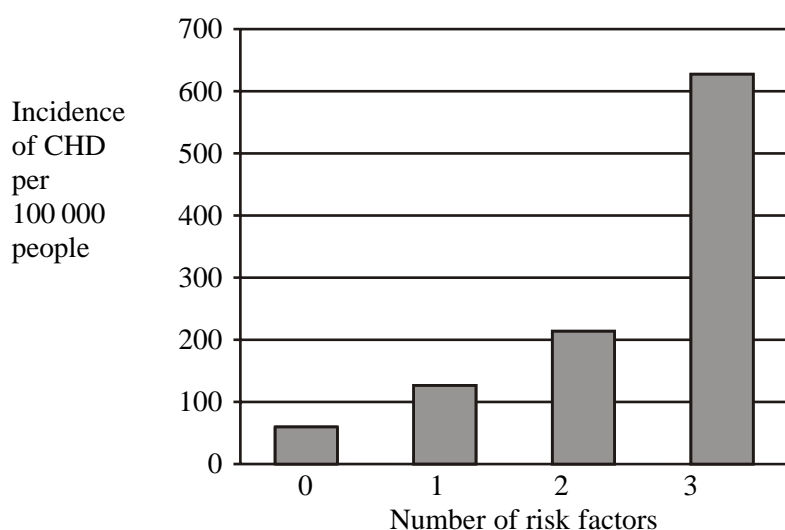
(3)

(iii) Explain why an increase in temperature to 25 °C would increase the rate of diffusion of substance B into the cells.

(2)

D   Several risk factors influence the onset of coronary heart disease (CHD), including high blood cholesterol level, high blood pressure and smoking.

The chart shows the effect of combining these three factors on the incidence of CHD.

(i)   Describe the effect on the incidence of CHD of increasing the number of risk factors.

(3)