

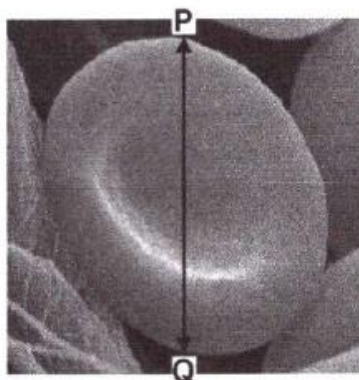
Organism exchange substances with their environment – AS Biology P1

1. No.2

0 2 . 1

Figure 2 shows an image of a red blood cell at a magnification of $\times 5500$

Figure 2

Calculate the actual diameter in μm of the red blood cell between points P and Q.

Show your working.

$$PQ = 40 \text{ mm.}$$

$$\text{Actual length} = \frac{40}{5500}$$

$$= 7.2727 \times 10^{-3}$$

$$7.3 \times 10^{-3} \times$$

$$1000$$

$$= 7.3$$

[2 marks]

$$7.3$$

Answer _____ μm

0 2 . 2

A haemocytometer is a special microscope slide that can be used to determine the mean number of red blood cells in 0.004 mm^3 of blood.

- A researcher prepared a 10^{-3} dilution of a sample of blood from an adult.
- Using a haemocytometer, the researcher determined that the mean number of red blood cells in 0.004 mm^3 of the diluted blood sample was 21

The volume of blood in the body of the adult was 4.8 dm^3

Calculate the total number of red blood cells in the body of this adult.

Show your working.

Undiluted blood
 $21 \times 10^3 = 21000 \text{ RBC per } 0.004 \text{ mm}^3$

RBC per mm^3 .

$$\frac{21000}{0.004} = 5250000 \text{ RBC/mm}^3$$

$$4.8 \text{ m}^3 = 4.8 \times 10^6 \text{ mm}^3$$

[2 marks]

Total number of RBCs
 $5.25 \times 10^6 \times 4.8 \times 10^6$
 $= 25.2 \times 10^{12}$
 2.52×10^{13}

Answer $2.52 \times 10^{13} \text{ RBC}$

0 2 . 3

The solution used to dilute the blood had to have the same water potential as the blood.

Explain why.

[2 marks]

Osmosis does not occur because of same water potential. Therefore, the Red blood cells do not burst.

0 2 . 4

There are four main blood groups in the human ABO blood group system.

Table 1 shows the basis on which each of these blood groups is classified.

Table 1

ABO blood group	Antigens present on red blood cells	Antibodies present in blood plasma
A	A	Anti-B
B	B	Anti-A
AB	A and B	No anti-A and no anti-B
O	No A and no B	Anti-A and anti-B

A transfusion of blood from a blood group **A** donor to a blood group **B** recipient would cause agglutination of the donated red blood cells.

Use information in **Table 1** to explain why.

[2 marks]

RBCs from group A have A antigens which bind with anti-A antibodies present in plasma of Group B recipient. This antigen-antibody reaction causes agglutination of red blood cells which can block blood vessels.

0 2 . 5

Using **Table 1**, give the blood groups of people who could accept a donation of blood group **O** without causing agglutination of the **donated** red blood cells.

[1 mark]

Blood groups A, B, AB and O.

2. No.6

0 6 . 1

Disinfectants are used to kill microorganisms on non-living surfaces. A student investigated the effect of different concentrations of disinfectant **X** on the growth of *Bacillus subtilis*.

The student:

- added 5 cm³ of a different concentration of disinfectant **X** to 5 different test tubes
- added 5 cm³ of distilled water to another test tube
- added 2 cm³ of a culture of *B. subtilis* to all 6 test tubes
- incubated the test tubes at 25 °C for 24 hours
- used a colorimeter to record the percentage of light absorbed by the contents of each tube.

Table 2 shows the student's results.

Table 2

Percentage concentration of disinfectant X	0	20	40	60	80	100
Percentage light absorbance	100	100	87	52	10	10

The student prepared the different concentrations of disinfectant **X**.

Describe how the student made 5 cm³ of the 60% concentration using distilled water and undiluted disinfectant.

[1 mark]

Use 3 cm³ of undiluted disinfectant and 2 cm³ of distilled water.

06.2

The student used a sterile pipette with 0.1 cm^3 graduations to transfer 2 cm^3 of *B. subtilis* into each test tube.

What is the uncertainty in measuring 2 cm^3 with this pipette?

Calculate the percentage uncertainty of this 2 cm^3 measurement.

[2 marks]

Uncertainty 0.05 cm^3

$$\frac{+0.1}{2} = \pm 0.05 \text{ cm}^3$$

$$\% = \frac{0.05}{2.0} \times 100 = 2.5\%$$

Percentage uncertainty 2.5%

06.3

Use Table 2 to evaluate the effectiveness of disinfectant X at killing microorganisms on non-living surfaces.

[4 marks]

Disinfectant X is equally effective at 80% and 100% as both have the same absorbance 10%, indicating similar reduction in bacterial growth.

Disinfectant is ineffective at 20% showing 100% light absorbance same as the control (6%) so no killing effect.

However absorbance does not confirm whether the cells are dead or alive. Since dead cells might still absorb light.

Disinfectant was also only tested on *Bacillus subtilis* so results may not be generalisable to other microorganisms.

3. No.9

09.1

Describe the role of haemoglobin (Hb) in the loading, transport and unloading of oxygen.

[5 marks]

Haemoglobin loads (binds) oxygen in the lungs where oxygen concentration is high. This occurs at a high partial pressure of oxygen.

Binding of the first oxygen molecule changes the shape of haemoglobin, making it easier for more oxygen molecules to bind. This is called cooperative binding.

Oxygen is transported in the blood as oxyhaemoglobin with the red blood cells.

Haemoglobin unloads oxygen in respiring tissues where it is needed.

This unloading occurs at low partial pressure of oxygen which promotes oxygen release.

09.2

Describe how a polypeptide is produced by translation of mRNA.

[5 marks]

mRNA attaches to a ribosome.
tRNA molecule binds to mRNA; their anticodons are complementary to the codons on mRNA. Each tRNA carries a specific amino acid. Peptide bonds form between adjacent amino acids. This process uses ATP to form peptide bonds. After donating its amino acid, the tRNA is released and can be reused. The ribosome moves along the mRNA, allowing the next tRNA to bind continuing polypeptide formation.