Name of the Student:_____
Max. Marks : 25 Marks **Time : 25 Minutes**

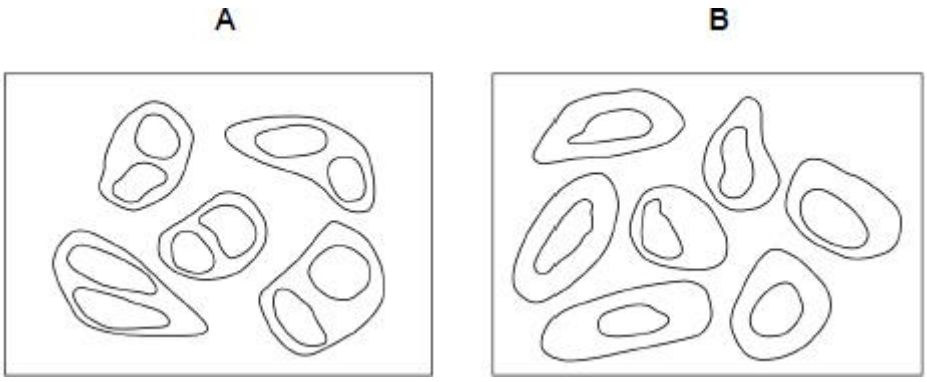
Q1.

(a) Scientists investigated a drug called MiTMAB as a treatment for cancer. MiTMAB inhibits cytokinesis.

Figure 1 shows drawings of cancer cells seen with an optical microscope from a:

- sample treated with MiTMAB
- control sample.

Figure 1



The cells in drawing **A** can be identified as those treated with MiTMAB.

Explain why.

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(2)

(b) MiTMAB acts as a non-competitive inhibitor of an enzyme called dynamin.

Suggest how MiTMAB can cause dynamin to become inactive.

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(3)

When active, dynamin has **two** functions:

- it stimulates cytokinesis
- it inhibits cell death.

The scientists treated actively growing cultures of cancer cells with MiTMAB.

They incubated:

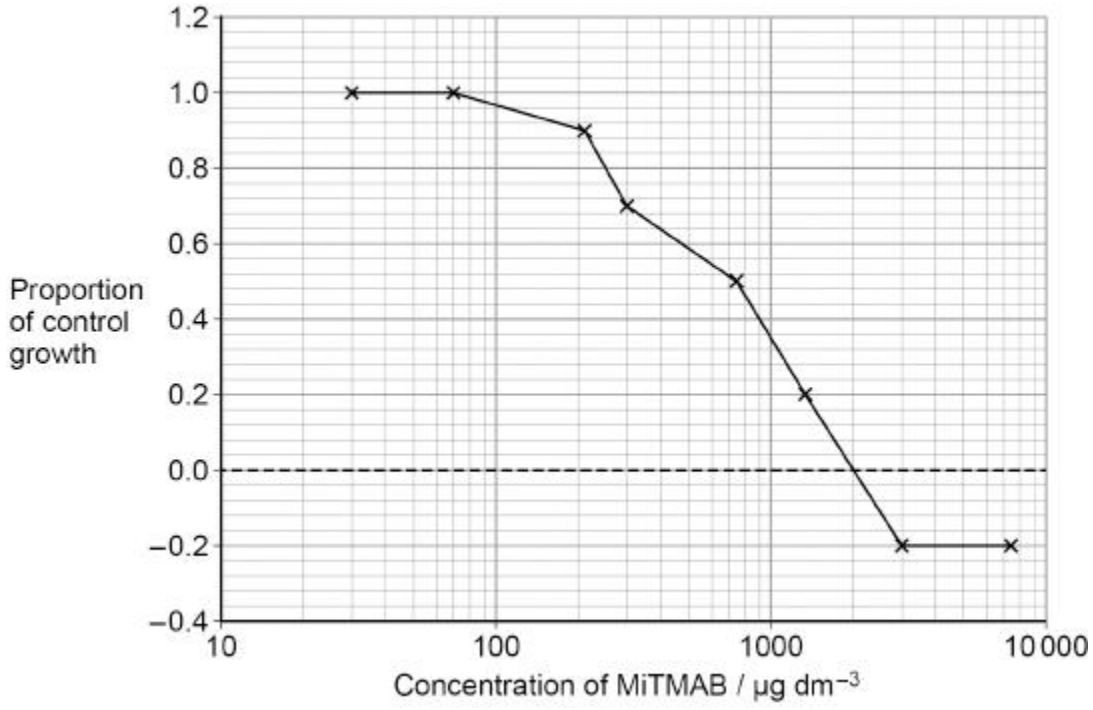
- one sample of 2500 cells without MiTMAB as a control
- eight samples, each with 2500 cells and a different concentration of MiTMAB.

After 72 hours, the scientists measured the number of cells in each sample.

Figure 2 shows the scientists' results.

A negative value for proportion of control growth means that fewer than 2500 cells were counted after 72 hours.

Figure 2



(c) Use all the information given to explain the results shown in **Figure 2**.

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(3)

(d) 0.01 dm^3 of MiTMAB solution was added to the treated cells.

Calculate the increase in mass of MiTMAB (in µg) added to the cells to reduce the cell growth from equal to the control to 0.0 of the control.

Show your working.

Answer _____ µg

(2)

(Total 10 marks)

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Q2.

(a) Below are **four** statements about the structure of prokaryotic cells.

1. No prokaryotic cell has DNA that is associated with proteins.
2. No prokaryotic cell has membrane-bound organelles.
3. All prokaryotic cells have one or more flagella.
4. All prokaryotic cells have smaller ribosomes than eukaryotic cells.

Which statements about the structure of prokaryotic cells are correct?

Tick (✓) **one** box.

A statements **1**, **2** and **3** ☐

B statements **1**, **2** and **4** ☐

C statements **2**, **3** and **4** ☐

D statements **1**, **2**, **3** and **4** ☐

(1)

A student investigated the effect of **two** antibiotics on the growth of the bacterium *Micrococcus luteus*.

During the investigation, the student:

- transferred 9 cm^3 of a liquid culture of *M. luteus* into each of **three** bottles
- added the antibiotic chloramphenicol to the first bottle
- added the antibiotic novobiocin to the second bottle
- added no antibiotic to the third bottle.

After 24 hours, he diluted the contents of each bottle by 1 in 100 000 (10^{-5}). He then transferred 0.25 cm^3 samples from the first bottle onto each of 3 separate agar plates. He repeated this with 0.25 cm^3 samples from the second bottle and the third bottle, resulting in 9 agar plates in total.

He incubated the plates for 48 hours.

The table below shows the number of colonies of bacteria he counted on each plate after 48 hours' incubation.

Plate	Number of colonies of bacteria		
	with chloramphenicol	with novobiocin	with no antibiotic
1	2	238	276
2	4	263	258
3	6	261	324

(b) Calculate the mean number of bacteria in the **undiluted** bottle of liquid culture containing novobiocin.

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Give your answer in standard form. Show your working.

Answer _____ bacteria

(2)

(c) Starting with a single bacterium, calculate how many generations it would take to produce at least the number of bacteria you have calculated for your answer in part (b)

You can assume no bacteria die.

You could use the ln or log button on your calculator to calculate your answer.

Answer _____ generations

(1)

(d) *M. luteus* is **not** resistant to chloramphenicol.

Suggest **two** reasons why the bacteria were able to grow in the culture containing chloramphenicol.

1 _____

_____

_____

2 _____

_____

_____

(2)

(Total 6 marks)

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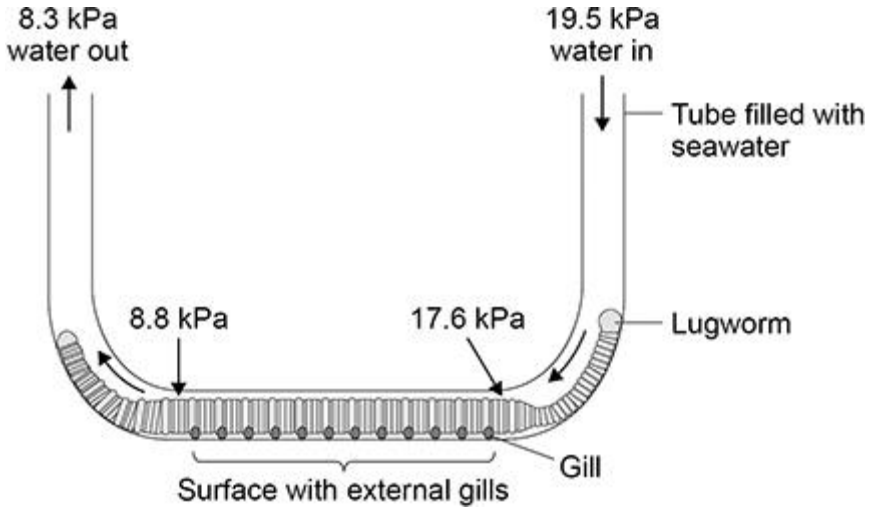
Q3.

(a) Lugworms create tubes in the sand on seashores. The tubes are filled with seawater.

A scientist measured the partial pressure of dissolved oxygen (pO_2) in seawater at different places in a tube with a lugworm inside.

Figure 1 shows her results.

Figure 1



The pO_2 of dissolved oxygen in lugworm blood is < 2.7 kPa

Using the data in **Figure 1**, what can you conclude about the uptake of oxygen over the entire body of the lugworm?

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_____

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(4)

(b) **Figure 2** shows the oxyhaemoglobin dissociation curve for a lugworm.

Figure 2

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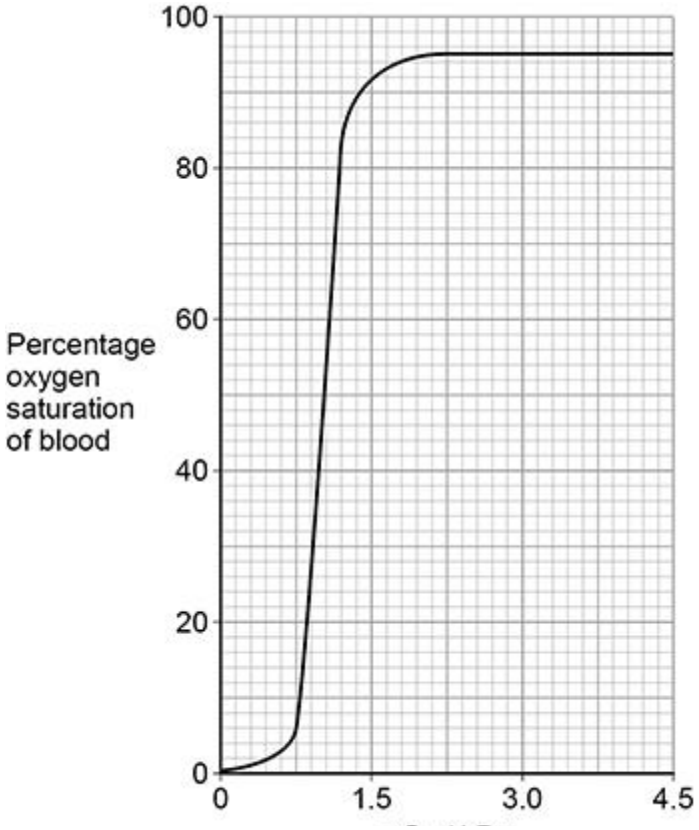

The oxygen saturation in the blood of a lugworm is 92%

The lugworm has 0.2 cm^3 of blood.

Calculate the volume of dissolved oxygen in the blood of this lugworm using this equation

$$pO_2 = \frac{CdO_2}{0.000\,031}$$

CdO_2 is the concentration of dissolved oxygen in the blood, with units cm^3 oxygen per cm^3 of blood.

Show your working.

Answer _____ cm^3

(3)

(c) The intensity of the red colour in blood is affected by the pO_2 of the blood. The intensity of the colour in a solution is measured using a colorimeter.

The scientist used a colorimeter to measure the intensity of red colour in samples of lugworm

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blood with different pO_2 values. She prepared a calibration curve with this information.

Describe how the scientist will use information from the colorimeter and her calibration curve to determine the pO_2 in a sample of lugworm blood.

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(2)

(Total 9 marks)

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