**1.** A student was studying the surface area to volume ratio of three unicellular organisms, **A**, **B** and **C**, from the same habitat. The diagram below shows the three organisms and some of the calculations the student made.

|  |  |  |  |
| --- | --- | --- | --- |
| scale:   0.075 mm | **A** | **B** | **C** |
| surface area / mm2 | 0.28 | 3.1 | 23 |
| volume / mm3 | 0.02 | 0.59 | 11.3 |
| surface area to volume ratio | 14:1 |  | 2:1 |

Adapted data © M Jones and G Jones, *Advanced Biology*, 1997, Cambridge University Press

(a) (i) Calculate the surface area to volume ratio for organism **B to the nearest whole number**.

Write your answer in the shaded box in the table.

[1]

(ii) By how many times does the surface area to volume ratio for organism **C** differ from that for organism **A**?

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

[1]

(b) The student determined the rate of oxygen uptake for the three organisms in cm3 of oxygen g–1 h–1. The student found that the results were:

1.0 cm3 g–1 h–1

0.5 cm3 g–1 h–1

7.0 cm3 g–1 h–1

State which of the three figures is most likely to be the value for the rate of oxygen uptake for **organism C**.

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[1]

(c) None of the organisms **A**, **B** or **C** has a transport system.

Explain why organisms larger than organism **C** need to have transport systems.

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[3]

[Total 6 marks]

**2.** The diagram below shows a mammal and a unicellular organism. The transport system in mammals is a double circulatory system driven by a pump (the heart), whilst unicellular organisms have no need for special transport systems.



(i) Explain what is meant by a *double circulatory system*.

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[2]

(ii) Explain **two** reasons why mammals need a circulatory system whilst unicellular organisms, such as that shown in the diagram, do not.

first reason ......................................................................................................

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second reason ................................................................................................

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[4]

[Total 6 marks]

**3.** The diagram below shows the trace from a spirometer. A spirometer is a device designed to measure the volume of air entering and leaving the lungs. A chamber in the spirometer contains soda lime to absorb the carbon dioxide released from respiration. The measurements shown were recorded from a healthy 16 year old student at rest.



(i) Calculate the mean tidal volume in the first 20 seconds.  
Express your answer to two decimal places. Show your working

Answer = ............................................... dm3

[2]

(ii) At a certain point, the student was asked to breathe in as deeply as possible and then breathe out as much as possible. The resulting change in the trace is shown in the diagram as **X**.

State the term given to measurement **X**.

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[1]

[Total 3 marks]

**4.** The vital capacity and the forced expiratory volume of a person with asthma were measured over a period of 23 days. The forced expiratory volume is the volume of air that can be breathed out in one second. On day 4 of the investigation, the person breathed in an allergenic substance.

The results are shown in the graph below.



Graph from ABC of Allergies, p28 top figure, edited by S.R.Durham.   
The British Medical Journal, 1998 (ISBN 0727912364)

(i) Calculate for day 1 the percentage of the vital capacity that was breathed out in one second.

Show your working and give your answer to the nearest whole number.

answer .................................. %

[2]

(ii) Using the data in the graph, describe the effect of the allergenic substance on the forced expiratory volume and the vital capacity.

forced expiratory volume .................................................................................

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vital capacity ...................................................................................................

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[3]

[Total 5 marks]

**5.** The figure below is a diagram of an animal cell as seen using a transmission electron microscope.



(i) Name the structures of the cell labelled **A**, **B**, **C** and **D**.

**A** ....................................................................

**B** ....................................................................

**C** ....................................................................

**D** ....................................................................

[4]

(ii) Structures **C** and **E** are examples of the same organelle.

Suggest why **E** looks so different to **C**.

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[2]

(iii) Calculate the actual length of structure **C**.

Show your working and give your answer in micrometres (µm).

Answer = .................................................. µm

[2]

[Total 8 marks]

**6.** The following table compares some of the features of prokaryotic cells and eukaryotic **animal** cells.

Complete the table by placing a tick () or a cross () in each box. The first one has been done for you.



|  |  |
| --- | --- |
| prokaryotic cells | eukaryotic **animal** cells |
| DNA present |  |  |
| nuclear envelope (membrane) present |  |  |
| cell wall present |  |  |
| plasmids present in cytoplasm |  |  |
| naked DNA present |  |  |

[Total 4 marks]

**7.** The diagram below is a drawing of an alveolus together with an associated blood capillary.



The line **AB** in the diagram represents an actual distance of 1.5 µm.

Calculate the magnification of the drawing. Show your working.

Answer = × .................................................

[Total 2 marks]

**8.** The table below compares the structures of prokaryotic and eukaryotic cells.

Complete the table.

|  |  |
| --- | --- |
| prokaryotic | eukaryotic |
| no true nucleus | genetic material held in a nucleus |
| genetic material consists of ‘naked’ DNA |  |
| average diameter of cell 0.5 – 5 µm |  |
|  | ribosomes about 22 nm in diameter |
|  | cell wall sometimes present |

[Total 4 marks]

**9.** State the word or phrase that best describes the ability of a microscope to distinguish between two separate points.

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[Total 1 mark]