School	*Candidate's Name (PLEASE PRINT)*

WINCHESTER
COLLEGE

Election

Tuesday 24 April 2018

SCIENCE

PRACTICAL SECTION

Time allowed: 45 minutes

Write all your answers in the spaces on this question paper

You may use a calculator

Instructions for the Practical

First, check that you have the apparatus listed below. You are not allowed to eat or drink anything during this practical.

- 10 mm x 10 mm x 10 mm gelatine cube containing cresol red at pH 8
- 50 cm^3 stomach extract (warning: mild irritant to skin)
- Scalpel
- White tile
- Petri dish
- Forceps
- Stopwatch
- 30 cm ruler
- Safety glasses
- Paper towel

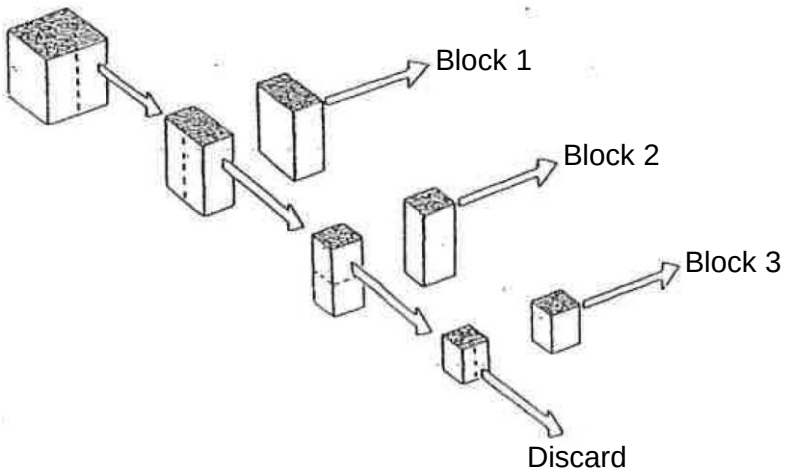
Instructions for the practical

In this practical you will investigate how the rate of diffusion is affected by the surface area and volume of a gelatine block. The information below will help you to understand the observations you will make.

Cresol red is an acid-base indicator that can be used to monitor pH. When immobilised in gelatine under alkaline conditions it is dark red. When exposed to an acid the indicator turns yellow.

1 (a) Prepare three gelatine blocks as follows:

1. Place the 10 mm x 10 mm x 10 mm gelatine cube containing cresol red onto the white tile and cut it in half.
2. Set one half aside and cut the remaining gelatine in half again.
3. Repeat step 2 one more time.
4. Discard one of the two smallest blocks.



5. Calculate the surface area and volume of each gelatine block and complete Table 1 with your values (values for Block 1 have been done for you).

6. Calculate surface area divided by volume for each block and add your values to Table 1 (the value for Block 1 has been done for you).

Gelatine block	Surface area (mm^2)	Volume (mm^3)	Surface area/volume ( )
1	400	500	0.80
2			
3			

Table 1

[6]

(b) Add the units of surface area divided by volume to the column header in Table 1.

[1]

(c) Explain why particles diffuse.

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.....

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[2]

2 You will be expected to use the apparatus as directed below. **Do not start the experiment yet.**

- Place all three gelatine blocks into the petri dish.
- Pour in all of the stomach extract to immerse the blocks.
- Start the stopwatch.
- Record the time taken for each block to change to a uniform yellow.

(a) State one controlled variable for the above experiment.

..... [1]

(b) Show the expected relationship on the axes below between the values of surface area/volume for each gelatine block and the time it would take for all the cresol red they contain to turn yellow.

[3]

(c) Explain why you have chosen this shape for your graph.

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.....

..... [2]

Show your paper to the invigilator and ask him/her to sign your prediction before continuing.

***Signed*: .....**

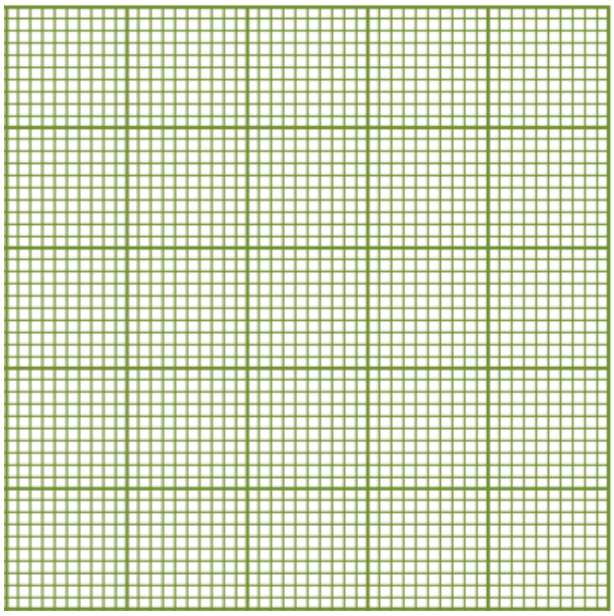
(d) **Begin your experiment.**

Attract the attention of an invigilator if your experiment takes longer than 10 minutes. You may wish to attempt some of the later questions in this paper if you have time between readings.

In the space below, record your data in a suitable table.

[5]

(e) Plot a graph of your results using the grid below.



[5]

(f) Describe your results. Include whether the data matched your prediction and if there were any unexpected results.

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..... [2]

(g) Explain your results.

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..... [2]

(h) State two ways you could decrease the time it takes for a molecule to diffuse to the centre of a gelatine block without changing the shape of the block.

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..... [2]

3 (a) If a large surface area is helpful to cells, explain why cells do not grow to be very large.

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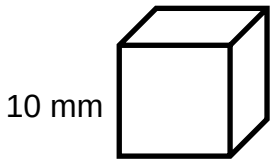
..... [1]

(b) Cube A has an edge length of 10 mm. Redraw the shape such that the volume remains the same, but the surface area changes to reduce the time a molecule would take to diffuse to its centre.



A
(not to scale)

[2]

(c) Bacteria are often described as rod-shaped. Explain why this is an advantageous shape for a single-celled organism to be.

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..... [2]

(d) State three molecules that diffuse through the cell membrane of an aerobic bacterium.

.....

..... [3]

(e) Some multicellular organisms, such as fish, possess specialised structures called gills. State and explain the features of gills that maximise the rate of gas exchange.

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..... [3]

(f) Name one organ other than the gills that is necessary for maintaining a high concentration gradient for gas exchange into the blood of a fish.

..... [1]

(g) State two advantages of being a large multicellular organism.

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..... [2]

[45 marks]

[End of examination]