

Eton College King's Scholarship Examination 2014

SCIENCE (SECTION 1)

(60 minutes)

Candidate Number: _____

INSTRUCTIONS

*Write your candidate number, **not your name**, in the space provided above.*

You should attempt ALL the questions. Write your answers in the spaces provided: continue on a separate sheet of paper if you need more space to complete your answer to any question.

The maximum mark for each question or part of a question is shown in square brackets.

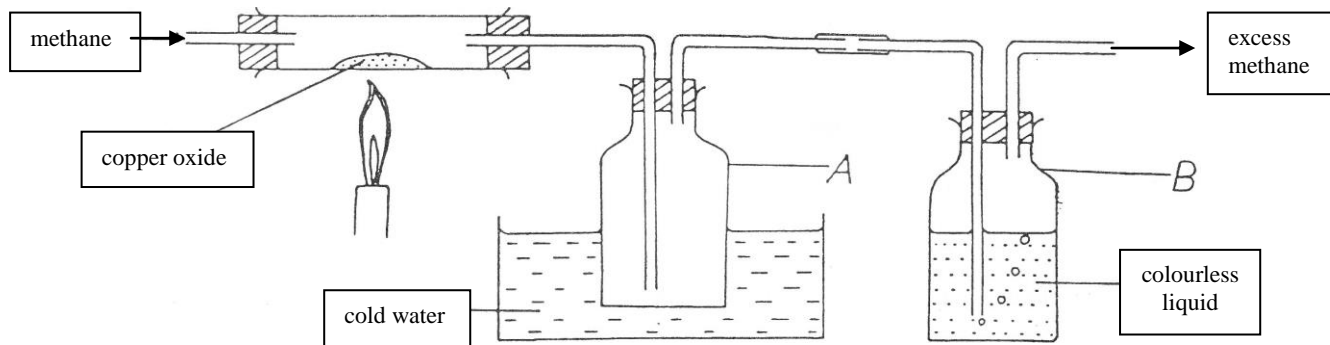
In questions involving calculations, all your working must be shown.

Do not turn over until told to do so.

For examiners' use only.

1	2	3	4	TOTAL

1. Methane, CH_4 , was passed over heated copper oxide inside a glass tube using the apparatus below.



The black copper oxide was heated until it glowed red. A colourless liquid appeared in bottle A and the colourless liquid in B turned cloudy. When the reaction had finished the heat was removed and the copper oxide had become a pink powder.

- a) Identify the pink powder. [1]

- b) Give a use of the substance you have identified in part (a) and describe a property which allows it to be used in this way. [2]

- c) What is the colourless liquid in A? Explain how it has been produced chemically. [2]

- d) Draw a particle diagram of the liquid in A in the box below. Use small circles (O) as the particles and use at least 20 particles. Assume gravity does exist.

[2]



- e) Suggest a reason for immersing bottle A in cold water.

[1]

- f) Explain why the colourless liquid in B turned cloudy.

[2]

- g) Write a word equation for the reaction which takes place when methane is passed over heated copper oxide.

[1]

- h) Not all the methane will react. The excess methane is burnt off for safety. Explain why.

[1]

i) If the copper oxide is not heated nothing happens. Explain why. [2]

j) Name another substance which might be used instead of methane to change the copper oxide into the pink powder. Explain why you have chosen this substance and write a word equation for the proposed reaction. [3]

k) Methane is a fuel and burns in air. Compare this combustion reaction with the reaction taking place inside the glass tube, making clear any similarities and differences. [4]

- 1) One way of testing the purity of a substance is to test its boiling point at atmospheric pressure. The solution in bottle B boils at a higher temperature than the pure liquid which appears in bottle A. Explain why. You may use a diagram if you wish. [3]

2. The picture below shows a single-celled organism called *Amoeba* engulfing an algal cell, in a process called phagocytosis. In this process, the algal cell is taken into the cytoplasm of the *Amoeba* where it is broken down, and used as a source of energy through the process of respiration.

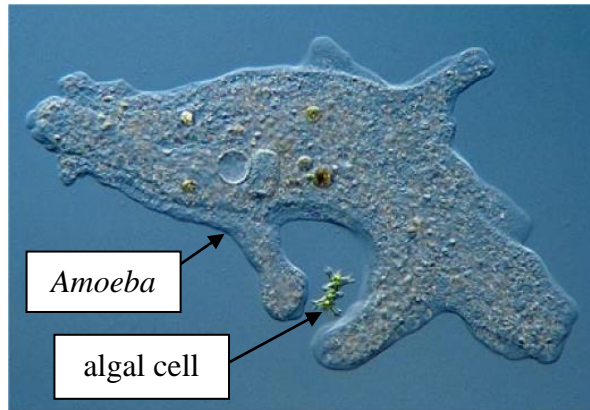


Image from <http://plantphys.info/organismal/lehtml/images/amoeba.jpg#>

- a) State two characteristics of living organisms (other than respiration) that have been described in the paragraph above. [1]

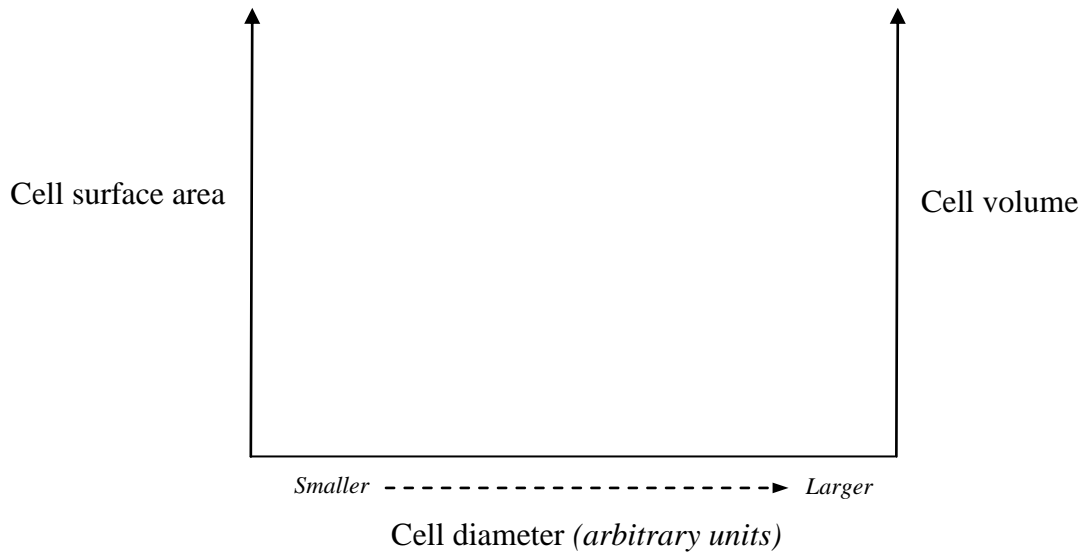
- b) Name two substances which enter cells and are used in the process of respiration. [1]

- c) Name and describe the physical process by which these substances enter cells. [3]

The volume of a cell dictates its energy demands, whilst the surface area of a cell dictates the rate at which the materials needed for energy release can be supplied.

- d) On the axes below sketch two lines; one to show the relationship between cell diameter and cell volume, and the other to show the relationship between cell diameter and cell surface area. [2]

Make sure you label each line clearly.



- e) Suggest advantages to a cell of being larger. [2]

- f) *Amoeba* are some of the largest unicellular organisms that exist, but they are still less than 1mm in diameter. Using the information presented in this question and your own knowledge, suggest and explain why larger organisms are multicellular. [3]

3. It is estimated that worldwide more than 50 billion chickens are reared by poultry farmers every year. The photograph below shows a common breed of chicken. Chickens are classified as birds.



Image from <http://www.kidseatsmart.ca/news-events/rootingforhealth/all-about-chicken/>

- a) State two diagnostic features of birds. [2]

Poultry farmers are always trying to find ways to increase the yield of chicken they can produce (measured in kilograms of chicken per year). Farmed chickens reach full size in approximately 45 days, whereas non-domesticated wild chickens take over 90 days to reach full size. This accelerated growth process has been achieved through the process of selective breeding.

- b) Describe how chicken breeders would have used selective breeding to produce fast-growing chickens. [3]

- c) Suggest strategies other than selective breeding that poultry farmers might use to increase their yield of chicken. [4]

- d) Geneticists have produced chickens that lack feathers. In some countries these featherless chickens are more desirable to chicken farmers than the normal feathered varieties. Suggest biological reasons why this might be so. [3]

4. A steel cable is used to make a safety line for a high ropes course. The cable is 16 m long and has a diameter of 1.0 cm. The density of the steel used to make the cable is 7000 kg/m^3 .

a) Calculate the mass of the cable. [2]

Before installation, the cable was tested for safety reasons. In order to do this the cable was suspended horizontally and placed under tension (i.e. stretched). It was found to extend by 2 mm for each 1000 N of force applied.

b) The cable is now subjected to 3500 N of tension. What will its extension be? [1]

The extension of a cable under tension depends upon the number of individual bonds between atoms that are being stretched.

c) An otherwise identical cable of twice the diameter is subjected to 3500 N of tension. What will its extension be? [1]

The original cable is now suspended vertically.

d) By how much would you expect the cable to extend under its own weight only, assuming that this weight acts entirely at the bottom end of the cable?

Earth's gravitational field strength is 10 N/kg . [2]

- e) The actual extension will be lower than the value calculated above. Briefly explain why the value will be lower and calculate what you think the actual extension will be. [2]

When the cable is suspended between two trees, it sags a little in the middle.

- f) Explain why the cable sags in the middle. [1]

- g) Explain why the extent of this sag is greater on a hot day. [1]

A different cable is used as a zip wire to allow people to slide out of the course. As a person slides out, they accelerate.

- Their speed increases by 2 m/s every second.
- It takes 5 seconds for a person to slide out using the zip wire, having started at rest.

- h) How long is the zip wire? [2]

[End of Section 1 (Theory)]