

Name and School:



OUNDLE

School

2019 Academic Scholarship
Preliminary Examination

Science

Time Allowed : 60 minutes

- Write your name on the question paper
- Write all your answers on the question paper
- Calculators are allowed

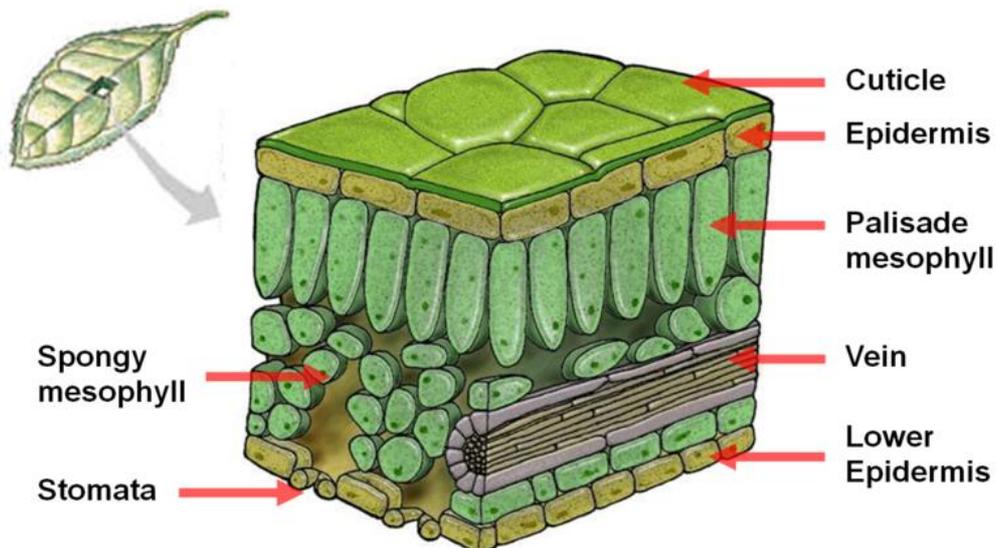
Biology Section

Question 1

a. In the space below, write the equation for photosynthesis.

[2]

b. The image below is a cross section (cut edge) of a leaf.



The palisade mesophyll cells is where the greatest amount of photosynthesis takes place. What structures would you expect to find lots of in these cells?

..... [1]

c. What two functions do the veins have?

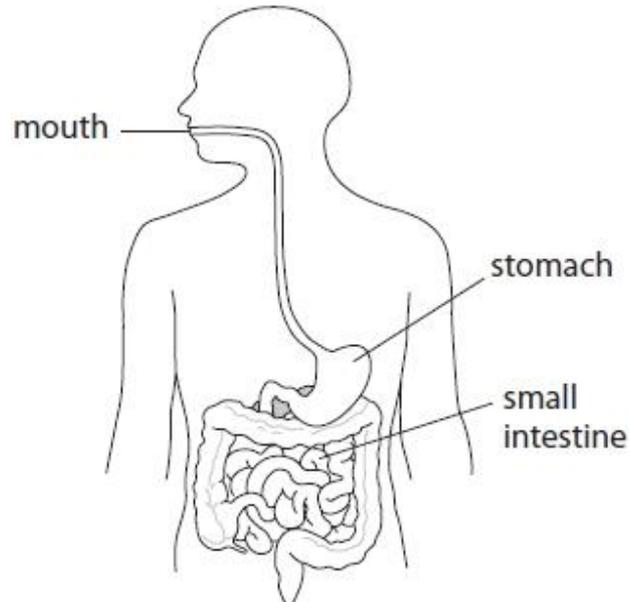
1

2 [2]

[Total: 5 marks]

Question 2

Here is a simple diagram of a human digestive system.



Use the following facts to answer the question:

- the total length of the average digestive system is 9m,
- the small intestine is 6m long.

a. What percentage of the total length is the small intestine? Make sure you show your working.

.....

.....

..... [2]

b. State one function for each of these major food groups:

Carbohydrates:

.....
.....

Fats:

.....
.....

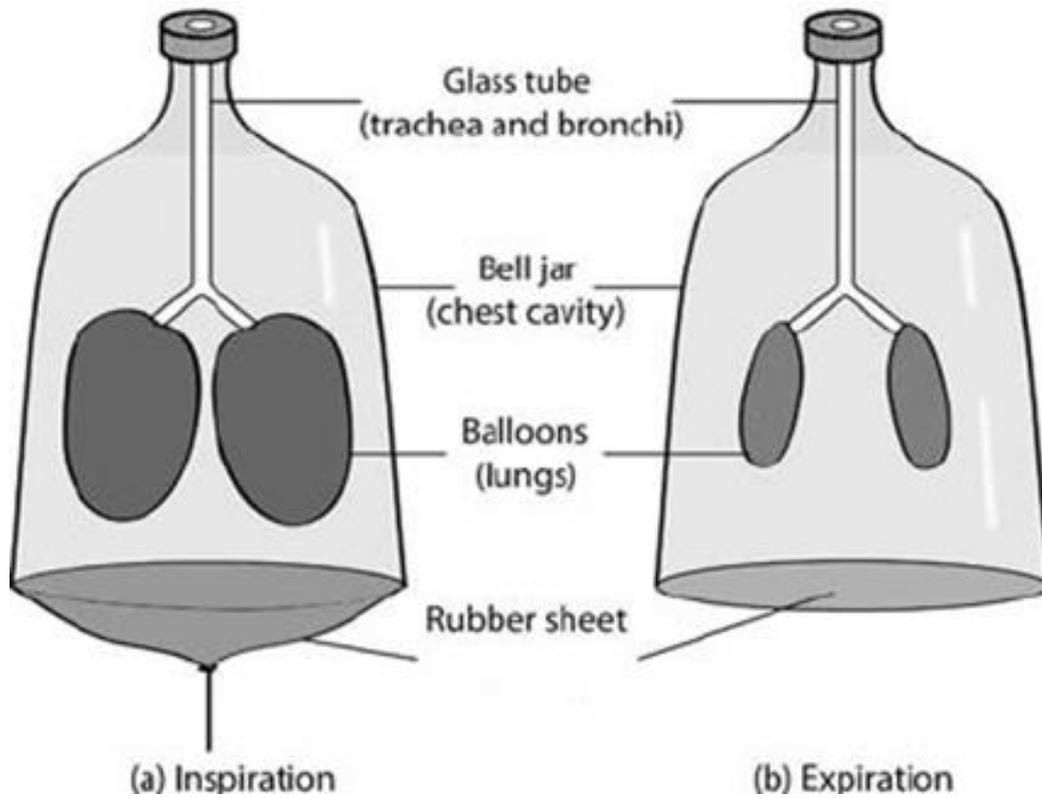
Protein:

.....
..... [3]

[Total: 5 marks]

Question 3

This is a simple model of how breathing works.



a. Which gas diffuses into the alveoli from the blood?

..... [1]

b. What process produces this gas?

..... [2]

c. This is not an accurate model of how breathing works. What structures are missing?

..... [1]

[Total: 4 marks]

Question 4

Aphids are insect pests. They feed on crop plants such as maize by sucking out the sugars made during photosynthesis. The aphids are predated by ladybirds.



a. Write a food chain that represents the feeding relationships described.

[2]

b. What is the name given to organisms that start every food chain?

..... [1]

c. If a farmer used a pesticide that killed many ladybirds, what do you think would happen to the maize plants? Explain your answer.

.....
.....
..... [3]

[Total: 6 marks]

Chemistry Section

Question 1

Air is a gas at room temperature. The chemical formulae below show some of the substances in the air.



- a. Put these formulae in the correct columns in Table 1 to show which substances are elements and which are compounds.

Table 1

Element	Compound

[2]

- b. Put the formulae in the correct columns in Table 2 to show whether the formula of each substance represents an atom or a molecule.

Table 2

Atom	Molecule

[2]

The coldest possible temperature is 'absolute zero', which is -273°C . As air is cooled towards absolute zero it liquefies.

Table 3 below gives the boiling points of the substances in air.

Table 3

Formula	Boiling point ($^{\circ}\text{C}$)
Ar	-186
CO_2	-78
H_2O	100
N_2	-196
Ne	-246
O_2	-183

c. A sample of air at a temperature close to absolute zero is allowed to warm up.

Which substance boils first?

..... [1]

d. Each particle of neon can be represented by a circle. ○

Carefully complete the diagrams below to show the arrangement of particles in neon gas and liquid neon.

Neon Gas	Neon Liquid

[4]

[Total: 9 marks]

Question 2

No prior knowledge of hydrocarbons and cracking is required to answer this question.

Hydrocarbons are molecules made up of only the elements carbon and hydrogen. Large hydrocarbons can be broken down into small ones via a process called cracking. This is an important industrial process since smaller hydrocarbons are much more useful as fuels.

Cracking dodecane (a hydrocarbon with 12 carbon atoms) gives two products, octane and butene.

The table below summarises the boiling points of some common hydrocarbons.

You may like to refer to Table 4 in your answers.

Table 4

Hydrocarbon	No. of carbon atoms	Formula	Boiling point (°C)	State at room temperature
Butane	4	C ₄ H ₈	-6	
Dodecane	12	C ₁₂ H ₂₆	216	Liquid
Ethane	2	C ₂ H ₆	-89	Gas
Methane	1	CH ₄	-161	Gas
Octane	8	C ₈ H ₁₈	126	

- a. Complete the Table 4 by writing the states of butene and octane at room temperature.

[2]

- b. Predict the state of tridecane (C₁₃H₂₈) at room temperature.

..... [1]

c. By considering the formulae given in the Table 4, deduce the formulae of the following:

i. Propene (contains 3 carbons)

..... [1]

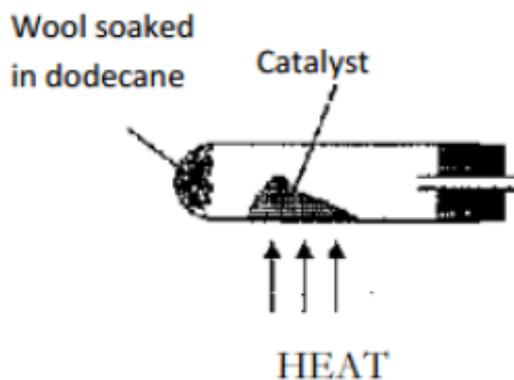
ii. Pentane (contains 5 carbons)

..... [1]

d. Dodecane can be cracked in the laboratory with simple apparatus.

Complete the diagram below using the information provided.

- The hot gaseous products are passed through a boiling tube surrounded by ice.
- Some of the gases pass out of this boiling tube and are collected by displacement of water in a test tube.



[3]

e. What is the purpose of the boiling tube surrounded by ice?

.....
.....
..... [2]

f. If 10g of dodecane was heated and 6.8g of octane was collected. What is the total mass of gaseous products?

.....g [1]

[Total: 11 marks]

Physics Section

Question 1

The Washington Monument is in the National Mall in Washington, D.C., built to commemorate George Washington, the first President of the United States.



You must show all your working to get as many marks as possible

Most of the marks in this question are for showing how well you can think. The final answers are less important than showing that you can think and work logically.

- a. There are **896 steps** to the top of the Washington Monument.

Estimate the height of one step and use this to estimate an approximate value for the height of the building in metres.

b. The base of the Washington Monument is 16m wide and 16m deep.

Calculate the area of the base of the building.

..... [1]

c. Use your answer to part *a* to calculate the volume of the building.

State any assumptions that you make.

Assumptions

..... [3]

The mass of the monument is approximately 80,000 tonnes, where 1 tonne = 1000 kg.

d. Write down the mass of the building in kg using powers of ten

..... [2]

e. Use your answer for the volume of the building in part c to calculate the average density of the building.

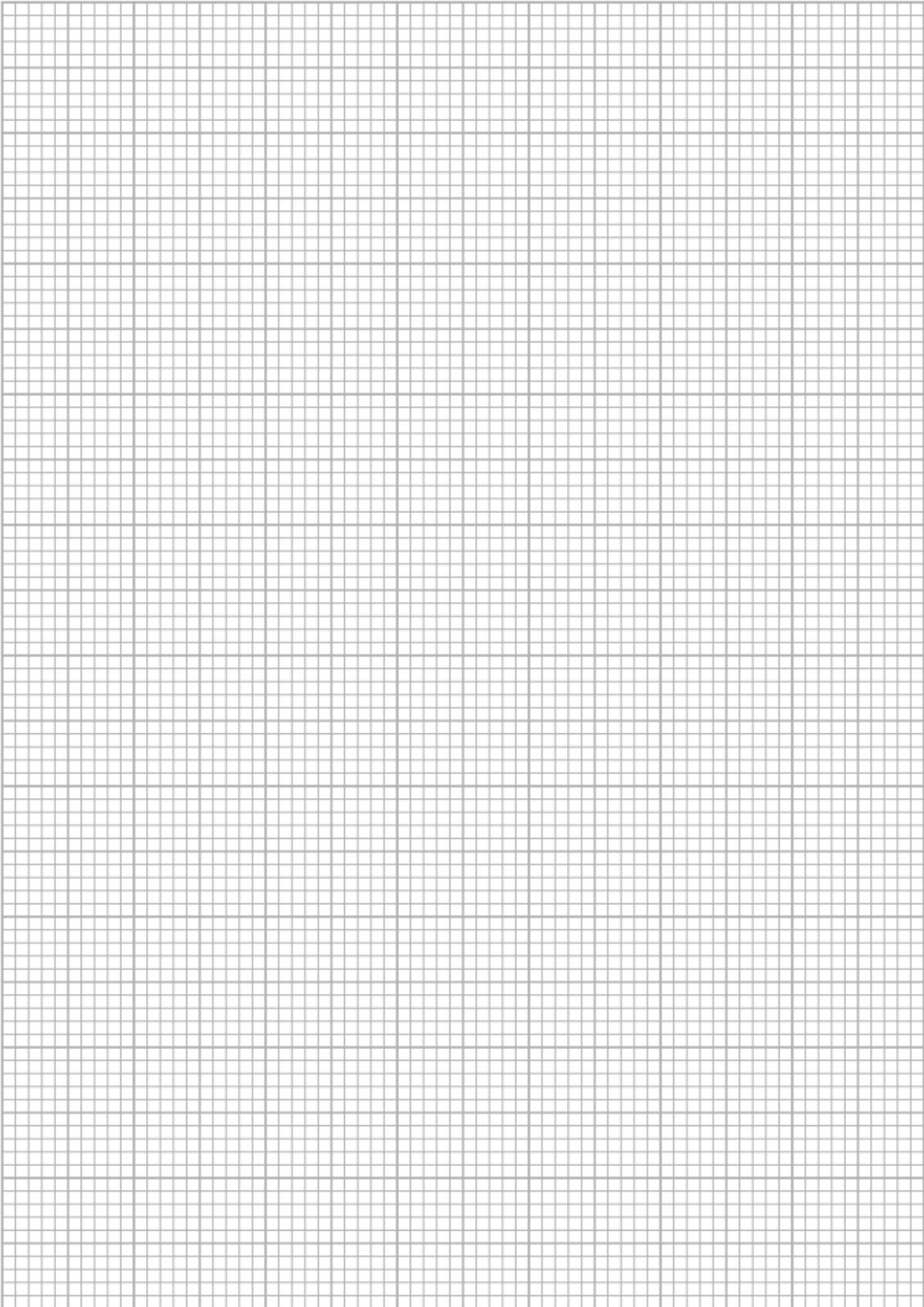
..... [4]

According to myth, a penny dropped from tall building can kill someone below. But is it true?

Below is a table of results showing the speed of a coin as it falls under gravity.

Speed (m/s)	Distance fallen (m)
0	0
20	20
39	80
59	180
78	310
98	490
118	710
137	960

f. Using the graph paper over the page, plot a graph of speed (y-axis) against distance (x-axis) fallen and join the points with a suitable best fit line.



g. Using your value for the height of the Monument in part *a*, use the graph to estimate the speed at which a coin dropped from the top would hit the ground.

..... [1]

h. Your answer for speed is in m/s. Convert this into miles per hour. Assume that 1 mile = 1600m

..... [4]

i. The data above assumes that there is no air resistance. How would you expect the data to change if air resistance was considered?

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.....

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.....

..... [2]

[Total: 24 marks]