

<i>School</i>	<i>Candidate's Name (PLEASE PRINT)</i>
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WINCHESTER
COLLEGE

Entrance Examination

SCIENCE

SPECIMEN PAPER 2021

Total time allowed: 1 hour 30 minutes

This paper is divided into **THREE** sections.

Section A Chemistry

Section B Physics

Section C Biology

Each section carries equal marks.

The mark for each question is given in brackets [].

All sections are composed of a number of short answer questions.

Candidates should attempt **ALL** the questions in these sections, answering in the spaces provided on the question paper. Calculators may be used.

Candidates will be penalized for giving answers to too many significant figures.

SECTION A – CHEMISTRY

A1 **Figure 1** shows the same test tube at four stages of an experiment.

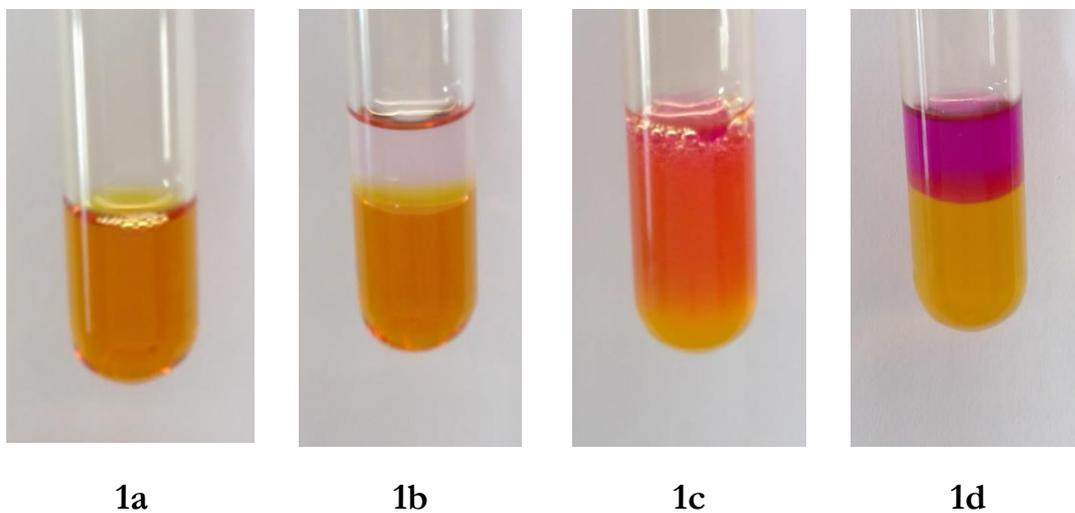


Figure 1

(a) 1a shows a solution of an element, iodine, in a compound, water.

Define the following terms:

(i) Element

.....
.....

[1]

(ii) Compound

.....
.....

[2]

(iii) Solution

.....
.....

[2]

(b) In picture **1b**, a layer of oil has been added to the same test tube.

Compare the densities of oil and water.

..... [1]

(c) The test tube was then shaken vigorously. A few seconds later picture **1c** was taken and then picture **1d** was taken after a few minutes.

(i) Describe your observations of the test tube in picture 1d.

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.....
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.....

[3]

(ii) State your conclusions about the way iodine dissolves in water and oil.

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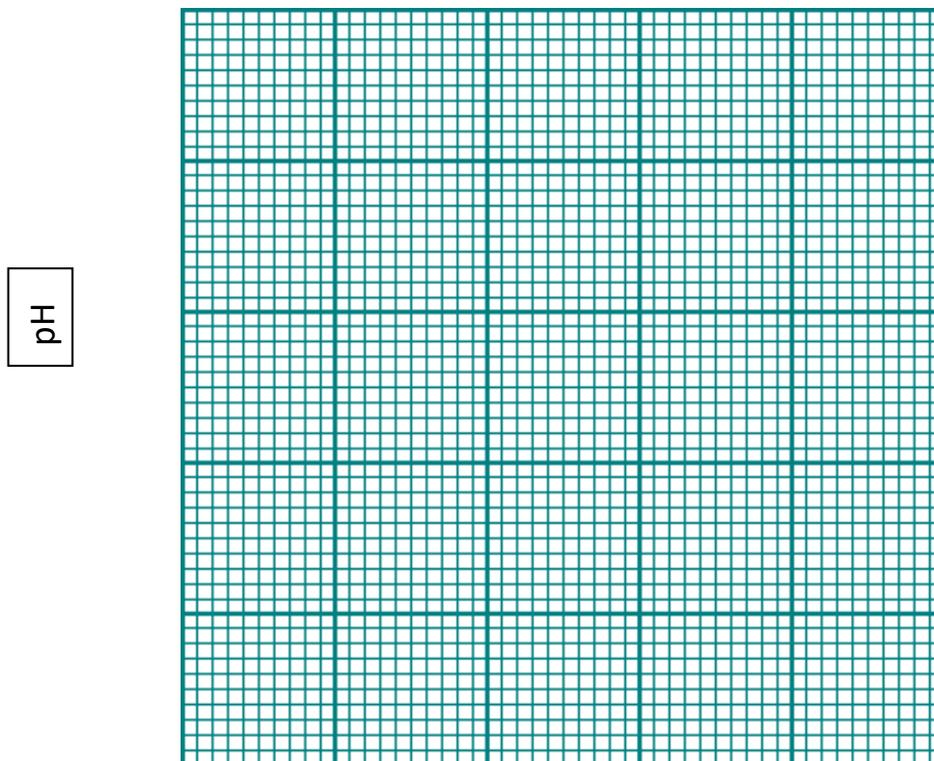
[2]

A2 The pH scale is used to describe acids and alkalis. The pH of sulfuric acid at different *concentrations* is shown in table 1.

Concentration / mol dm ⁻³	0.10	0.050	0.020	0.010	0.0050	0.0025
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pH	0.70	1.00	1.40	1.70	2.00	2.30
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- (a) Use the graph paper below to plot these data on a suitable graph. Draw a line or curve of best fit.



[6]

- (b) Use your graph to predict the pH of sulfuric acid at a concentration of $0.040 \text{ mol dm}^{-3}$. Show clearly on your graph how you obtained your answer.

.....

[2]

- (c) Nickel, copper and zinc are successive elements in the periodic table. The table below shows the observations recorded when small pieces of each metal were added to separate test tubes containing a clear, colourless solution of sulfuric acid at a concentration of 1.0 mol dm^{-3} .

Nickel	A few bubbles formed on the surface of the metal. Over a few days, the solution went from colourless to green and bubbles continued to form.
Copper	The metal and solution showed no visible change after several days.
Zinc	Bubbles rose continuously from the surface of the metal. After a few days, the pieces of metal were noticeably smaller, but there was no visible change in the solution and the bubbling stopped.

- (i) Place the three metals in order of reactivity from most to least reactive:

most reactive

second most reactive

least reactive

- (ii) Suggest why bubbles stopped appearing on the zinc after a few days. [1]

.....

[2]

A3 Ethyl ethanoate is a clear, colourless, organic liquid. It is highly volatile, meaning that it evaporates easily. In common with most other organic liquids, it is highly flammable, and burns readily in air.

- (a) **Figure 2** shows a beaker containing ethyl ethanoate. Complete the **magnified view of particles** to show the arrangement of particles around the surface of the liquid. [3]

o = ethyl ethanoate particle; ● = air particle

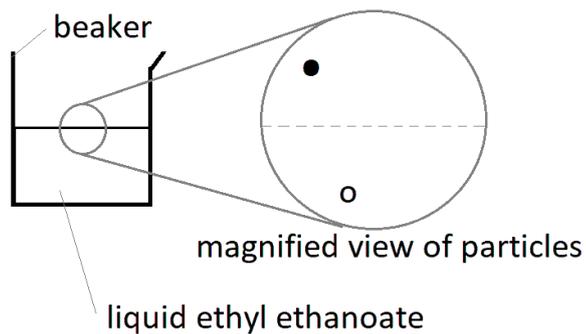


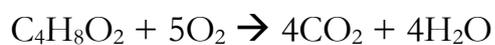
Figure 2

- (b) The molecular formula of ethyl ethanoate is $C_4H_8O_2$. Explain what this formula means.

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

[3]

- (c) The equation for the combustion of ethyl ethanoate is



Convert this balanced chemical equation into a word equation.

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.....

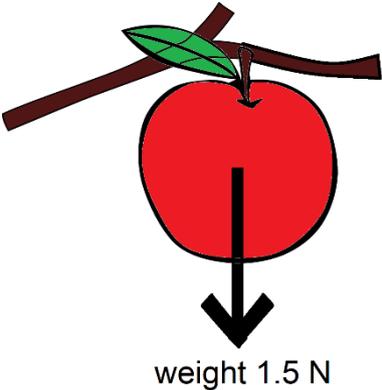
[2]

End of Section A

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SECTION B - PHYSICS

B1 A ripe apple with a weight of 1.5 N is hanging on a tree as shown; it is not moving.



(a) (i) On the diagram, mark and label an arrow clearly showing the name, size and direction of one other force acting on the apple. [2]

(ii) Explain how you know what size this force must be.

 [2]

(iii) The apple's stem breaks and it begins to fall. Explain, in terms of forces, what happens to the apple's speed.

 [2]

(b) A meteor is travelling vertically through the Earth's atmosphere. The forces on it are as shown.

Explain, giving a reason in each case, whether the energy in the following stores is increasing, decreasing or remaining constant.



(i) The gravitational store (i.e. gravitational potential energy of the meteor)

.....
.....

[2]

(ii) The kinetic store (i.e. kinetic energy of the meteor)

.....
.....

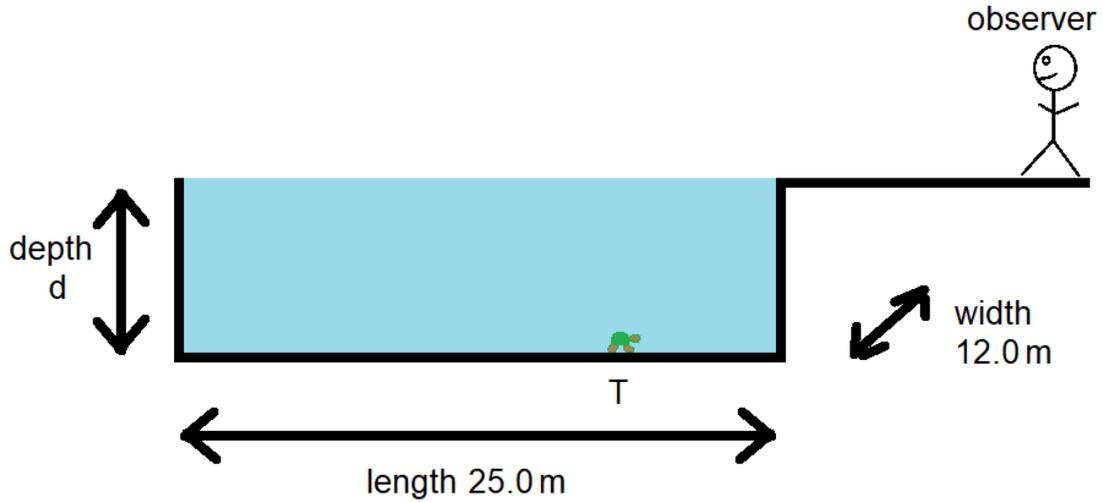
[2]

(iii) The thermal store (i.e. thermal energy of the meteor and its surroundings)

.....
.....

[2]

B2 A swimming pool is in the form of a cuboid 25.0 metres long and 12.0 metres wide. It is filled with sea water of density 1025 kg/m^3 which has a mass of 615 tonnes (615 000 kg).



(a) Calculate the following, showing your working:

(i) the depth, d , of the pool

.....

[3]

(ii) the pressure exerted by the water on the bottom of the pool

.....

[4]

- (b) A small turtle (marked T) is positioned as shown. Explain how it is possible for the observer to see the turtle when the pool is full even though they would be unable to do so if the pool were empty. Add rays of light to the diagram to illustrate your answer.

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

[3]

- (c) Katie and Carter are swimming lengths of the pool. Katie swims at a constant speed of 1.5 m/s and Carter at 1.2 m/s. Showing your reasoning, calculate how far apart they are when Katie reaches the far end of the pool.

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

[3]

B3 Below is some data about the planet Jupiter.

1. The axis of Jupiter is tilted at 3 degrees whereas Earth's is tilted at 23 degrees.
2. Jupiter rotates on its axis once every 10 hours.
3. Jupiter orbits the Sun once every 12 years.
4. Jupiter's mass is over 300 times that of Earth.
5. Jupiter is over 5 times further from the Sun than Earth is.
6. Jupiter has over 70 natural satellites, though four of them are much larger than the others.

Use these items of information to explain the following:

- (a) The weight of an object at the surface of Jupiter is much greater than it would be at the surface of the Earth.

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

- (b) A day at the surface of Jupiter is much shorter than a day on the surface of Earth.

..... [1]

- (c) Over much of Earth's surface the length of night and day changes significantly between summer and winter, but on Jupiter this effect would be much less pronounced.

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

End of Section B

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SECTION C – BIOLOGY

C1 This question is about food chains and webs.

Here is a food chain with the first trophic level missing:



(a) State the type of organism that always occupies the first step of a food chain.

.....
 [1]

(b) Explain why this is.

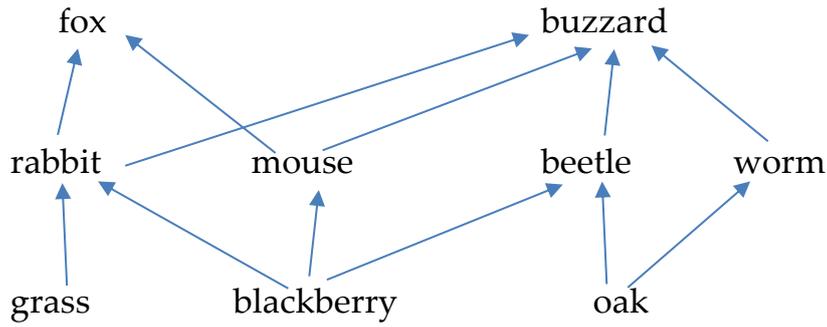
.....

 [3]

(c) Complete the food chain above with an appropriate example organism.

[1]

Here is a typical food web:



(d) Define and explain the effect on one of the species if the following happened:

(i) buzzards disappeared

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

[2]

(ii) mice disappeared

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.....

[2]

(iii) grass disappeared

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.....
.....

[2]

(e) What term do biologists use to describe animals such as foxes and buzzards?

.....

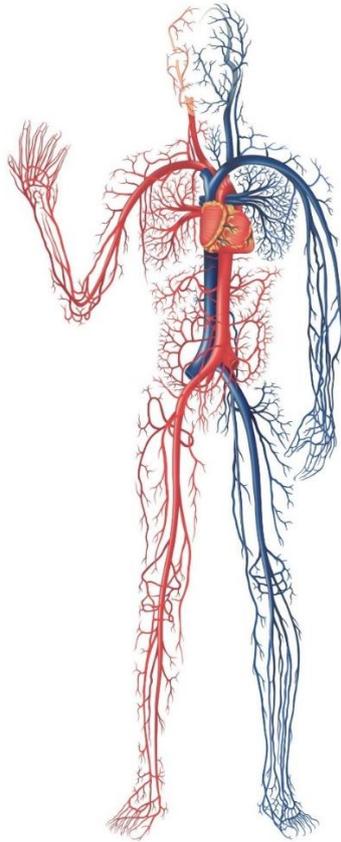
[1]

(f) How many separate food chains are present in the food web above?

.....

[1]

C2 Here is one of the systems of the human body:



(a) Name this system.

..... [1]

(b) Why does the heart have valves?

..... [1]

(c) Blood is pumped to every cell in the body. Give three important things that blood provides or removes to keep cells alive.

(i) [1]

(ii) [1]

(iii) [1]

C3 This question is about plant reproduction.



Apple flower



Apple fruit

- (a) What adaptations do some flowers have to persuade animals to visit them?

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

[3]

- (b) Some plants produce fruit around their seeds. Explain how a plant is able to make fruit which has a sweet taste and attracts animals to eat it.

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[3]

- (c) Why has the plant evolved fruit to be eaten by animals?

.....

[1]

C4 Fossils are imprints of organisms that lived millions of years ago found in rocks. Below is a fossil of the head of an extinct marine reptile called *Ichthyosaur* which lived 90 million years ago.



(a) Explain how this fossil might have formed.

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.....

[3]

(b) Not every organism which has lived is preserved as a fossil. Suggest and explain one factor which might increase the chance of an organism being fossilised.

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[2]

End of Section C