Name ……..…

Current school ……

WELLINGTON
COLLEGE

13+ SCHOLARSHIP EXAMINATION 2022

SCIENCE

TIME ALLOWED: 45 minutes

TOTAL MARKS: 36 (marks for each question are shown in brackets)

- **Read the questions carefully and answer in the space provided**
- **Calculators may be used**
- **A copy of the periodic table is provided at the back of the paper**

In late 2017 it was suggested that the outer reaches of our solar system could be hiding a new planet.[1] In 2022, the Science Department at Wellington College decided to give it the name **Wellingtune** and use the 13+ Scholarship Exam as a chance to explore some of the science behind visiting a new planet.

Planet Ten renamed as Wellingtune[1]

Reference: [1] *https://institutions.newscientist.com/article/mg23431314-400-weird-orbits-hint-planet-ten-might-lurk-at-solar-system-edge/* [accessed 10/01/22]

Q1 Wellingtune follows a circular orbit around the Sun and travels 25,000,000,000 miles during each orbit. Each orbit takes 282 Earth years.

(a) What is the velocity of the orbit? Give your answer in miles per (earth) year

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Answer..... miles/year [2]

(b) Convert your answer to m/s (meters per second). You may assume there are 365.25 days in each year and 1600 meters to the mile.

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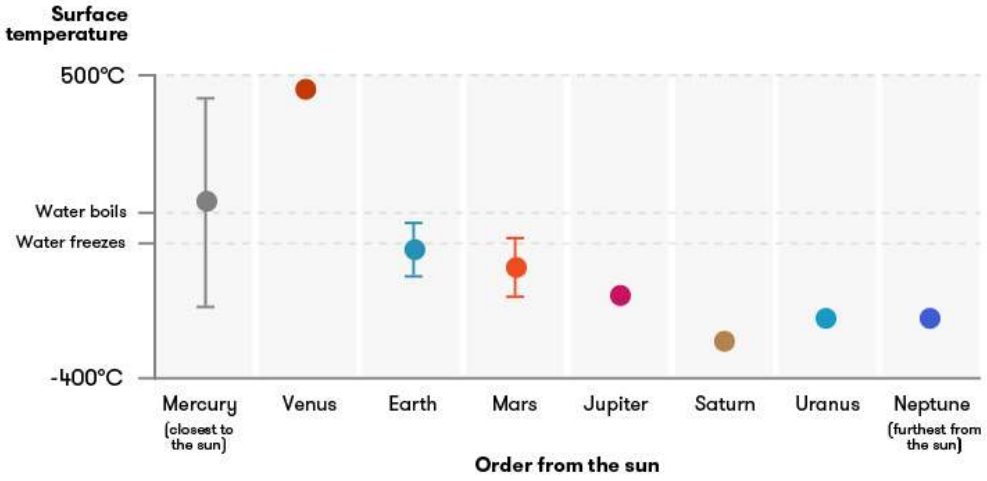
Answer.....m/s [2]

Q2 The diagram below shows the surface temperature of the planets. The vertical bars illustrate the range of temperatures that may occur on each planet.



(a) State two key factors that affect the surface temperature of a planet.

1 .....

2 ..... [2]

(b) Wellingtune is even further from the sun than Neptune, estimate the surface temperature of Wellingtune. Explain your reasoning.

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..... [1]

Q3 It is decided to send a satellite to Wellingtune to learn more about the planet. The satellite will be attached to a rocket and launched into space.

(a) Rocket launch sites are always found on (or near) the equator. Why is this?

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..... [1]

(b) A 500 kg satellite will output 500,000,000 Joules of energy to reach Wellingtune. However, the fuel will contain more energy than this. Explain why.

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..... [2]

(c) Light travels at a finite speed, approximately 300,000,000 m/s. Nothing can travel faster than light. Why does this present a problem for controlling a satellite remotely as it nears Wellingtune?

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..... [2]

A robot was sent to Wellingtune to analyse the materials on the surface of the planet. Scientists discovered that ice forms a large part of the planet's surface.

Taken from: https://wallpaperaccess.com/ice-planet

Q4 Below the ice is a liquid. A sample of this liquid is collected and returned to Earth.

(a) Suggest an experiment which would allow the scientists to determine whether the liquid below the surface is pure water or a mixture.

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..... [2]

(b) The ice on Wellingtune is made up of deuterated water, D_2O. Deuterium is an element similar to hydrogen but has some different properties.

(i) How many elements are there in D_2O? .....

(ii) How many atoms are there in D_2O? .....

(iii) Is D_2O a mixture or a compound? .....

[3]

(iv) Suggest how you could determine whether the deuterated water from Wellingtune's ice is lighter or denser than the water from ice on Earth.

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(c) A sample of the liquid below the ice is tested to check the pH.

(i) How could you determine the pH of the liquid?

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..... [1]

(ii) The scientists found the pH of the liquid to be 5. What can you deduce from this?

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..... [1]

Q5 The core of Wellingtune is made up of precious metals that are rare on Earth.

(a) One common property of metals is that they are sonorous. What do we mean by this?

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..... [1]

(b) Give an example of where we commonly use some of the rare-earth metals such as lanthanum and neodymium.

..... [1]

(c) Aluminium has been found on Wellingtune as a pure metal. Explain why we do not find uncombined aluminium on Earth but instead as an ore.

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..... [1]

Q6 At the space station garden on Wellingtune, astronauts grow vegetables to add fresh food to their diet. Write and balance the symbol equation for photosynthesis.

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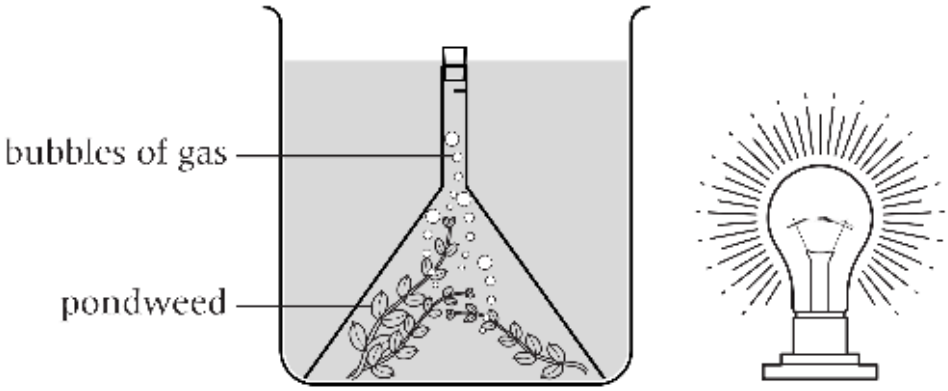
..... [2]

Q7 The astronauts are conducting experiments at the space station to determine how to increase the speed of photosynthesis. This experiment was set up to test the effect of different environmental conditions on the speed of photosynthesis.



(a) The light bulb is moved further away. Predict the effect on the number of bubbles produced.

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(b) Explain your reasoning.

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..... [2]

Q8 Due to the conditions on Wellingtune, it is unlikely that plants will grow naturally.
Design a room where plants can be grown in the space station. Your answer should include how each feature of the room will maximise the growth of plants. You may present your answer as a labelled diagram.

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..... [4]

Q9 The absence of gravity in space makes living in a spacecraft physically undemanding. Without regular use and exercise, the muscles weaken. Design an investigation to find out how levels of protein in the diet effect muscle strength. Include experimental details in your answer.

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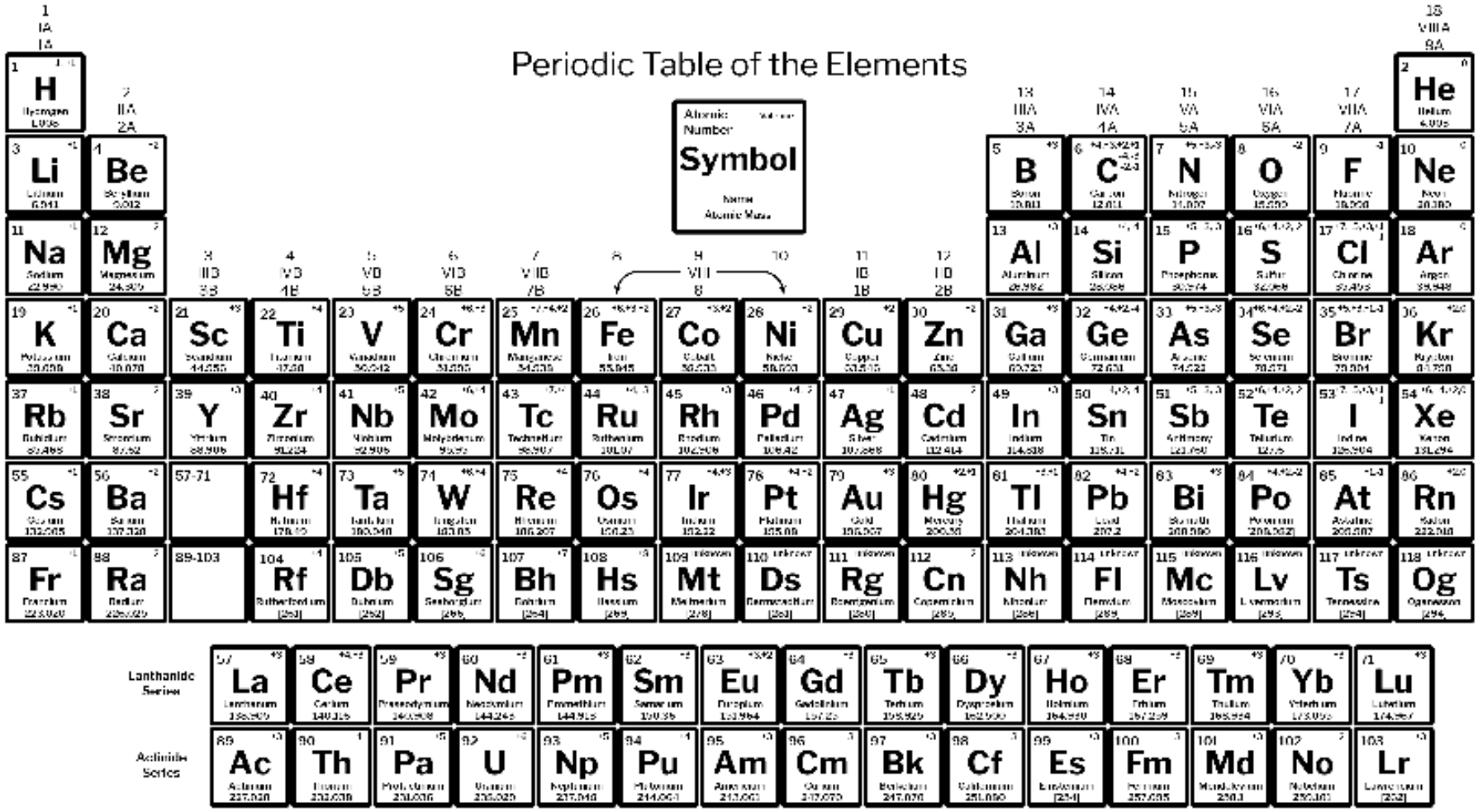
..... [4]

End of Question Paper


Periodic Table of the Elements
Atomic Number
Symbol
Name
Atomic Mass
Lanthanide Series
Actinide Series