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Eton College King's Scholarship Examination 2021

SCIENCE 1 (Theory)

(60 minutes)

Candidate Number: _____

Remember to write your candidate number on every sheet in the space provided.

*You should attempt **ALL** the questions. Write your answers in the spaces provided.*

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

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

Total Marks Available: 70

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1	2	3	4	5	TOTAL [70]

Do not turn over until told to do so.

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1. Below is a photograph of a tiger shark. Tiger sharks are large predators, capable of growing to a length of 5m.

(a) Tiger sharks are varied hunters. Their diet consists of fish, crustaceans, sea birds, sea snakes, seals and turtles. To which kingdom do all the tiger shark's prey belong?

_____ **[1]**

(b) If you were a scientist, how could you quickly tell whether tiger sharks were carnivorous predators?

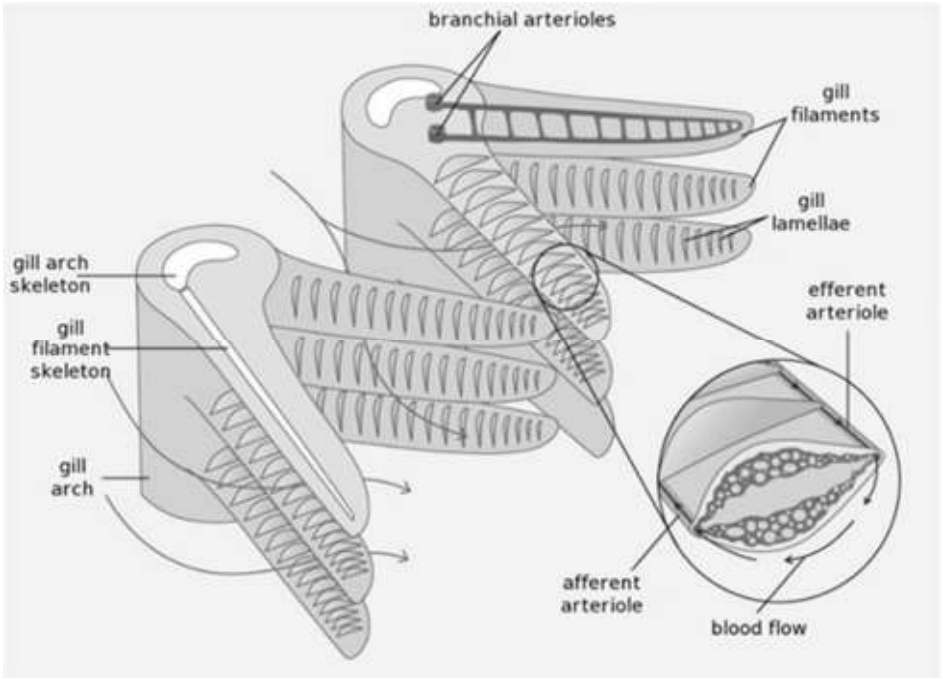
_____ **[1]**

(c) Tiger sharks have similar colouration to most other species of sharks. They have darker backs and lighter underbellies. Explain why this is an advantage.

_____

_____ **[2]**

One of the species that the tiger shark preys upon is the bottlenose dolphin. These animals belong to different phyla: tiger sharks are fish; bottlenose dolphins are mammals. The diagram below shows the structure of fish gills.



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(d) Name two adaptations shared by the structure of fish gills and mammal lungs. Explain how each adaptation assists in absorbing oxygen.

Adaptation:_____

Explanation:_____

_____

_____

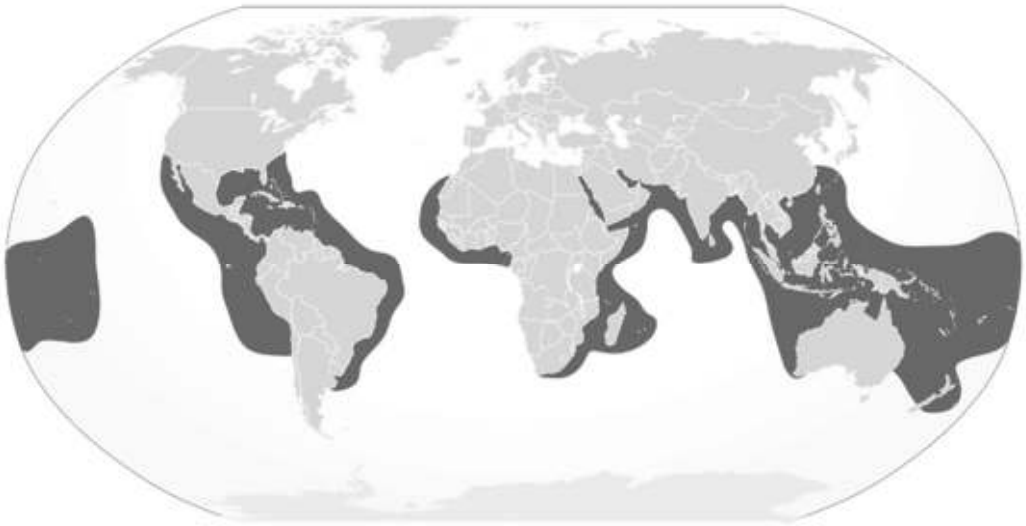
Adaptation:_____

Explanation:_____

_____

_____**[4]**

The map below details the range of the tiger shark on Earth.



(e) Suggest what may happen to the tiger shark's range if the climate continues to warm.

_____

_____

_____**[3]**

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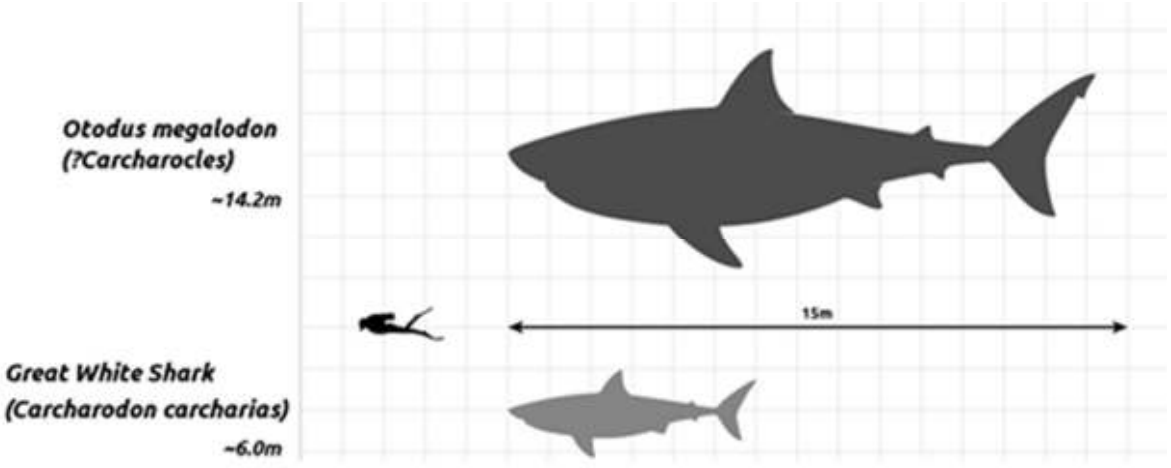
Sharks have existed for millions of years. Though numerous changes have occurred through evolution, many characteristics have remained similar for millennia. One extinct species of shark is megalodon, which lived approximately 23 to 3.6 million years ago. Below is a diagram comparing the size of megalodon to modern day sharks and humans.



Megalodon is thought to have hunted baleen whales to survive. Unlike most fish, it is suspected megalodon was mesothermic: while not truly warm blooded, it could maintain a body temperature greater than the surrounding water temperature. This is a characteristic shared by many modern sharks today.

Despite ice ages around the time of extinction, scientists now believe megalodon went extinct owing to changes in its feeding habits.

(f) With reference to its prey, suggest three changes that may have occurred to cause megalodon to become extinct.

One:_____

_____

Two:_____

_____

Three:_____

_____ **[3]**

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2. This question is about seawater.

(a) Seawater covers over 70% of the earth's surface. It is a solution. What do you understand by the word *solution*?

You might like to use some of the following words in your definition: solid, liquid, gas, element, compound, mixture, soluble, insoluble, solvent, solute.

_____

_____

_____ **[2]**

(b) The following table shows the percent by mass of the six most abundant elements, but there are two gaps. Fill in the missing, non-metal, elements.

Element	Percent by mass
Oxygen	85.84
	10.82
	1.94
Sodium	1.08
Magnesium	0.1292
Sulfur	0.091

[2]

(c) Draw a particle diagram of seawater in the box below. It should show clearly that it is a liquid and a mixture. You should take gravity into account in your diagram. You should use a minimum of 20 particles but may wish to use more.

[3]

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(d) Seawater is slightly alkaline. Suggest a pH value that seawater might have.

_____ **[1]**

(e) An estimated 30-40% of the carbon dioxide that humans release into the air dissolves into the oceans. What effect will that have on the acidity of the oceans?

_____

_____ **[1]**

(f) The four most abundant metals in seawater are sodium, magnesium, potassium and calcium. They do not exist as their atoms but as their ions (charged particles), as part of a compound which dissolves in the water. To discover whether these elements could be extracted from their compounds using carbon an investigation was designed where carbon was mixed with a solution of each element and observations made. It was known that iron is extracted from iron oxide using carbon as a reducing agent in blast furnaces. For all the experiments the same result was observed because all the metals are more reactive than carbon. What was this result?

_____

_____ **[1]**

(g) Describe an experiment you might conduct to put these four metals in a reactivity series. You should include:

- any chemicals used;
- the observations you make to show a reaction has occurred;
- the conclusions you could come to;
- at least **one** word equation.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ **[4]**

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3. This question is about the difference between chemical and physical changes.

(a) Explain what the difference is between a chemical and a physical change. You should use specific examples in your explanation.

[2]

(b) To test whether a gas is carbon dioxide, it is bubbled through limewater which will turn cloudy in the presence of carbon dioxide. Limewater is a solution of calcium hydroxide (chemical formula $Ca(OH)_2$) which reacts with the carbon dioxide. How is the observation that the limewater turns cloudy linked to the solubility of the product of this reaction?

[1]

(c) The substance produced in the reaction in (b) has the same chemical composition as limestone. State the chemical name of this substance.

[1]

(d) If you continue bubbling carbon dioxide through limewater, the cloudiness disappears. The chemical that is produced is calcium hydrogencarbonate [chemical formula $Ca(HCO_3)_2$]. Explain this observation.

[2]

(e) Write a word chemical equation for the reaction between limestone and hydrochloric acid.

[2]

(f) Give a use of carbon dioxide and explain a chemical or physical property that is the reason for this usage.

[2]

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(g) Mass is conserved both in physical changes and in chemical changes. However, when a sample of copper powder, a sample of copper oxide powder and a sample of copper carbonate powder were heated separately in a test tube using a Bunsen burner, the mass of only one of the samples stayed the same. Describe and explain any observations and this result.

In your answer you should include:

- which sample stays the same and why;
- what happens to the other samples in terms of their masses and why;
- any observations you might make;
- any chemical equation you think is relevant;
- any comments on chemical or physical changes.

[4]

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4. In his 1687 work *Philosophiae Naturalis Principia Mathematica,* Newton proposed that the *acceleration* of an object depends on the resultant force acting on it divided by its mass, according to the equation:

$$\text{acceleration} = \frac{\text{resultant force}}{\text{mass}}$$

(a) Define the term acceleration.

_____

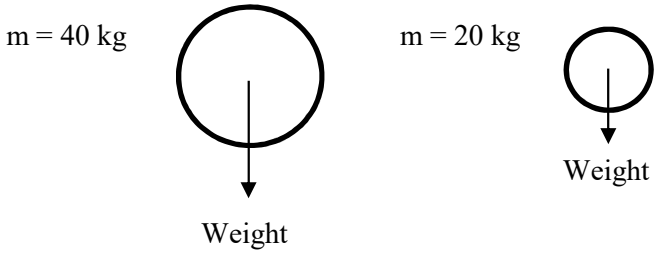
_____ **[1]**

(b) According to Newton's Law, what is the physical difference between an object with a large mass and one with a smaller mass?

_____

_____ **[1]**

(c) Roughly 100 years earlier, Galileo Galilei supposedly dropped two cannonballs from the Leaning Tower of Pisa to show that their time of descent was independent of their mass.



i. By using Newton's Law to calculate their acceleration, show that the cannonballs both hit the ground at the same time [Take g = 10 N/kg and ignore air resistance].

_____

_____

_____ **[2]**

ii. Justify why air resistance can be ignored in this example.

_____

_____ **[1]**

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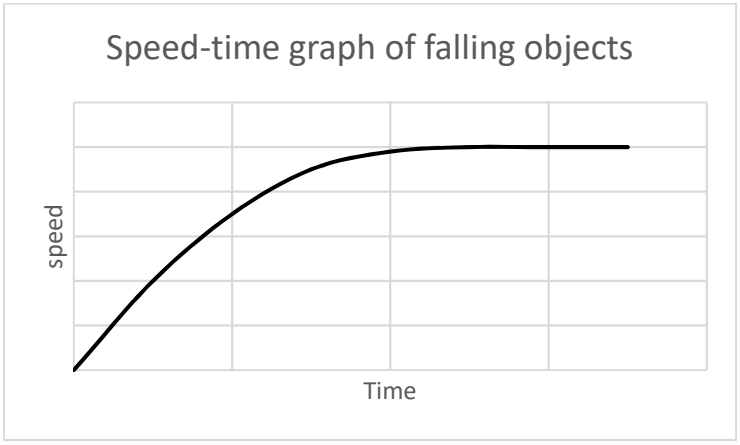
(d) For an object falling downwards, the force of air resistance acts in the opposite direction to weight, meaning:

$$\text{resultant force} = \text{weight} - \text{air resistance}$$

The graph shows a speed-time graph for a falling hammer.



i. A feather is also dropped. Sketch a line describing the falling feather on the same set of axes. **[2]**

ii. The hammer has a mass of 0.5 kg. What is the maximum air resistance force the hammer experiences during its fall? [Take g = 10 N/kg]

_____

_____

_____**[2]**

iii. Explain the microscopic origin of air resistance.

_____

_____**[2]**

iv. The force (in newtons) of air resistance for the hammer is modelled by the equation.

$$\text{air resistance} = 0.002 \times v^2$$

Where 0.002 is a co-efficient that accounts for the shape of the object and the medium through which it moving and v is the speed (in ms^{-1}) of the object experiencing the air resistance.

What is the maximum speed reached by the hammer?

_____

_____

_____

_____**[3]**

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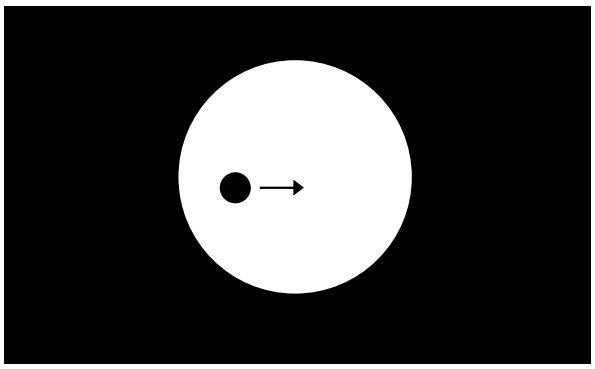
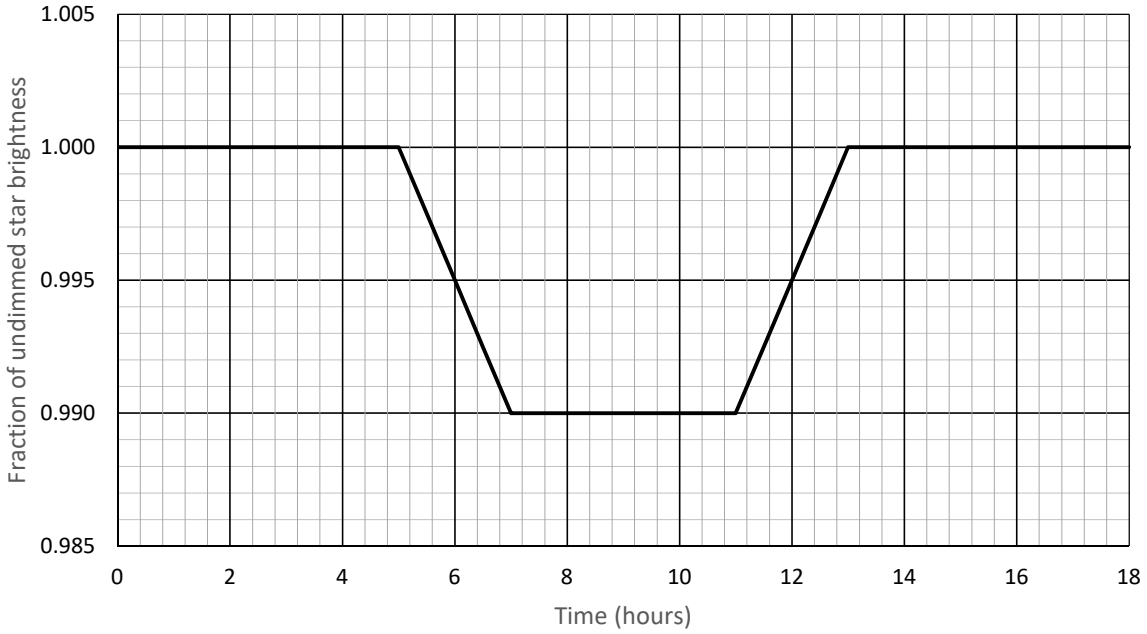
5. This question is about exoplanets.

In 2019 Michel Mayor and Didier Queloz were awarded part of the Nobel Prize in Physics for their 1995 discovery of the first planet around a star other than the Sun. Since then, over 4000 other 'exoplanets' have been discovered.

Many of the discoveries have been made using the so-called 'transit method', in which the passage of the exoplanet between us and the star causes a measurable dip in the brightness of the star's light. The figure below shows the dark disk of the planet moving across the bright disk of the star:



The graph below is a simplified example of the 'light curve' of a star. The dip in the star's brightness, expressed as a fraction of the undimmed brightness, is due to a planet's transit.



(a) From the graph, determine the time of transit from the moment the planet's disk is fully in front of the disk of the star until the moment it begins to leave the disk of the star.

_____

_____ **[1]**

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(b) Explain briefly why the light curve decreases gradually from 1.000 to 0.990, rather than dropping abruptly.

_____

_____**[1]**

(c) Using data from the graph, calculate the radius of the planet as a fraction of the radius of the star.

_____

_____

_____**[2]**

(d) The star is like our Sun, and has a radius of 1 solar radius (700 000 km). Calculate the radius of the planet (in metres).

_____

_____

_____**[2]**

(e) Calculate the speed of the planet in metres per second.

_____

_____

_____**[2]**

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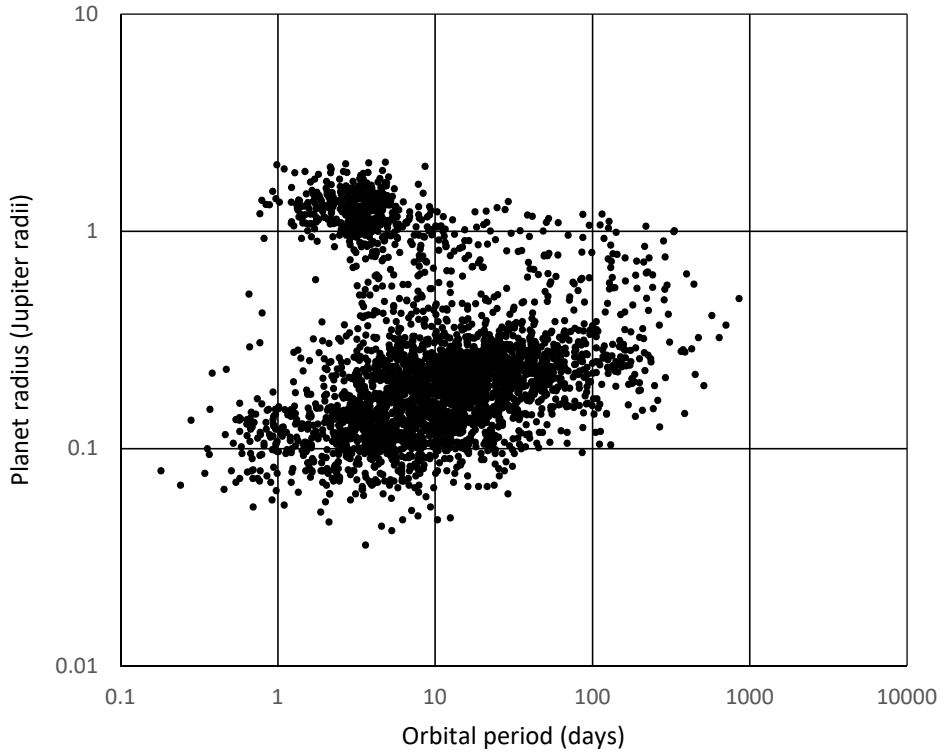
Different discovery methods are more or less sensitive to different types of planets. The graph below shows the distribution of over 3200 exoplanets as a function of their orbital period (measured in Earth days) and their radius (measured in Jupiter radii). It is obvious that there are two main groups of planets; these two groupings are a result of using two different discovery methods.



(f) By circling one of the groups, identify which group was discovered via the transit method. **[1]**

(g) Justify your choice.

_____

_____

_____ **[2]**

(h) Indicate where you think Jupiter would lie on this graph by adding a point on the graph and labelling it 'J'. **[1]**

(i) Explain whether or not you think Jupiter would be an obvious candidate for detection by the transit method by an alien observer looking at our Solar System.

_____

_____

_____ **[2]**

[End of paper]

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Paper Notes: 13+ Science Question Paper (13+ Science Past Paper (2021))

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Overview

This is **Eton College's King's Scholarship Examination Science 1 (Theory) paper from 2021**, a 60-minute assessment designed for candidates sitting the **13+ entrance examination** for entry to Eton's prestigious scholarship programme. The paper tests scientific reasoning and knowledge across biology, chemistry, and physics, with questions requiring both short written answers and extended explanations.

The paper contains **five major questions** spanning diverse topics: marine biology and evolution, seawater chemistry and reactivity, chemical versus physical changes, Newton's laws of motion and terminal velocity, and exoplanet detection methods. Questions are allocated between 1 and 4 marks each, with a **total of 70 marks** available. Candidates must show all working in calculations, and calculators are permitted throughout.

This examination is aimed at academically strong Year 8 pupils preparing for entry to one of the country's most selective independent schools. The interdisciplinary nature of the questions, the requirement for clear explanations, and the application of scientific principles to unfamiliar contexts make this a challenging paper that rewards both breadth of knowledge and depth of understanding.

How this paper is organised

The paper is divided into **five numbered questions**, each addressing a different area of science. Question 1 (11 marks) focuses on biology through the lens of tiger sharks and megalodon; Question 2 (14 marks) explores the chemistry of seawater, pH, and metal reactivity; Question 3 (14 marks) examines chemical and physical changes using examples from limestone and copper compounds; Question 4 (15 marks) applies Newton's second law to falling objects and air resistance; and Question 5 (16 marks) investigates exoplanet detection using transit photometry.

Each question is broken into multiple sub-parts labelled (a), (b), (c), and so on, with individual mark allocations shown in square brackets. Some sub-parts are further divided (e.g. 4(c)(i) and 4(c)(ii)). Answer spaces are provided directly on the question paper, and candidates are reminded to write their candidate number on every sheet.

The format mixes short-answer questions (1 or 2 marks) with extended responses requiring several lines of explanation (up to 4 marks). Diagrams, graphs, and data

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tables appear throughout, and candidates must interpret these visual elements as well as perform calculations and write word equations. The **60-minute time limit** requires efficient time management across the full range of topics.

Topics covered

- Biological classification and kingdoms, focusing on carnivorous diet identification and predator adaptations
- Comparative anatomy of gas exchange surfaces, including gill and lung structure, surface area, and blood supply
- Evolution, extinction, and palaeontology, examining megalodon and the environmental pressures on species survival
- Solutions, solubility, and concentration, defining solute and solvent and interpreting percentage composition by mass
- Particle theory and state changes, including drawing particle diagrams for liquid mixtures with attention to gravity
- pH scale, alkalinity and acidity, and the effect of dissolved carbon dioxide on ocean chemistry
- Metal reactivity series, extraction of metals using carbon, and designing experiments to compare reactivity
- Distinguishing chemical and physical changes, including observations, mass conservation, and product identification
- Newton's second law (F = ma), calculating acceleration and justifying assumptions about air resistance
- Terminal velocity, forces in equilibrium, and microscopic explanation of drag forces
- Exoplanet detection using the transit method, interpreting light curves, and calculating planetary radii and orbital speeds
- Graphical analysis and data interpretation, including speed-time graphs and scatter plots with logarithmic scales

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How to use this paper for revision

- Review the reactivity series of metals thoroughly, and practise writing word equations for displacement reactions and thermal decomposition reactions.
- Practise drawing and interpreting graphs, especially speed-time graphs and light curves, ensuring you can extract quantitative data accurately.
- Revise the particle model of matter so you can draw diagrams that clearly show particles in solids, liquids, and gases, and explain physical properties.
- Strengthen your understanding of Newton's second law by working through problems involving weight, mass, and acceleration, and learn to rearrange F = ma confidently.
- Familiarise yourself with the characteristics of different animal groups (fish, mammals, reptiles, birds) and the adaptations that suit them to their environments.
- Work on writing clear, structured explanations that use scientific vocabulary precisely and link observations to underlying theory.
- Prepare to apply knowledge to unfamiliar contexts, such as extinct species or astronomical observations, rather than simply recalling memorised facts.

Common mistakes to avoid

- Confusing chemical and physical changes: remember that chemical changes produce new substances with different properties, while physical changes only alter appearance or state.
- Forgetting to show all working in calculations, which loses marks even if the final answer is correct. Always write out each step, including units.
- Misinterpreting graphs by reading values off the wrong axis or failing to notice logarithmic scales, which are used in the exoplanet scatter plot.
- Writing vague explanations that lack scientific terminology; for example, saying 'it reacts' rather than describing what happens during a displacement reaction.
- Mixing up mass and weight, or neglecting to use the correct formula (weight = mass × gravitational field strength) when calculating forces on falling objects.
- Overlooking the instruction to take gravity into account when drawing particle diagrams, which should show denser arrangement near the bottom of a container.

Exam technique

Start by reading through the entire paper to identify which questions you find most straightforward, then tackle those first to secure marks quickly. Question 1 and

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Question 5 involve extended reading and interpretation, so allow sufficient time for these. **Allocate your 60 minutes proportionally to the marks available**: a 4-mark question deserves roughly five minutes of your time, while a 1-mark question should take about one minute.

In calculation questions, always write out the formula you are using, substitute the values with units, and show each step of your working. Even if you make an arithmetic error, clear working can earn method marks. For questions requiring explanations, structure your answer in short sentences, using scientific vocabulary correctly and linking cause and effect explicitly.

If you finish early, go back and check your answers carefully. Look for missing units, misread data from graphs, and incomplete explanations. In questions like 2(g) or 3(g) that ask for detailed descriptions, make sure you have addressed every bullet point in the question prompt. Use the mark allocation as a guide: a 4-mark question expects four distinct points or a detailed argument with multiple stages of reasoning.

What to revise alongside this paper

To consolidate your understanding of this paper, revise **rates of reaction** and factors affecting them (temperature, concentration, surface area), as this underpins much of the chemistry content. Study **gas laws and pressure**, which link to particle behaviour and the microscopic explanation of air resistance. Review **energy transfers in food chains and ecosystems**, building on the predator-prey relationships in Question 1.

For physics, extend your work on Newton's laws to cover **momentum and collisions**, and explore **gravitational fields** in more depth to understand weight and orbital motion. In biology, deepen your knowledge of **natural selection and speciation**, which connect to the extinction scenario in the megalodon question.

Finally, practise **experimental design and fair testing**, as Question 2(g) requires you to plan an investigation. Look at past papers that include graph interpretation and data analysis, especially those involving **astronomy and space science**, to prepare for the style of reasoning required in Question 5.

Key terms

> **Kingdom**, **Carnivore**, **Adaptation**, **Evolution**, **Extinction**, **Solution**, **Solute**, **Solvent**, **pH**, **Reactivity series**, **Chemical change**, **Physical change**, **Mass conservation**, **Acceleration**, **Resultant force**, **Terminal velocity**, **Air resistance**, **Exoplanet**, **Transit method**, **Light curve**

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Eton College King's Scholarship Examination 2021

SCIENCE 2 (Data Analysis)

(30 minutes)

Candidate Number: _____

Remember to write your candidate number on every sheet in the space provided.

*You should attempt **ALL** the questions. Write your answers in the spaces provided.*

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

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

Total Marks Available: 30

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Total [30]	

Do not turn over until told to do so.

A new coronavirus disease was named COVID-19 by the World Health Organization (WHO) in February 2020. The disease is caused by a novel coronavirus called SARS-CoV-2, which has since spread rapidly across the globe. Patients with COVID-19 show symptoms of respiratory illness including fever, cough, fatigue and radiographic evidence of pneumonia, such as inflammation and damage to lung tissue. Most patients show only modest symptoms, but some become severely sick, requiring hospital admission and, in some cases, intensive care unit (ICU) treatment.

This question is about two scientific studies, both carried out in 2020, into the role of vitamin D in preventing and treating COVID-19. As well as having an important role in bone formation, vitamin D is important in the proper functioning of the immune system and can help to reduce excessive inflammation in the body.

The first study proposed an hypothesis that there is a potential association between mean levels of vitamin D in various countries and the number of cases of COVID-19.

(a) What do you understand by the term *hypothesis*?

_____

_____ **[1]**

To investigate this hypothesis the researchers focussed on European countries only, searching the records for mean blood levels of vitamin D in each country and using the number of cases of COVID-19 per 1 M population in each of the countries up to 8th April 2020. The data are set out in the table below:

European Country	Mean vitamin D (nmol/L)	Cases of COVID-19 per 1 M population
Belgium	49.3	2019
Czech Rep	62.5	488
Denmark	65.0	933
Finland	67.7	449
France	60.0	1671
Germany	50.1	1309
Hungary	60.6	93
Iceland	57.0	4736
Ireland	56.4	1230
Italy	50.0	2306
Netherlands	59.5	1199
Norway	65.0	1123
Portugal	39.0	1289
Slovakia	81.5	125
Spain	42.5	3137
Sweden	73.5	834
Switzerland	46.0	2686
UK	47.4	895

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(b) Vitamin D level was measured in units of nmol/L. What do you understand by this unit of measurement?

_____

_____ **[2]**

(c) Why are cases of COVID-19 measured ' (/1 M)' – per million - of the population?

_____

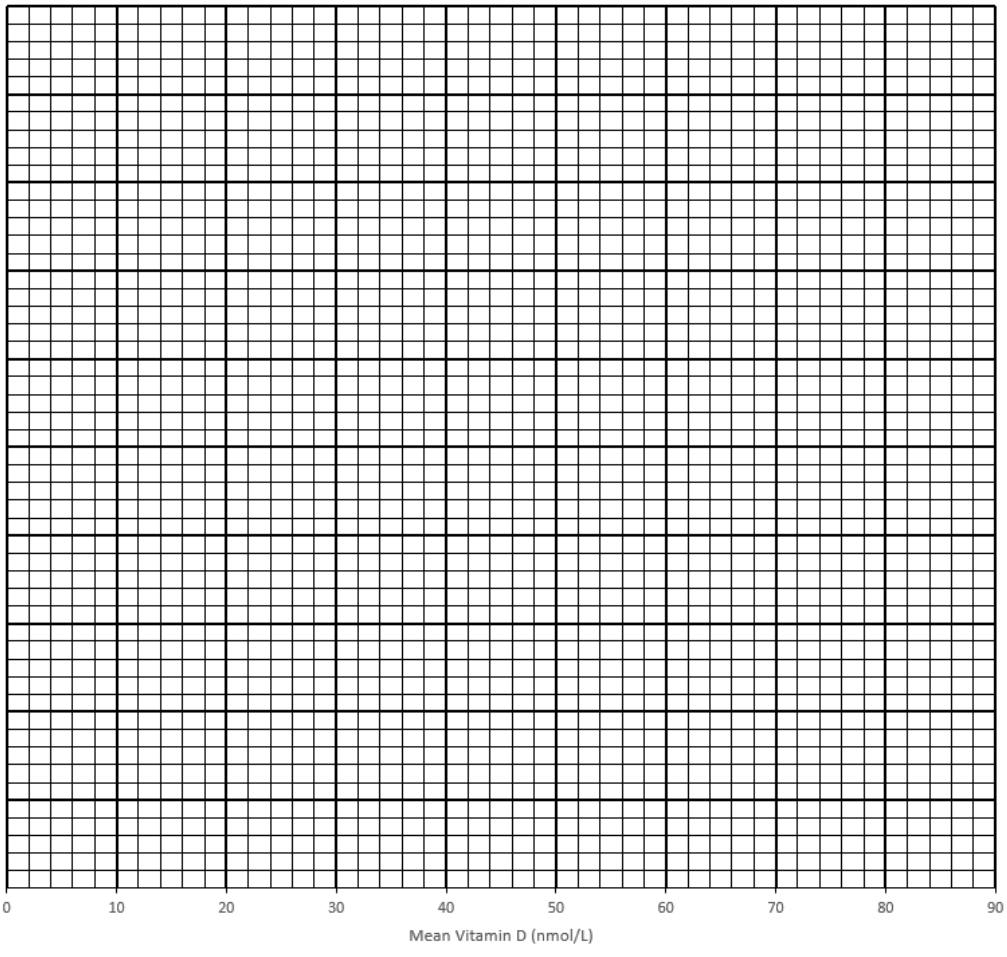
_____ **[1]**

(d) Suggest a possible reason for focussing only on European countries in this study.

_____

_____ **[2]**

(e) Using the grid below, plot the data in the table as a scatter graph, where each point plotted represents a country. Draw a **single** straight line of best fit through the plotted points.
[There is no need to label each point with the name of the country] **[4]**



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(f) Looking carefully at the data and graph, discuss whether it is fair to conclude that higher levels of vitamin D in the blood cause reduced rates of infection with SARS-CoV-2.

[4]

(g) Discuss the reliability of these data. Suggest ways in which the data may be unreliable and discuss the implications of this when drawing conclusions from the study.

[3]

The second study (a randomised, double-blind clinical trial) investigated whether vitamin D might be an effective treatment in those admitted to hospital with COVID-19. 76 patients displaying symptoms of viral pneumonia and testing positive for SARS-CoV-2 were admitted to hospital in Cordoba, Spain. 50 patients received dosages of vitamin D over the next 7 days, compared to 26 control patients who did not.

(h) The study was *a randomised, double-blind clinical trial*. Using the information in the above paragraph, explain what is meant by this.

[4]

(i) Explain why 26 control patients were included in this study.

[2]

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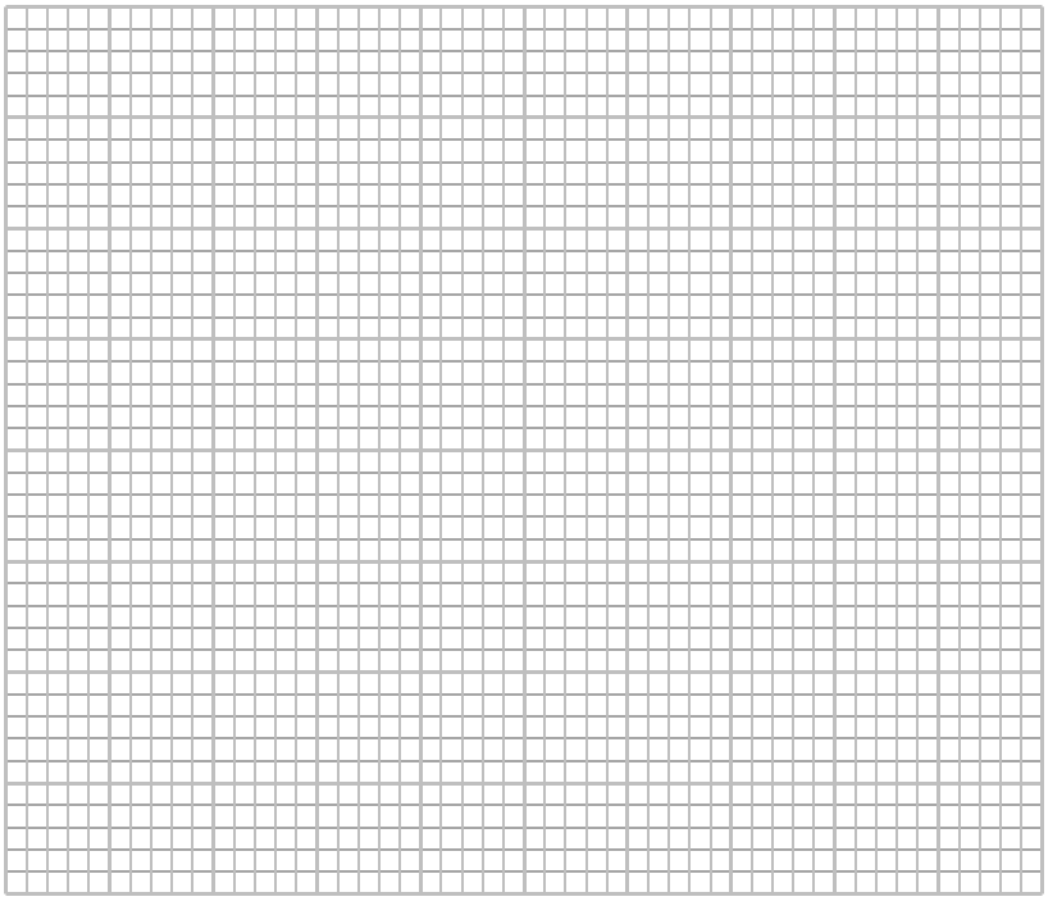
Of 50 patients treated with vitamin D, one required admission to the ICU, while of 26 untreated patients, 13 required admission. Of the patients treated with vitamin D, none died. Of the 13 untreated patients requiring admission to the ICU, two died and the remaining 11 were eventually discharged from hospital.

(j) Using the grid below, display these results in a **single** suitable bar chart, which makes the comparisons between the treatments and medical outcomes clear and meaningful. **[4]**



(k) The results suggest that vitamin D was an effective treatment for those admitted to hospital with severe symptoms of COVID-19. To what extent do you agree with this conclusion? Suggest what was done to make this study a 'fair test' and discuss the possible limitations of its findings.

_____

_____

_____

_____

_____ **[3]**

[End of paper]

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Paper Notes: 13+ Science Question Paper (13+ Science Past Paper (2021))

Compiled by SATs-Papers.co.uk to help you get the most from this paper.

Overview

This is the **Science 2 (Data Analysis)** paper from **Eton College's King's Scholarship Examination 2021**, a 30-minute assessment worth **30 marks** designed for candidates sitting the **13+ entrance** examinations. The paper focuses exclusively on scientific data interpretation and evaluation, drawing on real-world research published during the COVID-19 pandemic. Calculators are permitted, and all working must be shown in the spaces provided.

The entire paper comprises a single extended question examining two scientific studies from 2020 into the role of **vitamin D** in preventing and treating COVID-19. The first study explores correlational data across 18 European countries, requiring candidates to construct and interpret a scatter graph. The second study analyses results from a randomised, double-blind clinical trial conducted in Spain, testing vitamin D as a treatment for hospitalised COVID-19 patients.

This paper suits academically strong candidates comfortable with **extended scientific writing**, graph construction, and critical evaluation of experimental design. The questions demand sophisticated reasoning about correlation versus causation, reliability of data, experimental controls, and the limitations of clinical trials. It tests scientific literacy at a high level, requiring candidates to think like working scientists rather than simply recall facts.

How this paper is organised

The paper contains **11 sub-questions** (labelled a to k) organised under a single thematic umbrella examining vitamin D and COVID-19. Marks range from **1 mark** for concise definitions to **4 marks** for extended discussion questions. The first seven questions (parts a to g) focus on the correlational European study, including a 4-mark graph-plotting task and two substantial evaluation questions worth 4 and 3 marks respectively.

Parts h to k address the Spanish clinical trial, with 4 marks allocated to explaining randomised, double-blind methodology, 4 marks for constructing a comparative bar chart, and 3 marks for critically evaluating the study's conclusions and limitations. Each question provides ruled lines for written responses, with grid paper supplied for the two

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graphing tasks. The space allocation suggests that extended answers are expected for the higher-mark questions.

The **30-minute time limit** is tight given the reading load and the requirement to produce two graphs plus multiple extended written responses. Candidates must manage their time carefully, balancing graph accuracy with the depth of written analysis required for the evaluation questions.

Topics covered

- Defining and understanding hypotheses in scientific investigation
- Interpreting scientific units of measurement (nanomoles per litre, nmol/L) in biochemical contexts
- Proportional data representation (per million population) to enable fair comparison between countries
- Constructing scatter graphs with best-fit lines from tabulated data
- Distinguishing correlation from causation in observational studies
- Evaluating data reliability and identifying confounding variables in epidemiological research
- Understanding experimental design: randomisation, double-blind protocols, and control groups
- Constructing comparative bar charts to display clinical trial outcomes
- Critically evaluating the validity and limitations of clinical trial conclusions
- Applying knowledge of immune system function and vitamin D physiology

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How to use this paper for revision

- Familiarise yourself with real scientific papers and their structure, particularly observational studies and clinical trials, so you can recognise methodological strengths and weaknesses quickly.
- Practise plotting scatter graphs accurately under time pressure, ensuring axes are labelled with units and scales are appropriate to the data range provided.
- When drawing lines of best fit, aim for equal numbers of points above and below the line, ignoring obvious outliers rather than forcing the line through every point.
- For questions about correlation versus causation, always consider alternative explanations (confounding variables) and whether the study design can establish a causal link.
- In evaluation questions, structure your answer as balanced: acknowledge what the study does well, then identify specific limitations with their implications for the conclusions.
- Review biochemical units (moles, molarity, concentration measures) and medical statistics terminology (per capita rates, ICU admission, mortality) to avoid confusion under exam pressure.
- When creating bar charts, plan your layout first: decide on grouping (by treatment or by outcome), ensure bars are clearly distinguished, and include a key if using multiple colours or patterns.

Common mistakes to avoid

- Confusing correlation with causation in part (f), stating that vitamin D 'causes' reduced infection rates when the study design can only show association between the two variables.
- Plotting scatter graph points carelessly or choosing inappropriate scales that compress the data into one corner, making patterns impossible to see clearly.
- Drawing best-fit lines through the origin or forcing them through specific points rather than balancing the scatter of all data points equally.
- Overlooking confounding variables in part (g) such as differences in testing rates, healthcare infrastructure, or demographics between European countries.
- Failing to address both aspects of 'double-blind' in part (h): that neither patients nor medical staff knew who received vitamin D versus placebo.
- Creating bar charts in part (j) that compare raw numbers rather than proportions, ignoring the different group sizes (50 versus 26 patients) which makes direct comparison misleading.

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Exam technique

With only **30 minutes** for 30 marks, you have roughly one minute per mark. Allocate time proportionally: 1-mark questions deserve brief, precise answers (one sentence), whilst 4-mark questions require structured paragraphs with multiple distinct points. Tackle the graph-plotting tasks (parts e and j) efficiently but accurately, as they are each worth 4 marks and can be completed relatively quickly if you work methodically.

For the extended evaluation questions (parts f, g, h, and k), use the mark allocation to guide depth. A 4-mark question typically requires **four distinct points** or two well-developed points with explanation. Read the question stems carefully: 'discuss' and 'to what extent' demand balanced consideration of multiple perspectives, not one-sided answers. Always relate your points back to the specific data and experimental design described in the paper.

If time runs short, prioritise completing all questions with at least some content rather than perfecting one detailed answer. Examiners can only award marks for what is written. Use scientific vocabulary precisely (correlation, causation, control group, randomisation, reliability, validity) to demonstrate your understanding, and always justify your reasoning with reference to the evidence provided in the studies described.

What to revise alongside this paper

This paper draws on **epidemiology and public health** concepts, so revising how scientists track disease spread, calculate infection rates, and identify risk factors will strengthen your understanding of Study 1. Understanding statistical concepts such as outliers, trends, and the difference between strong and weak correlations will help you interpret the scatter graph more confidently.

Revise **experimental design principles** thoroughly: independent and dependent variables, constants, control groups, sample size, randomisation, and blinding. Understanding why these features make experiments 'fair tests' is essential for parts (h), (i), and (k). Look at examples of clinical trials and learn to spot their limitations (small sample size, short duration, single location, ethical constraints).

Broaden your understanding of the **immune system** and how vitamins and minerals support immune function. Research how scientists evaluate potential treatments, including the ethical frameworks that govern medical research on human subjects. Familiarise yourself with real COVID-19 research papers published in 2020-2021 to see how the scientific community responded to a novel disease threat in real time.

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Key terms

> **Hypothesis**, **Correlation**, **Causation**, **Confounding variables**, **Scatter graph**, **Line of best fit**, **Randomised controlled trial**, **Double-blind**, **Control group**, **Placebo**, **ICU (Intensive Care Unit)**, **Reliability**, **Validity**, **Per capita (per million population)**, **Nanomoles per litre (nmol/L)**

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