MARINE SCIENCE

Paper 0697/11
Theory and Data Handling

Key messages

Candidates should ensure they read all of the information given in the question carefully and may need to revisit the entire question as there may be information that helps guide them for subsequent parts of the question. This was particularly noticeable in **Question 4(a)**, where some candidates restated the ecosystems given as examples in the question, and **Questions 4(b)** and **4(c)** where some candidates only referred to recreational activities.

Candidates generally showed a good command of relevant scientific vocabulary which was used accurately and enabled them to fully understand and access the questions. The exception to this was the word 'sustainability' in **Question 1(a)(iii)** where some candidates thought this meant to increase the catch, so provided incorrect responses.

General comments

Many candidates were well prepared and had obviously referred to past papers and mark schemes when preparing. Candidates generally demonstrated a good understanding across the breadth of the syllabus but sometimes found application of their knowledge to new situations more demanding. Candidates appeared to have sufficient time to complete the question paper, with few answers left blank.

For the questions requiring a longer response, such as **Questions 5(b)** and **8(a)**, candidates should be reminded to think more broadly across the syllabus and draw in additional information from other relevant sections of the syllabus.

Correct spelling of certain words is expected, which need to sound correct, e.g., for the kingdom in **Question 2(c)(ii)** 'ukarya' was given benefit of doubt, but not 'eurakara'.

Comments on specific questions

Question 1

(a) (i) Many candidates recognised and correctly named fishing method **L**, with many giving cast net for method **J** and trawling for method **K**. Most candidates gained at least partial credit.

(ii) Some candidates were able to give one reason, but few gave two. Generally, candidates could state that method **J** had a mesh size suitable for juveniles to escape from. Some candidates mentioned that juveniles could be thrown back, but they needed to state that they are still alive, as other throwback methods don't target/juveniles, or they are often dead or unlikely to survive. Only a small number of candidates tried to explain why methods **K** and **L** had higher juvenile losses, but some of these answers could not be credited as they did not say that the juveniles were unlikely to survive when caught in these methods.

(iii) Some candidates did not know the meaning of the word 'sustainable' used in this context, as they gave responses that focused on methods to increase the catch rate, such as putting more basket traps down, baiting them, or reducing the mesh size. Candidates who achieved credit mentioned quotas or closed seasons in equal number.

(b) The majority of candidates were able to rearrange the equation and calculate the total distance and so achieved partial credit. Stronger candidates recognised that the signal had to go to the fish and

back and were able to rearrange the equation to calculate the distance and divide by 2. Weaker candidates were often not able to correctly rearrange the formula and often divided the numbers instead. A small number of candidates correctly completed the calculation but then divided their answer by 0.04 to get the original 1480.

Question 2

(a) The majority of candidates gained at least partial credit. Many candidates correctly identified the midnight zone but had greater difficulty in correctly identifying the pelagic and subtidal zone. For the subtidal zone many candidates chose the definition of the intertidal zone.

(b) (i) Candidates found this a more challenging question. Some candidates thought that with a higher tide the salinity would be lower as there is more water present, rather than recognising that there would be more salt water present compared to the fresh water input.

(ii) Some candidates referred to the roots keeping the mangrove attached to the substrate, or leaf adaptations which did not gain credit as the question asked specifically for the adaptation to waterlogged soil with low oxygen concentration. Some candidates were able to state pneumatophores or aerial roots, and some mentioned gas exchange. Fewer candidates recognised that the importance of this was so that the roots could exchange gas with the atmosphere (rather than the water) and so did not provide enough information to gain full credit.

(c) (i) Many candidates were able to achieve partial or full credit, often mentioning the dark bands for camouflage or the spitting ability to knock prey into the water. However, many candidates who quoted the spitting ability did not mention that the mouth had an adapted/special shape to allow this. Some candidates confused the archerfish with the mudskipper and commented on adaptions for moving onto land.

(ii) Many candidates were able to correctly classify the archerfish, but some candidates gave ‘fish’ as the kingdom or domain. Weaker performing candidates suggested invertebrate as the domain.

Question 3

(a) (i) Most candidates correctly identified the plate boundary as divergent, and many also stated that this is because the distance between the continents was increasing. Only few candidates mentioned new seafloor being formed from the mid-oceanic ridge. Many candidates stated the names of the continents moving apart. Candidates needed to be careful to mention continents rather than countries moving further apart.

(ii) Many candidates were able to state that the movement that made the plates move was occurring in the mantle, and that this was caused by convection currents in the mantle. A few candidates referred to convection currents in the core which was not creditworthy.

(b) Most candidates achieved at least partial credit, most often for the correct energy change occurring during evaporation. The most common error was giving an increase or decrease in energy for precipitation.

(c) (i) Overall, candidates found this a challenging question with some candidates achieving partial credit and only stronger performing candidates gaining full credit. Some candidates mentioned a difference in salt concentration between salt water and fresh water, but few considered the long-term effect of evaporation on the ocean leading to the salts washed from the rivers producing a higher salinity level.

(ii) This question was generally answered well. Weaker performing candidates could not provide a reason for the Red Sea having a salinity over 35 ppt, but stronger candidates often gave good responses, recognising the temperature as being high and so there would be more evaporation. Many candidates also stated that the Red Sea had little exchange with the rest of the world ocean, was landlocked, or that there was little precipitation or fresh water input.

(iii) Only stronger performing candidates were able to give a valid response relating to the concentration of dissolved carbon dioxide in fresh water or sea water. Some candidates went beyond the requirements of the syllabus and mentioned hydrogen ion or hydroxide ion concentration in either fresh water or sea water, or carbonate buffering in sea water.

Question 4

(a) Most candidates were able to state at least one other coastal ecosystem, with many gaining full credit on this question. A small number of candidates restated the ecosystems given in the question.

(b) Many candidates stated that they provide a food source and often coastal protection. Some candidates' answers were too vague to gain credit, giving responses such as 'they stop tsunamis'. Others suggested jobs or an improved economy but needed to give specific examples. Weaker performing candidates tended to make statements such as 'to make medicine' while stronger performing candidates made statements such as 'mangrove ecosystems can provide a source of medicines'. Some candidates simply stated 'timber' which was too vague. All of the coastal ecosystems can provide some form of food, but only mangroves provide timber, while other ecosystems can provide materials such as sand or rock for building purposes, so they needed to give more detail than timber.

(c) A few candidates referred only to the effect of tourism so had not read the question carefully enough as they were asked for the impact of two other human activities. Many candidates stated fishing, but some did not go on to mention overfishing and its impact. Some candidates did not appear to have read the question carefully and only discussed the effects of tourism on the ecosystems.

Question 5

(a) The majority of candidates correctly identified a function of the cell wall. The most common error was giving the function of the cell membrane, controlling substances entering and leaving the cell.

(b) Many candidates were able to score partial credit, with many stronger performing candidates demonstrating a clear understanding of the differences between respiration and gas exchange. Some candidates mentioned glucose releasing energy when discussing respiration but did not state that this was a chemical reaction with oxygen. One common error was candidates stating that energy was made, produced or created, rather than released. Candidates should be aware that the energy comes from the light energy from the sun, captured during photosynthesis and passed on in chemical compounds which is released during respiration.

(c) (i) Most candidates correctly defined herbivore.

(ii) Many candidates found this a more challenging question, with only stronger performing candidates mentioning that carnivores were in a higher trophic level than herbivores. However, some mentioned that around 10 per cent of energy is passed from one trophic level to the next.

Question 6

(a) Many candidates gained partial credit, often for the idea that larger pieces of plastic break down in the water to form microplastics. Few candidates gave a named source of plastic, or suggested how it reached the ocean, with many candidates simply stating 'people dump plastic in the ocean'. However, most plastic found the oceans is washed or blown into watercourses and then carried downstream. This may take the form of existing microplastic from clothing or body scrubs, or larger plastic items such as water bottles or plastic bags.

(b) (i) Most candidates correctly read the two values from the graph but divided by the value for the group 'with microplastics' rather than 'no microlastics' and so gained only partial credit.

(ii) Some candidates suggested the microplastics blocked light for the coral to photosynthise despite the information given that there is no mutualistic relationship of cold-water corals and zooxanthellae. Some candidates referred to plastic being toxic, while some candidates suggested that it could cause physical damage to the polyp, but often did not go into sufficient detail e.g., 'the plastic hurts the polyp' rather than 'the plastics cause damage to the polyp'.

(iii) Stronger performing candidates identified that the zooxanthellae provided the polyps with nutrients due to their photosynthesis, and so the polyps in both groups would have a higher growth rate. A small number of candidates identified that the difference in growth rates may have reduced due to

the zooxanthellae photosynthesising to produce some nutrients for those in the water with microplastics.

(iv) Many candidates were able to gain partial credit, often by mentioning recycling, or banning single-use plastics, or a named example such as plastic water bottles. However, few candidates gained full credit as they named the strategy without explaining how that would reduce the plastics in the ocean.

Question 7

(a) Many candidates gained partial credit, often mentioning sustainability with ecotourism.

(b) (i) Many candidates found it difficult to relate the rules to the particular situation the question asked about. Many candidates correctly stated that rule 2 would reduce noise or light pollution which could confuse the turtles. Fewer candidates recognised that any activity in the ocean may stop turtles coming ashore or that vehicles can damage the turtles. For rule 1, some candidates stated it would reduce pollution but needed to be more precise.

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(iii) Many candidates suggested a suitable sustainable method, with many giving a reason such as lower carbon emissions or less noise. However, some answers were too vague on the reason, stating ‘it would not release pollutants’. A small number of candidates might not studied the map as they suggested coming from the ocean by paddleboat or sailing boat, but could still gain partial credit if they stated that it would reduce noise or carbon emissions.

(iv) Only the strongest performing candidates gained full credit. Others often did not describe the conflict, such as competition for land, without expanding on that further by giving an effect that may occur.

Question 8

(a) This question required candidates to take information from different aspects of the syllabus. Both phytoplankton and zooplankton were mentioned in the question to encourage candidates to think about both types of plankton. Many only referred to plankton in general as one homogenous group. Candidates were still able to achieve partial credit if they did this but mentioning both types of plankton as well as discussing each of them. Many candidates mentioned that plankton were producers/photosynthetic, but did not gain credit if they just implied this to be the case for all plankton. Some candidates then discussed why photosynthesis was important and gained partial credit for this. Stronger performing candidates mentioned both for full credit.

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MARINE SCIENCE

Paper 0697/12
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MARINE SCIENCE

Paper 0697/13
Theory and Data Handling

There were too few candidates for a meaningful report to be produced.

MARINE SCIENCE

Paper 0697/21
Theory and Practical Skills

Key messages

In future series, candidates should

- make sure that they know all the core practicals listed in the syllabus
- show all their working when performing calculations
- select linear scales for graphs that have sensible increments to make plotting easier
- make sure that drawings are larger than the original image
- when answering questions with the command word 'discuss', describe all data patterns and suggest explanations, always exploring all data and information.

General comments

Factual recall was generally very strong, and many candidates wrote answers using scientific terminology appropriate to IGCSE standard. Most candidates demonstrated a strong knowledge of all topic areas, but a few candidates tended to use terminology inaccurately. Mathematical skills were strong, and most candidates showed their working. This is good practice as even if the final answer is incorrect, partial credit may be awarded for a correct method. Recall of core practicals that are listed in the syllabus was very strong with many candidates giving excellent, detailed descriptions of how to test for lipids, how to use a Secchi disc and how to measure the profile of a shore.

Generic practical skills are also assessed on this paper. Most candidates were able to suggest apparatus, comment on accuracy, identify variables and plan an investigation. Most candidates had a good understanding of how to plan an experiment to investigate the effect of the profile of a shore on the number of turtle nests present. When writing investigative plans, candidates should be clear as to how they will change the independent variable, how they will measure the dependent variable, suggest control variables, and consider safety. A few candidates confused measuring the profile of a shore with measuring the particle size profile of sediment.

Graph skills were generally excellent, but a number of candidates used non-linear scales. When drawing graphs, candidates should make sure that they use linear scales, fully label all axes, and make use of most of the grid space. Candidates are also recommended to use sensible increments when making the scales as this makes it less likely that they will plot points inaccurately.

Drawing skills were generally excellent and most candidates presented drawings that had continuous lines, had no shading, were in proportion and were of an acceptable size. Drawings should be larger than the original photograph and should be drawn in pencil.

Many candidates found data analysis challenging. If candidates are asked to 'discuss' data, they should first describe any patterns evident in the data and then offer suggestions for the patterns. The command word 'discuss' also requires candidates to explore data or an issue fully rather than restricting the answer to one aspect.

Comments on specific questions

Question 1

(a) This question asked candidates to state two of the main characteristic features of crustaceans. Common, correct answers included bilateral symmetry, the presence of compound eyes, an exoskeleton, and having two pairs of antennae. Some candidates confused crustaceans with

annelids. Some candidates stated that crustaceans have two antennae, rather than two pairs of antennae. Some candidates gave vague answers such as “crustaceans have a shell”, rather than an exoskeleton.

(b) (i) Many candidates gave a correct example of a nutrient group, typically proteins, carbohydrates or vitamins. Some candidates gave named examples, but the question asked for a nutrient group rather than specific examples. A few candidates stated fats or lipids, but the question asked for another group rather than lipids.

(ii) This question was generally well answered with many candidates gaining at least partial credit and a significant number going on to gain full credit. Many candidates stated correctly that the shrimp would be ground up or crushed and that ethanol would be added. Many also stated that a white emulsion would be produced, but a common error was to not mention the addition of water. Many candidates also stated that the mixture would need mixing. A small number of candidates gave correct alternative methods, such as the addition of Sudan III stain, or the grease spot test. Some candidates gave incorrect tests such as the biuret test or Benedict’s test.

(iii) This question asked candidates to explain the importance of lipids. Many candidates gained at least partial credit with a significant number gaining full credit. Common correct answers included the role of lipids as energy sources, as insulators, and in assisting buoyancy. A small number of candidates confused lipids with proteins and suggested that they are used in growth and repair.

Question 2

(a) (i) This question assessed candidates’ generic practical skills and asked them to describe a piece of laboratory equipment that could be used to measure out 100 cm^3 of water. Many candidates gained credit for correctly suggesting the use of a measuring cylinder or pipette. Common incorrect answers were beakers and measuring jugs. Candidates should understand the purposes of typical laboratory equipment.

(ii) This question also assessed candidates generic understanding of practical work and asked for two ways that accuracy could be improved. Common correct answers included drying the beaker before weighing it, using a thermostatically controlled water bath, and repeating the experiment to enable means to be calculated (replication was accepted as in this case, the results would be closer to the true value if replicates were performed and a mean calculated). Some candidates incorrectly suggested using more temperatures, weighing the water by itself and controlling other variables (which would not necessarily improve accuracy).

(b) This question presented candidates with a graph that showed how temperature affected the change in mass of the sample of carbonated water. The question asked candidates to explain the effect of increasing temperature. Many candidates gained at least partial credit with some going on to gain full credit. Many candidates described correctly the effect of increased temperature by stating that the mass decreases or that the change in mass increased. However, some candidates incorrectly stated that the change in mass decreased. This is incorrect as the actual change in mass increases at higher temperatures. Stronger answers went on to explain that at higher temperatures particles have more kinetic energy, move faster and so the carbon dioxide gas escapes faster. Many candidates also correctly stated that the solubility of carbon dioxide decreases as temperature increases. Some candidates incorrectly referred to evaporation of water molecules.

(c) This question asked candidates why warm water is usually found on top of cold water. Stronger answers stated that in warmer water, the water molecules have more kinetic energy and spread out more, take up more volume, and so the density is lower. Stronger answers also stated that warm, lower density water floats to the top (or cold, higher density water sinks). Common incorrect answers suggested that “warmer, higher density water floats”, and others simply restated the question about warmer water lying on the surface.

Question 3

(a) (i) This question asked candidates to identify a primary consumer in an ocean food web. Most candidates were able to correctly name shrimp, mackerel, or copepods. A small number of candidates incorrectly suggested phytoplankton or sharks.

(ii) This question required candidates to extract and draw the longest food chain in the food web. Many candidates drew the food chain correctly and placed the arrows in the right directions. Where candidates did not gain full credit, it was often for missing out one organism or for reversing the directions of the arrows. A small number of candidates incorrectly drew pyramids or drew parts of the food web rather than a single food chain.

(b) (i) This question assessed candidates' drawing skills. Most candidates correctly used pencil rather than pen, and only a small number of candidates included shading. Most candidates drew unbroken, clear lines, and most drawings were at least as large as the original image. Candidates should always make full use of the space and produce drawings that are at least as large as the original image. Some candidates found drawing the dinoflagellate in the correct proportions challenging.

(ii) This question required candidates to measure the length of the dinoflagellate and use the magnification to calculate its actual length. Most candidates gained at least partial credit with many going on to gain full credit. Where candidates did not gain full credit, it was often due to incorrect rounding and/or not giving the final answer to two significant figures or measuring the length in cm and then not converting into mm. Candidates should be clear of the difference between decimal places and significant figures.

(iii) (iv) These questions assessed candidates understanding of dinoflagellate classification. In **(b)(iii)**, candidates had to state the kingdom and in **(b)(iv)** candidates had to give one feature other than the possession of two flagella that is present in dinoflagellates. Many candidates correctly stated that dinoflagellates are classified in the Protoctista kingdom, but a number of candidates gave incorrect suggestions such as Eukarya or Plantae. Many candidates were also able to name a feature such as the possession of chloroplasts or their microscopic size.

(c) (i) This question assessed candidates' understanding of a core practical, the use of a Secchi disc to estimate phytoplankton numbers. Many candidates showed excellent knowledge of how to use a Secchi disc and correctly described how they are lowered into the water until they are no longer visible, the length of the rope measured and then subsequently the length remeasured when they are raised and become visible again. However, a number of candidates did not seem to recall how a Secchi disc is used and confused them with plankton sampling nets, suggesting that they could be used to trap the phytoplankton.

(ii) This question assessed generic practical skills and asked candidates to suggest why the Secchi disc does not give an accurate measure of population sizes. Many excellent suggestions were seen which included the ideas that the Secchi disc only measures turbidity, that other factors could affect the turbidity, that the light may vary, and that the test is very subjective.

Question 4

(a) (i) This question required candidates to identify the mantle in a diagram of the Earth. Most candidates were able to answer this question correctly with a small number giving incorrect answers such as rocks.

(ii) This question asked candidates to describe the structure of the Earth's core. Stronger answers stated that there is a solid inner core and a liquid outer core and that the core contains iron and/or nickel. Some candidates incorrectly suggested that the inner core is liquid, and others mentioned the inner and outer core but did not describe how they are different. Partial credit was awarded for mention of the inner and outer core if no other credit had been awarded.

(b) (i) This question assessed candidates' knowledge of ocean currents, and candidates were asked to state what is meant by the term 'oceanic current'. Many correct answers were seen which described the movement of water in a particular direction, but many other answers gave vague references to water movement, or upwelling, with no idea of direction. This term is defined in the syllabus, and candidates should ensure that they know all the terms that are defined in the syllabus.

(ii) This question followed on from **(b)(ii)** and asked for a factor, other than the spinning of the Earth or wind, that causes oceanic currents. Many correct answers were seen that suggested factors such as density, temperature gradients, or tides. A number of candidates restated the question and

suggested wind speed, and others gave vague factors such as climate change. The syllabus lists a range of factors which candidates should be familiar with.

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(ii) This question asked candidates to name one of the independent variables in the investigation. Both wind speed and wind direction were independent variables, and most candidates were able to correctly name one. A number of candidates confused independent and dependent variables and incorrectly stated current speed. Knowledge of independent and dependent variables is an important generic practical skill.

(iii) This question asked candidates to describe how mean current speed can be determined. Most candidates demonstrated excellent knowledge of the practical method and gained at least partial credit, with many gaining full credit. Most recognised that it would be necessary to measure the time taken to travel a set distance and then the speed is calculated by dividing the distance by the time. Many also correctly stated that replicates would be needed to produce a mean current speed.

(iv) This challenging question assessed candidates' data analysis skills and required them to discuss if the results of the investigation supported the idea that current speed increases when wind speed increases. Stronger answers stated that on days one to three, the wind speed did increase along with the current speed and then gave examples of how on days four and day five, when the wind came from different directions, that increased wind speed did not increase the current speed. Stronger candidates also explained that the prevailing wind direction was from the Northwest and that wind direction clearly also affects current speed. When asked to 'discuss' data, it is important for candidates to explore all aspects of the data fully.

Question 5

(a) This question asked candidates how MARPOL standards reduce the environmental impacts of oil transports. Most candidates recognised that the risk of oil spills is reduced and many also described the role of double hulls. Only stronger candidates went further by describing how special areas are needed to wash out the hold or the need to control release of sewage and garbage. A few candidates gave vague answers about improved boat design without giving specific methods such as the use of double hulls.

(b) (i) This question asked candidates to produce a line graph. The quality of line graphs was generally good, and most candidates labelled the axes carefully with units and joined points with a ruler and straight lines. The most common error was to not use a linear scale. When deciding on the scales, candidates should choose sensible increments. Some candidates chose unusual increments for the scales which makes plotting points difficult and increases the risk of inaccurate plotting.

(ii) This question asked candidates to describe the effect of increasing the ratio of dispersant to oil on the effectiveness of the dispersant. Most candidates gained at least partial credit for correctly stating that the effectiveness increased; but fewer candidates identified the turning point in the data where the effect begins to level off. If asked to describe data and more than one mark is allocated, candidates should identify the trends and pick out turning points.

(iii) This mathematical question was answered well, and most candidates were able to identify that the ratio needed would be 0.05; they then used this to calculate a mass of 250 kg of dispersant. The most common errors were not adding a unit and multiplying by 0.55 rather than 0.05.

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(c) This final part of the question asked candidates to discuss the environmental advantages and disadvantages of using wind turbines placed into oceans. Most candidates demonstrated a good knowledge of the topic with most gaining at least partial credit and many going on to gain full credit.

Most candidates recognised that both advantages and disadvantages were needed, and many candidates structured their answers to clearly show different aspects of each. Common correct answers for the advantages included the fact that wind power will not run out, and that the release of carbon dioxide and therefore the risk of climate change would be reduced. Common correct disadvantages included the risk of birds colliding with the turbines, damage to the seabed and habitats, as well as the costs. Some candidates tended to focus their answers on only one or two aspects. In a four mark 'discussion' question, candidates should explore a topic fully.

Question 6

(a) This question asked candidates to explain the role of migration in the life cycle of the leatherback turtle. Most candidates were able to gain at least partial credit with many gaining full credit. Most candidates recognised that on hatching, young turtles head into the ocean, and many excellent descriptions of the movement of turtles towards the Sargasso Sea were seen. Many candidates explained that migration enabled the turtles to move to areas with fewer predators, to find food, and to find mates. Many candidates also stated that females would return to the same beach that they were hatched on to lay eggs. Where candidates did not gain full credit, it was usually for not adding enough detail or for simply describing what the migration pattern is rather than explaining its role.

(b) (i) This question required candidates to extract information from the graph to identify the percentage of female turtles that hatch from a nest at 30 °C. Most candidates were able to identify the correct value.

(ii) This question required candidates to use their answer from **(b)(i)** to calculate the number of male and female turtles that would be produced. Most were able to complete the calculation correctly. A few candidates were unable to use a percentage and so gained no credit.

(iii) This question drew all the information together and asked candidates to explain why fossil fuel usage would result in a lower turtle population. Stronger answers explained that carbon dioxide release from burning fossil fuels could lead to an increase in global temperature and so fewer male turtles would hatch resulting in a lower rate of breeding. Some candidates also correctly suggested that a change in temperature may cause a sea level rise reducing the number of nesting sites and/or affecting the food chains. A few candidates gave vague answers about an increase in pollution affecting turtle eggs or a general fall in the number of turtles hatching. Candidate needed to refer to specific effects of pollution and use data in the question to support their answers.

(c) This question assessed candidates' experimental planning. The question required candidates to investigate the effect of the profile of sandy shores on the number of turtle nests present. Stronger candidates gave experimental methods to measure the shore profiles using poles and clinometers. A number of candidates confused measuring the profile of a shore with measuring the particle sizes of sediment. Stronger candidates also gave a method for measuring the dependent variable, often suggesting using quadrat sampling and the counting of nests. A few candidates incorrectly suggested counting eggs, rather than the number of nests. Stronger candidates also considered the need to standardise other variables such as the time of year or day and other features of the shore. Many gave a relevant safety measure such as the need to check tide times or working in a group and showed an ethical understanding by explaining that it is important to not disturb the turtle nests. When answering investigative planning questions, candidates should describe how to change the independent variable, describe how to measure the dependent variable, consider all the standardised variables, consider replicates, and consider how to ensure safety and ethical considerations if it involves living organisms.

MARINE SCIENCE

Paper 0697/22
Theory and Practical Skills

Key messages

In future series, candidates should

- make sure that they know all the core practicals listed in the syllabus
- show all their working when performing calculations
- select linear scales for graphs that have sensible increments to make plotting easier
- make sure that drawings are larger than the original image
- when answering questions with the command word 'discuss', describe all data patterns and suggest explanations, always exploring all data and information.

General comments

Factual recall was generally very strong, and many candidates wrote answers using scientific terminology appropriate to IGCSE standard. Most candidates demonstrated a strong knowledge of all topic areas, but a few candidates tended to use terminology inaccurately. Mathematical skills were strong, and most candidates showed their working. This is good practice as even if the final answer is incorrect, partial credit may be awarded for a correct method. Recall of core practicals that are listed in the syllabus was very strong with many candidates giving excellent, detailed descriptions of how to test for lipids, how to use a Secchi disc and how to measure the profile of a shore.

Generic practical skills are also assessed on this paper. Most candidates were able to suggest apparatus, comment on accuracy, identify variables and plan an investigation. Most candidates had a good understanding of how to plan an experiment to investigate the effect of the profile of a shore on the number of turtle nests present. When writing investigative plans, candidates should be clear as to how they will change the independent variable, how they will measure the dependent variable, suggest control variables, and consider safety. A few candidates confused measuring the profile of a shore with measuring the particle size profile of sediment.

Graph skills were generally excellent, but a number of candidates used non-linear scales. When drawing graphs, candidates should make sure that they use linear scales, fully label all axes, and make use of most of the grid space. Candidates are also recommended to use sensible increments when making the scales as this makes it less likely that they will plot points inaccurately.

Drawing skills were generally excellent and most candidates presented drawings that had continuous lines, had no shading, were in proportion and were of an acceptable size. Drawings should be larger than the original photograph and should be drawn in pencil.

Many candidates found data analysis challenging. If candidates are asked to 'discuss' data, they should first describe any patterns evident in the data and then offer suggestions for the patterns. The command word 'discuss' also requires candidates to explore data or an issue fully rather than restricting the answer to one aspect.

Comments on specific questions

Question 1

(a) This question asked candidates to state two of the main characteristic features of crustaceans. Common, correct answers included bilateral symmetry, the presence of compound eyes, an exoskeleton, and having two pairs of antennae. Some candidates confused crustaceans with

annelids. Some candidates stated that crustaceans have two antennae, rather than two pairs of antennae. Some candidates gave vague answers such as “crustaceans have a shell”, rather than an exoskeleton.

(b) (i) Many candidates gave a correct example of a nutrient group, typically proteins, carbohydrates or vitamins. Some candidates gave named examples, but the question asked for a nutrient group rather than specific examples. A few candidates stated fats or lipids, but the question asked for another group rather than lipids.

(ii) This question was generally well answered with many candidates gaining at least partial credit and a significant number going on to gain full credit. Many candidates stated correctly that the shrimp would be ground up or crushed and that ethanol would be added. Many also stated that a white emulsion would be produced, but a common error was to not mention the addition of water. Many candidates also stated that the mixture would need mixing. A small number of candidates gave correct alternative methods, such as the addition of Sudan III stain, or the grease spot test. Some candidates gave incorrect tests such as the biuret test or Benedict’s test.

(iii) This question asked candidates to explain the importance of lipids. Many candidates gained at least partial credit with a significant number gaining full credit. Common correct answers included the role of lipids as energy sources, as insulators, and in assisting buoyancy. A small number of candidates confused lipids with proteins and suggested that they are used in growth and repair.

Question 2

(a) (i) This question assessed candidates’ generic practical skills and asked them to describe a piece of laboratory equipment that could be used to measure out 100 cm^3 of water. Many candidates gained credit for correctly suggesting the use of a measuring cylinder or pipette. Common incorrect answers were beakers and measuring jugs. Candidates should understand the purposes of typical laboratory equipment.

(ii) This question also assessed candidates generic understanding of practical work and asked for two ways that accuracy could be improved. Common correct answers included drying the beaker before weighing it, using a thermostatically controlled water bath, and repeating the experiment to enable means to be calculated (replication was accepted as in this case, the results would be closer to the true value if replicates were performed and a mean calculated). Some candidates incorrectly suggested using more temperatures, weighing the water by itself and controlling other variables (which would not necessarily improve accuracy).

(b) This question presented candidates with a graph that showed how temperature affected the change in mass of the sample of carbonated water. The question asked candidates to explain the effect of increasing temperature. Many candidates gained at least partial credit with some going on to gain full credit. Many candidates described correctly the effect of increased temperature by stating that the mass decreases or that the change in mass increased. However, some candidates incorrectly stated that the change in mass decreased. This is incorrect as the actual change in mass increases at higher temperatures. Stronger answers went on to explain that at higher temperatures particles have more kinetic energy, move faster and so the carbon dioxide gas escapes faster. Many candidates also correctly stated that the solubility of carbon dioxide decreases as temperature increases. Some candidates incorrectly referred to evaporation of water molecules.

(c) This question asked candidates why warm water is usually found on top of cold water. Stronger answers stated that in warmer water, the water molecules have more kinetic energy and spread out more, take up more volume, and so the density is lower. Stronger answers also stated that warm, lower density water floats to the top (or cold, higher density water sinks). Common incorrect answers suggested that “warmer, higher density water floats”, and others simply restated the question about warmer water lying on the surface.

Question 3

(a) (i) This question asked candidates to identify a primary consumer in an ocean food web. Most candidates were able to correctly name shrimp, mackerel, or copepods. A small number of candidates incorrectly suggested phytoplankton or sharks.

(ii) This question required candidates to extract and draw the longest food chain in the food web. Many candidates drew the food chain correctly and placed the arrows in the right directions. Where candidates did not gain full credit, it was often for missing out one organism or for reversing the directions of the arrows. A small number of candidates incorrectly drew pyramids or drew parts of the food web rather than a single food chain.

(b) (i) This question assessed candidates' drawing skills. Most candidates correctly used pencil rather than pen, and only a small number of candidates included shading. Most candidates drew unbroken, clear lines, and most drawings were at least as large as the original image. Candidates should always make full use of the space and produce drawings that are at least as large as the original image. Some candidates found drawing the dinoflagellate in the correct proportions challenging.

(ii) This question required candidates to measure the length of the dinoflagellate and use the magnification to calculate its actual length. Most candidates gained at least partial credit with many going on to gain full credit. Where candidates did not gain full credit, it was often due to incorrect rounding and/or not giving the final answer to two significant figures or measuring the length in cm and then not converting into mm. Candidates should be clear of the difference between decimal places and significant figures.

(iii) (iv) These questions assessed candidates understanding of dinoflagellate classification. In **(b)(iii)**, candidates had to state the kingdom and in **(b)(iv)** candidates had to give one feature other than the possession of two flagella that is present in dinoflagellates. Many candidates correctly stated that dinoflagellates are classified in the Protoctista kingdom, but a number of candidates gave incorrect suggestions such as Eukarya or Plantae. Many candidates were also able to name a feature such as the possession of chloroplasts or their microscopic size.

(c) (i) This question assessed candidates' understanding of a core practical, the use of a Secchi disc to estimate phytoplankton numbers. Many candidates showed excellent knowledge of how to use a Secchi disc and correctly described how they are lowered into the water until they are no longer visible, the length of the rope measured and then subsequently the length remeasured when they are raised and become visible again. However, a number of candidates did not seem to recall how a Secchi disc is used and confused them with plankton sampling nets, suggesting that they could be used to trap the phytoplankton.

(ii) This question assessed generic practical skills and asked candidates to suggest why the Secchi disc does not give an accurate measure of population sizes. Many excellent suggestions were seen which included the ideas that the Secchi disc only measures turbidity, that other factors could affect the turbidity, that the light may vary, and that the test is very subjective.

Question 4

(a) (i) This question required candidates to identify the mantle in a diagram of the Earth. Most candidates were able to answer this question correctly with a small number giving incorrect answers such as rocks.

(ii) This question asked candidates to describe the structure of the Earth's core. Stronger answers stated that there is a solid inner core and a liquid outer core and that the core contains iron and/or nickel. Some candidates incorrectly suggested that the inner core is liquid, and others mentioned the inner and outer core but did not describe how they are different. Partial credit was awarded for mention of the inner and outer core if no other credit had been awarded.

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MARINE SCIENCE

Paper 0697/23
Theory and Practical Skills

There were too few candidates for a meaningful report to be produced.