# MARINE SCIENCE

**Paper 0697/01**
**Structured**

## Key messages

Candidates need to ensure they understand what they are required to produce for different command words, as some candidates did not make sufficient links in some of the "explain" questions. Some candidates would have benefitted from improving their use of scientific terminology in their answers.

## General comments

Candidates seemed to be well prepared and many stronger candidates gave excellent answers to demonstrate their knowledge and understanding across the syllabus content. Most candidates attempted all questions. Sometimes candidates made good points and started an answer to a question, but did not check on what they were asked, so did not make the final link to achieve more marks.

## Comments on specific questions

### Question 1

**(a) (i)** Many candidates were able to state that a primary producer was an organism which performed photosynthesis, or made their own food, with some stronger candidates stating they are organisms which convert light energy into organic matter. Many candidates stated it was the start of the food chain, or that it is food for other organisms, which was not sufficient here.

**(ii)** Weaker candidates often stated it was "what ate what" or "predators and prey" rather than the flow of energy.

**(b)** As this was an explain question, details were required . Some candidates simply stated, "less cod means more sea urchins", without the explanation of why less cod leads to more sea urchins. Many stronger candidates answered this comprehensively.

**(c)** Whilst many stronger candidates were able to name a correct use for one or both nutrients, weaker candidates often stated, "for growth" or "for energy".

**(d)** Most candidates found this question challenging but stronger candidates were able to provide two or three reasons for energy loss between trophic levels. Many others talked more vaguely about "loss of nutrients", "metabolic waste" or "only 10% of the energy is transferred".

### Question 2

**(a) (i)** Many candidates were able to name the three methods. The most common correct answer was pole and line, and the least well known was the longline, when candidates often suggested gill nets.

**(ii)** Many candidates were able to suggest a correct problem caused by trawling of either by-catch or damage to the seabed. Disruption of the sea bed was not sufficient for the idea of damage to this area.

**(b) (i)** Some candidates gave answers which did not exactly address the question, such as saying more algae would grow on natural materials, or that it is more environmentally friendly. Quite a few candidates talked about the fish eating the plastic. This is less likely when the mesh is large and

attached so did not achieve credit, but some candidates said as the plastic breaks up, fish may eat it and cause problems to them or organisms higher in the food chain, which did achieve credit.

**(ii)** Many weaker candidates again discussed the damage to the seabed, but that would not be a concern for purse seine nets. Some talked about "reducing the fish stock" but as any form of fishing would have that effect, they needed to include the idea that they remove too many or large numbers of fish, or that the stock is overexploited or overfished.

**(c)** Most candidates gained at least partial credit, with many scoring full credit. Links between the material and disadvantages were generally better known than the advantages. Quite a few candidates were not sure which type of material was renewable.

**Question 3**

**(a) (i)** Candidates needed to give the full name of tectonic plates to achieve credit. Many simply stated "plates" and some mentioned only oceanic or continental plates. If they named both, credit was awarded.

**(ii)** Many candidates understood the formation of a tsunami was something to do with plates moving but did not give enough detail to achieve credit. Some did understand it was due to a sudden movement of tectonic plates, with some also able to state this caused an earthquake, or that a sudden underwater volcanic eruption could cause a tsunami. Some candidates tried to explain plates being stuck on each other, but often just referred to pressure "being formed" rather than understanding the effect of the pressure build up, and that this is released suddenly. Some candidates understood that these events lead to a displacement of a huge volume of water at once, which causes the wave to start moving.

**(b)** Most candidates attempted this question but found it challenging. However, some were able to suggest that the line became more taut which sent a signal, and some suggested the device measured the speed of the water and when it detected a change, a signal was sent. Few candidates mentioned a change in pressure.

**Question 4**

**(a) (i)** Many candidates were able to state either cephalopod or gastropod.

**(ii)** Nearly all candidates calculated this correctly.

**(iii)** Of the candidates who gained credit here, most suggested that demand had not increased, or that quotas or other methods of catch control had been applied, all of which were valid answers.

**(b) (i)** Candidates often found expressing themselves quite difficult. Some mixed up intensive and extensive, and some referred to either intensive or extensive twice in their answer, and so contradicted themselves, e.g., "extensive is cheap to set up but extensive costs more". The most common correct answers were control of the environment, or control of a stated feature, such as temperature, for intensive aquaculture, feeding requirement for intensive, and lower cost for setting up an extensive system.

**(ii)** While some candidates gave the names of intensively reared species, many of their suggestions were for extensively aquacultured species.

**(iii)** Many candidates stated that much land would be used for aquaculture operations, however many are entirely sea based, so use very little land. Other candidates stated habitat damage, which required more detail for the award of credit, while some of the stronger candidates were able to suggest water pollution from feed or faeces, with a few mentioning diseases. None suggested escape of farmed fish which can affect wild fish when they breed with them.

**(c)** Most candidates achieved at least partial credit here, with many candidates achieving full credit.

**Question 5**

**(a)** Candidates could usually identify the tentacles and mouth but found the mesenteries more difficult. However, stronger candidates accurately identified and described the function of all structures. A

common error was to forget that the mouth also acts as an anus for removal of waste, and both were required for credit.

**(b) (i)** Many candidates found this difficult as they just stated, “they collect food particles” or did not give the required scientific detail, e.g., “they act as a weapon by injecting and killing the prey”. For full credit, candidates needed to mention a toxin, or that the prey was paralysed or immobilised in some way.

**(ii)** Candidates again often lacked detail in their answers, with some saying it provided the colour to attract prey near it, or that they eat the zooxanthellae. Most stronger candidates knew that energy was passed to the polyp, and a few knew they were photosynthetic, but gave little detail of the photosynthetic process.

**(c)** Some candidates gave effects on the ecosystem but did not include the effect on the fishery itself. Some correctly stated that the area was a nursery ground, and that biodiversity may be reduced. Many stated there would be fewer fish but did not go on to say that this would reduce catch. Candidates needed to ensure they completely answered the question asked and should ensure that they review the question again when they have written their answer.

**Question 6**

**(a)** Many candidates gave a clear description of a market, but many missed out a vital element of the description, such as only mentioning buyers or sellers.

**(b) (i)** A significant number of candidates just stated “decreased population” without any reason about why the population decreased, so did not achieve credit. In stronger answers, most stated overfishing had occurred.

**(ii)** A significant number of candidates explained that the price would increase, with some of these simply restating that there was a decrease in catch, rather than explaining that the decreased catch results in a reduced supply to customers, which causes the price to rise.

**(c) (i)** Stronger candidates gave named examples of a natural resource, or stated they are resources found naturally or in the environment of a country’s borders. Some stated that these could be used for economic purposes which was insufficient, with fewer stating they could be sold or traded, or that a profit could be made from them.

**(ii)** Most candidates found this question challenging but stronger candidates mentioned some form of government involvement or assistance.

**(d)** Many candidates were able to give at least one suitable method that the government could use to ensure long term sustainability of a fishery, usually the idea of quotas was suggested, with boat or gear restrictions also commonly given.

**Question 7**

**(a)** Answers here were often too vague for full credit. For carbon dioxide, many candidates suggested vehicles rather than the fossil fuels that power the vehicles. For plastics, many just stated litter, rather than a named plastic item that is often discarded. Slightly more candidates recognised the human source of excess nutrients, but then for noise stated factories or loud music, rather than thinking about how sound may enter the oceans.

**(b)** A lot of candidates answered this question very well and were able to give several problems with litter landing in the ocean, including feeding on it, getting caught in it, and the effect this may have on the organisms, most usually suggesting death. Few mentioned any of the problems caused by ingestion or entanglement that leads to the death of the organisms.

**(c)** Only the strongest candidates were able to explain any of the pollution control methods used for oil spills, with most suggesting how to stop the spills in the first place rather than what efforts are made to clean up once they have occurred.

**Question 8**

This question tested candidates' classification skills, being given a description of an organism and they then classified its kingdom and group.

**(a)** Most candidates identified that this was a plant but few then identified it as a flowering plant or seagrass.

**(b)** Most candidates recognised it was in phylum animalia, and many stronger candidates named either crustacea or arthropod for the group.

**(c)** Some stronger candidates were able to identify this as being a protoctist, with many stating monera, but more identified it as an algae, with some stating it was a red algae. The strongest candidates correctly named it as rhodophyta.

# MARINE SCIENCE

**Paper 0697/02**
**Paper 2**

## Key messages

The standard of answers this year was very good and most candidates showed strong graph skills, good data analysis and strong factual knowledge of all areas of the syllabus. In future series, candidates should:

- select sensible linear scales for graph axes
- apply their own knowledge to unfamiliar data with confidence
- use key technical vocabulary in their answers
- make sure that they know what all the command words require.

## General comments

Most candidates had prepared very well for the examination. Graph skills were generally very good and candidates' approach to mathematical calculations was also good. Some candidates found data analysis more challenging and needed to try to approach unfamiliar data with confidence. Answers to extended factual recall questions in ***Section B*** were often excellent but some candidates did not give enough depth and technical detail in their answers to gain high scores. Some candidates found **Question 3(b)** concerning the chemical factors that affect marine organisms challenging and frequently gave vague answers about physical factors. **Question 4(b)**, however, was answered much better with many candidates giving detailed, accurate answers.

## Comments on specific questions

***Section A***

**Question 1**

**(a) (i)** This question required candidates to draw a graph to show the catch of yellowfin tuna each year between 2013 and 2018. Most candidates were able to label axes with units, select linear scales, plot points accurately and join the points with straight lines. Few drew bar charts. The main error was the generation of a linear scale for the catch. A significant number of candidates did not select a linear scale and many others selected unusual increments such as 7.5 s. Candidates should try to use scales with sensible increments such as 2 s, 10 s, 100 s etc. so that there is less risk of making plotting errors. Some candidates plotted the wrong column of data but still gained some credit for correct labelling, scale production and joining points.

**(ii)** Most candidates were able to gain at least partial credit for recognising that the catch goes down then up. Many went on to correctly identity the turning point. If a description of data is allocated more than one mark, candidates should look for turning points or detailed aspects of the data.

**(iii)** This question was answered well with most candidates correctly calculating the CPUE.

**(iv)** Many candidates found this question challenging. The question asked candidates to suggest two reasons for the steep fall in CPUE. Many candidates gave vague answers about demand changing. As CPUE fell, the data showed that more effort was being put in to catch fewer fish. Stronger candidates gave suggestions for the fall in catch such as disease, increased predation or migration.

**(v)** Many candidates gained credit for this question. The question required candidates to suggest a reason why the number of days of all the boats fishing was likely to be an inaccurate measure of

fishing effort. Answers that gained credit included the ideas that boats have different sizes, different fishing gear, and have different numbers of crew.

**(b)** This question assessed candidates' interpretation of how artificial reefs can increase the catch of commercial fish species. Candidates were presented with data from an artificial reef including the increase of area of reef covered with coral polyps, the number of different species found on the reef and the catch of rainbow runner fish. Most candidates gained at least partial credit with many stronger candidates gaining full credit. Most recognised that the coverage of the reef increased over time, and this led to an increase in other species due to the presence of more food or niches. The catch of rainbow runners increased after the number of prey species increased. Some candidates did not recognise that the other species provided food for the rainbow runners.

**Question 2**

**(a) (i)** This question assessed knowledge of carbohydrates. Many candidates correctly recognised that oysters contained the most glycogen and so had the most carbohydrates. A significant number of candidates suggested salmon contained the most carbohydrates.

**(ii)** Many candidates were able to correctly calculate the mass of tuna that would contain 50 g of protein. Most gained at least partial credit for giving the correct unit.

**(iii)** This question was generally answered well with most candidates recognising that salmon would go rancid due to the high fat content being oxidised by the oxygen in the atmosphere. A significant number of candidates incorrectly suggested tuna.

**(b) (i)** Most candidates were able to correctly use the graph to calculate an 8-day difference in shelf life of the seabream when it was kept at 0 °C rather than 12 °C.

**(ii)** Many candidates found calculating a percentage difference challenging and divided the difference by 10 rather than 2.

**(c) (i)** Stronger candidates often gained full credit while weaker candidates gained partial credit. Candidates were required to look at the data in the table and explain why using clean ice and careful handling was the best preservation method for fish on boats. Many candidates recognised that using clean ice and careful handling preserved the fish for longer than using rough handling and dirty ice. Stronger candidates were able to explain that using clean ice had almost the same effect as using disinfectants and would be cheaper or would not affect the taste of fish.

**(ii)** Only stronger candidates gained credit on this question. Many candidates simply described the data and did not give explanations for why careful handling, clean ice, and disinfectant reduced bacterial and enzymatic activity. Candidates should be careful to give explanations rather than descriptions if asked to explain.

***Section B***

**Question 3**

**(a)** This question asked candidates to outline the main features of wet and dry monsoons. Some candidates gave excellent answers that thoroughly explained the differences in wind direction, times of year, effects of weather and effects on fishing. A significant number of candidates wrote answers that confused the direction of the winds and/or confused the times of year when each monsoon occurs. Only the very strongest explained the roles of temperature differences and pressure differences in generating the monsoons. Weaker candidates often gained partial credit, typically for describing the weather conditions.

**(b)** Many candidates found this question challenging and often gained only partial credit. Some excellent, detailed, and accurate answers were also seen that gained full credit. Weaker answers often discussed physical properties such as temperature, light intensity, and pressure rather than chemical properties. Some candidates also restricted their answer to only one chemical property such as salinity. Stronger candidates listed several factors, typically pH, oxygen, salinity, and solutes and then went on to explain how each affected marine organisms.

**Question 4**

**(a) (i)** Many candidates gained at least partial credit. Weaker answers often confused long-lining with purse seine fishing or gave inaccurate details, such as the use of barbless, unbaited hooks and did not mention the large number of hooks used. Stronger candidates recognised that surface fish are targeted using baited, barbed hooks and that the lines often contain a large number of hooks and are towed from boats.

**(ii)** Most candidates had some idea of how FADs work. Stronger candidates explained that FADs consist of a floating device connected to an anchor by a rope and went on to explain how growth of phytoplankton led to the development of a food chain. Weaker answers often gained partial credit for a correct description of an FAD but then gave limited detail as to why fish are attracted towards them.

**(b)** This question was answered well by many candidates and even the weakest candidates often gained partial credit. Candidates were asked to describe the uses of three navigation devices found on boats. The most common ones given were compasses, radar, sonar, GPS, and charts. Most candidates knew the function of compasses, but few explained their magnetic nature. Most candidates were aware of GPS, but fewer went on to explain their roles. Some weaker candidates confused sonar and radar, incorrectly suggesting that radar is used to identify underwater obstacles and fish shoals.

# MARINE SCIENCE

**Paper 0697/03**
**Practical Assessment Paper**

## Key messages

Centres should ensure that candidates are familiar with and have preferably carried out most of the core practical activities listed in the syllabus. Any of these investigations can be tested. Many candidates did not seem to be familiar with the streamlining investigation and seemed unsure of the word “streamlined”.

Candidates seemed well prepared for this exam and demonstrated a good understanding and application of their practical skills.

## General comments

Candidates generally completed this paper well, attempting most questions, but **Question 3(b)** was the most commonly omitted. The quality of drawings, table and graph construction were in many cases excellent. Candidates’ skills in planning an investigation were good but many found the evaluation more difficult.

## Comments on specific questions

### Question 1

**(a)** Many candidates made a very good attempt at this question, and the quality of the drawings was generally very good. The size of drawings was good, and lines were generally neat. The most problematic area was the observation skill in ensuring they had included all parts of the fish. The most often missed part was the solitary pectoral fin, with the second most common error being missing the second eye on the fish.

**(b) (i)** Most candidates were able to label at least 1 or 2 features correctly. Some candidates did not name a median fin but labelled a fin as “named median fin” or chose the pectoral fin to label. Most candidates correctly identified the lateral line, but many mislabelled the operculum as the first line behind the eye rather than the one a little further back.

**(ii)** This question was often not attempted. Many candidates measured the length of the specimen in the photograph or of their own drawing rather than using the value given in the question.

**(iii)** Most candidates were able to supply a value to apply to the formula, but again this was often the length of their own drawing rather than the length of the specimen in the photograph. Candidates should always show their working as partial credit may be awarded for any correct working even if the final answer is incorrect.

### Question 2

**(a)(i)** The most common error was candidates stating that specimen **B** was a crustacean, rather than giving the phylum it belonged to. Candidates often gave species **A** as either echinoderm or cnidarian

**(ii)** The table caused candidates difficulty in stating the type of limbs present, requiring jointed or non-jointed, and the position of the eyes, being on eye stalks or on the carapace for the crustacean, and on the head for the cephalopod. Most candidates correctly identified antenna as present or absent, and many correctly identified the number of limbs on each species, with a few identifying species **B** as having five pairs, which was an acceptable alternative.

**(b) (i)** Candidates were required to read a value from the graph, which some did with impressive accuracy, giving a correct value of 5:12.

**(ii)** Many candidates were able to give the correct height of the tide, but some were not sufficiently accurate, giving a value of 2.5 rather than 2.6 m.

**(iii)** Many candidates were able to calculate the difference between their stated time for **(i)** and the low tide at 12:00. Again, some stronger candidates were able to do this with a high degree of accuracy.

**(c) (i)** Most candidates named this correctly as a hydrometer.

**(ii)** Many candidates answered this correctly, but some gave the inverse order. Carefully reading the question was important to recognise which order the samples should be given in. A small number of candidates gave a random order.

**Question 3**

**(a)** Many candidates seemed to be familiar with this investigation and could give some valid points, with many answering very well. Some candidates did not choose a measuring cylinder but a beaker to measure volume with, so they did not understand the difference in accuracy of the two pieces of apparatus, or that errors in using a beaker would be quite large. A few candidates did not make it clear which value was subtracted from which in order to calculate the volume of the shell, or stated initial – final volume, which would provide a negative number. Most candidates could state that density = mass ÷ volume.

**(b)** This investigation appeared to be much less well known by candidates, but it is a required practical. However, candidates who were not familiar with it gave a variety of ways of trying to establish this. Some of the weaker candidates did not seem sure what streamlined meant, as they said to count the number of lines on each shell. Others who knew speed = distance ÷ time, tried to give methods where shells were dropped into a measuring cylinder full of water and time how long it took to reach the bottom. Others developed original ideas of how to apply a force to a shell and measure how far the applied force moved it. Although it is a required practical, credit was awarded where a valid scientific method was given.

**Question 4**

**(a) (i)** Candidates were generally able to draw good results tables, correctly adding units in the column header rather than in the body of the table. Many candidates scored full credit here.

**(ii)** Most candidates were able to accurately calculate the mean of the mass of the shells, with most demonstrating their methods. Those who did not show their calculation and gave an incorrect answer could not be awarded any credit, whilst those who showed their method sometimes achieved partial credit when it was clear where the error had been made. Candidates should be encouraged to show their working so that partial credit can be awarded for different parts of the calculation process.

**(ii)** Many candidates were able to calculate the ratio of shell length : shell mass, but a small number gave this as a shell mass : shell length ratio.

**(b)(i)** Candidates were given the axes, so most were able to correctly plot the points and also label the axes correctly. Many candidates chose to extrapolate their line of best fit to the *x*-axis however, so they were not able to achieve full credit. Many of the lines they drew would have been a good line of best fit if they had limited their line to the data points provided.

**(ii)** Most candidates accurately read off the value for a shell length of 90 mm and many had drawn lines on their graph to help them.

**(iii)** Most candidates were able to state the correct relationship between length and mass.

**Question 5**

**(a)** Candidates often gave a relevant list of equipment, often including safety equipment, needed for the investigation. Many explained how they would use a transect line to collect systematic data, and others correctly identified how to take random samples at different distance from low tide mark using a grid and random number tables. However, some confused these two methods and did not explain their method with enough detail. Many candidates drew an example of a results table that could be used, and an example of a graph they may draw from their method. Whilst many wrote a conclusion, few related this back to the original hypothesis in terms of being able to say if the hypothesis should be accepted or not.

**(b)** Stronger candidates generally answered well. Some candidates just stated anomalous result, rather than showing an understanding of identifying anomalous results or describing why they may have occurred.