

MARINE SCIENCE

Paper 5180/01
Structured

Key Messages

Where a question requires a short response, such as a letter or number, only one answer should be given.

Where it is necessary to change an answer, the original one should be crossed out clearly: it is unwise to attempt to write over an existing answer. Very often the result is an answer that cannot be read.

Candidates should try to frame their answers clearly and in an unambiguous manner. The use of bullet points is perfectly acceptable in some type of questions.

In questions requiring a numerical response, the units should always be given unless they are printed on the answer line.

General Comments

It was pleasing to note the ability of candidates in Assessment Objective B, handling information and application of knowledge and understanding, as shown in **Question 5 (a)**.

Candidates displayed a sound understanding of classification (**Q3a**).

On the other hand it was disappointing to note the lack of knowledge and understanding of certain fundamentals of the syllabus such as food spoilage (**Q2c**) and the life cycle of the sea cucumber (**Q8b**).

Comments on Specific Questions

Question 1

- (a) The process of photosynthesis was generally well known and there were some excellent descriptions including all the relevant information to gain full credit. Any confusion that was shown was usually concerning the roles of water and carbon dioxide in the process.
- (b)(i)(ii) Most candidates were able to describe the change in light intensity as illustrated in the graph although the numerical data needed for the second mark was either omitted or incorrect. Fewer candidates were able to give an adequate reason for the change.
- (c) There were many very good explanations as to why marine animals are most abundant in the top 100 metres of the ocean. These largely concentrated on the availability of food in that region of the ocean. Many other candidates attempted to explain the situation in terms of temperature, density or salinity effects.

Question 2

- (a) (i) Many candidates labelled part **P** of the virus correctly as the head but part **Q** was often incorrect with “body” being a common response.
- (b) A wide variety of names were quoted for the parts of the bacterial cell. Part **S** (flagellum) and part **T** (cell wall) were the structures most well known.
- (c) As indicated in the General Comments, this question did not elicit the quality of response that had been anticipated. References to bacterial reproduction and the term putrefaction were quite well known and occasionally the production of toxins was referred to. In the main, the majority of responses were written in very general terms and contained little relevant detail.

Question 3

- (a) This question was extremely well answered with many candidates gaining maximum credit.
- (b) (i) This part of the question was also well answered and the large majority of candidates were able to name two animals that live on the sea bed.
 - (ii) This was generally well known.

Question 4

- (a) (i) Despite some confusion between seine and trawl gear, this part of the question was reasonably well answered. The gill net was the most recognised fishing gear.
 - (ii) The method of using a gill net to catch fish was well known and understood, and there were many excellent descriptions.
- (b) (i) The meaning of the term by-catch was well known, although some candidates had difficulty in expressing their ideas.
 - (ii) Only a small number of candidates appreciated that increasing the mesh size is an appropriate method of reducing the by-catch.
- (c) Many candidates appreciated that the nets could cause physical damage to coral reefs. However, fewer candidates stated how this damage was actually caused.

Question 5

- (a) (i)(ii) Both parts of this question were very well answered and most candidates were able to extract the appropriate data from that given in the table.
 - (iii) The mathematical skill needed to answer this part of the question was shown by very many candidates and consequently many candidates attained full credit.
- (b) Many candidates appreciated that, in addition to the materials shown in the table, a balanced diet would require water, vitamins and fibre.
- (c) (i) Only a minority of candidates were able to name a nucleic acid.
 - (ii) Many candidates placed links correctly between the 5-carbon sugar and the phosphate and pentose base. On some occasions, an incorrect link between the organic base and the phosphate molecule was drawn.

Question 6

- (a) Most candidates were able to describe one feature of a tsunami, namely a large wave. Few candidates made a reference to the speed of movement of the wave. Some candidates went beyond the scope of the question and gave descriptions of the formation of the tsunami.
- (b)(i) This calculation question was well answered by most candidates.
- (ii) The majority of candidates were able to describe at least two types of potential damage caused by a tsunami. Usually, these centred on destruction of buildings, deaths and some type of damage to habitats or the coral reef.

Question 7

- (a)(i) Most candidates read the graph correctly.
- (ii) While most candidates were able to describe the changes in the catch of Atlantic cod in general terms, e.g. decrease followed by an increase and then another decrease, few elaborated on this and gave numerical data from the graph to illustrate the changes.
- (b) Many candidates were able to suggest at least one, and usually two, reasons for the changes in the catch.

Question 8

- (a)(i)(ii) Most candidates recognised the structures and were able to state the function of **B**.
- (b) The descriptions of the life cycle of the sea cucumber were very varied. Some were clear and precise with all the relevant detail included while others were the exact opposite. These lacked the correct information or included irrelevant details pertaining to the sea cucumber. Often details of reproduction were part correct or even contradictory.

Question 9

- (a) Many candidates were fully aware of the roles of producers and consumers in an economic situation. There were very few who confused the terms with those used in ecology.
- (b)(i) This part of the question elicited a wide variety of responses. Many candidates appreciated that the price would fall, but a minority were aware that the fall in price was to stimulate demand.
- (ii) Many candidates stated clearly the meaning of the term equilibrium. Many other candidates attempted to ascribe the term to features of the supply and demand graphs they had obviously been taught.

Question 10

- (a) The descriptions of pollution were usually vague and lacking in details.
- (b)(i) Most candidates were able to extract two correct pollutants from the text.
- (ii) Some of the responses omitted the main aspect of regulation of pollution, i.e. fines, and often selected irrelevant information from the text.
- (iii) This part of the question was very poorly answered. Surprisingly few candidates referred to heavy metals' toxicity or the possibility of bioaccumulation.

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Paper 2

Key Messages

Candidates should:

- read the questions carefully, consider the command words used and note the mark allocation for each part
- select appropriate information to answer the questions
- try to avoid including irrelevant material in the answers
- include units, where appropriate, with numerical answers
- use scientific terms and vocabulary.

General Comments

This was the first time that candidates took these examinations for the revised syllabus. The overall performance was similar to that of previous years with some candidates coping very well, although there were also some who found the questions difficult. Both **Questions 1** and **2** now involve data interpretation and application of knowledge with understanding. The focus of **Questions 3** and **4** is recall and explanation of the syllabus factual content. Candidates generally coped better with **Questions 1** and **2** than **Questions 3** and **4**, although there were some very detailed answers to **Question 3** part **(b)**, a number of which readily gained maximum credit.

Comments on Specific Questions

Section A

Question 1

- (a)** The majority of candidates were able to plot a bar chart of a high standard, with many gaining maximum, or nearly maximum credit. Almost all candidates chose an appropriate linear scale for the y-axis and plotted the values accurately. Occasionally, either or both of the axes were unlabelled; candidates are expected to label the axes fully, with units where appropriate.
- (b)** Almost all candidates correctly referred to the overall increase in the value for production. There were some instances where candidates effectively gave the graph a descriptive title, rather than describing the trend shown by the data.
- (c) (i)** This part proved to be more discriminating. Many candidates carried out the subtraction correctly but did not include units (millions of dollars) with their answer. Candidates are reminded of the importance of including appropriate units with numerical answers. Some candidates attempted to find the mean increase in value or calculated a percentage increase, neither of which was required.

- (ii) This part also proved to be difficult for candidates, often because they tried to explain why the production by aquaculture may have increased rather than why the value of production had increased. Candidates sometimes gained credit for references to an increase in production, or to an increase in demand for these products. There were also a number of references to changes in aquaculture technology, employment, or the benefits of production by aquaculture. Whilst these may increase the production, they do not necessarily increase the value of production. A few candidates referred to increases in fishing effort, or to increased catches, which are not appropriate in the context of aquaculture production.
- (d) This part proved to be more accessible to many candidates and a number gained maximum credit for listing some of the advantages of the production of prawns by aquaculture, compared with harvesting wild stock. Many candidates appreciated the idea of a lower capital investment, there being no need for expensive fishing gear, increased yield or predictable yield by aquaculture and possible health benefits. Some candidates also correctly referred to the benefit in terms of conservation of wild stocks.

Question 2

Part (a) of this question was generally answered more successfully than parts (b), (c) and (d).

- (a) (i) The majority of candidates correctly identified herring; a small number named other species such as haddock.
- (ii) The majority of candidates also correctly identified whiting, although other species including cod were occasionally seen.
- (iii) The majority of candidates correctly identified the year as 2007; a small number gave 2008 or 2010.
- (iv) The majority of candidates correctly added the figures and gave the total as 79 585.
- (b) (i) This part proved to be more difficult and relatively few candidates correctly calculated the percentage. Some candidates used incorrect figures from the table in their calculation and a number of candidates did not attempt this part.
- (ii) This part also proved to be difficult as candidates generally did not refer to the change in the percentages, as directed by the question. There were some good answers, in which candidates correctly referred to both the percentage increase and the quota increase and the possible change in cod population from 2007 to 2010. There was a tendency to attempt to explain the data in terms of fishing effort rather than changes in quotas.
- (c) In general, candidates coped slightly better with this part and a number referred to both quotas as a limit on the fish catch and the fact that this helps to prevent overfishing. There was a tendency to repeat the wording of the question and state simply that quotas maintain the MSY without any further explanation. A number of answers incorrectly described the possible effect of different fishing methods on fish populations or included irrelevant material on imports and exports.
- (d) This part proved to be more accessible to candidates and there were some good answers which readily gained credit, usually for references to restrictions on fishing methods, closed seasons, closed areas, or surveillance. Some of the weaker answers simply listed different fishing methods, or referred to ways in which domestic industries may be protected against competition from imports, with reference to tariffs and embargos.

Section B

Question 3

This question was designed to test knowledge and understanding of the external and internal features of a bony fish, from syllabus Theme 3. There were some very good, detailed answers to part (b), but the answers to part (a) were more variable.

- (a) (i) Relatively few candidates were able to give an acceptable function of the lateral line, for example, detection of changes in pressure or detection of vibrations in water. Some of the answers gave a description of the lateral line but without including reference to its function.
- (ii) More candidates were able to give an appropriate function of scales, with references to either protection from mechanical abrasion or from predators, or to their effect on reducing drag. Some candidates referred to the use of scales in the determination of the age of a fish. Whilst this is true, it is not really a function of scales.
- (iii) This part was also not well answered as there was some confusion between the function of paired fins with median fins. Candidates were expected to state that median fins control, or reduce, yawing and rolling movements. A significant number of answers included functions of paired fins, such as acting as hydrofoils, or their use in turning or braking. For candidates to be given credit in this part they were expected to qualify their answer with a reference to controlling, or reducing, for example, so a simple statement such as “they are used for yawing” was not considered to be sufficiently accurate.
- (b) There were some very good answers to this part, giving details of the structures and functions of the internal features of a bony fish. A number of answers readily gained maximum credit; this was a topic that was clearly familiar to many candidates. However, a small number of candidates did not attempt this part, or included irrelevant or incorrect material in their answers. Some of the poorer answers gave accounts of the *external* features of a bony fish, or general accounts of the life cycle of a tuna, or the nutritional benefits of tuna.

Most of the good answers to this part included references to the following features: skeleton, gills, heart, swim bladder, gonads, stomach and muscles. Candidates were also given credit for additional features, such as kidneys, pyloric caeca, liver and nervous system. It was surprising to see a number of references to the presence of lungs in bony fish. Some candidates included a detailed diagram in their answer; these diagrams could be given credit for labelled features, although these were usually also included in the written account.

Question 4

This question was intended to test knowledge and understanding of aspects of Theme 4, with particular reference to nutrients and their recycling in marine ecosystems. Although there were some good answers to this question, candidates in general found it more difficult than **Question 3**.

- (a) (i) The majority of candidates gained at least partial credit for this part, usually for giving an example of a primary producer such as phytoplankton. There were some instances, however, where candidates named both phytoplankton and zooplankton as producers. Good answers went on to explain how primary producers are involved in the capture of light energy and the synthesis of organic materials through photosynthesis. Many candidates also appreciated that primary producers are the start of food chains, making food available to higher trophic levels. Some of the weaker answers explained the term producers in the context of economics, referring to fishing, farming or mining. This illustrates the importance of reading the question carefully because the introductory sentence set the context of inorganic nutrients and their importance for the growth of primary producers in marine ecosystems.
- (ii) This part proved difficult for candidates, mainly because the answers generally lacked precise details of the roles of nitrates and phosphates in the growth of primary producers. The majority of answers simply referred to the ions being essential for growth but without giving any specific roles of these ions. There were, however, some good answers with references to the requirement of nitrates for the synthesis of amino acids and proteins, and the requirement of phosphates for DNA (for example) that readily gained credit.

- (b)** The majority of candidates found this part difficult and few attained maximum credit. There were some rather confused accounts with descriptions of downwelling or restatements of the wording of the question, without further explanation. This question required candidates to focus specifically on the role of upwelling in replenishing nutrients in the upper layers of an ocean, but there was also a tendency for candidates to include a lot of irrelevant material on food chains and productivity. A number of candidates correctly referred to the upward movement of both water and nutrients from the sea bed, but rarely explained how this was brought about with reference to, for example, wind-driven currents.
- (c)** There were some good, detailed answers to this part, with full accounts of nutrient recycling in marine ecosystems. Some of these good answers were illustrated with references to specific nutrients, such as nitrate and ammonium ions. As with part **(b)**, there were some accounts of the movement of nutrients through a food chain but some of these accounts did not explain the subsequent release of nutrients through the action of decomposers. Some of the weaker answers did not distinguish between nutrients and food becoming available to consumers. Many candidates gained partial credit for this part, usually for references to the death of organisms and their subsequent breakdown by bacteria or fungi. Higher scoring answers included references to the release of nutrients, with specific named examples, and to the ensuing uptake of these inorganic nutrients by producers.

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Paper 5180/03
Practical Assessment Paper

Key Messages

Candidates should:

- read the questions carefully, note the 'command words' and the mark allocation
- use a sharp pencil for drawings
- include units, where appropriate, with numerical answers
- read values from graphs carefully
- be careful when converting units from one form to another, for example mm to cm
- be familiar with all the core practicals included in the syllabus.

General Comments

This was the first examination for the revised syllabus and this paper replaced the coursework. This paper is designed to test many of the same skills that were included in the coursework, such as making and recording accurate observations, recording and interpreting experimental results, experimental procedures and use of apparatus, and designing and evaluating an experiment.

This examination is not a substitute for carrying out coursework and centres are encouraged to integrate practical work into teaching programmes to help candidates develop the skills of scientific enquiry and to enable them to cope with the Practical Assessment Paper. These skills (Assessment Objective C) are included in the syllabus and the majority of these can be developed using the minimum of apparatus and materials, including an improvised hydrometer or quadrat.

In general, candidates coped more successfully with **Questions 1, 3 and 4**. The answers to the other questions were generally of a poorer standard; **Question 5**, in particular, proved to be particularly difficult and was not attempted by a number of candidates.

Comments on Specific Questions

Section A

Question 1

- (a) The quality of the drawings of the specimen was very variable. Many were drawn carefully with attention to the shape, features and proportions, but there were also some drawings which showed little resemblance to the actual specimen. Candidates were given credit for drawing the specimen the correct size, of correct proportions with reference to the depth of the body and the relative size of the caudal fin in relation to the body, with neat lines, and with the correct features shown. In addition to the features shown in the specimen, some candidates drew additional features such as finlets. The general quality of many of the drawings would have been improved with the use of a sharp pencil, and drawing continuous lines rather than a sketchy outline.
- (b) This part proved to be accessible to the majority of candidates as almost all were able to identify and label these four features correctly.

- (c) A surprising number of candidates did not attempt this part and did not include a scale showing the actual length of the specimen. Candidates were required to draw a line against their drawing to show that the actual length of the specimen is 24 cm, but some attempted to calculate a magnification or the scale of their drawing compared with the actual length. Consequently, the answers to this part were rather variable.

Question 2

- (a) (i) Only about half of the candidates identified the phylum correctly as Arthropoda. A number of candidates named the class, Crustacea, but many other phyla, including Echinodermata, Mollusca and Chordata, were also seen.
- (ii) A minority of candidates were able to give two characteristic features of arthropods. Candidates were expected to refer to the presence of jointed appendages and the presence of an exoskeleton. Various other features of arthropod classes such as compound eyes and the presence of antennae were quite often seen on scripts, but these are not general features of arthropods.
- (iii) The answers to this part were variable; marks were usually gained for suitable comparisons between antennae, pincers and the relative thickness of the legs. Some of the answers referred, incorrectly, to habitat or behaviour of the organisms. A number of candidates stated that antennae are absent in the crab, rather than being smaller or shorter than those of the shrimp.
- (b) (i) The majority of candidates measured the maximum width of the shell correctly, although some did not include units with their answer. A small range of values was accepted and candidates were expected to include units (either mm or cm) in their answer.
- (ii) The answers to this part were more variable than to part (b)(i). Whilst many candidates correctly indicated that their measurement should be divided by 78, there were sometimes inconsistencies in the units used, such as dividing 4.7 by 78. Some candidates incorrectly multiplied their measurement by 78 or attempted to express their answer as a percentage.
- (c) (i) The majority of candidates answered this part correctly, giving an answer of either 5.1 m or 5.2 m. As with part (b)(i), candidates were expected to include units with their answer.
- (ii) The answers to this part were rather more variable than (c)(i) and many different times for the high tide were seen. It may help candidates with questions of this sort to practise reading values accurately from graphs.

Question 3

- (a) (i) The majority of candidates were familiar with the use of biuret reagent. Millon's reagent was also seen quite frequently, but the use of this reagent should be discouraged because of its toxicity and harmful effects on the aquatic environment. For full credit, candidates were expected to name the reagent and to describe the colour change correctly, including the starting colour of the reagent.
- (ii) Candidates seemed to be familiar with a test for reducing sugars, with many describing Benedict's test, including a reference to heating and the colour changes observed. Candidates were also given credit for descriptions of Fehling's test, or the use of sodium hydroxide and copper sulfate. When candidates failed to score marks in this part it was usually because they described the importance of reducing sugar (or protein) in the diet.
- (b) There were some very good, detailed answers to this part. Measurement of current speed seemed to be an activity with which candidates had first-hand experience. Credit was given for descriptions of the timed float method and how speed is calculated. Some candidates included additional, but irrelevant, details in their answer with references to the use of a compass to find direction or a thermometer to find the temperature. A small minority of candidates gave no details of the timed float method instead describing an experiment to measure tidal amplitude or to determine the density of sea water.

Question 4

- (a) The majority of candidates tabulated the data using a neatly drawn table, with many gaining maximum credit for this part. By convention, the units are usually indicated once only in the column heading (e.g. 'height / mm'). A number of candidates did not include the mean length and the mean height, which were also required for full credit.
- (b) Relatively few candidates plotted these data in an appropriate form. Candidates were expected to plot a line graph to show the relationship between length and height with an appropriate line of best fit. Credit was awarded for labelling both axes, choosing suitable, linear scales for each axis, plotting all the points correctly and for drawing a straight line of best fit through the points, without extrapolating.

One common error was to plot two separate lines, one for length and one for height, against the number of each limpet. However, this does not show the relationship between the two variables and it is difficult to draw a conclusion from such a graph. Candidates can improve their attainment on such questions by practising their graph plotting skills and the selection of the most appropriate type of graph for a given set of data.

- (c) The overall performance on this part was similar to that for part (b). Candidates were given credit for indicating that height and length are proportional, or for giving a description of the relationship, such as "as height increases, length also increases".

Question 5

This question was intended to give candidates an opportunity to plan and critically evaluate an investigation to test a given hypothesis. The question was based on one of the core practicals in Theme 4 of the syllabus (*field work including the use of a quadrat, transects and random sampling to investigate the distribution of organisms in a marine littoral habitat*).

It was clear that some candidates had carried out similar investigations using quadrats and systematic sampling using a transect. Consequently, they were able to give some practical details in part (a), but almost all candidates found it difficult to evaluate the investigation.

- (a) The majority of candidates gained some credit in this part, usually for indicating the use of a quadrat, counting the number of sea grass plants within the quadrat (or estimating the percentage cover using a gridded quadrat) and for including an appropriate safety precaution. References to random sampling (rather than systematic sampling, using a line transect) and further practical details were included less often. Some candidates suggested a suitable size for a quadrat, such as 0.25 m^2 and were given credit for this. Candidates who mentioned random sampling usually referred to 'throwing the quadrat', but this not considered to be a suitable method; the use of random coordinates is preferred.
- (b) In this part, candidates were expected to explain how their results would be presented and analysed. This part was answered less successfully than part (a), although a number of candidates gained credit for reference to tabulation of their results. Relatively few of the answers described in detail how the results could be analysed, with references to the calculation of means of repeated results and presentation of the results in a suitable graphical form. In this case, a bar chart, showing the mean population density of sea grass in the two areas would be appropriate. Very few of the answers referred to the results in relation to the original hypothesis and explained how the results might support the hypothesis.
- (c) This part was found to be the most difficult by candidates and a number did not attempt it. Few candidates included suitable limitations in their answer and very few made acceptable suggestions for further work. Credit was usually given for references to difficulty in counting individual sea grass plants and for repeating the investigation at different times of the year.

Some candidates suggested that they should take "more samples", but did not explain why the number of samples might be a limitation. Suggestions for further work should be related to the original hypothesis, such as investigating other factors that might affect the distribution of sea grass, rather than launching completely new investigations into an unrelated hypothesis.