# MARINE SCIENCE

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| **Paper 9693/01**             |
| **Structured Questions**      |
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## Key messages

A high standard of scientific knowledge and understanding was displayed by many of the candidates. Many candidates gave clear, articulate and accurate responses and most candidates attempted every question.

Candidates should be reminded to use the correct scientific vocabulary when describing and explaining phenomena. Understanding the meaning of key terms outlined in the syllabus not only gains credit independently but can provide an aide to answering longer prose questions.

## General comments

There were several instances where candidates gave answers which did not address the focus of the question. It would be beneficial for some candidates to practise highlighting key information in the stem, particularly the command words, to identify what is expected from them in their responses. The command words of describe and explain were frequently confused.

The number of marks available for each question and the number of answer lines provided is a good indicator of the level of response required. Candidates should be reminded to read the stimulus material in each question carefully and to complete all the instructions given.

## Comments on specific questions

### Question 1

**(a) (i)** Most candidates described what was meant by the term predator in reasonable detail. Some candidates were not specific enough in their responses and referred to a predator consuming organisms rather than animals.

**(ii)** Some candidates incorrectly calculated a percentage difference. The question asked for candidates to state their units, but a number of candidates did not do this.

**(iii)** The majority of candidates were able to explain why the mean distance between the fish decreased in terms of protection from predators.

**(b) (i)** Candidates could generally suggest at least one advantage of shoaling.

**(ii)** Candidates could generally suggest at least one disadvantage of shoaling.

### Question 2

**(a) (i)** This question was very well answered with the vast majority of candidates able to state the correct sequence.

**(ii)** There was some confusion between the meaning of the terms theory and hypothesis preventing some candidates from accessing credit here.

**(b)** Candidates generally labelled the figure correctly. Occasionally candidates tried to label the sediment as the coral reef and the lagoon as being outside the coral reef.

**(c)**     This question was answered particularly well with many strong, succinct and accurate responses seen. It was clear that many of the candidates had a good understanding of factors that cause coral reef erosion.

**Question 3**

**(a) (i)**     Many correct arrows were seen added to the figure. Occasionally arrows were drawn pointed downwards or in the opposite direction.

**(ii)**     There was some confusion seen in some responses to this question. Candidates should be reminded to pay attention to the command words used in the question. Candidates should have used the information contained in Fig. 3.1 to describe the differences between the two maps. Some candidates tried to explain the reason for the differences.

**(iii)**     Some candidates showed good understanding of the effect of El Niño on fish population by relating the reduction of upwelling to the productivity in this area of the ocean. Some candidates tried to argue that fish population would increase.

**(b)**     This topic proved challenging for many candidates. Few seemed to have enough knowledge on how surface currents are formed. The most common error was to explain how underwater currents are produced. The strongest responses referred to how convection currents in the air above the ocean surface are formed.

**Question 4**

**(a) (i)**     Most candidates gave the correct number of trophic levels. The most common incorrect answer was four trophic levels.

**(ii)**     The majority of candidates could identify the first consumer in the food chain. Very occasionally the incorrect answers of phytoplankton or mackerel were given.

**(iii)**     Only stronger candidates answered this question well. Many candidates gave their answer in terms of energy loss between the trophic levels. The strongest responses included that to calculate dry mass, organisms would be killed and that it would be impossible to collect all the organisms from the entire trophic level.

**(iv)**     Candidates usually drew and labelled a pyramid relating to the food chain shown. The majority of candidates did not take into account that the question asked for a pyramid of numbers and so the bar for the parasites should have been drawn a longer length than the tuna.

**(b)**     Most candidates gave two correct responses. Photosynthesis was the most popular response. Occasionally candidates tried to suggest that feeding was a source of energy.

**(c)**     Some excellent responses were seen with many candidates gaining at least partial credit. Several correct reasons for loss of energy between trophic levels were seen.

**Question 5**

**(a) (i)**     The most common error here was to reverse the names of the parts of the Earth in the list. Occasionally candidates confused oceanic and continental crust.

**(ii)**     Many candidates gave the correct process for calculating the density. The most common error was to use the terms mass and weight interchangeably presuming they meant the same thing.

**(b) (i)**     Candidates had some knowledge of the meaning of the term estuary but were often unable to make enough relevant points to gain full credit. The strongest responses referred to the physical environment of an estuary and the nature of the water.

**(ii)**     Some good responses were seen with many candidates able to relate the slow movement of water with reduced erosion and increased deposition. Some candidates were vague in their responses and referred to accumulation of sediments but needed to go further to explain how this was able to occur.

**Question 6**

**(a) (i)** The vast majority of candidates gave the correct unit. Very occasionally candidates tried to calculate a value.

**(ii)** The general trends were usually described well.

**(iii)** Candidates could generally read values from the graph accurately. Occasionally candidates did not read the stimulus material carefully enough and gave the range of the halocline rather than the thermocline.

**(b)** This topic was well known with the vast majority of candidates able to state at least one factor that affects salinity in seawater.

**Question 7**

**(a) (i)** The correct answer was commonly seen. Common incorrect responses included feeding and excretion.

**(ii)** Candidates showed good knowledge of the processes occurring at this stage in the nutrient cycle. Many candidates gained full credit and gave clear and accurate responses on this question part.

**(b)** This topic proved more challenging. Many candidates related carbon dioxide to lack of photosynthesis but did not expand on this much further. The strongest responses explained the link between carbon dioxide in the atmosphere and carbon dioxide dissolved in seawater and related this to productivity.

**Question 8**

**(a)** The meaning of the term ecosystem was not well defined by many candidates. Some candidates confused the meaning of the terms environment with community and population. Several candidates only referred to animals rather than organisms and others referred to organisms interacting with each other with no mention of their environment.

**(b)** Candidates often gained credit for referring to sand being an unstable substrate. Only the strongest candidates related this to lack of areas for attachment and so a lack of producers. References to special adaptation such as burrowing were often correctly given.

**(c)** The majority of candidates named an example of an extreme environment.

**(d)** This question was generally well answered. Most candidates gave shark as an example of an organism that inhabits a generalised niche. Very occasionally some candidates confused generalised and specialised niches and gave examples such as coral-eating butterflyfish.

# MARINE SCIENCE

**Paper 9693/02
AS Data-Handling and Free-Response**

## Key messages

- Candidates need to ensure they read all the information provided carefully and should remind themselves of this as they work through questions.
- Candidates should ensure they use scientific/technical language when giving their answers.
- Candidates need to be encouraged to look at investigations critically, e.g. is there sufficient detail in the method for others to carry out the same investigation, are all variables controlled, or is there more than one independent variable?

## General comments

The vast majority of candidates completed their answers within the space provided, and attempted every question. Some candidates had difficulty in expressing themselves appropriately in the essay questions in **Section B**. These candidates may have benefited from taking more time to read and think about the question before giving their answer. A few candidates contradicted themselves in their answers; rereading their answers to ensure they have not done this would have been beneficial.

## Comments on specific questions

*Section A*

**Question 1**

**(a)**     Many candidates gave a suitable hypothesis for the investigation. However, weaker candidates sometimes just stated the name of one of the substrates. For credit to be awarded, the effect this may have on settlement of the larvae should have been given. A few candidates made their hypothesis about growth or survival of the barnacles, but the investigation was clearly aimed at settlement. Candidates should be clear on how to construct a hypothesis.

**(b)**     Most candidates gave an answer that was appropriate, although some were too vague to gain credit. Answers such as "amount of water", "size" or "time" were seen when candidates needed to use more scientific language such as "volume of water", "size of each piece of substrate" or "total time larvae were left to settle".

**(c)**     Candidates needed to consider the quality of the data here in that few had settled in any of the tanks. The number of barnacle larvae introduced may have been very small, so there was no statistical difference and more larvae may have been needed to improve the investigation. Stronger candidates suggested having all substrates in a single tank so the larvae had a choice of substrates and that the time may not have been long enough for settlement to occur. Few candidates recognised that removing the substrate regularly may have had a detrimental effect on the larvae.

**(d)**     As little detail was provided in the method, there was plenty of scope for candidates to make suggested improvements. Many candidates were able to state that the investigation should be repeated or stated other variables that needed to be controlled. Fewer commented on the number of larvae added to the tanks or that there may have only been a small number added to start with, which would make it difficult to identify anomalous results.

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**Question 2**

**(a) (i)**   Some candidates did not read the instructions given in the question and calculated the mean for all samples. In addition, a few did not round their answer to the nearest whole number.

**(ii)**   Many candidates recognised that the value was well outside of the range of the other values and so was an anomalous result. Some candidates simply stated the value was low, but did not say in comparison to what. All the values could have been low compared to other cell densities during the investigation. Candidates should be encouraged to use comparative terms.

**(b)**   Most candidates were able to select suitable scales for the graph and plotting was generally accurate. However, some candidates found the 1750 mark point challenging, often placing it at 1700 or 1800 rather than ensuring they plotted accurately. Candidates sometimes did not include the axes labels, or forgot to add their units. Candidates should use an x for their plotting points, as a large spot where the point should be can decrease accuracy. Some candidates also joined the points as a dot-to-dot plot, rather than trying to create a smooth curve as requested.

**(c) (i)**   Most candidates stated the day when the *Tetraselmis* population was at its maximum and gave that as the reason for their choice.

**(ii)**   Whilst most candidates stated that the population would continue to decrease, only the strongest candidates recognised why that would happen, with many simply stating "the graph starts to go down".

**(d)**   The majority of candidates correctly recognised photosynthesis as the process.

*Section B*

**Question 3**

**(a) (i)**   Many candidates were able to state that muddy conditions were required, but were often vague in their answers, stating "correct oxygen/salinity levels", or "sunlight". Stronger candidates also recognised that the water would be a mixture of fresh and salt water, and gave correct conditions for the muddy sediments to form, i.e. slow flowing water, although few mentioned that there would be little slope or in a sheltered position. A few candidates stated the mangroves provided resistance to wave action, rather than recognising that low wave action is required for them to form initially which was asked for.

**(ii)**   Strong candidates were able to identify that there were two tides a day, and that the incoming tide brought in more saline water. However, some candidates indicated salinity would be higher at low tide due to more evaporation occurring. A few candidates tried to link this to spring and neap tides and the movement of the sun and moon. Candidates needed to link their knowledge of delta formation with knowledge on salinity.

**(iii)**   The majority of candidates stated that more shore erosion would occur, while many also mentioned loss of habitat or loss of nursery grounds.

**(b)**   Stronger candidates could clearly link their knowledge of delta formation to the effect some of these conditions would have on coral growth, particularly the effect the river sediment and the lower/changing salinity would have. Some candidates stated that salinity in the delta is high, rather than appreciating it is less saline than full sea water, so preventing coral growth. Many mentioned turbidity of the water preventing or reducing photosynthesis, and some recognised that the sedimentation would mean no firm substrate for attachment of the polyps.

**Question 4**

**(a) (i)**   This question was generally well answered, and candidates showed a clear understanding of how hydrothermal vents are formed. A few candidates thought they were formed by the magma emerging from the vent rather than from the dissolved minerals precipitating out when they reach the cold water.

**(ii)**   Many candidates gave a good definition of succession, and usually knew that *Tevnia* was a tubeworm, with many also mentioning chemosynthetic bacteria. However, a few stated the

tubeworm was chemosynthetic. Some weaker candidates gave statements such as "*Tevnia* turns into *Riftia*" which implies evolution of one species to another rather than that it has been outcompeted by the faster growing *Riftia*. Weaker candidates need to be encouraged to use scientific terminology to help clarify their answers.

**(b)** Whilst most candidates referred to carbon dioxide, some referred only to carbon. Candidates must be made aware of the difference between gaseous carbon dioxide which can dissolve, and solid carbon. Stronger candidates were able to provide causes of additional carbon dioxide in the atmosphere from a named anthropogenic or natural occurrence and could explain the impact this had on seawater and on organisms with calcium carbonate skeletons. Few candidates were able to explain that increased carbon dioxide can increase the rate of photosynthesis in producers, with many stating it would decrease photosynthesis.

# MARINE SCIENCE

**Paper 9693/03**
**A2 Structured Questions**

## Key messages

- Candidates should be reminded to read and process the information provided at the beginning of each question carefully so that their answers make reference to this information.
- Candidates need to identify the command word and understand the difference between 'describe' and 'explain' so that they answer the question being asked.
- Candidates should be reminded to use precise language and avoid vague terminology e.g. "temperature affects productivity", or "non-motorised water sports do not cause pollution".
- Candidates would benefit from further practise analysing graphs and tables and should use the data provided to support their answers.

## General comments

There were some very good responses where candidates demonstrated an excellent knowledge of the syllabus. Stronger candidates were able to process the information provided, while some gave generalised answers that gained partial or no credit. This was particularly evident in **Questions 4**, **5** and **6**. Generally, topics such as photosynthesis, salmon life-cycle and ecotourism were well understood, while selective breeding and the effect of thermoclines proved more challenging.

## Comments on specific questions

### Question 1

**(a) (i)**  The majority of candidates could name two examples of marine phytoplankton. Common errors included kelp, bacteria and red and brown algae.

**(ii)**  Most candidates correctly stated that the habitat of marine phytoplankton is the surface waters of the open ocean.

**(b)**  Partial credit was obtained by many candidates, usually for stating that glucose was produced as an end-product of photosynthesis. Stronger candidates were able to state the role of chlorophyll and light energy in this process. Some answers were too vague to gain credit e.g. "light is required", or "chlorophyll is needed" while others were irrelevant to the role of carbon fixing e.g. "dissolution takes place" or "oxygen is produced as a waste product".

**(c)**  Stronger candidates mentioned limiting factors; to gain credit, both light and temperature were required. Some candidates made no reference to the graph and were unable to state that most productivity occurs between mid-May and mid-September. To gain further credit, temperature needed to be linked to enzyme activity and light to photosynthesis. A few candidates incorrectly stated that high summer temperatures would denature enzymes.

**(d) (i)**  Answers were often too vague e.g. "a change in temperature with depth" or candidates said that the thermocline was "a barrier between warm and cold water".

**(ii)**  Those candidates who understood the effects of a thermocline realised that if it was absent, more upwelling would occur, so bringing more nutrients to the surface to increase productivity. Few candidates included an example of a nutrient and its use in phytoplankton. Answers such as "nitrogen is required for growth" were not specific enough to gain credit.

**Question 2**

**(a) (i)**    Almost all candidates could name both gases correctly.

**(ii)**    Diffusion was correctly named by the majority of candidates. Incorrect answers included respiration and breathing.

**(b) (i)**    Full credit was awarded in most cases.

**(ii)**    To gain credit, candidates needed to study Fig. 2.2 carefully to notice that the arrows, and therefore the water flow, were larger at point **A** than at point **C**. Some candidates gave the same answer for point **A** as for point **C**.

**(c)**    Stronger answers received credit for stating that the larger egg had a smaller surface area to volume ratio and linking this to diffusion being less efficient. There were very few references to the greater water flow rate maintaining a concentration gradient, but a few answers correctly stated that this would bring more oxygen to the egg. Very few references were made to the removal of $CO_2$ or to oxygen being required for respiration.

**(d) (i)**    To gain credit, candidates needed to read the information provided carefully to notice that 75 per cent of the eggs died, so 25 per cent survived and the temperature reading for 25 per cent survival was 16.5 °C.

**(ii)**    Candidates were required to use all the information provided and their own knowledge to answer this question. Partial credit was common, usually for stating that cold water contains more oxygen or that there was a higher survival rate in cold water or that larger eggs have a larger yolk to supply the alevin. There were very few references to diffusion rates or to less demand for oxygen.

**Question 3**

**(a)**    Rocky shore and freezing waters were the most common incorrect answers, while some candidates defined habitat and ecological niche which could not be credited. Many candidates correctly stated that the blue king crabs had a generalised niche, but this by itself was not sufficient to receive credit.

**(b) (i)**    Almost all candidates could identify the trend shown on the graph.

**(ii)**    Many candidates received full credit for stating that more crabs were being caught, so the population decreased. There were very few references to competition or to catch per unit effort.

**(iii)**    Many answers did not receive credit as candidates repeated their answer for **(b)(ii)**. Stronger answers linked overfishing with a reduction in the number of crabs able to breed, so the population was unable to recover. There were a few good answers referring to global warming and to increased predation and their effects on the crab population.

**Question 4**

**(a)**    Candidates who had read and processed the information provided answered well. Some answers given were unrelated to the information provided.

**(b)**    Most candidates gained at least partial credit, usually for the monsoon bringing heavy rain. Stronger candidates added that this brought a surplus of freshwater and there were several correct references to the ditches and gates allowing excess water to drain from the ponds. Again some answers were not related to the information given in the question.

**(c)**    Stronger answers were related to the figure and the information provided and included correct comparisons from the graph as well as general benefits to the farmer of rotational polyculture. Some candidates only quoted figures from the graph, which was not enough to gain credit as manipulation of figures was also required, e.g. that fish at high depth in rotational polyculture increased yield by 2950 kg per hectare per year.

**Question 5**

**(a)**    Most candidates answered this question well and gained full credit, usually for stating that increased drag on the boat would mean that more fuel was required. References to invasive species were not credited.

**(b)(i)**    Many candidates repeated the information in the question that it causes females to develop male characteristics and went on to state that fewer eggs would be produced rather than reducing the number of females able to produce eggs. Few candidates continued their answers to give the consequences on larvae or offspring numbers which would reduce recruitment in future years.

**(ii)**    Many answers repeated the word bioaccumulation and made statements such as "TBT bioaccumulates at each level in the food chain" which were not credited. Only stronger candidates referred to producers such as algae absorbing TBT or referred to consumers eating large amounts of the previous trophic level, so that tuna and dolphins had the highest levels of TBT. Few candidates mentioned that TBT could not be excreted from the body.

**(iii)**    Partial credit was commonly awarded, usually for the idea that sediments contain TBT for many years. References to TBT decomposing were not credited. Answers involving dredging and the lack of regulation by some countries were rarely seen.

**Question 6**

**(a)**    Only the strongest candidates were able to give a suitable definition of ecotourism. Answers such as "tourism which causes no harm to the environment" or "tourism focused on wildlife" were not credited.

**(b)**    Most candidates answered this question well and many gained full credit. Common errors were giving general answers which were not related to the information provided. In some cases answers were too vague to gain credit e.g. "non-motorised water sports do not cause pollution" or "do not harm the coral".

**(c)**    Again, some candidates did not refer to the information provided. Candidates should focus their answers on features which undermine conservation. Many answers were vague e.g. the natural river pool was stated as "people would disturb the ecosystem" or answers focused on hardwood floors instead of the fact that they had been imported from Asia.

**Question 7**

**(a)(i)**    Very few candidates gained full credit here. Many answers produced offspring with the advantageous features rather than adults with advantageous features being selected for breeding together. There were very few references to the fact that selective breeding took place over many generations or to the fact that it was carried out by humans.

**(ii)**    Only stronger candidates stated that selective breeding involved whole genotypes, but that genetic engineering involved the transfer of one gene from one species to another.

**(b)(i)**    Most candidates realised that the purpose of tank **B** was a control experiment. However, a few candidates stated that it was a control variable.

**(ii)**    This was a challenging question for many candidates. Tank **A** had 1000 of the largest fish removed at each generation, so left a population with genes for smaller size. These were the only fish left to breed, so passed on the gene for small size to their offspring. Incorrect answers included references to the size of the tank or amount of food given to the fish.

**(iii)**    Full credit was commonly awarded for stating that the fish in tank **C** would increase in size.

**(c)(i)**    Stronger candidates correctly stated that the promoter would activate the required gene. A few candidates incorrectly stated that the promoter turned the gene on and off.

**(ii)**    Many candidates answered this question in term of genetically modified salmon, stating that the advantage was increased growth or that they reached market size faster and that the disadvantage was the problems associated with fish escape. The question asked for the advantages and

disadvantages to the fish breeder. Stronger candidates were able to state that the fish could command a higher price due to their novelty value and the possible objection to buying genetically modified fish. Few references were made to restrictions to imports of genetically modified fish or to the fact that a licence was required.

# MARINE SCIENCE

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**Paper 9693/04**
**A2 Data Handling and Free Response**

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## Key messages

In future series, candidates should:

- ensure they are familiar with all the mathematical requirements, including calculating gradients
- be familiar with command words such as 'compare' and discuss'
- write extended answers that are detailed and use full scientific vocabulary
- approach unfamiliar data with confidence and explore all aspects rather than focusing on only one.

## General comments

The general standard of answers was good and many candidates were able to give excellent, detailed answers. Most candidates had strong mathematical skills, but some were unable to calculate percentage changes and/or the gradient of a line. Data analysis was often found to be challenging; it is advisable for candidates to practise analysing unfamiliar data in preparation for exams. When answering questions with data, candidates should look for clear patterns and then look for aspects that do not fit trends.

Most candidates demonstrated an excellent understanding of topics such as sewage pollution, gaseous exchange, the oyster life cycle and the effects of aquaculture on other coastal industries. However, candidates should ensure that their answers are relevant to the question asked. Many gave an answer to **Question 4(c)** that contained correct information but was not relevant to the question. A few candidates underestimated the level of depth of answer required at this level, particularly for **Question 3(b)** which required a comparison of gaseous exchange in corals and grouper.

## Comments on specific questions

*Section A*

**Question 1**

**(a) (i)** Most candidates were able to use the graph to determine the correct depth of corrosion. Some candidates incorrectly used the line for middle and high latitudes, and others misread the *y*-axis scale. Candidates should be careful to read labels on graphs and diagrams carefully.

**(ii)** Many candidates were able to calculate the rate of corrosion and most were careful to show their working. A few candidates did not give correct units, and some divided the time by the change in depth of the steel. When giving units, candidates should use correct notation, in this case giving mm year$^{-1}$ rather than mm/year.

**(iii)** This question was challenging for many candidates. Stronger candidates recognised that the rate of corrosion would mean that the steel would be totally corroded in 70 years, and some supported their answer with a calculation. Many frequently went on to state that this would lead to leakage of oil. Weaker candidates often gave vague answers that stated that rate of corrosion would be fast. Candidates should ensure they refer to information from the question when asked to.

**(iv)** Most candidates gained at least partial credit on this question. The effect of oil on oxygen levels, its toxicity, the smothering of birds' feathers, and prevention of photosynthesis were frequent answers. Some candidates gave vague answers such as, "oil kills birds and fish" but needed to give more detail for credit.

**(b)** Some candidates found this question challenging and gave answers that simply stated that the data supported or opposed the hypothesis. Few candidates recognised that the data did not refer directly to biodiversity, but actually measured percentage cover by different organisms. Most were able to identify that the cover by corals increased with age and some went on to give very good answers that identified that other organisms did not give the same trends. Some candidates recognised that the Japan wreck data did not fit the general pattern and that it had a much greater depth. Many candidates showed a good understanding of the scientific method and so recognised that the data was not entirely valid due to the different depths and usage of the wrecks. When provided with complex data, it is important for candidates to explore it fully rather than only focusing on one aspect.

## Question 2

**(a) (i)** Some candidates found calculating percentage changes difficult. This is an important mathematical skill that candidates should practise. The most common error was for candidates to divide the yield in tilapia grown alone by the yield in tilapia grown with shrimp at high density.

**(ii)** Most candidates were able to gain partial credit by recognising that increasing the density of shrimp reduced the yield. Only stronger candidates gave detailed answers that stated that the low-density shrimp increased the yield, whilst both medium-density and high-density reduced it. Candidates need to be careful to describe data precisely.

**(iii)** Most candidates were able to correctly suggest two variables. Some weaker candidates suggested changing the shrimp density and others gave irrelevant variables. When stating a variable such as food, candidates should be careful to refer to mass of food or type of food rather than just food alone.

**(b)** Stronger candidates answered this question well. Most recognised that cleaning costs would be lower, and many went on to state that feeding costs for the shrimp would also be lower. Only a few recognised that the shrimp would be an additional saleable product and that if low-density shrimp were used, the yield of tilapia would increase. Weaker candidates often gave only one benefit.

*Section B*

## Question 3

**(a)** Most candidates were able to gain partial credit but very few gained full credit. There was some confusion about whether air or water contains a higher oxygen concentration and very few recognised that the oxygen content of water is very variable. These two statements are given in the syllabus and candidates should be careful to learn all areas of the syllabus. Some candidates misunderstood the question and explained how oxygen dissolves in water.

**(b)** This question generated a wide range of marks with stronger candidates answering well and nearly every candidate gaining at least partial credit. Most candidates were able to explain that diffusion is used by both organisms and that a large surface area is important. Many stronger candidates gave excellent, very detailed answers that explained the need for thin diffusion surfaces in both organisms and the need for blood, pumped ventilation and gills in groupers. Several candidates gave impressive detail, referring to counter-currents, gill lamellae and the necessary ventilation movements. Some candidates incorrectly suggested that groupers use ram ventilation. The command word for the question was, 'compare' and candidates needed to make a comparison, looking for similarities and differences rather than just describing gaseous exchange in the two organisms.

**(c)** This question was well answered by the majority of candidates. Candidates generally had an excellent understanding of eutrophication and the reduction of oxygen in the water due to inorganic ions. Many gave detailed explanations of the bioaccumulation of toxins and the effects of sediment on light penetration and photosynthesis. There was some confusion between the effects of fertilisers and pesticides, with some candidates suggesting that pesticides cause algal growth.

**Question 4**

**(a)**      Most candidates gained at least partial credit. Many candidates were able to give examples of each type of fertilisation method and then suggest that internal fertilisation increases the chance of fertilisation and is less wasteful. A significant number suggested that internal fertilisation enabled more parental care of offspring but this is not a direct benefit of internal fertilisation.

**(b)**      The majority of candidates were able to give at least one correct larval stage, and many were able to describe the planktonic stages of life. Excellent terminology and detail was often given by stronger candidates, with many referring to trochophore, veliger and pediveliger stages. Many stated that the pediveligers attach to a substrate but did not clearly imply that they sink and settle onto the substrate. Only a few candidates went on to describe the growth into male and then female oysters.

**(c)**      This question was challenging for many candidates. Weaker candidates tended to give vague answers about general unemployment and/or money in the local area but did not link this to named industries. The question asked about the impact on other industries, rather than the general impact. Many candidates referred to general effects of pollution rather than linking this to the effect of pollution on fishing and/or tourism. Stronger candidates gave detailed answers that specifically referred to the effects on tourism, fishing and transport. Some candidates tended to focus on only one aspect, typically the fishing industry. The command word for the question was 'discuss' and this required candidates to explore the topic as fully as possible and not to restrict their answers to one aspect. Some candidates gave excellent detail and explained why tourism could be reduced as well as the effects of escape of oysters and/or pollution on the wild stocks. There were some impressive answers that explained how industries may be impacted by increased transport and infrastructure and how increased revenue from taxation could lead to better development.