May 2012 subject reports

Environmental systems and societies

Overall grade boundaries

Standard level

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 16	17 - 31	32 - 41	42 - 53	54 - 64	65 - 76	77 - 100

Internal assessment

Component grade boundaries

Standard level

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 7	8 - 14	15 - 19	20 - 24	25 - 29	30 - 34	35 - 42

General comments

The May 2012 Internal Assessment moderation session saw the largest group of candidates to date. As new schools come on board they quite naturally go through the learning curve, some faster than others. As more school become involved, the variety of practical continues to astonish. This session there were schools using Geiger counters to measure low level radiation, as well as the more typical lab and field studies.

The problems where there were some, had mostly to do with schools that have not been teaching the program for very long and are making quite typical mistakes. Teachers that have doubts during the year regarding various aspects of the program would do well to read previous versions of the subject report because these tend to focus on areas that are giving schools trouble. Additionally the Teacher Support Material in the OCC is a great resource.

The biggest problems in planning tended to center around the identification of variables, a detailed description of **how** samples/quadrats/transects are chosen and the designing of a method that will generate sufficient relevant data. Some students in various schools had trouble separating dependent from independent variables. As has been mentioned before, this needs to be taught directly as it seems to be a rather difficult concept for some students. Some schools work with the concept of manipulated vs responding variable and the language is perhaps easier to understand. When student set out to perform a sampling exercise, clearly they have not invented quadrats or belt transects. So what in fact are they designing? The

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answer of course is how transects or other sampling sites are chosen. As this is critical in determining if the test is “fair” or biased, indicating how the sites are chosen is crucial for top marks. Finally, in other reports it has been stated that for sampling exercises or for laboratory work, five repeats of each treatment are the minimum necessary to achieve a complete on aspect 3 of this criterion. In the case of transects, because of the time constraints typically present in most schools, three parallel transects are considered a minimum. As this has been repeated again and again, there seems to be no excuse for marks that are awarded for one sample in each treatment. The sad thing is that the student is getting the message that this is fine, when in fact it is not.

Data Collection and Processing: A good data table needs to be self-explanatory which implies a good title, units in the column or row headings and good row or column labels. Ideally the table should be able to stand alone. It is frustrating to see students loose marks for placing units in data cells because this should have been corrected in early stages of the Scheme of Work. If the lack of a title makes it impossible to interpret a data table, it is possible that the student will receive no marks for aspect 1 of DCP.

Data processing was well done by many candidates, with some schools including some great statistical techniques such as Pearson rank coefficients, or Chi squared tests. However a good many schools are using practically no statistical analysis beyond an average. A good data set should allow the calculation of means and medians, and the standard deviation. This is largely why five repetitions are expected in planning, i.e. to allow for the calculation of statistics that permit students to arrive at some conclusions regarding the **quality** of their data.

In aspect 2 of DCP there continue to be problems with the use of significant figures, and this is odd because most students are quite likely to be in an IB math class where this topic is addressed. Finally, many students loose marks because they do not include a sample calculation in their processing.

The biggest problems with aspect 3 of DCP is the graphing of raw data. As has been mentioned in previous reports, graphing of raw data, in the absence of any processing, will normally result in no marks for aspects 2 or 3 of DCP. Again, this ties in with Planning. A practical that generate one Dissolved Oxygen reading for each of five sites on a river, when graphed as such, will generate no marks for aspects 2 or 3. However if a few more samples are taken, a running average can be calculated. If each site is sampled three times, these can be averaged, and the results graphed.

Discussion, Evaluation and Conclusion: Perhaps the weakest aspect of this criterion was aspect 1, Discussion. There was very little evidence of students addressing the quality of their data. This in large part has to do with aspect 1 of DCP. The lack of statistics, makes it difficult to determine whether data are robust. Often discussions were begging for comparisons to theory or literature values. Students should be able to discuss what should have happened in theory in their work. Aspect 2 tended to be well done, however almost automatically students should mention the need to repeat their work to validate it, or gather more data. In science this is practically a requirement to improve the reliability of conclusions. Aspect 3, Conclusion generally suffers from two faults. The first has to do with conclusions that are general statements about the condition of the planet. For example after doing a practical on the

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effects of pH change on germination of seeds, concluding that acid rain is a serious global problem. The second relates to conclusions that aren't directly supported by or related to the data. The most common mistake students makes is not citing their data as they write their conclusions.

Standard Level Paper One

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 8	9 - 16	17 - 22	23 - 27	28 - 31	32 - 36	37 - 45

The areas of the programme and examination which appeared difficult for the candidates.

According to the responses to the G2 forms, 62% of the teachers felt that the paper was of a similar standard to last year's paper, 11% indicated that it was a little or much more difficult and 20% considered that it was easier. The great majority (96%) of the teachers considered that the level of difficulty of this paper was appropriate. Syllabus coverage, clarity of wording and presentation of the paper was considered satisfactory or good by 100% of the teachers.

The general comments provided by the teachers were very positive. Several examiners mentioned that this paper was fair, questions were quite interesting and balanced, and overall the paper challenged the students in terms of content. However, several teachers felt that there were too many definition questions.

There were no problems with the Spanish and French translations of this paper.

The specific comments are discussed below.

There was no one area that candidates found difficult, it varied between candidates. However, pollution in general did not score very highly.

Students were not always clear about point source pollution delivering nutrients.

A lot confused eutrophication and depletion of oxygen with reduced pH.

Giving a definition for BOD - most candidates wrote that it was the amount of oxygen required by organisms living in the water.

Looking at the effect of changing conditions was a challenge for some.

Energy efficiency of terrestrial vs. aquatic food production systems was a challenge for many.

The greenhouse effect and how particulates can change conditions or how different gases behave.

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Ecological footprint was understood but the explanation for differences between countries proved a difficult task for many.

The difference between monitoring and controlling was a major issue.

The areas of the programme and examination in which candidates appeared well prepared.

Most students appeared to be able to look at data and get information from that. How to calculate populations and diversity appeared good, as was discussion about zoos and conservation. Diversity Index, as a technique, was done well by a high percentage of candidates. The use of keys for identification was also good - most students scored well on this.

Soils appeared to be covered well and the triangular graph posed few problems in interpreting and responses on soil conservation suggested a good level of knowledge and understanding.

Many candidates demonstrated excellent conceptual understanding, particularly of complex concepts such as ecological footprint, point source, non-point source and carrying capacity.

Candidates showed lots of evidence of sound understanding of different environmental value systems and how these relate to actions/decisions taken by different communities.
Length of answers seemed to be closely linked to the number of marks allocated. Most candidates seemed to finish the paper.

The strengths and weaknesses of the candidates in the treatment of individual questions.

Question 1

a) This question was answered correctly by the great majority of the candidates.

b) Most candidates accurately indicated the capture-mark-release-recapture method.

c) This question was answered very well by most candidates

d) Some issues with this question as student were sometimes a bit vague about the criteria. A large number of candidates misunderstood the criteria for the design of a reserve as resources required for the species.

e) Both strengths and weaknesses were not outlined with regards to zoos. Some candidates either stated only strengths or only weaknesses.

Question 2

a) Some students were very good on point vs. non-point sources but were not always clear about what the pollutant was (waste, discharge etc.). Weaker students struggled with the

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sources of nutrient pollution - responses were too often vague and general lacking focus on nutrients, i.e. nitrates / phosphates.

b) This question was answered very well by most candidates. Although there were still some students who answered isolated or closed.

c) BOD definition was poorly done, and many students went with it being the oxygen that all the things in the water required to live.

d) i) Many candidates have not given all four required names of the organisms and only cited perch and frogs.

ii) Some student went with the loss of food source but many had problems understanding the concept of pH and its effect on the water quality. Many candidates got only one mark in this question.

Question 3

a) Most candidates answered this question accurately and recognised that this could not be an energy pyramid but some confused it with a pyramid of numbers.

b) This question was answered very well by most candidates.

c) Most candidates calculated the correct Simpson's diversity index.

d) i) This question was answered very well by most candidates.

ii) This question was answered very well by most candidates but was more challenging for students, they tended to come up with simplistic ideas, some just said some species were just too similar and went no further

Question 4

a) i) Many students were correct in their calculation of this but some forgot to indicate millions.
ii) Students were less clear with their responses, many talked about area and population size as reason for difference rather than making the links between industry and waste or cars and emissions, etc. It also caused the less able students problem in writing a response beyond a general reference to level of development.

b) i) Most of the candidates have defined carrying capacity correctly.

ii) A reasonable number of students had some sensible ideas about why carrying capacity was hard to determine, not always clearly expressed.

Question 5

a) Most candidates correctly chose loam.

b) Most correctly chose soil B but reasons were sometimes not strong

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c) Candidates answered this question well.

d) This was not as well done many got the transformation but were not as strong with the transfers or vice versa.

e) This question was the most poorly answered on the entire paper. A significant number of students gave answers about the energy involved in the harvesting with terrestrial and aquatic systems, many who did understand the question only gave one point (both sides). Nevertheless, stronger candidates wrote responses which were often good enough for more than the 3 max.

Question 6

a) Many candidates struggle with this question and quite a few students said that ash would trap heat and warm planet rather than reflect incoming radiation. There did not appear to be a good understanding of particulates and their affects at all.

b) Most candidates answered this question accurately but many just gave greenhouse gases and not gases responsible for acid deposition

c) The named gas was OK but the majority of student gave responses for the control of the pollution rather than monitoring, there was also a little confusion between direct and indirect methods. The great majority of candidates commented on control rather than monitoring - either the question was not understood or this element of pollution was not covered well.

Recommendations for the teaching of future candidates.

Use the syllabus to guide the study and make sure all aspects in syllabus are covered. Teachers should spend more time in the basic ideology of the course, i.e. understanding the systems approach and the concept of energy.

Remind candidates to read questions carefully, and to underline command terms. Ensure candidates have a copy of the glossary of terms from the syllabus and recommend that they learn the definitions. For example, students should be reminded that an evaluation consists of both strengths and weaknesses. Setting up tables and using dot point can be valuable in looking at pros and cons.

Write only in boxes provided or additional papers, some students still write on the edges of the paper.

Help candidates to relate theoretical understanding of ecosystem function to actual case studies of ecosystems.

More practice with calculation questions and interpretation of graphs would be ideal for students.

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Language and the precision of terms and the science not well used and this led to under quality of answers. For example, students need to have solid knowledge about the difference between the greenhouse effect and ozone depletion as well as the concept of pH and acidity.

Further comments

Many candidates could answer the straight forward questions adequately but where challenged when it came to questions which required that they explain, illustrate or think about what could happen or why something did happen.

More practice with questions like this could prove beneficial.

From an examiner: This year the online marking was so much easier to complete than last year - mark scheme was clear, seeds were straightforward and on the two instances when out of tolerance the feedback and guidance was obvious - a huge improvement on last year. The general standard of candidate responses seemed very similar to last year based on the allocation seen - with possibly fewer very weak scores in single figures.

Standard Level Paper Two

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 9	10 - 18	19 - 23	24 - 31	32 - 39	40 - 47	48 - 65

The vast majority of schools who responded using the G2 form, felt that the level of the paper was appropriate, and either at a similar level or slightly more difficult than 2011. Clarity of wording and presentation were also deemed good by the majority of respondents.

Opinions on the case study were mixed with some feeling it was innovative and accessible, and others feeling it was too challenging for their students. Some specific comments noted that the purpose of the essays is to test analytical and synthesis skills rather than pure recall and that in general they did a good job of testing these skills. Question 2c was highlighted as being too broad and challenging compared to other part cs in the section B, and this point is acknowledged. The inclusion of more definitions than in previous sessions was also commented upon, though advice in previous examiner reports has been to emphasize the importance of reinforcing key terms, and this was therefore felt to be reasonable. The use of the terms Cornucopian and Deep Ecologist did raise some concerns, although both terms are found in the model of environmental value systems in topic 7, and a variety of approaches to this question were credited by examiners.

The areas of the programme and examination which appeared difficult for the candidates.

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Candidates are often still not able to write in sufficient detail to gain full marks. This could often be seen in more open-ended responses when there was a need for candidates to be able to identify multiple discreet points, rather than repeating similar points.

Some candidates are still spending too long on the case study at the expense of the essays though time management skills seem to be improving.

Misunderstanding of command words like justify, distinguish and evaluate is an issue. Justifying or giving reasons for statements was a particular weakness in this paper this session.

Definition of key ESS terms remains a problem which has a big impact on attainment. Candidates who had rote learned definitions still did not always show understanding of the terms as concepts. There is a general lack of precision.

Drawing systems diagrams, and identifying input/outputs of system diagrams is still hard for many candidates. There remains a need for candidates to know how to draw scientific diagrams.

Thinking holistically and synthesis – drawing disparate parts of the syllabus together is still difficult for candidates. Aim 8 of the course - to appreciate that human society is both directly and indirectly linked to the environment at a number of levels and at a variety of scales – is tested explicitly through section C of the essays. Linkages are needed but are often not there.

Candidates struggle to connect their knowledge of examples with ecological principles – matching theory with reality is clearly difficult for them.

Poor conceptual understanding of negative feedback, sustainability, ecosystem function and biodiversity was evident.

When discussing ecocentric value systems candidates often failed to go past the desire to preserve, omitting the importance of ecosystems over human needs.

Assessment objective 4 stresses the need to make reasoned and balanced judgments using appropriate economic, historical, cultural, socio-political and scientific sources. Only the very best candidates were able to demonstrate this balance.

The areas of the programme and examination in which candidates appeared well prepared.

Candidates seemed to be able to find the information easily in the resource booklet and the case study generally offered fewer problems than the essays. They do well with succinct questions that require succinct answers. They seem to do well with reading the Resource Booklet and analyzing data. Many candidates did reasonably well when asked for specific definitions. They also were able to justify their opinions with facts from the Resource Booklet with reasonable competency.

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A good grasp of ideas on Gaia and Global warming (especially knowledge of causes and effects) was demonstrated as was recall of some key definitions such as sustainability and biodiversity. Technical terms were frequently used instead of their mere definitions. Topics like conservation of biodiversity, natural income, equilibrium, succession, zonation, productivity and biodiversity were handled skilfully by many candidates.

Candidates are increasingly confident with discussing Technocentric and Ecocentric approaches and coped well with different viewpoints and approaches e.g. Deep Ecologist vs. Cornucopian. They also showed improved understanding of core content eg. feedback, and were able to give examples such as predator/prey relationships effectively.

Regarding command terms, it was clear that many candidates understand what to do when asked to deal with simple verbs and relatively complex ones such as annotate, explain or discuss.

Candidates were able to use a variety of named examples throughout their papers which seems to suggest that case studies are being used in lessons. For example most had named case studies of conservation, but needed more specific detail at times.

The strengths and weaknesses of the candidates in the treatment of individual questions.

A surprising, and perhaps somewhat disappointing number of candidates did not know that very dry conditions (less than 250mm pa of rainfall) leads to a desert biome and not to, for example, Tropical Rainforest. The world map and the location of Iraq should have been a clear indication that it is not Tundra either. A popular incorrect response was ‘wetlands’ or marshlands which are of course not biomes. It is possible that some candidates mistook Centigrade for Fahrenheit and thus misinterpreted the graph.

A majority of the candidates were able to identify factors in determining species under the "Red List". Two correct factors were needed for full marks however. Common mistakes included issues of predation, rates of reproduction and reference to gene pool. Most candidates were able to identify reeds and fish as two forms of natural income. Other responses such as the role of ecological services and other products such as fur from otters were accepted.

Students struggle to gain full marks for the systems diagram for water resources, often giving factors that were unrelated to water, especially for the outputs (which required more thought). More careful reading of the question is needed here, and this demonstrated that even if students have learned some parts of the syllabus eg. the water cycle, they are not always able to apply this knowledge in new situations. This was also evident in the question where they were required to identify the correct stage of demographic transition from the population pyramid of Iraq. Candidates were hedging their bets giving double answers eg. stage 1/stage 2, which could not be credited. Descriptive accounts were not credited either.

The candidates were then required to relate an increasing population to implications for water resources and many struggled to do this, becoming confused by the graph on rain fed and irrigated crops. To gain full marks candidates needed to make the link between an expanding

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population and water resources. Lack of clarity in answers was a common problem here, as were repetitive answers. Candidates seemed to think all answers had to relate to crops and irrigation, when in fact any increased demand on water resources would have been credited.

Candidates were generally able to interpret the graph comparing species in different marshes, though were not always able to articulate this effectively to gain full marks. Some degree of quantification was required above simply stating that there had been a decrease or increase since historical records. Attention to detail was the issue in the responses comparing water quality in the marshes with few candidates acknowledging that there were differences *between* the reflooded marshes when compared to the natural marshes. Some recognition of this was required for full marks. Recognising the shades of grey in the data is an important skill. The final part of this question required three distinct points to be made. The majority of candidates highlighted the presence of salts and pollutants but were unable to think of another factor, showing an ability to pick obvious points from the resource booklet but perhaps not reason them through.

Responses to the question on willingness to pay were done well, showing a good understanding of the range of factors which affect environmental value systems, and a pleasing ability to interpret the difficult map. The final part of this section however proved more challenging for candidates. It required an evaluation of the plan to completely reflood marshes, yet many candidates simply described their own plan to reflood the marshes or were confused by the notion of partial reflooding in the past and full reflooding in the future. Evaluation generally requires some weighing up of the pros and cons of a scheme but some responses simply dismissed the plan as a bad idea. Many candidates mistakenly believed that natural marshes would be re-flooded, thus lowering water quality and biodiversity. Very few students therefore achieved high marks for this question. Many only identified 2 or 3 aspects e.g. wetlands provide important habitats for endangered species and that re-flooding may not be successful due to salinity of the soils, but few went further than this.

SECTION B

Essay 2

There has been a noticeable improvement in the ability of candidates to define key terms such as succession and zonation, but distinguishing between them requires a little more than this, and this question (like the question on sustainable development and sustainability) was designed to test understanding of the concept rather than simply a rote learning of the definition. Understanding of succession was stronger than understanding of zonation, with a number confusing zones with biomes. Examples were often too broad to be of use in assisting the candidate to make their point.

Few students were able to explain effectively why a climax community is diverse and therefore stable. Marks were commonly achieved through discussion of how interruption caused loss of species and food source. Responses were often too general and repetitive often just repeating the principle, already given in the question, that diversity provides stability.

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Question 2c was a distinct challenge for those who attempted it. The need to link points about the functioning of an ecosystem to effective resource management was often overlooked. The most popular issue was sustainable harvesting and succession, whereas diversity and cycling of matter were only identified by the best candidates. This question and the problems in conceptual understanding that it highlighted emphasize how candidates often struggle to bring parts of the syllabus together in a holistic way.

Essay 3

This was a popular question which was in general managed well. Precision in core terminology is still needed however and many candidates relied on the colloquial use of the term abundance saying it is “when there is a lot of something” rather than using the term in its ecological sense. Although the majority of the candidates were able to give a reasonable (but mostly incomplete) definition for biodiversity, they failed to acknowledge that biodiversity includes not just variety/number of all species but also genetic and habitat diversity. Few knew that abundance is one component of biodiversity.

Despite concerns raised in the G2s about the terms cornucopian and deep ecologist this question was generally handled extremely well by candidates who remembered from the continuum in the syllabus that one was a technocentric response and the other was ecocentric. Responses which took this approach were credited.

The best responses to part c began with a clear and accurate definition of Ecological footprint. There is a tendency to confuse footprint, which involves hypothetical area of land, with general use of resources. Most missed the ‘absorb waste’ element of footprint and so revolved their answer around over-consumption of resources in MEDCs. Few candidates demonstrated an understanding of the principle of earth-share which is implicit within ecological footprints. Most candidates distinguished between ecocentric and technocentric approaches but the discussion of either approach usually lacked specific examples.

Essay 4

Most candidates showed a good understanding of the central ideas of the Gaia hypothesis, but found it harder to compare with more ‘traditional’ views of the earth. Despite concerns raised in the G2 about whether this was a fair question, traditional could be interpreted in very broad terms and a range of reasonable interpretations was credited.

A good understanding of negative feedback was often demonstrated though the use of diagrams to communicate this understanding was still a challenge for many. Fewer pictures of cows and rabbits appeared this session, but some ‘picto-diagrams’ were still evident which should be discouraged as they are unnecessary and time consuming for candidates to draw. Candidates choice of examples was generally sound though not always sufficiently explicit with regard to the key causal links eg 'prey increase so predators increase' without explaining why.

Most candidates were able to articulate clearly which issue they saw as the bigger threat. Most identified Global Warming, arguing that biodiversity was a subset of this, though a greater range of points was clearly needed for full marks. A large number of candidates just

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listed many impacts of Global Warming or biodiversity loss, rather than exploring different kinds of reasons for it being a bigger threat. There was the perennial error of confusing, and lumping together, all the major atmospheric pollution issues including acid rain and ozone depletion. This misconception needs to be regularly challenged in classes.

Essay 5

The first part of this question tested understanding of core concepts of sustainable development and sustainability. Candidates who simply wrote the definitions gained some marks but not all. Only a small minority were able to reproduce the 'official definition' of sustainable development first made popular in the Bruntdland Report, though this was not required for full marks.

Many candidates showed a good understanding of biomes and were able to distinguish between GPP and NPP. Poor answers failed to discuss the influence of climatic factors e.g. insolation/precipitation/temperature. Understanding of 'biome' was occasionally too specific (eg Amazon rainforest) or too broad (eg 'forests' or 'aquatic').

The final part of this question highlighted the importance of studying actual case studies and not just theory. A number of candidates simply described design principles rather than thinking through broader possible criteria. These criteria could have focused on the success of outcomes, design *or* methods. Many candidates lost marks as they did not justify their choice of criteria but simply stated them or were not able to evaluate their own case study against the criteria. Some candidates discussed zoos as conservation areas which made for poor responses.

Recommendations for the teaching of future candidates.

The following is a summary of the advice for teaching future candidates:

1. Review the meanings of command terms so students know what is required in each question.

2. Encourage students to make annotated diagrams large and clear if they are using them.

3. Make sure students pay attention to the "point value" for each question to gauge how many different and distinct statements they need to address to earn full marks. Encourage candidates to give clear, diverse and discreet marking points, rather than a single vague, limited, and repetitive discourse.

4. Encourage students to break up their answers into the relevant sub sections to make it easier for the examiner to identify which part of the question they are answering.

5. Ensure sufficient time is dedicated to the teaching of core ecological principles and concepts. In particular explicitly explore ‘meta-ecology’ issues (like energy flow) and relate them to concrete examples (like reducing water input to Iraq marshes means fewer reeds, which is fewer producers and less autotrophic energy fixation dictating that higher tropic levels will also be reduced as a consequence).

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6. Reinforce the importance of learning key definitions and terminology eg. biodiversity, sustainability. While rote learning of key definitions may have its place, a firm grasp of the underlying concepts behind the terminology and the ability to communicate this understanding is essential. Poor definitions at the start of a question can lead to the 'snowball effect' whereby the rest of the answer suffers from a weak foundation.

7. Clarify how expression of ideas marks are allocated and perhaps use them in your own marking so students get used to developing their answers, including examples and structuring their ideas.

8. An interdisciplinary approach in teaching should help students to approach essay questions holistically.

9. Spend additional time addressing common misconceptions eg. difference between carbon footprint and ecological footprint and between ozone depletion and climate change.

10. Candidates should be encouraged to write within the space provided within the exam paper.

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