Sports exercise and health science (SEHS)

Overall grade boundaries

Standard level

Grade:	1	2	3	4	5	6	7
Mark range:	0 – 16	17 – 32	33 – 44	45 – 55	56 – 67	68 – 78	79 - 100

Standard level internal assessment

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 – 8	9 – 16	17 – 22	23 – 27	28 – 33	34 – 38	39 - 48

The range and suitability of the work submitted

The variety of investigations, duration and coverage of the practical programme was varied and was excellent in some schools. There was a range of hands-on activity in most core topics along with a sound use of ICT.

The quality of IA work was varied across schools. Some candidates produced outstanding reports with very thorough background research and reference to ethical issues both in their design and again in their conclusion. Most schools used appropriate investigations of a sound standard.

The moderators were concerned when the only marks appearing on the 4/PSOW form were the two marks required for internal assessment. There was often no indication that candidates were marked a number of times using the criteria. One wonders how these candidates receive the necessary feedback to improve their performance.

Candidate performance against each criterion

In some schools teachers applied the criteria rigorously and clearly, and moderators needed to make only relatively small adjustments to the marks. In schools where the descriptors of the different aspects were ignored, moderation may have reduced the marks quite severely.

Teachers who included the "complete", "partial" and "not at all" breakdown of their marks were providing helpful information to the moderators. When this was combined with comments and feedback to candidates it was very clear how teachers awarded marks. There was a large number of teachers who took a lot of time and trouble to prepare their internal assessment sample. This effort was very much appreciated and they should be congratulated for their efforts. It was a lot easier for a moderator to confirm a teacher's marks when there were clear, readable notes accompanying the sample.

Design

The design process was very strong across the moderated samples. Moderators commented that when standard protocols were used by candidates they were referenced and significantly modified or applied to the candidate's own investigation. The range of values of the independent variables and number of repeats (ideal to have 3-5 repeats for each variable) was not always sufficient to establish trends or permit statistical analysis. A minimum of five participants was also needed to undertake further statistical analysis in the form of standard deviation.

Data collection and processing (DCP)

A problem relayed by moderators was that some investigations did not generate sufficient quantitative data for adequate processing. Associated qualitative data was also expected and this was not always given. Candidates need to be taught that observations made during the experiment will assist them in determining the validity of the data and will strengthen their conclusion.

It may be that class data is required in order for the candidate to gain access to sufficient data for significant data processing and determination of uncertainties. The moderators understand this; however, if class data is used for DCP assessment, a number of precautions must be respected. Candidates must present their own data and this can be achieved either by presenting their own data first or by clearly identifying which is their own data in a pooled data table. Unfortunately, there were occasions when subjects did not present any raw data and included only processed data. Moderators are also looking for a brief statement explaining why the candidate gave a particular value of uncertainty for both raw and processed data.

Some candidates did not include descriptive titles for each data table. Every header requires appropriate units along with the error margin. The error margin could be human error as this is often more applicable (e.g. ±0.5 seconds, ± 0.5cm). The number of decimal places must reflect the precision of the measuring instrument.

When calculations are made it is important that the pathway to the answer is clear. This does not always mean there has to be a worked example but a result that springs up out of nowhere will not be credited. Teachers need to remind candidates that a large standard deviation does not necessarily show data is unreliable; it just shows a wide spread. When IA involves many different subjects this large standard deviation is probably to be expected (depending on the variable being measured). Candidates need to revisit the processed data they present as often this can be represented in one

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graph rather than 4 separate graphs. Presenting processed data on a graph is expected and indeed required for full assessment under DCP. Teachers need to be aware of this requirement.

Here are some examples of situations where moderators needed to adjust the marks awarded by teachers.

- Tables did not have a descriptive title containing both the dependent and independent variables.
- Units missing in the table column headings (note: decimal units should be used).
- No uncertainties were given in the column headings of tables of data collected using measuring instruments.
- Data (raw or processed) were inadequately presented.
- There were inconsistent decimal places in tables.
- The decimal places did not correspond to the precision of measurements.
- Lack of data meant that individual averages could not always be processed.
- The processed data (2 decimal places) on occasions had a higher degree of precision than the raw data.
- The absence of associated qualitative observations where they were valuable.
- The absence of statistical treatment of the data when it was possible.
- A linear line of best fit was included even when the data was clearly S-shaped or had some other non-linear pattern.
- Raw data was plotted in graphs that did not actually reveal anything (Note: raw data can be plotted to derive maxima, minima, optimal rates, intercepts or to reveal correlations).
- Raw data was plotted when the mean should have been calculated and plotted (often the mean was actually calculated and then ignored by the candidate when plotting graphs).
- There was no presentation of uncertainties in graphical data either by using trend lines or error bars or uncertainty ranges on the axes.
- Error bars, when used, were not identified or accompanied by an explanation of what the values meant.

Conclusion and evaluation (CE)

Many candidates failed to score full marks on the conclusion and evaluation component and this is an immediate area for attention. To maximize the marks in CE (aspect 1) candidates must include data from their results to back up their findings and must refer to the appropriate statistical test to discuss the significance of their data. Candidates need to think beyond the given data in order to provide a justification based on a reasonable interpretation of the data. Such insight might look at the extremes of the data range, the origin of the graph or the y-intercept for some physical meaning. Candidates might even give the overall relationship some physical interpretation. Teachers need to look for this when awarding aspect 1 a "complete", as many times moderators had to change a "complete" to a "partial". Stronger candidates added value to their own data findings by referring to or comparing and contrasting with existing data or theory.

Anomalies were sometimes identified and excluded, however, this could be developed further through a discussion of the possible origin of these anomalies. CE is best assessed when candidates have also designed and performed the investigation themselves.

Candidates in some schools show that they have developed a mature sense of criticism of their investigation. Their evaluation of results was based upon a balanced critical analysis of the data. Many candidates constructed three parallel columns corresponding to CE aspects 2 and 3: (1) Error, (2) Significance of error and (3) suggested improvement; horizontal rows may be more appropriate

with regard to format. The inclusion of separate rows for the significance of the weakness helped to draw candidates to the importance of discussing the significance in addition to just identifying the weaknesses. When discussing the significance of the weakness, few candidates referred to their actual data or backed up the issues they identified in order to justify their statements.

When evaluating procedures, weaker candidates often commented on mistakes and lack of numbers in their sample rather than methodical errors or ways to improve the investigation. Candidates need to be taught that they should describe at least 3 major weaknesses and more if there are more present. Evaluation is a good discriminator of high achieving candidates and teachers would do well to remember this when they are marking their candidates' work.

Manipulative skills (MS)

Evidence on the 4/PSOW forms indicates that candidates are being exposed to a sufficient range of investigations. This ensures that manipulative skills can be assessed correctly. However, a large number of moderators notice that some schools awarded 6/6 for the whole sample for this criterion. There was no discrimination between candidates.

Recommendations for the teaching of future candidates

- Many schools allow candidates only two opportunities to earn their best marks. It is recommended that after candidates become familiar with the expectations of IA they have a number of opportunities to be assessed (perhaps 3 or 4) from which the highest two of each criterion are used for their IA mark.
- Read the feedback from this session and act upon it.
- Share the IA criteria with their candidates and explain them.
- Apply the internal assessment criteria rigorously.
- Consult the OCC for Teacher support material (TSM) for the IA component of the course. The TSM shows how the criteria should be applied in the assessment of practical work. It consists of a series of investigations or part investigations by candidates that have been assessed by moderators using the assessment criteria.
- Set open-ended themes with enough scope to provide a variety of research questions for the
- Ensure that investigations have the potential to generate sufficient data for substantial processing.
- Teachers should give candidates experience in identifying independent, dependent and controlled variables.
- Encourage candidates to make additional observations about their experiment (qualitative data).
- Teach candidates that each data table should include a descriptive title containing both the dependent and independent variables. Every header also requires appropriate units along with the error margin.
- Teach candidates that the number of decimal places must reflect the precision of the measuring instrument and all decimal places must be consistent in raw and processed data.
- Although many schools correctly appreciate errors and uncertainties, this remains one of the weaker areas for some other schools. Teachers need to address the appropriate treatment of uncertainties in lab work.
- Teach candidates that plotting graphs of raw data is often insufficient if nothing can be derived from them.
- Only processed data is to be presented graphically and the x and y axes must be clearly labelled. When candidates use error bars on graphs, there needs to be an indication of what

these values represent.

- CE Aspect 1 (concluding) should include data to back up findings and reference to the appropriate statistical test to discuss the significance of the data.
- Further challenge candidates to add value to their own data findings by comparing and contrasting with existing data or theory before starting an investigation and again once the results are complete.
- Reinforce to candidates that they should not rely solely on websites as references; the Internet should be used to complement more quality assured sources.
- Citations of references should be presented correctly; Extended Essay guidelines give very helpful information.
- Encourage candidates to report briefly on ethical issues in their design and again in their conclusion.
- Bind or staple candidates' work.
- Make sure that you are using the most up-to-date version of the 4/PSOW form
- Check that all the parts of the 4/PSOW form are completed correctly. It is helpful if the full IA titles (candidate) of investigations are included on the 4/PSOW form as this makes it easier for the moderator to match up the candidate work for assessment.
- Enclose all instruction sheets and/or summaries of oral instructions for the investigations in the moderation sample. Most schools complied with this requirement. When Data collection and processing (DCP) is being assessed, the method designed by the candidate or provided by the teacher is required.
- Complete one 4/IA form signed by all the teachers for your school's sample. Internal standardization of the marking between colleagues is essential.

Further comments

It was clearly evident that some teachers linked and worked with other colleagues to ensure internal standardization had taken place. Schools should continue to link and work with the Biology Department to set a common standard and aid the internal standardization process.

Clerical

Most schools enclosed all the instruction sheets and/or adequate summaries of oral instructions for the investigations in the moderation sample.

Teachers need to ensure that the latest version of the 4/PSOW form (available on the OCC) is used and filled in correctly as this was often not the case. The hours allocated for practical work should not include time allocated for write-up of investigations (D, DCP & CE). The hours allocated should be recorded only once on the form, and grades, where appropriate, (on the same line for a single investigation) awarded for D, DCP & CE. Some schools sent photocopies of candidate work. Usually these were of good quality. Photocopies of graphs and diagrams using colour can be confusing. It would be better to send the originals and keep a photocopy.

Ethics and Safety

SEHS will inevitably involve investigations using human subjects and teachers should carefully consider the approach to experiments on human physiology. Safety must be paramount in investigations. Using fellow candidates for investigations into the effect of exercise on heart rate can be considered unsafe if the health status of the candidates is not determined first. Some schools already expect their candidates to use a pro-forma to obtain signed consent from participants in

experiments. This is good practice but it was too rare and moderators commented on the absence of signed consent in investigations involving human subjects. The International Baccalaureate (IB) does not wish to inhibit investigations but it does want to stimulate a responsible attitude towards experimentation. If necessary, teachers may need to make adjustments to their practical scheme of work especially where human volunteers are involved. Candidates should also be encouraged to report briefly on any ethical issues which arise during their investigations e.g. confidentiality of participants. The animal experimentation policy and ethical practice poster can be found on the subject homepage on the Online Curriculum Centre (OCC).

ICT coverage

There was evidence of excellent ICT coverage and some schools have made an effort to equip themselves with the necessary materials to carry out data logging. However, data loggers must be used with care in investigations. Teachers and candidates are strongly advised to read the relevant section of the subject guide.

Graph plotting using software was perhaps the easiest and most widespread for schools to apply. However some candidates still need to be taught the correct conventions of graphing. There was a tendency to use bar charts for everything amongst the weakest candidates, perhaps because it is the default setting. Legends (keys) are not always necessary and some candidates did not seem to know how to de-select them. When they were needed candidates often had difficulty labelling them appropriately – candidates often presented the different curves as "series 1" and "series 2".

ICT is an area that candidates could explore further with regard to the presentation of their data; candidates could make wider use of spreadsheets and databases and further develop their presentation of processed data. Conventions of presenting tabulated data still need to be followed when spreadsheet tables are inserted into document files (e.g. centering numbers, adjusting the number of decimal places, column headings).

Standard level paper one

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 – 7	8 – 12	13 – 17	18 – 20	21 – 23	24 – 26	27 - 30

Statistical analysis

The overall performance of candidates and the performance on individual questions are illustrated in the statistical analysis of responses. These data are given in the grids below. The numbers in the columns A-D are the numbers of candidates choosing the labelled option.

The question key (correct option) is indicated by a shaded cell.

The difficulty index (perhaps better called facility index) is the percentage of candidates that gave the correct response (the key). A high index thus indicates an easy question. The discrimination index is a measure of how well the question discriminated between the candidates of different abilities. In general, a higher discrimination index indicates that a greater proportion of the more able candidates correctly identified the key compared with the weaker candidates. This may not, however, be the case where the difficulty index is either high or low.

SL paper 1 item analysis

Question	A	B	C	D	Difficulty Index	Discrimination Index
8	0	0	0	68	100.00	0.00
17	1	0	0	67	98.53	-0.04
18	0	2	66	0	97.06	0.09
11	0	2	0	66	97.06	0.09
26	3	64	1	0	94.12	0.13
23	64	1	3	0	94.12	0.13
2	64	1	0	3	94.12	0.17
27	1	4	63	0	92.65	0.22
25	63	1	2	2	92.65	0.13
6	0	1	61	6	89.71	0.17
12	2	60	5	1	88.24	0.30
28	4	0	5	59	86.76	0.09
20	0	9	58	1	85.29	0.13
22	2	58	6	2	85.29	0.39
30	3	4	3	58	85.29	0.26
14	10	57	1	0	83.82	0.35
19	10	2	0	56	82.35	0.22
7	5	56	1	6	82.35	0.30
1	56	10	2	0	82.35	0.26
29	56	9	3	0	82.35	0.39
16	54	10	4	0	79.41	0.30
21	12	53	1	2	77.94	0.43
4	8	1	8	51	75.00	0.43
24	17	0	49	2	72.06	0.39
9	48	16	0	4	70.59	0.17
15	45	6	13	4	66.18	0.52
10	5	2	45	16	66.18	0.43
13	23	2	43	0	63.24	0.43
5	19	5	43	1	63.24	0.48
3	9	40	9	10	58.82	0.43

Standard level paper two

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 – 7	8 – 15	16 – 19	20 – 25	26 – 32	33 – 38	39 - 50

General comments

There were no blank papers which is good to see. There were also very few blank question areas. There was generally good use of command terms.

Section A did contain a lot of easy marks; candidates and teachers appeared to have learnt from May 2014 feedback – e.g. calculate = show working; also there were some similar topic areas covered.

Questions 5 and 6 were the most popular – few did 7.

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

Section A:

- 1ci and ii not totally sure about SD
- 1d some candidates still neglecting to show calculations or units
- Basic anatomical identification of aspects in diagram not always done well.
- lever and its application was variable – all 3 levers could be used at this joint with clear explanation
- 2d actual figures were often inaccurate however the intent that athletes would consume more macro nutrients was acknowledged.
- 3a occasionally question misinterpreted – functions noted rather than structures – candidates need to read questions carefully
- 3b sequence not clearly understood at times
- 4c not done overly well – mixed up between MOT and EETProgamme

Section B

6a candidates need to remember the context for the question

6c there were 2 movements possible to talk about. Confusion regarding muscles engaged and causing movement; eccentric contraction mentioned for relaxing muscle – note the guide has eccentric relaxation.

6d modes of exercise and affect on VO2 score still not well understood

Question 7 – very few candidates selected.

7e it was not easy for those who did study design to get full marks

5a understanding of movement is due to pressure differences not always understood.

5b different aspects of chemical and nervous control not understood strongly

5c while specific skill attributes were not always identified the relationship between skill level and phase was well understood by most.

5d PRP generally well understood and its connection to single channel hypothesis and also practical application good

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

- Data questions done very well. Used the data well with the extended questions/ answers.
- Calculations generally done extremely well
- The 3rd law is well understood and applied.
- ATP-PC application to energy required for short intense work was generally very good.
- 2d actual figures were often inaccurate however the intent that athletes would consume more macro nutrients was acknowledged.
- Principal ventilatory structures was done well.
- Heart excitation overall well known
- Distribution of blood during exercise also
- Welford's model and the relationship between SA and memory

Most candidates chose question 5

5b generally stronger with chemical triggers rather than the nervous controls

5c while specific skill attributes were not always identified the relationship between skill level and phase was well understood by most.

5d PRP generally well understood and its connection to single channel hypothesis and also practical application good

Question 6 was the second most popular question

Question 7 – very few candidates selected. Evaluation of aerobic test done well – need to try and have an even split of positive and negative.

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

- 1ci and ii not totally sure about SD
- 1d generally done extremely well – but subjects neglecting to show calculations or units
- 1f and g usually done very well – the 3rd law is well understood and applied.
- 2a identification of aspects in diagram not always done well.
- 2b lever and its application was variable – all 3 levers could be used at this joint with clear explanation
- 2d actual figures were often inaccurate however the intent that athletes would consume more

macro nutrients was acknowledged.
- 3a occasionally question misinterpreted – functions noted rather than structures – read questions carefully
- 3b sequence not clearly understood
- 4c not done overly well – mixed up between MOT and EETProgamme

5a understanding of movement is due to pressure differences not always understood.

5b different aspects not understood strongly

5c while specific skill attributes were not always identified the relationship between skill level and phase was well understood by most.

6a candidates need to remember the context for the question

6c there were 2 movements possible to talk about. Confusion regarding muscles engaged and causing movement; eccentric contraction mentioned for relaxing muscle – handbook has eccentric relaxation.

6d modes of exercise and affect on VO2 score still not well understood

Question 7 – very few candidates selected. Those that did study design struggled to get full marks. Evaluation of aerobic test done well – need to try and have an even split of positive and negative

Recommendations and guidance for the teaching of future candidates

Encourage candidates to write something for each question even when they are unsure – it may just help and trigger something or get them a mark. Often even starting with a definition and then trying to apply the concept to the question can help.

Read questions carefully before answering – check for key words – structure – function, etc.

Learn the command terms as much as the various concepts – this will assist in the application of knowledge.

For *evaluate* try and have a balanced number of positive and negative points.

Standard level paper three

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 – 5	6 – 11	12 – 16	17 – 20	21 – 25	26 – 29	30 - 40

General comments

- The use of past papers and mark schemes can be particularly useful to prepare for the examination. Candidates need to be mindful of the number of marks allocated per question and respond appropriately.
- It was good to see the full range of options attempted.
- It was pleasing that no candidates undertook more than 2 options.
- It was also pleasing to see candidates attempt questions and not leave them blank.

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

Option A

2b. Candidates struggled with this question. It would be a good discriminator as a lot of candidates outlined the effects of Beta Blockers on the body i.e. reduce heart rate/anxiety and not the potential risks. Candidates who scored well mainly considered low blood pressure, fatigue and reduced performance as the risk factors.

3a. A lot of candidates discussed the fact that plyometrics would improve power but failed to describe the training elements of a plyometric program. This may have been a lack of understanding of the command term.

4b. Candidates in this question struggled with the discussion component. i.e. adaptations were identified but often lacked the physiological explanation for the adaptation.

Option B

Candidates struggled to effectively describe the difficulty cold water creates for effective thermoregulation.

4c. Candidates struggled with the evaluation component. i.e. they described mental imagery but many failed to achieve full marks as little evaluation was apparent.

6b. Some candidates ventured beyond the personality theories outlined in the guide or considered Atkinson's motivation theory and as such were not awarded marks for this information.

7. This question required application so candidates needed to consider appropriate examples to illustrate their answers.

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8b. The evaluation component again distinguished between candidates. The majority of candidates struggled with this question.

Option C

9c. Candidates surprisingly struggled with this question. There was limited evidence of being able to recall Physical Activity recommendations. Better responses include time per day/number of days and mentioned the use of strength training.

Limited understanding of the term "environmental barriers"

Option D

Limited understanding of Dietary practices to control body composition

14b. Most candidates struggled with this question. They took the perspective of rehydrating through use of sports drinks rather than considering the role of the renal and endocrine systems in regulating electrolyte balance within the body.

15a. There was some confusion regarding the use of bicarbonate loading with a number of candidates confusing it with carbohydrate loading.

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

On the whole candidates handled the data based questions effectively.

Option A

The definition and benefits of ergogenic aids were well understood.

3b. Candidates demonstrated a good understanding of the indicators of overtraining.

Option B

Candidates demonstrated a good understanding of personality theories.

Good understanding of theories of arousal in sport i.e. drive reduction and catastrophe.

8c. Candidates were able to provide a clear outline of progressive muscular relaxation.

Option C

Candidates demonstrated a good understanding of osteoporosis and diabetes.

Option D

Candidates clearly understood techniques for monitoring hydration status

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

Option A

1b. Candidates had some difficulty interpreting the graph as units were not present. As a result, provided the process was apparent the answer was accepted as correct.

e.g. 13.9 – 12 = 1.9 gkg -1

Option B

5b. Some responded by identifying "Non-professional soccer players" which was accepted. The group is correctly identified as "Group B".

Option C

10a. Appeared to be a straightforward question but there was some confusion apparent amongst candidates.

11a. Most candidates identified the release of endorphins as enhancing psychological well being. Some concentrated their entire response to this and failed to offer other reasons.

Option D

15b. Candidates tended to identify nutrient imbalance but struggled to access a range of other possible effects.

Recommendations and guidance for the teaching of future candidates

A clear understanding of the command terms is essential to achieve optimal marks. In this regard the use of tables is useful for questions asking candidates to compare.