

November 2016 subject reports

Sport, exercise and health science

Overall grade boundaries

Standard level

Grade:	1	2	3	4	5	6	7
Mark range:	0-17	18-31	32-42	43-53	54-65	66-76	77-100

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 quality of the candidates' IA work continues to improve and teachers should be congratulated for their efforts. Teachers are also to be commended for acting on the 2015 subject report, and for taking a lot of time and trouble to prepare their Internal Assessment sample. The variety of investigations, duration and coverage of the practical programme was varied and was excellent in some schools. Once again, there was a range of hands-on activity in most core topics along with a sound use of ICT by some students. Most schools used appropriate investigations of a sound standard. Examiners commented that candidates performed according to teacher strengths and weaknesses, as similar candidate strengths and weaknesses were reflected within each sample. For example, there were schools that submitted outstanding designs and conclusions with quality literature reviews and very thorough background research along with reference to ethical issues. Some other schools appeared to struggle with data collection and processing, whereas others had outstanding statistical analyses and/or conclusions and evaluations but were challenged in formulating research questions and designs. Some schools already expect their students to use a pro-forma to obtain signed consent from participants in experiments. This is good practice but it was too rare and examiners commented on the absence of signed consent in investigations involving human subjects. Candidates should also be reminded to report briefly on any ethical issues that arise during their investigations e.g. confidentiality of participants. Using fellow

candidates for investigations into the effect of exercise on heart rate or effect of caffeine supplementation on performance can be considered unsafe if the health status of the candidates is not determined first.

There is an increase in the number of designs with caffeine supplementation (e.g. oral pills, red bull) being used as the independent variable and this being deemed to be at 'safe' levels by the student administering them. This is problematic at best, and could lead to unintended side effects in students in practical activities, based on the fact that the student is not a medical professional, and in turn not able to accurately evaluate students and medicine. 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.

The examiners continue to be concerned when the only marks appearing on the 4/PSOWSEHS 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 and provided with opportunities to practice the skills required.

Candidate performance against each criterion

There appears to be substantial variability in how practicals are approached and marked, suggesting that more training is needed to bring better understanding and consistency between teachers. In some schools, teachers applied the criteria rigorously and clearly, and examiners were able to make relatively small adjustments to the marks. Teachers who included the "Complete", "Partial" and "Not at all" breakdown of their marks were providing helpful information to the examiners. When this was combined with comments and feedback to candidates it was very clear how teachers had awarded marks. It was a lot easier for an examiner to support a teacher's marks when there were clear, readable notes accompanying the sample. Limited or no written teacher comments on reports for students also makes one wonder how these candidates receive the necessary feedback to improve their performance. Schools that included internal standardisation generally produced work of a higher quality and with marks being line with the SEHS assessment criteria.

Design (D)

Candidates are commonly not showing some curiosity as they present very undemanding Research Questions where the outcome is well defined in the syllabus or self-evident; alternatively, the report describes a 'commonplace' school investigation with a procedure that has not been adapted or extended in any way. Teachers who are encouraging candidates to be creative with their own designs and who in turn provided insightful pieces of work are to be commended, even if some did lead to trivial results. Most designs submitted followed the scientific method of conducting research; however, some students (and teachers) continue to have difficulty identifying independent, dependent, control and confounding variables. Candidates must be taught to always include measurements when outlining the dependent (measure) variable, e.g. cm and check their independent (change) variable. Most candidates were very well trained in providing a list of the controlled variables and discussing how the

impact of confounding variables could be reduced. Examiners commented that when standard protocols were used by candidates they were often not referenced and significantly modified or applied to the candidate's own investigation. One of the weaker areas for some schools is in the form of the methodology; it must be clear, explain how the dependent, independent and control variables have been appropriately considered and include enough procedural detail. To gain a Complete for Design Aspect 2 the method needs to be detailed, numbered (ideally) and it should be possible to follow it with no previous knowledge (e.g. include protocol, equipment, sample, numerical amounts, units of measurement). The range of values of the independent variables and number of repeats (ideal to have 3-5 repeats for each variable) were 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 and candidates need to be explicit with regard to number of participants to ensure they can attain a Complete for Design Aspect 3. Consent forms were often used; however, many candidates did not make reference to this in their method and as such there was no option for subjects to withdraw.

Data collection and processing (DCP)

A problem relayed by examiners was that some investigations did not generate sufficient quantitative data for adequate processing, with some candidates presenting raw data rather than processed data. Associated qualitative data was generally evident and it was clear that teachers had taught candidates that observations made during the experiment will assist them in determining the validity of the data and in turn strengthen their conclusion.

Examiners commented that DCP seems to be the criterion in which there is a greatest variation in application in what teachers are expecting and teaching. To gain a Complete for DCP Aspects 1 and 2 candidates need to include descriptive titles for each data table. Errors or uncertainties still seemed an area of confusion. Every header requires appropriate units along with the error margin. The error margin could be systematic (human) error as this is often more applicable (e.g. ± 0.5 seconds, ± 0.5 cm) than mechanical error. Examiners are also looking for a brief statement explaining why the candidate gave a particular value of uncertainty for both raw and processed data. The number of decimal places must reflect the precision of the measuring instrument. Teachers need to remind candidates that the processed data must be to the same degree of precision as the raw data and this was often not the case as candidates were recording data to a higher degree of precision (2 decimal places).

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. Candidates in general are either presenting their own data first or by clearly identifying which is their own data in a pooled data table, which is great to see. When calculations are made, some candidates are providing one or more worked examples. 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. Almost all candidates are showing the mean and standard deviation calculations. Teachers need to continue to remind candidates that a large standard deviation does not necessarily show data is unreliable when using humans as subjects; it just shows a wide spread. When IA involves many different subjects this large standard deviation is probably to be expected in that there is the possibility of unreliability - this is where qualitative data from the experiment can help explain things. Most

candidates seemed well coached in statistics and applied t-tests and correlation coefficients whenever appropriate, which was great to see.

Presenting processed data on a graph is expected and indeed required for full assessment under DCP. Teachers need to be aware of this requirement and that computer-generated graphs proved problematic in terms of the x and y -axis, labels and plotting of data. Teachers must teach candidates how to add error bars for both line graphs and bar graphs, and to practice all of these in a software tool such as Excel. Many candidates did not include descriptive titles for each graph and often had two titles, which stated the same thing; others plotted several graphs when one would have been sufficient or presented data from which nothing could be derived.

Examiners stressed the need for teachers to spend more time on teaching the fundamentals of how to process and present data through visual forms and the appropriateness of such graphical representation.

Where examiners had to reduce teachers' marks it was for the following reasons:

- Tables and graphs 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.
- 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.
- 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)

CE continues to be best assessed when candidates have designed and performed the investigation themselves. Many candidates failed to score full marks on the conclusion and evaluation component. 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. 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 should be developed further through a discussion of the possible origin of these anomalies.

Candidates often constructed three horizontal rows corresponding to CE Aspects 2 and 3: (1) weakness, (2) significance of error and (3) suggested improvement. Candidates in some schools show that they have developed a mature sense of criticism of their investigation with their evaluation of results being based upon a balanced critical analysis of the data. 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 reminded that they should describe at least 3 major weaknesses and more if there are more present. Despite the inclusion of separate rows for the significance of the weakness which helped to draw candidates to the importance of discussing the significance in addition to just identifying the weaknesses, this continues to be an immediate area for attention. When discussing the significance of the weakness, the teacher needs to highlight that students must refer to their actual data or back up the issues they have identified in order to justify their statements and gain a Complete for CE Aspect 1 as this was often marked over generously. Candidates need to be reminded that modifications must be specific as in many cases they are superficial and marked over generously by teachers. 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/PSEHS forms indicates that most candidates are being exposed to a sufficient range of investigations. This ensures that manipulative skills can be assessed correctly. However, a large number of examiners notice that some schools are attributing 6/6 for the whole sample for this criterion and that there appears to be very little 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. **[NOTE: This is only relevant to 2017 assessments as the IA assessment changes in 2018]**
- Read the feedback from this session and act upon it.
- Share the IA criteria with their candidates and explain them.
- Consult the Online Curriculum Centre (OCC) for Teacher support material (TSM) for the IA component of the course if this has not been referred to. 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 examiners using the assessment criteria.
- Guide candidates away from repeating classic investigations or working on the same research question when they design their own investigations.
- Set open-ended themes with enough scope to provide a variety of research questions for the whole class.

- 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).
- Ensure candidates keep their students' anonymity and refer to them by a number and not personal names.
- 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.
- Teachers must teach candidates how to add error bars for both line and bar graphs, and to practice all of these in a software tool such as Excel.
- 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.
- 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.
- 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.
- Make sure that you are using the most up-to-date version of the 4/PSOWSEHS form.
- Check that all the parts of the 4/PSOWSEHS form are completed correctly. It is helpful if the full IA titles (candidate) of investigations are included on the 4/PSOWSEHS form as this makes it easier for the examiner 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/IASEHS form signed by all the teachers for your school's sample. Internal standardisation 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. Teachers are encouraged to work with the other science subjects where appropriate, to ensure common understanding of standards.

Clerical

Teachers must ensure that the latest version of the 4/PSOWSEHS form (available on the OCC) is used and filled in correctly as this again was often not done. It is crucial that schools refer to the OCC to gain guidance on filling in forms and complete this basic task correctly. 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. There appears to be confusion about what the cross was for in the boxes under the different criteria and for each investigation; some schools used this to identify the practicals sent but several used this to show all the practicals that had been assessed. The cross is to identify the top 2 grades and to identify the work being sent to the examiner as part of the sample. All assessed work should include the mark out of 6 if the teacher at some point throughout the course assessed that work.

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. As stated in the "Guidelines for the use of animals in IB World Schools" in the IB animal experimental policy any experimentation involving human subjects must be with their direct, legally obtained written permission. Investigations involving any body fluids must not be performed due to the risk of the transmission of blood-borne pathogens. The only exception would be an investigator using their own saliva or sweat. Experiments that administer drugs or medicines or manipulate the environment or diet beyond that which can be regarded as humane is unacceptable in IB schools. In other words, exposing candidates to caffeine, alcohol or energy drinks is not appropriate as you are exposing subjects to conditions outside their normal environmental tolerance limits. The general consensus with many science teachers is that consuming recommended dosage for nutritional ergogenic aids is not likely to lead to significant changes in behaviour and, if any changes do take place this may be due to confounding variables. This is especially true given the small sample size and no recording of other variables in a scientific way. Therefore, ingesting sufficient nutritional ergogenic aids, such as caffeine tablets, creatine, sports drinks, protein supplements (legal over the counter products) to lead to a statistically significant difference in results is going beyond what should be ingested by humans in the short time frame.

ICT coverage

There was evidence of sound 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 and possibly target ICT as an area to develop.

Graph plotting using software continues to be 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 some candidates had difficulty labelling them appropriately; candidates often presented the different curves as “series 1” and “series 2”. Candidates need to be advised that graphs should only have one title, and not two, which was sometimes the case.

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. centring 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	8-11	12-15	16-19	20-22	23-26	27-30

General comments

Each session teachers are invited to submit comments about each exam on form G2. These forms can be downloaded from the OCC. These comments provide valuable evidence used by the senior examining team during the Grade Award meetings. For this session no G2 forms were submitted. It may be that teachers were happy with the paper; however it is still important for the examining team to have this feedback to help in their analysis.

The mean score/mark was 23.82 (range 13 – 30). This is down compared to November 2015 which was 25.10 (range 13 – 30).

Statistical analysis

The overall performance of candidates and the performance on individual questions are illustrated in the statistical analysis of responses in the grids below. The numbers in the columns A–D and Blank are the numbers of candidates choosing this as their answer. The shaded cell indicates the correct question.

The difficulty index (perhaps better called facility index) is the percentage of candidates that gave the correct response. 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.

Paper one item analysis

Number of candidates: 115

Question	A	B	C	D	Blank	Difficulty Index	Discrimination Index
1	4	34	64	13		29.57	0.32
2	106	7	2	0		92.17	0.16
3	7	88	6	14		76.52	0.37
4	0	1	108	6		93.91	0.13
5	1	100	6	8		86.96	0.24
6	17	11	18	69		60.00	0.47
7	110	3	0	2		95.65	0.03
8	5	21	72	17		62.61	0.55
9	95	4	1	15		82.61	0.24
10	2	105	6	2		91.30	0.18
11	17	66	8	24		57.39	0.53
12	0	5	3	107		93.04	0.18
13	14	0	0	101		87.83	0.21
14	6	109	0	0		94.78	0.11
15	100	12	3	0		86.96	0.24
16	4	85	15	11		73.91	0.45
17	5	21	85	4		73.91	0.11
18	79	17	12	7		68.70	0.55
19	96	8	9	2		83.48	0.26
20	0	114	1	0		99.13	0.03
21	50	2	34	29		43.48	0.45
22	2	3	10	100		86.96	0.24
23	13	2	2	98		85.22	0.16
24	1	105	8	1		91.30	0.18
25	20	3	84	8		73.04	0.39
26	104	2	2	7		90.43	0.18
27	0	0	112	3		97.39	0.03
28	23	17	13	62		53.91	0.58
29	2	2	13	98		85.22	0.13
30	2	16	0	97		84.35	0.29

Comments on the analysis

Difficulty

The difficulty index varies from about 30% (relatively “difficult” questions) to about 97% (relatively “easy” questions). The papers gave an adequate spread of marks while allowing all candidates to gain credit.

Discrimination

All questions had a positive value for the discrimination index. Ideally, the index should be greater than about 0.2. This was achieved in the majority of questions. However, a low discrimination index may not result from an unreliable or poor question. It could indicate a common misconception amongst candidates or it is a question with a high difficulty index which says that the candidates were well prepared for this topic area.

“Blank” response

Pleasingly there were no blank responses in this session.

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

The following areas evidenced some weaknesses and should/need to be improved upon:

- 1.1.3 long bone;
- 2.1.3 vital capacity;
- 2.1.6 % O₂ carried by Hb;
- 4.3.9 angular momentum;
- 5.2.2 Welford's model;
- 6.3.3 tests for body composition.

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

The following topics/sub topics were answered well:

- 1.2.4 insertion;
- 1.2.5 anatomical locations;
- 2.1.1 principal ventilator structures;
- 2.1.2 functions of airways;
- 2.2.6 cardiac output;
- 2.2.13 cardiovascular adaptations;
- 3.1.1 macronutrients;
- 3.1.7 unsaturated fats;
- 3.1.8 protein structure;
- 3.2.3 fat storage;
- 3.3.3 respiration;
- 4.1.1 motor unit;
- 4.3.1 vectors;
- 4.3.6 levers;
- 4.3.11 projectile;
- 5.1.8 skill;
- 5.2.10 psychological refractory period;
- 5.2.11 motor programmes;
- 5.3.2 stages of learning;
- 5.3.6 transfer of learning;
- 6.2.3 PAR-Q;
- 6.1.2 mean calculation;
- 6.3.1 fitness components;
- 6.3.3 tests of aerobic fitness.

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

Question 1

The most difficult question on the paper. More people answered C - short bone.

Question 2

Based on AS 1.2.4 in the SEHS syllabus, this question had a satisfactory discrimination index.

Question 3

A mid-difficulty question, with a good discrimination, and D was the main distractor.

Question 4

Seen as an easy question, and D was the main distractor. Students have been exposed to this type of question previously and have clearly got their heads around the different features.

Question 5

An easy question for most students. This question had a good discrimination index.

Question 6

The 5th hardest question on the paper, with a good discrimination index.

Question 7

The 3rd easiest question which had a low discrimination index. Despite this it is a key area of the syllabus for students to know. The challenge for candidates is to be able to understand the application of this knowledge in various contexts.

Question 8

The 6th hardest question with B and D as the main distractors.

Question 9

A mid-difficulty question which a good discrimination index. D was the main distractor.

Question 10

A relatively easy question, which candidates have come across before. Surprisingly some students are still identifying well known macronutrients; which may indicate that they are not reading the question clearly.

Question 11

The 4th most difficult question – the different oils is a tricky one to recall. A and D were the main distractors.

Question 12

An easier question, with B as the main distractor.

Question 13

A good question, with A as the only distractor. It had a good discrimination index.

Question 14

This is clearly an area and an answer familiar to students. A was the only distractor.

Question 15

A mid difficulty question, with B as the main distractor.

Question 16

A mid difficulty question, with C and D as the main distractors.

Question 17

A mid difficulty question, with B as the main distractor.

Question 18

A challenging question in the mid-difficulty continuum, with B as the main distractor. Students are not recognising that as one increases the other decreases.

Question 19

A straight forward question, with B and C as the main distractors.

Question 20

This was the easiest question, with the lowest discrimination index. It is a formula which students are clearly familiar with.

Question 21

The 2nd hardest question with C and D as the main distractors. It had a good discrimination index.

Question 22

A good question on the paper, with C as the main distractor. The discrimination index was fair.

Question 23

A mid-difficulty question with A as the main distractor. The discrimination index was fair.

Question 24

This question had a fair discrimination index and was answered quite easily, with C as the main distractor.

Question 25

A mid-difficult question, with A as the main distractor. It had a good discrimination index.

Question 26

An easy question, as it should be for a question on this topic area, with a poor discrimination index.

Question 27

The 2nd easiest question, as expected for a question on this topic area, with a poor discrimination index.

Question 28

The 3rd most difficult question with the wrong answers having similar numbers of candidates selecting them – showing that there is some uncertainty in the various tests. One of the issues could be that very few candidates would have experienced the body composition tests as opposed to the other tests in the syllabus.

Question 29

An easy question, with a poor discrimination index as it should be for a question on this topic area.

Question 30

An easy question, with a good discrimination index. B was the biggest distractor.

Recommendations and guidance for the teaching of future candidates

Encourage students to take their time with the paper. They must not leave a question blank. Where a question is difficult, look to eliminate any answers that are definitely wrong and this will help to increase the chances of them getting the correct response.

Standard level paper two

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0-5	6-10	11-15	16-21	22-27	28-33	34-50

General comments

This paper was very similar to many recent papers in terms of style but appeared to be slightly more challenging. The data questions in Question 1 appeared to be particularly challenging for candidates. Section A provided some easy recall type questions followed by questions which required candidates to apply their knowledge. Question 7 was the most popular question in section B with question 5 the least.

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

- Describing the Borg Scale as a method of assessing exercise intensity requires a more detailed focus. Using the mark scheme in conjunction with wider reading will help.
- Candidates were often vague identifying the oblique muscles.
- Concepts of study design in an applied context were a challenge for pupils. They struggled to define and apply the terms reliability and validity in the context of a sport of their own choice. Taking a more applied approach to analysing tests used for different sports may help students to apply theory to practice.
- Many candidates struggled with analysing and describing the energy systems in detail. There was a lack of understanding of how to analyse the strengths and weaknesses of the ATP-PC system.
- Candidates became confused between characteristics of muscle and the structure of skeletal muscle.
- Many candidates struggled to access full marks by applying Newton's third law to uphill running.

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

- Knowledge of gaseous exchange and the mechanics of breathing.
- Recall of components of blood was good.
- The recall of steps of muscle contraction was good.
- Recall of the structure of the carbohydrates.
- Candidates could usually recall the function of glucagon.
- Candidates had a good grasp of centre of mass and the changes with different high jump techniques.

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

Section A

Question 1

- a) Candidates answered this question well, very few incorrect answers.
- b) This was a poorly answered question with many candidates not reading the full question. Many candidates described standard deviation with little to no application to the data presented in the question.
- c) This was also a challenging question for many candidates.
- d) Many candidates struggled to access 2 marks for this question. Most gained the first marking point only.
- e) This was a strongly answered question.
- f) This question was generally answered very well with most candidates referring to just the one teaching style as per the question.
- g) Many candidates struggled to access two marks for this question. Most candidates only gained the first mark point.

Question 2

- a) Most candidates were able to identify X as the external obliques, and Y as the Ilium. Many candidates referred to the pelvic girdle and just the obliques and lacked specificity for this question.
- b) Overall a very strong question for candidates with most accurately identifying the hinge joint.
- c) Many candidates were able to identify the movement as plantar flexion. A high proportion of candidates just referred to flexion and identified the muscle; however the question required the specific muscle contraction and this was often omitted in the candidate's answer.
- d) Another strong question for many candidates, with most candidates responding with erythrocytes. Very few candidates identified platelets.

Question 3

- a) Generally candidates answered this accurately; however there were a number of candidates who confused this for the sinoatrial node.
- b) Many candidates scored 1 mark for this question identifying that cholinesterase is the enzyme which breaks down acetylcholine. However, there is still a misconception that cholinesterase is a neurotransmitter. Cholinesterase is also known as acetylcholinesterase.

c) Overall this question was answered well, although many candidates failed to recognise the specific focus of this question and discussed the synapse and depolarisation of the muscle and changes to troponin and tropomyosin which were irrelevant to this question.

Question 4

ai) This question was answered very well. Many candidates were able to give the specific chemical formula for glucose.

aii) Many candidates were able to identify that a condensation reaction occurs and this causes a release of a water molecule. However, many candidates struggled to gain a second mark for this question. Further detail of the condensation reaction process is required.

b) Many candidates understood the role of glucagon; however many believed that glycogen breakdown to glucose is called glycogenesis. Therefore specific advice should be given to candidates to help them understand the key difference between similar key terms. Some candidates failed to focus on the question regarding fasting. Some candidates became confused between glucagon and glycogen.

c) Many candidates could describe the ATP-PC system but struggled to analyse the strengths of the energy system. Very few candidates gained two marks for this question.

Section B

Question 5

a) For those candidates who had selected Q5 many confused the requirements of the question with the characteristics of muscle. Candidates should develop their ability to describe anatomical structures as those who attempted this question found it difficult to express their understanding coherently. Some candidates drew a diagram to demonstrate their knowledge and this helped to provide evidence to support their response.

b) Many candidates were able to identify that systolic pressure rises with endurance running. However very few candidates were able to access further marks for this question. Overall this was a poorly answered question.

c) Many candidates achieved 3 or more marks for this question. Many of the responses focused on ATP production, by products and fuel breakdown.

d) This was a poorly answered question. Candidates struggled to relate the concept of validity and reliability to a sport of their choice. Many candidates confused validity with accuracy and many candidates were unable to access more than one mark per term.

Question 6

a) Most candidates scored high marks on this question. They were able to correctly identify the flow of gases, how this occurred and the changes that occur during exercise.

b) Some candidates demonstrated excellent examination techniques and placed this information into a table. Many candidates struggled to compare the two systems and only accessed the contrasting marking points. Candidates lacked specific knowledge of the number of ATP molecules produced in each system and this requires further revision and clarification. Many candidates were able to identify some by-products but lacked depth in their answer and rarely scored more than 3 marks for this question.

c) Most candidates were able to refer to the changes from novice to skilled performer across the three stages of learning. Generally, most candidates correctly identified the stages of learning; however few candidates could accurately describe the stages in enough detail to allow them to access the full marks.

d) Candidates had a strong understanding that correlation does not mean causation; however they struggled to apply this further to gain more than 2 marks for this question.

Question 7

a) This was a strong question for many candidates, often accessing 4-6 marks. Some candidates confused the responses with 6a and explained gaseous exchange. Further reference to specifically the external intercostal muscles and changes in thoracic cavity would improve the quality of the answer for this question.

b) Many candidates were able to distinguish between the position of centre of mass for Fosbury flop and scissor kick, gaining two of the four marks. However, many candidates struggled to suggest how this had an impact on performance.

c) Many candidates defined Newton's third law, and then applied this to uphill running. From an examination technique candidates are advised to apply the law directly unless the definition is directly requested. Most candidates were able to access two marks from their applied definition but struggled to provide greater detail to discuss the impact of Newton's third law on uphill running.

d) This question was the least accessible question for Q7. Many candidates focused on positive, negative and zero transfer and struggled to apply this to a suitable relevant example. Some candidates were unable to accurately link the type of transfer to appropriate examples. A revision of the definition of each type of transfer would benefit candidates answering this question.

Recommendations and guidance for the teaching of future candidates

- Candidates should be encouraged not to leave an answer blank. They will not be penalised for writing wrong answers; additionally, the writing process may trigger their memory of the required knowledge.
- Candidates must try to answer the focus of the question rather than writing everything they know about the topic area.
- Candidates must be careful to provide enough knowledge to cover the marks allocated for the question. If there is insufficient space in the answer box, pupils may continue

their answer on additional paper.

- Students should continue to develop their understanding of question command terms, for example compare and contrast, state and discuss.

Standard level paper three

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0-8	9-16	17-19	20-23	24-27	28-31	32-40

General comments

- Very few blank questions.
- Only one candidate answered more than 2 options.
- Hand writing at times was an issue.
- Some candidates need to ensure that they respond to the command term being used, particularly for evaluate.
- Term “risk factors” was not understood sometimes.
- Generally, the standard was very good, with very few very weak scripts but many very strong ones.

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

- Responses to plyometrics question often too vague.
- Body surface area to mass ratio.
- Periodization.
- Issues with personality research.
- Population studies providing evidence for hypokinetic disease.
- Risk factors not always understood.
- Medulla and loop of Henle function.
- Water distribution in athletes.

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

- Describing preventative steps for heat-related disorders.
- Maintenance of core body temp in cold environment.
- Defining ergogenic aid.
- Benefits of steroids.
- Feelings from being stressed.
- Defining hypokinetic disease.
- Health consequences of obesity.

- Major risk factors for osteoporosis.
- Analysis of type 1 and 2 diabetes.
- Monitoring hydration.
- Sources of protein.
- Enzymes for protein.
- Harmful effects of protein.

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

Option A

Question 1

- a) An easy question to start.
- b) Seldom incorrect.
- c) Inconsistently answered and often too vague, though some improvement compared to previous years.

Question 2

- a) Candidates answered this well.
- b) Few listed the features, but most were able to describe the features.
- bii) Most understood that a larger surface area leads to a greater loss of heat.

Question 3

- a) Well answered and well understood.
- b) Well answered.
- c) Not an easy question and getting full marks was difficult.

Option B

Question 4

- a) and b) Generally well answered.
- c) Thought stopping not always clearly articulated.
- d) Many candidates forgot to look at limitations.

Question 5

- a) Mostly done well.
- b) Generally understood.
- c) The trick here is to read the question and answer it as it intends. Generally answered well.

Question 6

- a) Generally understood well.
- b) Very challenging question where candidates struggled to get more than two marks. Many answers given indicated a lack of truly understanding the question.

Option C

Question 7

- a), b) and c) Done well.
- cii) This was sometimes a struggle to articulate fully what was needed. Many appeared to fail to grasp what the question was asking.
- d) Generally answered well.

Question 8

- a) and b) Generally well understood.

Question 9

- a) Consistently excellent answers.
- b) Generally well answered.

Option D

Question 10

- a), b) and c) Done well.
- di) and dii) not always clear and an area for improvement.

Question 11

- a), b) and c) Generally answered well.
- d) Generally answered well for two marks though most struggled to get three.

Recommendations and guidance for the teaching of future candidates

- Carefully read the question to ensure that the intent of the question is clearly known
- Learn the command terms and consider how they need to be answered.
- Check the marks that are allocated to the question and ensure that they have the same or more points made.
- Many candidates used the additional answer booklets much more effectively than previous years. However, some students were still writing outside of the boxes, which made it difficult for the examiners to read.
- Candidates should be encouraged not to leave an answer blank. They will not be penalised for writing wrong answers; additionally, the writing process may trigger their memory of the required knowledge.
- Ensure that handwriting is legible.