

May 2016 subject reports

Sports, exercise and health science

Overall grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 14	15 - 27	28 - 40	41 - 52	53 - 65	66 - 76	77 - 100

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. Most schools used appropriate investigations of a sound standard.

The majority of students were allowed to conduct their own investigations with teacher prompt, however, insufficient latitude in some schools with designs continues to result in the whole class attempting the same or similar investigation. Many candidates produced outstanding reports with very thorough background research and reference to ethical issues both in their design and again in their conclusion. Some teachers continue to provide too much information and as a result students cannot be awarded a complete for their design. Moderators commented that there were many cases where the teacher appeared to provide candidates with the method, and this often resulted in candidates re-writing it and submitting it as their own design. Teachers rarely commented on the unsuitability of designs that are already covered completely in readily available literature such as the effect of running intensity on heart rate levels and often awarding full marks. There is an increase in the number of designs with caffeine supplementation (e.g. oral pills) 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.

Some students need more freedom to choose their own area of investigation with the opportunity to fail early on and prevent gross errors in final submissions. The moderators were 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 does appear to be a lot of variability in how practicals are approached and marked, suggesting more training is needed to bring better understanding and consistency among teachers. In some schools teachers applied the criteria rigorously and clearly, and moderators were able to make 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. It was a lot easier for a moderator to support a teacher’s marks when there were clear, readable notes accompanying the sample. No or limited written teacher comments on reports for students also makes one wonder how these candidates receive the necessary feedback to improve their performance.

Design (D)

Variability is noted in the quality, and expectations of students from different regions around the world, and it is hoped that as teachers gain more experience and understanding, this will improve. Candidates are often not showing curiosity such as presenting 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 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. Moderators 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, as it must be clear 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 and can be followed with no previous knowledge (e.g. protocol, equipment, sample, numerical amounts, units of measurement). 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.

Some schools were using established design prompts, however, in some cases, the prompts were not appropriate because the teacher gave the candidate the equipment, relevant formula and the independent variable. Teachers should avoid setting designs that are already covered completely in readily available literature. The research question/focused problem is different to the teacher prompt and candidates should include the dependent (you measure) and the independent (you change) variables.

Data collection and processing (DCP)

A problem relayed by moderators was that some investigations did not generate sufficient quantitative data for adequate processing, with many candidates presenting raw data and not processed data. Associated qualitative data was also expected and teachers must teach candidates that observations made during the experiment must be included (where relevant) as they will assist them in determining the validity of the data and in turn will strengthen their conclusion.

Moderators 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. Moderators 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. 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. Candidates must plan and produce their own data table. Teachers who provide candidates with a pre-formatted data table can expect to have their marks moderated down.

When calculations are made the majority of 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. Moderators commented that candidates could be further extended when processing data, as many did not seem well coached in statistics or the use of applied T-tests.

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, or had two titles, which stated the same thing.

Moderators 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 moderators 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.
- 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)

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. 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 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 taught 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 they must refer to their actual data or back up the issues they 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 need to be specific as in many cases they are often superficial. 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/PSOWSEHS 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 moderators 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.
- 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 Online Curriculum Centre (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.

- 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.
- 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 and organize work by candidate rather than the IA criteria.
- 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 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/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

Some schools did not include complete information about their investigations and this directly affected the progression of moderation. Teachers **MUST** enclose all the instruction sheets and/or adequate summaries of oral instructions for the investigations in the moderation sample.

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 the case in the majority of schools. It is crucial that schools refer to 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 continues to appear 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. Some schools sent photocopies of candidate work and usually these were of good quality. Photocopies of graphs and diagrams in black and white 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 or effect of caffeine supplementation on performance can be considered unsafe if the health status of the candidates is not determined first. 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 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 that 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 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 candidates often 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).

Paper one

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 7	8 - 10	11 - 13	14 - 16	17 - 21	22 - 23	24 - 29

General comments

This is the third mainstream May session for SEHS, which was a pilot course until May 2014. 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, it is hoped that more will be submitted in future sessions. For this session forty-three G2 forms were submitted. The majority (31) stated that the level of difficulty was appropriate and 9 indicated it was too difficult. Fourteen stated it was of a similar standard to last year’s paper, whilst 23 stated it was more difficult in comparison with last year’s paper. The clarity of wording of the paper ranged from very poor to excellent, and the presentation ranged from poor to excellent. In feedback to the suitability of

the question paper in terms accessibility and cultural/religious/ethnic bias most forms agreed with suitability of the question paper based on religion/belief system and ethnicity. At least one form somewhat disagreed with the suitability for learning support and another strongly disagreed with ethnicity. One G2 form provided additional comment regarding Q25 where they felt that there were two possible answers. This is addressed later in this report.

The mean score/mark was 16.18 (range 4 – 29). This is down compared to May 2015 which was 17.93 (range 6 – 29).

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 and Blank are the numbers of candidates choosing the labelled option or leaving the answer blank.

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.

Paper one item analysis (Note that Q16 is discounted)

Number of candidates: 2021

Question	A	B	C	D	Blank	Difficulty Index	Discrimination Index
1	374	808	417	421	1	20.63	0.01
2	1469	74	253	225		72.69	0.48
3	97	403	1296	225		64.13	0.44
4	83	1128	298	512		55.81	0.28
5	459	396	1022	142	2	19.59	0.28
6	1665	187	39	129	1	82.38	0.30
7	318	1080	122	499	2	53.44	0.30
8	190	574	695	557	5	34.39	0.25
9	738	358	182	742	1	36.52	0.32
10	327	1164	204	323	3	57.60	0.50
11	219	1364	191	246	1	67.49	0.47
12	1401	168	70	381	1	69.32	0.39
13	142	1380	419	79	1	68.28	0.37
14	1239	232	298	250	2	61.31	0.32
15	98	645	478	799	1	31.91	0.50
16*	294	181	1134	412		.00	0.00
17	286	243	1421	70	1	70.31	0.40
18	1005	305	511	200		49.73	0.48
19	570	343	526	580	2	28.70	0.27
20	1020	363	394	241	3	50.47	0.23
21	167	1515	312	27		74.96	0.34
22	73	1736	35	177		85.90	0.27
23	522	1283	70	142	4	63.48	0.36
24	44	163	826	987	1	48.84	-0.05
25	507	1335	130	48	1	25.09	0.15
26	486	490	924	118	3	45.72	0.38
27	218	33	152	1617	1	80.01	0.38
28	814	67	132	1007	1	49.83	0.46
29	898	92	21	1009	1	44.43	0.18
30	58	94	158	1709	2	84.56	0.23

Comments on the analysis

Difficulty

The difficulty index varies from about 20% (relatively “difficult” questions) to about 86% (relatively “easy” questions). The papers gave an adequate spread of marks while allowing all candidates to gain credit.

Discrimination

All questions except Q24 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 question. It could indicate a common misconception amongst candidates or a question with a high difficulty index.

Blank response

Seven questions had no blank responses (Q2, Q3, Q4, Q16, Q18, Q21, and Q22). However, there were a number of blank responses throughout the test, ranging from 1 blank (e.g. Q1) to one question with 5 blank responses (i.e. Q8). This may indicate that some candidates left the questions they were unsure of, while some had insufficient time to complete their responses. Candidates should be reminded that there is no penalty for an incorrect response. Therefore, if the correct response is not known, an educated guess should be made. In general, some of the “distractors” should be capable of elimination, thus increasing the probability of selecting the correct response. If candidates concentrate on selecting the correct response – instead of working out the correct answer (as they might in paper 2) – then there should be adequate time to complete all the questions and check the doubtful ones.

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:

1.1.10; 2.1.6; 2.2.5; 2.2.6/2.2.8; 3.3.6; 4.3.6; 4.3.12; 5.2.5; 5.2.9; 6.3.2.

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

The following topics/sub topics were answered well:

1.1.2; 2.1.1; 3.1.3; 3.2.5; 3.2.6; 4.3.3; 5.1.8; 5.2.1; 6.1.1; 6.3.3.

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

The candidates were very well prepared for the following questions:

2 (1.1.2); 6(2.1.1); 17 (4.3.3); 21 (5.1.8); 22 (5.2.1); 27 (6.1.1); 30 (6.3.3).

The candidates were not well prepared for the following questions:

1 (1.1.10); 5 (2.1.6); 16 (4.3.6); 19 (4.3.12); 25 (5.2.9).

Question 1

The 3rd most difficult question on the paper, B was the main distractor, very poor discrimination. This was a 'structural' question (AS 1.1.10) i.e. this is not a 'functional' question. The term 'ankle' is used within the SEHS syllabus under AS 4.3.6.

Question 2

Based on AS 1.1.1 in the SEHS syllabus, this question had a good discrimination index, and C and D were the main distractors.

Question 3

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

Question 4

A mid-difficulty question, and D was the main distractor. The diagram used for this question is used in a wide range of textbooks.

Question 5

The most difficult question on the paper. C was the main distractor and A was the 2nd distractor. More candidates chose C or A than B (correct response). It was highlighted in one of the G2s that the term 'iron compound' (B) was misleading, it should have been 'iron-containing'.

Question 6

The 3rd easiest question on the paper, and B was the main distractor.

Question 7

Based on AS 2.1.5 in the SEHS syllabus and found within AS 3.3.8 a mid-difficulty question, and D was the main distractor. It is noted that the term 'Hering-Breuer reflex' (C), although a familiar term used in Physical Education and/or Sports Science, is not in the SEHS guide and possibly was then easily discarded.

Question 8

One of the more difficult questions, with C and D as main distractors. There were 5 blank responses for this question. One of the G2s highlighted a typo within this question i.e. 'systematic' should have been 'systemic'.

Question 9

Another difficult question based on AS 2.2.2 and 2.2.8 (which includes the term 'cardiovascular drift' in the SEHS syllabus), with D as the main distractor. More candidates chose D than A (correct response).

Question 10

A mid-difficulty question, with A and D almost equal main distractors. There were 3 blank responses for this question.

Question 11

A question about 'composition' i.e. AS 3.1.3 (and not 'structure' i.e. AS 3.1.4). A mid-difficulty question, with D as the main distractor closely followed by A.

Question 12

An easier question, with D as the main distractor.

Question 13

An easier question, with C as the main distractor.

Question 14

The term 'Golgi apparatus' is used in the SEHS syllabus AS 3.3.1, under 'Teacher's Notes'. A mid-difficulty question with C as the main distractor followed by D and B in that order.

Question 15

A more difficult question, with D as the main distractor and C as another distractor. More candidates chose D than B (correct response).

Question 16

The 2nd most difficult question on the paper, with C as the main distractor. More candidates chose C than D (correct response). On reflection of this question at GA it was the consensus that the presentation of the diagram was confusing and that the correct answer (D) under load should have been Z + W based on the diagram presented. None of the other options were correct and 'D' was the most correct. It was decided to discard this question from the paper.

Question 17

An easier question, with A as the main distractor followed by B.

Question 18

A challenging question at the more difficult end of the mid-difficulty continuum, with C as the main distractor.

Question 19

A challenging question, with A as the main distractor followed by C.

Question 20

A mid-difficulty question, with C as the main distractor followed by B. There were three blank responses.

Question 21

An easier question with C as the main distractor.

Question 22

The easiest question on the paper, with D as the main distractor.

Question 23

A mid-difficulty question with A as the main distractor. There were 4 blank responses.

Question 24

This question had a negative discrimination index and was a challenging question, with C as the main distractor.

Question 25

A difficult question, with B as the main distractor. More candidates chose B than A (correct response). It is possible a significant number of candidates confused reaction time with response time.

Question 26

A challenging question, with B and D as almost equal distractors. There were 3 blank responses.

Question 27

An easy question, with A as the main distractor.

Question 28

A question based on Cooper's 12 minute run test, which is used to estimate aerobic power/ VO_{2max} /cardiovascular-respiratory fitness. A mid-difficulty question, with A as the main distractor and D as the correct answer.

Question 29

A more difficult question, with D as the main distractor.

Question 30

The 2nd easiest question on the paper, with C as the main distractor.

Recommendations and guidance for the teaching of future candidates

The questions where students faced challenges were applying knowledge and understanding for: synovial joints; haemoglobin in oxygen transportation; the pulmonary and systemic circulation; heart rate during exercise; the ATP-CP system; anatomical representation of levers; the Bernoulli principle; the difference between reaction time and response time.

Paper two

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 5	6 - 11	12 - 17	18 - 23	24 - 30	31 - 36	37 - 50

General comments

There has been a pleasing reduction in the number of responses being left blank. Candidates answered the data based questions much more effectively and utilised the additional answer booklet with much more success.

While many candidates are following the intent of the command term for the question – there are still many who ignore this key aspect. For example in question 1a where candidates are asked to “calculate”; they are providing just the answer and so depriving themselves of a crucial mark. Other command terms such as ‘describe’ had students simply listing features, ‘compare and contrast’ candidates are only referring to one group the whole time – when they need to refer to both throughout.

Overall, candidates in this session have struggled with some of the basic recall questions, which are throughout the paper. Areas such as DOMS and interoceptors, which have been brought up previously, continue to be areas which students struggle with.

From section B, question 7 was selected by candidates the most followed by 5 with question 6 the least.

Many of the candidates in this May session appear to be well under prepared for the examination. The layout of the examination provided some fundamental/ factual questions which then led into areas which were more complex. Students were struggling with all of these components. The question arises – “are students given enough class/ teaching time to succeed in this course?” It would be well worth teachers considering this as they plan ahead.

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

- Identifying a suitable fitness test for muscular power.
- Identifying the organelle – mitochondria and then to be able to identify a component of this organelle.
- Identifying characteristic common to muscle tissue.
- Centre of mass was not always well understood by candidates perhaps a practical exercise would help to deepen the understanding on the topic.
- Identification of the anatomical region of vastus lateralis proved to be difficult for many students.
- Candidates seemed to get confused by definition of cell respiration.
- Identifying cardiac muscle.
- Explaining the reason for higher VO_2 max in males often not known.
- Inability to see the axial skeleton having functions beyond protection.
- Identifying 3 valid tests of aerobic capacity.
- Evaluate a fitness test for the required number of marks.
- Identify 3 complete classifications of skills.
- Some students not attempting the data questions.
- Students struggled to define the overload principle.
- Providing examples to demonstrate the functions of the axial skeleton.
- The effect of static and dynamic exercise on diastolic blood pressure.
- Describing the mechanics of inhalation.
- Explaining the aerobic system and the contribution of the energy systems within an activity.
- DOMS: students still struggled to explain the concept of DOMS and the effects of DOMS on the body.
- A few candidates struggled with the clarity of definition for centre of mass.
- The causes of oxygen deficit.

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

- Demonstrating their working out and including the unit measurement was better than in previous years.
- Dealing with data questions and being able to make general observations from the data was positive with many pupils achieving near maximum marks.
- Understanding that VO_2 max between genders is different.
- Candidates were able to identify the protection aspect of the axial skeleton well.
- Candidates outlined the functions of components of blood well.

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

Section A

1a The majority of students clearly laid out their workings and included the unit measurement. However marks were lost for not including the above and placing the decimal place in the wrong position.

1b Many pupils were able to accurately define COM, however this was an area of inconsistency with many pupils just referring to the position where mass is centred.

1c Very few students were able to achieve full marks for this question with many of their responses focusing on a description of the data rather than analysis.

1d A wide range of answers were provided however this questions was not answered well. Often answers were very vague and students struggled to use the appropriate anatomical terminology to explain the position of the muscle.

1e Many students achieved all three marks for this question. However at time students struggled to make the comparison between by just using terms such as larger or greater.

1f Many pupils answered this well, however a popular incorrect answer was hand grip dynamometer or flexed arm hang.

2a Many pupils just identified the structure as the mitochondria rather than the specific layer of the matrix or they named another organelle or left it blank.

2b Many pupils repeated the definition found within the guide, however many pupils referred to aerobic respiration and regularly missed its key function which is to produce ATP.

2c Most pupils gained 2 marks by identifying the diaphragm contracting and the lungs expanding. However, many pupils were limited by identifying the intercostal muscles rather than the specific external intercostal muscle. A few pupils discussed exhalation rather than inhalation. Many pupils discussed gaseous exchange and the pathway of air flow and misunderstood the requirements of the question to discuss the mechanics of the action.

2d Few students achieved full marks for this question. Many pupils demonstrated confusion between the site of the Krebs cycle and electron transport chain. Very few pupils were able to identify that glycolysis is the first stage of the aerobic system and that it breaks down glucose into two pyruvate molecules.

3a Some pupils answered this well, however a few pupils listed the two characteristics, rather than describe them. Elasticity and Contractility were the most common answers.

3b Few students achieved full marks for this question. Many actually left this question blank. Very few were able to focus their response to the question.

3c Few pupils were able to identify the three stages of signal detection. Many students were able to identify the factors that influence detection of stimuli. However many students only focused on the stimuli being received and sent to the brain.

4a Quite a few students identified this as skeletal muscle.

4b Overall most students confused the question to rest and exercise. Most students were able to access 1 mark by stating that static exercise causes diastolic pressure rise. However very few students were able to identify that during dynamic exercise diastolic pressure remains constant.

4c Overall most pupils were able to achieve 1 mark but struggled to explain the cause for the difference between males and females.

Section B

5a Often answered very poorly with most pupils only providing protection as a role of the axial skeleton. However most pupils provide suitable examples.

5b A few pupils were able to achieve full marks. However most pupils achieved 2 marks by identifying the correct direction of oxygen and carbon dioxide.

5c Most pupils were able to correctly identify when oxygen deficit occurs and how oxygen debt is paid back after exercise. However very few candidates were able to achieve full marks.

5di Most pupils were able to identify Harvard step test, 12-minute cooper's run and Multistage Fitness test. However very few pupils achieved full marks. Many pupils inaccurately referred to a VO₂ max test rather than direct gas analysis with something like the Bruce Treadmill Test.

5dii Most pupils struggled with analysing these tests and struggled to achieve full marks. They were more intent on describing the test.

6a This was poorly answered with many students struggling to distinguish between the two types of skill.

6bi The most popular answer was gross and fine, open and closed. However many students struggled to offer a third component with some students referring to cognitive and perceptual motor skills as the classifications.

6bii Due to the difficulty answering 6bi in full many students were unable to achieve full marks for this question. Many students struggled to offer suitable sporting examples for the full continuum.

6c Many students were able to describe the basic differences between a skilled and novice performer but were unable to clearly outline the characteristics of a skilled performance. This was one of those questions where listing the factors was simply not enough – they needed to prove clear discussion of the factors is required.

6d Students found this the most difficult aspect of the question. Students mainly described the systems and rarely identified all three systems appropriately. Students were unable to link the use of the systems with the contributions made within the team sport.

7ai Many students struggled to articulate their definition of overload to clearly demonstrate their knowledge.

7aii Many students struggled to refer to the principles of overload and discuss the ways in which it can be applied to endurance training.

7b Many students were able to achieve 2 marks, commonly referring to the red white blood cells and the platelets. However many students wrote about three components rather than a detailed answer for the two components.

7c This was a well answered question with many students identifying stroke volume increases and a reduction in resting heart rate. However many students struggled to achieve 5 marks because they simply listed the adaptations.

7d Few candidates gained more than two marks for this question. Many students referred to methods to prevent DOMS rather than explaining the causes and when DOMS occurs.

7e Students were generally able to compare the difference between their main function. However many students were unable to identify and compare the main structural characteristics for both types of fibre.

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 questions need to be answered.
- Check the marks that are allocated to the question and ensure that they have the same number (or more) points made.
- Many students used the additional workbooks much more effectively. However, some students were still writing outside of the boxes, which made it difficult for the examiners to read.
- Candidates should be advised 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.
- Although many students answer just one full question in section B, there are still some students who tried to answer part questions from 5, 6 and 7 – this should be discouraged.
- If a question requires students to discuss concepts in relation to an example they must ensure that they don't neglect this as the general rule of thumb the example is required for full marks.
- Teachers and schools to reflect on the number of hours that they have in order to teach this course.

Paper three

Component grade boundaries

Grade:	1	2	3	4	5	6	7
Mark range:	0 - 4	5 - 9	10 - 16	17 - 21	22 - 25	26 - 30	31 - 40

General comments

Responses for options B and D were perhaps more disappointing than for options A and C.

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

Following the trend of recent years, option A appeared to be the most favoured option, but all four options were covered and it is re-assuring that the four options were attempted. Generally, there is the impression that most candidates were very well prepared for this exam but some candidates were not well prepared. It is of concern that a number of candidates attempted to answer all four options (only two are required) and they appeared to be weaker candidates. The weaker candidates seemed to struggle with not only knowledge and/or understanding but also application, with poor linking of theory to practice. The following areas seem to have been difficult for some candidates:

- qu. A2a distinguish between training and overreaching[A.1.1];
- qu. A2c describe various methods of training [A.1.2];
- qu. B4d evaluate mental imagery [B.4.3];
- qu. B5c discuss social learning theory [B.1.2];
- qu. B6a label a graphical representation of the arousal performance relationship [B.3.2/3.3];
- qu. C7d discuss how a lifestyle of physical inactivity increases the risk of cardiovascular disease [C.2.5];
- qu. C9b discuss the major risk factors for type 2 diabetes [C.4.2];
- qu. C10a define the term mood[C.7.1];
- qu. D11d discuss the use of nutritional ergogenic aids in sport [D.4.9];
- qu. D12b explain that homeostasis involves monitoring levels of variables and correcting changes in levels by negative feedback mechanisms [D.2.4];
- qu. D13.b discuss the association between body composition and athletic performance [D.3.4];
- qu. D14a define the term glycemic index [D.4.4].

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

Many of the candidates demonstrated a good knowledge and understanding of their options, and there were some really excellent papers. However, there is a very wide spread of total marks for this paper and some of the very low marks attained are of concern i.e. some candidates appeared to be not prepared for this exam. Generally, the data set questions were answered well by the majority of candidates with some candidates evidencing a first class knowledge, understanding and application throughout their paper. The candidates appeared to be well prepared for the following areas:

- qu. A2b indicators of overtraining [A.1.3];
- qu. B6b distinguish between cognitive and somatic anxiety [B.3.6];
- qu. B4d evaluate mental imagery [B.4.3];
- qu. C8b the relationship between major societal changes and hypokinetic disease [C.1.5];
- qu. C9a compare type 1 and type 2 diabetes [C.4.1];
- qu. C10b the role of exercise in reducing the effects of depression [C.7.4];
- qu. D13a the reasons why humans cannot live without water for a prolonged period of

time [D.2.1].

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

Option A

1a well answered.

1b for the most part, candidates were secure in their interpretation and analysis.

1c some candidates did not respond to the command term.

1d it was surprising to find that a number of candidates misinterpreted the question and approached it from 'health risks during exercise in the heat'.

2a there were some disappointing answers partly because some candidates did not respond to the command term, and others did not know or understand that overreaching is transient overtraining.

2b generally, very well answered.

2c a large number of disappointing answers, and it would appear that many candidates did not understand what is meant by muscle action, with very few responses based on eccentric followed by concentric action.

3a some candidates appeared to have misunderstood the term 'classes', and presented specific examples within a class.

3b generally well answered.

3c more candidates need to focus on answering the question – and this question was about 'benefits' of using diuretics – not negative outcomes.

Option B

4a straightforward interpretation of data.

4b generally well answered.

4c some candidates lost a mark by not stating the units.

4d there were not many who discussed how mental imagery fits into a training programme alongside physical training, which is a key component of it. Generally, many seemed confused about how to undertake imagery.

5a some answers were too vague to be awarded the mark.

5b significant numbers of candidates identified ethical issues, which is puzzling.

5c not conceptually difficult – but there were many candidates who struggled to explain social learning theory.

6a very few seemed aware of catastrophe theory as a multidimensional model. Recognising the multidimensionality of it is key to understanding performance anxiety.

6b answered reasonably well.

6c a wide range of responses for this question.

Option C

7a well answered.

7b well answered.

7c well answered.

7d some candidates need to focus their answer on ‘physical inactivity’ – although they made some good points about diet, this was not answering the question.

8a an easy question and generally well answered.

8b many candidates were secure on this question.

9a generally well answered, with a range of correct responses.

9b some candidates appeared to confuse risk factors with consequences.

10a surprisingly not well answered and there were some poor answers despite clarity within the teacher’s notes for this.

10b generally well answered question, with many candidates recognising specific hormonal effects.

Option D

11a generally well answered.

11b well answered.

11c generally well answered.

11d some disappointing answers, with many candidates seemingly not knowing or understanding that the key to answering this question is the impact on lactic acid.

12a surprisingly poorly answered by many candidates.

12b many candidates did not appear to understand the question and did not respond to ‘using an example’ appropriately.

13a generally well answered.

13b responses suggest that candidates need to improve their knowledge, understanding and application of body composition, weight, and sport performance.

14a disappointingly poor responses, with many not reporting the 'immediate effect on blood glucose concentrations'.

14b a wide range of responses.

Recommendations and guidance for the teaching of future candidates

- teach two options and give equal weighting to both options;
- ensure that the candidates know to answer only two options;
- respond appropriately to the command term;
- answer the question – do not simply report knowledge of an assessment statement.