SCOTTISH QUALIFICATIONS AUTHORITY

Principal Assessor Report 2004

Assessment Panel:	**Physics**

Qualification area

Subject(s) and Level(s) Included in this report	**Physics Advanced Higher**

Statistical information: update

Number of entries in 2003	1374 – pass mark stage 1414 – final number

Number of entries in 2004	1391 – pass mark stage 1414 - final number

General comments re entry numbers

Uptake now steady, but conversion from Higher to Advanced Higher continues to increase since Higher numbers are falling slightly.
Past numbers below:

2001 – 1026
2002 – 1378
2003 – 1414
2004 - 1414

Statistical Information: Performance of candidates

Distribution of awards

Year	Number of Passes			% Pass Rate				
	A	B	C	A	B	C	A - C	D/No Award
2002	432	336	281	31.7	24.7	20.6	77.0	23.0
2003	432	346	295	31.4	25.2	21.5	78.1	21.9
2004	429	321	304	30.3	22.7	21.5	74.5	25.5

Comments on any significant changes in percentages or distribution of awards

A slight drop in overall pass rate – probably due to the decrease in the mean value of investigation mark.

Grade boundaries for each subject area included in the report

Distribution of awards	%	Cum %	Number of candidates	Lowest mark
A	30.3	30.3	429	88
B	22.7	53.0	321	74
C	21.5	74.5	304	60
D	7.8	82.3	110	53
No award	17.7	100	327	

General commentary on passmarks and grade boundaries

- While SQA aims to set examinations and create mark schemes which will allow a competent candidate to score a minimum 50% of the available marks (notional passmark) and a very well-prepared, very competent candidate to score at least 70%, it is almost impossible to get the standard absolutely on target every year, in every subject and level
- Each year we therefore hold a passmark meeting for each subject at each level where we bring together all the information available (statistical and judgmental). The Principal Assessor and SQA Qualifications Manager meet with the relevant SQA Business Manager and Statistician to discuss the evidence and make decisions. The meetings are chaired by members of the senior management team at SQA
- We adjust the passmark downwards if there is evidence that we have set a slightly more demanding exam than usual, allowing the pass rate to be unaffected by this circumstance
- We adjust the passmark upwards if there is evidence that we have set a slightly less demanding exam than usual, allowing the pass rate to be unaffected by this circumstance
- Where the standard appears to be very similar to previous years, we maintain similar grade boundaries
- An exam paper at a particular level in a subject in one year tends to have a marginally different set of grade boundaries from exam papers in that subject at that level in other years. This is because the particular questions are different. This is also the case for exams set in centres. And just because SQA has altered a boundary in a particular year in say Higher Chemistry does not mean that centres should necessarily alter boundaries in their prelim exam in Higher Chemistry. The two are not that closely related as they do not contain identical questions
- Our main aim is to be fair to candidates across all subjects and all levels and maintain standards across the years, even as syllabuses evolve and change

Comments on grade boundaries for each subject area

Examination

Cohort similar to last year.
Question paper – marking scheme - 2 marks were seen as inaccessible to most candidates and the boundaries were lowered by one at the grade A boundary and by two at the C compared to 2003.

Investigation Report

Markers are becoming more confident in using the marking scheme and subsequently were able to evaluate quality from average reports.
This probably caused the lowering of the mean investigation mark from 15.7 to 14.1 out of 25.

Mean Marks by Component

Year	Examination (100)	Investigation (25)
2002	63.6	17.1
2003	60.7	15.7
2004	60.7	14.1

Comments on candidate performance

General comments

Examination
A well-balanced paper with enough differentiation to allow a good spread of results.
In some cases, candidates started off very well in the unit 1 questions and had demonstrated obvious ability. However, they fell down on the last unit – perhaps their enthusiasm was waning due to unconditional offers from universities?
There was no evidence of candidates running short of time.

Investigation Report
Again, as markers gain experience of using the marking scheme, candidates were rewarded for quality in key areas throughout the scheme.
It was felt by many markers that the overall standard was less than last year.
Very few scored in the range 23 – 25.
It would still appear that some centres do not pass on to their students all the information on the requirements.
Some candidates were penalised by not having the exemplification / correct information on report writing highlighted by the school.
Proof reading of some investigations did not happen, probably due to late submissions.

Areas of external assessment in which candidates performed well

Examination

1. The relativity question set candidates on the right track. Vast improvement in the handling of this type of question.

3. Well done. Good knowledge and application of the equations for circular motion.

7d Good knowledge of resultant forces or resolution of forces depending on method used.

10c Application of force on a conductor.

13c Good knowledge of combination of uncertainties.

Investigation Report
Presentation of reports was good.
Use of digital photography continues to grow.
Improvement shown under the discussion category – first three marks in evaluation of experimental procedures.

Areas of external assessment in which candidates had difficulty

Examination

2c Should have equated mgh = ½ $I\omega^2$.
d Outward / centrifugal force often stated. Careful explanation of centripetal force required.

4b (ii) Grade A question – many had trouble with this question.

5b (ii) Many did not use the unbalanced force.

6a (i) Candidates should be directed towards all definitions located in the content statements.
6a (ii) Some confusion shown over electric field strength and work done. Also incorrect to use $V = q / 4\pi\varepsilon_o r$.
6b (ii) Very poor diagrams – no field lines at 90^o to conductor.

7b Some confusion over this method.
7c (ii) Many calculated only one potential and those who calculated two invariably did not attain a subtraction of potentials.

8b A type question with an overall poor response.
8c Many tackled this from first principles and attained the correct answer – however they failed to apply the same knowledge required for part b.

9a Many disappointingly showed a decay graph for this question.
9b Important to remember that the emf generated is negative so giving a positive rate of change of current. Note this is not a potential divider problem.

10b (iii) Wrong formula used – direction often wrong or omitted.

11a Surprisingly poor attempts.
11c Average score 1 out of 2 – either forgetting to use + in bracket term or reduce the amplitude.

12a (i) Strict definition required.

13a Division by 11 often seen.
13c Improvement identified but justification often poor.

Investigation Report
Introduction – very few candidates scored full marks – justification of formulae required.

Procedures – some circuit diagrams lacked detail, digital photographs not labelled, level of demand penalised here.

Results – in some cases not enough data given.

Uncertainties - inappropriate averaging used, significant figures a problem.

Analysis - spreadsheet packages, graphs – though care should be taken in the following areas: size; origin not shown; scaling; grid lines too small or missing. Pasco can show dot to dot lines if not used properly.

Discussion - evaluation of discussion as a whole – students still find this difficult – **more guidance is required plus a reduction from 3 to 2 marks – the 1 mark being moved to uncertainties – see later.**

Presentation - problem with references – see later.

Recommendations

Feedback to centres

Examination

General point – Candidates should be directed to the content statements of the course for use in their revision.
Definition of electric field strength was poorly attempted.
Careful explanation of **centripetal force** is required.
Question 2d (i) The 5N force is not great enough to supply the required centripetal force to maintain the circular path of the friction pads – **there is no centrifugal / outward force acting on the friction pads.**
It would appear that many candidates did not have the opportunity to try the experiment stated in question 7b – can be repeated with small cans placed on an insulator.
A popular question is the current growth curve for an inductor – correct application of equation requires the back emf to be negative giving a positive rate of change of current.
Plane polarised waves **vibrate or oscillate** in the **one** plane.
Investigation
Proof Reading
In many cases, it appeared that the investigations had not been proof read by a teacher. There were many basic mistakes that could easily have been corrected if a draft copy had been proof read.
A possible reason for this is students submitting their report at the last minute.
It is strongly recommended that the candidates be told a submission date well before the official SQA deadline.
Proof of Candidates' Own Work
Centres should ensure that evidence covering the performance criteria of Outcomes 1 and 2 for the Physics Investigation unit (D388 13), is kept in a diary format.
This evidence could be required for retrospective moderation, particularly where a candidate has been passed for the unit but has not submitted a final draft investigation.
The blue front cover should also be signed and dated by both the teacher and the student.
Educationally, the investigation continues to have a recipe format with little true investigation opportunity. However, the opportunity to have some independence in experimental work at this stage is still seen as an important part of the students' development.
There can be some question, although difficult to prove, whether the investigation is all the candidates own work. This is very much dependent on the schools' approach on the introduction of the investigation. **It is important not to just hand out old projects / investigations for viewing or triggering ideas, without ensuring their collection afterwards.**
It is probably better to use brief accounts of possible investigations so the students can research these using appropriate references.
Reports – some candidates were disadvantaged due to not reading the **Guidance on Course Assessment for Candidates.**

It is recommended that the following information on how the marking scheme is applied should be photocopied and distributed to the students.

Notes on Marking of Investigation		
No **half marks** were awarded throughout.		
Introduction		
Summary: purpose	Should be at the beginning of the report.	
findings.	Findings (numerical values) were often omitted. Findings should be consistent with purpose e.g. comparison of different methods of measurement.	**(1,0)**
Underlying Physics:	**Not good enough to just give equations.** Physics behind the formulae should be explained. Quality mark awarded here.	**(3,2,1,0)**
Procedures		
Diagrams / descriptions	Generally well done. Labelled digital photographs excellent although there were some that were too small, making clarity a problem. Apparatus / circuit diagrams should also accompany these where appropriate.	**(2,1,0)**
Apparatus use	Should include **how** readings were taken. Description should be clear enough to allow replication of experimental work.	**(2,1,0)**
Level of demand	Centres should ensure that the investigation is at an appropriate level. Basic Outcome 3 experiments alone are unacceptable. They can possibly be used as an introduction.	**(2,1,0)**
Results		
Data sufficient/relevant	Most candidates awarded a mark here.	**(1,0)**
Uncertainties	Still a problem area. Types, combinations, inappropriate use of random uncertainty (e.g. applying to different methods of finding the refractive index), finding the uncertainty in the gradient a straight line graph for no reason, significant figures.	**(2,1,0)**
Analysis of data	Improvement in use of spreadsheet packages. Still some problems - lack of grid lines for graphs, size of graphs, origin omitted, error bars missing where appropriate. Spreadsheets packages may be used to establish the equation of a straight line plus the uncertainty in the gradient and intercept.	**(2,1,0)**
Discussion		
Conclusion	Must relate to the purpose of the investigation.	**(1,0)**
Evaluation of Procedures	Not specific / detailed enough. Sometimes better to break down into [1]assessment criteria where applicable. Sources of uncertainties ignored, no mention of limitations of equipment.	**(3,2,1,0)**
Evaluation of Investigation	Poorly attempted. Candidates had difficulty with this section. Very little mention of modifications and further improvements in sufficient detail.	**(3,2,1,0)**

Presentation	Title, contents, page numbers - any one omitted - (0)	**(1,0)**
	Readability	**(1,0)**
	References - must be cited in text - e.g. ref 1, ref 2, etc. Reference at back should not only list the book or website, but also the appropriate page number so the marker can easily check on these.	**(1,0)**

[1] See assessment criteria in **Guidance on Course Assessment for Candidates.**

Incorrect Application of Random Uncertainty

e.g. Finding **g** using a Pendulum

Varying the length l and measuring the period T of the pendulum.

Different values of g were calculated for each l and T.

A mean value of g was calculated with associated random uncertainty. **This is incorrect.**

Allowance for random uncertainty in the measurement of time is made when measurements are repeated for one value of length.

A better way of finding g is to plot a graph of T^2 against l and then calculate the gradient of the line.

Investigations frequently classed as non-commensurate with AH.

Output of a Solar Cell

Golf Ball - basic bouncing experiments, Standard Grade angle of launch.

Specific Heat Capacity - simple Standard Grade experiments with uncertainties included.

Efficiency of Electric Motor

Efficiency of a Transformer.

Investigations where no measurements were taken e.g. making a hologram, construction of an electronic device.

Those listed were Higher or Standard Grade level with no real attempt at extension work.

Popular Investigations

Different methods of measuring g.

Different methods of measuring refractive index.

LCR circuits

Factors affecting Capacitance.

Factors affecting Inductance.

Measurement of Magnetic Field Strength using a Hall Probe.

Stretched Strings.

e/m for an Electron

Speed of Sound

Determination of Planck's Constant - Find λ of light emitted and forward biased voltage just lighting LED.

Interference of Light

Young's Modulus.

Surface Tension

Viscosity

Focal Length of Lenses.