SCOTTISH QUALIFICATIONS AUTHORITY

Principal Assessor Report 2003

Assessment Panel:	Physics
Qualification area:	
Subject(s) and Level(s) Included in this report	Physics Advanced Higher

Statistical information: update

Number of entries in 2002	
Pre appeal	1,378

Number of entries in 2003	
Pre appeal	1,374

General comments re entry numbers

Numbers consolidating last year's increase, – 4 decrease of 0.3%

Grade boundaries at C, B and A for each subject area included in the report

Grade	Threshold (125)	Threshold (%)
A	89	71
B	75	60
C	62	50

Mean Marks by Component

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

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's ability comparable to last year.

The mean mark dropped due to a more demanding paper.

Investigation Report

This year saw the removal of the oral examination and the internal mark awarded by the centre.

Compared to last year the revised marking scheme allowed markers more scope to reward quality.

These factors had the effect of lowering the mean mark.

Grade boundaries were set with these factors in mind.

Comments on candidate performance

General comments

Examination

A good well balanced paper. Candidates found the paper accessible.

However, there were two questions, 6(c) (d), worth a total of 3 marks that only a handful of candidates attempted successfully.

Investigation Report

The new marking scheme allowed quality to be rewarded more than it was last year. This meant that fewer candidates picked up marks easily by just following a recipe.

Areas of external assessment in which candidates performed well

Examination

1(b)(i)(ii) Radial acceleration and force well understood.

2. Application of rotational dynamics - excellent responses.

5(b)(c) Relativity equations - good handling.

7. Well attempted.

10. Candidates well prepared in application of wave equation.

12. Good response — although a few candidates had difficulty in the clear explanation of polarised and unpolarised light.

Investigation Report

Candidates are improving in their use of spreadsheet packages. Digital cameras are on the whole used well.

General layout of reports was good.

Areas of external assessment in which candidates had difficulty

Examination

1(c)(iv) Percentage uncertainty in t^2 = 2 x Percentage uncertainty in t — very few candidates gained full marks for this question.

1(c) Marking scheme: central force increases (1 mark)
component of reaction now acts radially or equivalent diagram (1 mark).

Poor response to this question.

2(c)(v) Care should be taken to have $\omega < \omega_0$ and $\alpha < 0$ when substituting into equation.

3(a) Very poor response — marks awarded for shape, direction and lack of symmetry.

3(b) (i) Negative sign must be given and maintained throughout in equation for E_p — Otherwise wrong Physics.

(**b)(iii)** Equation for escape velocity often used here. (0 marks)

4(b)(i) Poor attempts — wrong extension or total length often used.

5(a) Must have unit **and** positive for one mark.

(b) Some tried using $r = Q_1Q_2 / 2\pi\varepsilon_o mv^2$ without fully understanding the question.

6(b) Many did not consider the force acting on both sides of the rectangular loop.

(c) Note the force remains constant in this case. The perpendicular distance from the axis to the line of action of the force changes. Poor response.

(d) Very few managed this. Note the magnetic field is perpendicular to AD and CD at all times. Accepted answers: The loop is always parallel to the magnetic field or the force always acts perpendicularly to the loop or highlighting idea of radial field.

8(b) Many said alpha particles would be slower.

(c) Poor response.

Marking scheme: α greater radius than β (1)
paths in opposite directions (1/2)
correct directions. (1/2)

9(a)(iii) Induced e.m.f. = - 2 V essential otherwise (1/2) for equation alone.

(b) Explanation of V_1 increasing and V_2 decreasing often omitted.

11(a)(i) Content statement 3.2.1 — Poor knowledge exhibited.

(iii) Answers to A and B often confused.

12(a) Many statements too vague.

Investigation Report

Uncertainties still cause difficulty. Significant figures— poor rounding.

Notation for powers of 10 often incorrect.

Evaluation of the investigation as a whole caused problems.

In some cases, there would appear to be no proof reading of the investigation by the teacher/lecturer at any stage. Many candidates under performed due to silly mistakes not being picked up.

References: candidates not given full information on format required.

Recommendations

Feedback to centres

Examination

General point — Candidates should be directed to the content statements of the course as an excellent revision tool. Poor knowledge of definitions was evident.

Uncertainties: again many candidates did not realise that

% uncertainty in t^2 = 2 x % uncertainty in t

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, eg comparison of different methods of measurement.
Underlying Physics:		Not good enough to just give equations. Physics behind the formulae should be explained.

Procedures

Diagrams/descriptions	Generally well done. Labelled digital photographs were for the most part excellent although there were some that were too small, making clarity a problem. Apparatus / circuit diagrams should also accompany these where appropriate.
Apparatus use	Should include **how** readings were taken. Description should be clear enough to allow replication of experimental work.
Level of demand	Centres should ensure that the investigation is at an appropriate level. Outcome 3 experiments alone are not acceptable. They could possibly be used as an introduction.

Results	
Data sufficient/relevant	Most candidates awarded a mark here.
Uncertainties	Still a problem area. Types, combinations, inappropriate use of random uncertainty (eg applying to different methods of finding the refractive index), finding the uncertainty in the gradient a straight line graph for no reason, significant figures.
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.
Discussion	
Conclusion	Must relate to the purpose of the investigation.
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.
Evaluation of Investigation	Poorly attempted. Candidates had difficulty with this section. Very little mention of modifications and further improvements in sufficient detail.
Presentation	Title, contents, page numbers - any one omitted - (0) References— must be cited in text — eg ref 1, ref 2, etc. Reference should not only list the book or website, but also the appropriate page number so the marker can easily check on these.

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

Incorrect Application of Random Uncertainty

Example, 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.

Proof Reading

In many cases, it appeared that the investigations had not been proof read by a teacher/lecturer. 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 reports at the last minute.

It is strongly recommended that the candidates be given an initial submission date well before the official SQA deadline to allow for proof reading.

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, eg making a hologram, construction of an electronic device.

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

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.

Aerofoils

Surface Tension

Viscosity

Focal Length of Lenses.

Novel Titles

Electromagnetic braking by Field Magnets

Neodymium magnets dropped down metal tubes — relationship between many variables possible.

Physics of a Camera - measurement of shutter speed, checking f stop numbers, chromatic aberration, measurement of focal lengths of lenses.

Centres should ensure the investigations reports are bound securely. Pages were missing from some investigations — the centres concerned were contacted.

Completed reports should fit the clear-faced envelopes provided by SQA.