SCOTTISH
QUALIFICATIONS
AUTHORITY

Principal Assessor Report 2005

Assessment Panel:	**Physics**

Qualification area

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

Statistical information: update

Number of resulted entries in 2004	1,414

Number of resulted entries in 2005	1,426

General comments re resulted entry numbers

Again good to see a slight increase in numbers.

Statistical Information: Performance of candidates

Distribution of awards including grade boundaries

Distribution of awards	%	Cum %	Number of candidates	Lowest mark
Maximum Mark- **125**	-	-	-	-
A	31.4	31.4	448	85
B	22.3	53.7	318	70
C	20.4	74.1	291	56
D	7.6	81.7	108	49
No award	18.3	100.0	261	-

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 arrangements evolve and change.

Comments on any significant changes in distribution of awards/grade boundaries

There is a slight increase of number of A passes (from 30.2 % to 31.4%).
However the total number of candidates gaining a grade C and above fell from 74.5% to 74.1%.
This gives 25.9% of candidates attaining a grade D or a no award.

Investigation

The relocation of the 1 mark from the **Evaluation** to the **Uncertainties** had the desired effect with a slight increase in the mean from 14.1 to 14.8.
This mark advantaged the better candidates with no change for the C candidates.

Grade Boundaries

The grade boundaries were lowered compared to last year – 3 marks lower for an A grade and 4 marks lower

for a C grade.
Markers found that the cohort had not changed drastically from last year. There was some evidence that candidates required the full time allocation with an increase in information to be assimilated from the questions.
On analysing the paper, it was felt that 3 marks adjustment for A candidates and a 4 mark adjustment for the C candidates would be fair to all.

Comments on candidate performance

General comments

Examination
A well balanced paper which perhaps required more reading than previous papers. There was some evidence that candidates needed the full time allocation to complete the paper.
The vast majority of candidates made a good effort at completion.
There were very few who did not make a reasonable attempt e.g scoring less than 20%

Investigation
The reallocation of the 1 mark from the evaluation to the uncertainties enabled candidates to be rewarded for the amount of effort put into this area.
There was little evidence of "new investigations". However it must be said that the more traditional investigations may still be new to the candidate.

Areas of external assessment in which candidates performed well

Examination

1. This was well attempted and gave the candidates a good introduction to the paper.

6. On the whole very well done, although some struggled with c(ii).

8c (ii) Well done – standard 2 marker

9. (b) Candidates have a good grasp of the Doppler effect.

10(a)(i)(ii) Fine with combinations of uncertainties.

Investigation Report

Presentation of reports was good.

Use of digital photography continues to grow.

Procedures generally well done.

Areas of external assessment in which candidates had difficulty

2(b), 4(a), 8(a), 11(a)
Any question involving definitions was poorly attempted.

2(b) Conservation of angular momentum - poor understanding.

2(c)(i)(ii) Units often incorrect.

2(e) Confusion between angular and linear kinetic energy.

3(a)(ii) Many candidates took **M** as being the **satellite mass**, in this case the moon.

3(b)(ii) Many did not retain the negative sign when adding the P.E and K.E.

4(b)(ii) $A\omega = 0.5$ Many took $A = 0.5$ m.

4(c) Poor understanding of this question.

5(a) Too many candidates were confused with the combination of fields and ended up with 1 mark out of 2.

5(b) The field lines must be perpendicular to the surfaces.

6(c)(ii) Many used $QV = ½ mv^2$ with V == 600 V (wrong).

7(a) (ii) Too often units were omitted for q:m.

7(b) Poor understanding of helical path. Few mentioned different velocity components.

7(c) Again poorly attempted – following on from part (b). Charges "attracted" by the magnetic fields.

8(b) Care must be taken to ensure that the induced emf across L is **-**12V.

8(d) Poor understanding of the question. Must state the bracelet **moves** in the magnetic field for the first mark.

9(a)(ii) Most candidates failed to achieve the mathematical link between **new intensity** and **associated amplitude.**

9(b)(iii) Many chose the incorrect sign in the Doppler equation.

10a(iii) Absolute uncertainties should be given to one significant figure.

10(b) (c) Difficulty in comparison of uncertainties exhibited.

11(a) Polarisation – must mention **vibrations** / **oscillations** in one or many **planes** – direction unacceptable.

(b)(i) Often no mention of "no reflected light from mirror".

(c) The majority of candidates described but did not **explain** the observation.

Investigation Report
See page 7 for advice
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 - significant figures a problem, inappropriate averaging used (see later)

Analysis **-** spreadsheet packages- graphs – although improving - size , zero 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.

Presentation **-** still a problem with references – see later.

Recommendations

Feedback to centres

Use of Calculators
Some older calculators, if not in scientific mode, will truncate giving an incorrect final answer e.g. in No 6(b)
$t = d/v = 90 \times 10^{-3} / 2.3 \times 10^{7}$ = 0.000000003 on display

Examination

Candidates should check out their understanding of definitions before sitting the examination.

More practice in conservation of angular momentum questions required.

Determination of direction of electric fields – poor response.

Candidates should be dissuaded from "remembering formulae" without an understanding of their derivation e.g. vertical deflection of electron beam in an electric field, distance of closest approach of an alpha particle from the nucleus of an atom, q:m ratio of a particle in cross fields.

Faraday's Law
$E = -L \frac{dI}{dt}$ refers to the emf induced across an inductor.

Qn 8(b) At $t = 0$, $E = -12V$

In an inductor / resistance series circuit, the voltage across the resistor will be given by

$V_s - L\frac{dI}{dt} = IR$ where Vs is the supply voltage.

(At $t = 0$, $I = 0$ so $V_s = L\frac{dI}{dt}$).

(There is scope for confusion if the emf of the supply is taken as *E*).

Uncertainties
Most candidates can now combine uncertainties successfully, but should now be looking to gain a fuller understanding of why so much time is spent on these. Many failed to see how the significance of comparisons affect a final answer **Qn 10 (b)(c)**

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 at least two weeks before the official SQA deadline.

Proof of Candidates' Own Work

Schools should ensure that evidence of Outcomes 1 and 2 is kept in a diary format. These could well be called on for moderation.

The blue front cover should be signed and dated by the student.

Educationally, the investigations tend 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 to 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 better to use brief accounts of possible investigations so the students can research these using appropriate references.

Reports – Refer to the "Guidance on Course Assessment for Candidates" which can accessed through www.sqa.org.uk.

Too many candidates failed to gain what should be "easy marks" due to not having followed the advice.

Markers commented that several investigations involved carrying out only one experiment – the majority of these investigations attained a very low mark.

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	Must be at the beginning of the report.	
findings.	Findings were often omitted. Findings should be consistent with purpose e.g. comparison of different methods of measurement or numerical values.	**(1,0)**
Underlying Physics:	**Not good enough to just give equations.** Physics behind the equations should be explained. Opportunity for markers to reward commensurate / good investigations.	**(3,2,1,0)**
Procedures		
Diagrams / descriptions	Generally well done. Digital photographs should be labelled. Most were 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 initial experiment.	**(2,1,0)**
Results		
Data sufficient/relevant	Most candidates awarded a mark here. (Must show all readings taken – no short cuts to average).	**(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), not finding the uncertainty in the gradient a straight line graph where appropriate, number of significant figures. (It is sufficient to show one example of each type of calculation involving data and the combination of uncertainties).	**(3, 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. Compare percentage uncertainties	**(3,2,1,0)**
Evaluation of	Poorly attempted. Candidates had difficulty with this section. Very little mention of	

Investigation	modifications and further improvements in sufficient detail. Describe difficulties, frustrations with problems encountered. **(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.

Impulse experiments.

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

Popular Investigations

Comparisons of different methods of measuring g.

Comparisons of 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 – comparison of different methods.

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.