Principal Assessor Report 2006

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

Comments on candidate performance

General comments

Examination

The examination was considered to be a fair paper, with the vast majority of candidates making a good attempt at the questions. Excellent performances in the grade A questions indicated a strong cohort.

Investigation

The mean mark fell from 14.8 to 13.4. There was little evidence of "new Investigations".
Again "easy" marks were not picked up in the report – markers expressed concern that information is not getting through to candidates (see later).
With new statistics available, it was interesting to see that there were 45 "new" centres with 32 dropping out, giving a net gain of 13. This to be expected at AH with fluctuating numbers from year to year.

Areas in which candidates performed well

Q2(a)	Well attempted with only unit marks dropped in some cases.
Q4	The equations booklet had a positive effect in this question with the kinetic energy equation being correctly selected.
Q6	Well done – candidates have a good grasp of charges in an electric field (part(c)).
Q7(a)(i), (ii)	Charges in electric and magnetic fields – good basic understanding.
Q7(c)	Relativity equation again well done.
Q8(c)	Standard application of $E = \frac{1}{2} LI^2$.
Q9	Excellent responses to particle physics.
Q10(a), (b)(i)	Very few omitted doubling distance between nodes to give λ.

Areas which candidates found demanding

Q1(a)(i)(B) Many candidates did not divide by 20 to give the uncertainty in T.

(iii) **% uncertainty in T^2 = 2 x % uncertainty in T !**
The majority of candidates omitted this from their calculation.

(iv) Candidates referred to centripetal, centrifugal, tangential, outward, frictional forces, etc
All that was required was identifying the tension and weight depending on the position of the aircraft.

Q2(b)(i) Many took $I = mr^2$ for the disc. The correct expression is given in the data booklet.

Q2(b)(ii), (c) Many candidates demonstrated a poor understanding of the conservation of angular momentum.

Q3(b) Silly marks dropped here either by forgetting to change km to m or failing to add the height to the radius of Mars.

Q5(a) (ii) The question asked "state" - the hint was not taken and many tried to, incorrectly, to calculate V.

(a) (iii) The curve should not touch axis.

(b) Either poor or no attempts at vector addition.

Q7(a)(iii) Poor response to this question – many candidates stated that the speed would double.

Q8(b) Candidates must realise that E = - 9V, **if not, then the maximum mark they can achieve is ½ for the correct equation.**

(d) **Rapid** collapse of magnetic field or **very high** rate of change of current.

Q10(b)(ii) Many candidates failed to recognise the effect of decreasing the frequency or measuring the distance between a greater number of nodes.

(c) Many just did not latch on the idea of intensity loss in the reflected wave.

Q11(a)(i) Symbols used with no clear explanation.

(b)(ii) Many failed to recognise that no phase change now occurs at the junction between the MgF and the liquid.

(c) Poor or little understanding shown.

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, Excel, etc. 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

Advice to centres for preparation of future candidates

Examination

Ensure candidates know
% uncertainty in T^2 = 2 x % uncertainty in T !

Absolute uncertainty should be given to one significant figure.
(Although not penalised in the exam, following the general marking instructions on significant figures).

Where candidates are given the numerical answer and asked to show what the answer is, it is important that they clearly state all equations plus any data used.

More practice in conservation of angular momentum problems required.

In descriptive or explain questions ensure all aspects are covered e.g. many candidates dropped ½ mark in 2(c) for not stating the angular momentum was conserved.

Candidates tend to be poorer in descriptive questions – more practice required.

Basic definitions should be committed to memory. – listed in content statements.

Some candidates are memorising formulae for distance of closest approach of charged particle towards atom, deflection of charged particles in electric field, etc – easy to make slips.
Better to understand from first principles.

Care should be taken when calculating the gravitational force or potential at a height above planet. **Remember to add on the radius of the planet.**

Candidates should be very familiar with the data booklet. At AH level there are three pages (includes moments of inertia) plus the periodic table.

Clearly show any data retrieval to pick up the data ½ mark.

To ensure that the substitution marks are awarded, it is better to substitute as soon as possible in an equation.

8(b)
This is being highlighted again.

$$E = -L\frac{dI}{dt} \qquad 9 = -L \times 12$$

L = - 0.75 H will be awarded ½ mark only for the equation (wrong physics)

***E* must be given as –9V.**

Proofs
Candidates should clearly define symbols used in their answer – diagrams should be used where possible.

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 to give time for proof reading and amendments.

The markers' form AH6 has been included to allow teachers to allocate marks for particular sections.

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 a very 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.

The Investigation should comprise of **3 to 4** related experiments – only in exceptional circumstances will 1 or 2 be sufficient to cover the recommended time of 10 – 15 hours experimental work.

Guidance for Understanding Standards in Physics at Advanced Higher level can be accessed via www.sqa.org.uk/sqasecure – secure website – password required – contact your SQA coordinator.

Investigation Unit Award

To pass the unit award, the teacher must be satisfied that the pupils have passed outcomes 1 and 2. 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 next sheet shows form AH6 which is used by the markers when allocating marks to different categories. Teachers might find this useful when proof reading the Investigations – any obvious omissions can be highlighted by giving zero marks.

(Note it is better if candidates write up the experiments sequentially). i.e. complete the procedures, results and discussion for the first experiment before describing the second, and so on.

National Qualifications **Form AH6**

Physics Advanced Higher Investigation Report **Marker's Record Sheet**

Name of Candidate _____ **Name of Centre** _____

Title of Investigation _____ **Marker Code** _____

Category	Marks Avail.	Marks award	Notes/comments
Introduction			
Summary: purpose(s) findings	**1**		
Underlying Physics: relevant complete appropriate level not simply coursework	**3**		
Procedures			
Diagrams and/or descriptions of apparatus	**2**		
How apparatus was used to obtain experimental data	**2**		
Level of demand: range of procedures replication control of variables accuracy originality sophistication	**2**		
Results			
Data sufficient relevant to purpose	**1**		
Uncertainties individual results final results	**3**		
Analysis of data graphs calculations	**2**		
Discussion			
Conclusion(s) relevant to purpose(s)	**1**		
Evaluation of experimental procedures: accuracy adequacy of repetition adequacy of sampling control of variables limitations of equipment reliability of methods sources of errors, uncertainties	**3**		
Evaluation of investigation as a whole problems overcome modifications significance/interpret findings further improvements further work	**2**		
Presentation			
Title, contents, pages numbered	**1**		
Clear concise readable	**1**		
References sufficient, relevant, specific	**1**		

Total	**25**		
General comment			

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 / findings. Must be at the beginning of the report, immediately following the content page. 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. Physics explained should be relevant to experimental procedures. **(3,2,1,0)**

Procedures

Diagrams / descriptions: Generally well done. Increase in use of digital photographs, but many unclear and unlabelled. Apparatus / circuit diagrams should also accompany these. **(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. Minimum of 3 / 4 experiments required – exception cases of 1 / 2 provided 10 / 15 hours experimental work. **(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 of a straight line graph where appropriate to do so, use of significant figures – poor. (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. Excel – use of LINEST good but care should be taken with size of points. 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. Lines should not be forced through the origin. **(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 – comment on reduction of these. **Better at the end of each experiment**.

		(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. Describe difficulties, frustrations with problems encountered. **(2,1,0)**	
Presentation	Title, contents, page numbers - any one omitted - (0) **(1,0)**	
	Readability **Write up experiments sequentially.** **(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 or date accessed 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, Interference of Light.

e/m for an Electron, Young's Modulus, Surface Tension, Viscosity, Focal Length of Lenses.

Speed of Sound – comparison of different methods.

Statistical information: update on Courses

Number of resulted entries in 2005	1,426

Number of resulted entries in 2006	1,437

Statistical Information: Performance of candidates

Distribution of Course awards including grade boundaries

Distribution of Course awards	%	Cum %	Number of candidates	Lowest mark
Maximum Mark - 125	-	-	-	-
A	32.4	32.4	465	88
B	24.8	57.2	357	75
C	19.6	76.8	282	62
D	7.2	84.0	103	55
No award	16.0	100.0	230	-

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.