Principal Assessor Report 2007

Assessment Panel:	**Physics**

Qualification area

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

Comments on candidate performance

General comments

Examination
The paper was accessible to all candidates with the vast majority having adequate time to complete the paper.
There was an excellent response to the paper which was seen to be fair.
Good responses to the A grade questions indicated a strong cohort.

Investigation

The mean mark fell from 13.4 to 13.3. There was little evidence of "new investigations".
Again "easy" marks were not picked up in the report – information not getting through to candidates.
(See later).

The number of presentations fell from 1422 to 1370, the first recorded fall since the start of AH.
There were 23 "new" presenting centres with 47 dropping out, giving a net loss of 24 centres.

Areas in which candidates performed well

1(b) From what was originally considered a difficult problem, candidates now cope very well with relativistic energy.
Average mark 3.5 out 4 (3.5 / 4).

2 (a)(i)(ii)
Calculations involving moments of inertia, angular velocities and accelerations tackled well.
Average marks (a)(i)(1.5 / 2), a(ii) (2.8 / 3).

5 (a)(i), (c)(i), (iii)
Calculation of V (numerical answer given), the forces on a charged droplet in an electric field and the calculation of the number of electrons on an oil droplet most candidates found easy.
Average marks (0.9 / 1) (0.8 / 1) (0.8 / 1).

6(a),(b)(i),(d)(i)
The components of magnetic field (numerical answer given), the force acting on a conductor in a field and use of the equation for a magnetic field around a current carrying conductor done well.
Average marks (0.9 / 1) (1.7 / 2) (1.7 / 2).

7(a)(iii)
Standard equation for energy stored in an inductor caused few problems.
Average mark (1.8 / 2).

8(a)(i)
Horizontal and vertical components of velocity - fine.
Average mark (1.6 / 2).

9(b)
Changing the sign in the equation to represent a wave moving to the left – fine.
Average mark (0.9 / 1).

11(a), (b)
Calculation of speed from distance between nodes (numerical answer given) – uncertainties question - good responses
Average marks (1.8 / 2) (2.1 / 3).

Areas which candidates found demanding

1(a)
Many scored 0 due to having incorrect integration equation at the start.
Average mark (1 out of 2).

2(a)
Centripetal force – still a problem area where candidates have to explain the situation presented.
Average mark (0.6 / 2).

3(a)(iii),(iv),(b)(i)
Definitions must be precisely stated – as in content statements.
Many did not give the expression for Ep as negative.
Ep = Ek was taken as wrong Physics – zero marks.
Average marks **(0.3 / 1) ,(0.6 / 2), (0.7 / 2).**

7(a)(i),(b)
Explanation of back emf – often no mention of **changing** magnetic field.
S open – omission of **collapsing** magnetic field or **large** rate of change of current.
Average marks **(0.9 / 2), (1 / 2).**

8(a)(ii)
Helical motion – explanation of circular motion fine, but many missed out that the horizontal velocity is constant or there is no horizontal force.
Average mark (0.7 / 2).

9(c)
$I \alpha A^2$ Application of equation poor.
Average mark (0.7 / 2).

10(a)(iii)
Why a lens is made non-reflecting? Poor response.
Average mark (0.4 / 1).

11(c)(i),(ii)
Uncertainties – poor use of language
Precise answer must be given – not good enough to say better equipment.
Average mark (0.3 / 1), 0.2 / 1)

Advice to centres for preparation of future candidates

Examination

- Ensure the starting equation is correct for derivations of equations of motion using calculus.
- Take care with the number of significant figures given in an answer.
- Explanations of an object that performs circular motion – this is due to the central force maintaining the orbit – remove this force and the object will fly off at a tangent.
  The central force can be supplied by friction, the back of a seat, component of gravity, etc.
- Satellites in orbit, escape velocities – take care, emphasise the negative sign in the case of gravitational potential energy.

- To obtain the expression for the escape velocity emphasise Ep + Ek = 0 at this point.
  Note: giving Ep = Ek resulted in zero marks. Also many candidates wrongly equated central force with gravitational force to find the escape velocity.
- When a numerical answer is given in the question paper, then **all equations** must be shown with appropriate substitutions. – this might include the correct substitution of any required constants. e.g. values of ε_o or μ_o.
- **Ensure candidates know the appropriate definitions given in the content statements.**
- Candidates tend to be poor in the "describe and explain" questions. More opportunity given in class for candidates to explain a situation to their classmates might be a way forward.
- Please ensure that candidates can explain the cause of a back emf, emphasising the role of the **changing magnetic field**.
- Candidates need more practice in using $I \ \alpha \ A^2$ – especially in the case of what happens to the amplitude if the irradiance halves.

Investigation

New guidance for both candidates and teachers / lecturers can be accessed through www.sqa.org.uk
Each candidate should be given a copy of the guide.

Included in the guidance to staff is the markers' form AH6, which will allow teachers / lecturers to allocate marks for particular sections. This will assist candidates in the improvement of the early draft of their reports.

Too many candidates fail to gain what should be "easy marks" due to not following the advice.

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.

Centres are reminded that the investigation must be solely the work of the candidate.

The results obtained **must** be through the candidate's own work.

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 / plan these using appropriate references.

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

The investigation should comprise **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.

Investigations which carried out the same procedures several times tended to score low marks e.g finding Young's modulus for 5 different materials using the same approach.

Use of University Facilities

It is pleasing to see schools using university support where possible. This not only gives the students experience of working in another environment but also creates an opportunity for the universities to demonstrate the facilities available.

However, it must be said that, if these facilities are used for an investigation, this should not be seen as quick fix, so that the investigation can be completed with one or two afternoon's lab work.

The high scoring "university investigations" are clearly well planned and have either introductory experiments done in school or a more specialised experiment attempted at university to round off the investigation.

Investigation Unit Award

To pass the unit award, the teacher must be satisfied that the pupils have passed outcomes 1 and 2.

Centres should ensure that evidence of outcomes 1 and 2 is kept in an investigation **record**.

This **record** could well be required for verification.

Again refer to latest guidance for teachers / lecturers.

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** are 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 the purpose e.g. comparison of different methods of measurement or numerical values given with associated uncertainties.	**(1,0)**
Underlying Physics:	**Not good enough to just give equations** – the symbols should be defined and the Physics behind the equations / derivations should be explained. Opportunity here for markers to reward commensurate / good investigations. Physics explained should be relevant to experimental procedures. References are normally cited under this heading.	**(3,2,1,0)**

Procedures

Diagrams / descriptions	Generally well done. Increase in use of digital photographs. These must be clear and labelled Apparatus / circuit diagrams should also accompany these.	**(2,1,0)**
Apparatus use	Should include a **detailed** account of **how** all measurements 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 procedures required** – exception cases of 1 / 2 provided 10 / 15 hours experimental work.	**(2,1,0)**

Results	
Data sufficient/relevant	Most candidates are awarded a mark here. Must show all readings plus units taken – no short cuts to average. Results are best displayed in tables. **(1,0)**
Uncertainties	Candidates should quote, where appropriate, calibration, scale reading and random uncertainty for each measurement made and combine these appropriately. Candidates were penalised for inappropriate use of random uncertainty – see the example given following this table. (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 their size and how they might be reduced. **Better at the end of each experiment**. **(3,2,1,0)**
Evaluation of Investigation	Candidates had difficulty with this section. Very little mention of modifications and further improvements in sufficient detail. Describe difficulties, frustrations with problems encountered. **Should be at the end of the report.** **(2,1,0)**
Presentation	Title, contents, page numbers - any one omitted - (0) **(1,0)** Readability **Write up experiments sequentially.** Do not group all the diagrams, descriptions, results, conclusions etc together. For the majority of cases, do not have the graphs in appendices – better to have them after the results of that particular experiment. **(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. References for diagrams alone not sufficient. There is no minimum number of references required, but they must be sufficient and relevant to cover the underlying Physics used in the investigation **(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.

Measurement of Planck’s Constant.

Aerofoil lift.

Statistical information: update on Courses

Number of resulted entries in 2006	1,437

Number of resulted entries in 2007	1,380

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	32.7	32.7	451	87
B	23.6	56.3	326	74
C	19.4	75.7	268	62
D	7.2	83.0	100	56
No award	17.0	100.0	235	-

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.