CARIBBEAN EXAMINATIONS COUNCIL

REPORT ON CANDIDATES' WORK IN THE CARIBBEAN ADVANCED PROFICIENCY EXAMINATION MAY/JUNE 2008

PHYSICS (TRINIDAD AND TOBAGO)

PHYSICS

TRINIDAD AND TOBAGO

CARIBBEAN ADVANCED PROFICIENCY EXAMINATION

MAY/JUNE 2008

GENERAL COMMENTS

The performance of the candidates in the 2008 examination was similar to that of the 2007. The mean score on the multiple choice paper remains significantly higher than that of the written papers. The examiner sees the need for candidates to gain more experience in problem solving and in analysis and interpretation of graphical data.

UNIT 1

PAPER 01

MULTIPLE CHOICE

Module 1

The mean score for the 15 questions on this mechanics module was 52 per cent with candidates scoring best on items about units, momentum, projectile motion and satellite motion.

An item requiring knowledge of the balanced forces on an object falling at terminal velocity proved to be the most challenging and tripped up more than 80 per cent of the candidates: there still seems to be a pre-Newtonian belief persisting that motion requires a resultant force. Another item about wind blowing on a door was also poorly done since few candidates realised that the resultant force would act at the centre of mass.

Teaching of Newton's 2^{nd} law in the form $F_{RES} = ma$ might help students to remember to the resultant force before applying the law. In the case of an item on vertical circular motion it might have prevented candidates from making the error of calculating the tension in the string by equating it to mrT^2.

Module 2

The performance on this Waves module was much better than that on the mechanics (mean 62 per cent correct) with candidates doing particularly well on items involving the energy of a pendulum, pitch and loudness, comparison of properties of light and sound waves and graphs for stationary waves.

The weak areas were:

> The calculation of the focal length of a lens to correct long sight proved to be too difficult for most candidates.
>
> Candidates did not know that the colours observed in a thin film are due to interference rather than refraction.

The calculation of the frequency of standing wave on a stretched string involved two steps - finding the wavelength and using v = fλ. Less than 40 per cent of candidates were able to do this.

Module 3

Candidates, on average, responded correctly to 57 per cent of these items. The poorest responses came for a Boyle's law item about a rising bubble - the majority of candidates ignored the atmospheric pressure in their calculations.

There were however many areas where candidates seem to have been well prepared including thermometers, temperature scales, cooling curves, conduction in metals and Young's modulus.

UNIT 1

PAPER 02

Question 1

Generally the graph of the motion of an object falling under gravity (Part (a)) was well done. But many candidates lost marks unnecessarily e.g. by using the table to calculate the gradient instead of identifying a large gradient triangle on the graph paper or by assuming the gradient was equal to g rather than $\frac{1}{2}g$.

Surprisingly at this level not many candidates could correctly draw all three sketch graphs for the variation with time of acceleration, velocity and displacement (Part (b)) and there were even candidates who were quite unaware that one of the equations for motion with uniform acceleration was required in Part (c).

Question 2

The attempts at drawing diagrams to explain double slit interference in Part (a) were acceptable. Candidates however often lost marks for labelling the superposition of two troughs with an X indicating destructive interference. Some candidates also confused diffraction with refraction and talked about the bending of the waves rather than the "spreading" as they went through a small aperture.

Part (b) proved to be more challenging: candidates were expected to use interference formula $a \sin\theta = n\lambda$ to find the position of the first maximum (n = 1) and second minimum (n = 3/2) of an interference pattern but very few of them gained full marks. Some could not even get as far as calculating the wavelength of the radio waves correctly because they thought the velocity was 340 m/s.

Question 3

Sometimes candidates learn a formula without having any understanding of its meaning. A glaring example occurred in Part (b) where a significant number of candidates wrote $T = 2\pi\sqrt{L/g}$ to calculate the tension T. In fact the answers to this part of the question were poor even by those who did not make this faux pas: many candidates ignored the centripetal motion and stated that the tension was equal to mg. They were however able to gain marks in the other sections since the examiners, as usual, applied the principle of "error carried forward".

To compensate the responses in Part (a) were good though there were some candidates unfamiliar with the graph for the stretching of rubber.

Question 4

Questions on errors and uncertainty in past examinations were very poorly done so the examiners were pleased to see the number of good attempts this time around: there were a large number of candidates able to score 10 or more marks out of 15.

Most candidates were able to distinguish between precision and accuracy in measurements but the examples they gave could have been better and reflected a “practical’ rather than theoretical approach.

Probably the easiest way to estimate the uncertainty in the specific latent heat in (c) is to add together the percentage errors in the three measurements. Candidates who did this (and did not make a careless error in dealing with the 10^{-3} kg) usually gained full marks. The traditional method of writing an equation relating fractional errors was utilised by some but required more care and often gave rise to mistakes in the calculations.

Candidates were not penalised for using the method of finding the maximum possible *L* value and the minimum value if they did it successfully. Unfortunately however most of them thought that combining the maximum values of the three quantities would give the maximum *L* which is not true.

Question 5

In Part (a) the wave diagrams showing refraction of water waves in a ripple tank were very poor in the majority of cases and the marks for this section were low.

In Part (b) though most candidates were able to read of values to find the frequency change in (i) some thought they could take a short cut and find the difference in wavelengths and use this for calculating the difference in frequencies.

In Part (ii) required candidates to be able to manipulate an equation to plot a straight line. Obviously this skill needs much more attention since few candidates were able to plot the correct graph and find the value of k from the gradient.

Question 6

Part (a) tested candidates understanding of the equation for thermal conduction. Some candidates found difficulty from the start since they did not relate P the rate of conduction to Q/t in their version of the formula.

Marks were lost in (ii) by candidates who only read approximate values from the graph and in (iii) by those who wrongly assumed that the gradient of the graph was equal to the thermal conductivity. The number of sketch graphs submitted for (iv) which were linear surprised the examiners – surely the similarity to Boyle’s law which they had studied since CSEC level would have precluded this error.

In Part (b) the last part of the question required the use of Stefan’s law but few candidates realised this and those few were often unable to handle the calculations so the scores were quite low.

UNIT 2

PAPER 1

(MULTIPLE CHOICE)

Module 1

Manipulation of the formula for resistivity and calculation of the current in a series/parallel combination of resistors caused some problems but otherwise the items in this module were well answered. The examiners were particularly pleased with improved performance on questions on the topics of electrostatics and magnetism.

Module 2

Two items about r.m.s. values for a.c. quantities and one on the op. amp. comparator received the poorest responses in the A.C. Theory and Electronics module (less than 30 per cent of candidates answering them correctly).

This year the overall performance on the electronics questions was better than in previous years particularly on those about digital electronics.

Module 3

Most candidates scored best on this module. They demonstrated a good grasp of concepts in radioactivity and atomic structure. However there were two very weak areas: use and understanding of the photoelectric equation and the calculation of binding energy per nucleon.

UNIT 2

PAPER 02

<u>Question 1</u>

Though there were many good answers to this question teachers need to be aware of some common weaknesses running through the marked scripts

In Part (b)(ii) inability to convert cm^2 to m^2.
 Failure to recognise that the maximum value of a sine or cosine is 1
 Omission of the number of turns in the e.m.f. calculation
In Part (iii) doubling the frequency doubles the peak e.m.f.

In Part (iv) to investigate changing the area of the coil the other factors must be kept constant.

<u>Question 2</u>

In Part (a) perhaps because of lack of exposure to practical work few candidates knew that a potential divider would be needed to vary the input potential of the operational amplifier and those that did could not connect it correctly.

Some errors occurred in the plotting of the amplifier characteristic that would not be expected at this level: plotting of rounded off values rather than the ones given; freehand drawing of straight lines; use of two table values rather than the best fitting line for the gradient.

It was also noted that many candidates did not use their graphs to find the maximum input voltages but tried to use the table instead.

Question 3

This question elicited a wide range of responses with a pleasing number of candidates able to score 14 or 15 marks. The areas which posed difficulties for some were:

writing (and plotting) 1/8 with only *one or two* significant figures
converting nm to metres incorrectly.
inability to manipulate the photoelectric equation to obtain the equation of the graph
determining Planck's constant from the gradient.

Question 4

In Part (a) the experiment descriptions were often poor with some not even mentioning how the temperature could be measured. The circuit diagrams submitted were good for the most part though some had ammeters in parallel and voltmeters in series. Some candidates attempted, without success, to use Wheatstone bridge circuits.

Although candidates confused the *potential at Q* with the p.d. across the 5 kΩ resistor they were still generally to determine the balance temperature for the thermistor. But some candidates assumed the potential at p was 0 V and said the temperature was 100 ^{0}C.

In Part (b) this simplified Kirchhoff's laws problem was generally very well done.

Question 5

Many candidates could only gain marks for the truth tables of the NOR and NAND gates in (a). It seems that in some schools the other parts of the new syllabus such as the replacement of a NAND gate with 4 NOR gates had not been studied.

Part (b) tested candidates' knowledge of adders and half-adders. This is not an easy topic especially if suitable apparatus for constructing the circuits is not available in the school. Responses such as "*The half-adder is used to add 2-bit binary numbers while the full-adder is used to add 3-bit binary numbers*" showed that teachers need to go back to basics when teaching this topic: starting with adding numbers together on paper and understanding the concept of "carrying" to the next column. In the last part of the question some candidates merely used two half adders to make a full adder failing to recognise that an OR gate was needed too. Surprisingly many of them went on to describe an application rather than giving an example to explain its *operation*.

Question 6

There were more low scores on this question than on any other in the paper. It appeared that candidates were not prepared for this part of the syllabus.

Millikan, as part of his methodology, determined the mass of an oil drop accurately: he then tried to preserve this oil drop and measure several times the charge it could acquire. To change the charge he used X-rays (particles could also have been used). Candidates confused this changing of the charge on a particular oil drop with the initial charging of oil drops as they emerged from an atomizer.

Thoughtless errors such as using *g* rather than *mg* for weight , poor manipulation of powers of ten and poor recall of Newton's 2nd law caused the scores in Parts (b) and (c) to be low even for those who had studied this topic.