CARIBBEAN EXAMINATIONS COUNCIL

REPORT ON CANDIDATES' WORK IN THE SECONDARY EDUCATION CERTIFICATE EXAMINATION

JANUARY 2011

PHYSICS
GENERAL PROFICIENCY EXAMINATION

GENERAL COMMENTS

This year 1497 candidates registered for the examination. This represents a 10 per cent decrease in candidates registered compared with 1664 in January 2010.

Once again candidates needed to show better mathematical skills in carrying out basic tasks such as scientific notation, solving equations, indices and simple geometry. More emphasis must be placed on demonstrated competence in mathematical skills in studying physics.

DETAILED COMMENTS

Paper 01 – Multiple Choice

The performance in this year's multiple choice paper improved over that of January 2010. The mean was 33.04 with a standard deviation of 9.69 compared with a mean score of 28.35 and standard deviation of 10.63 in 2010.

Paper 02 – Structured/Essay Type Questions

This paper consisted of one data analysis, two structured, and three essay-type questions.

Question 1

Section A
This question was based on the concepts surrounding motion in a straight line. Candidates were required to draw a graph consisting of two segments, calculate the slope and determine, using the slope, how far the sprinter would be from the finish line after 10s.

Areas of Good Performance

This was a good question in that it tested graphical and mathematical skills. It also required definitions of two basic concepts involved in the question — velocity and acceleration. The question was also relevant to candidates' experiences as sprinting is a common sporting experience in school life. The Caribbean is also noted for world-class sprinters.

Two main areas of good performance were in (a) plotting the graph and (b) determining the slope of the graph. Most of the graphs were well done.

Core criteria in marking a graph include labels with units, correct axes orientation, regular scales, plotting and best straight line or curve.

In determining the slope, a large triangle is needed, correct read offs, calculation and two significant figures are also required.

Areas of Weak Performance

For Part (a) some candidates incorrectly defined velocity as rate of change of distance. The correct definition of velocity is the rate of change of displacement.

In Part (f) candidates found difficulty with the calculation of how far from the finish line the sprinter would be. Distance travelled is the area of the trapezium or the area of a triangle and a rectangle. Candidates had to subtract this distance from 100m to determine how far it was from the end.

General Comments and Recommendations

(a) Candidates should use the graph page to its maximum.

(b) Candidates should use Ö or x when plotting points.

(c) Candidates should be given adequate practice in drawing and analysing graphs, straight lines and curves.

Question 2

Section D – Waves and Light

This question was based on the electromagnetic spectrum and refraction. The first part of the question asked for the recall of radiations and the sources and uses of some waves were required.

The second part of the question involved calculations with the velocity of waves formula $V=f\lambda$ and the refractive index formula.

Areas of Good Performance

Part (b) (i) of the question was well done. This section required candidates to calculate the frequency of gamma rays. Part (b) (ii), the refractive index formula, was also well known.

Areas of Weak Performance

Part (b) (ii), ray going from glass to air instead of air to glass, resulted in candidates writing n = (Sine of smaller angle/Sine of larger angle). Many candidates did not even realize that the angle to be found must be greater than 35^{o}.

General Comments and Recommendations

(a) Teachers should have students use refractive index formula with $n\sin\theta$.

(b) Attention should be placed on rays entering as well as leaving another medium. Calculations should involve the reversibility of light.

Question 3

Section E – Electricity and Magnetism

Electrical symbols and Ohm's Law were the main topics explored in this question. These are necessary in assisting students solve problems in electricity. A Symbol/Name table was created to help students respond in a user-friendly manner. Components used were the cell, rheostat, bulb, alternating current supply, diode and the fuse. Part (b) was based on the popular V=IR formula.

Candidates responded mostly in a satisfactory manner.

Areas of Good Performance

Part (a) which required candidates to use the circuit symbols and Ohm's Law formula, was well done.

Areas of Weak Performance

Part (b) (iv) where a series and parallel combination was presented to get the equivalent resistance was poorly done. Candidates need more practice with the parallel arrangement of resistors and the use of the reciprocal formula.

General Comments and Recommendations

Teachers are expected to have students fully explore circuit configurations from a single component in a circuit to combinations of series and parallel.

Question 4

Section C – Thermal Physics and Kinetic Theory

The first part of this question required candidates to write an activity to show how temperature varies as a substance cools. Napthalene was suggested as a substance. The second part concerned calculations with respect to specific latent heat. This question proved challenging to candidates especially the calculation parts.

Candidates must be well prepared for the exam and specific latent heat is a more involved concept where a change of state occurs. A simple formula is applied E= mL. The L value depends on the specific phase change. Also $E = mc\Delta\theta$ is used as heat is absorbed or liberated during a temperature change.

The formula required to use in Parts (b) (iii) and (b) (iv) involve the combination of the two formulas above.

Areas of Good Performance

Candidates performed well on Part b (i) which dealt with the determination of the mass of melted ice.

Areas of Weak Performance

In Parts (iii) and (iv), candidates had problems getting the equation for these parts correct. It shows a weakness in the understanding of the concept of "specific latent heat".

The responses which were expected for Parts (iii) and (iv) are as follows:

(iii) Energy = heat gained by ice to melt + heat gained by melted ice

or $Q = m_i l_f + mc_w\Delta\theta$

or $= 10\ l_f + 10(4.2)(20)$

or $= 10\ l_f + 8405$

(iv) $4200 = 10\ l_f + 840$

General Comments and Recommendations

(a) There is a greater need to cover the topic of Specific Latent Heat with relevant examples.

(b) The experience of cooling an object and drawing cooling curves must be explored by candidates.

Question 5

Section E – Electricity and Magnetism

This question is rooted in Topic 7 of Section E of the Syllabus. It is not a difficult topic to understand but the question was not generally well done.

Areas of Good Performance

Candidates were able to recall the formula for efficiency and its calculation.

Areas of Weak Performance

In Part (a), candidates had difficulty in drawing an appropriate diagram to describe how the magnitude of the e.f.m. induced in a conductor depends on the rate of change of magnetic flux.

In Part (b), candidates did not understand the concept of electromagnetic induction and its application in making electric cars more efficient.

General Comments and Recommendations

(a) Candidates can learn about this topic via a ‘hands on’ approach.

(b) Another approach is the viewing of videos. The popular YouTube website has over 4 000 videos on this topic. This will certainly help candidates.

Question 6

Section F – The Physics of the Atom

This question tested ideas related to the idea of a model of the atom. The Thompson and Rutherford models were required. The other topics explored were Atomic structure and Radioactivity-Half Life.

Areas of Good Performance

Parts (b) (i), (ii), and (iii), all relating to atomic structure, were well done by the majority of candidates.

Areas of Weak Performance

Part (a), which required a description of two great scientists as it relates to the nature of the atom, posed difficulties for candidates. Expected responses are outlined below.

(a) J. J. Thompson

IDEAS (1) Perhaps atoms were like solid balls of positive charged matter with electrons dotted about like currants in a pudding

(2) There needed to be enough negative electrons to make the whole pudding electrically neutral.

NAME OF MODEL – The "plum pudding" model

Ernest Rutherford

IDEAS (1) Atoms might have a very small central core or nucleus with a strong electric charge which would deflect $\propto$ - particles.

(2) This nucleus would be surrounded by electrons of the opposite charge which filled up the rest of the atom.

General Comments and Recommendations

(a) Although it may seem like history, candidates must have a clear understanding of the evolution of scientific thought and must realize that in science ideas can change.

(b) Teachers can use a craft/technology education approach in this topic as models of the atom can be made and used in a display/presentation.

(c) Once more there are many web-based resources that teachers can use — shockwave applications, animations, virtual labs.

Paper 03/2 – Alternative to School-Based Assessment (SBA)

Question 1

Section C – Thermal Physics and Kinetic Theory

This question concerned the verification of Snell's Law. It tested Use of Knowledge (6 marks) and Experimental Skills (14 marks). It involved measuring an angle from a protractor, determining the sine of angles, drawing a graph and using the graph to support or refute Snell's Law.

Areas of Good Performance

The question was generally well done. Candidates were generally able to read off the angle, complete the table and draw the graph.

Area of Weak Performance

Candidates lacked the understanding that this graph passes through the origin. If candidates had remembered that Sine $0^{o} = 0$, they would have had the correct orientation of the graph.

General Comment

This experiment is a core experiment for preparation for the CSEC exams. It was clear that candidates were able to display the required skills tested.

Question 2

Section C – Thermal Physics and Kinetic Theory

This question involved the concepts of specific heat capacity and specific latent heat of fusion. Provided with a graph, candidates were required to determine five points from the graph. They were also required to calculate the slope of the graph from its value, and by checking with a table, determine the specific heat capacity of a given sample.

Areas of Good Performance

Parts (a) and (b) (ii), the identification of point on the graph and determination of the slope, were well done.

Area of Weak Performance

The application of 10^3 proved difficult for some candidates.

General Comments and Recommendations

(a) Students learn through experience and teachers should ensure their students get the widest hands-on experience as possible.

(b) Some students need more graph skills developed. Again, teachers should give adequate practice in this area.

Question 3

Section B – Mechanics

This question investigated the concept of centre of gravity and required candidates to confirm or reject the assertion "The centre of gravity of all uniform and regular shapes is at the centre of the shapes".

Areas of Good Performance

In Part (a), candidates generally knew the apparatus that was required. Some left out the fact that at least three different shapes should be used. The triangle is a very important shape as it makes the assertion false.

Area of Weak Performance

Part (d), comparing the centre of each shape with the point where lines cross on suspension of the shape, was poorly done.

General Comments and Recommendations

(a) This was a question based on a standard experiment but with a little twist with a triangle. A number of candidates did not recognize this.

(b) More practice is needed in the writing up of experiments.