

CARIBBEAN EXAMINATIONS COUNCIL

**REPORT ON CANDIDATES' WORK IN THE
SECONDARY EDUCATION CERTIFICATE EXAMINATION**

JANUARY 2012

**PHYSICS
GENERAL PROFICIENCY EXAMINATION**

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GENERAL COMMENTS

This year 1,225 candidates wrote the examination. This represents a 13.2 per cent increase in candidates compared with 1,063 in January 2011.

Once again, candidates needed to show better mathematical skills in areas such as scientific notation and solving equations. More emphasis must be placed on using mathematical skills in studying Physics. Teachers should also ensure that students can write coherent multi-step essay-type responses. One example where candidates had difficulty writing concerned the Direct Current (DC) motor and how it works.

DETAILED COMMENTS

Paper 01 – Multiple Choice

Performance on the multiple-choice paper was comparable to that of January 2011. This year, the mean score was 31.74 with a standard deviation of 9.83, compared with a mean score of 33.04 and a standard deviation of 9.69 in January 2011.

Paper 02 – Structured/Essay-Type Questions

This paper consisted of one data analysis, two structured and three essay-type questions. All questions were compulsory. Performance on Paper 02 showed improvement compared with January 2011. This year, the mean score was 38.95 with a standard deviation of 21.38, compared with a mean score of 34.24 and a standard deviation of 18.65.

Section A

Question 1

This question was based on the concepts surrounding using the Principle of Moments to find the mass of and weight of an object given the gravitational field strength. Candidates were required to use data given to draw a graph, determine the gradient and use the gradient to find the mass.

Areas of Good Performance

This question tested graphical, mathematical and analytical skills. It required a definition of a basic concept — moments.

Candidates performed well on Part (a) which required them to complete a table using information shown in a diagram. Part (b) which required them to plot a graph, Part (c) which required them to determine the slope of the graph and Part (d) where they were required to read off from the graph, were areas of good performance.

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

In determining the gradient the following were required:

- A large triangle
- Correct read offs
- Calculation of an appropriate number of significant figures
- The unit where applicable.

Areas of Weak Performance

In Part (e), too many candidates defined the principle of moments very loosely as “anticlockwise moments equal clockwise moments”.

The comprehensive definition is *For a system in equilibrium, the sum of the clockwise moments about a point is equal to the sum of the anticlockwise moments about the same point.*

In Part (e), candidates for the most part, did not realize that to find the weight in newtons, the mass had to be in kilograms. A few candidates are still having problems converting grams to kilograms.

Candidates should

- use the graph page to its maximum
- use a \odot or \times when plotting points
- be given adequate practice in drawing and analyzing graphs- straight lines and curves.

Question 2

This question was based on fundamental quantities and their SI units and measurement. The first part of the question tested candidates’ ability to recall basic facts concerning fundamental quantities and linear scales.

The second part of the question involved calculations on density and pressure.

Area of Good Performance

The main area of good performance was in Part (a) (i) which required candidates to recall symbols and units and Part (b) (i) where they were asked to find the density of a cement sample.

Area of Weak Performance

Part (a) (ii) which required candidates to state the difference between a linear and a non-linear scale was poorly done. Teachers should spend some more time with students on this area when studying scales on instruments.

Recommendation

Teachers should consider a more practical approach to scales with as many examples as possible.

Question 3

This question was based on Einstein's mass-energy equation, the pros and cons of utilizing nuclear energy, the structure of the atom and radioactive emissions.

Performance on this question was, for the most part, not good.

Areas of Good Performance

Parts (a) (i) where candidates were required to recall Einstein's mass-energy equation, Part (a) (ii), which required candidates to state arguments for and against the utilization of nuclear energy and Part (b) (i) where they were required to balance the equation to find atomic and mass number, were generally well done.

Areas of Weak Performance

Part (b) (ii) and Part (c) presented difficulties for candidates. Candidates had problems applying the formula $E = mc^2$ and identifying the Helium nucleus (He).

Recommendation

Teachers should make sure that there is a more complete coverage of syllabus objectives. It appeared that many candidates had not yet covered the topics.

Section BQuestion 4

The first part of this question was based on an understanding of the operation of a Direct Current (DC) motor. The second part involved calculations of frequency and period of an alternating current, the voltage across and the power dissipated in a resistor. The vast majority of candidates performed well below expectation on this question.

Area of Good Performance

Candidates were able to use the formula $V = IR$ in Part (b) (ii) to find the voltage correctly. However many did not understand clearly what "peak to peak" meant. "Peak to peak" measures the span of the voltage from maximum to minimum.

Areas of Weak Performance

Candidates performed particularly poorly on Part (a) which required them to explain how the coil of the D.C. motor is able to rotate continuously. Part (b) (i), which dealt with the period of the alternating supply, also proved to be quite a challenge.

The response expected by the examining committee for Part (a) is as follows:

C — Current flows through the coil

M — As a magnetic field is present

F — Coil experiences upward and downward force respectively

R — Rotation of coil results

S — Split ring reverses the current in arms
 R — Continuous rotation realized

Teachers should engage students in a more hands-on manner when the topic of electricity and magnetism is being taught. Students should then be taught to express these experiences clearly and teachers may even use a multiple intelligence approach to teach the topic — drawing posters, making up calypso and reggae songs and so on. This topic is an integral one in any electricity course.

More attention needs to be paid to the fundamental concepts of unit conversion.

Question 5

This question was framed around the solar water heating system. Alternative energy is getting very popular across the Caribbean and globally and candidates must be sensitized about the impact of this technology in the Caribbean which experiences no shortage of solar energy.

This question involving temperature, specific heat capacity and the transfer of thermal energy was generally well done.

Areas of Good Performance

Parts (a) (i) and (ii) were well known as most candidates were able to score full marks.

Area of Weak Performance

In Part (b) (ii) candidates were not able to correctly identify that the system in the solar water heating system which demonstrates heat transfer by convection is the collector.

The expected responses for the various parts of this question include:

- (a) Good absorption — a black surface
- (b) Convection — the collector
- (c) The greenhouse effect — glass cover
- (d) Conduction — copper tubing
- (e) Reduction of heat transfer by conduction — insulation.

Recommendation

The fact that a change in the Kelvin temperature is the same as a change in Celsius should be emphasized.

Question 6

This question required candidates to (i) differentiate between transverse and longitudinal waves (ii) to recall and use the wave equation $v = f\lambda$ and (iii) solve problems on the propagation and reflection of sound waves.

Area of Good Performance

Part (b) (i) was well done.

Areas of Weak Performance

Although Part (b) (i) was reasonably well done, a number of candidates failed to follow up in Part (b) (ii) by finding the depth correctly. Most candidates found the distance travelled by the sound which was twice the depth.

A good solution would have been:

Total Distance = 2 x depth

$$2d = vt$$

$$d = vt/2$$

$$= 1450 \times 0.3 / 2$$

$$= 217.5 \text{ m}$$

OR

$$s = vt$$

$$s = 1450 \times 0.3$$

$$s = 435$$

$$d = s/2$$

$$= 435/2 = 217.5 \text{ m}$$

Candidates also had difficulty with calculating the frequency correctly in Part (a) (ii). Based on Velocity = frequency \times lambda.

Recommendation

More work needs to be done with applying the units associated with the various quantities.

Paper 032 – Alternative to School-Based Assessment (SBA)

The mean for this paper was comparable to that of 2011. In 2012, the mean was 21.88 compared with the mean of 22.94 in 2011. The maximum available mark was 40. The standard deviation for 2012 was 8.02 compared with 7.89 in 2011.

Question 1

This question required candidates to determine the refractive index of a glass block using Snell's Law. It involved measuring an angle from a protractor, drawing a graph and using the graph to find the refractive index of the glass.

Areas of Good Performance

The question was generally well done. Candidates were able to plot points correctly and calculate the gradient. Many of the candidates realized that the refractive index is $\sin i / \sin r$ but were not able to use the gradient to obtain it.

Areas of Weak Performance

Many candidates did not read the value correctly and were unable to state appropriate precautions. A large number of candidates did not begin the scales on the axes at 0.100.

Recommendation

Candidates should be instructed not to 'break' scales, especially when told where to begin.

Question 2

This question involved the drawing of circuit diagrams, calculating resistance and identifying an electrical component based on its I–V characteristics.

Area of Good Performance

This question was generally well done. Part (c) where candidates were required to plot a graph was satisfactorily done except for the drawing of a smooth curve.

Areas of Weak Performance

In Part (a) for the most part voltmeters were not appropriately connected and in Part (b) calculations of resistance were not recorded to an appropriate number of significant figures.

Recommendations

Students should be given more exposure to electrical circuits in a practical setting and more emphasis should be placed on graphical work involving best fit curve.

Question 3

This question tested candidates' ability to (i) read off values from a given graph and (ii) determine what graph to plot from a given equation in order to obtain a straight line graph.

Area of Good Performance

Part (a) which required candidates to read off coordinates from the graph was particularly well done.

Area of Weak Performance

Very few candidates were able to answer Part (b) satisfactorily.

General Comments and Recommendations

Students need more practice with extracting ' $y = mx + c$ ' from a given equation. The mathematical skill of "changing the subject of the formula" needs to be developed among candidates.