C A R I B B E A N E X A M I N A T I O N S C O U N C I L

REPORT ON CANDIDATES' WORK IN THE SECONDARY EDUCATION CERTIFICATE EXAMINATION MAY/JUNE 2007

PHYSICS

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GENERAL PROFICIENCY EXAMINATION

MAY/JUNE 2007

GENERAL COMMENTS

Ten thousand eight hundred and forty-seven candidates registered for the examination this year compared with 10,330 in June 2006. This represents an increase of 5% when compared with June 2006.

Candidates showed weaknesses in performing mathematical calculations and in understanding some concepts which are sometimes overlooked by teachers. The calculations involving the scientific notation are still presenting some candidates difficulty. Teachers are encouraged to have students competent in the use of the scientific notation.

Teachers are encouraged to deliver the syllabus in a complete manner rather than choosing a core of objectives. This examination is a critical building block for further study at the Caribbean Advanced Proficiency Examination (CAPE) and for university level courses.

Paper 01 – Multiple Choice

The performance in this year's multiple choice paper has improved over that of June 2006. This year, the average score was 38.72 out of a possible 60, with a standard deviation of 11.49.

Paper 02 – Structured Questions

Question 1

Data Analysis, Section A – Physical Measurements and Units, Section C – Thermal Physics

Performance Overall

The average mark for this question was 14.49 out of a possible 30 and the standard deviation was 7.43. Approximately 30 candidates scored full marks.

Areas of good performance

Part (b), plotting of the graph. Most candidates demonstrated a good display of plotting skills. Skills tested were labelling, using appropriate scales, plotting, drawing the best line, fine line and extrapolation.

Areas of weak performance

Part (f). A large number of candidates failed to realize that if the pressure is doubled, the volume is halved. Features of Line 2 were (i) x-intercept is the same as Line 1 and (ii) y-intercept is $\frac{1}{2}$ that of Line 1.

General comments and recommendations:

(a) It is expected that when asked to draw a diagram, it is also labelled.

(b) The key criteria in determining the slope of a graph are

(i) a large triangle

(ii) correct read offs

(iii) calculation with units.

(c) Candidates should be given adequate practice in graph skills before marking for School Based Assessments.

(d) Syllabus objectives assessed: C 1.9 (b), A 3.1, A 3.2, A 3.3.

Question 2

Section B – Mechanics

Performance Overall

The average mark was 6.53 out of 16. The standard deviation was 4.51. Approximately 280 candidates scored full marks.

Areas of good performance

Part (b) (iii), the calculation of the average speed of the car.

Part (b) (iv), using the formula F = ma.

Areas of weak performance

The linking of b (i) to b (ii). This involved a drawing of how velocity changes with time but includes the identification of reaction time on the graph.

Acceleration was taken by some candidates as average speed divided by time instead of change of velocity divided by time. There was also a misconception of velocity as being speed.

General comments and recommendations

(a) Teachers should ensure that candidates have a good understanding of the concepts of average speed, velocity change, and per unit time.

(b) There is a need to perform activities involving reaction time and plot associated graphs.

(c) Syllabus objectives assessed: B 3.2, B 3.3, B 4.3.

Question 3

Section B – Mechanics and C – Thermal Physics and Kinetic Theory

Performance Overall

The average mark for this question was 7.11 out of a possible 14. The standard deviation was 3.40 and approximately 100 candidates scored full marks.

Areas of good performance

Part (b) concerning energy conversion and loss, and part (c) the calculation of energy using $E = MC\Delta\theta$.

Areas of weak performance

Part a (ii) – Many candidates did not recognise that emission of radiation was the issue in this section.

Part d – Many candidates wrote the wrong equation. Here $E = ml_V$ was the needed equation. In part (c) and (d) candidates are still being confused with scientific notation.

General comments and recommendation

Teachers should ensure that candidates, in their study of thermal physics, know that

(i) shiny surfaces are poor emitters of radiation,

(ii) a change of temperature in ˚C and K carries the same value and

(iii) candidates should pay attention to vocabulary, grammar and appropriate use of Physics terms and symbols.

Syllabus objectives assessed: B 5.4, B 5.18, C 4.1, C 4.2, C 4.3, C 4.4, C 3.3, C 3.8.

Question 4

Section D – Waves and Light

Performance Overall:

The average mark for this question was 7.11 out of a possible 16 and the standard deviation was 3.40 . Approximately 10 candidates scored full marks.

Areas of good performance

Section (c) (iv) and (v) of the question were generally widely known. Candidates appear to be familiar with $n = \frac{\sin \hat{i}}{\sin \hat{r}}$ and $n = \frac{c}{v}$.

Areas of weak performance

Section (a) and (b) presented difficulties for candidates. Teachers are encouraged to look at the history of physics and relevant theories concerning the wave-particle duality. Some candidates gave the properties of light instead of the two theories.

In Section (c) part (i); although simply asked to say that all light was reflected at C, they were explaining how and why total internal reflection occurs.

General comments and recommendations:

(a) The following content should be well internalised by candidates

$$\frac{\text{Sin } \theta_1}{\text{Sin } \theta_2} = {}_1n_2 = \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2}$$

and total internal reflection via the use of a light-pipe.

A hands-on approach to this topic is highly recommended.

(b) Syllabus objectives assessed: D 2.2, D 2.4, D 2.5, D 5.1, D 5.4, D 6.5, D 6.6.

Question 5

Section E – Electricity and Magnetism

Performance Overall

The average mark for this question was 4.7 out of a possible 14 and the standard deviation was 2.59. Approximately 4 candidates scored full marks.

Area of good performance

Section (c) of this question was widely known. Most candidates knew the formula Q = it and the unit of charge – the coulomb.

Areas of weak performance

Section (a) part (ii). This involved explaining why there is a net force of attraction. The response expected includes two statements: (i) negative attracts positive and attraction greater than negative – negative repulsion. Part (iii) charging by contact was a difficult concept for some. Section (c) – conversion of millisecond to second.

General comments and recommendations

(a) There is a need for more hands-on experiences in this area – use of electroscopes. The need to discuss practical applications of lightning rods emphasizing the conducting path.

(b) Syllabus objectives assessed: E 1.1, E 1.2, E 1.3, E 1.4, E 1.5.

Paper 03 – Essay Questions

Question 1

Section B – Mechanics

Popularity

This was a popular question on the paper and was attempted by approximately 83% of the candidates.

Performance Overall

The average mark for this question was 5.63 out of a possible 20 and the standard deviation was 3.93. Fewer than 10 candidates scored full marks.

Area of good performance

Section (b) which involved the application of the formulae kinetic energy = $\frac{1}{2}mv^2$ and potential energy = mgh, was the section showing a good performance.

Areas of weak performance

Sections (a) and (c) presented difficulty to students. The statement of Newton's first and second laws of motion is precise and does not require any explanation. The second law can be expressed in terms of acceleration or the rate of change of momentum of a body.

The explanation of how a satellite remains in orbit around the earth involves the following four points:

(i) A satellite needs centripetal force to maintain an orbit.

(ii) Gravitational attraction.

(iii) Causes an acceleration towards the centre.

(iv) This prevents the satellite from going off in a straight line.

The solution to section (c) parts (i) and (ii) involve the application of the formulae a = F/m and $a = \frac{\text{change in velocity}}{\text{time}}$ respectively.

General comments and recommendations

(a) There is a need for teachers to ensure that candidates can use the following terms in context and have a clear understanding of the concepts: "speed", "velocity", "moment", "momentum" "net force", "unbalanced force" and "resultant". Candidates can be engaged in little oral and written activities using these terms appropriately.

(b) Syllabus objectives assessed: B 3.1, B 4.2, B 4.3, B 5.1, B 5.8, B 5.10.

Question 2

Section D – Waves and Light

Popularity

This was another popular questions on the paper and was attempted by approximately 56% of the candidates.

Performance Overall

The average mark for this question was 6.04 out of a possible 20 and the standard deviation was 4.18 .

Areas of good performance

Section (c) part (i) using $\lambda = \frac{v}{f}$. A large marjority of candidates got this part correct.

Areas of weak performance

Section (a) Definition of vibrating in phase. Candidates were expected to respond with – Particles always at same position (1) and moving in the same direction (1) or crest and crest/trough and trough (1) moving in step with one another/in the same direction (1).

Section (c) part (iv). The expression "effect on the observations" did cause some confusion in some minds and did not lead to distances – the distance between A and B is less (1). Section (c) part (ii) the sketching of the graph of displacement vs position posed a challenge.

General comments and recommendations

(a) Candidates need to gain greater experience in this area. This can be attained through practical demonstrations using the slinky, ripple tank and rope. Another effective method of learning about this area is through simple visual aids or low cost/free computer-based resources. The internet is a rich source of free resources.

(b) Syllabus objectives assessed: D 1.1, D 1.2, D 1.3, D 2.6, D 3.2

Question 3

Section C – Thermal Physics and Kinetic Theory

Popularity

This was the second most popular question and was attempted by 72.3% of the candidates.

Performance Overall

The average mark for this question was 5.90 out of a possible 20 and the standard deviation was 4.69. At least 12 candidates scored full marks.

Areas of good performance

Most of the candidates knew

(i) that particles bombard each other

(ii) the gas law and density formulas

(iii) about the relative spacing of particles in liquids and gases.

Candidates were also familiar with the pressure law formula as needed for Section (b) part (ii) of the question.

Areas of weak performance

(i) The concept of what occurs during phase change and bombardment being a force on an area, i.e. pressure.

(ii) Interpretation of numbers/data in section (b) and the conversion from Degrees Celcius to Kelvin.

(iii) The fact that energy change must state from which form of energy to which other form of energy.

General comments and recommendations

(a) There should be a greater emphasis on

(i) what happens to molecules during phase changes

(ii) conversion of temperature between scales and

(iii) more practice in questions involving numbers.

(b) Syllabus objectives assessed: C 1.9, C 1.10, C 3.7.

Question 4

Section F – The Physics of the Atom

Popularity

This question was attempted by approximately 38% of the candidates.

Performance Overall

The average mark for this question was 7.51 out of a possible 20 and standard deviation 5.34. Approximately 20 candidates scored full marks.

Areas of good performance

Most candidates knew the equations and how to determine protons, neutrons and electrons.

Areas of weak performance

Section (c) parts (i) and (ii). Even though some candidates mentioned that decay was unaffected by temperature they also thought that "very high temperature" might make a difference.

General comments and recommendations

(a) This section of the course is relatively simple but many teachers rush this area at the end of the syllabus. If time is taken, students would enjoy and perform better on this section.

(b) Computer software can be used to facilitate learning.

(c) Syllabus objectives assessed: F 1.2, F 2.4, F 2.5, F 3.6, F 3.12

Question 5

Section E – Electricity and Magnetism

Popularity

This question was attempted by approximately 38% of the candidates.

Performance Overall

The average mark for this question was 5.85 out of a possible 20 and the standard deviation was 4.83 .

Areas of good performance

Section (b) parts (i) and (ii), using the formulas V = IR and P = IV respectively.

Areas of weak performance

(i) The labelled diagam and explaining the operation of the loudspeaker.

(ii) Section (c) part (i) writing $R_{TOT} = \frac{1}{R_1} + \frac{1}{R_2}$ instead of $\frac{1}{R_{TOT}} = \frac{1}{R_1} + \frac{1}{R_2}$.

(iii) Section (b) part (iii). Candidates did not realise that it was 15% of the energy needed.

General comments and recommendations

(a) Just over one-third of the population chose this question. Teachers have to spend more time on electromagnetism on the whole. It is a tough sub-section with instruments as the d.c. motor, magnetic relay, loud speaker, ac generator and the transformer. Teachers should allocate a significant time-frame to cover this section especially.

(b) Syllabus objectives assessed: E 7.10, E 3.3, E 4.7, E 4.15.

Paper 04 – School-Based Assessment (SBA)

This year random sampling was applied and centres provided five books instead of each teacher providing five books. Schools are reminded to plan for common SBA assessments from early in the school year. Teachers can engage students in other practical activities but not for SBA marks. Adequate exposure to the four skills is important before students are marked. Most centres had an acceptable performance in SBA.

Note the following:

1. Ten or more topics should be covered over the two years.

2. Each skill is to be tested at least 4 times (16 labs minimum).

3. More than 5 laboratory activities with graphs should be completed.

4. All criteria should be to a 1 mark breakdown.

5. Clear instructions and mark scheme are required for each SBA marked activity.

6. References: CXC Physics Module -1 School Based Assessment in Physics; CXC Physics Syllabus - pp 62-71.