

CARIBBEAN EXAMINATIONS COUNCIL

**REPORT ON CANDIDATES' WORK IN THE
CARIBBEAN ADVANCED PROFICIENCY EXAMINATION**

MAY/JUNE 2009

PHYSICS

PHYSICS**CARIBBEAN ADVANCED PROFICIENCY EXAMINATION****MAY/JUNE 2009****GENERAL COMMENTS**

The number of candidates for CAPE Physics in 2009 increased for Unit 1 from 2527 to 2970 and decreased for Unit 2 from 1855 to 1783.

Some areas of poor performance were:

- Newton's laws of motion and their application
- Simple Harmonic Motion
- The explanation of the First Law of Thermodynamics

DETAILED COMMENTS**UNIT 1****Paper 01****Module 1**

Candidates found difficulty with:

- Question 6 – which tested the equations of motion and their application
- Question 12 – which tested satellites in orbit

Module 2

Candidates found difficulty with:

- Question 20 – which tested the representation and interpretation of transverse wave motion on a graph.
- Question 23 – which tested the representation and interpretation of standing wave motion in a graph.

Module 3

Candidates found difficulty with:

- Question 36 – which tested the movement of heat through an insulated composite metal rod.
- Question 37 – which tested the application of Stefan's Law in heat radiation with respect to a large blackened metal cube.
- Question 41 – which tested the application of the first law of thermodynamics to an isothermal process.

- Question 43 – which tested the molecular model of liquids.
- Question 44 – which tested the interpretation of information from a force-extension graph.
- Question 45 – which tested the calculation of the work done from a force-extension graph .

UNIT 1

Paper 01

Question 1

This question was intended to test candidates' understanding of 'momentum' and 'impulse of a force' and to relate the two quantities by analysis of a graph. Parts (b) (i), (iii) and (c) (i) were basic and elementary, affording every candidate the opportunity to score a minimum of 6 marks. It was not unusual for candidates to write the equation required for (a) (i) using symbols other than those given, simply because they could not define 'impulse' as $F \times t$ and relate it to change in momentum. Some candidates failed to recognise that the line to be drawn in (c) (ii) could be drawn from the coordinates (0, 17.6) and (5.6, 3.9) derived from the answers to Part (b) of the question. Few candidates correctly analysed the graphs to obtain answers for Parts (c) (iv) and (v).

Question 2

Simple Harmonic Motion (S.H.M.) as it applies to the depth of water at a harbour as the tide changes was the emphasis in this question.

Part (a) merely tested if the candidates really understood what is Simple Harmonic Motion. It was disappointing to see how few candidates could state the criteria required for a system to be performing S.H.M.

In Part (b), a number of candidates misinterpreted the graph of variation of depth of water in the harbour with time, and treated it as a portrayal of a wave in the sea. It was a sketch graph, not drawn to scale. Candidates should be encouraged to use very specific language or expressions when giving word responses. Too many vague descriptions were used in describing the procedure in Part (b). This is a planning and design skill in the SBAs.

Many candidates performed poorly in Part (c) (i) and (ii). Their mathematical skills failed them. ' $\omega\tau$ ' is the angle of the function and cannot be separated into $\sin \omega$ and τ . The calculator needed to be in the **radian** mode rather than degree mode, to obtain the following answers:

c (i) 4m; c (ii) 1 hour, 5 hours; c (iii) 4 hours.

Question 3

This question focused on Specific Objective 1.5 of Module 3.

Candidates were able to apply the equation for the 'empirical scale' in Part (a). Precisely what was being asked in (b) (i) was not clear to the average student and so the question did not yield the type of responses expected by the examiner. All that was needed was a statement suggesting 'to agree with old Celsius scale'.

In Part (c) it was instructed that the P_{tr} scale should start at 0, because in Part (e) the intercept had to be read off. Candidates seemed not to appreciate the reasoning for this and proceeded to start both scales from zero. The range of data for P_t/P_{tr} was too small for a proper graph to be plotted starting P_t axis from zero. The graph plotting skills, which should be developed in the SBAs, left a lot to be desired in this question. It must be emphasised that the accurate relationship between Celsius and Kelvin is $0^\circ\text{C} = T_k - 273.15$ and **not** 273.16.

Paper 2

Question 4

Part (a) (i) of this question was done the worst. All the definitions were in general poorly stated. ‘Kinetic energy’ being the best done and ‘energy’ the worst. It was surprising that candidates who scored high marks in this question could not define energy as ‘the capacity to do work’. Even though a number of candidates could define kinetic energy, too many candidates gave vague or incorrect responses such as ‘energy in motion’, ‘moving energy’, etc. Many candidates confused gravitational potential energy with gravitational potential.

In Part (a) (ii) candidates were in general not sequential in their proof for kinetic energy and omitted steps.

For Part (b) (ii), instead of determining the velocity by equating kinetic energy to gravitational potential energy, attempts were made at using the equation. $v^2 = u^2 + 2as$. Using $v=r\omega$ to solve for ω was done by many candidates, but the weaker students attempted to use $a=r\omega^2$ and substituted $a=9.81\text{ms}^{-2}$. The centripetal force was not understood to be the resultant of the tension and the weight and therefore should not have been included in the free body diagram. In order to determine the

tension, many candidates correctly used $(T = mg + \frac{mv^2}{r})$, but some of the weaker candidates even

attempted to use $T = 2\pi \sqrt{\frac{l}{g}}$.

Question 5

This question was intended to test the use of the formula $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$ as it applies to the human eye in correcting eye defects. Most candidates had a reasonable idea of ‘accommodation’ but very few candidates could distinguish between ‘depth of focus’ – the distance or range within which images seem to be in focus and the term ‘depth of field’ which applies to a range of object distances. Some treated these terms as being synonymous. It was easy to identify the eye defect as long-sight and know that it can be corrected with the use of a convex lens, but to illustrate this with a ray diagram

proved to be difficult. The need to use the formula $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$ to solve (c) (i), (ii) and (iii) was easily recognised, but many candidates failed to apply the sign convention correctly to the appropriate object and image distances. Another downfall was not knowing that a power of 2.0 D applies to a lens of focal length 0.5 m (or 50 cm) in the S.I. system. Correct calculations gave answers: c (i) 50 cm, (c) (ii) 200 cm; c (iii) 3.5 D.

Question 6

This question tested candidates' ability to state and use some equations in Thermodynamics. There was no doubt that candidates had met equations like $\Delta\mu = Q + W$; $C_p - C_v = R$; $PV = nRT$; $Q = nC_v \Delta T$ and $W = P \Delta V$, but making an accurate statement for **each** symbol caused problems. Expressions such as 'work done **by**' and 'work done **on**' need to be clarified. Candidates lost marks carelessly: not changing the subject on an equation correctly; incorrect read-offs from the graph: these were two of the popular mistakes. Candidates at this level should show a greater appreciation for significant figures and avoid stating final answers to numerous figures when the data provided is only quoted to a few significant figures.

UNIT 2**Paper 01**

Candidates scored well on the questions on this paper.

Paper 02Question 1

The topic on I – V characteristics is well known by most, but at this level candidates are expected to be familiar with the use of the potential divider circuit used to examine I - V characteristics. They need also to understand the advantage of using the potential divider instead of putting a rheostat in series with the ammeter and the diode.

Part (c) involved some mathematics with a logarithmic equation, which proved to be a problem for some candidates. Candidates must not shy away from these mathematical techniques which are part of the Physics course. Please refer to the syllabus under "Mathematical Requirements".

Answers: $n = 1.5$; $k = 5 \times 10^{-3}$

Question 2

There were some good attempts at this question.

Parts (a) (i) and (ii), could be answered by most candidates.

In Part (a) (iii), candidates had a good theoretical knowledge for constructing the NAND gate with the NOR gates, but failed to apply it practically in the QUAD NOR gate diagram, by making the correct connections.

In Part (b) (ii), completing the truth table was easy, but a surprising number of candidates could not use the output from the table to deduce the answer for Part (b) (iii) and simply say 'the lamp will burn when A and B have different states'.

In Part (c) (iv), difficulty was again experienced in constructing the EX-OR gate using a combination of NAND gates. Perhaps greater emphasis could be placed on equivalence relationships using NAND and NOR gates.

Question 3

This question required a good understanding of the quantities in the photoelectric emission equations $hf = \Phi + \frac{1}{2}mv^2$ and $hf = \Phi + eV_s$ and the ability to use them appropriately. The majority of candidates knew that h is the symbol for Planck's constant, but there was a variety of misconceptions expressed for the other symbols, hence the difficulty in sketching the graph for Part (a) (ii) and clearly identifying the stopping potential, V_s . Again, lack of knowledge and clear understanding of the symbols in the formulae was reflected in Part (b) (iii). The gradient of the graph is $\frac{h}{e}$ and not h ; intercept of the frequency axis is the threshold frequency. The nature of the question was such that 4 marks could have been scored for plotting the graph without any sound knowledge of the topic of photoelectric emission.

Question 4

The responses to this question suggest that candidates are not spending enough time trying to comprehend well enough to be able to explain and apply concepts.

Part (a) was testing a recall of knowledge on magnetic fields and electromagnetic induction, and many were unable to express their thoughts with any degree of clarity. It was obvious that they had done

the topics, but failed to make an accurate recall of the formulae $B = \frac{\mu_0 I}{2\pi r}$, $B = \frac{\mu_0}{2r} NI$, $B = \mu_0 nI$ as listed in the syllabus.

Which formulae are to be applied and when, caused problems. Some candidates could not distinguish between n and N , hence they juggled with the numerical data given in an attempt to gain marks in Part (b). Those who knew and understood what the symbols in the equations represented easily gained marks in the calculations.

Answers (b) $12.6 \times 10^{-3} \text{ T}$; $1.58 \times 10^{-5} \text{ Wb}$; 15.1 mV .

Question 5

The objectives tested were well within the syllabus. However, it was amazing to see the number of candidates who either did not, or could not, determine the frequency of a waveform having been given its period, as in Part (c) (i). Based on the responses, candidates appeared not to be familiar enough with the specific objectives of the syllabus on operational amplifiers. Far too many candidates failed to see that the graph in Fig. 6 is a logarithmic graph and as such the actual frequency between 1 and 10, 10 and 10^2 etc. is not on a linear scale. It was disappointing to see how many candidates at this level did not convert ms to s correctly. In Part (c), although candidates recognised that 'clipping' would have occurred at 15V, the failure to apply this by the flattening of the graph for the output voltage was obvious.

Question 6

This Radioactivity question was not so well done by many candidates. The definition of 'half life' was the only thing that allowed some candidates to get a single mark. There were some candidates however who were able to score full marks and presented their responses in clear logical steps. As occurred in some of the earlier questions, the mathematics caused a problem. Correct use of SI Units and simple conversions like hours to seconds should not be a problem at this level.

Part (c) was not readily comprehended and was worth 5 marks, so that candidates scoring less than 10 marks surely lost their marks in Part (c).

Answers: (b) (i) $12.8 \times 10^{-6} \text{ s}^{-1}$; (ii) 2.51×10^{19} atoms; (iii) $3.21 \times 10^{14} \text{ Bq}$
(c) 6000 cm^3

Paper 03/2 - (Alternative to Internal Assessment)

Fourteen candidates wrote this paper which was offered for the first time this year. Candidates' responses revealed that they were not well prepared for this paper. The mean for this paper was 21.43 out of 48 and the range was 7 – 34. It is expected that as the offering of this paper becomes widely known more candidates will opt to write this paper and performance will increase.