Province of the
EASTERN CAPE
EDUCATION

ASSESSMENT AND EXAMINATIONS DIRECTORATE
Bundy Park, Private Bag 4571, King William's Town, 5600
REPUBLIC OF SOUTH AFRICA, Website: www.ecdoe.gov.za

NSC 2015 CHIEF MARKER'S REPORT

SUBJECT	PHYSICAL SCIENCES

PAPER	1

DATE OF EXAMINATION:	6 NOV 2015	DURATION:	3 HOURS

This section of the instrument is aimed at providing valuable feedback to schools, subject advisors, teachers and learners about common errors committed by candidates in the answering of questions, to assist teachers and subject advisors to identify areas that need to be given special attention in the teaching and learning of the subject in 2016.

Your responses will be based on two parts:

Section 1: General overview of Learner performance in the question paper as a whole

Section 2: Comment on candidates' performance on individual questions (Detailed explanations must be provided **per question** as follows: (You may include sub questions where necessary)

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
(b) Why the question was poorly answered?
(c) Provide suggestion for improvement in relation to teaching and learning
(d) Describe any other specific observations relating to responses of learners
(e) Any other comments useful to teachers, subject advisors, teacher development

SECTION 1: (General overview of Learner Performance in the question paper as a whole)

The Question Paper was fair.

The format of the questions was different. This also shows that candidates need to understand the work. Teachers and candidates must not only rely on working through previous papers. If they only work through previous papers without understanding the work, they will not be able to answer questions which are set in a different way, as in this paper.

Question 3.3 and Question 11.3 were challenging, even to the top candidates. It was a good idea that these questions were set and the end of a specific question and not at the start ie. 2.1 or 11.1.

The distribution of marks was good. However,
Question 2.1.3: Too many marks allocated (5 instead of 4)
Question 5.1: Too few marks allocated. (3 instead of 4)

It was brought to our attention at the marking centre that some of the formulae were not on the data sheet.

$V_{rms} = I_{rms}\ R$

$W_{ave} = V_{rms}\ I_{rms}\ \Delta t$

$W_{ave} = I_{rms}^2\ R\ \Delta t$

$W_{ave} = \frac{Vrms^2 \Delta t}{R}$

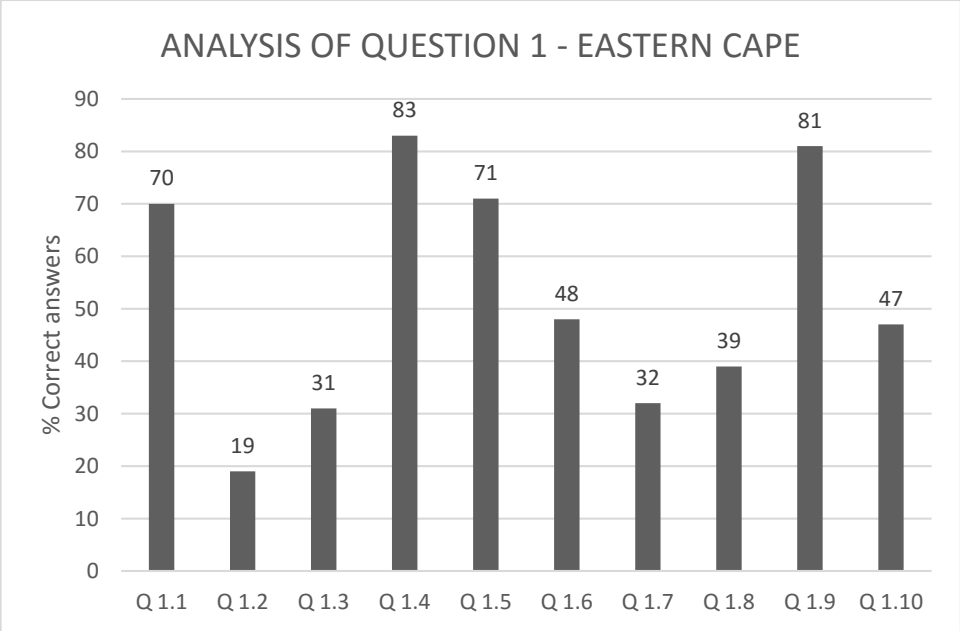
This led to slight confusion when marking. These formulae should be added to the data sheet.

When marking the force diagram in Question 5.2, the memorandum should have indicated that only one mark can be lost for extra forces on diagram and only one mark can be lost if arrows are not indicated. A similar rubric could be added as in Question 7.2.

SECTION 2: Comment on candidates' performance in individual questions

(It is expected that a comment will be provided for each question on a separate sheet).

QUESTION 1



(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

The average mark for the 100 scripts used for analysis is 52,1%.

Questions 1.1, 1.4, 1.5 and 1.9 were correctly answered by more than 70% of the candidates used in the analysis.

Questions 1.2, 1.3, 1.7 and 1.8 were correctly answered by less than 40% of the candidates used in the analysis.

The most candidates obtained 8 marks or more for this section.

(a) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Question 1.2: This type of ratio question was challenging for most of the candidates. It could also be that many of the candidates from rural areas do not understand the concept of an elevator.

Question 1.3: From responses in other questions where candidates have to take readings from given graphs (Question 11), it seems as if it is a challenge for many candidates.

Question 1.7 and Question 1.8: Finding the relationship between values when certain variables change, seems to be a challenge for candidates.

(b) Provide suggestions for improvement in relation to Teaching and Learning
Multiple Choice-type Questions should be included in as many tests as possible. The skill of eliminating possible wrong choices must be taught to the learners. All previous exam papers can be used to improve this skill. Nevertheless, the better the learners understand the content of the work, the better they will do in this section.

(d) Describe any other specific observations relating to responses of learners
No specific observations.

(e) Any other comments useful to teachers, subject advisors, teacher development etc.
Since tests that consist only of Multiple Choice question are easy to mark, these type of tests can easily be done in a class. Teachers will need to spend some time preparing these tests, but it will be to the advantage of the candidates when answering Question 1 of this paper.

QUESTION 2

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

Question 2.1.1: Candidates still struggle to get the terminology right in defining Newton's Third Law.

Questions 2.1.2 & 2.1.3: Candidates had a problem in identifying the difference between static friction and kinetic friction. (f_s and f_k).

Question 2.1.4: Many candidates (good and poor) used the system approach in answering this question. Giving 3/5 marks for this approach is unfair since university textbooks use this method. It needs to be conveyed to teachers exactly why this method cannot carry full-marks.

Question 2.2: The candidates failed to recognize that the weight of the rock is the force of attraction between the rock and the planet.

There was also a problem with the conversion of km to m. This trend of struggling with conversions was evident throughout the question paper.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Question 2.1.1: Wrong use of terminology. The candidates sometimes use the word different instead of opposite.

Question 2.1.2 & 2.1.3: Candidates have a problem in identifying all the forces acting on the different masses and which are stationary and which are moving.

Question 2.1.4: There were problems with identifying which values to use when subscripts are involved. Setting up 2 equations and then solving for the unknown value was a challenge. This is a mathematical consideration but it once again emphasizes that it is important that Mathematics needs to be taken with Physical Sciences.

Question 2.2: The problem seemed to be that candidates confuse Gravitational force and Gravitational acceleration.

(c) Provide suggestions for improvement in relation to Teaching and Learning

Teaching needs to improve on the following matters in relation to this question:

1) Correct usage of the equations of motion should be practised.
2) Conversions: km to m.
3) Stating definitions correctly.
4) Identification of all the forces acting on an object.

(d) Describe any other specific observations relating to responses of learners
The use of subscripts needs to be emphasized. The identification of the correct forces when drawing free-body diagrams.

(e) Any other comments useful to teachers, subject advisors, teacher development etc.
Teachers need to use a wide variety of different questions from various textbooks in order to help the candidates to understand the work better.

QUESTION 3

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

Question 3.1 and Question 3.2 were answered well while Question 3.3 was very poorly answered.

As a whole, the question was one of the poorly answered questions.

(c) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Question 3.1: Candidates could answer this question. Many of the candidates failed to see that they needed to double the time.

Question 3.2: Generally well answered. Many of the candidates knew that a straight line needed to be drawn. However, if they did not double the time in Question 3.1, they could not correct it in Question 3.2.

Question 3.3: This question was very challenging, even for the top candidates. This Level 4 question was a good question and presented the opportunity to test every candidate's knowledge of perpendicular motion. Setting up 2 equations with 2 unknown values, and then solving it mathematically was really difficult for the majority of the candidates.

(c) Provide suggestions for improvement in relation to Teaching and Learning

Straight forward use of equations of motion and drawing of graphs should be basic things that are taught, since these are tested in all Physical Sciences P1 Question papers.

This question, especially Question 3.3, tests the candidate's ability to think critically. The teachers need to explain to learners how to approach a problem which consists of 2 motions. The learners need to understand that the total displacement of the 2 objects in this case is 30 m. They also need to understand that the one object was in the air 1 second longer than the other one. They need to then correctly bring this into their calculations to solve the problem. Too many candidates just started writing down equations of motion without understanding what they were doing.

(d) Describe any other specific observations relating to responses of learners

In this question is was clear that many candidates were confused with regards to positive and negative direction. They did not know how to differentiate between the two. This was tested in this question and therefore many candidates struggled to answer the questions correctly.

Candidates were also confused about what values to use for v_i and v_f. Such basics should be well-taught in Grade 10 and Grade 11. It should not be a problem for Grade 12 learners to use equations of motion correctly. Plotting and drawing graphs should also be taught well since this is also tested in every paper.

(e) Any other comments useful to teachers, subject advisors, teacher development etc.
The proper use of Data Sheets is important. Teaching Equations of Motion properly in Grade 10 and Grade 11 is important.

QUESTION 4
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
This was a good question and it was expected that the candidates would have done better. The candidates were confused with the initial and final velocities of the bullet and rifle. The candidates could not recognise that the final velocity calculated in Question 4.1 was the initial velocity that was used in Question 4.2.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
Candidates struggled to recognize that the Conservation of Momentum equation had to be used and also struggled to make the correct substitutions. The candidates did not recognise the connection between momentum, equations of motion and F_{nett}.
Teachers need to explain to their learners how the sigma ($\sum$) sign works and how it can be used in this problem. The candidates tend to write $p_i = p_f$. The correct use of subscripts is essential. Conversion from g to kg was often done incorrectly.

(c) Provide suggestions for improvement in relation to Teaching and Learning
Teachers need to use a variety of textbooks and must rely less on past exam papers. Using past exam papers is a good thing, but there seems to be a tendency to rely on these papers and memorandums without proper teaching. In this Question paper, much of the format of questioning was different and therefore, if the candidate did not understand the content, he/she had a problem in answering the question. Once the content has been properly taught, the teachers can use as many past exam papers and much as they like, since PRACTISE + PRACTISE is a very good way of preparing the candidates. Correct use of the data sheet is encouraged.

(d) Describe any other specific observations relating to responses of learners
It was noted that Term 1 work was not revised properly. Candidates also struggled to do Grade 11 work since they did not revise it properly. The candidates also did not understand the relationship between the various aspects (Principle of Momentum Impulse) that were tested in this question. Teachers should adapt their teaching methods in order for the learners to understand this. It is suggested that the EC Department of Education or National Department of Basic Education present workshops on all aspects of the syllabus. This will enable teachers to teach the content of the subject better.

(e) Any other comments useful to teachers, subject advisors, teacher development etc.
There needs to be better communication between all the stake-holders in order to provide the best opportunity for every learner. Learners, Teachers, Principals, District and Provincial Officials must all be part of this effort. This effort should include all schools in the province, in order that teachers can share techniques and ideas with each other.

QUESTION 5

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

This was one of the questions that was answered well in relation to the other questions.
The use of the Work-Energy Theorem remains a challenge to most candidates. This is as a result of them not being able to identify all the forces acting on an object.

The inability of the candidates to use subscripts correctly (P_{avg}, v_{avg} and W_{nett}) was evident in this question and cost the candidates many marks.

The candidates struggled with providing the correct units in their final answers. (This was evident throughout the paper).

Seeing that the angle of inclination was not given, candidates struggled to find $F_{//}$ which they needed to use in calculating W_{nett}.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Candidates still struggle with the use of W_{nett}, W_{nc}, ΔE_k and ΔE_p. Until this is taught properly, learners will struggle with the Work-Energy Theorem and Conservation of Mechanical Energy-type questions.
Candidates do not understand the difference between the terms "change" and "rate of change". This limits their ability to do this question.
If the velocity of an object is initially 0, candidates tend to omit this value when working with the change in E_k, for example.
When drawing free-body diagrams, candidates need to know the difference between a force (F_g) and the components of a force ($F_{//}$ and $F_{\perp}$). Components can be indicated with a dotted line and an arrow.
The use of cos 0° and cos 180° in $W_{nett} = F_{nett} \Delta x \cos \theta$. Candidates do not know how to use these values and when to use 0° or 180°.

(c) Provide suggestions for improvement in relation to Teaching and Learning

Correct use of the data sheet.
Correct use of subscripts in all formula.
Drawing free-body diagrams correctly with each force having a label and arrow. It must be noted that many candidates did not use rulers to draw neat diagrams.
Learners need to round off their answers correctly.
Candidates must clearly show all the steps in their calculations.

(d) Describe any other specific observations relating to responses of learners
Teachers need to emphasize the situation where mechanical energy is conserved. They also need to point out the difference between conservative and non-conservative forces. Teachers need to emphasize the importance of forces acting on objects and the direction of each force. It is important that the learners know how to use each force and its direction to calculate the work done by that specific force. The use of cos Θ is important.

(e) Any other comments useful to teachers, subject advisors, teacher development etc.
Teachers should encourage learners to make it a habit to solve scientific problems on a daily basis, from Grade 10. The correct use of data sheets and subscripts. Teachers must be encouraged to set up their own questions for learners and other teachers in their district. By this interaction between teachers, the teaching skills of the teachers participating will improve.

QUESTION 6

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

From the Rasch-analysis made from 100 scripts, this question was answered the best. However, the different way in which it was asked made it difficult for the learners to understand how to solve it.

Questions 6.1.1, 6.1.2 and 6.1.3 were basic questions and many learners could answer them. Some struggled to state the Doppler Effect correctly and also to give the correct reason for Question 6.1.3.

Candidates struggled to use the values in the table to substitute into the Doppler equation and then find the value of the speed of sound. It was evident that many candidates lacked the mathematical skills to solve the problem once they had done the substitution.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Candidates struggled to distinguish between f_L and f_S as well as v_L and v_S. This caused them not to substitute correctly into the Doppler equation. Incorrect rounding off of the final answer also led to a loss of marks.

(c) Provide suggestions for improvement in relation to Teaching and Learning

Correct use of the data sheet.

Distinguishing correctly between f_L and f_S as well as v_L and v_S will help the candidates to do better in this problem.

Definitions, principles and laws should be taught better and learners should do revision of this aspect of the syllabus on a regular basis. If a candidate knows all his laws and principles and definitions, then he could easily obtain12 to 14 marks. This fact is very important in the teaching of the subject.

Most learners had the ability to write down the Doppler equation.

(d) Describe any other specific observations relating to responses of learners

The change in the pattern of the question from previous years, affected the learners' ability to answer the question. This proved that teachers must not only make use of past exam papers in order to teach the content of the subject.

(e) Any other comments useful to teachers, subject advisors, teacher development etc.
Teachers must emphasize the importance of subscripts. In this question, candidates who do not understand what the various subscripts mean, struggled to obtain any marks. This question (6.1.4) also proved that learners who do not have the mathematical ability, struggle to solve these type of problems. The Education Department should make a decision that learners not be allowed to do Physical Sciences without Mathematics. (Physics is the application of Mathematics)

QUESTION 7

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

The question was answered well compared to other questions. Candidates made many basic errors, which cost them many marks.

In Question 7.1: Learners incorrectly gave the answer for the number of electrons as a negative value.

In Question 7.2: The force diagram was problematic due to the fact that learners did not provide a label and arrow for each force. They also tended to draw extra forces which cost them marks.

In Question 7.4: Most of the candidates could identify the formula that they needed to use to solve the problem.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Most of the candidates did not realize that the formula used to calculate the number of electrons is on the data sheet.

Many candidates could not see the relationship between the use of a Force diagram and Electrostatics.

Candidates struggled to convert μC to C and cm to m. They also did not know how to implement the 7° angle into solving this problem. Their mathematical inability to use their calculators correctly using scientific notation is a point of concern. All these factors lead to candidates losing marks, even if they knew the content of the work.

(c) Provide suggestions for improvement in relation to Teaching and Learning

Teachers need to provide all the learners with data sheets. (In Grade 10, 11 and 12).

Even though many learners identified the correct formula to solve Question 7.4, some confused this formula with Newton's Law of Gravitation.

Since this section of the syllabus is done in Grade 11, proper revision needs to be done with the Grade 12 learners. This needs to be done before the June examinations so that the candidates can do well in this section in June and September and therefore score better marks in the final examinations.

(d) Describe any other specific observations relating to responses of learners

In Question 7.3, candidates used "mass" instead of "charge" in Coulomb's law. This indicated that they were confused between Coulomb's Law and Newton's Law of Universal Gravitation.

(e) Any other comments useful to teachers, subject advisors, teacher development etc.
Correct use of the data sheet. The inability of candidates to do the correct conversions (μC to C and cm to m), is a matter of concern. It is evident in this question that learners are not taught to 1. Use their calculators correctly (especially in scientific mode) 2. To apply trigonometric calculations in Physical Science 3. Round their answers off correctly. Definitions, principles and laws should be taught better and learners should do revision of this aspect of the syllabus on a regular basis. Drawing the free-body diagram was challenging to most learners. This needs to be taught appropriately in Mechanics.

QUESTION 8

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

The question was asked in such a way this year that it was required that the Nett electric field (E_{nett}) be calculated in Question 8.1 and the Nett force (F_{nett}) in Question 8.2. Since many previous papers asked it the other way round (F_{nett} and then E_{nett}), learners tended to try to calculate F_{nett} in Question 8.1 and E_{nett} in Question 8.2. This indicated that the teachers are placing too much emphasis on previous exam papers without the learners being taught the content.

The candidates did not realize that the answer of Question 8.3 was just double the answer they calculated in Question 8.2. Just the word "double" would have been sufficient to answer Question 8.3.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

Candidates seem to confuse the use of $F_{nett} = \frac{kQ1Q2}{r^2}$ and $E_{nett} = \frac{kQ1}{r^2}$.

They did not know when they had to use each of these formulae.

Most of the candidates struggled to determine the direction of the Nett Force on the charges (F_{nett}) and the direction of the Nett Electric Field (E_{nett}). Since the charges were different (+ and -), it was confusing to the average learner. This led to them not adding the vector quantities correctly to find the final F_{nett} and E_{nett}.

Conversion from m to cm was problematic.

It seems as if the candidates made use of the data sheets, but could not identify the correct formula that they needed to use.

Many of the candidates did not know that the unit of Electric field is $N.C^{-1}$.

The inability of the candidates to use the calculator in scientific mode was evident in this question.

Mistakes made in the rounding off of final answers remains a problem.

(c) Provide suggestions for improvement in relation to Teaching and Learning

Proper revision of Grade 11 work is necessary.

The proper use of data sheets.

Candidates need to know the direction of forces between charges and in electric fields.

Better use of calculators is required.

Knowledge of the correct units and rounding off of final answers necessary.

(d) Describe any other specific observations relating to responses of learners
In this question, very little mathematical manipulation was required in finding the answer. However, the fact that many candidates could not use their calculators properly to get to the final answer, is costing them marks. It is also a problem that learners do not know the definitions. This is something that pupils should be tested on regularly. All the definitions are provided in the Examination Guidelines and teachers should make them available to the learners.

(e) Any other comments useful to teachers, subject advisors, teacher development etc.
Doing basic things correctly in the classroom would help the learners to a great extent. Providing each learner with all the definitions, use of data sheets, knowledge of units and rounding off correctly would be to the advantage of the learners. In this specific question, revision of Grade 11 work is important.

QUESTION 9

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

This question was not answered well. Many candidates could not interpret the circuit diagram. It was obvious that not enough revision was done of Grade 10 and Grade 11 work.

Question 9.1: Candidates did not know Ohm's Law. Many candidates obtained just the mark for "if the temperature remains constant".

Question 9.2: The candidates that understood the circuit could use V = IR effectively to answer this question. Learners struggled to show how they calculate the ratio of the current in the 2 parallel resistors.

One of the problems was that some candidates tried to change the subject of the formula before attempting the question. They would start with $I = \frac{R}{V}$ and them get $\frac{0}{4}$ marks for the question.

Teachers need to advise the learners to use the correct formula (✓) as provided on the data sheet, substitute the values (✓ / ✓) and then write the answer with the correct units. (✓).

Question 9.3: Many candidates struggled to understand how Power (12 W) could be used in finding the answer. The problem seems to be that learners do not understand circuits where parallel resistors are in parallel with another resistor.

Question 9.4: There still exists a problem with candidates not being able to identify what values to use to determine V_{ext} and V_{int}.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

It is clear that not enough revision was done on Grade 10 and Grade 11 work.

A common error in this question is that learners do not always know how to use the relevant formulae correctly. The candidates also used the wrong formula to calculate the magnitude of the parallel resistance. They used $R_{//} = \frac{1}{8} + \frac{1}{16}$. They get to the correct answer, but this is mathematically wrong. This cost many candidates valuable marks.

(c) Provide suggestions for improvement in relation to Teaching and Learning

If candidates want to change the subject of the formula, they must have confidence to do it correctly. It was noted that candidates do not use sufficient subscripts (R_P, R_1 and I_1) to identify the different components.

The correct use of data sheets. (The formula to calculate $R_{//}$ must be used as it is on the data sheet). Candidates need to round off the final answer correctly.

Correct use of the calculator is important. In this question, candidates must know how to calculate fractions (and their inverse) by using the calculator.

(d) Describe any other specific observations relating to responses of learners
Learners tend to want to use a formula, whether it is related to a question or not. They then try to manipulate the data to fit into the formula they have pre-selected. They then calculate values that make no sense at all. The reason for this is unknown but it could be that the teachers are using a wrong approach to teach this section of the work.

(e) Any other comments useful to teachers, subject advisors, teacher development etc.
Learners need to improve their mathematical skills in order to answer this question. They need to have confidence in doing fractions, improve their skill in changing the subject of the formula and rounding off the final answer correctly. The learners need to know which formulae to use from the data sheet.

QUESTION 10
(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?
This question was answered very poorly. Question 10.1: These questions required observation skills which a large number of candidates did not display. Question 10.2: It was clear from the response of the candidates that they do not understand the concept of generators and ac. The use of subscripts in the formulae needed to make the calculations is very important. The candidates did not use the subscripts correctly. They struggle to differentiate between V_{max} and V_{rms}, I_{max} and I_{rms} and P_{ave} and P.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.
Most candidates do not know the difference between ac and dc. It also seems to be a problem that candidates cannot answer multi-step questions, such as those that were asked in Question 11.2.1 and Question 11.2.2. The use of the correct units for the answer is also a problem. Many of the candidates did not recognize that the unit for I_{max} is A (ampére).

(c) Provide suggestions for improvement in relation to Teaching and Learning
This section appears problematic for the teachers. It seems as if they do not use the correct methods to teach the learners the difference between ac and dc circuits. It is clear that the importance of subscripts is not emphasized. With a better understanding of this section of the work and how to use the data sheet correctly, learners would be able to obtain better marks for Electrodynamics.

(d) Describe any other specific observations relating to responses of learners
The learners were not well prepared for this section of the syllabus. The learners did not do enough revision on Electric circuits and therefore struggled with Electrodynamics.

(e) Any other comments useful to teachers, subject advisors, teacher development etc.
From the responses of the candidates in this paper, it seems as if this question of the paper is a challenge for the teachers to teach. It seems necessary that workshops be held to help the teachers have a better understanding of this section. Electricity as a whole (Questions 9 and 10) was answered poorly and thus requires attention. The teachers need to teach the learners how to use the correct formulae (ac and dc) from the data sheets.

QUESTION 11

(a) General comment on the performance of learners in the specific question. Was the question well answered or poorly answered?

This question was the worst answered question.

Question 11.1: Candidates do not how the Photo Electric Process works. They struggled to explain the process.

Question 11.2: The plotting of a graph from the values on a table was problematic for the majority of the candidates. The axes and scale were on the given graph and most candidates failed to do the basic plotting.

Question 11.3: For all the candidates who failed to get Question 11.2 right, this question became almost impossible to answer. Only 1 or 2 marks could be obtained if the candidates did not get Question 11.2 right.

(b) Why was the question poorly answered? Also provide specific examples, indicate common errors committed by learners in this question, and any misconceptions.

The drawing of the graph was challenging to most of the candidates. After plotting some points, they could not draw a line of best fit (with a ruler) and therefore lost all the marks.

The fact that $\frac{1}{\lambda}$ was used in the table, confused many candidates. This caused them not to see that it could be used to find f_o and W_o.

Many candidates, even those who obtained high marks, did not see the relationship between the gradient of the graph and Planck's constant, h.

Question 11.3 was one of the Level 4 questions in the question paper. It was asked in an unfamiliar way. Many candidates tried to use the formula $E = W_o + E_{k(max)}$ to answer the question without using the graph that they had drawn. This was not the correct approach to the question.

(c) Provide suggestions for improvement in relation to Teaching and Learning

For this question to be answered correctly, candidates needed to have a very good understanding of various aspects of Science, not only the Photo Electric Effect.

They needed to understand the process of the Photo Electric Effect, know how to draw a graph, make correct and accurate readings off the graph and then use certain aspects of the given formula to get to the final answer. Many different skills were tested.

In order to answer Question 11.3.2, the candidates could have used 2 methods to answer the question. They could have determined the gradient of the graph or extrapolated the straight line in order to calculate h. Most of the candidates did not recognize any of these 2 methods.

Learners do not fully understand the terms used when working with the Photo Electric Effect. Terms such as Work Function (W_o) and Threshold frequency (f_o) are terms that need to be explained. If learners do not understand all the terms, they will not understand the process.

(d) Describe any other specific observations relating to responses of learners
In this question, it became obvious from the candidates' responses that they also struggled to use their calculators efficiently. The use of scientific mode on the calculator remains a challenge for many learners. This skill should be taught in Grade 10 and should not be a challenge for Grade 12 learners. The drawing of graphs from data given (as in the table) should be done on a regular basis. It was also evident in this question that candidates with limited mathematical knowledge struggled to solve the problems. This question proved that it is important that Physical Sciences learners need to also take Mathematics.

(e) Any other comments useful to teachers, subject advisors, teacher development etc.
Teachers need to use different sources to find various types of ways of asking questions from this section of work. Different textbooks are good sources to use. After the content has been thoroughly taught, teachers should then use previous question papers. This question also goes to prove that teachers need to try and create their own Level 4-type questions and share it at Cluster Level with other Science Colleagues.

NAME OF THE CHIEF MARKER: **SIGNATURE** **DATE**