UNIVERSITY OF MALTA

SECONDARY EDUCATION CERTIFICATE
SEC

PHYSICS

May 2014

EXAMINERS' REPORT

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

SEC EXAMINERS' REPORT MAY 2014

SEC Physics
May 2014 Session
Examiners' Report

Section 1: Statistical Information

The total number of candidates that registered for the Sec Physics examination in May 2014 was 3748, with 2166 sitting for a Paper I + IIA and 1582 candidates sat for Paper I + IIB. The number of candidates sitting for SEC Physics was approximately the same for 2013. However there was an increase in candidates sitting for the higher level paper.

Table 1: ***Distribution of candidates' grades for SEC Physics May 2014***

GRADE	1	2	3	4	5	6	7	U	ABS	TOTAL
PAPER A	197	362	422	690	271			217	7	2166
PAPER B				164	269	422	215	467	45	1582
TOTAL	197	362	422	854	540	422	215	684	52	3748
% OF TOTAL	5.26	9.66	11.26	22.79	14.41	11.26	5.74	18.25	1.39	100

Section 2: Comments regarding candidates' performance

2.1 General Comments

This SEC Physics Examination report provides information on the performance of candidates. It is hoped that it will not only be useful to teachers in their teaching but also in the preparation of candidates for future examinations. It is intended to be constructive and informative and to promote better understanding of the specification content, of the operation of the scheme of assessment and of the application of assessment criteria.

The Physics syllabus aims to introduce the subject not just through content but more through higher cognitive skills such as comprehension and application. This was reflected as much as possible in the examination paper, where, although there was still an element of knowledge and recall questions, candidates were also face problem solving questions. The majority of the candidates were prepared well for the complexities and demands of the examination papers. It was clear that many candidates continue to make good use of past papers and other available resources. The quality of written answers to individual questions was variable, especially when taking into account candidates who sat for option A or option B individually. Many candidates could have gained more marks by stating definitions correctly and carefully examining the questions. Some candidates were incorrectly using technical terms. Candidates
would have also benefitted from planning their written answers and showing greater reasoning in the answers. In questions were the candidate had to explain or describe a procedure it is once again recommended that using bullet points, rather than a paragraph, can be more effective when communicating complex physical ideas as at times extended writing presented some candidates with a real challenge.

2.2 Paper 1

Table 2: ***Analysis of raw scores in Paper 1 questions by paper choice***

Question		***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	***Total***
Paper (IIA)	***Mean***	6.2	5.8	4.9	6.9	7.4	4.6	8.1	5.4	7.4	7.9	64.6
	S.D.	2.0	2.3	2.9	2.2	1.8	2.2	2.3	2.2	2.5	1.9	16.4
	Facility Index	0.6	0.6	0.5	0.7	0.7	0.5	0.8	0.5	0.7	0.8	0.79
	Discrimination Index	0.7	0.8	0.8	0.8	0.6	0.7	0.7	0.8	0.8	0.7	
Paper (IIB)	***Mean***	3.9	2.3	1.2	3.4	4.4	1.7	3.9	2.3	2.6	4.3	30.3
	S.D.	1.8	1.8	1.8	2.4	2.2	1.5	2.8	1.8	2.3	2.6	14.8
	Facility Index	0.4	0.2	0.1	0.3	0.4	0.2	0.4	0.2	0.3	0.4	0.3
	Discrimination Index	0.5	0.7	0.7	0.7	0.7	0.6	0.8	0.7	0.8	0.7	

The mean is the "average" candidate score to a question. It is computed by adding up the number of marks earned by all candidates, and dividing that total by the number of candidates. The standard deviation, or S.D., is a measure of the dispersion of candidate scores. That is, it indicates how "spread out" the scores were. The Facility Index is a measure of how easy or difficult is a question. Item discrimination refers to the ability of an item to differentiate among candidates. The closer the value is to 1, the better the discrimination.

Question 1

In question number 1, candidates did not perform as proficiently as one would have expected. Candidates mainly failed in part 1a(iii) as many had difficulty in explaining why Martin was in winter time. Most candidates answered shortly 'because the earth is tilted' showing a lack of true understanding of what this entails. Unexpectedly, there was a weak response in part c(i), where a high percentage of the cohort answered wrongly "Earth, Sun, Milky Way and Solar System' – This means that these candidates do not have a clear idea of distances and sizes in outer space. In question d, candidates had to write one economic benefit of space exploration, however many of them gave answers which were more or less science fiction, mostly inspired by films.

Question 2

A substantial number of candidates in part (a) used the equation F = 1/T to find the frequency where T was taken to be 60s.Likewise candidates used the velocity of the fly (6.5m/s) instead of the velocity of sound when calculating the wavelength. In part (c) some candidates used one of the equations of motion to find the time, namely s=(u+v/2)t. This was a wrong choice. In the last part of the question candidates fared quite well since most candidates knew that sound travels in air by vibrations, in longitudinal waves and by compressions and rarefactions and also reasoned well that streets would not be noisier since the sound produced is of a frequency above the audible range. Some even

mentioned that the sound produced is ultrasound. A number of candidates associated a louder sound with a change in frequency and not with a bigger amplitude.

Question 3

This question resulted to be the most difficult to answer although most candidates got the first part correct; however, a few confused the term neutrons with nuclei and nucleons. The candidates' grasp of this topic seems not to be a solid one. Many deduced that since neutrons are the most populous particles in an atom of U-238, then, the atom is neutral. A considerable number also failed to identify that the number of positive charges equals that of the negative charges in a neutral atom. In the second part of the question, some got confused with the *Count Rate* at *Day 3* as it was not a round number, 3000. The 5 in 3005 was not understood to be due to measurement (instrument) tolerance. In the last section candidates showed a lack of understanding of how to calculate *half-life*

Question 4

Many candidates were not able to give the full definition of pressure. In several cases, candidates defined pressure as a 'force on an area' and not on a unit area. On the other hand most candidates gave the correct unit for pressure. Candidates showed understanding of the fact that pressure is transmitted within the hydraulic system but very few of them mentioned that the force F_2 is larger than force F_1 because area A_2 is larger than A_1. In the rest of the question many candidates gave the correct solutions and units. A point to note is that the candidates who answered the first part of the question could elicit the correct reasoning.

Question 5

Most candidates successfully attempted part (a) of this question, even though there were some candidates who did not change kJ to J, in which case they were awarded one mark only. Most candidates managed to plot a graph which covered a large area of the graph paper; used a correct scale and marked correct points; they also labelled the graph and gave the correct title. It is suggested that candidates do not use a dot (.) to mark points of the graph as these would be covered once the line is drawn. Candidates are advised to use a sharpened pencil and make sure that the points are clearly marked. In part b) ii) many stated that Jeremy's suggestion is correct since the graph is a straight line but most of these candidates failed to mention that the straight line passes from the origin. There were a number of candidates who got confused since even though they managed to plot the graph with a best straight line, they then explained that the two variables are not directly proportional since the graph is not a 'perfect' straight line.

Question 6

Many candidates were not able to explain and answer the questions in full using scientific terminology. This showed poor scientific literacy. Candidates were able to draw the correct arrows of the diagram in the first part of the question. Very few candidates showed understanding of Kinetic Theory since the candidates' explanation did not include an increase in the molecule motion which in turn results in an increase in volume and hence a drop in air density which makes hot air rises to be replaced by cold air. Candidates tried to explain convection without mentioning the convection currents. Many candidates understand that the water particles which evaporate from the body reduce body temperature but very few realize that it is because they cause the body to loose energy. Many candidates demonstrated confusion between the properties of sun light and radiant heat from the Sun. They explained that the features mentioned blocks the Sun's light.

Question 7

Most of the pupils performed really well in question number 7. Indeed, throughout one could notice that overall candidates show greater dexterity at working calculations rather than expressing themselves in qualitative questions. Marks were mainly lost in part b (ii) where a small part of the cohort tried to work out the total resistance by adding 80 Ω to 60 Ω and using the answer (140 Ω) in the formula for parallel circuits with the 100 Ω or even with (80 Ω + 100 Ω); showing a lack of understanding of part series and part parallel circuits.

Question 8

Most candidates did not draw the forces in the correct direction, implying that *Fleming's Left-Hand Rule* and its application is not comprehended. In the rest of the question overall many candidates did quite well although some failed to mention the cutting of flux lines in a(ii) or candidates copied the primary turns incorrectly. That is, instead of *4000*, a number put *400* in the equation in b(i). Few candidates answered correctly part b(ii) showing that there is a lack of understanding of electricity principles related to this question

Question 9

Overall candidates did well in this question although either through carelessness or for another reason the answer lacked attention to detail. Candidates drew the correct symbol for a battery but connecting the poles with a wire in a short circuit. In such cases no marks were awarded. Candidates drawing just one cell, a number of cells or one cell with wires attached on either end were not penalised if they gave the right polarities .Once again conversions are still a big headache to candidates. Most candidates did not know how to convert time to seconds. Unfortunately marks were lost because of this reason. In the last parts of the question candidates who were incorrect in the previous calculation were not penalized when using their answer in this question. A number of candidates used the equation P = E/t but did not work out P as VIt.

Question 10

The drawing in part (a) was done well, although some of the weaker candidates lost marks as they did not draw the correct flux directions and there were also a few candidates who drew magnetic field lines which crossed each other. In part (b) the direction of the current and magnetic polarity were generally well answered. Many also scored well in part (c) of this question, however there were a number of candidates who produced confused responses. It seems these weaker candidates did not grasp the aim of this particular experiment, in that they gave answers which were not directly related to this experiment, like for example in part (i) they mentioned that the ammeter is seen to give a reading and did not comment about the iron nails which move upwards towards the iron core. In part (ii) some candidates were completely off track as they mentioned that the current in the wire will increase since the number of turns of the wire is increase, here one can note that these particular candidates were confusing this experiment with another experiment about induced current. This shows that some candidates do not read the question well and just give out answers without really thinking.

2.3 Paper II

Table 3: ***Analysis of raw scores for Paper IIA and Paper IIB questions***

Question		***1***	***2***	***3***	***4***	***5***	***Total***
Paper (IIA)	***Mean***	8.3	10.5	12.0	11.6	9.5	51.9
	S.D.	4.6	4.4	4.2	5.0	4.1	18.3
	Facility Index	0.9	1.5	0.8	0.8	0.9	0.9
	Discrimination Index	0.8	0.8	0.8	0.8	0.8	
Paper (IIB)	***Mean***	6.5	5.6	7.3	7.5	2.2	30.1
	S.D.	3.1	3.6	4.1	4.5	2.4	14.0
	Facility Index	0.3	0.3	0.4	0.4	0.1	0.3
	Discrimination Index	0.8	0.8	0.8	0.9	0.8	

Paper IIA

Question 1

Unfortunately this resulted in being the most difficult question of the paper. It is evident that most candidates confuse the various components (LDR, LED, diode, etc).Candidates who drew an incorrect symbol in (b) continued using the wrong symbol for an LED throughout the problem. Obviously candidates were penalised for this error only once. Candidates seem not to read or understand the question properly. Some candidates included a variable resistor, a switch and a bulb showing that they did not understand what was asked, but were simply drawing a circuit they remembered from class. Few candidates included the torch in the circuit. Often candidates think that the answer to the question is quite complex such as when they suggest an addition to the circuit in part d(iii) failing to realize that the solution was simpler than they thought. Again, candidates failing to understand how the LDR works could not relate resistance/current to light intensity. Most candidates mentioned the relationship between resistance and current without mentioning light. The way the question was set meant that candidates giving ohm's law are awarded both marks even if the question was intended to give the relationship between resistance/current and light intensity. Few candidates managed to assimilate how the LDR can be used since may still remarked that the circuit should still be switched on and off manually during the day or night. Candidates did fairly well in the last part of this question with quite a good number of candidates correctly stating that a typical use of the LDR is to adjust the brightness of mobile phones displays although some candidates mentioned the alarm clock as using an LDR. It is highly probable that candidates were confusing the LDR with LED showing the time in electronic clock displays.

Question 2

Main problems encountered were in the first part of the question (a)(i) where the candidates assumed that they had to time the duration from when the car was released up until it stopped moving. A number of candidates also mentioned factors such as thinking and braking reaction that would affect the time and distance of a car going down a slope. In part (a) (ii) the majority of the candidates consistently pointed out that the mass and the type of slope used must be kept constant. Also common was the fact that the car is let go freely without an initial push down the slope. Although the majority of candidate showed that they are aware that varying the slope's inclination and measuring the final distance are the variants in such an investigation, in part a(iii) however a good number of candidates thought that the slope had to be changed every time in order to vary the inclination. This goes against what was originally stated in part (a) (ii). For part (a) (iv) most conclusions given were correct and candidates show that they understand that once the height is varied there is a direct relationship as to the stopping distance – in fact most candidates stated that height is directly proportional to distance that the car travels. In the last part (a) (v) candidates repeat that the slope must be frictionless, that the mass of the car has to remain constant and a good number state that repeated readings are needed as to minimise experimental errors. In the second part of the question namely part (b) (i) almost all candidates give the correct explanation required by quoting Newton's 1^{st} Law of Motion and relate it to the concept of inertia. It was also evident that the candidates understand that in the absence of a resultant force the body would remain at rest or keep on moving in a straight line. A limited amount of candidates however mistakenly quote Newton's 3^{rd} Law of Motion stating that to every action there is an equal but opposite reaction. Ample confusion was witnessed in part (b) (ii) where the candidates although aware of the change in momentum formula fail to use correct substitutions for velocity change and therefore use +14 instead of -14 ms^{-1} when calculating the momentum change. In part (b) (iii) candidates give correct answers as the impact force experienced however once again fail to understand the importance of the –ve sigh when giving the final answer. In the last part of the question (b) (iv) again the majority of candidates give correct explanations relating to the impact force being inversely proportional to the time and give detailed explanations of how the seat belt helps increase the time of collision and therefore lessons the force experienced.

Question 3

In this question about lenses and geometrical optics, candidates in general performed rather well in all parts and sections. Candidates did very well in the first part of the question. In part (b), as expected candidates did very well in sections (i), (ii) and (iii) but not so well when they were required to name a practical use of the setup. Quite a good number of candidates found no difficulties in drawing the ray diagram required in part (b)(v) and no difficulties either in stating the differences in the image properties of the two setups. In part (c) of the question, many candidates identified the proper relationship between the image distance and object distance but performed rather badly in section (ii). Very few candidates managed to think through the process of identifying the point where the image distance is equal to the object distance and then calculate the focal length by dividing one of the distances by two. Candidates did very well in part (c) (iii), many stating that the image that will be produce will be a virtual image and therefore making it impossible to measure the image distance.

Question 4

Overall the performance of the candidates in this question was quite average. Candidates did quite well in the first part of the question which was mainly recall. In fact a good number of candidates drew a diagram and gave a good account showing how to find the specific heat capacity of a block.
Although a substantial amount of candidates mentioned heat losses as a source of error but failed to understand that this will lead to a higher specific heat capacity.
Some candidates got confused of which metal will have the higher temperature as they failed to relate the temperature rise does not only depend on the amount of heat given to an object but also to the specific heat capacity of the object.

Question 5

Overall candidates scored fairly low marks in this question. The main problems being that candidates experienced difficulty in explaining with the aid of diagrams how the shifting of the centre of gravity affects the overall balance of the pile of books. Majority of answers simply stated that weight overall changes and the books topple over. Good diagrams were given part b(i) however a small minority do not include the distances from the pivot to the forces on each side. In part (b) (ii)once again it is evident that candidates lack qualitative skills when describing investigations carried out. Very few candidates score high marks in this part as most fail to answer the question relating to how an unknown mass can be found. The majority of candidates state that anticlockwise moments are equal to clockwise moments and stop there. They also understand that to find the moment they have to use force multiplied by distance from pivot however when this is given they do not elaborate further as to how from the force the mass can be found. It seems as if candidates just reproduce theoretical facts irrespective of what the question entails. In (c) almost all candidates failed to answer correctly this part showing that they are not aware of the forces acting in the give situation. This is again witnessed in part (c) (ii) where the candidates have showed very little knowledge as to how calculate moments although they correctly state the principle of moments. It also follows that for part (c) (iii) the candidates again have little notion of the fact that when an object is in equilibrium moments as well as forces must balance and so the majority of answers given were incorrect. Most candidates stated that the reaction force at A and the force exerted by the spring are not the same however do not give clear explanations to support their answer. On the other hand for parts (c) (iii) and (c) (iv) candidates are well aware of Hooke's law and give correct answers for the fact that the spring extends when subjected to a force (some candidates seems to think that it is compressed and are also aware that if the force exceeds the elastic limit the spring would become permanently deformed or snap.

Paper IIB

Question 1

Most candidates did not know what LDR stands for in part (a). Its symbol was also not very familiar and was therefore not recognised in the given circuit for part (b)(i). It seemed that most candidates never used an LDR in practice as the position T for the torch was found to be challenging. Most candidates answered part b(iii) and (v) well however.
There were again difficulties to identify a minimum value of current on the ammeter when the torch is on the lowest level of brightness in part (b)(vi) - due to the LDR's high resistance. Again this suggested not seeing an LDR work in the lab. In part b(vii) few candidates realised the need to omit the ammeter or place bird scaring device in series.
For part (c) (i) candidates had the impression that daylight saving time was the reason why the given setting was not suitable for the whole year rather than the amount of sunshine daily. In (c)(ii) exposure to sunlight and switching on and off manually was not realised by most candidates. However, the use of the LDR in practice was often given correctly.

Question 2

Overall, candidates sitting for Paper IIB did not do very well in this question. In general, many candidates did not take into account that the question was about a toy car and not a real one. In fact, many candidates gave the answer for part (a i) as "thinking distance + braking distance" when it should have been the "horizontal distance a car takes to stop". Many candidates gave "stopwatch" as the answer for (a ii) instead of mentioning an instrument which measures length. In part a(vii), many candidates wrote "read measurements well" / "read carefully" as precautions. These are definitely incorrect. Candidates should be taught that precautions are those measures which are taken to

ensure a more valid and reliable experiment. It should be obvious that measurements are taken carefully! A good number of candidates did mention Inertia in the explanation for the answer to part b(i), while many candidates said that the dummy gets injured when the car collides. The importance of writing the correct units (momentum, acceleration) should be emphasised. Overall, in this question, the candidates showed a lack of experimental practice. Practicals are important for candidates to assimilate the theory behind the principles taught during the lessons.

Question 3

Candidates did quite well in this question especially for parts (a) and (c). In part (b) the position of the F was generally more demanding compared to C. Characteristics of the given image IB were identified well in part (b)(iii). However, better accuracy was expected for determining the magnification of IB. Most candidates used the equation with the horizontal distance in front or behind the lens. The use of such an image in a projector was answered correctly by most candidates. Most difficulties were noted in drawing the image I1B1 in part (b)(vi) and to compare the two images together in part (b)(vii).

Question 4

This question was about density and specific heat capacity. The first part tested the candidates' knowledge of density. Unfortunately candidates found it difficult to put the liquids in the right order. The same can be noted for the rest of the question. Candidates found difficulty to find solutions to the question. It seems that candidates could not recall what was done at school during the examinations. Most candidates presented a practical report on the same topic of the question. Some candidates got confused in calculations whilst others wrote incorrect units.

Question 5

This question proved to be rather difficult for the majority of the candidates. In what regards part (a) the candidates did not give the right definition of centre of gravity. Some of them discussed stability / instability instead of giving the right definition. In part (b) many candidates did not understand that they had to use the diagram to help them explain why the books will topple. In general, many candidates did fairly well in part (c), indicating that this experiment is done is schools. In part d(i) very few candidates managed to find all the forces and draw them correctly. The poor performance in parts d(ii) and (iv) showed that very few candidates mastered the concept that for equilibrium the upward forces should balance the downward forces and the clockwise moments should be equal to the anticlockwise moments. A number of candidates either gave the wrong unit for moments or did not give a unit at all.

2.4 Comments regarding school-based Practical Coursework

The number of candidates applying as private candidates reduced considerably this year. Each private candidate was interviewed about his/her laboratory work. Most candidates presented a vast range of practical reports and of a decent standard. It should be stressed here that candidates resitting the examination do not need to resubmit the coursework but inform MATSEC to transfer the mark obtained in the previous session. Candidates will need to resubmit only if they improved or added additional information to their coursework. Following communication from the MATSEC Support Unit a number of school candidates had their practical work moderated. Approximately 20% of the schools were moderated. The following notes should be noted.

- Most schools have improved the level of work presented and moderators commented that in general the work was of an acceptable level
- In some schools graphs lack gradient calculations.
- As in previous years it must be stressed once again that a teacher demonstration can never replace the candidates actually performing an experiment. It was clear that in a handful of school investigations especially are being dictated. This is not commendable.
- Unfortunately it must be noted out the some schools did not present any investigations. Although this is an option in the syllabus it is highly recommended that candidates investigate a particular area of the syllabus.

Chairperson
2014 Examination Panel