UNIVERSITY OF MALTA

SECONDARY EDUCATION CERTIFICATE
SEC

PHYSICS

May 2012

EXAMINERS' REPORT

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

SEC Physics
May 2012 Session
Examiners' Report

Section 1: Statistical Information

The total entry for 2012 was 3911, with 2246 sitting for a Paper (I + IIA) and 1665 candidates sat for Paper I + IIB. The number of candidates sitting for SEC Physics decreased by 3.3% from 2011. However this decrease is mainly due to Paper IIB candidates since the amount of candidates sitting for a Paper IIA practically remained unvaried. Paper IIB candidates decreased by 123 registrations.

Table 1: ***Distribution of candidates' grades for SEC Physics May 2012***

GRADE	1	2	3	4	5	6	7	U	ABS	TOTAL
PAPER A	191	374	439	716	300			220	6	2246
PAPER B				175	375	450	191	417	57	1665
TOTAL	191	374	439	891	675	450	191	637	63	3911
% OF TOTAL	4.88	9.56	11.22	22.78	17.26	11.51	4.88	16.29	1.61	100

Section 2: Comments regarding candidates' performance

2.1 General Comments

This SEC Physics Examination report provides information on the performance of candidates in the respective year. 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.

Question style followed that was being used in previous years with accordance to the criteria set in the new 2012 syllabus. Thus questions dealt with testing the application skills, practical situations whilst others had historical/STS setting. There was also a fair share of recall and knowledge questions.

It is clear that most candidates are being prepared well for this style of paper, with most candidates now familiar with the different styles of question. On the other hand candidates need to give precise answers using correct scientific terminology. The amount of space left for a candidate to write his/her an answer should give a clear indication of the depth and amount of answer expected. Candidates should learn how to use just the given space and how to be selective and concise in their answers.

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***	6.91	8.44	7.16	7.07	5.05	5.60	6.87	5.27	5.2	6.09	63.3
	S.D.	2.29	1.99	2.08	1.92	2.1	2.18	2.05	2.32	2.36	2.31	16.3
	Facility Index	0.69	0.84	0.72	0.71	0.5	0.56	0.69	0.53	0.52	0.61	0.63
	Discrimination Index	0.77	0.66	0.73	0.70	0.61	0.77	0.69	0.73	0.77	0.72	
Paper (IIB)	***Mean***	3.63	4.93	4.23	4.5	3.1	2.97	3.81	2.61	2.13	3.67	33.0
	S.D.	2.36	2.81	2.18	2.33	2.0	2.03	2.29	1.85	1.82	2.32	18.2
	Facility Index	0.36	0.49	0.42	0.45	0.31	0.3	0.38	0.26	0.21	0.37	0.33
	Discrimination Index	0.78	0.81	0.73	0.73	0.65	0.76	0.74	0.67	0.74	0.73	

Question 1

The improper terminology with respect to the forces and their incorrect positioning on the diagram was symptomatic of most replies. Many students opted to give a direct answer rather than quoting the equation and showing the workings. This method of giving answers is not advisable. Some students gave incorrect units and in some cases no units at all, losing most all of the marks. The inverse relationship between force and distance from pivot was incorrectly stated in a good number of scripts.

Question 2

In determining the area to establish the distance covered, units were quoted in $\mathbf{m^2}$ rather than **m**. As in question 1, a good number of candidates tend to give a direct answer rather than quoting the equation and workings. In the determination of the gradient, some candidates inverted the axes resulting in the reciprocal of the gradient being determined. Furthermore in a number of cases, the result did not have the correct units or no units at all. The replies related to the steps a person would take prior to stopping i.e. thinking and braking, a good number of students got the replies correct. However when coming up with reasons that could

influence stopping distance some students went to great lengths to reply to this question, completely forgetting that only two marks was allocated to this reply.

Question 3

A number of candidates did not understand the meaning of *denser* since they did not grasp the concept of the question. Although at times detailed accounts were given, few candidates stated that internal energy is directly proportional to temperature. As stated previously candidates should learn how to be concise in their answers by writing only the relevant information. Candidates showed that they were quite confident with the mathematical part of this question; however, conversion from **g** to **kg** was beyond the grasp of most of the candidates. The last part of the question allowed to students to use their imagination and give a variety of answers. Most students did in fact mange to come up with correct answers.

Question 4

Again this question shows that candidates are not taking their time to read the question properly. Certain mistakes could have been easily avoided if the required attention was given before answering the question. Although the first part of the question dealt with electrical conductors a good number of candidates answer the first question in terms of thermal conductivity. Most candidates showed good knowledge of circuits when they drew a correct labelled circuit diagram. Some candidates did not give an example of a solid in part (c) of the question. The last part of the question was answered well by the majority of the candidates.

Question 5

Candidates did not do very well in this question. Although many of them did manage to draw a well sized graph with the correct labelled axis, very few candidates plotted the graph with an intercept. This could have been due to the fact that the intercept was very small – 0.2 N – and therefore the candidates passed the straight line through the origin. This was taken into consideration whilst marking. Other common mistakes included changing the x-axis and y-axis and using the values given in the table as a scale on the axes. A good number of candidates got (b) correct although some tried to get the answer analytically rather than from the graph. However many candidates did not give any units or gave the wrong units for the gradient in part (c). The lack of intercept mentioned above lead the candidates to get part (d) wrong giving the value of F as 0 N. Many candidates found difficulty in working part (e) with many of them dividing by two the value given in (d), instead of multiplying it by two and then converting it to kg.

Question 6

Not many candidates scored high marks on this question. Many candidates answered part a(i) correctly but a good number worked out the resultant force of the forward and backward forces in the diagrams without answering what was required. In part a(ii) most candidates were not able to list two forces that oppose the direction of motion. Furthermore, most candidates answered part b(i) correctly but some of them failed to quote the correct units for momentum. Quite a few candidates stated the units of momentum as **kg/m/s**. Finally, a good portion of candidates wrongly answered the last part of the question even if some of them changed the time value to 120 s.

Question 7

The majority of candidates did well in question 7. The crest, through and amplitude were marked correctly in many cases in part a(i) and (ii). There were a number of mistakes when calculating the frequency of the wave as candidates used 6 seconds rather than 4 which is the time to complete one wave. Very few candidates answered part a(iv) correctly. Some stated that energy decreases with distance rather than it is transformed into other forms of energy. Diagrams drawn in part b were correct and some were partially correct as the candidates drew the correct wave pattern but did not pay attention to drawing the correct wavelengths.

Question 8

An average performance was noted in question 8. Very few candidates could give a correct definition of the term ionisation in part a. It seems that candidates find application questions more challenging since poor answers were given in part b when explaining why gamma radiation is not used in smoke detectors due to its low ionizing ability. Many stated that alpha radiation should have a long half-life in part c although not all could give a correct reason for this choice. Again in part d although candidates stated that smoke detectors are not dangerous to human begins if attached to the ceiling; very few could explain that this is due to their low range in air. A significant number of candidates chose the correct isotope in part c(i) worked out the correct number of protons and neutrons in part c(ii).

Question 9

In general, many candidates fared badly in this question. In question c(i), very few pupils wrote the correct answer that the "*Force is directly proportional to the rate of change in momentum"*. Most of them answered in short F= ma; whilst some others answered that Force is proportional to the acceleration only; without mentioning that mass is kept constant or the part which underlines that mass and acceleration are indirectly proportional when Force is kept constant. In part b(i), many candidates wrote their answer as 0 without any units. This mistake was penalized as it shows lack of attention to units. In part b(ii), very few pupils were able to convert **km/hr** to **m/s**, even though it was clearly stated that candidates should give the answer of momentum in kg m/s. In part c(i), a common mistake was to use the mass

of 84 kg instead of 70 kg. This again might show that pupils fail to read carefully the questions asked.

Question 10

In question 10a, many candidates did not give detailed answers to identify the poles of the Lodestone. A generous number of candidates answered '*get a magnet*' or '*get a compass'*. Even more, those who used the compass method failed to highlight whether the compass was placed close to the stone, under the influence of its magnetic field, in which case the compass arrow would point to the magnetic South of the stone; or by placing the compass away and hanging the lodestone under the influence of the Earth's magnetic field and thus, the top of the stone which points to the geographic North Pole of the Earth would be the magnetic North of the stone. In part b(iii), few pupils were able to obtain the full marks as most did not mention the alignment of the magnetic dipoles. In part c, most pupils drew the magnetic field pattern and the direction correctly. However, one must mention that little attention was given not to cross the lines of force. This mistake was not penalized nevertheless; it is worth mentioning that more emphasis should be given to this detail.

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***	10.23	12.64	12.14	11.19	9.92	55.85
	S.D.	4.43	4.70	4.28	3.81	4.14	18.24
	Facility Index	0.51	0.63	0.61	0.56	0.50	0.56
	Discrimination Index	0.86	0.84	0.84	0.81	0.84	
Paper (IIB)	***Mean***	7.17	9.03	8.37	7.19	5.72	34.26
	S.D.	4.54	4.29	4.36	3.91	3.83	19.81
	Facility Index	0.36	0.45	0.42	0.36	0.29	0.34
	Discrimination Index	0.87	0.84	0.85	0.81	0.82	

2.3.1 **Paper IIA**

Question 1

Most candidates were able to answer the first part of the question without too many problems. Surprisingly, in part (i) very few students managed to draw a suitable circuit. Even though a good number mentioned connecting Ammeters (in series) and Voltmeters (in parallel), many still had difficulty to include them in their correct position in the circuit. The calculation in part (ii) was generally fine as well as the table requested in part (iv)., although many used the equation $P= I^2R$. Many got an answer of 7.2 W. Others did not work the voltage across the 10 Ω resistor but used the 12 V in the equation P=VI. Many had difficulty to give a correct description of the experiment in part (iii), very often describing the setup rather than the method used. Same can be said for the precautions in part (v) in which a lot of students mentioned reading the thermometer correctly, or connecting the circuit correctly but rarely coming up with more important ones such as stirring water to ensure a uniform temperature.

Question 2

Most students managed to draw the diagram correctly, although many did not make use of dotted lines and quite a number did not draw the image, but at least concluded correctly that the image is virtual although many did not explain why. Very few said that the image cannot be produced on a screen. The other parts of the question were in general answered correctly. When drawing ray diagrams in most cases the rays lacked arrow heads to indicate direction. The other parts of the question were in general answered correctly.

Question 3

A significant number of candidates do not know how to define pressure, very often defining it as '*force on an object'*. Few converted the diameter into meters before calculating the area and then had problems to calculate the pressure in Pascals. On a positive note, a good number gave the unit as **N/cm^2**. Many could not clearly explain the advantage of the pointed end of the drawing pin.
Writing down the report in part b(i) was problematic for many, especially those who tried to write a lot, mainly describing it rather explaining its mode of operation. Parts b(ii) and b(iii) were in general answered correctly. As regards part (iv), a good number mentioned environmental advantages such as reducing waste, reducing electricity consumption, etc. However there were also other who mentioned the idea of a force multiplier. In part (v) many just said that the system becomes inefficient but failed to explain in what way.

Question 4

In the first part, many mentioned a whole range of equipment that may be used, most commonly ammeters and voltmeters. Part (ii) may have appeared easy and obvious for many. This was reflected in the over simplistic answers they gave. For example find which turbine is rotating fastest and that would be the best one, or find which is producing the most

power and that would be the best one, however they failed to explain how these measurements are to be made. Furthermore, a substantial number did not know that the generator is used to produce electricity. The precautions indicated were the usual ones, reading the meters correctly, connecting the meters correctly, etc.
The straightforward calculation of gravitational potential energy was in general answered correctly; however, not all students were able to calculate (ii) correctly because they did not divide the energy by two. Part (iii) was in general answered correctly, although surprisingly a significant number do not seem familiar with the principle of conservation of energy.
The distinction between renewable and non-renewable forms of energy was in general acceptable. The idea that non-renewable forms of energy take millions of years to be formed should not be encouraged as it gives the impression that for example fossil fuels are still being formed. The advantages given in part (ii) were not always clear, very often being based on popular ideas rather than scientific ones. For example that fossil fuels are cheap, very efficient, and easy to get, while solar energy is cheap. Perhaps it is cheap in the sense that the running cost is minimal but the capital investment is very large.

Question 5

In this question the candidates fared worst. A considerable number of candidates were conversant with the definition of Lenz's Law. Many answered this question correctly although many referred to the current or magnetism of the coil. Surprisingly, very few managed to draw a correct diagram of the magnetic field or to explain clearly why a transformer will not work with a dc supply. A considerable number of students calculated the power input and did not find 60% of it to get the power output. The rest of the questions were in general answered correctly.

2.3.2 **Paper IIB**

Question 1

In general candidates did not perform well in this question. Candidates clearly showed that either they lack knowledge in the subject or they do not read the question properly since in many parts of the question they either did not answer or did not answer the question directly. In part a(ii) very few candidates knew why a thick wire should be used. They were unaware of the relationship between the resistance and the thickness of the wire. Some said that current would flow faster if a thick wire were used. Many simply commented that a thick wire would be more difficult to cut or to melt with the heat that is generated when the current flows through the wire. In part a(iii) wrong fuse values were given in a considerable number of cases. A number of candidates do not know that the potential difference is represented by the symbol V in the formula for Ohm's Law. They subsequently substituted the value of 12 V for V in the formula and continued to find a value for either I or R. Wrong units were given in a number of cases. Few candidates obtained this part of the question correct. In the last part of the question incomplete and incorrect circuits were given in most cases. Usually

candidates drew the ammeter in series but the voltmeter was usually incorrectly placed. Some did place the voltmeter in parallel but it was placed in parallel with the battery or with the ammeter itself. In other circuits the coil of copper wire was not even included. The last part of the question was quite frequently either left out or wrong. Many tried to explain the effect of the resistance on the temperature of the liquid – they said that as current passes through the coil, it becomes hot and thus the temperature of the liquid increases. Few gave the required answer.

Question 2

Candidates performed significantly better in this question when compared to the other questions in the paper. A good number of candidates knew that the image formed was virtual but they failed to explain why the image was virtual. However it must be noted that candidates found it quite hard or made a number of mistakes when drawing ray diagrams and other related diagrams. Diagrams lacked accuracy and neatness. Many of those who attempted the questions drew arrows in the wrong direction. Most candidates labelled angles instead of rays. In a number of instances the labelling was done haphazardly without indicating to which ray it was referring. Also, there were candidates who had an idea of how the parallel beam of light would pass through the different types of lenses, but unfortunately most diagrams were drawn haphazardly and did not indicated rays converging from a single point or diverging from a single point. A number found difficulty in reading the required values from the ray diagram. Incorrect properties were given in a number of cases. Quite a number of candidates gave two words that had the same meaning as two different properties of the image. Many mixed up the properties of the image given by a mirror with that of the image given by a lens. A considerable number of candidates said that the image would be blurred.

Question 3

Many students are aware that pressure has to do with force and area however when it comes to giving the S.I. unit they seem to get confused and give wrong units - most typical answers are *Joules* or *square metres* – a few give the units of force divided by those of area. Very few students give Pascals as the S.I unit of Pressure. Calculations of the area of the pin's head were mistakenly given in cm squared and the error was carried forwards in part (iii) when they used the formula for pressure correctly however, using the answer given to the area in part (ii). In part (iv), most students circled the correct words in the statement description showing that overall they understood the relationship between pressure, force and area. In the second part of the question the majority of students gave correct answers by stating that the small piston gets pushed down showing that there is an overall understanding of the working mechanism of the hydraulic press shown in the given diagram. When dealing with the calculations concerning Pressure at A and the force exerted by the large piston not all candidates were able to give correct answers since the formulas used where not correct. This shows that most students have difficulties when changing the subject of the formula such as when finding the force. Also there is ample confusion as to the S.I units of force and

pressure. Difficulties could also be seen when dealing with large numbers. In part (iii) nearly all candidates failed to give correct explanations regarding the size of the pressure at A and B. Most were of the opinion that at A the pressure has to be greater than that at B – on the other hand, the few students who answered that pressure will be the same failed to explain why this is so. In part (v) there were a considerable number of pupils who gave correct answers as to what happens to the large piston as the small piston is pushed down – this once again, shows an understanding of the workings of the apparatus given. Candidates had no idea how many times the force is magnified and just state 3 or leave the question blank – as to the last part most answers given stated that either there will no longer be any air bubbles or if there are air bubbles they cannot be compressed

Question 4

The majority of students were able to put the sequence of the experiment to test which turbine generates more current, part a(i) in the correct order but then did not give correct precautions to keep experimental errors to a minimum. Candidates should realise that obvious precautions (do not touch with wet hands) do not suffice. Most of the candidates lost marks in question b due to the fact that they did not convert the mass (55g=0.055kg) of the ball and due to missing units. On the other hand the part on power stations was answered correctly in the absolute majority. Some more emphasis on the advantages of fossil fuels should be made.

Question 5

As per candidates sitting for Paper IIA very few students were able to state Lenz's Law correctly. Most of the candidates answered part b(i) (magnet pushed into the coil) correctly but common misconceptions were evident in b(ii) and b(iii). The majority of students answer to b(ii) (Magnet is pushed into the coil at a faster speed) with "*faster deflection*" or "*current passes faster*". "*Pointer stays as it way"* (deflected) was a common answer for b(iii) (Magnet is left inside). : many students showed general understanding of the magnetic properties of steel but very few mentioned "*ferro-magnetic*". The absolute majority of the candidates gave two suggestions of how to induce a larger current in c(ii) instead of the requirements to induce current. A small percentage of the candidates drew the magnetic field pattern of the transformer correctly and were able to explain (2 reasons) why the transformer is never 100% efficient. On the other hand the majority of the candidates were able to calculate the number of turns of secondary coil and the output power.

2.4 Comments regarding school-based Practical Coursework

As per normal procedure a number of school candidates had their practical work moderated since approximately 20% of the schools were moderated. The practical work of private candidates was corrected from MATSEC examiners. Apart from this private candidates were also interviewed regarding their practical work. A random sample of school candidates

chosen by MATSEC were also interviewed. Interviews help the examiners to verify the authenticity and level of the laboratory work presented. The following points, though recurrent in the last few years, need to be repeated.

- It is very clear that most school are carrying out their laboratory sessions in a satisfactory manner. It is of utmost importance that these laboratory sessions are not seen by students and teachers as a mark gaining machine but as a tool so that the students can grasp the concepts and the practical skills required. Students presented their practical work according to the new syllabus although their instances were candidates did meet the requirements of the syllabus.
- Again this year a number of teachers took up the suggestion to show the distribution of the marks per practical report. This will definitely add value to the formative learning of the candidate. On the other hand it is clear that a small amount of teachers are not following the criteria set in the syllabus to mark the laboratory reports. It must be made clear that MATSEC moderators are using these criteria to analyse the candidates' reports when they visit schools.
- It must be stressed that a teacher demonstration can never replace the candidates actually performing an experiment. Although it is very evident that these have been reduced considerably. However candidates are expected to set up their own apparatus, observe and take readings, write their own method and precautions, draw graphs if applicable and write a conclusion. Teachers may aid the candidates by providing a hand-out that complements the experiment but ultimately the candidate should arrive at his/her own conclusions.
- In the case of private candidates, all the above instructions apply. Private candidates are treated in the same way as other candidates and are expected to perform their own experiments. These are required to be of the same SEC standard as those presented by other candidates. It must be stressed that doing 15 experiments in a couple of days, is not the correct way of doing such practice.

Chairperson
Board of Examiners
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