

UNIVERSITY OF MALTA

**SECONDARY EDUCATION CERTIFICATE
SEC**

PHYSICS

May 2015

EXAMINERS' REPORT

**MATRICULATION AND SECONDARY EDUCATION
CERTIFICATE EXAMINATIONS BOARD**

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SEC Physics May 2015 Session Examiners' Report

Section 1: Statistical Information

The total number of candidates that registered for the SEC Physics examination in May 2015 was 3455, with 2077 sitting for a Paper I + IIA and 1378 candidates sat for Paper I + IIB. The number of candidates sitting for SEC Physics was less than in previous years in both options.

Table 1: Distribution of candidates' grades for SEC Physics May 2015

GRADE	1	2	3	4	5	6	7	U	ABS	TOTAL
PAPER A	169	376	418	643	252			201	18	2077
PAPER B				107	262	367	182	410	50	1378
TOTAL	169	376	418	750	514	367	182	611	68	3455
% OF TOTAL	4.89	10.88	12.10	21.71	14.88	10.62	5.27	17.68	1.97	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 expected 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.

Candidates should use the answer space given and the number of marks allocated to a question as a guide as to the amount of detail required in an answer. Furthermore, candidates are advised to neatly cross out any working they do not want assessed, setting out their work clearly so assessors can follow what they have done. In the questions that involved a number of steps, it is helpful if the candidate explains all their working. In questions that required explanations, candidates performed quite poorly. It is recommended that they should carefully consider what the question is asking and answer accordingly. They should not simply write information from their notes, as this can result in the inclusion of irrelevant, contradictory or incorrect material. When responding to questions that required an explanation, some candidates answered in -point format. This may help to ensure good, concise answers. There is no need to restate the question in an answer. When questions asked for a diagram, some candidates did not use the space available. It is important that diagrams are sufficiently large and clearly labelled. Graphs on the other hand were generally drawn well. Candidates are to be reminded that answers to all questions should have the appropriate working. Full marks may not be awarded where only the answer is shown, and some credit can often be given for working even if the final answer is incorrect. The formula alone is generally not worth any marks. It is expected that formulas be copied accurately from the formula sheet provided with the examination. The rounding-off of calculations should be done only at the end, not progressively after each step. Answers should be simplified to decimal form. Care needs to be taken when reading the scales on the axes of graphs. Candidates should ensure that their answers are realistic. Illogical answers should prompt candidates to check their working.

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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	7.3	6.4	6.4	7.3	5.9	6.4	6.1	5.4	5.1	6.2	62.7
	S.D.	2.1	2.5	2.1	1.9	2.7	2.6	2.1	2.6	2.3	2.4	16.4
	Facility Index	0.7	0.6	0.6	0.7	0.6	0.6	0.6	0.5	0.5	0.6	0.6
	Discrimination Index	0.7	0.7	0.6	0.6	0.7	0.7	0.7	0.6	0.7	0.7	
Paper (IIB)	Mean	3.7	2.2	4.0	4.4	2.3	2.4	3.1	2.7	2.6	3.0	30.5
	S.D.	2.6	2.2	2.2	2.4	2.3	2.4	1.8	2.0	2.1	2.4	16.0
	Facility Index	0.4	0.2	0.4	0.4	0.2	0.2	0.3	0.3	0.3	0.3	0.3
	Discrimination Index	0.8	0.7	0.5	0.6	0.6	0.7	0.7	0.5	0.7	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

The overall performance of the candidates in this question was quite good. Candidates gained marks for giving the right definitions of mass and weight in part (a) although there were a few candidates who could not get this far. However, a number of candidates forgot to convert the mass to kilograms before calculating the weight. Candidates were able to name and indicate the position of the centre of gravity of the plank. Many candidates gave the correct explanation for choosing the smallest face for maximum pressure to be exerted.

Question 2

In part (a), candidates wrote $8/4 = 2 \text{ m/s}$. For some reason many wrote m/s instead of m/s^2 . In equations of motion, the symbol s was in most cases taken as speed. In part (c), candidates worked through simple proportion. Answers to part (d) were quite varied. Some had inverted axis, without units. Many had numbers which do not correspond or no numbers with values. The most common graph presented was:



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Some labelled the axis distance/time. Many labelled values 8 and 4. Few drew the linear part of the graph to the value 5.5s. In part (e), candidates described the path taken by the dog such that in the first 4s he was accelerating than it runs for 2s at constant speed and finally it decelerates for 1.5s. Others said momentum before = momentum after or said that the velocity increases and then remains constant without actually referring to the momentum as required

Question 3

Most candidates demonstrated a good knowledge of circuitry basics and replied to parts (a) and (b) correctly. With respect to part (c), there appears to be a difficulty in translating the theory into a practical example with most candidates opting to give a vague interpretation which was by no means considered as acceptable. There also appeared to a difficulty in expressing oneself correctly. Part (d) proved to be similar to part (c) in that even fewer candidates gave the correct answer, with a good number of candidates connecting a wire to both switches. In general it appears that whilst most candidates have good grounded theory there appears to be problems in the translation to practical situations. Part (e) was tackled correctly by most candidates, thus confirming that most candidates are aware that current and resistance are inversely proportional to each other. Part (f) proved problematic to a good number of candidates, confirming the trend indicated above. This is especially so in the case of part (f)ii.

Question 4

A good number do not have a clear idea of what a renewable source of energy is, even though this topic has been in the syllabus for a long time and similar questions have been set in the past. A good number gave answers such as 'from a renewable source' or simply gave examples of renewable energy. Most candidates managed to give a good explanation of non-renewable energy. Many did not actually indicate how the source may be used. For example some simply indicated solar energy or nuclear energy without explaining how it may be used for heating purposes.

Question 5

Overall, the candidates' performance in this question was average. The completion of the table was the easiest part, although some students found difficulty in finding the reciprocal of the volume. Many candidates lost marks since they still lack those skills required to plot a graph properly, such as: a good scale, proper drawing and labelling of axes and plotting. Candidates showed minimal understanding of the molecular theory, with parts (iv) to (vi) proving to be the most difficult.

Question 6

Most candidates fared well on this particular question especially in part 6(a)i. The most frequently recurring mistake in question (a)ii was to work out the time in seconds rather than in hours. In part (c) of the question, most candidates explained the function of these three safety features adequately with the exception that a consistent number of pupils confused the circuit breaker and the fuse, writing down the same answer for both.

Question 7

In general, this question was answered well. Many did say that the volume increases when the balloon is heated but then some failed to give an explanation. There were some who had problems to explain why the balloon rises. Some tried to explain it in terms of the increase in inner pressure, some by convection within the balloon while many did say that when heated the density of the air decreases.

In order to explain how to return the balloon to the ground, many did say by lowering or stopping the heating, others said by cooling the balloon without clearly indicating how this can be achieved, others correctly mentioned that some of the hot air may be released. There were some who came up with

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other ideas such as pumping cold air into the balloon and increasing the weight. The calculation was in general correct. Many did make use of Newton's laws but very often they mentioned Newton's third law. According to this law the forces should be equal and opposite but they act on different bodies. In this case the weight of the balloon acting downwards and the upward forces (air resistance and upthrust) both act on the same balloon.

Question 8

Most candidates found this question quite difficult in particular part 8(b). In part (b)i, a considerable number of pupils wrote two different characteristics of stars and planets, without making a clear distinction between the two. A typical wrong answer was 'stars are luminous and planets orbit stars'. Such an answer fails to focus on the differences between the two. In part (b)ii, many candidates answered correctly Proxima Centauri, however, they gave incorrect reasons as to why this is so, such as 'Proxima Centauri is close to the Sun'. In part (b)iii, a large number of the cohort did not score maximum marks. This is because most of these candidates failed to write down that the Earth has a larger mass and thus a larger gravitational pull.

Question 9

A good number of candidates knew what the instrument was however many were confused about the table in part (b) and failed to answer what source A was. Those who figured out that the source was beta gave the correct reason for their answer. In the following question, most candidates knew that radiation is always around us but failed to name it "background radiation" which was the expected answer. Very few candidates filled in the background radiation values in the next table but most of those who did gave the correct reason. On the contrary almost every candidate attempted the two safety precautions and most answers were correct. The same cannot be said for the last question, were most candidates ignored the alpha source and gave any practical use of radioactive decay.

Question 10

This question was rather straight forward however candidates failed to get the full marks in the first question because most candidates simply stated that the magnet will align itself to the North but did not specify that it was the North Pole of the Earth or why this is so. In part (b), most candidates obtained at least 1 mark because they figured that end B was a South however few mentioned that it might be a ferromagnetic material and simply said that it was a metal. The choice of metal in the next question was answered by most and a correct explanation was given. In the next part of the question many candidates mentioned the electrical and stroking method with some even drawing a small diagram. Those who did not obtain maximum marks failed to say that the switch was opened before the magnet was removed or that stroking needs to be done in the same direction. Wrong answers included the word "rubbing the metal bar" which was confused with charging by rubbing or implied left to right rubbing. The last part of the question was answered correct by the majority of the candidates.

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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	9.1	10.0	12.2	10.4	9.5	51.3
	S.D.	4.9	5.0	4.2	3.8	4.4	19.0
	Facility Index	0.5	0.5	0.6	0.5	0.5	0.5
	Discrimination Index	0.8	0.8	0.8	0.8	0.8	
Paper (IIB)	Mean	7.3	6.9	9.4	7.5	6.9	38.0
	S.D.	4.4	3.8	3.8	4.3	3.9	16.7
	Facility Index	0.4	0.3	0.5	0.4	0.3	0.4
	Discrimination Index	0.8	0.7	0.7	0.8	0.8	

Paper IIA

Question 1

The overall performance of the candidates in the first part of the question, concerning work done and energy conversions was fairly good. Most candidates however failed to give the correct definition of work done, as only a few listed that the force and displacement should be acting in the same direction. In the second part of the question, in which the candidates were asked to find the common velocity of two cars after impact, most found difficulty in reaching the correct answer. This occurred mainly as the fact that the cars were moving in opposite directions was not taken in consideration, and the correct units were not used when calculating the total momentum before collision. In this part of the question, only the candidates who could apply Newton's second and third laws of motion managed to gain the allocated marks.

Question 2

Overall candidates scored below average to average marks in this question dealing with electromagnetism. In general this reflects that this topic is not well grasped in terms of the underlying concepts behind principles involving Fleming's Left Hand Rule as well as those relating to Faraday's Law. For part (a), a good number of candidates showed little knowledge that when a wire is moved parallel to the magnetic field there is no cutting of the magnetic field lines and therefore no movement is obtained on the ammeter. Those, on the other hand, who understood this principle however failed to state there was no deflection on the ammeter which in turn implies no current flow. Once again this shows that candidates fail to give qualitative answers when asked to explain what happens in a particular situation.

For section (b), there is ample confusion as to the direction of the current flow and the resulting polarity at the ends of the solenoid. However a good majority of candidates drew correct diagrams of the experimental setup needed for this part - that is a solenoid and the power supply requested. Most candidates show clear understanding of the functions and use of electromagnets however for part (v) there is again great confusion as to what is actually happening when a dc source is replaced by an ac source. The vast majority of answers simply state that there is a flow of current in both directions as the current is now alternating.

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Question 3

The overall performance of the candidates in this question was of average, even though the question should not have presented itself to be a difficult question. Most candidates distinguished correctly between longitudinal and transverse waves and identified that energy is being transferred in both processes. However the majority only managed to obtain part of the marks in the section about the bell-jar experiment, as they did not make the necessary distinction between the observations and the conclusions from this experiment. In the second part of the question, concerning the wave equation, a noticeable difficulty was encountered while calculating the wavelength, frequency and velocity of the wave. Most candidates also failed to convert the units into the required format. In the last part of the question dealing with refraction of water waves at a boundary, candidates performed weakly, as only a few succeeded in completing the diagram correctly.

Question 4

In part 4(a), most candidates managed to accurately calculate the pressure at different depths and successfully add the given value of atmospheric pressure. The majority of the candidates also stated that pressure increases with depth. However, it should be noted that a number of candidates did not compare both submarines with the original submarine X but only compared Z and Y together. In part 4(b), quite a number of candidates had problems with calculating the area of the hatch. Some also, mistakenly, added the value of atmospheric pressure to their calculations. Furthermore, very few candidates managed to attribute practical reasons (friction, weight of hatch, suction on the inside etc.) as to why the hatch would require a different force value to the one just calculated. Most candidates reverted to unspecified answers such as 'energy is lost'. In part 4(c), the majority of the candidates stated valid properties of ultrasound but it is to be noted that most answers, although marked as correct, were very general and not specific to ultrasound. In the second part very often not enough detail was given to merit the full three marks, often due to a lack of appropriate terminology ex: longitudinal, propagated, vibration etc.

In part 4(d), most of the candidates performed well. It is to be noted that it seems as if a number of candidates mixed ultrasound with ultraviolet when it came to mentioning practical used of ultrasound. It should be highlighted that the absolute vast majority of the candidates limited ultrasound to pre-natal scanning.

Question 5

Candidates' performance in this section was satisfactory. In fact the first part of the question dealing with the given circuit is on the whole well answered although there are some problems when it comes to drawing the wire CD in parallel with AB and then calculating the new resistance. This seems to have confused the candidates and most calculations given are incorrect. As to part (c), majority of candidates understand and explain correctly the relationship between resistance of a wire and how this is affected by changes in thickness, diameter and material of the wire used.

The main difficulties arose when the candidates were given a situational example and asked to come up with an experimental setup involving a tungsten filament together with a fan and a power supply. Most candidates fail to mention the added instruments needed namely the ammeter and the voltmeter and so obviously the error carries forth when drawing the experimental setup and the explanation as to how to go about to analyse the relationship between the wind speed and the resistance of a wire. Once again it is evident that there is lack of application of theory with actual practice.

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Paper IIB

Question 1

Most candidates answered the first part, concerning work and the last part, concerning Newton's third Law of motion, correctly. However many candidates were not able to answer the part concerning momentum correctly. Many showed lack of understanding of the principle of conservation of momentum. Very few candidates used the correct sign convention for the opposite direction of the velocities of the toy cars.

Question 2

It is clear that the dynamics behind induced currents is all but lost amongst the candidates. There was hardly a handful who could state Faraday's Law. The candidates in their huge majority could not arrive to the conclusion that a current carrying conductor under the influence of a field (non-parallel), experiences a force, hence motion, as predicted by Fleming's Left-Hand Rule. The candidates showed a lack of grasp of the underlying principles of induced currents.

Question 3

Many candidates were able to distinguish between longitudinal and transverse waves and identify which one represents sound and X-ray correctly. Again the majority of the candidates answered the second part, concerning sound waves correctly. However very few candidates were able to find the wavelength and the frequency in the third part of this question. Many candidates lost marks for inaccurate diagrams representing the refracted waves. In several cases candidates did not complete the last two wavefronts and did not present equal wavelength throughout their diagram.

Question 4

The equations used to answer the questions were picked haphazardly. For example, pressure due to a column of (sea)water was attempted with $P = \text{Force} \times \text{Area}$. The process of the addition of individual pressures to find the total is nowhere to be found in the majority of the replies. It seems that the candidates do not distinguish between the meaning of characteristics and usage. They are considered interchangeable. The time of wave transit was rarely divided by 2. The last question, where an advantage and disadvantage of Ultrasonic Waves over X-rays was being asked, mostly yielded answers related to Ultrasound OR X-rays, and not relative to one another.

Question 5

Most candidates could not determine the combined resistance of resistors in a circuit. There is no understanding of the relationship between resistance due to the length and area of a conductor. The same applies to the effect on resistance by temperature and wind speed (cooling effect of wind on a hot resistance wire). The candidates fared better in the last part of the question, where they were asked to draw an electric circuit diagram and the tabulated sequence of the investigation.

2.4 Comments regarding school-based Practical Coursework

The average for the presented coursework is 13.5% for Paper IIA and 11.8% for candidates that sat for the Paper IIB option. 187 candidates did not present any coursework, whilst another 12 candidates scored no marks. Considering that most candidates have studied Physics for the past three years, it is a pity that either through negligence or unfortunate circumstances that candidates do not score any marks in this component. On the other hand it should be noted that some schools might be over marking their students, particularly in schools where the school average is 15 or very close to 15. In a very small number of schools, candidates were given full marks for work which was either not of

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SEC standard or else was incorrect. Approximately 20% of the schools were moderated. The following notes should be noted. Once again it must be noted that most 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
2015 Examination Panel**