EXAMINERS' REPORT

AM PHYSICS

FIRST SESSION 2018

L-Università ta' Malta

MATSEC
Examinations Board

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General Statistics

The distributions of grades awarded in the May 2018 exam are presented in the table below.

Table 1: Distribution of grades awarded in May 2018.

GRADE	A	B	C	D	E	F	abs	TOTAL
NUMBER	20	52	106	84	44	39	21	366
% OF TOTAL	5.5	14.2	29.0	23.0	12.0	10.7	5.7	100

General Comments by Markers

Paper 1

Section A

Question 1

Candidates had an average performance in this question. They were able to show that equation is homogeneous in terms of base units but found difficulty in determining the percentage increase of the frequency in part (a). Some candidates showed lack of knowledge in determining the direction of the vectors at different points along the path.

Question 2

Candidates had a good performance in this question. The main difficulties encountered were the lack of providing practical examples of moving objects that use the principle of conservation of momentum and the lack of proper interpretation of the four graphical options given to explain the answer in part c (ii).

Question 3

Candidates had a good performance in this question. They were able to state the various energy conversions while correctly deriving the GPE at location A relative to location B. The majority of them derived the correct expression for the speed at B and determined the mechanical energy lost from A to B.

Question 4

Candidates had an average performance in this question. They performed well in parts (a) and (b) but found difficulty in deriving a formula for the stress in terms of the given parameters. In part (e), a significant number of candidates did not provide the frequency in revolutions per minute.

Question 5
Candidates had a below average performance in this question. Unexpectedly the force representing weight was often drawn at the base of the ladder in part (a). Candidates demonstrated lack of knowledge on the use of moments to calculate the tension particularly by identifying pivot points that made calculations complex.

Question 6
Candidates had a good performance in this question. Correct definitions for resistivity and conductivity were provided by most of the candidates. The combined resistance was derived by most of the candidates who were also able to calculate the total resistance of the galvanometer and resistance. Some candidates found difficulty in determining the internal resistance of the battery.

Question 7
Candidates had an average performance in this question. They correctly stated Hooke's law and clearly explained why the laying of rail tracks is done in cold weather. In part (d), the candidates found difficulty in deriving an equation for the energy stored per unit.

Question 8
Candidates had an average performance in this question. In part (a), there were instances where candidates interchanged the cathode at A with the anode at B. Most of the candidates provided a clear description of the apparatus provided that demonstrates the photoelectric effect. In part (cii), some candidates found difficulties in using the correct equation to determine the threshold frequency.

Section B

Question 9
The candidates had a good performance in this question. Most of the candidates were able to provide correct answers to part (a), while in part (b) some of them did not identify the most likely directions of the ball to land in the basket. In part (bii), some candidates were unable to determine the time for the ball to reach the chair and consequently were unable to use the equation for the vertical distance to determine the minimum velocity with which she should throw the ball to miss hitting the chair.

Question 10
The candidates had a good performance in this question. In part (e), some of the candidates did not provide a negative sign for the angular acceleration while in part (g), they were unable to start by using Newton's second law of rotation $\tau = I\alpha$ to change it in terms of the required parameters. In part (h), very few candidates were able to derive the provided expression for the translational acceleration. This question was the least opted for by the candidates.

Question 11
The candidates had an average performance in this question. It was noted that for part (a), the candidates provided just one clear correct condition and usually missed to relate that the sum of torques due to all external forces about any axis must be equal to zero. Responses to part (b) showed lack of knowledge on the use of the moments to determine F_b. Similarly, some answers to part (c), indicated an inability to use the correct components of various forces.

Question 12

The candidates had a good performance in this question, although some responses included incorrect free body diagram of the forces acting on the man at the bottom of the swing. However, in part (a), candidates demonstrated to be knowledgeable on subject. Some inadequate responses to part (biii) showed an inability to determine the initial and final angular velocity in order to determine the angular acceleration.

Question 13

The candidates had an average performance in this question. In part (a), some candidates failed to mention work done against resistive forces as part of the energy conversion. In part (b), the elastic potential energy was often left out from the total energy while in part (f) candidates failed to derive an expression for the maximum velocity.

Question 14

The candidates had a good performance in this question and responses indicated that candidates were knowledgeable in describing temperature effects on electrical conductivity, number of electrons and holes in intrinsic semiconductors. However, they were less knowledgeable on how to change an intrinsic semiconductor in a p-type and how conductivity is affected. In part (b), most of the candidates provided correct explanations and in part (c) they correctly stated Kirchoff's circuit laws. In part (d), very few candidates used the correct laws to determine the three currents. This question was the most opted for by the candidates.

Question 15

The candidates had an average performance in this question. Some responses missed to mention the strong nuclear force in part (a), while some responses to part (b) showed an inability to determine the distance of closest approach. Inadequate answers to part (d), indicated lack of knowledge on fundamental particles and their corresponding neutrinos.

Paper 2

Question 1

In part (a) of this question, the absolute majority of candidates provided the required equation in the correct format. However, many candidates failed to clearly explain the meaning of two of the terms in the equation. Very frequently candidates stated that ΔU stands for internal energy while failing to specify that it represents the change in the internal energy of a system after it experiences heat transfer or mechanical work. The same applies to ΔQ. Many candidates failed to specify that this term represents the net heat transfer rather than an amount of heat energy. Also, in part (c), marks were deducted for failing to write down the conditions under which the first law of thermodynamics applies. Furthermore, the vast majority of candidates did well in part (d). They were able to identify the correct equation while generating a correct numerical answer. Very few candidates failed to include units with the numerical answer.

Question 2

This question was about kinetic theory of gases. The absolute majority of candidates attempted this question and gave the four main assumptions associated with kinetic theory. However, a good percentage of candidates could not derive the relationship between the mean molecular kinetic energy and the temperature of an ideal gas. Here, it is good to note that responses provided show a lack of discipline in the way a mathematical proof is presented. Presentation

skills are lacking while in some cases no justification is given between one step and the next. Furthermore, in part (c) some candidates ignored the fact that the temperature was not given in Kelvin.

Question 3

The absolute majority of candidates were able to recall Newton's Law of Gravitation. However, some of them were not able to explain its universality. A good number of candidates were able to derive Kepler's Third Law of planetary motion but only a few worked out the radius of orbit correctly. Miscalculation of the periodic time was a very common mistake.

Question 4

The majority of candidates were able to explain capacitance but did not quote the relevant equation. Only few candidates were able to state which graph would yield the energy of a capacitor. A large number of responses indicated a misconception that charge of an isolated capacitor increases when dielectric is inserted between the plates. Answers related to what happens to the energy of the capacitor were poor. On the other hand, candidates did well in explaining and working out correctly the new capacitance when dielectric was inserted.

Question 5

Most candidates were able to define magnetic flux density and the Tesla. However, the majority gave only one assumption. They were also able to identify Fleming's Left Hand Rule as the rule to be used in parts (c) and (d). The absolute majority worked out correctly the magnitude of the force in part (d), but were not able to draw a proper diagram to indicate the direction clearly.

Question 6

A very high percentage of candidates demonstrated poor performance in this question. In part (a) candidates found it difficult to recall a law with a high degree of accuracy. The vast majority of candidates also performed poorly in the numerical part of this question, part (c). Lack of presentation skills was evident when trying to solve a numerical problem, with a number of candidates finding it difficult to follow logical steps leading to a final correct answer. In particular, a high percentage of candidates either ignored the fact that the plane of the coil was not perpendicular to the direction of the field or resolved the field vector incorrectly.

Question 7

Overall, candidates performed moderately well in this question. In general, all parts of this question were attempted. Responses given indicated that a high percentage of candidates did not recall with accuracy the conditions for SHM, many found difficulty in distinguishing between distance and displacement, and others did not specify that displacement is measured from the equilibrium position. Also, the word 'centre' was used instead of the phrase 'equilibrium position', which is unacceptable given that the word 'centre' is not even defined in SHM. Furthermore, the majority of candidates could recall equations for the calculation of amplitude, acceleration and energy.

Question 8

Candidates performed moderately well in this question about wave theory. Only the minority were able to explain the principle of superposition of waves. It was also evident that candidates did not emphasise the mathematical importance of the principle of superposition. It was very common to read about the 'sum' rather than the 'algebraic sum' or 'addition' rather than 'vectorial addition'. At this level of study candidates are expected to tune themselves to this level of detail. On the whole, candidates showed understanding of the difference between stationary and progressive waves. However, a good number opted to describe properties of one

kind of wave without contrasting it with the other kind of waves. Furthermore, the majority of candidates could identify the relationship between tension and frequency for the last parts of the question.

Question 9

Numerous candidates attempted this question about Thermodynamics. In part (a) most candidates identified the importance of thermal equilibrium. However, very few emphasised the importance of thermal contact over sufficient amount of time for accurate temperature measurements. In part (c) the majority of candidates were able to describe the triple point of water. However, none of the candidates were able to identify two advantages of using the triple point of water. Particularly in part (d), responses given lacked detail. While, most candidates have a good idea of how a constant-volume gas thermometer works, the majority failed to quote the relevant equation used to determine the temperature through a constant-volume gas thermometer. It is also evident that candidates still find it difficult to explain how a gas thermometer can be used to establish an ideal temperature scale. At the end of the question a high percentage of candidates used various methods to determine the required resistor's value. However, in a large number of cases candidates substituted for values without writing down the formula in the first place.

Question 10

This question was among the most popular and was attempted by the majority of candidates. Overall, most candidates who attempted this question performed moderately well. The majority of candidates were able to explain the meaning of 'specific heat capacity' and 'specific latent heat of vaporisation' but almost all the candidates did not support the explanation with a relevant equation. Also, the majority of candidates were not able to apply the principle of latent heat in order to explain the situations presented in part (b). In part (c), a high percentage of candidates showed understanding of the required experiment. However, a good percentage of candidates presented a diagram of apparatus which disagrees with the method they reported. Furthermore, many candidates showed lack of presentation skills while composing all sections of the experiment.

Question 11

Candidates demonstrated poor performance in this question. Particularly, candidates showed lack of organisational skills in part (c). Overall, the majority of candidates were not able to recall a proper definition for the thermal conductivity of a material. Also, the absolute majority of candidates were not able to sketch proper graphs as required in part (b). However, the majority of candidates chose the 'potential design' as the one which conducts heat more efficiently. Furthermore, the majority of candidates could easily handle the formula for thermal conductivity in order to answer part (ci). However, many candidates found it difficult to calculate the intermediate temperature as required in part (ii).

Question 12

This question was among the least popular with candidates where about 35% of the population attempted it. In their majority, candidates attempted only the first parts of this question. The absolute majority of candidates had a good idea of the concept of electric field strength but did not state that the unit charge needs to be positive. However, responses given indicated candidates got mixed up in the relation between equipotentials and electric field lines and many drew the field lines instead of the equipotentials. In part (c), most candidates were able to draw the projectile trajectory of both particles and identify their horizontal velocity. They were also able to use Newton's second law to find their acceleration. However, very few candidates were able to integrate the principles of projectile motion to an electric field. In fact, the absolute majority did not attempt the last part of this question.

Question 13

This question was meant to assess candidates about basic principles of alternating current. Overall, candidates showed good understanding of this chapter. Most candidates demonstrated ability to recall and apply relevant mathematical equations. However, the absolute majority of candidates who attempted this question showed lack of understanding of the phase lag which exists between the current and voltage signals in an a.c. circuit. Also, most candidates were not able to fully explain how large inductors can be used in series with home computers to reduce high-frequency sound output as required in part (c)(v).

Question 14

This question was very popular with candidates. Overall, the majority of candidates scored moderately well in many parts of the question. However, lack of detail in many of the candidates' responses still prevailed. As an example, many candidates did not draw arrows on rays of light to indicate its origin. Also, some candidates did not give a full account of how to determine the focal length of a lens.

Question 15

This question was very popular with candidates. Most candidates who attempted this question attempted all parts. Overall, candidates showed an acceptable level of understanding of how our Universe was formed billions of years ago. However, a high percentage of candidates still find it difficult to communicate a good level of detail in good English. Furthermore, most candidates do understand the concept of redshift but almost none of the candidates provided good axes labelling for the graph illustrating Hubble's law.

Paper 3

In the first part of the practical paper, the candidates were asked to use Hooke's law experiment to determine the unknown mass of steel washers that were loaded onto a steel spring. A graph of the number of masses loaded on the hanger against the position of the pointer was used to determine the mass of the steel washers. The mass of the steel washers was then used in the second part of the experiment. In the second part of the experiment, rotational oscillations of a shaft with a variable moment of inertia suspended from a copper wire was used to determine the rigidity modulus of copper. The moment of inertia of the shaft could be altered by two nuts (whose mass was 20% that of the steel washers) that could be screwed on the shaft till they were close together at the centre or unscrewing them so that they were at the far ends of the shaft. Candidates were asked to make several measurements that included timing and length/thickness measurements. A second graph was then used to determine the rigidity modulus of copper. In general, candidates did very well in the practical session, with the average mark being slightly higher than 85%. The number of candidates that obtained 85% or higher is about 65%. Markers noted the following difficulties as encountered by candidates in this exam:

In part A:

- a good number of candidates were unable to use prior knowledge of Hooke's law to derive an equation from scratch;
- a small number of candidates incorrectly worked out the gradient;
- candidates correctly sketched and plotted well sized graphs with only very few candidates not writing down the axis titles and the graph title;

- the value of the gradient was given without its unit;

In part B:

- a small number of candidates were unable to choose which configuration provided the largest moment of inertia;
- a handful of candidates incorrectly read the timing from the stopwatch (e.g. 00:19:05 was written as 0.19 seconds instead of 19.05 seconds);
- a very small number of candidates incorrectly stated the uncertainty in a single measurement of time read from a stopwatch and from a ruler;
- a number of candidates incorrectly performed the calculations required to complete the table;
- a good number of candidates were unable to show that the unit of the rigidity modulus is Pa;
- were unable to find one source of error and one corresponding precautions;

Candidates did well in this practical session as is the trend in the last couple of years.

Chairperson
2018 Examination Panel