L-Università ta' Malta

MATSEC
Examinations Board

Examiners' Report

IM Applied Mathematics

First Session 2023

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A. STATISTICAL INFORMATION

The total number of candidates who registered to sit for Intermediate Applied Mathematics was **31**, which is **6** candidates less than in 2022.

Table 1 shows the distribution of grades for the First 2023 Session of the examination

GRADE	A	B	C	D	E	F	ABS	TOTAL
NUMBER	2	3	9	3	4	2	8	31
% OF TOTAL	6.5	9.7	29.0	9.7	12.9	6.5	25.8	100.0

Table 1: Distribution of grades for IM Applied Mathematics, First Session 2023

B. GENERAL REMARKS

In general, the candidate's answers to the questions showed the full spectrum range of knowledge and problem-solving skills. Some candidates were very well prepared whilst others performed poorly.

C. COMMENTS ON PAPER

Question 1.

A system forces in 2D was given and the candidates had to write each force in ***(i, j)*** notation. In addition, they had to calculate the equilibrant and compute the horizontal distance of the equilibrant's line-of-action from a specified point. Most of the candidates understood the question well and answered correctly. They showed good understanding of components and how to take moments about a point. Some candidates found the resultant instead of F in part (b). Some candidates left part (c) unanswered.

Question 2.

The candidates had to calculate the tension and the modulus of elasticity of two identical strings which were used to suspend a mass. Most of the candidates identified the geometry correctly and resolved vertically to be able to find the tension. However, some candidates did not realise that the system was symmetric (or did not resolve horizontally) hence could not imply that the tensions were equal and ended up with more unknowns than equations. All candidates were aware of Hooke's law and the equation to calculate the modulus of elasticity.

Question 3.

The question requested the candidates to draw the FBD of a suspended rod in equilibrium, and calculate the tensions in the strings and the location of the centre of mass along the rod. Most of the candidates managed to draw the FBD and extract the equations of equilibrium but some candidates did not solve for the unknowns (tension forces). Some candidates got mixed up when writing the moments equation and some did not even try to solve part (c).

Question 4.

The candidates had to compute the centre of mass (CoM) of an irregular shaped lamina. In addition, they had to calculate the angle between a particular side and the vertical when hung from a specific point. Some candidates got the shape of the lamina wrong but the method to calculate the CoM was correct. Part (b) was more challenging where most candidates just took the tangent of the CoM's coordinates without any logic.

Question 5.

The question requires the candidates to split the motion of the two vehicles and use the equations of motion for constant acceleration (or self-constructed graph) to find the maximum speed of the car and the time take by the truck to accelerate. Most of the candidates answered correctly. They used the equations of motion for constant acceleration and most candidates drew the correct v-t graphs. Some candidates did not split the motion of each vehicle between acceleration and constant speed and they tried to solve for the unknowns considering the parameters obtained from the full motion.

Question 6.

The correct sketch was drawn for the situation discussed in the problem by nearly all the candidates and this helped the majority of the candidates to obtain the correct equations for the forces acting on the two particles. Still some candidates did not solve the two equations for the forces acting on the particles correctly to evaluate the acceleration asked for in part (a) of the problem. Those who answered part (a) of the problem correctly substituted the value of the acceleration obtained in one of the two equations obtained earlier to evaluate the tension in the string asked for in part (b) of the problem. The third part of the problem, in which the candidates had to find the force exerted on the pulley was not attempted by a good number of candidates.

Question 7.

In the first part of the problem, some candidates did not calculate the frictional force acting on the particle on the inclined plane and so the work done against friction could not be correctly obtained. For the other part of the problem, the real vertical height covered in doing the distance suggested on the inclined plane was to be used to calculate the work done against gravity, but this height was not evaluated correctly by some candidates. Still some candidates were still able to answer one or both parts of this problem correctly.

Question 8.

The main mistake in applying the principle of the conservation of momentum in this problem was that some candidates ignored the fact that the particles were moving in the opposite directions before impact and so the signs used for the velocities were not supposed to be the same; this led to incorrect equation in terms of the velocities. Again, some candidates also ignored the opposite direction of the velocities of the two particles when the coefficient of restitution was expressed in terms of the velocities of the particles before and after impact and so the equation obtained was not correct; the candidates solved the equations but the velocities after impact obtained were not correct if one or both mistakes were committed. Some candidates obtained the two equations correctly and were also able to obtain the correct results for the first part of the problem. In the other part of the problem, few candidates correctly worked the magnitude of the impulse but the velocities used in the calculations were not correct in some cases.

Question 9.

To solve this problem, the candidates had to resolve the forces acting on the car as it was rounding a bend on the road in two directions, ideally horizontally and vertically so that two equations can be obtained; obviously the speed of the car had to be involved in the derivation of these equations. A ratio of these two equations could then be obtained. After simplifying this ratio and using the information provided in the problem, the maximum speed at which the car can travel round the bend if slipping outwards is not to occur was then deduced. Hardly any candidates obtained the appropriate equations correctly and this led to the loss of the majority of the problem's marks.

Question 10.

In part (a) of this problem, the horizontal and vertical components of the velocity were supposed to be defined in terms of the speed of the particle and angle of elevation when the time was 5 s. The result of this part of the problem could be deduced by using the two components of the velocities equations obtained. Once the value of the angle of elevation is obtained, any one of the two equations for the components of the velocity obtained earlier could be used to calculate the velocity of the particle asked for in the second part of the problem. The greatest height reached by the particle above the ground occurs when the vertical component of the velocity of the particle is zero. This fact is used to obtain the time taken by the particle to reach the greatest height and the time obtained is then used to calculate the greatest height using the appropriate relationship. To obtain the speed of the particle at time 7 s asked for in part (d) of the problem, the vertical component of the velocity had to be evaluated. The horizontal component of the velocity for the particle is constant through the motion. The two components of the velocity are used to obtain the speed of the particle when the time is equal to 7 s.

Chairperson
Examination Panel 2023