L-Università ta' Malta

MATSEC
Examinations Board

Examiners' Report

SEC Graphical Communication

Main Session 2023

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A. STATISTICAL INFORMATION

The total number of candidates who registered to sit for Graphical Communication was **392.** Of these registrations, **298** opted for Paper 2A and **120** opted for Paper 2B.

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

GRADE	1	2	3	4	5	6	7	U	ABS	TOTAL
PAPER A	21	48	61	60	50	-	-	49	9	298
PAPER B	-	-	-	2	13	16	16	27	20	120
TOTAL	21	48	61	62	63	16	16	76	29	392
% OF TOTAL	5.4	12.2	15.6	15.8	16.1	4.1	4.1	19.4	7.4	100

Table 1: Distribution of grades for Graphical Communication 2023, Main Session

B. GENERAL REMARKS

General Remarks on the Written Examination

Sixty five percent of the candidates who sat for the Graphical Communication exam achieved a grade of between 1 and 5. Eight percent attained a grade of between 6 and 7, while nineteen percent failed this examination. Seven percent of the candidate were absent.

Paper 1 consisted of six questions which covered the following topics (including the average attainment score relative to the total marks):

1. plane geometry (91.4%);
2. construction of circles and tangent (55.9%);
3. circles in contact / ellipse (49.7%);
4. surface developments (33%);
5. sectional machine drawing and dimensioning (62.5%);
6. one-point perspective (48.4%).

Ranked in order of difficulty, the average marks attained in questions 1 and 5 were at 91% and 62% respectively followed closely by question 2 at 55%. This indicates that in the plane geometry, sectional machine drawing and the construction of circles questions candidates fared moderately well. The average attainment in questions 3 and 6 were around the 50% mark, thus candidates fared average in these two topics; circles in contact / ellipse and one-point perspective drawings. In the question, that of surface developments drawings candidates fared badly, below 35% of the average attainment relative to the total marks.

Paper 2 consisted of seven questions which covered the following topics (including the average attainment score relative to the total marks):

1. computer graphics (85.4%);
2. vectors and ideograms (52.9%);
3. cycloids (54.3%);
4. isometric drawing (51.3%);
5. intersection of solids (37.5%);
6. auxiliary elevations (38%);
7. assembly (39.2%).

As expected and within the normal trends, candidates fared particularly well in the the computer graphics question with an average attainment of 85%. This year the ideogram topic was paired with the vectors, and candidates fared slightly worse than usual in this question. The average attainment in these topics was around the 50%, which was also the case for the cycloids and isometric drawing. When it comes to spatial awareness candidates, yet again, did average in the isometric drawing where they had to convert two orthographic views to an isometric sketch and a pictorial drawing. Most of the solutions showed poor sketching skills and it is suggested that more work is done on freehand sketching and spatial excercises. Despite the fact that most candidates attempted this question, many were very far off with tries not resembling the actual solution at all. The cycloid question proved to be a little bit easier for candidates but it was noted that many candidates still confuse the cycloids with the helices. The candidates fared rather badly in the assembly, auxiliary elevations and intersection of solids question, attaining close to 40% on average. The use of physical teaching/learning aids and digital resources, where candidates can visualise the 3D structures better, can help them to improve in these areas.

C. COMMENTS ON PAPER I AND PAPER II

Paper I

Question 1 – Plane Geometry (14 marks)

In this question the candidates were asked to construct and shade a navigational compass. The design of the compass consisted of an octagonal frame having a series of concentric circles, a large four-pointed star to denote the four main winds, and another smaller four-pointed star rotated at 45°.

All the candidates attempted this question. Most of the solutions were satisfactory. The average mark was 13/14 for Paper A candidates and 12/14 for Paper B candidates.

The main glitches that resulted in loss of marks were the following:

- The octagonal frame was not constructed correctly. In some cases, the candidates constructed a hexagonal frame. In other cases, irregular polygons were created.
- The outlines of the stars were not joined as instructed on the examination paper.
- The design was not correctly lined in. In some cases, faint lines were drawn bold and vice versa.
- The shading of the design was sometimes untidy. Shading should be light to keep the drawing clean and, in the meantime, save time.

	0	1 - 7	8 - 13	Full marks	Abs	Total
Option A	0	2	187	99	10	298
Option B	0	4	54	16	20	94

Table 2: The performance of candidates in question 1

Question No.2 – Construction of Circles and Tangents (14 marks)

This question consisted of the profile of a shield. Half of the shield had to be constructed while the other half had to be mirrored from the first.

Candidates were examined on their knowledge of:

- Drawing circles to a given dimension on a given centre,
- Finding the centre and drawing a circle given its radius and 2 points on its circumference,
- The 3-point circle method,
- Drawing a tangent from a point to a circle,
- Accurately and neatly mirroring a drawing.

Almost all candidates attempted this question with only a few leaving it completely empty. The main difficulties encountered were the 3-point circle method and the tangent. Most of the candidates couldn't use the 3-point circle correctly and the majority opted to draw the tangent without any construction whatsoever thus losing valuable marks. Most of the candidates, managed to mirror their drawing correctly.

Common Mistakes:

- No construction in the 3-point circle method.
- No construction in the tangent.

	0	1 - 7	8 - 13	Full marks	Abs	Total
Option A	0	159	97	32	10	298
Option B	0	69	5	0	20	94

Table 3: The performance of candidates in question 2

Question No. 3 – Circles in contact / ellipse (20 marks)

This question consisted of the profile of a Telephone and a Speech Bubble. The Telephone had to be constructed using circles in contact and radius corners while the speech bubble was an ellipse which included a tangent.

Ellipse:

Most of the candidates attempted this part of the question. The great majority opted to use the concentric circles method and managed to construct the ellipse successfully. However, it was noted that in many cases, while the construction was neat and accurate, the freehand on the ellipse was often shaky, dirty, or thick. Candidates were also required to construct a tangent to the ellipse. Many were not able to locate the focal points thus making them unable to construct the tangent.

Common Mistakes:

- Freehand curve not smooth or dark and dirty.
- Not locating the focal points.
- Not measuring the correct distance where the tangent was meant to be constructed.
- Drawing the tangent at random.

Circles in Contact:

Almost all candidates attempted this part of the question. Candidates were given 5 centres; A, B, C, D and E which had to be drawn at a given radius. Then they were required to find by construction the centre of various circles whose radius was also given. These included:

- External tangential Arcs
- Internal tangential Arcs
- Radius Corners

Many of the candidates did not locate the centres correctly, opting to draw construction arcs from the wrong circles or at the wrong dimension. When it came to radius corners, most managed to draw the ones on a right angle correctly but did not construct those on the given obtuse angles.

Common Mistakes:

- Not locating the required centres by construction.
- Drawing arcs from a randomly placed point of tangency.
- No knowing how to draw a radius corner when the angle in not a right angle.
- Neatness and accuracy.

	0	**1 - 10**	**11 - 19**	**Full marks**	**Abs**	**Total**
Option A	4	122	157	5	10	298
Option B	4	65	5	0	20	94

Table 4: The performance of candidates in question 3

Question No. 4 – Surface developments – (16 marks)

Orthographic views and a pictorial view of a thin sheet metal dust pan where given. The candidates were requested to complete the end view and construct a one-piece full surface development of the dust pan which must include the sides and the top of the truncated rectangular pyramid.

This question tested the candidates' understanding of the principle of first angle orthographic projection and surface development of a rectangular pyramid. Most candidates performed badly in this question, showing clearly that they struggled with:

1. constructing an end view of a truncated rectangular pyramid in first angle orthographic projection;
2. constructing the development – the candidates did not visualise it as a truncated rectangular pyramid and tried to construct the development as different surfaces;
3. constructing the true length of the edges of the pyramid;
4. transferring the true lengths marking the corresponding radial lines on the development;
5. drawing fold lines;
6. adding the top of the truncated pyramid in the development.

	0	**1 - 7**	**8 - 15**	**Full marks**	**Abs**	**Total**
Option A	6	212	65	5	10	298
Option B	15	59	0	0	20	94

Table 5: The performance of candidates in question 4

Question No. 5 – Sectional machine drawing and dimensioning (16 marks)

A pictorial view of a bearing plate was given. The plan, the end elevation, and the profile of the sectional front elevation were also given. Candidates had to:

a. complete the sectional front elevation of the bearing plate on cutting plane M-M, in the space provided;
b. insert one radial and one linear dimension on the orthographic views;
c. show all centre lines and ignore hidden detail.

Most candidates performed well in this question. The following are the main hitches which are worth noting:

1. some candidates did not know how to construct the sectioning of the cylinder and holes using outlines, instead they used hidden detail;
2. a good number of candidates did not draw fillets and the centre lines;
3. a few candidates hatched the ribs and the web even though it was 'cut' longitudinally. PP 8888 clearly states that a web / rib is not sectioned even if it lies in a given cutting plane, that is, if it is 'cut' longitudinally.
4. several candidates did not hatch the webs that were cut across;
5. a number of candidates did not hatch using 45° lines.

However, the main stumbling block was dimensioning. Many candidates either skipped inserting the radial and the linear dimension or failed inserting the dimensions correctly. As it was mentioned in previous years, we would like to point some guidelines on correct dimensioning:

1. Extension lines and dimension lines are thin and continuous, thus without a middle gap.
2. On engineering drawings, arrow heads should be sharp, black, and filled in.
3. Small gaps are left between the extension lines and the orthographic drawing.
4. Extension lines project slightly beyond the dimension line.
5. Where possible, dimension lines should be located outside the drawing.
6. The measurement in millimetres is always placed above and not touching the dimension line.
7. Vertical dimensions are always viewed from the right-hand side of the drawing.
8. The symbol R is placed before a radius and the symbol ∅ is placed before a diameter.

	0	**1 - 7**	**8 - 15**	**Full marks**	**Abs**	**Total**
Option A	7	41	211	29	10	298
Option B	17	31	25	1	20	94

Table 6: The performance of candidates in question 5

Question No.6 – One-point perspective drawing (20 marks).

In this question, the candidates were given two orthographic views and an isometric projection of a royal throne. The throne was situated in a room and placed on a platform. A carpet from the front of the room leads to the platform, rises up and continues to lead to the base of the throne. The candidates were asked to draw an estimated single-point perspective drawing of the set up. The picture plane, the divisions indicating the tiles and courses, and the bottom left-hand corner four tiles were given.

Some candidates presented nearly perfect solutions. Others had a reasonable idea of the perspective drawing principles and presented acceptable solutions. Other candidates had little or no idea of the perspective rules and presented a catalogue of deformed thrones. The average mark for Paper A candidates was 11/20. The average mark for Paper B candidates was 4/20. The following were the main shortcomings which resulted in loss of marks:

- The diagonal line passing through the corners of the four given tiles was not drawn. This resulted in the tiles not being foreshortened according to the perspective rules. Some candidates foreshortened the tiles in an approximate manner while others drew the receding tiles equal by using the division of a line method.
- The heights of the throne were taken directly from the picture plane. These heights were supposed to be taken from the picture plane, towards the vanishing point and then projected to the throne from the correct depth of the room. This mistake resulted in a variety of distortions of the throne.

- The tiles under the platform were not drawn. Some candidates thought that, since these tiles were not visible in the given drawings, these were not necessary in the perspective drawing. In fact, these were very much necessary as the bases of the platform and throne were to be drawn first on the tiles and then projected upwards according to the given heights.
- In a number of cases, the lines were either too dark and thick or very light and thin (nearly invisible). Both extremities are not recommended. It is important that all lines remain visible (in some cases the tiles under the platform were erased). Finally, to complete the task, the visible tiles and objects are to be lined in with bold, sharp lines.

	0	1 -10	11 - 19	Full marks	Abs	Total
Option A	4	124	148	12	10	298
Option B	4	68	2	0	20	94

Table 7: The performance of candidates in question 6

Paper II

Question No. 1 - Computer Graphics (10 marks)

Most candidates have attempted the question and did well achieving full marks or close. One of the main mistakes was swapping the x and y coordinates. Occasionally they only swapped one point, mostly the first point in Paper 2B which produced a very recognisable mistake. One more common mistake was that some candidates have filled in the design with colour, rather than leaving it just as an outline. Some candidates have marked the points with a cross and it was penalized if the cross was too large or significantly degraded the overall appearance of the design. Some lack of neatness and precision was also observed.

In Paper 2A it was noted that many candidates stopped the red design short of what it was meant to be. This is probably because they assumed that it should stop at the end of the green line. Also, it was noted that some have drawn the black lines in red at first, then did their best to cover it with black. Another notable mention is that one of the Paper 2B candidates has drawn the design totally correct but pixellated, similar to how raster images are made up in an actual digital image.

	0	1 - 4	5 - 9	Full marks	Abs	Total
Option A	7	7	156	118	10	298
Option B	7	6	37	21	23	94

Table 8: The performance of candidates in question 1

Question No. 2 – Vectors and ideograms (16 marks)

Regarding Paper 2A, it was observed that many good answers were given, indicating a satisfactory understanding of the topic of vectors by most candidates. However, a few candidates still struggled with the topic's overall concept. Many incorrect answers were due to lines not being taken parallel from the space diagram. Additionally, some candidates wrongly marked the resultant with an arrow pointing upward, indicating an equilibrant instead.

Another common mistake was the incorrect measurement of the resultant from the vector diagram, leading to different magnitudes being given. Furthermore, several candidates drew a freehand sketch of the crane instead of the vector diagram, demonstrating a general lack of understanding of the topic or not reading the question well. It was noted that most candidates who opted for Paper 2B omitted the vector diagram completely or attempted only a freehand sketch, often in the space allocated for the pictogram.

Moving on to the safety signs, most freehand sketches were of poor quality and did not resemble the objects they were supposed to portray. The colour application on most signs was messy, with some candidates also using incorrect colours that did not adhere to recognized standards. A percentage of pictograms though, when drawn using the right colours, were too small or unrecognizable, making it difficult to interpret their intended representation.

	0	**1 - 7**	**8 -15**	**Full marks**	**Abs**	**Total**
Option A	3	96	188	1	10	298
Option B	0	64	6	1	23	94

Table 9: The performance of candidates in question 2

Question No. 3 – Cycloids (16 marks)

Question 3 focused on the topic of cycloids. It was observed that very few candidates completed the cycloids correctly. One of the main issues was the vertical orientation of the cycloid, which seemed to pose a challenge for candidates.

Many candidates made the mistake of marking the steps on the directing line and attempting to mark the radius of the circle on the vertical generating lines from there. Some candidates even omitted the generating lines altogether. Naming the type of locus proved to be challenging for most candidates, with a wide range of answers, including 'pivot', 'moving point of mechanism', or leaving the name out completely.

The application of colour in rendering parts of the trophy was mostly haphazard and lacked neatness. Several candidates simply labelled the parts they were supposed to render instead of actually rendering them. Candidates who opted for Paper 2B often omitted the construction of the cycloid entirely or attempted a freehand drawing of the cycloid without any construction whatsoever.

	0	1 - 7	8 - 15	Full marks	Abs	Total
Option A	5	95	182	6	10	298
Option B	4	50	16	1	23	94

Table 10: The performance of candidates in question 3

Question No. 4 – Isometric drawing (12 marks)

Most have shown an ability to convert from orthographic to 3D even if the quality of the freehand was not so good in Paper 2A. Some candidates have used a ruler for drawing the freehand sketch. It is very important that candidates understand that this disqualifies them from that part of the question losing all the marks allocated. A few candidates have drawn the object in the wrong orientation, some still showing the ramp and some putting it at the back side. If the ramp was still showing the candidates have lost one mark but if they have oriented the object so that the ramp does not show, then they have lost more as some features did not show and were unable to be corrected. This practice should be discouraged as some candidates may be doing this on purpose to reduce the work required. It is also notable that the quadrant lacked neatness and accuracy in many drawings. The fact that the grooves in the ramp did not extend to the top also proved difficult for some candidates.

Many did well in this question in Paper 2B. With the freehand part of the question, it was not specified if the drawing was to be in isometric, or otherwise. A few candidates took the opportunity and have drawn the object in freehand using other conventions which was not penalized. As with Paper 2A, some candidates have drawn the object in the wrong orientation, and this may be on purpose as the candidates may not be aware that this will lose them many marks and think they can get away with doing an easier task without being penalized.

	0	1 - 6	7 - 11	Full marks	Abs	Total
Option A	17	121	131	19	10	298
Option B	5	34	32	0	23	94

Table 11: The performance of candidates in question 4

Question No. 5 – Intersection of solids (16 marks)

Question 5 involved the intersection of a pentagonal prism with a cylinder. Most candidates accurately drew the front elevation but encountered difficulties when constructing the developments. Candidates in general found the construction of the development of the cylindrical part easier compared to that of the prism.

One common mistake was the omission of intermediate points in the development of the prism, resulting in inaccurate intersection curves on the development. Some candidates also connected the intersection line on the top of the development with straight lines instead of curved lines. Many candidates failed to include fold lines, and some did not attempt the development of the prism at all.

Candidates who sat for Paper 2B struggled with taking intermittent points to construct the seam between the two solids, often resulting in straight intersecting lines instead of curved ones. Furthermore, many of these candidates failed to attempt the required development and even struggled in copying two simple words using simple block letters.

	0	1 - 7	8 - 15	Full marks	Abs	Total
Option A	29	150	108	1	10	298
Option B	6	47	18	0	23	94

Table 12: The performance of candidates in question 5

Question No. 6 – Auxiliary elevations (16 marks)

Many candidates in Paper 2B have not attempted this question. Some have just shown the knowledge that they need to project lines towards the x-y line and no proper understanding of the concepts involved. Some candidates in Paper 2A have worked out the arc by drawing a circle in the front view and dividing it into 30-degree divisions as done in the standard way, ignoring the fact that alternative divisions have been provided already by the examiner.

Some have also been confused by the centre of the arc as they have found the centre on the auxiliary view and drawn an arc with the compass. Some must have also been confused by the given air vents in the auxiliary with one candidate going as far as labelling the said vents with a question mark. Very few candidates achieved full marks in this question, bearing in mind that this is a topic which candidates usually find difficulty with. It should be noted as well that this is the first time that auxiliary has been re-introduced after Covid mitigation measures in previous years.

	0	1 – 7	8 - 15	Full marks	Abs	Total
Option A	19	130	135	4	10	298
Option B	27	36	8	0	23	94

Table 13: The performance of candidates in question 6

Question No. 7 – Assembly (14 marks)

Most candidates have attempted this question, many of whom knew the main concept of the exercise. Some candidates left it out.

In Paper 2A, some have just drawn the hull complete with hidden lines, without regard to the other parts. This may show that those candidates did lack the necessary understanding and have just drawn one of the parts. Candidates, who got close to full marks, have forgotten some part or another of the drawing such as the hidden lines, windows on the front view, or some of the centre lines. Even among the high achievers, some circles were not drawn as neat, especially the smaller windows' circles in the front. A circle template although not strictly required, is recommended as this facilitates such tasks.

	0	1 – 7	8 - 13	Full marks	Abs	Total
Option A	27	155	101	5	10	298
Option B	21	42	8	0	23	94

Table 14: The performance of candidates in question 7

D. CONCLUDING COMMENTS

The examiners note that candidates need training to approach the principles and contents of Graphical Communication in a holistic manner and to ensure that the following shortcomings are adressed.

- Poor knowledge of basic geometric constructions.
- Lack of reading the question thoroughly and following through with all instructions.
- Many attempts made by trial and error method.
- Lack of proper colouring and shading techniques.
- Lack of overall neatness with some candidates producing very smudgy solutions.
- Lack of dimensioning knowledge.
- Lack of knowledge of engineering standards and conventions.
- Lack of knowledge on true lengths and surface developments.
- Very poor skills in drawing a one-piece full surface development.
- Lack of differentiation between construction lines and outlines.
- Poor freehand sketching skills.
- Lack of accuracy in many solutions.

Chairperson
Examination Panel 2023