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REPORTS OF EXAMINERS

SCHOOL INTERMEDIATE EXAMINATION

SCHOOL LEAVING EXAMINATION

MATRICULATION EXAMINATION

1967

(b) Most candidates answered this question correctly. Of those who did not, the most common error was in ignoring the repeated letter a.

Q. 6—(a) Most candidates were familiar with the rules of matrix multiplication, and apart from arithmetical errors this question was well done. Several candidates correctly found that A^3 is equal to the unit matrix, but did not then equate A^{-1} with A^2.

(b) Candidates did the matrix multiplication or inversion reasonably well, but had difficulties in finding k when two matrices are equated, and when a matrix is factorised.

Q. 7—(a) This question was well done, apart from numerical errors.

(b) Some difficulty was experienced in expressing the problem in the form of equations. However, once this was done, most candidates carried out correctly the appropriate matrix algebra.

Q. 8—Very few candidates knew how to combine two probability distributions to find the distribution of the sum of the variables even in this simple discrete case. The last parts were rarely attempted, and again the conclusion is drawn that the knowledge of conditional probability is weak.

Q. 9—See comments to question 8 of the original syllabus. In addition few candidates demonstrated knowledge of the formula for the standard deviation of an average.

Q. 10—See comments to question 9 of the original syllabus.

PURE MATHEMATICS

In both syllabuses many candidates failed to do themselves justice through being unable to express themselves clearly and precisely when this was necessary. The spelling of "asymptote" has improved; that of "integer" needs some attention. Some formulae were applied blindly; other formulae, such as those for the general angle as required in Q. 2 (b) (old syllabus) and Q. 2 (a) (alternative syllabus) are not known sufficiently well.

Old Syllabus

The single examination paper on the old syllabus this year differed from the two papers of previous years in two minor aspects: some of the earlier questions contained a part which went further than routine work, and the last two questions did not have any leads to suggest a line of attack. It was felt that these changes made the paper slightly harder but that this benefited candidates as they seemed less prone to spend time unsuccessfully on work which was beyond them. Some three-quarters of the paper should have been within the capabilities of all candidates who had worked steadily throughout the year.

Many candidates omitted to define their symbols when such definition was necessary. For example, while the use of a, b, c to denote the sides of a triangle ABC is accepted practice, the formulae $\frac{1}{2}r^2(\theta - \sin\theta)$ for the area of a segment of a circle is only true when θ is defined as the angle at the centre of the circle (see Q. 7).

The answers of some 10% of the candidates showed that the subject was quite beyond them.

Detailed Comments

Q. 1 (18 marks allotted)—Well done on the whole, though there are still candidates who do not know the meanings of the words "integer" and "consecutive".

Q. 2 (18 marks allotted)—(a) An easy identity, but very few candidates noted that the right hand side is not defined when $\sin A = 0$.

(b) Expressions for the general angle were not well known, and those who knew the usual form did not always indicate the numbers which were denoted by "n".

(c) Many candidates found a value for x, and a value for y, but gave little attention to the requirements of the question that x and y should both be positive, as small as possible and satisfy both of the equations simultaneously.

Q. 3 (18 marks allotted)—The three examples on selections and arrangements should have been within the capacity of every candidate. About two-thirds of the candidates made a good attempt at (a) and (b). There were many ingenious explanations for (c); most of the fallacies in the reasonings would have been exposed if the arguments had been set out more carefully. Many candidates thought that a triangle is determined by any three points whatsoever.

Q. 4 (16 marks allotted)—Candidates who read this question carefully did it well. Others ignored the instructions to determine the values which y cannot take, and proceeded to sketch the graph without this information. The asymptotes were generally obtained without difficulty but sometimes the graphs were conspicuously in conflict with the associated calculations.

Incorrect statements such as "$1 > y > 9$" were frequently to be found and few candidates seem to be able to distinguish between "$<$" and "$\leqslant$".

Q. 5 (16 marks allotted)—(a) Candidates who first showed that the left hand side of the equation was equal to $\log(1 - x^6)$ generally obtained full marks. Too many, however, asserted that

$$\log(a + b) = \log a + \log b$$

and were careless in their handling of brackets.

(b) This question was very testing and the answers submitted showed up several weaknesses. These were in the handling of inequalities when negative quantities are involved — many candidates avoided this issue by first obtaining the inequation $(6/5)^n > 2$, in knowing the sign of $\log x$ for $0 < x < 1$, and in understanding what is meant by "the smallest integer".

Some candidates used a trial and error method or first solved the equation $(5/6)^n = \frac{1}{2}$ but few of these were able to give a satisfactory explanation as to how the solution of the original problem could then be found.

Q. 6 (18 marks allotted)—Candidates who depended upon memorization of formulae fared badly here. The cartesian equation of the parabola is $y^2 = 1 - 2x$; its parametric representation was given explicitly in the question and for no value of a does $(at^2, 2at)$ give another representation. There was also too much reliance on a formula for the equation of a normal to a parabola in standard form, which was inapplicable in this question.

Q. 7 (20 marks allotted)—In the first part of this question, many candidates interpreted the phrase "correct to two decimal places" to mean "correct to the nearest minute". Those who tackled the rest of the question as it was set, doing each part separately, had little trouble, but many attempted the two parts together and became hopelessly confused.

Candidates would have been well advised not to use the letter "θ" to denote an angle of their own choosing, since one of the requirements was to locate which angle was represented by the "θ" given in the question. Further confusion arose by denoting points on the diagram by A and B when these letters had already been used to refer to particular areas. Lack of familiarity with the identity $\sin \alpha = \cos(\pi/2 - \alpha) = \cos(\alpha - \pi/2)$ made the last part of the question difficult for all but the best candidates.

Q. 8 (18 marks allotted)—(a) The first part of this was done well. In the second part most candidates overlooked the possibility that $-\sqrt{pq}$ could also be the second term.

(b) This was a popular question and most candidates showed a good understanding of the work involved.

Q. 9 (27 marks allotted)—A number of candidates managed to eliminate θ or ϕ from the given pair of equations and thence obtained an inequality for k^2; some of these also made a reasonable attempt at proving the converse. But very few (even among the candidates obtaining good honours) realized that the question provided a lot of scope for considering the conditions under which the formal operations were valid, though a few realized that $\sin \phi \neq 0$ leads to limitations on θ.

Q. 10 (21 marks allotted)—Many candidates spent a lot of time finding the locus of C, which was not required, instead of asking themselves what geometrical facts they knew about the incentre and incircle of a triangle. The best answers were obtained by those who gave P the co-ordinates (x, y) and endeavoured to find a relation between x and y in terms of known constants by using geometrical properties of the figure.

Alternative Syllabus

Candidates who attempted the questions on the alternative syllabus showed generally that they had comprehended the new material quite well. Q. 3 and Q. 7, on complex numbers and functions respectively, were reasonably well done, but Q. 1, on matrix methods, caused unexpected trouble.

Candidates use of "$\Rightarrow$" to mean "implies" and "$\Leftrightarrow$" to mean "implies and is implied by" was often ungrammatical and illogical. Their indiscriminate use should be discouraged.

Q. 1 (18 marks allotted)—Most candidates knew when the sum and product of two matrices could be formed. The only matrix product whose evaluation presented difficulty was PV. Many candidates did not realise that this product is a 2×2 matrix.

In (iv) over one quarter of the candidates did not realise that the matrix A does not possess an inverse and used a variety of methods to force an inverse to appear. Those who obtained two simultaneous linear equations in three unknowns did so correctly but most of these then assumed that solutions did not exist. Only a few candidates realised that there were infinitely many solutions.

Q. 2 (18 marks allotted)—(a) Expressions for the general angle were not well known, and those who knew the usual form did not always indicate the set of which "n" was a member.

(b) Generally well handled except for those who did not realise that e^{mx} is never zero and sought to solve the equation $e^{mx} = 0$ by taking logarithms of both sides!

(c) Most candidates stated the integration by parts rule correctly but less than half could apply it properly.

(d) Well done.

Q. 3 (20 marks allotted)—(a) Most candidates showed that they understood the meaning of the argument (phase) and modulus of a complex number but few managed to give reasonably complete answers. In (iii) there was little to show which parts of the boundary candidates considered to be part of the set, though this information was clearly sought in the question. Many candidates found the use of a broken curve a convenient means of indicating a portion of the boundary which was excluded from the set but such a notation should always be defined in the answer.

(b) Well handled apart from mistakes in the argument of α, which many candidates gave as $-\frac{1}{4}\pi$ instead of $\frac{3}{4}\pi$. Those who placed α on an Argand diagram avoided this error. Not all candidates recognised $\bar{\alpha}$ to be the complex conjugate of α. Candidates who used de Moivre's theorem to evaluate α^7 obtained the result easily.

Those who used the notation (r, θ) for a complex number handled it well.

Q. 4 (16 marks allotted)—The asymptotes were generally obtained without difficulty and most candidates located the stationary point correctly although few of them indicated why it was a minimum. Sometimes the graphs were conspicuously in conflict with the associated calculations.

Q. 5 (18 marks allotted)—(a) The polynomial expansion of $(1 + x)^n$ was well known. Very few candidates seemed able to prove the inequality.

Only one candidate realised that if $x = 0$ equality occurs for all positive integers, but he failed to notice that if $n = 1$ then equality occurs for all x.

(b) Many candidates did not seem to know this piece of bookwork and most of the others who attempted it found difficulty in writing a clear statement of the argument involved.

Q. 6 (18 marks allotted)—Candidates who depended upon memorization of formulae fared badly here. The cartesian equation of the parabola is $y^2 = 1 - 2x$; its parametric representation was given explicitly in the question and for no value of a does $(at^2, 2at)$ give another representation. There was also too much reliance on a formula for the equation of a normal to a parabola in standard form, which was inapplicable in this question.

Q. 7 (29 marks allotted)—(a) Reasonably well handled. When sketching the graphs candidates were expected to recognize that $x = (y - 2)^2$ is the equation of a parabola whose vertex is at (0, 2) and whose axis is parallel to the x-axis. Extensive calculations (including differentiating in order to find the vertex) should not have been necessary before sketching; those candidates who could sketch the graphs immediately had no need to provide such justification.

In finding the inverse function many were able to do no more than interchange the symbols x and y. Others showed that $y = 2 + \sqrt{x}$ led to the statement $x = (y - 2)^2$ but were unable to continue. Those who wrote $f^{-1}(x) = (x - 2)^2$ had little difficulty in obtaining the correct domain and range.

A number of candidates failed to note that the domain of f^{-1} is the range of f and the range of f^{-1} is the domain of f. Several obviously thought that "inverse" and "reciprocal" are synonymous terms.

(b) Most candidates failed to realise that the domain of the composite function $f \circ g$ must be a subset of the domain of g. Thus although $f \circ g(x) = x + 5$ and so appears to be defined for all x, the domain of $f \circ g$ is $\{x : x \in R, x \geqslant 0\}$.

A number of candidates also failed to recognize $(g \circ f)'$ as the derivative of the function $g \circ f$.

Q. 8 (18 marks allotted)—(a) Candidates had little difficulty in finding the required area. However many failed to read the question carefully and consequently found the volume of the solid formed by rotation about the wrong axis. Arithmetic slips were common in this question.

(b) Many candidates did well with the first integral but with the second few saw that the substitution $t = u - 2$ yields an integral with terminals -2 and $+2$ so that, by appealing to symmetry, the result of the first part can be applied directly.

Q. 9 (20 marks allotted)—Candidates usually knew how the eccentricity determined the conic, but were generally unable to locate the focus at the pole correctly.

Q. 10 (19 marks allotted)—Few candidates appreciated that under a binary operation with the identity element *all* elements are left unchanged; and that in a field each element must have an additive inverse, and each element, other than the additive identity, must have a multiplicative inverse.

Many candidates handled the discussion of $\oplus$ quite well.

MUSICAL APPRECIATION

Written Paper

It is difficult to speak of average standards in a subject that attracts few candidates, but there did appear to be a decline in standard. Some candidates lacked the necessary background to cover the full course with any depth, and many relied on second-hand statements rather than first-hand acquaintance with the music.

Q. 1—Most candidates preferred to continue the given opening and the standard was fair, with the usual faults of poor structure and climax. In contrast, the poem offered some dramatic opportunities which were seized by a few candidates with conspicuous success.

Q. 2—Of those who chose the first part of this question, most dealt adequately with Wagner, but many seemed to know very little of Verdi. Such well-known favorites as "Carmen" and "Faust" were often completely ignored.

Of those who chose the second part most wrote on Wagner and here the examiners were disturbed by a number of foolish, categorical statements concerning Wagner's inability to write interesting melodies and rhythms. Such statements do not impress, and merely confirm the student's ignorance of the actual music.

Q. 3—A popular question, but only moderately well answered. Most candidates knew something of the symphonies, but often no more than the names of the ballets.

Q. 4—Most students could deal adequately with the "classical" aspect of Brahms' music, but found difficulty in explaining the "romantic" aspect.

Q. 5—Some students were so confused here that it was impossible to decide which part of the question they were trying to answer. In general the instrumental music was poorly treated, but the madrigal fared much better.

Q. 6—Most candidates could outline the salient points concerning Elgar, Walton, Vaughan Williams and Britten, but few could develop their thoughts to describe the "broad paths" of development. Elgar and