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FOREWORD

This booklet contains reports written by Examiners on the work of candidates in certain papers. **Its contents are primarily for the information of the subject teachers concerned**.

MATHEMATICS

GCE Advanced Subsidiary Level

Paper 8719/03

Paper 3

General comments

There was considerable variation in the standard of work on this paper and a corresponding spread of marks from zero to full marks. The paper appeared to be accessible to candidates who were well prepared and no question seemed to be of undue difficulty, though correct solutions to the final part of **Question 7** (complex numbers) were rare. Adequately prepared candidates seemed to have sufficient time to attempt all questions and presented their work well. However Examiners found that there were some very weak, often untidy, scripts from candidates who clearly lacked the preparation necessary for work at the level demanded by this paper. All questions discriminated to some extent. Overall, the least well answered questions were **Question 4** (implicit differentiation) and **Question 7** (complex numbers). By contrast, **Question 3** (trigonometric equation) was usually answered very well and Examiners were impressed by the work of many candidates on **Question 10** (vector geometry).

The detailed comments that follow inevitably refer to common errors and can lead to a cumulative impression of poor work on a difficult paper. In fact there were many scripts showing a good and sometimes excellent understanding of all the topics being tested.

Where numerical and other answers are given after the comments on individual questions, it should be understood that alternative forms are often possible and that the form given is not necessarily the sole 'correct answer'.

Comments on specific questions

Question 1

This was fairly well answered by a variety of methods. Most candidates were able to use logarithms correctly in attempting to find at least one of the critical values.

Answer: $1.58 < x < 3.70$.

Question 2

The most popular method was to remove a numerical factor and expand $\left(1+\frac{1}{2}x^2\right)^{-2}$. The binomial expansion was often correct but the numerical factor was quite frequently wrong and sometimes omitted or lost in the course of the solution. The minority who attempted to expand the given expression directly tended to be less successful.

Answer: $\frac{1}{4}-\frac{1}{4}x^2+\frac{3}{16}x^4$.

Question 3

This was very well answered and solutions were often completely correct. Most errors were associated with the solution of the equation $\cos\theta = -1$. Often $\theta = 0°$ was included as a solution, but it was equally popular to assert that the equation has no solutions.

Answers: 33.6°, 180°.

Question 4

In part **(i)**, there were many good attempts at implicit differentiation, the main error being the omission of the minus sign when giving the final answer. Candidates who first rearranged the equation and attempted to remove some of the square roots were often unsuccessful. Failure to square correctly led to worthless solutions based on incorrect relations such as $y = a - x$ or $y = a + x$.

Part **(ii)** was poorly done. Relatively few candidates appeared to understand how to obtain the coordinates of P. Those that did have a valid method often made errors in handling square roots. In forming the equation of the tangent at P, a persistent error was the use of a general gradient rather than the specific gradient at P.

Answers: **(i)** $-\sqrt{\frac{y}{x}}$; **(ii)** $x + y = \frac{1}{2}a$.

Question 5

In part **(i)**, most candidates sketched $y = \sec x$ and $y = 3 - x^2$, but some worked with acceptable alternatives after rearranging the equation. Candidates should be reminded of the importance of labelling sketches and thus making it clear to Examiners what is being attempted. The quality of the sketches was generally poor with, for example, $y = \sec x$ rarely fully correct and $y = 3 - x^2$ commonly presented as a straight line. Examiners remarked that candidates seemed better prepared for part **(ii)** than in previous questions on this topic. Part **(iii)** was frequently correctly done. The most common error here was to carry out the calculations with the calculator in degree mode rather than in radian mode. Here, as in part **(ii)**, there was evidence that some candidates did not have a correct appreciation of the notation $\cos^{-1}x$.

Answer: **(iii)** 1.03.

Question 6

Part **(i)** was generally quite well answered. Most candidates used the product rule correctly and solved the linear equation in x resulting from setting the derivative to zero and removing the non-zero common factor of e^{-2x}. However for some candidates this common factor presented problems and led to them making a variety of algebraic errors. Examiners also noted that a minority seemed to believe that the turning point occurred when the second derivative was zero. Most candidates attempted to apply the method of integration by parts correctly in part **(ii)** and inserted the correct limits $x = 0$ and $x = 3$. However many otherwise sound solutions lost marks because a sufficiently diligent check for sign errors was not made throughout the working.

Answers: **(i)** $3\frac{1}{2}$; **(ii)** $\frac{1}{4}(5 + e^{-6})$.

Question 7

Part **(i)** was well answered. In part **(ii)**, the point corresponding to u was usually plotted accurately, and many candidates demonstrated some knowledge of the correct locus for z. However, there were often errors in the sketch. For example, it was common for the circle to have a radius greater than 2, and candidates who had different scales on their axes usually failed to take this fact into account. Very few candidates showed any indication that they had a method for completing part **(iii)**. Credit was given to the small number who at least identified the relevant point by drawing the appropriate tangent to their circle. But of this group of candidates there were only a few who went on to calculate the required argument.

Answers: **(i)** $1 + 2i$; **(iii)** 126.9°.

Question 8

Even though the correct form of partial fractions was given, a substantial number of candidates ignored *A*, the first term. A similar error of principle was quite often made by those who chose to divide first. They usually found *A* = 1, and obtained a quadratic remainder, but then set the remaining two partial fractions equal to f(*x*), i.e. they failed to use their remainder as the new numerator. However most candidates were clearly familiar with a method for evaluating constants and there were a pleasing number of fully correct solutions. In part **(ii)**, much of the integration was good. Those who had failed to obtain *D* = 0 usually encountered severe difficulties here and wasted time that might have been better spent looking for the error in part **(i)** that got them into this situation. Examiners remarked that some candidates with correct solutions did not show sufficient evidence of how they obtained the final (given) answer.

Answer: **(i)** $1-\frac{1}{x-1}+\frac{2x}{x^2+1}$.

Question 9

Most candidates separated variables correctly and showed a sound understanding of the methods needed for each part. Many solutions to part **(i)** were correct, apart perhaps from a sign error, and usually included a constant of integration. In this question, as in **Question 4** above, Examiners reported that candidates frequently made errors when manipulating or removing square roots.

Answers: **(i)** $2\sqrt{(P-A)}=-kt+c$; **(iii)** 4; **(iv)** $P=\frac{1}{4}A(4+(4-t)^2)$.

Question 10

This was well answered even by candidates who had not scored particularly well on earlier questions.

There were many successful solutions to part **(i)**. Having used two component equations to calculate *s* or *t*, many candidates went on to calculate the other parameter and check that the third equation was satisfied. However, some omitted this step or else checked in one of the equations already used. Also some forgot to conclude by stating the position vector of the point of intersection.

A variety of methods were seen in part **(ii)**. Though it is not in the syllabus, some candidates used the vector product correctly. The most popular method was to set up two equations in *a*, *b*, *c* and, having obtained *a* : *b* : *c*, use the coordinates of a point on one of the lines to deduce the equation of the plane.

The standard of work was encouraging and can be improved even further if candidates can become more persistent in checking their work for arithmetic errors (particularly sign errors).

Answers: **(i)** 3**i** + **j** + **k**; **(ii)** $7x + y - 5z = 17$.

Paper 8719/05
Paper 5

General comments

Compared with last year, there was a much better response to this paper. With the possible exception of **Question 2**, many candidates of wide abilities found that they could make good inroads into all the questions.

On the whole, the solutions were well presented and in only an extremely small number of cases was there any evidence of candidates having insufficient time to complete the paper. One aspect of problem solving that could benefit candidates is the need to draw a *neat* sketch which contains all the relevant information, both known and that which is to be found. Hopefully this would then have avoided, for example, equating θ to the semi-vertical angle of the cone in **Question 2**. Or again, in **Question 6**, the component of the weight of the cyclist down the plane would not have been omitted so often when attempting to establish the differential equation.

Comments on specific questions

Question 1

The majority of candidates coped well with this straightforward example of circular motion and only the weakest failed to score maximum marks.

Answer: 25 000N.

Question 2

Despite the fact that the word 'cone' appeared four times in the question, many candidates took the centre of mass of the solid cone to be $\frac{20}{3}$ cm from the base. When candidates are provided with the formula list MF9, there can be no excuse for this sort of carelessness. Equally as bad were those less able candidates who apparently stumbled on the correct value for θ from $\tan\theta = \frac{20}{10}$. As mentioned above, this error could probably have been avoided if the sketch had not been so carelessly drawn.

What was expected in part **(ii)** was that candidates would establish the range of values of the coefficient of friction for which the cone would tilt before sliding. Many candidates merely stated on the first line of their solutions that $\mu > \tan\theta$ as though it was some quotable formula. Although a similar comment was made last year, it should be re-iterated that an inequality needs some qualifying statement. For example, it would have been equally true to state that $\mu < \tan\theta$ provided that there was the added statement 'the cone slides before tilting'.

Answers: **(i)** 63.4°; **(ii)** $\mu > 2$.

Question 3

Good candidates coped well with this question but many of the rest failed for a variety of reasons. In part **(i)** the compression of the spring was often taken to be 0.3 m rather than 0.1 m. It is perhaps also worth mentioning that confusion exists in the minds of some candidates between the modulus of elasticity associated with Hooke's Law and Young's modulus. In the application of Newton's Second Law of Motion the weight of the particle *P* was often omitted and the incorrect answer 110 ms^{-2} was seen all too often.

In part **(ii)** the E.P.E. was invariably found correctly but in part **(iii)** there was a lot of trouble experienced with the G.P.E., either through the incorrect value being used or even omitted altogether from the energy equation. Inevitably weak candidates tried to find the speed of *P* by using the formula $v^2 = u^2 + 2as$. This must be wrong because this formula can only be applied when the acceleration is constant. Here the force in the spring varies as the compression varies and hence the acceleration cannot be constant.

Answers: **(i)** 100 ms^{-2}; **(ii)** 1.1 J; **(iii)** 3 ms^{-1}.

Question 4

All candidates who had a good grasp of statistical ideas scored well on this question. In part **(i)**, although the obvious axis about which to take moments was *BC*, many chose an axis through *A* parallel to *BC*. There were often some tortuous methods to establish that the centre of mass of the triangle was 11.5 cm from *BC* but, nevertheless, a high proportion of candidates eventually arrived at the correct 6.37 cm. Most candidates appreciated that they had to take moments about *A* in part **(ii)** and to resolve vertically in part **(iii)**. Usually the less able candidates failed to appreciate that the tension could only be found by taking moments and the answer to part **(iii)** was invariably $T\sin 30°$.

Answers: **(ii)** 94.2 N; **(iii)** 32.9 N.

Question 5

Part **(i)** was well done. Although there were a number of ways of finding α, most candidates chose the simplest method by applying $v^2 = u^2 + 2as$ to the vertical component of the motion.

In part **(ii)** the response was disappointing in that candidates of all abilities made the mistake of assuming that the speed of the stone after rebounding was 10 ms^{-1}. The only possible conclusion that could be drawn was that many candidates labour under the impression that the speed of a projectile is constant at all points of its trajectory. Perhaps if more candidates had drawn a neat sketch with all information on it, instead of trying out all the projectile formulae that they knew, this error could have been avoided.

The ideas required to solve part **(iii)** were well known, although inevitably there were still some who attempted to find the angle using a ratio of displacements rather than speeds. A less obvious source of error was from those candidates who attempted to find the angle by adapting the Range formula. Although the horizontal displacement found in part **(ii)** was correctly doubled, the speed was taken to be 16 ms^{-1} rather than the speed with which the stone hits the ground ($\sqrt{208}$ ms^{-1}).

Answers: **(i)** 36.9°; **(ii)** 9.6 m; **(iii)** 56.3°.

Question 6

There was a high degree of success with parts **(i)** and **(ii)**. Even though the required answers were given, many candidates handled the application of Newton's Second Law of Motion in part **(i)** and the integration and algebraic manipulation in part **(ii)** in a confident manner. The most frequent errors in part **(ii)** were the omission of the minus sign in the integration of $\frac{1}{5-v}$ and the lack of a constant of integration (or the blithe assumption that putting $t = 0$ and $v = 0$ must lead to $c = 0$).

Only the best candidates made a success of part **(iii)** by realising that further integration was necessary by putting $v = \frac{\mathrm{d}s}{\mathrm{d}t}$. A few chose the harder route by making a fresh start with the original differential equation with acceleration = $v\frac{\mathrm{d}v}{\mathrm{d}x}$. Although the candidates knew what to do, the solutions often foundered on the inability to integrate correctly. All other attempts seemed to be based on finding the speed at the top of the slope (4.32 ms^{-1}) and then erroneously applying a constant acceleration formula (e.g. $s = \frac{1}{2}(0 + 4.32)20$). Again, as in **Question 3 (iii)**, as there is a variable force ($8v$ N), this must lead to a variable acceleration.

Answer: **(iii)** 56.8 m.

Paper 8719/07

Paper 7

General comments

This was a well attempted paper where most candidates were able to apply their knowledge of the subject. There was no evidence of any time pressure on candidates to complete the paper and, on the whole, presentation was of an acceptable standard. Once again some candidates lost accuracy marks by writing down final answers to two significant figures, instead of three, and in some cases did not appreciate the difference between three significant figures and three decimal places. **Question 4** was particularly well answered, while **Questions 6** and **7** proved to be the most demanding. There were cases of particularly good scripts with candidates gaining full marks, but equally some very poor attempts were also seen. A good spread of marks was obtained.

Comments on specific questions

Question 1

This question was reasonably well attempted, though some candidates did not appreciate that the width was $2 \times z \times$ s.e. and were therefore unable to make any progress with the question. Errors included using $z = 1.645$ rather than $z = 1.96$ and more commonly omitting the factor of 2 on the width (that is, using the inequality $z \times$ s.e. < 2).

Answer: $n = 14$.

Question 2

A Poisson approximation was required for this question. Many candidates used a normal approximation which was not valid since $np < 5$. Also some candidates ignored the instruction to use an approximation and used Bin(45000, 0.0001). Some marks were available for these candidates but full marks were only awarded for using the correct Poisson approximation (even though the same final answer could have been obtained). Candidates who correctly used Po(4.5) generally reached the correct final answer. Errors such as Po(0.45) or Po(0.22) were seen as well as choosing the wrong probabilities to sum. It was also noted that some candidates failed to *add* their probabilities of 2, 3, and 4 and even $P(2) \times P(3) + P(4)$ was seen.

Answer: 0.471.

Question 3

Most candidates were able to score marks on this question. However, many errors were seen in attempting to find the correct mean (19) and variance (12) of Su Chen's upgraded throw. Use of N(19,17) was common.

Answer: 0.586.

Question 4

This was a particularly well attempted question, even by weaker candidates. One error frequently seen was to miscalculate *l* and use 2.5 rather than 0.25. A final answer of 0.002 (or 0.0022) was very common and showed a lack of understanding of three significant figures. In part **(ii)** some candidates used $e^{-k} = 0.9$ instead of $e^{-k/80} = 0.9$, but many candidates successfully found the correct value of *k*. Again 8.4 rather 8.43 was often given as the final answer and without the previous unrounded figure accuracy marks were lost. It was surprising on this question that a few (even good) candidates used log rather than ln, even stating $\log e = 1$.

Answers: **(i)** 0.00216; **(ii)** 8.43.

Question 5

This was also a reasonably well attempted question. Some candidates used 117 rather than the s.e. of $\frac{117}{\sqrt{26}}$, and a common error in part **(ii)** was to use a one-tail test (though follow through marks were available). It was pleasing to note that, on the whole, candidates stated their null and alternative hypothesis and were able to give final conclusions related to the situation in the question. It is important that candidates show that they are *comparing* their value with $\pm$ 1.645 (or equivalent), either by an inequality statement or a clear diagram. Some candidates failed to show this comparison and consequently marks were lost.

Answers: **(i)** 0.985; **(ii)** No significant change.

Question 6

Candidates were particularly good at part **(i)** where they were required to define type I and type II errors. However, despite knowing the definition very few candidates were able to apply this knowledge in part **(ii)**. The situation required Bin(5, 0.94) for part **(a)** and Bin(5, 0.7) for part **(b)**. Unfortunately very few candidates used these distributions with the correct parameters and attempts at other Binomials, or a Normal, or even a Poisson distribution were seen. This was consequently a low scoring question; with full marks only occasionally seen.

Answers: **(i)(a)** Rejecting H_0 when it is true, **(b)** Accepting H_0 when it is false; **(ii)(a)** 0.266, **(b)** 0.168.

Question 7

This was, surprisingly, not a particularly well attempted question, though many candidates made a good attempt at integrating by parts in **(iii)**.

Part **(i)** required the candidates to show that $k = 3$, and many errors and unconvincing solutions were seen. An integral from zero to infinity of ke^{-3x} was required and should have been equated to one. Many candidates were unable to state these limits, and integrals with no limits or incorrect ones (1 to 2 or 0 to 1) were common. Full, convincing, working was required for part **(i)**.

Part **(ii)** produced better solutions though sign mistakes were common. Integrals with incorrect limits from 0 to $\frac{1}{4}$ were also seen.

In part **(iii)** many candidates gained a few marks for attempting to integrate by parts. Limits of zero to infinity were needed and many candidates did not use these and made similar errors to those in part **(i)**. Again, sign mistakes were common.

Weaker candidates confused mean with median.

Answers: **(ii)** 0.0959; **(iii)** $\frac{1}{3}$.