GCE EXAMINERS' REPORTS

GCE
MATHEMATICS C1-C4 & FP1-FP3
AS/Advanced

SUMMER 2017

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MATHEMATICS

General Certificate of Education

Summer 2017

Advanced Subsidiary/Advanced

C1

General Comments

Candidates' performance this year seemed to be very much on a par with that on the 2016 C1 paper. Most questions were well answered and there were very few parts of questions which caused general problems to the majority of candidates.

Individual questions

1. Most candidates found parts (*a*) and (*b*)(i) to be fairly straightforward. However, only a minority were able to earn full marks in (*b*)(ii). There were many examples of incorrect ratios being written down for cos *BCA*, possibly because of a poorly drawn sketch or the absence of a diagram altogether. Probably for the same reason, relatively few candidates were able to write down the geometrical name for triangle *ACD* in (*c*)(ii).

2. There were more mistakes than usual in this year's surds question. In part (*a*), the fact the denominator was negative led to incorrect signs in the final answer, whilst in part (*b*) there were several examples of candidates who were unable to deal with $4\sqrt{169}$, $3\sqrt{196}$ and even $5\sqrt{9}$.

3. Part (*a*) caused very few problems. In part (*b*), however, many candidates put their expression for $\frac{\mathrm{d}y}{\mathrm{d}x}$ equal to the gradient of the normal at *Q* rather than the tangent.

4. The only difficulty which arose here was that in part (*b*), some candidates were unable to correctly identify as a maximum the stationary value of what was a negative quadratic expression.

5. Most candidates knew the correct form of the binomial in part (*a*) although there were some minor errors of computation. In part (*b*), some of the equations involving the coefficients of x and x^2 also contained x itself.

6. It was disappointing in this question to see so many candidates who had first of all correctly found the critical values then giving their final answer as 'either $x \geq -4$ or $x \geq -{}^{3}/_{2}$'. Those who drew a sketch were more likely to get the correct final range of values for x.

7. It was only part (*c*) that caused any difficulty here and most of the errors which occurred were arithmetic errors. Many candidates got the correct answer by simply dividing the cubic expression by $2x + 1$. Others successfully applied the remainder theorem to find $f(x)$ when $x = -\frac{1}{2}$. Unfortunately, evaluating $f(-1)$ and then dividing by 2 is not a valid method. Relatively few tried to use their answer to part (*b*).

8. Part (*a*) was well answered, but in part (*b*), many of the facts about the stationary point were incorrect whilst some of the statements made by candidates did not involve the stationary point at all.

9. It did seem that this year more candidates were able to find the derivative of the given expression from first principles using correct and consistent notation throughout.

10. This turned out to be quite a straightforward question as far as parts (*a*) and (*b*) were concerned but in general, answers to part (*c*) were not as good. It was not uncommon to see candidates trying to apply $b^2 - 4ac = 0$ in some way or another in this part.

MATHEMATICS

General Certificate of Education

Summer 2017

Advanced Subsidiary/Advanced

C2

General Comments

Candidates found this C2 paper to be similar in standard to the corresponding paper last year. There was no evidence that the paper was too long, as the vast majority of candidates attempted every question. As usual, many candidates lost marks due to poor algebraic skills, particularly in questions 2, 3, 5 and 7. The attempts at questions 9(*b*) and 10 were generally disappointing.

Individual questions

1. The majority of candidates scored full marks on this question.

2. Part (*a*) was generally well answered, though a small, but significant, number of candidates failed to correctly factorise the quadratic in $\sin\theta$. Part (*b*) was generally well done, but some candidates wasted time by forgetting that the angles referred to a triangle.

3. The simplification of $-2x(x + 5)\cos 60^\circ$ caused the only problem in this question.

4. It was surprising that many candidates failed to gain full marks for this proof. They either failed to write down at least three pairs of terms that included both the first pair and the last pair, or missed out the summation line for $2S_n$. Part (*b*) was very well answered with very few candidates using terms instead of sums. In part (*c*) the presentation and notation used often lacked precision, and many candidates wrote down a lot of unnecessary equations before suddenly realising that $5d = 45$ and that the required term equalled 2129.

5. Part (*a*) was generally well answered though a few candidates used the 13^{th} term and a few used S_{12}. The main error in part (*b*) was writing $100(1 - 1.2^n)$ as $100 - 120^n$. A large percentage of the candidates who derived $1.2^n = 31.948$ completed the question using logarithms or trial and improvement.

6. Part (*a*) was well answered and very few missed out the constant. Most candidates found $a = -4$ but were less convincing in proving that $b = 32$. A significant number of candidates gave the area of the triangle as -64 and even more made errors in using the limits correctly for the area under the curve.

7. The attempts at the proof seemed better this year, with most candidates scoring at least the first two marks. Very few correct solutions were seen for part (*b*). Although the power law was usually applied correctly, the plus sign between the second and third terms caused many candidates to apply the addition law instead of the subtraction law. A high level of success was seen in part (*c*).

8. Part (*a*) was generally well answered. In part (*b*), a few candidates had problems in expanding $(2x + 4)^2$, and the candidates who chose to factorise the quadratic, often forgot to state that due to the repeated root, the given line was a tangent. Candidates who used the discriminant were often more successful in producing a complete answer.

9. The majority of candidates scored full marks in part (*a*). The attempts at part (*b*) of the question were very disappointing. Very few candidates saw the need to express $R^2 - r^2$ as $(R + r)(R - r)$ in order to eliminate R and r, and derive an expression for K in terms of x and L. Some candidates substituted $R = r + x$ in both the expressions for L and K and a few were successful in deriving the required equation.

10. Part (*a*) had a mixed response with many candidates scoring 2 marks and many others scoring 0. The response to part (*b*) was also mixed, with most of the successful candidates stating that 29 999 998 was not a multiple of 3. Some candidates produced an alternative solution that all the terms of the sequence must end with 7 or 2.

MATHEMTAICS

General Certificate of Education

Summer 2017

Advanced Subsidiary/Advanced

C3

General Comments

This year, there was an increase of 3 in the mean mark and in general, candidates found the paper to be quite an accessible paper. However, there were questions which some candidates found difficult. These were 1(*b*), 5(*b*) and 6(*b*)(ii).

Individual questions

1. Part (*a*) caused very few problems but part (*b*) was poorly answered. One common error involved just multiplying the answer to part (*a*) by $-\frac{3}{2}$. Another was to write down $\int_5^7 \ln 3 \, dx = \ln 3$.

2. Many candidates were able to earn full marks on both parts of this question.

3. There were very few problems in part (*a*). Although part (*b*) was also generally well answered, there were examples of candidates getting the wrong power of $(7 + 4t)$ in the denominators of both $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$. There were also some examples of the incorrect use of notation throughout part (*b*).

4. The majority, but not all, of the candidates were able to gain full marks in part (*a*). By now, most are very adept at using their calculators to carry out iteration but several candidates lost the final mark in part (*b*) as a result of an incorrect final statement.

5. Part (*a*) caused very few problems. In part (*b*), however, it was clear that many candidates did not know the derivative of $\cot y$, nor did they realise that this information was given in the Formula Booklet. Different methods were used to find this derivative, but even so some candidates were not awarded the corresponding mark because they then wrote down $\frac{dy}{dx} = -\text{cosec}^2 y$. In order to give a complete solution to the question, candidates then had to substitute $1 + \cot^2 y$ for $\text{cosec}^2 y$ and then x for $\cot y$. Not all were able to do this correctly.

6. In part (*b*)(ii), it was disappointing to see that many candidates were unable to take the hint given in the question. Many of the attempts at integration here were totally incorrect.

7. In part (*a*), some candidates, after carrying out algebraic manipulation, claimed that there were no counter-examples to the given statement. This unfortunately did not take into account the fact that x could be negative. The majority of candidates were able to earn both marks in part (*b*), although it was not uncommon to see $a = -2$, $b = 6$ given as a solution.

8. Generally well answered. Although there were some examples of poor algebraic manipulation, many candidates were able to gain full marks on this question.

9. Another well answered functions question. The part which caused most difficulty was, perhaps surprisingly, part (*b*).

MATHEMATICS

General Certificate of Education

Summer 2017

Advanced Subsidiary/Advanced

C4

General Comments

The candidates' response to the paper was less positive than the previous year. Whilst most candidates coped satisfactorily with the standard questions, their performance on the rest of the paper was more mixed. The questions which caused most problems were questions 3(*a*), 4 and 9 and to a lesser extent, questions 2(*b*), 5(*b*) and 7(*b*).

Individual questions

1. (*a*) Well answered, with most candidates getting full marks.
   (*b*) Although many candidates realised that there was an increase of x^2-2x+1 in the numerator only a small number saw that they could factorise the quadratic and simplify the fraction. Many candidates expressed $\frac{x^2-2x+1}{(x-1)^2(x+4)}$ in partial fractions and then used their answer to part (*a*) to arrive at the final answer. Quite a few candidates went back to the beginning rather than use their answer to part (*a*).

2. (*a*) Caused very few problems.
   (*b*) This was a poorly attempted question. In addition, some candidates had only one answer to the quartic equation $x^4=16$, consequently losing two marks.

3. (*a*) There was a mixed response to this question. Many candidates changed $\cos^2 x$ into $1-\sin^2 x$ obtaining $8\sin^2 x-14\sin x\cos x-5=0$. After dividing through by $\cos^2 x$ and ending up with $-\frac{5}{\cos^2 x}$, the vast majority were not able to proceed. Many of them did not even divide the -5 by $\cos^2 x$. Nevertheless, quite a few candidates were awarded full marks for this question.

   (*b*)(i) Well answered, but some candidates lost unnecessary marks due to not expanding $\cos(\phi-\alpha)$ and not attempting to compare coefficients.
   (*b*)(ii) Many candidates were able to find the least value of the fraction, but they were not able (or they omitted) to state the value of ϕ for which it occurs.

4. There were only a few completely correct solutions to this question. Some candidates were unable to expand $(\cos x + \sec x)^2$ correctly and many did not know that $\cos x \times \sec x = 1$. Furthermore, quite a few candidates did not know how to integrate $\sec^2 x$ so they changed it to $\frac{1}{\cos^2 x}$ and then to $\frac{2}{\cos 2x + 1}$. It is important to note that the integral of $\sec^2 x$ is given in the Formula Booklet!

5. (*a*) Well answered, but a significant number of candidates left out the range of values of x for which the expansion was valid.
   (*b*) Only a few candidates realised that the expansion could be obtained by an appropriate substitution for *x* (i.e. $x = y + 2y^2$). It was disappointing to see many candidates splitting $(1 + 4y + 8y^2)^{-\frac{1}{2}}$ into $(1 + 4y)^{-\frac{1}{2}} + (8y^2)^{-\frac{1}{2}}$.

6. (*a*) The vast majority of the candidates were able to derive the equation of the tangent in the required form.
   (*b*) The majority of the candidates were able to derive the equation $p^3 - 12p + 16 = 0$. It is important to note that there has been an improvement in the solution of the cubic equation by use of the factor theorem. However, there were many candidates who did not show any working, but simply stated that $p = 2$, $p = 4$ omitting to convince us that they know that $p = 2$ is a repeated root and that there is not another solution to the cubic. Many also failed to notice that $p = 2$ corresponds to the point (4*a*, 8*b*).

7. (*a*) Generally quite well answered.
   (*b*) Many failed to notice that simplifying $\int x^3 \times u^4 \times \frac{du}{2x}$ would enable them to directly substitute for x^2. Instead they expressed *x* as $\sqrt{u-1}$, but were not able to use the rules of indices/surds successfully in order to fully simplify their expression in *u*.

8. (*a*) Well answered.
   (*b*) Many candidates were able to work through to the penultimate line, but unfortunately quite a few were not able to express *N* in terms of *t* correctly.

9. (*a*) This was a poorly attempted question. A good number of candidates were able to write down the vector **BC**, but many candidates were not able to derive the vector equation of BC in the given form. Many candidates are still leaving out the **r** on the left hand side of the vector equation of the line.
   (*b*) Many candidates used λ in the vector equation of this line as well which caused problems in part (*c*) as candidates ended up with two equations in terms of λ only.
   (*c*) Some candidates attempted to compare coefficients of their vector equations, but only a few managed to arrive at the final solution and find the position vector of the point of intersection.

10. This was another poorly attempted question. Although this type of question has been asked many times, candidates are still failing to get full marks. This is mainly due to candidates skipping steps and claiming that 7 is factor of *b*, before stating that 7 is a factor of b^2.

MATHEMATICS

General Certificate of Education

Summer 2017

Advanced Subsidiary/Advanced

FP1

General Comments

The candidature was generally good with some excellent scripts seen.

Comments on Individual Questions

1. This question was well answered by most candidates with very few arithmetic errors seen in determining the adjugate and inverse matrices.

2. Questions on this topic have been generally well answered in the past so it was a surprise to find that this question was the second worst answered question on the paper. Most candidates knew what had to be done but careless algebraic manipulation often led to errors being made.

3. This was the best answered question on the paper. The more common method was to find z in the form $x + iy$ and hence the modulus and argument of z, rather than find the moduli and arguments of each of the three complex numbers in the question and use those values to find the modulus and argument of z.

4. Part (a) was well answered by most candidates. In part (b), however, some candidates found it difficult to explain why T had no fixed points.

5. This question was well answered by many candidates using just two row operations. Some candidates, however, seemed to have no set procedure to follow so that they required more than two operations although usually ending up with the correct answer. Most candidates knew how to solve part (b) but some made algebraic errors in finding the expression for x.

6. Questions on induction have not always been well answered in the past but solutions to this question were generally good. It was pleasing to note that the final conclusion mark was usually awarded.

7. Candidates in general are fairly confident in dealing with problems involving logarithmic differentiation and this question was well answered by most candidates.

8. This was the worst answered question on the paper. Candidates who wrote

$$x + \mathrm{i}y = \frac{1}{u + \mathrm{i}v}$$

were usually able to obtain expressions for x and y in terms of u and v. However, some candidates began with

$$u + \mathrm{i}v = \frac{1}{x + \mathrm{i}y}$$

and then found that they ended up with expressions for u and v in terms of x and y. Attempts to invert these expressions to give x and y in terms of u and v were usually unsuccessful. Solutions to part (*b*) were reasonably good with algebraic manipulation the main source of error. Solutions to part (*c*) were generally disappointing with few candidates realising that the best method was simply to put $w = z$ and simply solve the equation $z^2 = 1$. Many candidates put $u = x$ and $v = y$ and attempted to solve the resulting equations with limited success.

9. This was a question involving quite a lot of algebraic manipulation but it was well answered by many candidates. Answers to part (*a*)(ii) were often disappointing with some candidates stating that the result implied that there were two imaginary rather than two complex roots.

MATHEMATICS

General Certificate of Education

Summer 2017

Advanced Subsidiary/Advanced

FP2

General Comments

The standard of the scripts was generally good with some excellent scripts seen. It would appear, from answers to Q8(*b*)(ii), that most candidates appear to believe that $\int \frac{1}{x}\,\mathrm{d}x = \ln x$ instead of the correct $\ln|x|$.

Comments on Individual Questions

1. Most candidates realised that they had to compare $f(x)$ with $f(-x)$ but it was surprising to see a number of candidates reaching the wrong conclusion.

2. This was the worst answered question on the paper with many candidates failing to spot that the integrand needed to be split into $2 - \frac{3}{x^2+4}$. Candidates who split the integrand into $\frac{2x^2}{x^2+4} + \frac{5}{x^2+4}$ were able to integrate the second term but almost invariably not the first. The first term can be integrated using the substitution $x = 2\tan\theta$ but this was not generally realised.

3. This question was well answered in general, the most common error being an incorrect argument for –8i.

4. Part (*a*) was well answered by most candidates. In part (*b*), most candidates expanded $(z + z^{-1})^5$ correctly but some candidates then equated this to $\cos^5\theta$ instead of $32\cos^5\theta$. This error was followed through in part (*c*) although the final mark could not be awarded because $\frac{256}{15}$ was deemed to be an unacceptable value for $\int_0^{\frac{\pi}{2}} \cos^5\theta\,\mathrm{d}\theta$.

5. Most candidates knew that $\cos\theta - \cos5\theta$ had to be changed into a product but a not uncommon sign error resulted in the incorrect equation $\sin3\theta\,(2\sin2\theta + 1) = 0$ instead of the correct equation $\sin3\theta\,(2\sin2\theta - 1) = 0$. At this stage, some candidates just cancelled the factor $\sin3\theta$ thereby losing some roots.

6. Most candidates found the partial fractions and then used their result to evaluate the integral in part (*b*)(i). Very few candidates gave a correct answer to part (*b*)(ii) with the great majority stating that the reason that $f(x)$ could not be evaluated over the interval $[-2,0]$ was that this would involve calculating the logarithms of negative numbers. It would appear that almost the entire candidature is unaware of the result that $\int \frac{1}{x}\mathrm{d}x = \ln|x|$ so that the modulus signs ensure that logarithms of negative numbers are never required.

7. Most candidates found the equation of the normal correctly and then substituted $(as^2, 2as)$ to obtain $2as = -ats^2 + at^3 + 2at$. Candidates who then wrote this as $2a(s-t) = -at(s-t)(s+t)$ were generally successful. Those candidates who attempted to solve the equation as a quadratic in s were often unable to proceed to the final result.

8. This question was well answered in general although some candidates were unable to solve part (*e*).

MATHEMATICS

General Certificate of Education

Summer 2017

Advanced Subsidiary/Advanced

FP3

General Comments

The standard of the scripts was generally good with some excellent scripts. However, solutions to Q1 were often much longer than necessary.

Comments on Individual Questions

1. This question was well answered in general with most candidates either introducing exponential functions or using $2\sinh\theta + \cosh\theta = r\sinh(\theta + \alpha)$. Several other successful methods were seen including starting with
$(2\sinh\theta)^2 = (2 - \cosh\theta)^2$ or $(2\tanh\theta + 1)^2 = (2\operatorname{sech}\theta)^2$.

2. This question was well answered in general. When faced with integrating $\dfrac{1}{3+2-t^2}$, candidates who completed the square in the denominator obtained the answer more quickly than those who introduced partial fractions.

3. This was the worst answered question on the paper. Most candidates were able to express the curved surface area in the form $2\pi\int_0^1 x^3\sqrt{1+9x^4}\,\mathrm{d}x$ but many were unable to take this result any further. Candidates were expected to see that, apart from a constant multiplier, x^3 is the derivative of $1 + 9x^4$ and then proceed appropriately.

4. Solutions to part (*a*) were often disappointing with algebraic errors seen. Parts (*b*) and (*c*) were well answered in general.

5. This was the best answered question on the paper although many candidates were unable to differentiate $\tan^{-1}\left(\dfrac{1}{\tanh\theta}\right)$ correctly. Some candidates rewrote this as $\tan^{-1}(\coth\theta)$ which is easier to differentiate

6. Solutions to part (*a*) were often disappointing with some candidates splitting the integrand into $\tan^{n-1}x\tan x$ and then attempting unsuccessfully to use integration by parts. Solutions to part (*b*) were sometimes incorrect due to algebraic errors being made.

7. Parts (*a*) and (*b*)(i) were well answered by many candidates. In part (*b*)(ii), many candidates failed to realise that the integration had to be done in two parts and that the answer to part (*b*)(i) was intended as a hint to indicate what these two parts were.

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GCE EXAMINERS' REPORTS

GCE
MATHEMATICS M1-M3 & S1-S3
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SUMMER 2017

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Annual Statistical Report

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MATHEMATICS

General Certificate of Education

Summer 2017

Advanced Subsidiary/Advanced

M1

General comments

This paper turned out to be generally accessible to most candidates. However, questions 3(*b*), 4(*c*) and 5(*c*) proved challenging and not many candidates managed to get full marks in question 7.

Comments on individual questions

1. This question gave the candidate a good start to the paper. There were the occasional sign errors in part (*b*) when candidates were either unsure or confused as to which direction they were taking as positive. A few candidates did not manage to isolate the forces acting on the man in part (*b*).

2. This question was generally well done by almost all but the weakest candidates. Some candidates made a sign error with the velocity of *Q* before collision either in one of the parts or sometimes in all of the parts except part (*d*).

3. Part (*a*) of this question was generally well done. However, in part (*b*), candidates failed to realise that as soon as the position of the man changes, the reactions at the pivot obtained in part (*a*) no longer holds. The majority of candidates tried to use the values obtained in (*a*) in part (*b*), even those who knew that the reaction of the pivot at *D* was zero.

4. The first 6 marks available in parts (*a*) and (*b*) were gained by the majority of candidates. In part (*c*), candidates managed to find the distance travelled during deceleration by a variety of methods, all correct. Hence the magnitude of the deceleration was also correctly found, but they did not manage to finish the question with a correct N2L equation, taking into account the resistance found in part (*b*).

5. Part (*a*) was a standard connected particles question and was generally well done by most candidates. Part (*b*) was also reasonably well done except for those candidates who used *g* as the acceleration, not realising that the correct acceleration to use was the one obtained in part (*a*) as the string was still taut. The response to part (*c*) was poor. Most candidates did not manage to find the component of *g* down the slope, which was the correct one to use.

6. Most candidates thought this was an easy 4 marks. The most common error was adding the masses up incorrectly.

7. Almost everyone manage to find the correct limiting frictional force. Many went on to find the correct maximum T, but inexplicably, many thought that the friction was zero when it came to finding the minimum value for T.

8. This was an easy question with no complications on this part of the syllabus and as such was well done generally. In part (*b*), many candidates did not manage to identify the correct right angled triangle.

MATHEMATICS

General Certificate of Education

Summer 2017

Advanced Subsidiary/Advanced

M2

General comments

This paper turned out to be rather more challenging than previous papers on this syllabus. Many candidates found questions 4 and 5 particularly difficult. Some did not know how to start, whilst others went down the wrong path altogether. In addition, many also had difficulties with questions 1 and 7. However, all questions should be accessible to candidates and several full mark scripts were seen.

Comments on individual questions

1. Disappointingly, in part (*a*)(i) the majority of candidates did not realise that the expressions to be differentiated consisted of products and therefore the product rule should be used. Many also did not seem to know how to find the speed given the velocity vector and simply ignored this part of the question. In part (*a*)(ii), some candidates, who found the speed, gave as their answer, the magnitude of the momentum instead of the required momentum vector. Part (*b*) was well done generally.

2. Full marks were gained by many candidates in this question.

3. This question was generally well done with a few candidates omitting the component of weight down the plane in their N2L equations.

4. In part (*a*), candidates did not seem to realise that for collision to occur, the particles needed to be at the same place at the same time. Therefore the particles had to be at the same height at the same time. This means that the initial vertical velocities were the same and indeed the particles must be travelling with the same vertical speed at the same time. Thus v could be obtained either by equating the initial vertical speed, or the speed at time t seconds, or the vertical height at time t s. In part (*b*), horizontal distances needed to be considered. Many candidates were able to recover in part (*c*) to gain the four marks available there.

5. This question required energy considerations. However many candidates proceeded by assuming that the tractive force/acceleration is constant which is not correct. This was a serious mistake and almost always lost the candidates all the available 8 marks. Even those who did consider energy were not able to calculate the work done by the engine (rate of work × time) and many simply omitted this term in their energy equation.

6. Candidates were back on familiar grounds with this vertical circular motion question. The main error was in the energy equation in part (*a*) where candidates treated the problem as if motion started at the bottom of the circular path instead of at 60° to the downward vertical. The concepts required in parts (*c*) and (*d*) did not seem to be widely known.

7. Part (*a*) was very badly done, but this is usual in this part of the syllabus. I am glad to report that many candidates recovered to make decent attempts at part (*b*), which was a question on elasticity.

MATHEMATICS

General Certificate of Education (Legacy)

Summer 2017

Advanced Subsidiary/Advanced

M3

General comments

Most candidates found the first 4 questions of the paper accessible, though question 4(*d*) was very badly done. Question 5 proved to be challenging. Most candidates recovered to give a good performance in question 6. On the whole, the paper is of a reasonable standard. A great many excellent scripts were seen. While most candidates presented their work logically and clearly, there were also some scripts which were very difficult to mark as candidates did not state clearly what they were trying to achieve.

Comments on individual questions

1. This question provided a good start to the paper.

2. Most candidates gained full marks on this question.

3. Parts (*a*) and (*b*) were generally well done. In part (*c*), a minority of candidates tried to use the initial conditions before finding the particular integral. Some had the wrong form for the Complementary function, using the one appropriate for repeated roots instead. Some candidates lost the root $m = 0$.

4. Parts (*a*) and (*b*) were well done. In part (*c*), some candidates elected to integrate the expression for v found in (b), which is in terms of t. This was fine if they remembered to use the substitution $v = 12t + 1$ at the end. However many candidates who used this method forgot this last step. Part (*d*) caused problems for many candidates. Some simply found the work done which was not requested. Perhaps there would have been a better response if the question had asked for the power instead.

5. Not many completely correct solutions were seen. Candidates started by differentiating either an expression for v obtained by taking the square root, or by differentiating v^2 using implicit differentiation. The mistake was not realising that the differentiation was wrt x and not t and therefore did not result in the acceleration. Some candidates did not realise that $v\mathrm{d}v/\mathrm{d}x$ was the acceleration. Many candidates also made a sign error by writing $-4x + 4$ as $-4(x + 1)$. Candidates could have also completed the square to obtain $v^2 = 2^2[2.5^2 - (x - 1)^2]$. This gave ω, the centre and the amplitude all at once. Some candidates wrote $-4x^2 + 8x + 21 = \omega^2(a^2 - x^2)$, forgetting that the x on the LHS is displacement from the origin while the x on the RHS is displacement from the centre. Therefore this will only be correct if the centre is at 0. The fact that the centre of the motion is at $x = 1$ also caused problems for candidates in part (*c*). Quite often $x = 3$ was seen, while the correct value to use was $x = 2$.

6. This question was reasonably well done. Some candidates had the friction at the wall in the wrong direction. The most common errors were algebraic ones, or omitting one of the relevant forces, usually the friction, when taking moments.

MATHEMATICS

General Certificate of Education

Summer 2017

Advanced Subsidiary/Advanced

S1

General Comments

The same general comment made last year is still appropriate, namely that the candidature covered the whole range with some candidates completely out of their depth at this level but also many candidates submitting excellent scripts.

Comments on Individual Questions

1. Part (*a*) was well answered by most candidates although those who just wrote

   $$P(A \cap B) = 0.1,\ P(A)P(B) = 0.06 \text{ therefore not independent}$$

   were not given the final mark on the grounds that in a 'show that' question, you have to explain why the numbers that you have obtained justify the required result. Parts (*b*) and (*c*) were not so well answered in general with some candidates assuming that *A* and *B* were independent in spite of proving the contrary in part (*a*). Candidates who drew a Venn diagram were generally more successful than those who relied on just algebra.

2. This question was well answered by many candidates. Calculating Var(*Y*) was the least well answered part of this question with $\text{Var}(Y) = 2^2 \times \text{E}(X)$ seen not infrequently.

3. This was by far the best answered question on the paper.

4. This was the worst answered question on the paper. A fairly common error in part (*a*)(i) was to misinterpret 'at least one' as meaning either 'more than one' or 'exactly one'. Solutions to part (*b*) were poor in general with many candidates unable to write down an expression for p_n. Candidates who wrote down a correct expression for p_n were often unable to solve part (*b*)(ii) correctly. Some candidates simple evaluated p_n for increasing values of *n* which was of course accepted as a valid method.

5. Part (*a*) was reasonably well answered although some candidates found the transition from B(10,0.7) to B(10,0.3) beyond their capability. In part (*b*), some candidates rounded the Poisson mean from 2.64 to 2.6 in order to use the Poisson table, a method which was not accepted.

6. Solutions to part (*a*) were generally good although some candidates made arithmetic errors in calculating the variance. Solutions to part (*b*) were often disappointing with many candidates failing to realise that the only possibilities were two 5s and one 4. Even candidates who realised that were often unable to calculate the required probability.

7. It has been reported previously that candidates are generally well able to solve problems involving the Law of Total Probability and Bayes' Theorem, often using a tree diagram, and part (*a*) was indeed very well answered. However, candidates find two-stage problems such as part (*b*) much more difficult and solutions to part (*b*) were generally poor. Candidates need to realise that Bayes' Theorem is a means of updating probabilities in the light of observed results so that part (*b*) was just a repetition of part (*a*) with the probability of the animal having the disease updated from 0.05 to 0.716... Then, of course, after the second test is positive, this probability is updated further to 0.991...

8. As reported previously, some candidates are far from comfortable dealing with continuous distributions. In part (*a*)(ii), some candidates calculated the 95^{th} percentile incorrectly as $F(0.95)$ instead of solving $F(m) = 0.95$. Many candidates were unable to solve part (*a*)(iii) with most candidates failing to realise that the required probability was given by $\dfrac{F(1.25)}{F(1.75)}$. In part (*b*), many candidates used differentiation correctly to find an expression for $f(x)$. However, many solutions to part (*b*)(ii) showed a complete lack of understanding of the process of integration.

MATHEMATICS

General Certificate of Education

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S2

General Comments

The general standard was good with a handful of excellent scripts. Many candidates lost marks by failing to interpret *p*-values in context when required and by using incorrect or no continuity correction when using a normal approximation.

Comments on Individual Questions

1. Part (*a*) was well answered by most candidates. However many candidates were unable to answer part (*b*) correctly. Although realising that

   $$P(W = 0) = P\{(X = 0) \cup (Y = 0)\}$$

   most candidates then assumed that the events $X = 0$ and $Y = 0$ were mutually exclusive so that

   $$P(W = 0) = P(X = 0) + P(Y = 0)$$

   not realising that the term $P\{(X = 0) \cap (Y = 0)\} = P(X = 0) \times P(Y = 0)$ had to be subtracted.

2. This was the best answered question on the paper. The most common errors were using an incorrect or no continuity correction and failing to interpret the *p*-value in context.

3. Parts (*a*) and (*b*) were well answered in general. Solutions to part (*c*), however, were often disappointing. The solution depended upon introducing the random variable $U = X_1 + X_2 + X_3 - Y_1 - Y_2$ and calculating $E(U)$ and Var(U). Some candidates used the incorrect notation $3X - 2Y$ which was condoned if the variance was calculated correctly but this notation often led to an incorrect variance and it should not be used in this way.

4. Part (*a*) was well answered in general, the most common error being an incorrect standard error. Solutions to part (*b*) were not so good in general with most candidates finding the correct *z*-value, 2.4, but then unable to convert this to the correct confidence level.

5. Solutions to part (*a*) were often disappointing with some candidates unable to switch correctly from B(50,0.75) to B(50,0.25). Some candidates tried to avoid this problem by using a normal approximation but this was not accepted.

6. Most candidates were unable to give a correct solution to part (*a*)(i), not realising that the wording of the question required a statement that $f(x) = 0$ otherwise. Solutions to part (*a*)(ii) and (iii) were generally good, the most common errors being in the algebraic manipulation. Solutions to part (*b*) were generally poor with many candidates uncomfortable when dealing with the probability distribution of $\frac{1}{X}$.

MATHEMATICS

General Certificate of Education

Summer 2017

Advanced Subsidiary/Advanced

S3

General Comments

The standard of the scripts was generally good with some excellent scripts. It was surprising to find that a number of candidates with full marks on all the other questions were unable to make any impression on question 2.

Comments on Individual Questions

1. This was the best answered question on the paper with arithmetic error the main cause for obtaining an incorrect interval.

2. This was by far the worst answered question on the paper. In part (*a*), some candidates, thinking that sampling was without replacement, began by attempting to enumerate all the possibilities. Some simply wrote that

$$P(X \le x) = \left(\frac{x}{6}\right) \times \left(\frac{x}{6}\right) \times \left(\frac{x}{6}\right) = \left(\frac{x}{6}\right)^3$$

without any justification and were of course given no credit. In part (*b*), many candidates were unable to determine an expression for $P(X = x)$. Some produced a table giving correct probabilities for all values of x but this was not accepted because the question asked for an expression in terms of x. In part (*c*), many candidates thought incorrectly that 'the most likely value' meant 'the mean value' and calculated $E(X)$ often obtaining 3.5.

3. This question was well answered by many candidates. The most common errors seen were an incorrect standard error and a failure to give the conclusion in context.

4. Part (*a*) was well answered by most candidates. As reported previously, however, most of the candidates are unable to explain correctly what is meant by a confidence interval. The most common incorrect answer was along the lines of 'a 95% confidence interval is an interval within which we are 95% confident that the value of p lies'. This may be an acceptable explanation to give to a lay person but it is not acceptable in an A-level Further Mathematics examination.

5. Most candidates realised that because the variance had to be estimated, the t-distribution had to be used to determine the confidence interval.

6. Candidates are generally confident in solving questions on this topic and most candidates found a and b correctly, almost invariably by first calculating S_{xx} and S_{xy}. In part (*b*), the candidates were expected to refer to the Formula Booklet to recall the standard error of *b*. Some candidates, however, chose the wrong standard error formula and some even thought that the standard error was $\frac{0.2}{\sqrt{6}}$, ie $\frac{\sigma}{\sqrt{n}}$.

7. This was a signposted question on estimation theory and solutions were generally better than solutions to questions on this topic in previous years. Most of the errors made were due to faulty algebraic manipulation although candidates who made errors were usually able to re-enter the question later on and gain credit.

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