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Examiners' Report

Edexcel GCE

Mathematics

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Core Mathematics Unit C1

Specification 6663

(Maximum mark: 75)
(Mean mark: 55.1; Standard deviation: 18.4)

Introduction

This paper gave the average AS candidate plenty of opportunity to demonstrate knowledge and understanding of the specification. Good marks were frequently earned on the first five questions and, while some aspects of the later questions proved more demanding, most candidates were able to accumulate enough marks to achieve a respectable total.
Most candidates appeared to have time to attempt all ten questions to the best of their ability. Despite having to manage without a calculator, most coped well with the level of arithmetic required. While many showed their methods clearly, there was often evidence of poor notation, which sometimes made it difficult for examiners to interpret candidates' intentions.

Report on individual questions

Question 1

There were many completely correct answers to this question. The vast majority of candidates knew that a square root was required in part (a), but part (b) caused a few more difficulties, with the negative power not always being interpreted to mean a reciprocal. Some cubed 16 before finding a square root, making unnecessary work for themselves, while others evaluated $16^{-\frac{3}{2}}$ as 12 or 48.

Question 2

This was a standard test of candidates' ability to differentiate and integrate. Answers to part (i)(a) were almost always correct, but in (i)(b) a few candidates seemed unfamiliar with the idea of a second derivative. Before integrating in part (ii), it was necessary to consider $\sqrt{x}$ as $x^{\frac{1}{2}}$ and $\frac{1}{x^2}$ as x^{-2}, and this step defeated some candidates. Apart from this, other common mistakes were to integrate x^{-2} to give $\frac{x^{-3}}{-3}$, to interpret $3\sqrt{x}$ as $x^{\frac{1}{3}}$ and to omit the constant of integration.

Question 3

Those candidates who equated the discriminant to zero to form an equation for k were often successful in reaching a correct answer, although a common mistake was to proceed from $4k^2 = 144$ to $4k = 12$. Other approaches, which included completing the square, factorisation attempts and trial and error, were rarely successful.

Question 4

Many candidates were able to produce fully correct solutions to this question. A small minority had difficulty in obtaining an equation in one variable, but apart from this, algebra was generally sound and mistakes were usually minor. Occasionally, having found values for x (or y), candidates failed to continue to find values for the other variable.

Question 5

Although just a few candidates were completely confused by the demands of this question, the vast majority scored full marks in parts (a) and (b). An occasional mistake in part (b) was to give –2 rather than 2 as the common difference. Part (c), however, in which a general formula for the sum to n terms had to be established, caused more difficulties. Those who used the arithmetic series sum formula with n as the number of terms were usually able to proceed convincingly to the given answer, but no credit was given to candidates who simply verified the given formula for a few specific values of n.

Question 6

Although there were many correct solutions to part (a), a substantial number of candidates thought that $y = -\mathrm{f}(x)$ could be represented by a reflection in the y-axis rather than the x-axis. In part (b), a method mark was given for an attempted "stretch" parallel to the x-axis, but other types of transformation were frequently seen, including stretches in the wrong direction, two-way stretches and a variety of translations. Stretching by a factor of 2 instead of $\frac{1}{2}$ was a common mistake.

Question 7

The main difficulty in part (a) of this question was the inability to divide correctly to express $\frac{5-x}{x}$ as two separate terms. Although $5x^{-1}$ was commonly seen, $\frac{x}{x}$ frequently became zero. This mistake still led to a value of 3 for the derivative, so usually went unnoticed by candidates (but not by examiners). The given answer in (a) enabled most candidates to proceed with parts (b) and (c), where there were many good solutions. Some thought, however, that for $\frac{\mathrm{d}y}{\mathrm{d}x} = 3$, the gradient of the tangent was $-\frac{1}{3}$, showing confusion between tangents and normals. Occasional slips were seen in part (c), but most candidates realised that the use of $y = 0$ was required to find the value of k.

Question 8

In part (a), most candidates were able to find, by one means or another, the coordinates of the point C. The given diagram seemed to help here, although it was disappointing that clearly inappropriate answers were sometimes not recognised as such. A few candidates made heavy weather of this first part, calculating distances or finding an equation for the line AC.
Methods for part (b) were generally sound, with the gradient condition for perpendicular lines well known, but numerical slips were common and, as usual, there were candidates who failed to give their equation in the required form, thereby losing the final mark. It was quite common in part (b) for candidates to find an equation for AC (which was not required) rather than simply to write down its gradient.
Weaker candidates sometimes omitted part (c), and others used unnecessarily lengthy methods to find the equation of the line AB ($y = 7$), perhaps getting it wrong and then trying to solve awkward simultaneous equations. Some candidates made false assumptions, perhaps taking E to be the mid-point of AB.

Question 9

In this question the demands parts (a) and (b) were sometimes confused, with candidates not making it clear whether they were finding the equation of the curve or the normal. The tangent equation was also frequently seen as a solution to part (a). Apart from these problems, many good solutions were produced for part (a), and most candidates were able to expand $(3x-1)^2$ correctly and to proceed to integrate in part (b) to find the equation of the curve. Occasionally candidates failed to use the fact that $P(1, 4)$ was on the curve and left their answer as $y = 3x^3 - 3x^2 + x + C$, losing two marks. Part (c) proved difficult for many candidates. Some omitted it, others stated the gradient of the given straight line and proceeded no further, and some only considered the gradient of the curve at a specific point. There were, however, some very good solutions to this part, in which candidates explained clearly why there was no point on the curve at which the tangent was parallel to the line. A popular approach was to form a quadratic equation by equating $(3x-1)^2$ to –2, then to show that the equation had no real solutions. Mistakes included equating $(3x-1)^2$ either to $-2x$ or to $1 - 2x$.

Question 10

Most candidates were familiar with the method of "completing the square" and were able to produce a correct solution to part (a). Sketches in part (b), however, were often disappointing. Although most candidates knew that a parabola was required, the minimum point was often in the wrong position, sometimes in the fourth quadrant and sometimes at (3, 0). Some candidates omitted part (c), but most knew what was required and some very good, concise solutions were seen. Those who used the answer to part (a) and formed the equation $(x-3)^2 + 9 = 41$ were able to proceed more easily to an answer from $x = 3 \pm \sqrt{32}$. Some candidates found difficulty in manipulating surds and could not cope with the final step of expressing $\sqrt{32}$ as $4\sqrt{2}$.

Core Mathematics Unit C2

Specification 6664

(Maximum mark: 75)
(Mean mark: 61.0; Standard deviation: 14.7)

Introduction

There were a number of year 13 candidates taking this paper in order to transfer to the new specification. As the content of C2 was largely work they had covered last year, the examiners were not surprised to see some extremely good scripts and many scoring full marks. For the intended target audience the paper worked well too, it was an accessible paper and most candidates were able to make a positive attempt to all the questions. Question 3 on logarithms and parts of questions 7 and 9 proved to be fairly discriminating. A number of candidates squandered marks by either not following the instructions in the questions (e.g. not writing answers to the requested degree of accuracy), or by making basic errors with signs (e.g when expanding brackets, changing sides in equations or simply copying from one line to the next.)

Report on individual questions

Question 1

This was usually answered very well with many totally correct solutions. Candidates who tried to remove a factor of 3^5, often made mistakes or forgot to multiply their terms by 243. By far the most common error was a failure to include brackets in the 3rd term and $2x^2$ rather than $(2x)^2$ was seen all too often. A few candidates had not understood the $\binom{n}{r}$ notation for binomial coefficients. Some wrote $\left(\frac{5}{2}\right)$ and occasionally this was interpreted as 2.5.

Question 2

Most candidates found the mid-point correctly in part (a). The commonest mistake was to use $\left(\frac{x_1 - x_2}{2}, \frac{y_1 - y_2}{2}\right)$ leading to (4, 6). There was some confusion in part (b) between the radius and the diameter and some candidates had difficulty in halving the diameter when in surd form. Most used $(x-9)^2 + (y-5)^2 = r^2$ to write down the equation of the circle as intended but some misquoted the formula with + signs, others used the diameter instead of the radius and some used *A* or *B* instead of the mid-point. A few candidates tried to use "*f*,*g* and *c*" formulae but usually without success. An interesting and successful alternative approach used the angle in a semicircle theorem. By defining a general point *P*(*x*, *y*) on the circle and simply equating the product of the gradients *AP* and *BP* to -1, the equation of the circle can be found without using the mid-point or finding the radius.

Question 3

Part (a) was usually answered well although some only got as far as $x = \log_3 5$ and either couldn't evaluate it, or failed to read the instruction to give to their answer to 3 significant figures. Some who did evaluate successfully then rounded cumulatively to obtain 1.465 leading to 1.47 but many candidates scored full marks here. A number of candidates used a trial and improvement approach in part (a). Whilst the answer could be obtained in this case it is not a recommended procedure for this type of question. Part (b) was one of the most discriminating parts of the paper. Whilst a reassuringly high proportion of candidates did achieve full marks here many incorrect procedures were seen. Log(2x +1) = log2x + log1 was quite common and a number of students drifted from $\log_2\left(\frac{2x+1}{x}\right)$ to $\frac{\log_2(2x+1)}{\log_2 x}$ apparently believing them to be equal.

Question 4

Most candidates knew the appropriate trigonometric identity to answer part (a) and full marks were usually score here. The candidates usually went on to solve the equation correctly but some errors occurred after this. Some students realized that x = -90 was a solution to sin$x$ = -1, but could not find its equivalent value in the required range, sometimes listing 90 instead or indeed as well. Many students found the other two solutions in the 1st and 2nd quadrants, but some false solutions occasionally appeared based on $180+\alpha$ or $360-\alpha$.

Question 5

The remainder theorem was the favoured (and intended) approach here and there were many perfectly correct solutions to this question using, only a small minority losing marks due to algebraic slips. Those who tried to use long division were usually less successful in obtaining two correct equations. Part (b) is a "show that" question and therefore requires some comment from the candidates in order to secure full marks, some merely showed f(3)=0 and therefore lost the final mark.

Question 6

Apart from the small minority who had little idea how a geometric series was defined most made good progress with this question. Part (a) caused the most problems with many candidates taking very circuitous routes, often involving finding the first or third term, to reach r = 0.9. Some forgot to square root and used r = 0.81 throughout the question.

Part (b) caused few problems and apart from a few candidates who used 49 instead of 50 in their formula for the sum in part (c) the only difficulty here was confusion between 3 d.p. and 3 s.f., but the mark scheme allowed many to gain full marks in part (d). Part (d) was answered well, although candidates with incorrect values of r (and $|r|>1$) had no qualms about using the S_∞ formula.

Question 7

Part (a) was answered very well by almost all the candidates but part (b) caused problems for many. Some assumed the triangle was right angled at *B*, but many tried to use the cosine rule. Despite the formula being given in the new formula sheet a few candidates misquoted it (having sin(0.7) instead of cos(0.7)) and the radians caused some confusion with many choosing to use degrees and occasionally forgetting to use the degree formula for sector area in part (c). Of those who had a correct expression for *BC*, some could not evaluate it correctly and others rounded too soon. Most could identify the 3 lengths required for the perimeter but the final mark required an answer of 15.7 only and was sometimes lost due to previous errors or a failure to round at this final stage. Part (c) was, in the main, handled well and most found the area of the sector correctly but some elaborate, and sometimes incorrect, methods for finding the area of the triangle *ABC* were used. The intended approach was to use $\frac{1}{2}\times 8\times 11\times \sin(0.7)$ but some identified this formula but could not apply it correctly (*BC* was sometimes used instead of *AB* for example) and a few forgot to switch the mode on their calculator to evaluate sin(0.7). Nevertheless there were a number of candidates who scored full marks on this part of the question.

Question 8

This question was caused few problems for the majority of candidates. Part (a) was answered very well mistakes were usually simply errors with signs. A small minority ignored the instruction to "use algebra" and used a graphical calculator or some form of trial and improvement to find the coordinates of *A* and *B*, they scored no marks in part (a) but were allowed to use these results in part (b). The most popular approach in part (b) was to find the area of the trapezium and subtract the area under the curve. The integration and use of limits was nearly always carried out correctly and many correct solutions were seen. The alternative approach of subtracting first and then integrating was often attempted the wrong way around, candidates found the curve minus the line and then had to "lose" the extra minus sign at the end. Most candidates gave the exact area but some gave up this final mark in favour of a decimal approximation.

Question 9

Part (a) was the worst answered part of the paper. Writing down a correct expression for the perimeter of the stage caused many problems: some had a $4x$ term whilst others thought the radius of the semicircle was $2x$. Those that used correct expressions for both area and perimeter could often proceed to the printed result but some incurred sign errors on the way. The remainder of the question was handled quite well with most showing a clear understanding of the methods required. There was some poor algebraic manipulation in part (b) and this cost many candidates several accuracy marks, $x = \dfrac{80}{4-\pi}$ was a common incorrect answer. Most used the second derivative, with a comment, in part (c) as intended although some successfully examined the gradient either side of their stationary point. Whether through tiredness or genuine confusion, several candidates substituted an incorrect value in part (d), usually the value for their second derivative from part (c), and a number of candidates forgot to square their value in the second term of the expression for the area. Most of those who got to part (d) rounded to the nearest m^2 as requested.

Pure Mathematics Unit P1

Specification 6671

(Maximum mark: 75)
(Mean mark: 47.2; Standard deviation: 17.4)

Introduction

The standard of answers on the whole was good, and candidates usually presented their solutions well. They did not appear to be short of time, though a number of candidates made little attempt at question 8, and a number made slips in their solution to the final part of Question 9. Question 4(a) discriminated well, as did Question 6(b) and Question 8(c).

Report on individual questions

Question 1

This question was answered very well. Nearly all of the candidates managed to substitute correctly to get the correct quadratic, and most then found two values of one variable. Many also found the corresponding values of the other variable, though some candidates forgot to do the last step of finding the other values. A significant minority subtracted the original equations, but a number of these made errors or were unable to rearrange $x^2 - x = 12$.

Question 2

Some candidates didn't attempt this at all. Those who did, generally got the first M1. A lot managed to factorise correctly or solve using the formula to get 0 and -1. Some however divided through by cos θ to lose the cos θ=0 solutions. The solution $\frac{3\pi}{2}$ was frequently omitted or written as $\frac{3\pi}{4}$.

Most candidates who had the correct answers did give them in the correct form ; 1.57, 3.14, 4.71 or 90, 180, 270 were seen only a few times. Extra solutions of 0 and 2π unfortunately were seen quite frequently.

Question 3

(a) Generally this was done very well with most candidates who used the factor theorem getting both marks. A few didn't get the A1 for giving a statement, and a few also used long division instead of the factor theorem so had no marks at all.

(b) The majority of candidates used long division , and mistakes, if made, were on the subtraction within the division (b=-5 was regularly seen). A number of candidates multiplied out and compared coefficients.

(c) Full marks was common, but those who lost marks seemed to be reluctant on a maths paper to write words! Conclusions were often missing or incomplete, and mistakes were made with the definitions of factor and solution – statements such as the solution or root is x-2 , or x=2 is a factor were seen often.

Question 4

(a) B1 seemed to be the most common mark for this part for the 8x. Many had no idea how to deal with the other part – some tried to multiply out but got confused by the indices. Others did successfully use the quotient rule, and some were able to deal with the differentiation correctly.

(b) The first M1 was given often, and quite a few gained the second M1 as well. The most common mistakes here were to have +½ as an answer, or $\sqrt[3]{5/8}$ from incorrect working in (a)

(c) The majority of candidates used the second differential method rather than considering the sign of dy/dx either side of the turning point. Some sadly didn't have a value for x to substitute, and others didn't have an x term in their expression for $\frac{d^2y}{dx^2}$. (The most common wrong answer was just $\frac{d^2y}{dx^2}=8$). If the candidate had parts (a) and (b) correct, they generally had (c) correct as well.

Question 5

(a) This was very well answered and the most common mistake was to use (1-p)/2=8 rather than (1+p)/2=8

(b) This was also generally answered very well. Some candidates did far too much work however, by finding the equation of the line ADC, instead of just the gradient. The most common mistake was to have 5/7 instead of -5/7, but even the candidates who had the wrong gradient were able to go on and gain marks for finding the perpendicular gradient and using the point (8,2) to find the equation of the line. Some didn't write their final answers as integers and so didn't get the final mark.

(c) Most gained M1 as they realised y=7 had to be used, and if they had the right equation they generally had the A1 too, although some candidates put their answer straight into decimal form. A significant number of the candidates assumed that D was the mid point of AB.

Question 6

(a) Most candidates had the area correct, but many had the perimeter as P=rθ only, and so were only able to go on and get an M1 in the next part. Another common mistake was to take the angle as (2Π-θ) or (360-θ) and so again only method marks could be obtained in part (b)

(b) The majority of candidates gained the M1 here, and generally those who had (a) correct had at least M2 in (b), and quite often all three marks.

(c) Generally this was very well answered. Even those who had very few marks in the first 2 parts were able to get full marks here. The most common errors were to get 4-1=3 as the denominator, or to do 2(√2+1)=2√2+1 as the numerator. Unbelievably some candidates took their wrong answer in (b) and tried to rationalise that in (c) rather than use the surd given on the question paper.

Question 7

Parts (a) and (b) were answered very well, with many candidates gaining full marks on these parts. The most common mistakes were to use $S_n=325$ rather than U_n in part (a), and to use the wrong formula in (b) e.g. n/2(a+(n-1)d)

(c) This caused major problems, and very few candidates had this correct. Many tried to use a GP with r=0.02, Those who did decide that r=0.98 tried to use the Sum formula, or use 7200(0.98) to the power of 23, 35, 36, 2 or 3. Some candidates who had the correct answer failed to give it to the nearest £ to gain full marks.
Sadly, some candidates didn't use any formulae at all, and calculated all values in all three parts – often coming up with the right answer, but it must have taken a very long time!

Question 8

Not enough steps of working were shown by many candidates here. Frequently k=√3/sin60=2 was stated without reference to the fact that sin60=√3/2

(b) This was well answered and many candidates had both parts correct. Of those who didn't quite a few gained a B1 follow through for p+180.

(c) Most candidates gained a few marks here, but not many had full marks. The most common mistakes were to find -53.1, then subtract the 60 to get -113.1 resulting in 180-113.1 and 360-113.1. Some didn't give their answers to 1dp, and others mistakenly stated that 0.8=sinx+sin60 and proceeded to geta range of erroneous solutions!

Question 9

(a) This was generally answered very well. Many candidates scored full marks, with others gaining B1, M1, A0, for answers such as $(x-3)^2-9$, or -27, or +27

(b) The majority of candidates did not use their (a) to get the answer in (b) but used differentiation. This meant that most candidates had this part correct, even if they had (a) incorrect or didn't attempt it.

(c) Again this part was well answered, especially by those who had done the differentiation in (b) as they went on to get the gradient of -6, and used (0,18) to get the equation of the line. Unfortunately, some assumed the coordinates of Q at (3,0), and found the gradient using the points A and Q, so didn't gain many marks at all in this part.

(d) Generally if candidates had answered part (c) correctly, they were able to do part (d) as well, although quite a few lost credibility because they stated that the gradient was 0. Many compared the x coordinates and deduced the line was parallel to the y axis and gained the credit.

(e) This was very well answered. Many candidates had full marks in this part even if they hadn't scored full marks earlier. A few candidates made the mistake of using the y value of 9 instead of the x value of 3 in the integral. Other errors included using a trapezium instead of a triangle, and some candidates made small slips such as the 18 being copied down as an 8 or integrating the 6x to get 6x/2, or $6x^2$. It is possible that these candidates were short of time.

Pure Mathematics Unit P2

Specification 6672

(Maximum mark: 75)
(Mean mark: 47.8; Standard deviation: 16.2)

Introduction

The paper seemed to be accessible to the majority of candidates and it was pleasing to see even the less competent candidates finding parts of questions that they could tackle with confidence. In general, the standard of presentation and the overall understanding of the topics tested were good. The only real problem is where candidates write their answers somewhere other than the pages allocated for the question and give no indication on doing so.

Questions 3 and 7(a) and (b) proved challenging even for the most able students. Few candidates matched the amount of time spent on a question to the number of marks available. Many candidates wasted time writing out vast intricate mathematical equations in an attempt to gain 1 or 2 marks.

Most candidates seemed to have the time to do themselves justice, although there was some evidence of rushed attempts at question 8.

As usual, poor understanding of basic (GCSE) algebra was the undoing of many. Squaring, cancelling, adding to/subtracting from both sides of equations all seemed techniques not practised by a large proportion of candidates. This was particularly evident in Questions 1, 3, 4, 5, 6, & 8

Answer also often "magically" emerged from incorrect working. A good example of this was in question 8(a) where candidates integrated $1/2x$ to $2x^{-2}$ and $\ln x/2$ to $2/x$ followed by lots of fudging to gain $x = ½$.

Report on individual questions

Question 1

Well received and well answered by the vast majority of candidates, who produced neat and concise solutions. Most errors were made in part (b) where the solutions were given as either ± 2 or just $\sqrt{2}$.

Question 2

Usually well done, though reflecting the part of the curve below the x-axis in part (a) defeated most. In part (b) many candidates drew $y = f(x/2)$. In part (c) the majority of candidates knew it was a reflection in the line $y = x$, with some losing marks for $x< -2$. The common error was the coordinates of the intercepts being interchanged.

Question 3

This question was poorly answered. Many candidates started by using $u_{n+1} = (-1)^{n+1}u_n + d$ or by establishing a value for d, usually by creating a u_0. The fact that all these also gave $u_5 = 2$ tended to lull candidates into a false sense of security. In part (b) most candidates realised $u_{10} = u_2$.In part (c) those who were not successful in (a) did on the whole recalculate u_2 and u_3, and then equate u_3 to $3u2$ to gain the method mark

Question 4

This question was either very well answered with students gaining full marks but a minority of candidates rotated about the wrong axis, whilst retaining the y limits (8 & 4). Those who attempted the correct formula often made errors in their algebra. Many candidates thought $\sqrt{(y - 4)} = \sqrt{y} - 2$ and then squared this.

Question 5

The majority of candidates gained the marks in part (a) although a few did not giver their answer to 3 significant figures. Part (b) was well answered by those who understood logs. Most did combine the logs correctly, but some did still split it up into

$$\log_2 2x + \log_2 x \text{ or } \frac{\log_2(2x+1)}{\log_2 x}.$$

Many candidates found the combination of logs and trig functions beyond them. sin x = -1/sec x was a frequent indicator of poor understanding, though many did display they knew sec x = 1/cos x . Quotient lines often slipped, ln 1/cos x becoming 1/ln cos x.

Question 6

This question was relatively well answered. In part (a) most candidates integrated correctly though some candidates did not use the limit $x = 0$.
In part (b) a minority of candidates left the gradient of the tangent as $2e^{2x}$. A few thought the gradient of the tangent was -1/2.
In part (c) the majority of candidates knew what to do but poor algebraic skills gave incorrect answers
Part (d) was usually well done, though some found $g^{-1}f(0)$ and the inevitable few fg(0).

Question 7

Parts (a) & (b) were poorly done with many candidates not getting (a) but working backwards to get (b). Much valuable time was wasted, often writing a page or more to gain 1 or 2 of the marks.

Part (c) was generally well done, with the main error being α being given in degrees rather the required radians.
In Part (d) most candidates gained one value for x, but either did not work out the second one or incorrectly used π – first one. Accuracy marks were also lost in both (c) and then (d) by students not using accurate answers in follow through work.

Question 8

In part (a) many candidates wrote $1/2x$ as $2x^{-1}$ and differentiated to get $2x^{-2}$. Many candidates then converted $-2x^{-2}$ to $-1/2x^{2}$. Much fudging then went on to arrive at $x = ½$, particularly since a large number had *d(ln x/2)/dx = 2/x*. A fair number tried to show f(1/2) = 0.
Part (b) Most candidates substituted in x = ½ correctly but a few did not know what to do with $\ln\frac{1}{4}$

Most candidates knew what to do in part (c), though a few candidates did not actually evaluate f(4.905) or f(4.915) or did so incorrectly. The phrase “change of sign” was often not mentioned, but replaced with long convoluted statements.
Part (d) was well answered but some candidates did miss lines out going from

$\ln\frac{x}{2} = 1 - \frac{1}{2x}$ to $x = 2e^{1-\frac{1}{2x}}$

In part (e) the majority of candidates did well with some students though some lost marks because they could not use their calculator correctly or did not give their answers to the required number of decimal places.

Pure Mathematics Unit P3

Specification 6673

(Maximum mark: 75)
(Mean mark: 44.7; Standard deviation: 15.1)

Introduction

Candidates found some of this paper quite demanding. However the standard of solutions on the more accessible questions was high, with very little poor work being seen. Most candidates demonstrated sound algebraic skills throughout and the level of accuracy in the calculation of numerical answers was exceptionally good. Where printed answers are given as an aid to the candidate, it is essential that they are aware that they need to show all the steps of their working in solutions. Jumping too readily to the printed answers loses valuable marks which may well have been earned. This was particularly seen in Question 7 part (b). Vector work was very poor in Question 5, even for candidates scoring consistently highly elsewhere.

Report on individual questions

Question 1

This proved to be a comfortable starter question with most candidates who used the remainder theorem scoring full marks. Those choosing to long divide ran into more difficulties but usually managed to complete both parts. A common error was to use $\mathrm{f}(\frac{1}{2}) = +3$ in part (a); however the question did not penalise candidates in part (b).

Question 2

Candidates commonly misunderstood that both the formulae for sin(A+B) and sin(A–B) were required by the rubric. The vast majority chose only one, prohibiting progress and usually abandoned the question at this stage. Many who did not complete part (a) attempted to integrate by parts, usually twice, in part (b) before leaving unfinished working. The more successful, or those with initiative, continued with both parts (b) and (c), either with their p and q values, the letters p and q, or hopefully guessed p and q values.

Question 3

This was a popular question. Candidates were fully prepared for this topic and few had difficulties at any stage. Even the weaker candidates were able to gain high marks, with clear precise methods, well presented. It was pleasing to see good diagrams clarifying solutions. A few candidates did have problems in part (b), confusing an initial good start of putting $y = 0$ into the original circle to solve for x, with finding new y values from the original circle after obtaining the x coordinates for the ends of the diameter.

Question 4

The vast majority of candidates were able to demonstrate their understanding of the binomial expansion, scoring highly. The accuracy in evaluating the binomial coefficients was impressive. Miscopying $\sqrt{1+x}$ as $\sqrt{1-x}$ was a common error. In part (b) the majority successfully showed a minimum at the origin, although few confirmed that the curve actually passed through the origin by evaluating f(0) = 0.

Question 5

Those well versed in vectors produced excellent solutions with a clear understanding at all stages. Most candidates attempted only parts (a) and (c). It was disappointing so many were unaware that an equation requires an equal sign; statements of the form
$5\mathbf{i} + 5\mathbf{j} + \lambda(3\mathbf{i} - 3\mathbf{j} - 6\mathbf{k})$, omitting "r =" were frequently seen.

In part (b) the majority of candidates did not appreciate $\overrightarrow{OC}.\overrightarrow{AB} = 0$ with $\overrightarrow{OC}$ being the vector equation found in part (a) and AB the vector direction of L. All too often candidates set up $OC = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$ to be perpendicular to the vector equation of the line not the direction of the line. At this stage most moved on, few attempting part (d). Of these, many treated the parallelogram as a rectangle. Successful candidates who did not realise OC was perpendicular to AB had far more work to do in finding an appropriate angle but nevertheless often made good progress towards a correct area.

Question 6

Many good attempts at part (a) were seen by those who appreciated $t = 2$ at P, or by those using the Cartesian equation of the curve. Algebraic errors due to careless writing led to a loss of accuracy throughout the question, most commonly

$$\frac{3}{2t} \to \frac{3}{2}t \to \frac{3t}{2}$$

Part (b) undoubtedly caused candidates extreme difficulty in deciding which section of the shaded area R was involved with integration. The majority set up some indefinite integration and carried this out well. Only the very able sorted out the limits satisfactorily. Most also evaluated the area of either a triangle or a trapezium and combined, in some way, this with their integrand, demonstrating to examiners their overall understanding of this situation.

Question 7

Candidates found this question challenging; however those who read all the demands of the question carefully were able to score some marks, whilst quite an appreciable minority scored them all. In part (a), the crucial step involved keeping signs under control. Seeing

$$-x\cot\left(x+\frac{x}{6}\right)-\int -\cot\left(x+\frac{x}{6}\right)\mathrm{d}x$$

or a correct equivalent, demonstrated to examiners a clear method. Sign confusions sometimes led to a solution differing from the printed answer.

Part (b) was the main source for the loss of marks in this question. It was disappointing that so many candidates rushed through with barely more than three lines of working between separating the variables and quoting the printed answer, losing the opportunity to demonstrate their skills in methods of integration. The majority separated the variables correctly. Very few made any attempt to include the critical partial fractions step, merely stating

$$\frac{1}{2}\int\frac{1}{y(y+1)}\mathrm{d}y=\frac{1}{2}\ln\left(\frac{y}{1+y}\right)$$

as printed. Some did not recognise the right hand side of their integral related to part (a), producing copious amounts of working leading to nowhere.

In part (c), the working to evaluate the constant c was often untidy and careless. Those who persevered to a stage of the form $\ln P = Q + R$ generally were unable to move on to $P = \mathrm{e}^{Q+R}$ in a satisfactory manner, often writing $P = \mathrm{e}^{Q} + \mathrm{e}^{R}$.

Pure Mathematics Unit P4
Further Pure Mathematics Unit FP1

Specification 6674 / 6667

(Maximum mark: 75)
(Mean mark: 47.47; Standard deviation: 15.81)

Introduction

The paper seemed to be accessible to the majority of candidates; there appeared to parts of all questions in which candidates could make a start, and very low marks were infrequent.

However, many candidates did not complete their final question, or clearly made a rushed attempt at it. The paper may have been a little demanding on time but in many cases long and/or time-consuming attempts at one or more of questions 2, 3, 6, 7 and the first two parts of 8 was the major reason.

Question 5 proved a very good source of marks for the majority of candidates; the given answer in part (b) no doubt helping. Question 7 proved to be the most challenging, with only the better candidates making much headway in part (a) and able to cope with the demands of part (c). Candidates short of time would have probably fared better if they had attempted question 8 before question 7, as it contained several parts with standard demands which were possible to complete quickly.

There was some aspect of several questions that caused problems, and scores over 70 were not in abundance. A large number of very goods scripts were seen, however, and it was pleasing to see so many candidates having a good knowledge of most areas of the Specification. The number of candidates entering for FP1 were relatively small but there was evidence to suggest that some were not fully prepared for the challenge.

Report on individual questions

Question 1

Most candidates were able to produce the general shape and position of the graph in part (a), and those who went on to superimpose the line with equation $y = 2x + a$ usually went on to gain full marks. There were some basic algebraic errors solving or setting up equations, the most common being $-x + 2a = 2x + a \Rightarrow x = a$ and $-x - 2a = 2x + a \Rightarrow x = -a$.
However, it was quite surprising at this level, to find a large number of candidates not realising that part (a) could be useful in answering part (b). It was very common to see two equations solved and the final answer given as $x < -3a$ and $x < \frac{1}{3}a$; some did proceed to justify the elimination of the former but this was not the norm.

Question 2

The knowledge of complex roots appearing in conjugate pairs was almost universally known.
There were many approaches to this question: some candidates tackled part (a) first, others chose part (b) first, and many combined the two.
Those candidates who tackled part (a) first usually went on to correctly find the quadratic factor $x^2 - 6x + 10$. The third root was then an easy step, although the linear factor $2x - 1$ was frequently left as the root. Many candidates, however, at this stage could not resist long division. The difference between

$$2x^3 + ax^2 + bx - 10 \equiv (x^2 - 6x + 10)(2x - 1) \text{ and}$$

$$\begin{array}{r|l} & 2x + (a+12) \\ \hline x^2 - 6x + 10 & 2x^3 + ax^2 + bx - 10 \\ & 2x^3 - 12x^2 + 20x \\ \hline & (a+12)x^2 + (b-20)x - 10 \\ & (a+12)x^2 - 6(a+12)x + 10(a+12) \\ \hline & (52 + b + 6a)x - (10a + 130) \end{array}$$

is clear to see; not only is the latter very time-consuming it is also open to more errors.
Of course, *a* and *b* can also be found from this work, but few candidates taking this route were completely successful. Even when *a* had been found candidates often forgot to go back to answer part (a) and state the third root.
Another common approach was to tackle part (b) first by setting $f(3 + i) = 0$ and solving the resulting simultaneous equations in *a* and *b*. Correct solutions were seen but again errors were common, particularly in simplifying $(3 + i)^3$.

Question 3

The vast majority of candidates were looking for an integrating factor but it was very common to see $\int \exp(2\cot 2x)dx = \sin x$ or $\sin^2 2x$. The mark scheme was sympathetic to these errors and "good" subsequent solutions could still gain 5 of the 7 marks.
As usual some candidates did not multiply the right hand side of the differential equation by the integrating factor which made the resulting integration too trivial.
There were a variety of strategies used to find $\int \sin x \sin 2x\,dx$. The majority of candidates took the direct route, viz. $\int 2\sin^2 x \cos x dx = \frac{1}{3}\sin^3 x + c$, but others made this more difficult by converting to $\int 2(\cos x - \cos^3 x)dx$. It is disappointing at this level to see $\int \cos^3 x dx = \frac{1}{4}\cos^4 x$!
Candidates who chose to use integration by parts often ran in to difficulty, not recognising that it needed to be applied twice, or having numerical and sign errors.
The omission of the constant of integration only lost the final mark.

Question 4

Part (a) was straightforward and, on the whole, answered well. A small minority differentiated incorrectly, but the more common error was to work in degree mode rather than in radians, so the answer 1.33 was frequently seen; this scored 3 out of the 5 marks.
Part (b) lost a little "in the translation" due to poor copying of the original curve. Marking was generous to accommodate this fact, but many candidates did not appreciate what was being asked of them and there seemed to be a very liberal interpretation of "tangents". Many tangents did not intersect the x-axis, and although the first may have been drawn at the point $\{5, f(5)\}$, the second was often drawn at a random point on the curve, sometimes at $\{5, f(5)\}$ again !

Question 5

This proved to be a high scoring question for the majority of candidates.
The method of differences was well understood, and although this was a standard question the manipulative skills shown were generally good, although the given answer, no doubt, helped some candidates correct minor errors.
Even those who were not successful in part (b) were able to gain the marks for part (c); the most common error being in evaluating S(100) – S(50).

Question 6

Candidates who could find $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ often went on to complete part (a) successfully, but it did tend to be an "all or nothing" part, although some candidates were able to differentiate $y = vx$ with respect to x correctly, but not cope with second differentiation. As usual the given result did miraculously emerge from totally incorrect working.
In parts (b) and (c) solutions were not as good as expected with, sadly, basic GCSE errors being as common as errors of technique, but a fairly generous mark scheme enabled most candidates to gain some marks. The majority of candidates knew how to find the complementary function but there were a variety of errors, ranging from auxiliary equations of the form $m^2 + 9m = 0$, $m^2 + m = 0$ to solutions of $m^2 + 9 = 0$ given as $m = \pm 3$.
In finding the particular integral there were two very common errors:

(i) choosing $v = kx^2$ as the form of the particular integral (not even finding $k = \frac{x}{2 + 9x^2}$ seemed to cause concern);

(ii) poor use of brackets with $v = ax^2 + bx + c$ or $v = ax^2 + c$, so that $\frac{d^2v}{dx^2} + 9v = x^2$ produced $2a + c = 0$, instead of $2a + 9c = 0$, with $a = \frac{1}{9}$.

Question 7

There is no doubt that this was the most challenging and least productive question for most candidates. In trying to convert from polar equations to cartesian equations many candidates often took a page of working for very little, if any, reward. The equation $r = 6\cos\theta$ was recognised, or plotted, as the correct circle in part (b) but its cartesian equation had often not been found in part (a). Recognition of $r = 3\sec(\frac{\pi}{3} - \theta)$ as a straight line was relatively rare, and its cartesian equation only found by the better candidates.

Some candidates who had been successful in part (a) used the cartesian equations of the graphs to find their points of intersection and convert them to polars coordinates, but for most candidates part (c) involved solving a trigonometric equation. Most candidates gained a

very generous first mark, but solving the resulting equation $\cos\theta\cos(\frac{\pi}{3} - \theta) = \frac{1}{2}$ was generally not well done; probably a sign that confidence had taken a knock in the earlier parts. Most candidates expanded $\cos(\frac{\pi}{3} - \theta)$ to give $\cos^2\theta + \sqrt{3}\sin\theta\cos\theta = 1$; those who progressed further to $\sqrt{3}\sin\theta\cos\theta = \sin^2\theta$ or $2\sin(2\theta + \alpha) = 1$, usually completed the solution, although cancelling $\sin\theta$ in the former case was quite common. A neat solution was to use the factor formulae to give $\cos\frac{\pi}{3} + \cos(2\theta - \frac{\pi}{3}) = 1$.

It was very disappointing to see "$\cos\theta\cos(\frac{\pi}{3} - \theta) = \frac{1}{2} \Rightarrow \cos\theta = \frac{1}{2}$ or $\cos(\frac{\pi}{3} - \theta) = \frac{1}{2}$", even though, more disappointingly in this case, they gave the correct answers !

Question 8

For candidates who had time to consider this question seriously marks were readily available, although methods were often long-winded, particularly in expressing $\frac{z}{w}$ in the $a + \mathrm{i}b$ form,

when both parts (a) and (b) became more testing.

Those candidates who used $\left|\frac{z}{w}\right| = \frac{|z|}{|w|}$ and $\arg\left(\frac{z}{w}\right) = \arg z - \arg w$, were able to give succinct answers, but even here there was not a widespread appreciation that the form of z displayed both $|z|$ and $\arg z$, and arg z was often given as $\frac{13}{12}\pi$ rather than $-\frac{11}{12}\pi$.

In part (c) a large number of candidates did not realise the significance of their answers to parts (a) and (b) and proceeded to find $\frac{z}{w}$ in the form $a + \mathrm{i}b$ before they could plot C.

Many candidates were able to gain some marks in part (d) although some thought that demonstrating that two pairs of sides of equal length in triangles *AOC* and *DOB* was sufficient to prove congruency and hence the equal angles.

Part (e) provided two easy marks for many candidates. Those candidates who assumed that triangles *AOC* and *DOB* were right angled did not gain full marks in parts (d) and (e) unless they justified the fact.

Mechanics Unit M1

Specification 6677

(Maximum mark: 75)
(Mean mark: 50.3; Standard deviation: 17.2)

Introduction

The paper was found to be accessible with a high overall mean. Candidates were clearly able to find things that they could do on the paper in general terms, and could show a significant level of positive achievement. The paper may have been slightly long, and there was occasional evidence that candidates may have been running out of time on the last question; however, one could not be certain as the last question was found to be quite hard and hence an incomplete answer here could just as well have indicated that a candidate was reaching the limit of what s/he could do on the question. The most discriminating parts of the paper were question 4(c) and perhaps questions 6 and 7. Generally, however, the level of competence in basic techniques appeared to be of a high standard and this was encouraging to see.

The requirement of candidates to give their answers to an 'appropriate' degree of accuracy continues to be a point at which some candidates lose marks. The general rule adopted over several exam sessions in Mechanics still applies: in questions involving the use of g as 9.8, answers should be given to 2 or 3 significant figures, and any higher level of accuracy is not deemed to be 'appropriate'.

Report on individual questions

Question 1

Virtually all candidates realised that they had to apply the principle of conservation of momentum and made a reasonable attempt to do so. Mistakes tended to arise in relation to the signs of the terms, with some taking no account of the directions of motion. Many too failed to make clear the direction in which they were taking their unknown velocity as positive in their equations. A clearly drawn diagram would have helped both candidates and examiners. In finding the impulse, again most knew what to do in principle but errors arose in the signs of the terms. The units of the answer for the impulse were often incorrect.

Question 2

In part (a) most could make a reasonable attempt at the question, though several effectively found the tension at A rather than at C, failing to multiply their answer by 3. In part (b) the general principle of taking moments was well known, and only a few candidates omitted forces (e.g. the weight) in their equations. Many fully correct answers were seen. A number of candidates still persist in failing to distinguish properly between weight and mass, omitting factors of g in their forces.

Question 3

This proved to be a good source of marks for many candidates, with full marks often being obtained. Constant acceleration equations appeared to be generally well known. Mistakes, if they occurred, tended to be in part (b) where some failed to take the full area under the graph into consideration (perhaps only considering the area of a triangle) and then fudging their answer obtained in relation to the sign.

Question 4

Parts (a) and (b) were generally well answered, though several lost a mark by failing to give their answers to an 'appropriate' degree of accuracy (which here, as in all questions using g as 9.8m, was to 2 or 3 significant figures). Part (c) was however very poorly answered. Several simply assumed that the value of the frictional force was equal to its value in limiting equilibrium, and then confidently stated that as the frictional force was *greater* than the component of the weight, equilibrium resulted (failing apparently to realise that equilibrium requires a zero net force). The condition that, for friction, F had to be *less than* (rather than equal to) μR was clearly not understood by the vast majority of candidates.

Question 5

This question was generally well answered and it was pleasing to see candidates being able to write down equations of motion for the two particles separately. Mistakes from weaker candidates arose from sometime including the weight of A in the (horizontal) equation of motion for A, or confusing the two particles and the forces acting on them. Most realised that they had to use the given data to solve part (a) though a few launched straight into writing down the equations of motion and then floundering when they did not have enough information to solve these. Answers to part (d) were almost uniformly incorrect: the vast majority stated that the inextensibility of the string meant that the tensions were the same (or constant throughout the string).

Question 6

Most could make good attempts at the first three parts of the question, though a misreading of the information (confusing 'AC' and 'BC' was not uncommon). In part (d) the most common mistake was to confuse signs again (similar to qu.1) in writing down the impulse-momentum equation, but most could then go on to use their result in an appropriate way to get a value for the time.

Question 7

This was probably the most discriminating question on the paper with only the top grade of candidates tending to complete the whole question successfully. Most could make a good attempt at part (a), and the writing down of the two position vectors in part (b) was generally well done. Parts (c) and (d) were however more taxing. Several could not start part (c) at all by subtracting the two position vectors; others could not progress because they failed to collect expressions for the components before finding the modulus of this vector. In part (d), several successfully restarted even though they had not reached the given answer in part (c). Many offered well presented answers to the solution of the quadratic equation. Some however failed to equate the d of the given expression to 15 (some using 15.1 or 16).

Mechanics Unit M2

Specification 6678

(Maximum mark: 75)
(Mean mark: 50.9; Standard deviation: 15.2)

Introduction

The paper proved accessible to the great majority of candidates and there was very little evidence of candidates being short of time. It was not uncommon to see scripts containing essentially complete solutions to all seven questions. However, questions 3, 5 and 6 (b) proved to be demanding for many and, in these questions, errors of mechanical principle were common. Standards of pure mathematical manipulation were high and, in contrast to some recent examinations, the vector question was generally well done. Where a numerical value of g is used, a candidate is expected to give their final answers to 2 or 3 significant figures and not all seem to be aware of this. Another source of error is premature approximation. If a candidate is giving an answer to 3 significant figures, they should be aware that, in order to obtain an answer of this accuracy, it is necessary to work to four figures. Question 7 was particularly susceptible to errors of this kind and the final answer was often given as $39.5°$, when $39.6°$ is accurate to 3 significant figures. Such errors are not heavily penalised but odd marks, lost here and there, can accumulate.

Report on individual questions

Question 1

This question was very well answered. In part (a) the majority of candidates showed that the principles of moments were well understood and that they knew how to establish the required exact answer. In part (b), a few could not analyse the force at the hinge but the majority were able to find the horizontal component asked for. A few went on to find the vertical component and some then combined the components into a resultant force. The examiners ignore such superfluous work but valuable time had been wasted. Time pressure often results from the use of inefficient methods and from doing unnecessary work rather than from the intrinsic difficulty of the questions.

Question 2

This question was also well done. A few added the masses of the circle and rectangle, rather than subtract them, and a few errors of sign in the moments equation were seen. Some candidates ignored the obvious symmetry of the diagram and took moments to find the distance of the centre of mass from *AB* and this, besides being unnecessary work, caused further difficulties if the distance found was incorrect. When an accuracy is specified in a question, the candidate is expected to give their answer to that accuracy to gain full marks.

Question 3

Energy and the work-energy principle are an area of weakness for many and, in part (a), it was quite common for candidates to find only the change in kinetic energy, ignoring the change in potential energy. No method was specified for part (b) and candidates were roughly evenly divided between those who used the work-energy principle, utilising their answer to part (a) and those who, essentially started again, using Newton's second law. If they had an incorrect answer to part (a), those using work-energy could gain 4 of the 5 marks in part (b). Errors of sign were often seen in the solutions of those who used Newton's second law. This often arose through uncertainty about the direction of the acceleration. A substantial minority of candidates treated the forces parallel to the plane as being in equilibrium, assuming that there was no acceleration.

Question 4

This was an excellent source of marks for the great majority of candidates, although there were a few who differentiated where they should have integrated and vice versa. In part (a), a few candidates stopped when they had found **F**. In part (b), the use of the inappropriate formula $\mathbf{r} = \mathbf{r}_0 + \mathbf{V}t$ was less frequently seen than in some recent examinations. Some candidates, having found the constant of integration, added it again, or subtracted it. This usually arose from not recognising the convention that *O* referred to the origin.

Question 5

Part (a) was well done but later parts of the question proved very discriminating. In part (b), the quickest method is to consider the whole system, but many who gave only one equation used a mass of 1000 kg or 1500 kg. If the car or the trailer is considered separately, then a pair of equations is needed and this was very rarely seen. Another source of error was treating the tractive force of 2000 N as still applying to the system. Part (c) was not understood by the majority of candidates; thrust often being confused with impulse or linear momentum. Thrust, along with tension, does appear in the M1 specification and can be tested on the M2 paper. In part (d), many thought that the work done was just the change in kinetic energy or made the equivalent error of, having found the distance moved in coming to rest, multiplying by 3500 N instead of 1500 N. Candidates did not seem to be expecting to be asked the work done by a specific force in a situation where there were three forces acting. A few used ratios and correctly, as all three forces have been acting over the same distance, calculated $\frac{3}{7}$ of the energy loss. In part (e), the majority knew that, in practice, resistance varies with speed.

Question 6

In part (a), nearly all candidates could obtain a pair of equations using conservation of linear momentum and Newton's law of restitution. The printed answer usually helped those who had made sign errors to correct them. Part (b) proved more difficult. The majority of candidates first found the velocity of *P*. A few, on recognising that the direction of *P* differed from the one they had used in part (a), reversed the direction of *P* and started all over again rather than correctly interpreting the results they already had. In doing so they sometimes confused their two sets of working. Those who had found the velocity of *P* often gave the inequality the wrong way round or produced fallacious work when solving the inequality. Another error, frequently seen, was to produce an inequality from the incorrect reasoning that the speed of one particle had to be greater than the other. The fully correct range $\frac{2}{3} < e \leq 1$ was rarely given. One neat, although equivalent, method of solution seen was to say that the velocity of separation had to be greater than the velocity of *Q*. This gives $3eu > \frac{1}{5}u\left(9e + 4\right)$ without the necessity of finding the velocity of *P*. Part (c) is demanding in its algebraic requirements and the signs were difficult for many to sort out. However many completely correct solutions were seen and the general standard of algebraic manipulation was good.

Question 7

As has been noted in previous examinations, those who attempted part (a) in one go, obtaining an equation equivalent to $4.9t^2 - 19.2t - 20 = 0$ were usually successful and, although there were some slips in sign, these were not common. Those who broke the time up into sections, for example, from *A* to the maximum height and from the maximum height to *C*, produced completely correct solutions less frequently. More stages in a calculation give more scope for error. Such methods are also, not infrequently, given in an incomplete form. Part (b) was well done and an incorrect answer in part (a) lost only one mark here. The most popular method in part (c) was to consider the components of the velocity at *B*. The alternative method using conservation of energy was rarely seen. It was not uncommon for candidates to find the vertical component at *B* and stop. This often did seem to be an error in understanding what was asked for in this part of the question, as such candidates often interpreted their answer correctly and completed part (d) successfully. An inefficient method of solution to part (c), not infrequently seen, was to find the time of flight from *A* to *B* and then to find the vertical component of the velocity. This calculation is awkward and carries a greater risk of sign errors than using $v^2 = u^2 + 2as$. Part (d) was well done although, as noted above, errors due to premature approximation were often seen.

Mechanics Unit M3

Specification 6679

(Maximum mark: 75)
(Mean mark: 45.5; Standard deviation: 16.9)

Introduction

The paper proved to be accessible to most candidates, although there were a few who failed to finish - usually because they had spent too long on the first three questions – and a few who had clearly been entered too soon and who had no idea how to tackle some of the questions. Question 5 proved to be the best source of marks, where even the weaker candidates were able to achieve a significant score. The most demanding questions were 2 (b), 6(b), 6(c) (ii) and 7(b). There was some evidence of the quoting of "standard" formulae, for example in question 1, $T = mrw^2$,which should be discouraged at all costs and could lead to loss of marks. Candidates should be encouraged to work from first principles at all times. Candidates still need to be reminded that they should not write in pencil and that they should enter the questions that they have attempted, in the order in which they have been attempted, into the grid on the front of the question paper. Also, candidates should be reminded that all supplementary sheets must be *tied* loosely into the booklet.

Report on individual questions

Question 1

This proved to be a good start for most candidates although a few used $r = 1.5$ and a significant number failed to give the answer in part (b) to the nearest degree.

Question 2

The first part was generally well done, although some candidates tried to introduce volumes into their calculations but there were very few fully correct solutions to part (b), where a good diagram was essential.

Question 3

The formula required in part (a) was not always well-known and even those that did quote it correctly were not always able to cope with the resulting integral. The second part was totally independent and was generally well-answered.

Question 4

Part (a) was successfully completed by the majority but there were were errors in parts (b) and (c) where a significant number measured x from the end of the oscillation rather than from the centre. The method was generally known in part (b) but the final part was a good test of comprehension and those that restarted using $x = 2L\sin wt$ were usually successful.

Question 5

This was easily the highest scoring question. There were often sign errors in part (a), where some candidates opted to use a substitution but the second part was usually completely correct.

Question 6

Most realised that the first part required the use of energy and were able to obtain the required result. There was a disappointing response to the "standard proof" in part (b); many candidates simply ignored the weight and scored no marks. Part (c) (i) was well done but there were few correct solutions to (ii), where most were unable to find the amplitude of the oscillation.

Question 7

Part (a) was generally well done but the second part proved to be much more demanding. Some thought that energy was conserved in the impact and scored few marks and even those that realised that conservation of momentum was required were unable to complete the question due to poor algebraic skills – an early simplification gave a linear equation rather than a very complex quadratic. The method was generally known in part (c) but there were relatively few correct answers, either due to the wrong mass being used or else a failure to round off the answer to 2 sf or 3 sf because of the use of $g = 9.8$.

Statistics Unit S1

Specification 6683

(Maximum mark: 75)
(Mean mark: 45.8; Standard deviation: 12.9)

Introduction

An accessible paper that proved to be demanding for a number of candidates towards the end. Some very good responses were seen by a large number of candidates, especially to the first four questions.

Report on individual questions

Question 1

A well answered question. A fairly small minority misread the question and calculated the probability of a faulty item. The majority of candidates can draw and use tree diagrams well although a significant minority fail to label them correctly. Also, too many candidates made the mistake of putting incorrect probabilities on the second section of the tree; some were products of probabilities while some were strange fractions such as 3/85, 82/85, etc. Overall, however, many candidates gained full marks on this question

Question 2.

A lack of detailed labelling in the box plot was common. Candidates should realise that 3 marks for parts where they are comparing etc. requires them to find three relevant points. Many only had one or 2 points and seemed to think that if they wrote enough about one point they could get the 3 marks. The last part was not well interpreted by many. They were likely to just say that the 2 values for Q_3 were the same. Most candidates can find quartiles and know how to display the information in box plots. There are still some candidates who do not draw a clearly labelled axis for their scale. Candidates need to remember that the purpose is to compare data so the scale needs to be the same for both sets of data. Some candidates can give good comparisons referring to range, IQR, median and quartiles, but many give vague descriptions concerning ‘spread’ and ‘average’ which gain no marks. They should be encouraged to be specific in their descriptions. Very few can interpret the upper quartile in context.

Question 3

Most candidates can plot and interpret scatter diagrams and use the formulae given in the formula book. A significant number of candidates still cannot correctly calculate the standard deviation to the required accuracy. A significant minority worked out the standard deviation of the x-values by mistake and of those who worked out the correct standard deviation, many used a premature approximation of the mean of 61.7 losing the accuracy mark

Question 4

A well answered question with many candidates scoring full marks. Some weaker candidates had difficulty in interpreting the probability function and producing a convincing argument in part (a) proved demanding for some.

Question 5

Candidates find it hard to translate the written information into a correct Venn Diagram, frequently forgetting to subtract one category from another. Many candidates only had 6 in the right place and 890 instead of 918 was a common error even for more able candidates. As follow through marks were allowed, they didn't lose as many marks as they might have for these initial errors. Conditional probability is not well understood, nor was the need for use of 'without replacement' in part (e). Some weaker candidates still leave answers greater than 1 for probability.

Question 6

This question was very demanding for candidates with many failing to understand what was required for part (c) and part (d), but usually picking up both marks for (a) and (b).
Some candidates did not understand what they were being asked to discuss in this question and it was clear that some centres had not taught probability from a practical point of view, while others were very familiar with using experiments to find empirical probabilities. The responses to part (c) and part (d) were generally vague and regularly incoherent.

Question 7

The best candidates picked up full marks for this question. Generally part (a) and part (b) were answered well. There were many longwinded solutions to part (c) and quite a few confused responses to part (d) with confusion between z-scores and probabilities. Most candidates can standardise and find probabilities correctly, although some still use variance instead of standard deviation. Many candidates missed the simplicity of part (c) trying to over complicate it, and most of these never attempted part (d), perhaps not realising that they did not require part (c) for part (d).

Statistics Unit S2

Specification 6684

(Maximum mark: 75)
(Mean mark: 46.9; Standard deviation: 16.1)

Introduction

Overall the candidates found the paper accessible although inevitably there were some questions that they found more taxing than others. The bookwork required to answer Question 2 had not been learnt in sufficient detail; the need to use the continuity correction was ignored by far too many candidates; interpretation of the phrase 'more than 4' was often incorrect and untidy working throughout the paper, particularly in Question 7, caused marks to be lost.

As has been said in other reports, candidates would be well advised that to score well on this paper they need to have a thorough understanding of all the topics in the specification and be able to pay attention to detail when answering questions.

Report on individual questions

Question 1

Candidates knew how to answer parts (a) and (b) but many did not work to sufficient accuracy. If they used their calculator instead of the tables they were expected to give their answer to the same accuracy as the tables. Too many of them did not read part(c) carefully enough. The random variable T was defined to be normally distributed and thus $P(T = 5) = 0$.

Question 2

The bookwork required to answer this question was not remembered as well as it should have been. Many candidates could not define a population or a sampling frame in detail or know why they might be different. In part (c) many candidates were unable to give in sufficient detail a justified example of the use of a census and a sample.

Question 3

Too many candidates left out 'continuous' in part (a). Continuous uniform or rectangular was required to gain the mark for the name of the distribution and very few candidates were able to specify the probability density function in full. This meant that few of them could answer parts (b) and (c) correctly but they were able to follow through and gain the marks in part (d).

Question 4

Most candidates wrote down two other conditions associated with the binomial experiment but too many did not use 'trials' when referring to independence. The alternative hypothesis was often wrongly defined and far too many of those using the normal approximation ignored the need to use the continuity correction. The conclusion needed to be in context but many did not do this. Few candidates made any sensible attempt to answer part (c).

Question 5

This question was a good source of marks for many of the candidates, with many of them gaining full marks. For those that did not gain full marks, the common errors were premature approximation; wrong interpretation of 'fewer than 4';ignoring the continuity correction and in part (c) using a Poisson approximation and then a normal approximation to this Poisson approximation.

Question 6

For those candidates that could interpret 'more than 4 accidents occurred' correctly parts (a) and (b) were a good source of marks. Part (b) was often well answered and many candidates gained full marks. In part (c) incorrect hypotheses and ignoring the continuity correction were the common errors coupled with poor use of the appropriate significance test. Candidates need to have a simple algorithm at their fingertips to deal with tests of significance.

Question 7

Many correct solutions to this question were seen, but there were also some poor solutions resulting from untidy working and poor arithmetic when substituting limits. The candidates seemed to know what methods to use but they could not always apply them accurately. Their integration and differentiation techniques were fine but using them in the various parts was at times disappointing. More care and attention to detail was needed.

Decision Mathematics Unit D1

Specification 6689

(Maximum mark: 75)
(Mean mark: 37.8; Standard deviation: 14.5)

Introduction

This paper proved to be accessible to the candidates, although there was some evidence of time being a problem for some candidates, there is still a need for centres to teach efficient methods of presentation. Good answers were often seen to questions 1, 4(b), 5(ii) and 6(a). Poor answers were often seen to 3(b), 6(c), 6(d) and 7(c).

Report on individual questions

Question 1

This was well-answered in general, with most candidates scoring nearly full marks. The most common error was in failing to indicate the change of status. Some candidates, who used a 'decision tree' to find more than one alternating path, did not make it clear which one they had selected. Some candidates did not take into account the changes to the matching caused by their first alternating path, when seeking their second.

Question 2

Although some very good answers were seen to part (a) many candidates were not able to give a precise explanation. Many tried to give an answer in general rather than specific terms. The response to part (b) was variable, with some very good and some poor diagrams seen. Common errors were omitting arrows, having more than one end point and making E dependent on C. There is a minority, but still a large number, of candidates using activity on node.

Question 3

There was a varied response to this question, with some very good and some quite poor responses seen. Part (a) was generally better attempted than part (b). In part (a) the candidates were asked to make the order in which they selected the arcs clear, many did not do this. Many candidates wasted time by drawing a succession of diagrams showing the addition of one arc at a time. Many candidates lost marks in Kruskal's algorithm by not showing the rejection of the arcs that created loops. In some attempts at Prim's algorithm, many did not list the arcs and others referred to rejecting arcs to prevent cycles from forming. Many wasted time in drawing a matrix for Prim. Part (b) was often poorly done with many candidates opting for Prim despite the two arcs not being connected. Of those who correctly selected Kruskal, only a few were able to give a coherent explanation.

Question 4

Some very good answers were seen to part (a), but many candidates produced disappointing attempts. Poor presentation and lack of concentration accounted for most errors in part (a); there was inconsistent choice of pivots, numbers that disappeared from the list, numbers that mutated into other numbers and, of course, numbers being reordered in the list. A large minority sorted the list into ascending order. A number of candidates are only selecting one pivot per pass, which rather defeats the object of a quick sort. Only a very few Bubble sorts were seen. Candidate would help themselves hugely by not fixing the position of the pivots until the line after they are selected, this would avoid the need to try to cram numbers into the ever-decreasing space formed by their previously chosen pivots. Candidates could then use the whole width of the line each time. Part (b) was usually well done. Some used the first fit algorithm and many put 134 into bin 5 rather than bin 3. Part (c) was often well attempted with the majority of candidates giving a clear, arithmetical argument.

Question 5

This was mostly well done, but Dijkstra's algorithm had to be very carefully applied to gain full marks. Common errors were to award a final label to vertex C before vertex E and an incorrect order of working values. Some candidates did not write down the shortest distance, but wrote down the shortest route instead. Some candidates did not realise what was being asked in part (ii) and explained how they achieved their shortest route from their labelled diagram. The majority, who did attempt the route inspection, were usually fairly successful. The commonest error was to state that the pairing BG + CD = 348. Most were able to state a correct route and its length.

Question 6

Part (a) was well answered by the vast majority of the candidates, with only a very few finding the sum of the values along the route. In part (b) the diagrams were often unnecessarily complicated by capacities, double arrows and arrows in the reverse direction. The initial labelling in part (c) was usually well done, although some omitted arcs BC and DE. As always candidates should avoid obliterating the initial values, the examiners have to try to read this to give credit! Some did not find all the flow augmenting routes, some found the routes but did not state the flow, and others did not update their diagrams and so oversaturated some arcs. Many failed to put arrows onto their diagram in (ii), or omitted the flow along one arc (often CE). Only the very best candidates were able to prove that their flow was maximal. Part (d) was usually poorly answered.

Question 7

Many omitted the instruction to maximise the objective. Most candidates were able to write down the 3 constraints correctly, although few remembered to include $x, y, z \geq 0$. Most of the candidates were able to form an initial tableau, although the value in the profit row was often left blank. Many candidates were able to state their row operations correctly, although some only wrote expressions such as – R2 rather than R1 –R2 and many forgot to state R2 /2. The practical meaning of part (c) was not understood by many candidates. Part (d) (i) was often well-attempted, but there were many calculation slips. In part (ii) candidates needed to expressly refer the presence of negatives in the final/profit/objective **row**. Very few stated the values of all seven variables in part (iii).

Grade Boundaries

January 2005 GCE Mathematics Examinations

The table below gives the lowest raw marks for the award of the stated uniform marks (UMS).

Subject Number	Grade Boundaries				
	80	**70**	**60**	**50**	**40**
6663	60	52	44	37	30
6664	62	54	46	38	31
6671	60	52	44	37	30
6672	61	54	47	40	34
6673	55	49	43	37	31
6674/6667	56	49	42	35	29
6677	62	54	47	40	33
6678	59	52	45	39	33
6679	53	46	40	34	28
6683	56	50	44	39	34
6684	56	49	43	37	31
6689	50	44	38	32	26

All marks are out of **75**.

Pass Rate Statistics

January 2005 GCE Mathematics Examinations

The percentage of candidates obtaining at least the given number of uniform marks (UMS) and grades are given below.

Subject Number	Number Sat	Cumulative Percentages of Candidates at Specified Grades					
		A	B	C	D	E	U
6663	23273	53.3	65.3	74.3	81.2	87.2	100.0
6664	8778	62.0	77.0	86.1	91.2	94.6	100.0
6671	3073	30.1	46.0	61.0	73.3	82.1	100.0
6672	5633	26.3	42.5	56.6	69.0	78.8	100.0
6673	2185	27.8	42.7	58.5	71.4	81.9	100.0
6674 / 6667	2140	33.6	52.1	68.9	79.6	86.5	100
6677	6170	32.3	51.2	64.6	75.2	83.7	100.0
6678	3058	37.2	56.7	71.6	80.3	86.8	100.0
6679	957	37.7	53.2	66.8	76.3	85.2	100.0
6683	7378	25.0	42.6	59.3	72.2	82.3	100.0
6684	2797	35.8	52.5	64.8	75.2	83.3	100.0
6689	2265	24.8	37.0	52.0	65.8	77.5	100.0

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