# ME10304 – Mathematics 1 – Feedback on the exam.
## Unit convenor: Dr D Andrew S Rees

**General comments.**

The average mark was roughly 71.3%, which is a little high and therefore I expect the Examination Board to moderate this downwards, possibly by 2%.

There were 15 marks below 40% although there may be two or three more after moderation. The lowest mark was 15% and the highest, 99%, which was obtained by two people. The question which was answered the best was Q8 on vectors — the average was 9.2/10 with 175 getting full marks. At the other end we had Q10 with an average of 5.1/10, 39 getting full marks and 45 getting zero including non-attempts.

<table>
<tr><td>Question 1.</td><td>Curve sketching. Average mark: 6.8/10. Quite a few students spent a lot of time writing huge amounts when it isn't necessary. Some tried to find minima and maxima — again not necessary for this question. A rather large number didn't put write on the axis the value of $x$ at which the pole or zero occurs; some marks were deducted for this.</td></tr>
<tr><td>(a)<br><br>(b)<br><br>(c)<br><br>(d)</td><td>Excellent. A few got it upside down, which isn't correct. Others thought that the single zeroes where double zeroes.<br><br>Very good. A few sketched $\tan x$ instead.<br><br>Probably the worst of the four. A substantial number sketched $\sin x/x$ which was on a problem sheet! Others sketched $\cos x/x^2$. Sometimes the envelope wasn't shown.<br><br>Generally very good indeed.</td></tr>
<tr><td>Question 2.</td><td>Complex numbers. Average mark: 8.2/10.</td></tr>
<tr><td>(a)<br><br>(b)<br><br><br><br><br><br><br><br><br><br>(c)<br><br>(d)</td><td>Excellent. The most common mistake was the unnecessary conversion of the answer into complex exponential form, rather than the writing down of the conjugate which is what was asked for!<br><br>Very good. Some students took half a page to do this even though it is a one-liner! Here is the glacially slow version which I saw on a dozen scripts (noting that I am using last year's problem because I am lazy):<br><br>$$z = 2e^{j\pi/4} = a + bj \quad \Rightarrow \quad r = 2 \text{ and } \theta = \pi/4 \quad \Rightarrow \quad a^2 + b^2 = 4.$$<br>$$\text{Also } b/a = \tan\theta = 1 \quad \Rightarrow \quad b = a \quad \Rightarrow \quad 2a^2 = 4 \quad \Rightarrow \quad a = \sqrt{2}$$<br>$$\Rightarrow \quad b = \sqrt{2} \quad \Rightarrow \quad z = \sqrt{2} + \sqrt{2}j.$$<br>The smart approach is $z = 2e^{j\pi/4} = 2[\cos(\pi/4) + j\sin(\pi/4)] = 2\Big(\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}}j\Big) = \sqrt{2} + \sqrt{2}j$.<br><br>Both methods are rigorous and perfectly correct, although the first can and almost always did yield real and imaginary components with incorrect signs.<br><br>The chief error made by many was an incorrect calculation of the argument. Some wrote $\theta = 1.287002$ which is the inverse tangent of (24/7). Others write $\theta = -1.287002$, but the correct answer lies in the second quadrant, and this may be seen using a quick sketch of $z$ in the Argand diagram.<br><br>Very good.</td></tr>
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| Question 3. | **Differentiation.** Average mark: 7.6/10. |
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| (a) | All three parts of this were answered well. |
| (b) | The great majority of students didn't assess whether the plus or the minus ought to be used for the square root. |
| (c) | Most students identified the maximum correctly. The critical point at $x = 0$ was a rising point of inflexion. Most students erroneously assumed that $y''(0) = 0$ is equivalent to this, but it isn't. One needs the further condition that $y'''(0) > 0$. |
| **Question 4.** | **Partial differentiation.** Average mark: 6.7/10. |
| (a) | This part was done very well in general. |
| (b) | Not so good. The number of critical points was five, but there were scripts claiming, one, two three and four! |
| **Question 5.** | **Integration 1.** Average mark: 7.4/10. |
| (a) | While the integration by parts usually proceeded well, there were two main errors. One involved both functions ($t^4$ and $e^{-2t}$) being differentiated. The other was a sign error in the final answer because it had been forgotten that one subtracts the value at the lower limit. |
| (b) | There were various substitutions that could be used. This also suffered with a final sign error. |
| (c) | A partial fractions integral. Mostly well-received. The most frequent error (about 10 students) was the rewriting of $2\ln\|u+2\| - \ln\|u+1\|$ as $2\ln(\|u+2\|/\|u+1\|)$. |
| **Question 6.** | **Integration 2.** Average mark: 7.1/10. |
| (a) | Generally very good. The answer was indeed zero! Apologies to that student who said that he/she would fume if the answer were zero; please don't do that in the lecture theatre and set off the smoke detectors! Although no-one did this, the result follows very quickly if $\sin(x + 2y)$ is expanded using the usual multiple angle formula. |
| (b) | One drawn from the problem sheets. Well done. |
| **Question 7.** | **Series.** Average mark: 6.1/10. |
| (a) | Not bad, not good either. |
| (b) | Well done. I would have preferred the answer not to involve the quotient of two factorials. |
| (c) | This too was ok. |
| (d) | Not good. For $(\sin \pi x)/(1 - x^2)$ l'Hôpital's rule only needed to be applied once to get a definitive case. The chief error was when the derivative of $(1-x^2)$ was written as $(1-2x)$, rather than $(-2x)$, which happened a lot. For $xe^{-2x}$, this needs to be rewritten as $x/e^{2x}$ before using l'Hôpital's rule once. This wasn't received well by the class. |

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| **Question 8.** | **Vectors 1.** Average mark: 9.2/10. |
| | The best question. Generally a walk in the park. I'll need to consider making this one more difficult in the future. Occasionally the cross product went astray. |
| **Question 9.** | **Vectors 2.** Average mark: 7.1/10. |
| | Generally parts (a) and (c) were answered very well indeed. Part (b) was usually answered well, and (d) was pretty good too. I was happy to accept both possible forms of the equation of the plane in part (c). |
| **Question 10.** | **Miscellaneous.** Average mark: 5.0/10. |
| | I got the impression that this was just a question too far, the last one on the last exam. Parts (e) and (f) were often answered correctly despite the length of part (e). The earlier parts were often just a messy approximation to what looked like a mathematical argument, a word cloud of mathematical fragments, maybe! The radius of convergence was frequently incorrect. |