MATH35012, 2017, exam feedback

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Comments on common errors/themes in the marked scripts are below:

1 A minor variation on the elastic string material to include a damping with coefficient λ. This was mostly well answered, but a surprising number of students had forgotten about the characteristic polynomial for solving constant coefficient ODEs. Some students used the answer given in the question to propose a solution for $T(t)$ then substituted it into the governing equation to find ω_n. I was (fairly) generous in marking such an approach, although the question clearly says "Using the method of separation of variables, show ...".

2 A straightforward question that involves the derivation of a dispersion relation, then a sketch of frequency-vs-wavenumber followed by finding the group velocity. This was mostly well answered, apart from the sketches, which were poor in many (but not all) cases. Some of the issues with sketching arose from simple algebraic mistakes in the derivation of the dispersion relation. Those that gave a correct sketch generally (and quite sensibly) examined the behaviour for $k \ll 1$ and $k \gg 1$. A surprising number of answers applied $l = 0$ to the dispersion relation despite the question asking for $l = 1$. Some answers expressed concern at the prospect of $\omega < 0$ – there is no problem with a negative frequency, as this merely determines the direction of propagation.

3 A standard piece of lecture material that was generally well answered. Algebraic mistakes in the derivation of the dispersion relation were common, which affected the remainder of the question. The most common such mistake was mixing up the derivatives such that sin and cos remained in the dispersion relation. The two wavenumbers are only real if U lies above a critical value, which should have been noted for a final mark.

4 This is a repeat of one of the example sheet questions. Marks were generally either high or low, with not much in the middle ground. Few scripts mentioned why we know that ϕ_2 and $\phi_1 + \phi_2$ both satisfy the wave equation.

5 This is the material of 'internal gravity waves', but cast into a slightly different wave system. A number of scripts obtained full marks for this question and overall it was generally well answered by those that simply followed the instructions in the question.

Part (i) follows in just a few lines if you write the governing equations in their component form. A few responses tried to keep the vector format, which will work, although the second of the two equations in part (i) involves a little more work as a vector operation.

Most attempts at part (ii) got to the required answer by combining the equations from part (i), or got close enough to obtain most of the marks.

Parts (iii) and (iv) are straight from the lecture notes. Again algebraic mistakes were common in determination of the group velocity in part (iii).

6 This was the worst answered question – some of the responses were pressed for time, whilst others simply did not follow the directions of the question or inappropriately repeated monopole material from the notes.

Part (i) was covered in the notes when discussing the monopole. It is the same methodology here, although we are not directly concerned with the monopole form of solution. The radial velocity is ϕ_r which some answers incorrectly replaced with f_r.

Part (iii) is a simple solution of the harmonic equation for $F(r)$ subject to $F(0) = 0$ from part (ii). The boundary condition at $r = L$ comes from part (i) – a number of scripts applied $F'(L) = 0$ which is incorrect (in general).

Part (iv) repeats the harmonic equation solution, but with a simpler $F(L) = 0$ boundary condition.

Please note that individual marks are not available from me, and the marks are not finalised until after the final meeting of the examination board.