NST/CST Part IA Mathematics Supervision Questions: Dr Ian Rudy

An asterisk (*) means a question is harder than most. Note that you will need a calculator for some questions, even though you are not allowed one in the exam.

Michaelmas Term

Supervision 1: Examples I A3, A4, A5, A6, A7*, B3, B4, B7, B8. Some notes on these:

A6: "concurrent" means "meet at a point".

A7: "coplanar" means the three points *and* the origin lie in a plane;"collinear" here means the three points all lie on a straight line. I think you need to assume the vectors **a**, **b**, **c** are *not* parallel to do the question.

Supervision 2: Examples I B10, B12, B13, C2, C3, C4, C5*, C6*, C7 (note that the phrase "passing through the points" refers to the flat surface and not the drill!), C11.

Supervision 3: See my tutorial on vector areas first, at https://tinyurl.com/y67ctwb4.

Examples I D1* (in (i) please could you find the projected area as a scalar, not a vector, and note that in (ii), the surface excludes the base and so is just the upper four triangular surfaces), D2* (note that there are *two* separate sets of parts (i) and (ii), one of which is over the page), E3, E4 (except don't bother with the very last bit - (e) of part (iii) - unless you are interested), F1 (except part (h), which is dull), F5, F7, F8, F10.

Supervision 4: Examples I F11 (look up the standard methodology if you don't already know it), F12, F14, F15, F16*, F18, F19, G3, G4, H5 (except part (a), which is dull).

Supervision 5: Examples I J1 (including (iii),(iv),(v)), K1, K2, L1, L2, N1, I1* (do last). Make sure you read my advice on limits and series (https://tinyurl.com/y2gyek88) before attempting K1, K1, L1, L2. If you are confused by N1 and/or the big O notation, please see https://tinyurl.com/yy9mutfe. Optional: if you want to understand the ε-δ definition of a limit, see https://tinyurl.com/y59xpnbf.

Supervision 6: Examples I M1, M2, N3, Examples II P4, P5, P6 ((d) is hard if you don't know the method; (e) could be trivial for you), P7, P10 (for the very last bit of this, they mean you to write $I+iJ$ in terms of the original integrals, so it is a new method of finding them), P11, P15 (calculator allowed). If Schwarz's inequality has not yet been covered in lectures, all you need is https://tinyurl.com/2c72b5yu.

Supervision 7: See my guide on multiple integrals (online at: https://tinyurl.com/y5f9ow4c). Examples II Q1, Q2, Q3 (except not the bit involving xe^{xy}, which is dull), Q4, Q5, Q6, Q7 (though do it any way you like - doesn't have to be induction. Don't worry too much about the "Verify" bit), Q8

Supervision 8: Examples II R1, R3, R4, R6, R7, R8, R10, R11, R12 and (optional) R13*. You could also look at R14 for amusement if you are interested.

Vacation Work: tripos questions:https://tinyurl.com/yxfb8z7a   Calculators allowed

Supervision 1: A big hint: make sure you know how to solve the Bernoulli differential equation. See (eg) Wikipedia. Examples I S3, S4, 6, 7, 8, plus question 1 from https://tinyurl.com/y2e8l8oo.

Supervision 2: Examples I 9, 12, 13, plus question 2 from https://tinyurl.com/y2e8l8oo. We may discuss 11 in the supervision; I do not want it handed in and the algebra is a bit involved, but you might want to look at it briefly before the supervision.

Supervision 3: Michaelmas Term Examples II P12 (i)-(iii) [We'll do this now that you have covered partial differentiation. You"ll need to apply the big formula that was derived in section 7.5.2 of the Michaelmas Term handout, and which tells us how to differentiate an integral with respect to a parameter. Reviewing the notes on its derivation is entirely optional.]. Then, once the lecturer has covered Section 2.2.9 of the notes, please try Lent Term Examples II 4, 6, 7, 8, 9 (difficult unless you know the standard method).

Supervision 4: Examples II 10 (but ignore their advice about $\mu(x)$ or $\mu(y)$ - find an integrating factor any way you like), 11, 12, 13.

Supervision 5: Any parts of 13 that you did not do for last week. Then question 3 from https://tinyurl.com/y2e8l8oo, Examples II 14, 16 (not (c) - it's just tedious, but do note that you have to determine the character of the stationary values in (a) and (b)), 17, 18, plus (both entirely optional) 21 and question 4 from https://tinyurl.com/y2e8l8oo.

Supervision 6: Examples III 6, 7, 9, 10 (is very short), 11, 12, 13, plus question 5 from https://tinyurl.com/y2e8l8oo.

Supervision 7: Examples III S3 and S4 from the Skills section, 14, 16 (please do not use the Divergence Theorem on it), 17, 18, 19, 20.

Supervision 8: Examples III 21, 23, 24, 25 (you may well not understand the * bit), 26, 28, plus question 6 from https://tinyurl.com/y2e8l8oo.

Vacation Work: I'll not be setting any vacation work explicitly, but you should attempt as many past tripos questions as you have time for. Use my webpage links to find my comments on past questions and bottom line answers to them.

Supervision 1: You can attempt these once the lecturer has finished section 1.2.3. Examples I 3, 5, 6, 7, 8, 9, 10, 11. You might usefully have a look at my tutorial on suffix notation at https://tinyurl.com/bdrau49h before attempting 6, 7 and 8. The current lecturer uses upper case for suffix notation, but past lecturers, and exam questions used lower case.

Supervision 2: Any of the suffix notation questions from last week we didn't go over (eg 6 and/or 7(ii)), plus: Examples I 12, 13, 14, 15, 17, 22, plus questions 1 and 2 from https://tinyurl.com/y5y2floy. You do not need to have covered section 1.6.2 of the lecture handout in order to do question 1.

Supervision 3: Examples I 24, 25, 26, 27, 31 (leave the harder part if you don't understand it) plus questions 3 and 4 from https://tinyurl.com/y5y2floy.

Supervision 4: From https://tinyurl.com/mr2dycsv (I'm using the 2021 questions as I prefer that version of question 4): 1, 3 (optional, and ignore their hint in the final paragraph regarding "Show that..." - find the solution any way you like), 4 (not easy), 5, 6 (optional).