

University of Saskatchewan  
Department of Electrical and Computer Engineering

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EE301 Electricity, Magnetism and Fields  
Final Examination  
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Welcome to the EE301 final examination. This is a closed book and closed notes examination. A formulae sheet is attached. You may use a calculator. The examination lasts **3** hours.

Answer all **6** problems.

Each problem is worth the same; subparts are weighted as indicated. Show your work and briefly explain what you are doing if appropriate; credit will be given only if the steps leading to the answer are clearly shown. If a symmetry argument is used, it is sufficient to write "By symmetry we know that...". Partial credit will be given for partially correct answers if the method used is correct. Be reasonably neat; credit will not be given for illegible answers.

None of the problems require intricate mathematical manipulations. If you get stuck with an impossible integral or equation, you are likely approaching the problem incorrectly.

## 1. Electrostatics

Two point charges of 200 nC and 50 nC are separated by 1 cm.

✓ a) (4) Determine the electric field and the potential at the midpoint between the two charges.

✓ b) (2) What is the total electric flux passing through an infinite plane that goes between the two charges?

✓ c) (4) The two charges are now enclosed inside a spherical metal shell with radius 2 cm; the metal has no net charge. What is the electric field outside the metal sphere?

## 2. Capacitance

A capacitor is constructed from three concentric, spherical metal shells with radii  $a$ ,  $2a$ , and  $3a$ . The space between the shells is filled with a dielectric with relative permittivity  $\epsilon_R$ . The inner shell is connected to the outer shell by a wire. Determine the formula for the capacitance between the middle shell and the other two shells.



