Partial and total knee joint replacements, including articular cartilage allograft, are frequently performed to alleviate the pain, suffering, and limitations on mobility of many patients. The need for this surgical procedure may have its origins in traumatic injury, chronic injury, or degenerative diseases including forms of arthritis.

1. Describe the origins of the need for partial or total knee joint replacements and articular cartilage allografts. Compare and contrast biological and mechanical properties of the normal and degenerated/diseased states of the tissues of the knee joint.

2. Describe two examples of current prosthetic and allograft approaches to remedy the problems noted above. Your description should include a brief discussion of the efficacy and degrees of successful long-term outcomes of these procedures.

3. Describe a proposed solution that you believe would be an improvement over current state-of-the-art. Your description should include considerations of the tissue biomechanics (including continuum mechanical considerations), biomaterials, kinematics, and biological properties and attributes of your solution. It should include the experimental approaches to test your proposed solution. Describe the anticipated outcome of those experiments and evaluations.

4. Describe the anticipated problems you might expect to encounter, and how you would overcome those problems.