APPENDIX TO BME QUALIFYING EXAM POLICY
SAMPLE QUESTIONNAIRES

SAMPLE QUESTIONNAIRE #1 (PULMONARY IMAGING)

Part 1: Critically assess the evolution of functional CT imaging as applied to the evaluation of pulmonary ventilation, perfusion, and V/Q. Discuss how this new CT methodology is advancing our understanding of (regional) lung function relative to what has been gleaned from MIGET, single breath wash-out methods and other more traditional measures which have been used previously to assess functional heterogeneity of the lung.

Part 2: Using this information, propose an experimental protocol to assess CT-based regional measures of pulmonary V, Q and V/Q. In this discussion include information regarding how you would go about determining a sample size for the experiment(s) you propose.

SAMPLE QUESTIONNAIRE #2 (BLOOD FLOW)

Hemodynamics in arteries have been studied and reported upon extensively using computational methods. Many challenges remain on the methods used for computational simulation and in interpreting its results in a clinically relevant manner.

1) What is the current state of literature on the computational simulation of blood flow in the Circle of Willis? What are the major challenges/limitations?
2) In the post processing of hemodynamics simulations of the Circle of Willis, what are the indices of blood flow that may have clinical relevance vis-à-vis in understanding the pathogenesis of disease states? Mention the ones that have been reported and also your own thoughts on additional ones if any.

SAMPLE QUESTIONNAIRE #3 (CERVICAL DISC MECHANICS)

Part 1) A number of factors are important when considering cervical disc replacement versus a traditional decompression and fusion surgery. Perhaps the most important consideration is that longer term studies and follow-up will be needed to fully understand the potential risks and benefits of cervical disc replacement. Discuss the current state of the cervical disc replacement procedure, including both the pros and cons.

Part 2) If money were no object, how would you go about establishing the efficacy of the motion-sparing procedure (e.g., computational *vs* experimental *vs* clinical studies)?

Sample questionnaire #4 (Calcium channels)

1) Describe the cellular mechanisms involved in sinoatrial pacemaking.
2) One hypothesis is that interactions between Ca^{2+} cycling and ionic mechanisms are required for pacemaking. Describe the evidence supporting this hypothesis and critical experiments that would prove or disprove it.

Sample questionnaire #5 (Mechanobiology)

(A) Cells exert forces on their surroundings (i.e., extracellular matrix, synthetic materials, and other cells). Describe in detail how cells attach and exert forces on their surroundings. What modulates the amount of force a cell produces? How do these mechanisms differ between fibroblasts and keratinocytes? One technique used to measure cell forces is cell traction force microscopy. Explain in detail how this technique works. What are the assumptions invoked and what limitations exist as a result? What are the implications of these assumptions if the measurements are made on fibrous materials, e.g., a collagen gel?

(B) Now imagine that you are testing the hypothesis that keratinocytes cultured on the surface of a collagen gel alter their cytoskeletal structure and the forces they exert on the gel in response to the amount of tension produced by dermal fibroblasts inside the gel. To test this hypothesis you will need to determine what forces are exerted by the keratinocytes. Describe how you will make this measurement. Can you use cell traction force microscopy or will you need to devise a new technique? If so, describe the new technique in detail. Also make sure to include details on the experimental conditions, such as the cells you will use, the culture conditions, and all the tests you would do prove your hypothesis.