

HOMEWORK #1
BME 416/516 Fall 2007

September 4, 2007

Due 8:00 am, September 11, 2007

Briefly (in 1-2 sentences) answer the questions:

1. Define the term “biomaterial.” *Lecture 1 Slides 6-7.*
2. Describe the difference between “graft” polymerization and “cross-linking” polymer networks. *Lecture 2 Slide 11. Chains are connected in cross-linked network to have better material properties.*
3. Why T_g is important for polymeric biomaterials? *Lecture 2 Slide 13. Determines glasslike or rubberlike behavior at given temperature.*
4. What is hot rolling? *Lecture 2 Slide 18.*
5. What is the significance of stress-strain curve for biomaterials? *Lecture 2 Slide 16. Determines stiffness (=modulus) and toughness of biomaterials.*
6. Identify elastic modulus, yield point, ultimate strength and failure strength in the typical stress-strain curve. *Lecture 2 Slide 15.*
7. Compare metals with polymers in terms of the ultimate or yield strength. *Lecture 2 Slides 20-22, 25-26. Higher ultimate and yield strengths for metals.*
8. What is the isoelectric point of a protein? *Lecture 3 Slide 2.*
9. What does “RGD” refer to? Explain its significance. *Lecture 4 Slide 11.*
10. List the possible interactions between proteins and biomaterial surfaces. *Lecture 3 Slide 3.*
11. Describe the physiological relevance and sequence of events involved in forming the “platelet plug.” *Lecture 3 Slide 13.*
12. Describe the difference between intrinsic and extrinsic coagulation pathways. *Lecture 3 Slide 14.*
13. Describe how heparin and plasminogen function as anticoagulants. *Lecture 3 Slides 17-18.*
14. Explain how monocytes, macrophages, and foreign body giant cells are distinctly different and yet related. *Lecture 3 Slides 21-22. Monocytes escape from blood stream to become macrophages, which can further develop into foreign body giant cells under frustrated phagocytosis.*
15. Describe the differences between macrophages and neutrophil functions. *Lecture 3 Slide 21. Macrophages in tissue, neutrophils in blood stream.*
16. Describe diapedesis. *Lecture 3 Slide 25. Describes how monocytes escape from blood stream.*
17. Describe the potential outcome of rough biomaterial surfaces. *Lecture 4 Slides 4-5. More protein adsorption, infection, foreign body reaction, better fixation of implants, but thinner fibrous capsule formation.*
18. Investigate the coatings for biomaterials to resist thrombosis (e.g., PEG/heparin coating or pre-clotting). *Lecture 4 Slides 7, 10, 26. PEG = hydrophilic, thus protein-resistant surface; Heparin = mimics vascular endothelial cells and enhance ATIII activity; Pre-clotting = blood clot itself is strong anti-coagulant, creating pseudointima.*

19. List the overall sequence of normal wound healing, starting from thrombosis/hemostasis to remodeling phase. *Lecture 3 Slide 29. Protein adsorption → blood coagulation (thrombosis) → inflammation (macrophages and neutrophils) → immune response (lymphocytes) → granulation tissue → angiogenesis → proliferative/repair phase → remodeling.*
20. What is granulation tissue? *Lecture 3 Slide 29. Temporary replacement tissue.*
21. Discuss the effect of surface roughness of implants towards (1) protein adsorption, (2) infection, (3) foreign body reaction, (4) fibrous capsule formation, and (5) fixation of implants. *Same as Q17.*
22. In THA, what are the most popular materials for (1) femoral stem, (2) head, (3) acetabular cup, and (4) cup liner, and why they are popular (i.e., what are their advantages)? *Lecture 4 Slide 13. (1) Ti (strong yet light) or Co-Cr (strong and resistant to corrosion) (2) Co-Cr (resistant to corrosion) or ceramic (resistant to corrosion, wear, biocompatibility) (3) UHMWPE (resistant to wear; easy to fabricate) or ceramic (resistant to corrosion, wear, biocompatibility) (4) Ti (strong yet light) or Co-Cr (strong and resistant to corrosion).*
23. What is metal allergy? *Lecture 4 Slide 18.*
24. Why does the sewing cuff of heart valve prostheses have roughened surface? *Lecture 4 Slide 6.*
25. What is PTCA? What is balloon angioplasty? *Lecture 4 Slide 22.*
26. Coronary artery stents are used in balloon angioplasty to primarily prevent _____. *Lecture 4 Slide 23. Restenosis.*
27. What are stent grafts? What is aneurysm? *Lecture 4 Slide 25. Stent graft = vascular stent + vascular graft. Aneurysm = dilation of blood vessel.*
28. What is anastomosis? *Lecture 4 Slide 27. Usually refers to the connection of blood vessels.*
29. Why is endothelialization required for vascular grafts? *Lecture 4 Slide 26. To prevent blood coagulation.*