Assessment of your knowledge

(a) Answer the following questions to assess your command on terminology, facts, concepts, and theories learned in this chapter.

1. What is the definition of a biomaterial?
2. What is a polymer?
3. What is a copolymer?
4. What are the differences between natural, synthetic, and hybrid polymers?
5. What is the relationship between monomers and polymers?
6. What is a noncovalent interaction and which ones do you know?
7. What is a covalent bond?
8. What is a hydrogel?
9. What is a composite material?
10. Why are synthetic biomaterials needed and used?
11. Name the two main growth types of polymerizations.
12. What are the five major functions of the extracellular matrix?
13. Is a protein a polymer? Why?
14. Name two types of degradation mechanisms within synthetic biomaterials.
15. What is enzymatic degradation? How can we introduce this into synthetic materials?
16. What is the storage modulus of a material? Why is it important?
17. Give one example of a stimuli-responsive polymer.
18. What is the most used molecular modification to introduce cell adhesion?
19. What is biomimicry?
20. What is a major consideration in designing solution for clinical use?

(b) Answer the following questions to assess your ability to apply the concepts and theories learned in this chapter in real life, clinical, and scientific situations:

1. If I wanted to create a hydrogel from poly (ethylene glycol) diacrylate designed to degrade only in the presence of cells, how would I do so? Be as specific as possible.
2. How does degradation rate of a material relate to the tissue formation/repair? What are strategies to increase or decrease the rate of the degradation within a synthetic material?
3. What are the similarities and differences between natural polymers in the ECM and synthetic polymers made by chemists?
4. Describe how collagen, a simple protein chain, can have many different materials forms? Give at least two specific examples.
5. What are the differences between ionic, covalent, and supramolecular bonds/interactions? What are the requirements and benefits of each?
6. If I wanted to create a biomimetic material based on the architecture of bone, what could I do? What are essential features, and how can I create these in a synthetic system?
7. When a wound becomes infected, it often becomes more acidic. How can I design a material to sense and react to this local infection?
8. Recreating the biochemical complexity of the native ECM within synthetic materials remains a major challenge. What are some of the most widely used ways to introduce this biochemical signaling? Which areas still need a lot of research and design?
9. You are designing a polymer biomaterial but are not sure yet how water-soluble it is going to be so you choose a polymer backbone to which you can easily attach various side groups. Which side groups would you attach to increase and which to decrease the water solubility of the final biomaterial? Also, which applications in the human body would favor a water-soluble and which would favor a water-insoluble biomaterial?
10. You are designing a cell therapy in which stem cells are supposed to be slowly released in the body over time. How do you design a suitable biomaterial for such a slow-release therapy? What do you need to take into account?