



UNIVERSITY OF GHANA
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SECOND SEMESTER EXAMINATIONS: 2012/ 2013
LEVEL 400: BACHELOR OF SCIENCE IN ENGINEERING
BIEN 402: TISSUE ENGINEERING AND BIOTECHNOLGY
TIME ALLOWED: 3 HOURS (GRADED AS 4 CREDIT HOURS)

Part 1: Multiple choice questions. Answer ALL questions in the answer booklet provided (15 marks)

1. The four principal types of tissues are
 - (a) muscle, nervous, skeletal, connective
 - (b) epithelial, skeletal, connective, reticula
 - (c) connective, skeletal, epithelial, nervous
 - (d) epithelial, connective, muscle, nervous
2. Functions of epithelial tissue include
 - (a) providing structural support
 - (b) protecting exposed surfaces
 - (c) conducting electrical impulses
 - (d) storing energy in the form of fat
3. Stem cells are interesting cell source for Tissue Engineering because:
 - (a) they are abundant in the human body
 - (b) they display plasticity and can thus form any cell type
 - (c) they can make identical copies differentiated cells thereby creating unlimited supply of cells
 - (d) they can make identical copies of themselves and differentiate
4. The transplantation of an organ or tissue from a donor to a genetically identical recipient like twins is called
 - (a) isograft
 - (b) autograft
 - (c) allograft
 - (d) xenograft
5. Transplants are one of the greatest achievements of Tissue Engineering and depends on:
 - (a) the organ being transplanted
 - (b) the age of the recipient
 - (c) the genetic information in the cell
 - (d) the history of the donor

6. The cytoskeleton responds to stress by exhibiting the following properties
- (a) elastic, plastic, failure
 - (b) strength, elastic, toughness
 - (c) elastic, resilience, plastic
 - (d) strength, resilience, toughness
7. Extracellular matrix carries the mechanical load of the following tissues:
- (a) muscle
 - (b) connective
 - (c) epithelial
 - (d) nervous
8. Tissue repair involves the proliferation of cells from:
- (a) the remnants of the injured tissue
 - (b) vascular endothelial cells to form new blood vessels
 - (c) fibroblasts which provide fibrous tissue for the formation of scars
 - (d) all the above
9. Stem cells that can differentiate to form other cell types are called
- (a) totipotent
 - (b) multipotent
 - (c) pluripotent
 - (d) xenopotent
10. Umbilical cord stem cells can serve the following functions
- (a) homing
 - (b) engraftment
 - (c) plasticity
 - (d) all the above
11. Under physiological loads, bone can assume
- (a) Hookean elasticity
 - (b) nonHookean elasticity
 - (c) both Hookean and nonHookean characteristics
 - (d) isotropic characteristics
12. Features such as the limb are recognizable because matter
- (a) is arranged into detectable patterns
 - (b) is arranged into regular patterns
 - (c) is arranged in different ways
 - (d) is arranged in communities
13. The region within the embryo that is capable of forming a limb is called
- (a) limb groove
 - (b) limb field
 - (c) limb node
 - (d) limb spindle

14. The term used to describe cells that will develop according to their new position but within the context of their history is called

- (a) positional history
- (b) genetic history
- (c) positional value
- (d) positional information

15. A common model used to predict positional information involve the utilization of gradients of signaling molecules called

- (a) morphogenes
- (b) pathogenes
- (c) genentic variation
- (d) mycogenes

Part II: Short answer questions. Answer ALL questions in the answer booklet provided (25 marks)

1. Give a brief explanation as to why embryonic stem (ES) cells could play an important role in tissue engineering. (3 marks)
2. What is the inherent potential risk from using ES cells in therapy? (3 marks)
3. A taxi was involved in an accident on the Tema highway, a patient suffers a fracture to the skull causing an irregular-sized defect of approximately 10cm in diameter as well as a full-thickness wound, of about 8cm x 4cm to the skin of his forearm. Identify a biomaterial and a tissue engineering technique that may be used to aid repair of the:
 - (a) Skull Fracture. (2 marks)
 - (b) Forearm injury. (2 marks)Explain the rationale behind your choices. (4 marks)

4. After isolating DNA from an organism you often need to ascertain its purity and also to identify its polynucleotide sequence
 - (a) Name 2 commonly used techniques to identify its purity. (2 marks)
 - (b) Describe the technique you will use to ascertain its identity. (3 marks)
 - (c) You need a segment of the DNA to clone into a vector. Describe the technique you will use to obtain the DNA fragment. (4 marks)
5. Mention one ethical and one commercial problem associated with the development of Tissue Engineering products. (2 marks)

Part III: Answer 3 questions from this section in the answer booklet provided. Each question carries 20 marks.

1. (a) Describe one Biomedical Engineering principle that you learned from reading the research papers presented in class. (8 marks)

(b) Tissue Engineering strategies can generally be divided into 2 categories; cell-based and biomaterial-based.

- (i) Discuss the strengths and weaknesses of each approach using examples from the lectures. (8 marks)
- (ii) Address some of the challenges of integrating the two approaches. (4 marks)

2. You have isolated a smooth muscle cell preparation that contracts when a drug (ligand) is applied. The muscle is connected to a force transducer that allows you to measure the force of contraction (cell response). The maximum force of contraction that the preparation is capable of is 1 N. A drug concentration of 1×10^{-8} M, produces a contraction force of 0.75 N.

- (a) Determine the K_d of the drug. (6 marks)
- (b) You add a ligand that competitively inhibits muscle contraction. When the ligand is added at a concentration of 5×10^{-7} M, the contraction force is reduced to 0.25 N. Determine the K_d value for the inhibitor. (8 marks)
- (c) What concentration of the drug is necessary to achieve the original contraction force of 0.75 N in the presence of 5×10^{-7} M of the inhibitor? (6 marks)

3. A cell culture is initially composed of 100 cells. After 12 hours the number of cells is 1.5 times the number in the initial population.

- (a) If the rate of growth is proportional to the number of cells present, determine the time necessary for the number of cells to triple. (8 marks)
- (b) What is the time required for a culture with 1×10^6 of the same cells to triple? Explain your results. (10 marks)
- (c) Under what conditions would the answer obtained in part (b) be invalid? (2 marks)

4. (a) List 4 soft tissues with obvious mechanical functions. (4 marks)

- (i) Is a soft tissue elastic or viscoelastic? (1 marks)
- (ii) Is the stress-strain relationship linear or nonlinear for a soft tissue? Illustrate with a diagram. (5 marks)

(b) The figure below shows a column of fatty tissue, determine the strain in each of the three regions. (10 marks)

