PART I: MULTIPLE CHOICE

DIRECTIONS: Each of the numbered items or incomplete statements is followed by answers or by completions of the statement. Select the ONE lettered answer or completion that is BEST in each case.

Use the following diagram to answer QUESTIONS 18 & 19

18. The diagram above shows:
   A. A Herring body
   B. A somatic motor neuron ending on a skeletal muscle fiber
   C. A visceral motor (autonomic) neuron ending on a smooth muscle fiber
   D. A synapse of one nerve on another nerve
   E. Cells in the pars distalis of the pituitary

19. The small clear vesicles labeled "X" in the diagram above are most likely to contain:
   A. Acetylcholine
   B. Norepinephrine
   C. Oxytocin
   D. Substance P
   E. TRH (Thyrotropin-releasing hormone)
20. A Nissl body is composed of:
   A. Nuclei
   B. Lysosomes
   C. The Golgi apparatus
   D. Rough endoplasmic reticulum (RER) and free polysomes
   E. Microtubules

21. Which of the following is/are true of the fetal adrenal gland?
   A. Relative to total body weight, it is large compared to the adult adrenal
   B. It possesses chromaffin cells but these are not segregated into a distinct medulla
   C. It works in conjunction with the placenta to produce steroid hormones
   D. The permanent cortex develops outside the fetal cortex
   E. All of the above

22. Suppose you were looking at a cross section of a sarcomere by EM. If you saw only thick filaments, and these filaments did not appear to be cross-linked to one another, you could conclude that this cross section had passed through what part of the sarcomere:
   A. H zone
   B. I band
   C. M-line
   D. Z line
   E. Zone of actin-myosin filament overlap in the A band

Use the following diagram to answer QUESTION 23

![Diagram of cartilage growth processes]

23. The diagram above illustrates which cartilage growth process?
   A. Appositional growth
   B. Periosteal growth
   C. Interstitial growth
   D. Unilateral growth
24. Which of the following statements is true when applied to the thyroid, but not true of any other endocrine organ:
   A. Hormone production by the gland is controlled entirely by the hypophysis
   B. It stores large amounts of its hormone precursor in an extracellular location
   C. It synthesizes all of the amino acids necessary for production of its hormones
   D. The cells that make up the organ come from two different embryonic sources

25. Which of the following is true concerning the perichondrium?
   A. It is found covering articular cartilage at a joint surface
   B. It is covered by a simple squamous epithelium
   C. Its inner cellular portion contains chondrogenic cells
   D. It is responsible for the interstitial growth of cartilage

26. Which of the following structures found in skeletal muscle is the smallest:
   A. Fascicle
   B. Myofiber
   C. Myofibril
   D. Myofilament
   E. Sarcomere

Use the following diagram to answer QUESTION 27

![Diagram of bone structure]

27. On the diagram above, the letter “B” refers to a/an:
   A. Haversian canal
   B. Canaliculus
   C. Interstitial lamella
   D. Osteocyte
   E. Volkmann’s canal
28. Excluding cells of the epineurium, perineurium and endoneurium, most of the nuclei within a peripheral nerve belong to:
   A. Neurons
   B. Schwann cells
   C. Fibroblasts
   D. Astrocytes
   E. Oligodendrocytes

29. Which of the following is true concerning a cement line:
   A. It is a layer of non-mineralized bone matrix found between each osteoblast and the mineralized bone matrix
   B. It demarcates the outer border of an haversian canal
   C. It represents the line of reversal from resorption to deposition in the formation of an haversian system (secondary osteon)
   D. Osteocytes from neighboring osteons can routinely communicate with one another across this line

30. A decrease in blood calcium levels would have its most direct stimulatory effect on cells in which of the following locations?
   A. Parathyroid gland
   B. Pars distalis of the hypophysis
   C. Pars nervosa of the hypophysis
   D. Thyroid gland
   E. Zona glomerulosa

31. Which of the following groups of cells contains only basophils that are found in the pars distalis?
   A. Somatotrophs, gonadotrophs, corticotrophs
   B. Corticotrophs, mammotrophs, gonadotrophs
   C. Mammotrophs, gonadotrophs, somatotrophs
   D. Thyrotrophs, gonadotrophs, corticotrophs
   E. Somatotrophs, gonadotrophs, thyrotrophs

32. In the peripheral nervous system, myelin is made by:
   A. Neurons
   B. Schwann cells
   C. Fibroblasts
   D. Ganglion cells
   E. Oligodendrocytes
33. Which of the following cell types produces alkaline phosphatase and is responsive to parathyroid hormone?
   A. Osteoblasts
   B. Osteoclasts
   C. Chondrocytes
   D. Fibroblasts
   E. Chondrogenic cells

34. Which of the following is true concerning the skeletal muscle Z-line:
   A. Alpha-actinin and nebulin anchor the thick filaments to the Z-line
   B. Thin filaments are anchored to the Z-line by titin
   C. Neighboring myofibrils are kept in register with one another via intermediate filaments at the Z-line
   D. It bisects the A band
   E. The distance between Z lines remains constant during a contraction

35. In which of the following locations would you find fibrocartilage?
   A. Forming the suture between two bones of the skull
   B. At the pubic symphysis
   C. In the tracheal rings
   D. In the epiglottis
   E. At an articular surface of a synovial joint

36. Which of the following is true concerning skeletal muscle regeneration?
   A. Skeletal muscle fibers cannot be repaired
   B. Satellite cells proliferate and fuse to form new myotubes
   C. The main defect that causes muscular dystrophies is the inability of the muscle to regenerate
   D. New myoblasts are recruited from bone marrow precursors, and migrate to the site of injury

37. Osteocytes:
   A. May play a mechanosensory role in the stimulation of bone remodeling
   B. Can coalesce with one another to form osteoclasts
   C. Are capable of limited resorption of the organic matrix of bone
   D. Can be found in bone that is organized into haversian systems, but not within circumferential lamellar bone
   E. Are the cells responsible for matrix mineralization of newly deposited bone tissue
39. Which of the following is true concerning the t-tubule system in human skeletal muscle?
   A. It is a derivative of the cell’s smooth endoplasmic reticulum
   B. T-tubules in skeletal muscle are larger than those found in cardiac muscle
   C. They are located at the M-line
   D. They usually form dyads with the adjacent terminal cisterna of the sarcoplasmic reticulum
   E. They contain voltage sensitive proteins that are activated when the plasma membrane depolarizes

39. Which of the following is true of woven bone?
   A. It is the only kind of bone that can be found in the bones of children
   B. Mineralization transforms it into lamellar bone
   C. It can be laid down de novo, where no bone or cartilage matrix previously existed
   D. It is capable of resisting mechanical forces better than lamellar bone

40. Which connective tissue layer can be found surrounding a single fascicle of muscle fibers:
   A. Endomysium
   B. Perimysium
   C. Epimysium
   D. Mesomysium
   E. Ectomysium

41. Parafollicular cells of the thyroid gland:
   A. Are derived from ektoderm in the floor of the oral cavity
   B. Are all located outside of the basement membrane of the thyroid follicles
   C. Contact the colloid in the thyroid follicles
   D. Produce a hormone that promotes the calcification of osteoid

42. The process of endochondral ossification:
   A. Is primarily responsible for increases in the width of developing long bones
   B. Allows a long bone to grow in length without disruption of the articular surface
   C. Begins through the transformation of chondrocytes into osteocytes
   D. Includes a zone of hypertrophy in which cells divide and produce more matrix
   E. Includes a zone of calcification in which cartilage matrix calcifies and becomes woven bone
43. **Multicellular neuronal cell bodies and cells containing dense core secretory granules are characteristically found in:**
   A. Adrenal cortex
   B. Adrenal medulla
   C. Parathyroid glands
   D. Pars nervosa of the hypophysis
   E. Thyroid glands

44. The organic portion of bone consists primarily of:
   A. Osteopontin
   B. Osteocalcin
   C. Type I collagen
   D. Type II collagen
   E. Hydroxyapatite

45. Identify the correct statement about the pituitary gland:
   A. Oxytocin and vasopressin are secreted by pituitocytes
   B. Pars tuberalis originates from the floor of the diencephalon (central nervous system)
   C. Pars distalis contains axons of secretory neurons whose cell bodies are in the hypothalamus
   D. Pars intermedia contains remnants of Rathke's pouch, and is derived from the neurohypophysis
   E. A decrease in the serum concentration of thyroid hormones normally results in increased secretion of TSH

46. The clear zone of the osteoclast:
   A. Contains actin filaments to help seal the region of the ruffled border to the bone surface
   B. Contains microfilaments but essentially lacks other organelles
   C. Creates a sealed microenvironment in which bone resorption can occur
   D. All of the above

47. Cartilage is particularly resistant to compressive forces. Which of the following properties of its extracellular matrix aids in this function?
   A. The matrix is highly vascularized
   B. The matrix has a high water content
   C. The matrix contains collagen fibers
   D. The matrix is highly acidophilic
48. Purkinje fibers:
   A. Have more myofibrils than ordinary cardiac myocytes
   B. Are indistinguishable from ordinary cardiac myocytes
   C. Are specialized for relaying impulses, rather than contraction
   D. Are nerve cells
   E. Both C and D are true

49. Bone is one of the target organs for growth hormone. Which cells must ultimately be stimulated in order to produce an increase in the height of a growing child?
   A. Osteoblast
   B. Osteocyte
   C. Osteoclast
   D. Chondrocyte
   E. Osteoprogenitor cell

50. What types of sensory receptors are most likely to be involved in the sensation of a painful stimulus?
    A. Free nerve endings
    B. Ruffini endings
    C. Encapsulated receptors in the superficial layer of epidermis
    D. Encapsulated receptors deep in the dermis

51. Abundant smooth endoplasmic reticulum and mitochondria with tubular cristae are characteristic features of cells that secrete:
    A. ACTH
    B. Aldosterone
    C. Calcitonin
    D. Cortisol
    E. Thyroxine

52. Which of the following is found in a typical synovial joint?
    A. Articular cartilage, composed of elastic cartilage
    B. A synovial membrane overlying the articular cartilage
    C. A fibrous capsule lined by a synovial membrane
    D. Sharpey's fibers anchoring the periosteum to the articular cartilage
    E. Synovial fluid, produced by the type A cells of the synovial membrane
DIRECTIONS: Each of the numbered items or incomplete statements in this section is negatively phrased, as indicated by a capitalized word such as NOT, LEAST, or EXCEPT. Select the ONE lettered answer or completion that is BEST in each case.

53. Identify the FALSE statement about the posterior pituitary:
   A. Antidiuretic hormone (ADH) affects the permeability of the collecting ducts of the kidney
   B. Some hormones produced by hypothalamic neurons are secreted in the neurohypophysis
   C. Over-secretion of ADH will cause production of a large volume of dilute urine
   D. Herring bodies are dilated portions of axons in the pars nervosa
   E. Oxytocin promotes smooth muscle contraction of myoepithelial cells surrounding the secretory alveoli of the mammary gland

54. All of the following structures are part of a muscle spindle EXCEPT:
   A. Afferent nerve endings
   B. Connective tissue capsule
   C. Efferent nerve endings
   D. Intramuscular collagen fibers
   E. Modified skeletal muscle cells

55. All the following statements about the pituitary gland are true EXCEPT:
   A. In amphibians and fish, the pars intermedia contains basophilic-producing melanocyte-stimulating hormone that affects pigmentation
   B. Hypothalamic neurons from the supraoptic and paraventricular nuclei produce vasopressin (ADH) and oxytocin
   C. The hypothalamo-hypophyseal portal system originates from a primary capillary plexus in the median eminence and ends in a secondary plexus in the pars nervosa
   D. Prolactin tumors in the pituitary may cause hyperthryroidism
   E. 

56. All the following are characteristic features of active thyroid follicular cells EXCEPT:
   A. Junctional complexes between follicular cells
   B. Extensive RER that often has distended cisternae
   C. Numerous phagosomes
   D. Numerous lysosomes
   E. A highly acidophilic cytoplasm due to the presence of very large numbers of mitochondria
57. Which of the following items INCORRECTLY states the mechanism that causes muscle weakness in the clinical condition described:
A. Mutations in dystrophin or other muscle components in muscular dystrophy
B. Abnormal increase of acetylcholine release by some spider neurotoxins
C. Abnormal elongation of postsynaptic folds by botulinum toxin
D. Blockage of acetylcholine receptors by some snake venoms

58. All the following statements about the pituitary gland are true EXCEPT:
A. Over-production of thyroid hormones (T3, T4) has a negative feedback effect on the hypothalamus and the pituitary gland
B. Thyrotropin-releasing hormone (TRH) is produced by basophils in the pars distalis
C. Chromophils may become chromophobes after they release most of their secretory product
D. Production of hormones by the adenohypophysis is induced by some hypothalamic hormones and inhibited by others
E. ACTH (adrenocorticotropic hormone) is secreted in the adenohypophysis by basophilic cells

PART II:
MATCHING: These sets of matching questions consist of a diagram or a list with lettered options, followed by several numbered items. For each numbered item, select the ONE lettered option that is most closely associated with it. Each lettered option may be used once, more than once, or not at all.

A. Axons
B. Clefts of Schmidt-Lanterman
C. Dendrites
D. Neuronal cell bodies in a sensory ganglion
E. Neuronal cell bodies in an autonomic ganglion
F. Nodes of Ranvier
G. Oligodendrocytes
H. Satellite cells
I. Schwann cells

59. Multipolar neuronal cells of the peripheral nervous system that often contain aquatic nuclei

60. Cytoplasmic processes that most often receive synapses from other neurons

61. A feature that is required in myelinated neuronal processes in order to maintain the viability of certain regions of Schwann cell cytoplasm

62. Gap between myelin of two adjacent Schwann cells

63. A non-neuronal cell type found only in ganglia of the peripheral nervous system
A. Dense bodies
B. Caveolae
C. Intercalated disks
D. Gap junctions
E. Dyads
F. Triads

64. Common in smooth and cardiac muscle but not in skeletal muscle
65. Attachment sites for thin filaments in smooth muscle
66. Small invaginations of the plasma membrane, found on smooth muscle cells
67. Site where two cardiac muscle cells are joined by fasciae adherentes and desmosomes

Use the following diagram to answer QUESTIONS 68-70

68. Capillary bed that runs between spongicytes
69. Capillary bed into which aldosterone is directly secreted
70. Capillary bed associated with norepinephrine secreting cells
A. Intramembranous ossification
B. Endochondral ossification
C. Modeling (surface remodeling)
D. Intratubidal remodeling

71. Results in the formation of mixed spicules containing woven bone and calcified cartilage

72. Is the process that allows bones to attain their proper shape and curvature throughout the growth period

73. Is the process by which the perosteal bony collar develops around the primary ossification center of a long bone diaphysis

74. Is the coupled process of bone resorption and bone deposition at a single site, resulting in the formation of an haversian system