MULTIPLE CHOICE QUESTIONS. Each of the following numbered questions or incomplete statements is followed by suggested lettered answers or completions. Select the ONE which is BEST in each case, and mark its letter on the answer sheet next to the appropriate question number.

37. Latchbridges can be best described as:
   A. rapidly cycling phosphorylated crossbridges
   B. slowly cycling dephosphorylated crossbridges
   C. rapidly cycling dephosphorylated crossbridges
   D. slowly cycling phosphorylated crossbridges
   E. rigor bridges

38. Activation of striated muscle involves:
   A. dihydropyridine receptors acting as a sodium sensor
   B. calcium release through ryanodine receptor
   C. activation of myosin by the myosin light chain kinase
   D. increase in cytosolic calcium via a Na/Ca exchanger
   E. Calcium binding to troponyosin

39. Smooth muscle cells and cardiac ventricular muscle cells are similar in that both:
   A. use tropomycin for contractile regulation
   B. use CaATPases located on the cell membrane to aid in relaxation
   C. use Na/Ca exchanger located on the sarcoplasmic reticulum to control calcium concentrations
   D. can use influx of extracellular calcium to directly initiate contraction
   E. can grade the amount of force developed by small changes in membrane potential

40. A slow twitch skeletal muscle as compared to a fast twitch skeletal muscle would most likely have:
   A. high capillary density and low mitochondrial density
   B. high capillary density and high glycolytic enzyme content
   C. high capillary density and high mitochondrial density
   D. high myosin ATPase activity and high mitochondrial content
   E. low myosin ATPase activity and high glycolytic enzyme content
41. The Na/Ca counter-transporter system:
   A. utilizes the energy in ATP to directly power transport of calcium up a concentration gradient
   B. normally transports calcium into the cell
   C. normally transports calcium out of the SR
   D. is activated by calmodulin
   E. none of the above

42. The mechanism responsible for the movement of carbon dioxide across a cell membrane is:
   A. the oxygen concentration gradient
   B. GTP hydrolysis
   C. a sodium driven counter transporter
   D. facilitated diffusion
   E. passive diffusion

43. Osmosis will occur from chamber A to chamber B through a semi-permeable membrane separating the chambers when:
   A. chamber A contains 100 mM CaCl₂ and chamber B contains 150 mM NaCl and the membrane is permeable to water only.
   B. chamber A contains 100 mM CaCl₂ and chamber B contains 150 mM NaCl and the membrane is impermeable to solutes.
   C. chamber A contains 200 mM CaSO₄ and chamber B contains 200 mM NaCl and the membrane is impermeable to all ions.
   D. chamber A contains 100 mM CaCl₂ and chamber B contains 100 mM NaCl and the membrane is impermeable to all ions.
   E. chamber A contains 150 mM CaCl₂ and chamber B contains 300 mM NaCl and the membrane is impermeable to all ions.

44. What is the resting membrane potential of a cell that has a K⁺ concentration 10 times higher inside than outside and a Na⁺ concentration 100 times higher outside than inside? The cell membrane is permeable ONLY to Na⁺.
   A. 0
   B. +60 mV
   C. -60 mV
   D. +120 mV
   E. -120 mV
45. A drug is administered that blocks voltage-sensitive $K^+$ channel activation. Which pair of effects should be observed in the action potentials recorded from skeletal muscle cells and nerve cells?

A. shorter action potential duration, no afterhyperpolarization
B. increased action potential amplitude, longer afterhyperpolarization
C. longer action potential duration, normal afterhyperpolarization
D. longer action potential duration, no afterhyperpolarization
E. decreased action potential amplitude, longer afterhyperpolarization

46. Which of the following events is responsible for determining the absolute refractory period of nerve and skeletal muscle cells?

A. voltage-sensitive $Na^+$ channel activation
B. voltage-sensitive $Na^+$ channel inactivation
C. voltage-sensitive $K^+$ channel activation
D. voltage-sensitive $K^+$ channel inactivation
E. voltage-sensitive $Ca^{2+}$ channel activation

47. Which of the following best describes the action of classical inhibitory neurotransmitters like GABA on the postsynaptic response?

A. increased conductance to $Na$ and $K$ through cation-selective channels
B. decreased conductance to $Na$ and $K$ through cation-selective channels
C. increased conductance to $Cl^-$
D. decreased conductance to $Cl^-$
E. decreased conductance to $Ca^{2+}$
48. A potential treatment for congestive heart failure is treatment with inotropic agents to increase contractility of the cardiac muscle cell. In the second physiology conference several hypothetical and real treatments were discussed. Why was treatment with calcium sensitizers considered to be a better potential approach than any other treatment discussed?

A. calcium sensitizers are rapidly degraded and are therefore less toxic than the other agents
B. calcium sensitizers will produce much longer and more efficient cardiac muscle action potentials than the other agents
C. calcium sensitizers are not naturally targeted by the immune system, thereby improving their efficacy
D. calcium sensitizers can be more specifically targeted to ventricular cardiac muscle cells, thereby reducing unintended global side effects
E. calcium sensitizers allow more calcium to be released from the sarcoplasmic reticulum with each heartbeat, improving contractile efficiency

49. A cell, whose membrane is permeable only to water and glycerol, contains 30 mM NaCl. It is placed in a solution containing 100 mM glycerol. The cell will:

A. swell to twice its initial volume
B. swell indefinitely until it bursts
C. shrink to half its initial volume
D. shrink until it has essentially no internal volume
E. maintain the same volume

50. The Na⁺-dependent glucose transporter is the major pathway for glucose transport in enterocytes. What effect would depolarization of the membrane from -50 mV to 0 mV have on glucose uptake by enterocytes?

A. it would increase
B. it would decrease
C. it would be unchanged

51. "Equilibrium" and "steady state" are different because:

A. an equilibrium always requires energy while a steady state does not
B. a steady state can never be at equilibrium
C. an equilibrium exists when opposing forces are equal while steady state occurs when two forces are acting in the same direction
D. an equilibrium never requires energy while a steady state may require energy for maintenance
E. equilibrium and steady state are the same thing and never different
52. The unstirred layer surrounding cells will:

A. Increase diffusional forces
B. Increase the partition coefficient
C. Increase the flux of a solute
d. Decrease the reflection coefficient
e. Increase the apparent diffusional distance

53. Which of the following properties or functions are directly associated with a dihydropyridine receptor:

A'. Sodium sensors
B'. Calcium flux
C'. Found only in smooth muscle
d'. Found only in T-tubules
e'. Na+/Ca++ countertransport activity

54. Which of the following best describes the structure/function of the terminal cisternae of the sarcoplasmic reticulum in skeletal muscle:

A'. Contains CaATPases important in the release of activator calcium
B'. Contains Na+/Ca++ exchangers important in the release of activator calcium
c'. Contains ryanodine channels important in calcium-induced calcium release
d'. Contains ryanodine receptors important for the release of activator calcium
e'. Contains dihydropyridine receptors important for the release of activator calcium

55. In skeletal muscle, the maximal velocity of shortening (V_max) in an isotonic contraction is determined by:

A. The preload
B. The afterload
C. The length at which the muscle is stretched
d. The number of active crossbridges
e. The predominant myosin isoform
56. In a cross-section through the A band of a skeletal muscle sarcomere, you could find:

A. thick filaments
B. the M-line
C. thick and thin filaments
D. the bare zone
E. all of the above

57. Replacement of half of the extracellular Na⁺ in a solution containing physiological concentrations of ions with choline (a large impermeant organic cation) would have what effect on the amplitude of a nerve action potential?

A. it would decrease
B. it would increase
C. it would be unchanged

58. The Na⁺/Ca²⁺ counter-transporter moves calcium out of the cytosol of cardiac myocytes and:

A. is an example of primary active transport
B. its rate would increase if intracellular sodium concentration was increased
C. is solely responsible for the reduction of intracellular calcium concentration in cardiac myocytes
D. is never active during the cardiac action potential
E. plays a role in the relaxation of cardiac muscle

59. In skeletal muscle at lengths longer and shorter than optimal, which of the following is correct:

A. the maximal afterload against which a muscle can shorten is increased
B. the maximal afterload against which a muscle can shorten is decreased
C. the maximal shortening velocity is increased
D. the maximal shortening velocity is decreased
E. changing length has no effect on muscle function
60. A patient with myasthenia gravis notes an improvement of symptoms after treatment with an acetylcholinesterase inhibitor. The primary mechanism for this improvement is:

A. an increase in the amount of acetylcholine released by the motor neuron onto the muscle
B. an increase in the number of acetylcholine receptors at the muscle end-plate
C. an increase in the concentration of acetylcholine at the acetylcholine receptor
D. an increase in the synthesis of acetylcholine by the motor neuron
E. an increase in the amount of norepinephrine released from the motor neuron

61. Inhibition of Na,K ATPase activity in an enterocyte will:

A. have no effect on Na, glucose co-transport
B. immediately stop glucose uptake into the cell
C. increase sodium efflux from the cell
D. increase glucose uptake into the cell
E. eventually decrease glucose uptake

62. In most cells, primary active transport is directly involved in the regulation of:

A. intracellular fructose concentration
B. intracellular calcium concentration
C. intracellular ATP concentrations
D. intracellular glucose concentrations
E. intracellular chloride concentration

63. Which of the following have similar mechanisms in striated and smooth muscles:

A. stimulus induced increase in intracellular calcium
B. sodium current
C. dihydropyridine receptor function
D. the crossbridge cycle
E. none of the above

64. Altering pre-load of a muscle changes:

A. the amount of force developed by a muscle
B. the maximal amount of force that can be developed by a muscle
C. the maximal velocity of shortening
D. the amount of tonic contraction
E. the rate of tonic relaxation
DIRECTIONS: Each of the numbered items or incomplete statements in this section is negatively phrased, as indicated by the capitalized word EXCEPT. Select the ONE lettered answer or completion that is BEST in each case.

65. All of the following are involved in a smooth muscle contraction EXCEPT:
   A. calcium and calmodulin dependent myosin light chain phosphorylation
   B. ADP and Pi release from the myosin S-1 subunit
   C. inositol triphosphate dependent influx of extracellular calcium
   D. calcium entry through receptor operated and voltage gated calcium channels
   E. myosin light chain phosphatase phosphorylation

66. All of the following statements are true EXCEPT:
   A. gradients of solutes across membranes drive the flow of water by osmosis
   B. the steady-state volume of the cell is determined by the relative concentrations of
      permeant solutes
   C. the osmotic caused by an individual solute depends on the permeability of the
      membrane to that solute
   D. the greater a solute’s permeability to the lipid bilayer, the less dramatic effect it
      will have on osmotic regulation

67. All of the following are components of a striated muscle sarcomere, EXCEPT:
   A. caldesmon
   B. tropomyosin
   C. nebulin
   D. titin
   E. alpha-actinin

68. The following are true of smooth muscle EXCEPT:
   A. relaxation is promoted by second messengers
   B. it uses a myosin-regulatory mechanism in grading force generation
   C. calcium plays an active role in force generation
   D. contraction is solely dependent on extracellular calcium
   E. tropomyosin is a major thin filament based protein
PHYSIOLOGY QUESTIONS FROM THE "WEIGHT LOSS" MODULE:

MULTIPLE CHOICE QUESTIONS. Each of the following numbered questions or incomplete statements is followed by suggested lettered answers or completions. Select the ONE which is BEST in each case, and mark its letter on the answer sheet next to the appropriate question number.

69. The "metabolic clearance rate" (MCR) for insulin:
   A. increases when the plasma insulin concentration increases.
   B. is the same thing, with the same units, as "insulin turnover."
   C. is the same thing, with the same units, as "insulin disappearance rate, (K_d)."
   D. represents how much plasma would have to be cleared completely to account for insulin disappearance.
   E. represents glucose uptake from the plasma in response to the prevailing insulin concentration.

70. Ghrelin:
   A. is released by adipocytes in response to fat deposition.
   B. increases insulin responsiveness in peripheral tissues.
   C. stimulates Neuropeptide Y (=NPY) release.
   D. is released by the small intestinal wall in response to the presence of carbohydrates.
   E. facilitates glucose transport through the blood-brain barrier.

71. Prolactin release:
   A. Stimulates milk ejection.
   B. Stimulates ovulation. Prolactin is essential for a normal menstrual cycle.
   C. Stimulates hypothalamic dopamine release.
   D. Inhibits breast growth.
   E. Is inhibited by estrogens.

72. Growth Hormone Releasing Hormone:
   A. is released from cells in the anterior pituitary.
   B. is released from cells in the posterior pituitary.
   C. is a hypothalamic hormone, released into portal blood vessels to the posterior pituitary.
   D. is a hypothalamic hormone, released into portal blood vessels to the anterior pituitary.
   E. is the same thing as Somatostatin.

73. SIADH:
   A. should be suspected in hypertensive cancer patients.
   B. is also called "diabetes insipidus."
   C. is one of several acronyms for the hormone "Somatostatin."
   D. is the hypothalamic inhibiting hormone, controlling ADH release.
   E. causes high urine volumes. It produces sustained inhibition of ADH release.
74. An adult patient, who has had a 39°C fever for 24 hours, finally takes some aspirin. Which among the following choices accurately describes what happens during the next hour, following aspirin intake?

A. The hypothalamic setpoint for temperature regulation rises toward 39°C.
B. The hypothalamic setpoint for temperature regulation drops to below 39°C.
C. The patient's skin blood vessels constrict.
D. The patient is likely to start shivering.
E. The "error signal" between the new, aspirin-induced setpoint and the patient's actual core temperature will become smaller at first.

75. In a comfortable environment, sitting quietly, healthy people lose most metabolic heat via:

A. radiation.
B. evaporation if they have a large body, convection if they are small.
C. conduction.
D. convection, regardless of body size.
E. evaporation of water from their respiratory tract, regardless of body size.

76. Increased sodium reabsorption from renal tubular fluid and potassium secretion into renal tubular fluid would most likely be due to:

A. Vasopressin.
B. Cortisol.
C. Insulin.
D. Aldosterone.
E. Norepinephrine.

77. Question: How could you distinguish whether recurring one-hour-long bouts of hypoglycemia in an adult man are due to a pancreatic tumor's over-production of a hormone, or to suicide attempts with self-administered hormone injections?

Best answer: Analyze the hypoglycemic plasma for:

A. Glucagon.
B. Insulin.
C. Glucagon-like Peptide.
D. C-peptide.
E. Pancreatic Polypeptide.

78. Infusion of this hormone is most likely to produce hypocalcemia

A. Calcitriol.
B. PTH.
C. PTH-related Peptide, (= PTHrP).
D. CRH.
E. Calcitonin.
79. How does Prolactin act most effectively to increase Ca²⁺ availability for milk production?
   A. Inhibition of Calcitonin release.
   B. Inhibition of Calcitriol release.
   C. Inhibition of PTH release.
   D. Stimulation of the renal enzyme 1-α-hydroxylase.
   E. It stimulates 1,25-di-OH vit D³ release which, in turn, stimulates PTH release.

80. Propylthiouracil (PTU) is an effective treatment for hyperthyroidism because it:
   A. Inhibits TSH release.
   B. Inhibits thyroid peroxidase activity.
   C. Lowers the affinity of thyroglobulin.
   D. Enhances levels of T₃.
   E. Decreases the activity of the Na⁺-I co-transporter.

81. Thyroid hormone in the plasma is bound most tightly to:
   A. Albumin.
   B. Thyroglobulin.
   C. Thyroxine-binding globulin.
   D. A resin.
   E. Calcium.

82. A patient presents with weight loss and several other symptoms of hyperthyroidism. Free T₄ levels are reported to be elevated. Why is it important to know whether TSH levels are high or low?
   A. If TSH levels are low, she has to be hypothyroid, and the T₄ assay result must be wrong.
   B. If TSH levels are low, she is likely to have a hypothalamic tumor, releasing TRH.
   C. If TSH levels are high, she is likely to have a T₃-secreting thyroid tumor.
   D. If TSH levels are high, she is likely to have Graves' Disease, instead of thyroid cancer.
   E. If TSH levels are low, TSI levels could still be high, which might explain the symptoms and the high T₄ level.

83. Permissive levels of cortisol are essential for:
   A. The actions of catecholamines on smooth muscle, including bronchodilation and blood pressure maintenance.
   B. The actions of thyroid hormones.
   C. Bone growth.
   D. Normal CNS function.
   E. All of the above.

84. 1,25 di-OH-vitamin D acts directly to:
   A. Inhibit bone resorption by osteoclasts.
   B. Stimulate synthesis of parathyroid hormone.
   C. Stimulate calcium uptake in the proximal tubule of the kidney.
   D. Inhibit calcitonin levels.
   E. Increase uptake of calcium and phosphate in the small intestine.
85. A football player's damaged right kidney was removed four years ago, following a car accident. Six weeks ago, at age 21, he suffered traumatic damage to his left kidney after an (illegal) tackle. Renal function seems to have recovered since, and there is no evidence of brain, neck, or spine injury. Today he is not well; irritable, unable to concentrate, feeling spells. His physicians suspect damage to the blood supply of his remaining adrenal gland, causing hormone insufficiency from all its regions. Which of the following observations would support that clinical reasoning?

A. Excessive Na+ retention by the kidney.
B. Hyperpigmentation of the skin.
C. High 17-ketosteroid levels in the urine.
D. Improvement of his symptoms when an adrenergic beta-blocker (propranolol) is administered.
E. "Moon face" and "buffalo hump."

86. The effect of which among the following is most likely to cause hypoglycemia?

A. Above-normal plasma levels of Cortisol.
B. Above-normal plasma levels of Growth Hormone.
C. Above-normal plasma levels of Epinephrine.
D. Diabetes mellitus.
E. Addison's Disease.

MULTIPLE CHOICE QUESTIONS. Each of the numbered items or incomplete statements in the following section is negatively phrased, as indicated by the capitalized word "EXCEPT." Select the ONE lettered answer or completion that is BEST in each case and fill in the circle containing the corresponding letter on the answer sheet.

87. Your patient has read about something called "leptin," and he wants you to explain what it is and prescribe some. All of the following parts of an explanation are correct, EXCEPT:

A. Leptins are hormones released by adipose tissue cells.
B. Plasma-borne leptin stimulates activity in the circumventricular organs (CVOs) via leptin receptors.
C. CVOs release leptin, CCK and GLP, inhibit GI motility and induce satiety.
D. Leptins inhibit the release of Neuropeptide Y (NPY).
E. Overfeeding causes leptin release.

88. The effects of increased plasma levels of human Growth Hormone include all of the following, EXCEPT:

A. Increased cell uptake of amino acids.
B. Stimulation of protein synthesis.
C. Increased glucose mobilization by stimulation of liver glycogenolysis.
D. Feelings of insecurity, aggression and rage.
E. Increased FFA release by adipose tissue.
89. Mildly elevated sympathetic nervous system activity in humans causes all of the following, EXCEPT:

A. Much more norepinephrine release than epinephrine release.
B. Enough epinephrine release to cause a variety of biologic effects.
C. Selective, regionalized effects mediated by sympathetic nerve fibers.
D. Glycogenolysis.
E. Lipolysis.

90. Octreotide is a synthetic version of somatostatin. Its actions include all of the following, EXCEPT:

A. Inhibition of pancreatic insulin release.
B. Inhibition of G1. motility and secretion.
C. Inhibition of Growth Hormone release.
D. Inhibition of tumor-induced hormone releases.
E. Stimulation of pancreatic glucagon release.

91. Insulin stimulates all of the following, EXCEPT:

A. Amino acid transport into muscle cells.
B. Protein synthesis in muscle.
C. Release of free fatty acids from adipose tissue.
D. Potassium transport into muscle cells.
E. Glycogen synthesis.

92. Normally, all of the following directly stimulate insulin release from the pancreatic beta-cells, EXCEPT:

A. Glucose.
B. Amino acids.
C. Epinephrine.
D. GLP-1 and GLP-2.
E. Cholecystokinin.

93. All of the following are commonly seen in patients with HYPOthyroidism, EXCEPT:

A. Goiter.
B. High TSH levels in plasma.
C. Low TSH levels in plasma.
D. Myxedema.
E. Warm, moist skin.

End of the Physiology questions.