

PHGY 213 – Introductory Physiology Lab 2
FINAL EXAMINATION

1. What is the origin of the surface electromyogram (EMG)?
 - a) Half-cell potentials.
 - b) Electrical currents flowing through surrounding tissues as muscles are activated.
 - c) Electromagnetic fields generated by unshielded power cords.
 - d) Skin potentials.
 - e) Summed action potentials recorded from alpha motoneurone axons.

2. Why does differential recording reduce electromagnetic interference?
 - a) Noise tends to affect only one electrode at a time, so those signals are cut in half.
 - b) The use of two electrodes balances out skin potentials.
 - c) Noise tends to affect both electrodes at the same time, so those signals are rejected.
 - d) Biological signals tend to affect both electrodes at the same time, so those signals are summed.
 - e) The use of two electrodes balances out electrode half-cell potentials.

3. In the Human Locomotion experiment, the monosynaptic stretch reflex was elicited by tapping the Achilles' tendon with a small hammer. How was the time of the tap detected?
 - a) By means of a contact-sensing mat.
 - b) By identifying the zero-latency motion artifact associated with the tap.
 - c) By means of a contact sensor placed against the ball of the subject's foot.
 - d) By measuring back 35 msec from the onset of the T-wave.
 - e) By means of a sensor in the head of the hammer.

4. In one part of the Human Locomotion experiment, light taps were applied to the heel and the subject extended his/her ankle as quickly as possible following each tap. The delay from the onset of the tap until the onset of EMG activity in gastrocnemius was called:
 - a) the voluntary response time.
 - b) the segmental stretch reflex time.
 - c) the monosynaptic stretch reflex time.
 - d) the long-loop reflex time.
 - e) the functional stretch reflex time.

5. The preferred hopping frequency of human subjects is probably based on:
- a) neural activity originating in the cerebral cortex.
 - b) voluntary reaction times.
 - c) brain stem reflexes.
 - d) central pattern generators located within the spinal cord.
 - e) visual feedback.
6. Which of the following is TRUE about measurement of the blood pressure
- a) Korotkoff sounds are heard when the artery is completely un-occluded.
 - b) The diastolic pressure can be measured by the method of palpation.
 - c) As the pressure in the cuff gradually falls so as be close to, but above, the diastolic pressure, there is a decrease in the loudness of the Korotkoff sounds.
 - d) In the lab exercise, when using the method of auscultation, the blood pressure in the radial artery was measured.
 - e) The method of palpation is a direct method.
7. Which of the following is TRUE about various electrocardiographs?
- a) The capillary galvanometer has a large magnet.
 - b) The movement of the string in the string galvanometer is caused by a changing electrical current flowing through the string.
 - c) The string galvanometer is the method presently used clinically to record the ECG.
 - d) The capillary galvanometer produces a clinically useful reading.
 - e) The first electrocardiograph recorded the mechanical activity of the pulse.
8. Which of the following is TRUE about conduction in the heart?
- a) During the P-wave, the action potential propagates along the specialized internodal tracts.
 - b) The left bundle branch bifurcates into two fascicles.
 - c) The septal branch of the His-Purkinje system goes to the right-hand part of the septum.
 - d) The epicardial ventricular muscle depolarizes before the endocardial ventricular muscle.
 - e) The two atria are activated simultaneously.

9. The average direction of depolarization in an abnormal subject's ventricles is straight upwards (i.e., towards the head). You would expect to see:

- a) no T-wave in lead II.
- b) a very small or a biphasic QRS complex in lead I.
- c) a small positive P-wave in lead I.
- d) a longer than normal PR-interval in lead III.
- e) a large R-wave in lead II.

10. The residual volume of the lungs

- a) is the amount of air expired during each breath.
- b) is larger in patients with a restrictive lung disease than in healthy individuals.
- c) is larger in patients with an obstructive lung disease than in healthy individuals.
- d) is one of the components of the vital capacity.
- e) does not depend on body size.

11. The volume of functional residual capacity (FRC)

- a) is equal to about 10% of the total lung capacity.
- b) is composed of the inspiratory reserve volume and the residual volume.
- c) decreases when the lung recoil pressure increases.
- d) decreases when the airway resistance increases.
- e) remains constant at different body positions.

12. A ratio between forced vital capacity (FVC) and forced expiratory volume (FEV_1) ABOVE 0.8

- a) is expected in patients with an obstructive lung disease.
- b) is expected in patients with decreased lung compliance.
- c) is always present when FVC is large.
- d) returns to normal after inhalation of the bronchial muscle relaxants.
- e) suggests an increase in vital capacity.

13. The test of vital capacity (VC)

- a) measures resistance of the airways.
- b) requires contribution of all respiratory muscles.
- c) must be done with a spirometer equipped with a CO_2 absorber.
- d) represents a static condition.
- e) gives the value of VC lower than the test of the forced vital capacity (FVC).

14. Following a test of vital capacity, composition of air in the spirometer
- depends on room temperature.
 - includes 21% of oxygen.
 - includes water vapor but not CO₂.
 - includes water vapor and CO₂.
 - depends on the size of the spirometer.
15. A patient with an obstructive lung disease has
- low lung compliance.
 - a deep and slow breathing pattern.
 - a shallow and rapid breathing pattern.
 - an increased inspiratory reserve volume.
 - an increased expiratory reserve volume.
16. What is the partial pressure of carbon dioxide in the alveoli in a healthy individual who voluntarily increased his ventilation from 5 l/min to 15 l/min, assuming that his/her body metabolic rate stays constant?
- 40 mmHg.
 - 46 mmHg.
 - 13 mmHg.
 - 600 mmHg.
 - 159 mmHg.
17. The ratio between Forced Expiratory Volume at 1 s. (FEV₁) and Forced Vital Capacity (FVC)
- decreases in patients with obstructive lung diseases.
 - decreases in patients with restrictive lung diseases.
 - decreases in individuals with small lung volumes.
 - is a measure of oxygen consumption.
 - increases when the functional residual volume (FRC) is elevated.
18. In healthy individuals, at the maximal level of exercise,
- minute ventilation increases in direct proportion to CO₂ production.
 - PCO₂ in the mixed venous blood decreases.
 - PCO₂ in the arterial blood decreases.
 - the arterial blood pH increases.
 - the expiratory reserve volume increases.

19. Indicate which one of the following statements is CORRECT:

- a) During exercise, minute ventilation increases because of an increase in the respiratory rate while the tidal volume remains unchanged.
- b) During mild exercise, the cardiac output increases more in an untrained individual than an athlete.
- c) During exercise, the blood flow is equally distributed to all organs.
- d) Oxygen consumption can be measured with a spirometer equipped with a CO₂ absorber.
- e) Maximal oxygen consumption is the same for men and women of the same age.

20. A steep relationship between the heart rate and increasing work load will be present when there is

- a) a large increase in the cardiac output.
- b) a large increase in the end diastolic volume.
- c) an increased endurance.
- d) a small increase in the stroke volume.
- e) a large decrease in the total peripheral vascular resistance.

21. During mild exercise,

- a) the arterial blood PO₂ decreases above the resting value.
- b) the alveolar PCO₂ decreases below the resting value.
- c) the arterial blood PCO₂ remains at resting level.
- d) the pulmonary blood flow remains at the resting value.
- e) the subjects hyperventilates.

22. Oxygen consumption

- a) can be measured from the difference between O₂ content in the mixed venous blood and that in the arterial blood.
- b) is maximal at 85% of the maximal heart rate.
- c) increases in direct proportion to PO₂ in the arterial blood.
- d) increases in direct proportion to PCO₂ in the arterial blood.
- e) is independent of oxygen supply.

23. In a sedentary individual, following 3 minutes of heavy exercise

- a) body temperature returns to normal in less than 1 min.
- b) heart rate returns to normal in less than 1 min.
- c) minute ventilation returns to normal in less than 1 min.
- d) metabolic rate returns to normal in less than 1 min.
- e) None of the above statements is correct.

24. Which of the following glands would be considered an endocrine gland?

- a) Submucosal glands.
- b) Salivary glands.
- c) Mammary glands.
- d) Thyroid glands.
- e) All of the above.

25. SDS-PAGE electrophoresis is a technique that can be used to

- a) separate proteins in their native, 3-dimensional configuration.
- b) verify the net charge of a protein.
- c) estimate the pKa of proteins.
- d) accurately determine protein concentration.
- e) None of the above.

26. What was the experiment that Bayliss and Starling employed to discover the idea of chemical messengers?

- a) Added acid to a denervated pancreas and showed that it would release insulin.
- b) Added acid to a denervated duodenum and showed that it could stimulate pancreatic secretions.
- c) Added insulin to a denervated duodenum and showed that it could stimulate pancreatic secretions.
- d) Added insulin to a denervated pancreas and showed that it would release glucagon.
- e) None of the above.

27. Using the Bradford method of protein quantification, you make a standard curve for a known concentration of BSA. The resultant equation is $y=0.0154x-0.0041$. The y axis is the Absorbance (595 nm) and the x axis is the protein concentration in $\mu\text{g/ml}$. After a 5 times dilution of your unknown protein sample, you get an absorbance of 0.12. What is your original protein concentration in mg/ml ?
- a) 100 mg/ml .
 - b) 0.1 mg/ml .
 - c) 0.04 mg/ml .
 - d) 0.4 mg/ml .
 - e) None of the above.
28. Beer's law can be used to determine the concentration of a protein sample, given the extinction coefficient of the protein that is being studied. In a cuvette with a pathlength of 1 cm, a protein sample with an extinction coefficient of $0.41 \text{ L mol}^{-1} \text{ cm}^{-1}$ was measured to have an absorbance of 0.862. What is the concentration of the protein sample?
- a) 0.475 mol L^{-1}
 - b) 1.613 mol L^{-1}
 - c) 0.568 mol L^{-1}
 - d) 0.138 mol L^{-1}
 - e) None of the above.
29. How was hCG purified from serum in the endocrinology lab?
- a) Using an antibody specific to the target protein.
 - b) Using a high pressure liquid chromatography column.
 - c) By using SDS polyacrylamide gel electrophoresis.
 - d) By binding to the Coomassie dye and eluting the protein.
 - e) None of the above.
30. What is the purpose of the increase in hCG concentration during the first days after fertilization?
- a) To maintain the corpus luteum.
 - b) To convert the corpus luteum to the corpus albicans.
 - c) To stimulate the growth of the follicle.
 - d) To stimulate an increase in GnRH from the hypothalamus.
 - e) None of the above.

31. While recording surface EMG activity during the Human Locomotion experiment, why was the computer set to sample the signal at 1000 Hz?
- a) 1000 Hz is the highest frequency content of the EMG.
 - b) The computer could not band-pass filter the signal between 50 and 350 Hz before sampling.
 - c) 1000 Hz is approximately three times the highest frequency content of the EMG.
 - d) 1000 Hz is the Nyquist sampling rate.
32. Which of the following might have contributed to motion artifacts recorded during the Human Locomotion experiment?
- a) Skin potentials.
 - b) Action potentials in the motor axons.
 - c) Electrode half-cell potentials.
 - d) Muscle action potentials.
33. Which of the following contribute(s) to the latency of a functional stretch reflex recorded from gastrocnemius in response to a suddenly applied and maintained stretch?
- a) Conduction delays in ascending pathways within the spinal cord.
 - b) Conduction delays in muscle spindle primary afferent fibres and in motoneurone axons.
 - c) Conduction delays in descending pathways within the spinal cord.
 - d) Processing time in the cerebral cortex.
34. During the Human Locomotion experiment, what did the contact-sensing mat measure when the subject performed a single step down from a 24 cm high wooden box?
- a) The force exerted by the subject's feet while in contact with the mat.
 - b) The time at which the second foot contacted the mat.
 - c) The subject's vertical velocity.
 - d) The time at which the first foot contacted the mat.

35. Assume that you measured the following during the Human Locomotion laboratory exercise:

- monosynaptic stretch reflex latency: 30 msec
- functional stretch reflex latency: 110 msec
- voluntary response time: 190 msec
- during rhythmical hopping at the preferred hopping frequency, the burst of EMG activity
- associated with a single hopping cycle began 110 msec before contact
- during rhythmical hopping at the preferred hopping frequency, the burst of EMG activity
- associated with a single hopping cycle ended 250 msec after contact

Based on these results, which of the following could have contributed to the control of rhythmical hopping?

- a) The functional stretch reflex.
- b) A voluntary response to first contact with the ground.
- c) The monosynaptic stretch reflex.
- d) Feed-forward control.

36. Which of the following is/are TRUE about the heart sounds?

- a) The first heart-sound is heard at the same time as the P-wave in seen on the ECG.
- b) The second heart-sound is heard at the same time as the QRS-complex in seen on the ECG.
- c) The heart-sounds are caused by the closing of the atrioventricular valves.
- d) A third heart sound is typically heard following the second heart sound.

37. Which is following is/are TRUE about the various measurements you made from the ECG?

- a) The PR-interval is the time from the start of the P-wave to the start of the R-wave.
- b) The QRS-interval is a measure of how long it takes the ventricular muscle to repolarize.
- c) The QT-interval is the time from the start of the Q-wave to the end of the T-wave.
- d) The QT-interval is a measure of how long it takes the ventricular muscle to depolarize.

38. Which of the following is/are TRUE about unipolar leads?

- a) aVR gives a deflection on the ECG that is smaller than VR.
- b) Wilson's central terminal is obtained by summing together the voltages at the right leg, the left leg, and the right arm.
- c) In taking these leads one disconnects the right-leg lead from the subject.
- d) The chest leads are unipolar leads.

39. When one obtains an R-wave with a bipolar lead, this means that:

- a) the two electrodes must be located on the same iso- or equi-potential line.
- b) the sink of a current dipole associated with this repolarization wavefront is moving towards the positive electrode.
- c) the two electrodes must be located at points equidistant from the sink of the current dipole associated with this depolarization wavefront.
- d) the source of the current dipole associated with this activation wavefront is moving towards the positive electrode.

40. The absence of a P-wave on the ECG in lead I might indicate that:

- a) the left atrium is depolarizing before the right atrium.
- b) there is some form of conduction defect within the left atrium.
- c) the patient must have an electronic pacemaker.
- d) the direction of atrial depolarization is perpendicular to the lead I axis.

41. A patient has complete atrioventricular block. A slow subsidiary ventricular pacemaker emerges, so that one can find P-waves on the ECG that are not followed by a QRS-complex and a T-wave before the next P-wave comes along. The absence of a small wave following the P-wave in this circumstance indicates that:

- a) the atrial repolarization wave is normally buried in the QRS complex.
- b) depolarization of the right atrium must be occurring before depolarization of the left atrium.
- c) the atrioventricular node is not functioning normally.
- d) the local-circuit currents generated by atrial repolarization must be much smaller than those generated by ventricular repolarization.

42. In the laboratory you calculated BTPS conversion factor. The calculation was necessary because

- a) you wanted to calculate oxygen consumption.
- b) there was a drift in the recordings of tidal volume with the spirometer.
- c) you wanted to estimate the volume of dry air exhaled during each expiration.
- d) volume of gas depends on their temperature.

43. The Forced Vital Capacity test

- a) can be used to estimate body metabolism.
- b) can be used to measure lung volumes and capacities in individuals deprived of the voluntary control of breathing.
- c) is a common test used to measure elastic properties of the respiratory system.
- d) causes short term hyperventilation.

44. An increase in the stroke volume during exercise

- a) is due to increased activity of the sympathetic system innervating the heart.
- b) is due to the increased venous return.
- c) is greater in trained than untrained individuals.
- d) is due to a decrease in the total peripheral vascular resistance.

45. Endurance training increases

- a) the number of mitochondria in the muscle cells.
- b) the capillary density in the working muscles.
- c) the enzymes required for aerobic metabolism.
- d) the resting heart rate.

46. Ventilatory response (below the breaking point) to exercise

- a) is greater in an endurance athlete than in a sedentary individual.
- b) depends on PCO_2 in the arterial blood.
- c) depends on PO_2 in the arterial blood.
- d) is directly proportional to the metabolic rate.

47. Indicate which of the following statement(s) is/are CORRECT:

- a) Voluntary increase in minute ventilation leads to hyperventilation.
- b) Until the ventilatory break point is reached, minute ventilation continues to increase in direct proportion to workload.
- c) During exercise, the 'muscle' and 'respiratory' pumps increase their influence on the venous return.
- d) During exercise, the total peripheral resistance decreases because of vasodilation of arterioles in the kidneys and the digestive system.

48. Which of the following would be considered endocrine diseases?

- a) Cystic fibrosis.
- b) Diabetes mellitus.
- c) Sickle cell anemia.
- d) Osteoporosis.

49. In the Bradford Method of protein concentration quantification,

- a) The Coomassie dye binds to nucleotides in the protein.
- b) The Coomassie dye binds mostly to negatively charged residues in the protein.
- c) The Coomassie dye binds to residues in the protein, shifting its absorbance maximum from 595 nm to 470 nm.
- d) The Coomassie dye binds to residues in the protein, shifting its absorbance maximum from 470 nm to 595 nm.

50. What are some of the blocks to polyspermy?

- a) There is a change in the egg cell membrane polarity (more negative).
- b) There is a change in the egg cell membrane polarity (more positive).
- c) The zona pellucida pushes away.
- d) Enzymes are released which break down the acrosomes of the other sperm.