

Exam #: _____

Physiological Foundations Spring 2002: Final Examination

May 1, 2002

Name: _____

SSN: _____

TA (For exam pick up): _____

Signature: _____

1.

TOTAL _____/80

EXTRA CREDIT ____/3

1. (2 pts) What is the width of an action potential produced by a neuron in the CNS:
 - A. 0.01 msec
 - B. 1 msec
 - C. 10 msec
 - D. 100 msec
 - E. 200 msec

2. (2 pts) When a limb muscle is stretched, which of the following events takes place:
 - A. Group Ia, primary spindle afferents of the stretched muscle, fire strongly and excite the alpha motor neurons to the same muscle.
 - B. Group Ia, primary spindle afferents of the stretched muscle, fire strongly and excite the gamma motor neurons to the same muscle.
 - C. Group Ib, golgi tendon organ afferents of the stretched muscle, responding to the increased force in the muscle as it is being stretched, fire and excite the alpha motor neurons of the same muscle.
 - D. A and C.
 - E. B and C.

3. (2 pts) Gamma motor neurons:
 - A. Innervate extra-fusal muscle fibers.
 - B. Innervate intra-fusal muscle fibers and have an important role in controlling muscle spindles.
 - C. Innervate the tendon region and control muscle force.
 - D. A and C.
 - E. B and C.

4. (2 pts) A slow type motor unit:
 - A. Has a small twitch tension.
 - B. Can sustain its tension and not fatigue even after repeated stimulation.
 - C. Is composed of a single motor neuron and a collection of muscle fibers.
 - D. A and B.
 - E. B and C.
 - F. A, B, and C.

5. (2 pts) Name the major descending tract that originates from the motor cortex and sends axons to the spinal cord.

6. (2 pts) When a person is sleep, the medullary reticulospinal tract is:
 - A. Highly active.
 - B. Weakly active.
 - C. Inhibiting limb muscles.
 - D. A and C.

7. (4 pts) At time $t=0$, the elbow of a subject is suddenly extended, i.e., the biceps is suddenly stretched. In condition 1, the subject is instructed to “assist the stretch”, and in

condition 2, the subject is instructed to “oppose the stretch”. For each condition, draw the EMG that should be recorded from the biceps. Label your plots and indicate the units of the axes.

8. **A.** (2 pts) How would you go about acquiring a “motor map” from the cortex of an animal?
- B.** (2 pts) After acquiring a motor map, we return and acquire another map from the same region a month later. During this period, the animal was trained to use his fingers to pick up small pieces of food. What should we see regarding his motor map for the fingers?
9. (3 pts) The activity of a cell in the motor cortex is recorded as a monkey makes movements with his arm to 8 different directions. How do we compute the preferred direction of this cell?
10. Audiologists distinguish between two types of hearing loss.
- A. Define the two types.
B. Give one cause for each type.
C. Give two effective treatments for each type.
D. What are the vision analogues of the two types of hearing loss?
11. The tuning of the auditory nerve is represented by the tuning curve of individual auditory-nerve fibers.
- A. Draw and carefully label a tuning curve for a normal auditory-nerve fiber.
B. Draw and carefully label a tuning curve for a noise-damaged fiber with the same BF as the normal fiber in (A).
C. The vowel /a/ as in “father” has formant frequencies at 700, 1100, and 2400 Hz. Draw and carefully label a rate-place representation for this vowel.
12. If you look at an oil painting from distance or closely at details, you generally get very different impressions. Which of these experiences is more a reflection of “perception” as opposed to “sensation”?
13. How would you use the psychometric function to determine the detection threshold of an indentation applied on your fingertip? Use a graph to assist your description.
14. What is the sensory receptor in the auditory system? How is the frequency selectivity of an auditory nerve established?

15. What are the two ways that are commonly used to measure information carried by spike trains?
16. Suppose discharges of an auditory neuron, in responding to a 100 Hz tone, show “phase-locking” to the stimulus. Sketch several periods of the stimulus and corresponding post-stimulus histogram.
17. Explain why your ability to tell two points apart over your skin surface is much better on your fingertip than on your back.
18. If receptive fields of two neurons have the same size, do they necessarily perform the same task in processing sensory information? Given an example.
19. Cortex can represent the spatial location of a loud speaker using either visual or auditory information. Which of these two neural representations is a “topographic map” and which is a “functional map”? Why?
20. In the visual system, neurons in the thalamus have “on-center” receptive field (RF). Explain how neurons in the primary visual cortex (V1) may develop orientation selectivity in their RF (you may use a graph).
21. Patients whose arm is amputated because of an accident often report the feeling of a “phantom limb” which, like a real limb, may feel itch or pain. In some patients, the sensation aroused from the phantom limb can be remedied by touching the skin surfaces around the face. Using the cortical map of skin surface discussed in the Wang lecture and given below, explain this phenomenon. Name a neural mechanism underlying these patients’ experience.