

Zoo400 Exam 1: Mar 25, 1999

NAME: _____

There is only 1 best answer per question. (1 pt each)

A large dendrite is 1mm long and has a diameter of 3.2μ . Calculate the following using the assumption that the dendrite is a cylinder.

NB: Area of a cylinder = $\pi \cdot diam \cdot length$.

Volume of a cylinder is $\pi \cdot diam^2 \cdot length/4$.

1. The area of the dendrite in cm^2 is:

- (A) 1e-8
- **B** 1e-4**
- (C) 1e4
- (D) 1e8
- (E) 2.5e4

2. The area of the dendrite in μ^2 is:

- (A) 1e-8
- (B) 1e-4
- **C** 1e4**
- (D) 1e8
- (E) 2.5e4

3. The volume of the dendrite in μ^3 is:

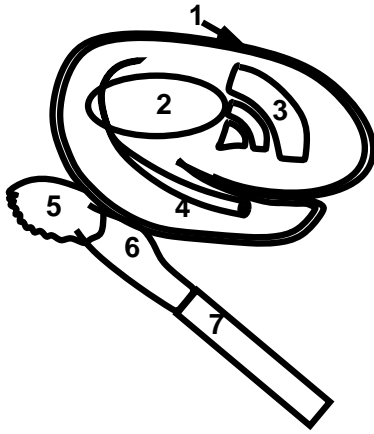
- **A** 7.5e3**
- (B) -7.5e3
- (C) 7.5e-5
- (D) 7.5
- (E) 2.5e4

4. If depolarization of the membrane allows calcium ions to enter the dendrite at a rate of $6e10 \text{ ions/s} \cdot cm^2$ what will be the average concentration of ions (in ions/μ^3) in the cytoplasm after 10 ms (assume uniform distribution and no diffusion out of the dendrite)

- (A) 1e-3
- (B) 1e3
- (C) 2e4
- **D** 8**
- (E) 20

Dendrite, axon and synaptic cleft are 3 structures that transmit information in the nervous system. They work at vastly different scales: 1 mm for dendrite, 1 m for axon, 20 Angstroms for synaptic cleft. Transmission rate for an axon is about 50m/s, for a dendrite about 100μ /ms. The following questions explore relationships between signals in these structures.

5. Assuming a 1 mm dendrite, 2 ms to reach threshold in the soma and a 1 m axon, how much time (in ms) does it take a signal to get from the end of the dendrite to the end of the axon?
- (A) 10
 - (B) 25
 - **C** 32**
 - (D) 40
 - (E) 50
6. Now assume that transmitter crosses the synapse at a rate of 2μ /s. Adding this onto the total time calculated above, what proportion of total transmission time is spent in the synapse?
- (A) 1%
 - **B** 3%**
 - (C) 5%
 - (D) 10%
 - (E) 15%
7. A thalamic relay cell can respond to negative (ie hyperpolarizing) input with an initial reduction in firing (inhibition) followed by late increase in firing (facilitation). Thalamic cells are inhibited by reticular cells after cortical cell firing. The relay cell projects back to cortex. One would expect the delayed feedback effect on the cortex to be:
- **A** positive**
 - (B) negative
 - (C) neutral
 - (D) indeterminate
 - (E) no feedback



8. A motor area involved in sequencing

- (A) structure #1
- (B) structure #2
- **C** structure #3**
- (D) structure #4
- (E) structure #5

9. structure #1

- (A) thalamus
- (B) basal ganglia
- (C) hippocampus
- **D** cortex**
- (E) cerebellum

10. structure #3

- (A) thalamus
- **B** basal ganglia**
- (C) hippocampus
- (D) cortex
- (E) cerebellum

11. A critical structure for remembering things that happened to you

- (A) structure #1
- (B) structure #2
- (C) structure #3
- **D** structure #4**
- (E) structure #5

12. Presumed site of thought and language as well as higher order processing of vision and audition.

****A** structure #1**

- (B) structure #2
- (C) structure #3
- (D) structure #4
- (E) structure #5

EMU assembler/machine correspondence:

ADD=0, DEC=1, INC=2, SKP=3, JMP=4, CLA=5, LDA=6, HLT=7

Other abbreviations:

ADDR=address, ACC=Accumulator, PC=program counter, IR=instruction register

EMU assembler commands: ADD=add ADDR to ACC, DEC=dec ADDR, INC=inc ADDR, SKP=inc PC on 0 in ADDR, JMP=set PC to ADDR, CLA=clear ACC, LDA=load ACC to ADDR, HLT=halt

All addresses are given in octal: **Octal to binary:**

0=000, 1=001, 2=010, 3=011, 4=100, 5=101, 6=110, 7=111

Octal to decimal: ... 7=7, 10=8, 11=9, 12=10, 13=11, ...

13. Which of the following would **NOT** work OK as a NOP. (NB a NOP is a no-operation, a step that will not effect the running of the program as it goes over that step).

(A) 7:3007

****B** 7:0007**

(C) 7:4010

(D) 7:2007

10:1007

(E) 7:1007

10:2007

14. Which of the following commands is NOT associated with a change in the value in the PC [hint: trick question]:

(A) 4:6005

****B** 4:7005**

(C) 4:2005

(D) 4:4005

(E) 4:3005

15. With 7 as the contents of the accumulator, the command 0001 will have the same effect as CLA if the contents of address 1 is:

(A) 6775

****B** 7771**

(C) 0000

(D) 7777

(E) 0007

The following questions pertain to this program (octal):

0:5000

1:0012

2:1011

3:3011

4:4001

5:6013

6:7000

16. The command in address 1 is a:

(A) CLA

(B) JMP

(C) SKP

(D) HLT

****E** ADD**

17. The binary **ADDRESS** referenced by the command in address 1 is:

(A) 110

(B) 011

****C** 1010**

(D) 110000001011

(E) 1101

18. The program performs a

(A) subtraction between numbers in address 12 and address 13

****B** multiplication between numbers in address 11 and address 12**

(C) multiplication between numbers in address 12 and address 13

(D) addition between numbers in address 12 and address 13

(E) addition between numbers in address 11 and address 12

The following questions pertain to this program (octal):

0: 5000
1: 0005
2: 0012
3: 6001
4: 4001
5: 7005
6: 7000
7: 7000
10: 7000
11: 2776
12: 1001

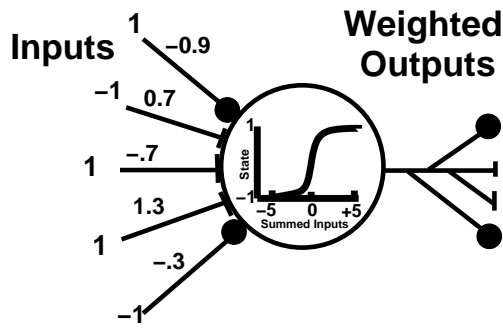
19. In general, a word in memory that is altered by a program is considered data while a word in memory that is executed (pointed to by PC, loaded into IR, processed by CPU) is considered part of the program. Which address holds a word that serves as both data and program.
- (A) 0
****B** 1**
(C) 3
(D) 4
(E) 5

[HINT: Questions 20 and 21 are hard – maybe you should skip them and come back]

20. The program will halt at address (ie the final address in the PC will be):
- (A) 1
(B) 4
(C) 6
****D** 10**
(E) 12
21. Which address is added to the ACC to produce subtraction by overflow:
- (A) 1
(B) 5
(C) 6
(D) 11
****E** 12**

ISIs: 4 ms, 8 ms, 6 ms, 3 ms, 4 ms

22. Given the interspike intervals above (in ms), we would say that the firing rate of the cell is most likely about:
- (A) 20 Hz
 - (B) 100 Hz
 - **C** 200 Hz**
 - (D) 400 Hz
 - (E) 600 Hz
23. This rate is likely to be indicative of
- (A) spontaneous firing
 - **B** an excited cell**
 - (C) an inhibited cell
 - (D) a bursting cell
 - (E) a tired cell
24. If we wish to detect rates down to 10Hz, we need to use a slow potential (EPSP) with a total duration of about: [hint: this is total duration, not tau from the alpha function]
- **A** 200 ms**
 - (B) 100 ms
 - (C) 50 ms
 - (D) 20 ms
 - (E) 10 ms
25. Maximum rate of neuron firing is limited by the duration of the action potential. An approximate value for maximum rate would be:
- (A) 50 Hz
 - (B) 100 Hz
 - (C) 200 Hz
 - **D** 1000 Hz**
 - (E) 5000 Hz
26. Which of the following is indicative of increased activity [according to neurobiology/rate coding theory/slow potential theory.]
- (A) hyperpolarization
 - **B** GLU (glutamate) transmitter release**
 - (C) increase in interspike intervals (spike firing period)
 - (D) an inhibitory postsynaptic potential (IPSP)
 - (E) decrease in firing frequency



27. The state vector of projections to the cell in the picture above is:
- (A) [-1 -1 1 -1 -1]
****B** [1 -1 1 1 -1]**
 (C) [-3 0.3 2.1 1.7 -0.5]
 (D) [-3 1.7 2.1 0.3 -0.5]
 (E) [-3 -1 0.3 1 2.1 1 1.7 -1 -0.5 1]
28. The total input to the neuron depicted above is
- **A** -0.7**
 (B) -0.8
 (C) 0.7
 (D) 0.8
 (E) 1.8
29. Making reference to the activation function depicted, the subsequent state of the neuron would appear to be about: [hint: look at the teeny-weeny numbers on the graph]
- (A) -1.0
****B** -0.8**
 (C) 0.0
 (D) 0.8
 (E) 1.0
30. Now assume that the cell above also has a projection back onto itself in addition to all of the other projections shown. Make this an excitatory projection with strength 1.0 [hint: draw it in]. If the other inputs remain at the same values as shown (ie clamped inputs), what will be the state of this unit do?
- (A) maintain the same value as in previous question
 (B) increase but not reach 1
****C** decrease but not reach -1**
 (D) steadily increase to 1
 (E) steadily decrease to -1

31. The concept of slow potential theory is associated with each of the following EXCEPT:
- (A) rate coding
 - (B) potential duration that matches periods to be integrated
 - **C** cell bursting**
 - (D) summation of postsynaptic potentials associated with incoming spikes
 - (E) integration of frequency information
32. According to rate coding theory, the spontaneous rate comes from:
- (A) intrinsic properties of the cell
 - (B) depolarization from external electrical fields
 - (C) excitatory inputs alone
 - **D** a mixture of excitatory and inhibitory inputs**
 - (E) inhibitory inputs alone
33. In rate coding theory, a negative times a negative creates a positive through all of the following EXCEPT:
- (A) Reduced firing rate in a presynaptic inhibitory cell
 - (B) Reduced GABA release at the synapse
 - (C) Increased interspike interval in a presynaptic inhibitory cell
 - (D) Reduced interspike interval in the postsynaptic cell
 - **E** Reduced average depolarization in the postsynaptic cell**
34. Ascii and bitmaps are 2 alternative ways of encoding the letter 'A'. Advantages of ascii for encoding include all of the following except.
- (A) It's likely to be more compact (require fewer bits)
 - (B) It will be relatively easy to convert 'A' to 'a' using subtraction or addition
 - **C** A graphical representation of the letter 'A' can be readily generated directly from the code**
 - (D) It can be more easily compared to other coded letters to determine if one of them is also an 'A'
 - (E) There is less room for ambiguity arising from alternative encodings for the same letter
35. Choosing the right representation for something is like choosing the right tool for a job, it can make the subsequent task enormously easier. Certain number bases have the advantage of direct translation of single digits into and out of base 2 (binary). This makes the task of reading and writing binary much easier. Of the following, which base would have that advantage.
- (A) 3
 - **B** 4**
 - (C) 7
 - (D) 10
 - (E) 12

36. Pointers are the basis of most of what we use as mechanical memory including file cabinets, libraries and computer memories. All of the following are true of pointer based memory except:
- (A) In a filing system, the pointers are often conceptual ones that give relative position based on alphabetical ordering rather than absolute position
 - (B) Loss of a pointer generally requires a full search of memory to retrieve the lost item
 - (C) A pointer is an address or an indicator that gives the location of a particular stored item
 - (D) Computers use pointers in order to keep track of which items of memory represent commands (programs) and which items represent data
- **E** It is easy to reconstruct a memory given a partial or degraded example of that memory.**
37. Marr's 3 levels of investigation do NOT include
- (A) definition of the problem
 - (B) the algorithmic level
 - **C** the neuroanatomical level**
 - (D) the implementation level
38. The slow potentials of slow potential theory refer directly to the
- (A) Duration of the action potential
 - (B) Time during which neurotransmitter is present in the cleft
 - **C** Duration of excitatory and inhibitory postsynaptic potentials**
 - (D) Duration of shunting potentials
 - (E) Duration of field potentials
39. Which of the following is not a neurotransmitter
- (A) GABA
 - (B) GLU
 - (C) glutamate
 - (D) γ -amino butyric acid
 - **E** GABA_A**
40. A top-down view of audition (hearing) would NOT likely take the view that:
- (A) hearing is designed for understanding speech
 - **B** hearing is designed to determine the location of objects**
 - (C) hearing is designed for discriminating types of sounds
 - (D) hearing is designed to separate out meaningful sounds from the background
 - (E) hearing is designed to provide warnings about dangerous situations