

Name: _____ KEY _____

BIOE/BIOP/MCB/NEUR 419

EXAM 1 (20 pts total)

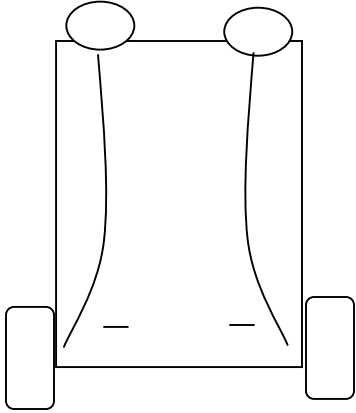
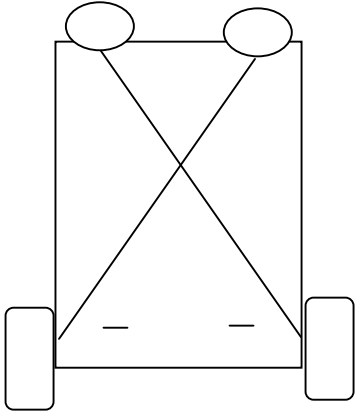
Spring 2009

(Provide the best response to each question. 20 questions, 1 point each)

1. In the history of life on earth, the first organisms to exhibit adaptive kinokinesis probably appeared about:

- a) 15 billion years ago
- b) 3.5 billion years ago**
- c) 550 million years ago
- d) 50 million years ago

2. Sketch a circuit diagram for a Braitenberg vehicle with the described behavior.

<p>a) approaches a light source and slows down as it gets closer</p> 	<p>b) avoids a light source and speeds up as it gets further away</p> 
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3-5 For each of the following scientific studies, indicate in the box to the left which aspects of the system is primarily under investigation, using the categories defined by Cariani:

A: syntactic B: semantic C: pragmatic

3. C	a study on differences in reproductive success of male songbirds based on how well they learn to produce an accurate copy of their father's song
4. A	a study of biophysical interactions between calcium and potassium currents in generating patterns of burst firing in single neurons
5. B	a study of how neurons in the frog visual system respond to various types of naturalistic stimuli, such as predators and prey

6. The change in membrane potential that is elicited when a *Paramecium* collides with an obstacle rapidly spreads over the cell, and is similar in many ways to the *action potential* of a nerve cell.

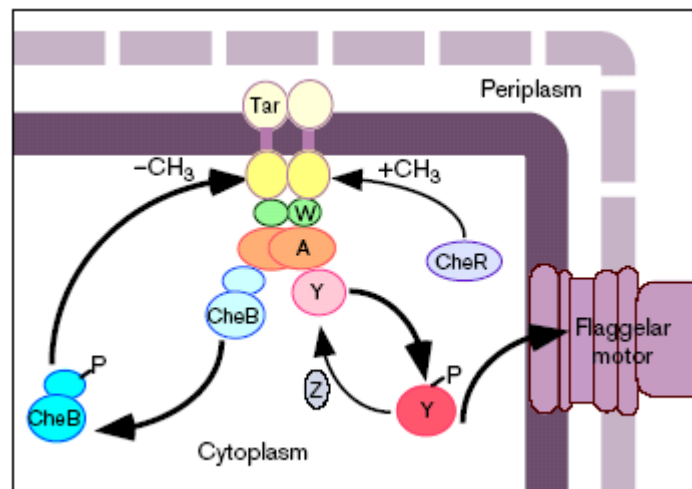
- a) **TRUE**
- b) FALSE

7. Male silkworm moths can detect female moths from great distances (more than a mile) by detecting very low concentrations of a chemical pheromone, bombykol. Dusenbery would characterize bombykol as:

- a) a causal agent
- b) an information agent**

8. Refer to the diagram of the bacterial chemotaxis pathway below. In the following list draw lines between each **component** in the left column and its corresponding **functional** role in the right column:

<u>Component</u>	<u>Signaling function</u>
CheA	sensor element
Tar	transmitter element
phosphorylated CheY	output element
flagellar motor	messenger/response regulator



9. Locomotor capabilities are important for microbes that have adopted a hunting life style that allows them to move to more favorable environments, while chemical secretion is more important for microbes with a farming life style that allows them to modify their local environment.

10. According to a hypothesis discussed in class, different sensory modalities may have their evolutionary origins either in solute (dissolved substance) or solvent (water) sensing mechanisms of single-celled organisms. Which of the following are thought to have arisen from solvent sensing (circle all answers that apply):

- a) vision **b) hearing** c) taste **d) touch**

11. In the Ferree and Lockery model of chemotaxis in *C. elegans*, the individual neurons have RC-circuit type input-output properties. The model demonstrated that by appropriately connecting these neurons together (circle the best response):

- a) circuit properties can control the timing of body wall contractions to produce a smooth, sinusoidal crawling motion
- b) the network can compute a temporal derivative, which allows the worm to assess the concentration gradient using sequential sampling in time, rather than simultaneous sampling in space**
- c) coincident activation of left and right sensors can signal the precise onset of a food stimulus
- d) lateral inhibition between the sensory neurons can enhance the contrast of the chemical gradient.

12. In Dusenbery's view, what are the three converging information pathways that influence an organism's behavior and over what time scales do they process/store information?

- | PATHWAY | TIMESCALE |
|-------------------|-------------------------------------|
| a) <u>genome</u> | <u>generations (evolutionary)</u> |
| b) <u>memory</u> | <u>organism's own lifetime</u> |
| c) <u>sensory</u> | <u>current state of environment</u> |

13. In *C. elegans*, a neuron with a cell body located in the main nerve ring with a neurite that is also confined to the nerve ring is most likely a:

- a) sensory neuron
- b) primary (sensory) interneuron**
- c) secondary (pre-motor) interneuron
- d) motor neuron

14. A 'type-1' Braitenberg vehicle has a single motor that runs only in the forward direction. The vehicle is subject to frictional forces that cause some random variation in its heading direction. The motor is driven by excitatory inputs from two sensors: a light sensor and a temperature sensor. When simulating a large population of such vehicles, they would tend to cluster in what region of a complex environment:

- a) bright, hot
- b) bright, cold
- c) dark, hot
- d) dark, cold**

15. Of the example organisms discussed in class, sponges (porifera) were the first multicellular organisms to evolve primitive nerve nets.

- a) TRUE
- b) FALSE**

16. Which of the following is NOT associated with the Cambrian explosion?

- a) cellular division of labor**
- b) climate instability
- c) predator-prey arms race
- d) axons for long distance communication

17-20. Consider the following examples of NetLogo code and indicate the corresponding type of orienting behavior that would be exhibited (answer may be used more than once, or not at all):

- (O) orthokinesis**
- (SK) simple klinokinesis**
- (AK) adaptive klinokinesis**
- (T) taxis**

17. O	<pre>ask bots [rt -10 + random-float 20 fd 10 *(snsL + snsR)]</pre>
18. T	<pre>ask bots [rt 10 * (snsL - snsR) fd random-float 1]</pre>
19. T	<pre>ask bots [rt 10 * (snsL - snsR) fd 10 * (snsL + snsR) / 2]</pre>
20. SK	<pre>ask bots [rt 10 * (snsL + snsR) fd random-float 1]</pre>