

BIOE/BIOP/MCB/NEUR 419

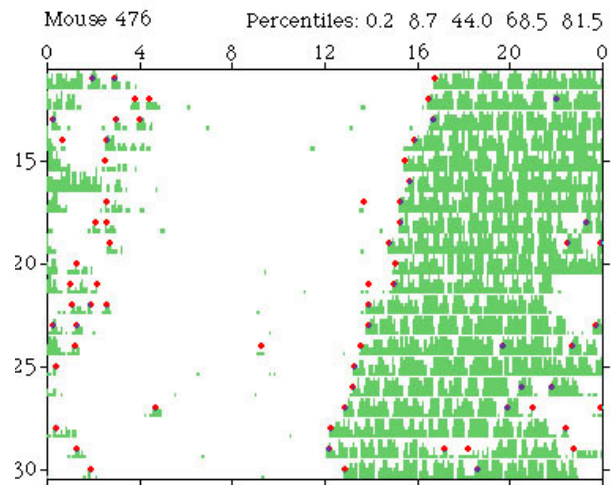
EXAM 3 (20 pts total)

Spring 2007

Name: _____ Key _____

(Provide the best response to each question. 20 questions, 20 points total)

1. The figure to the right shows the running wheel activity of a mouse kept in total darkness.



- a) What are the *time* units on the horizontal axis? Hours
- b) What are the *time* units on the vertical axis? Days
- c) The mouse exhibits an activity pattern

with a period that is **shorter** / **longer** than 24 hours (circle the correct response).

2. If the mouse in the experiment above were exposed to bright light during the SUBJECTIVE pre-dawn (4 am) period of it's activity cycle, it's activity on the following day would likely be shifted **earlier** / **later** / **no change** (relative to when it would have occurred without the light exposure)?
3. If the mouse in the experiment above were exposed to bright light during the SUBJECTIVE mid-day (noon) period of it's activity cycle, it's activity on the following day would likely be shifted **earlier** / **later** / **no change** (relative to when it would have occurred without the light exposure)?

4. Which of the following animals has the narrowest active sensing beam?

bats **(dolphins)** electric fish ?

5. For the bat's sonar system, assume that the outbound energy and reflected energy both experience inverse-square geometric spreading. How much weaker would the sensory signal be, if a target object were moved twice as far away from the bat?

a) 2 times weaker

b) 4 times weaker

c) 8 times weaker

d) 16 times weaker

6. What selective pressure might favor the evolution of an active sensing probe signal that is pulsed intermittently, rather than left on continuously?

Pulsed output can conserve energy; Pulsed output can make the animal less conspicuous to predators .

For questions 7-8, indicate the type of long-term memory and likely brain region involved in storing the information. Choose from the following lists:

Memory systems

a) episodic, b) semantic, c) procedural, d) emotional

Brain regions

1) amygdala, 2) cerebellum, 3) striatum, 4) medial-temporal lobe/diencephalon

7. Remembering where you were and what you ate for breakfast yesterday morning.

Memory system (a-d): a

Brain region (1-4): 4

8. Being able to ride a bicycle, after having not ridden one for several years.

Memory system (a-d): c

Brain region (1-4): 2 or 3

9. Give an example of a natural circumstance in which episodic memory capabilities might confer a selective advantage to a non-human organism.

Food caching in jays; allows the animal to efficiently store and retrieve food resources; must keep track of 'what', 'where', and 'when' food was cached

10. The Dennett paper "Out of the Armchair and into the Field" discusses a vervet monkey vocalization (a type of a grunt) that is labeled MIO. Dennett discusses strategies for trying to determine its meaning. Monkeys usually generate the MIO vocalization:

- a) in response to visual sighting of a predator on the ground (e.g. a snake)
- b) in response to visual sighting of monkeys from another social group
- c) as part of a courtship ritual

d) when a monkey is about to move out of the trees into the open grass

11. List, and briefly describe, TWO general signal modulation strategies that animals can use to improve the specificity of their communication signals:

a) AM (amplitude modulation) – variation in intensity/strength over time

b) FM (Frequency modulation) – variation in frequency content (tonal properties) over time

12. In a dense forest, what sensory modality is likely to work best for long-range communication?

a) acoustic

b) chemical

c) tactile

d) visual

13. List TWO specific adaptive benefits of trail-pheromone communication in ant foraging

a) Selects the best food source

b) Selects the shortest path to the food source

Or: Recruits more foragers to a food source.

14. Ants must make a choice between two pheromone trails; the branch on the left has chemical concentration C_L and the branch on the right has chemical concentration C_R . The probability for selecting the left branch is modeled mathematically as:

$$P_L = \frac{(C_L + k)^2}{(C_L + k)^2 + (C_R + k)^2}$$

If $C_L = k$ and $C_R = 3k$, what is the probability that the ant will choose the branch on the RIGHT?

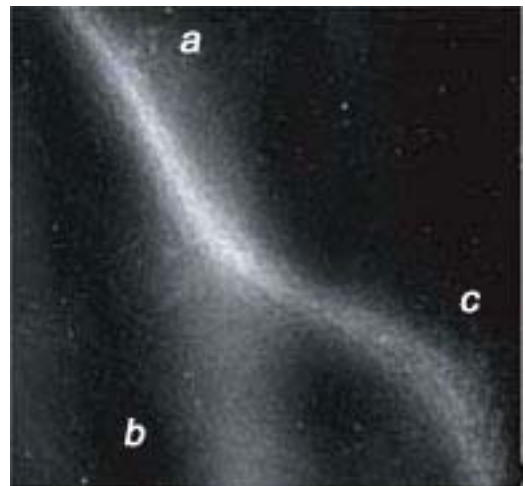
a) 20%

b) 33%

c) 66%

d) 80%

15. In the diagram to the right, which of the ant pheromone trails (a-c) most likely leads back to the nest? a



16. In the context of ant foraging, what is the disadvantage of depositing a trail pheromone that has an extremely high evaporation rate?

The signal is lost before other ants can discover the trail.

17. Give an example of how an emotional response regulates the ability of an organism to acquire second-order resources:

Baby bird chirping elicits foraging/feeding response in parent

18. The desert ant *Cataglyphis* combines what three spatial navigation strategies in order to find its way back to the nest after a foraging excursion?

a) Path integration

b) Sky/light polarization compass

c) Visual landmarks

19. The navigation strategy of *Cataglyphis* is largely **procedural** / **map-based** (circle the best response).

20. A neuron in the rat brain is most active when the rat is in a particular spatial location near its nest. Activity levels are high whenever the rat is in this location, independent of whether it is facing toward or away from the nest. A neuron with these response properties would most likely be found in the:

a) amygdala

b) cerebellum

c) hippocampus

d) striatum