

There should be 8 pages to this exam - take a moment and count them now. Put your name on the first page of the exam, and on each of the last 2 pages (those with short answer or essay questions). On the answer (bubble) sheet, please fill in name and course info (3100-217-001.)

**READ THE ESSAY AND SHORT ANSWER QUESTIONS CAREFULLY!**

Exam begins on next page

SCORE (to be filled in by grader)

Multiple choice:

17 questions (34 points total); 2 points each x \_\_\_\_ ==> \_\_\_\_\_

Short answers:

18) 11 points \_\_\_\_\_

19) 4 points \_\_\_\_\_

20) 4 points \_\_\_\_\_

21) 4 points \_\_\_\_\_

22) 6 points \_\_\_\_\_

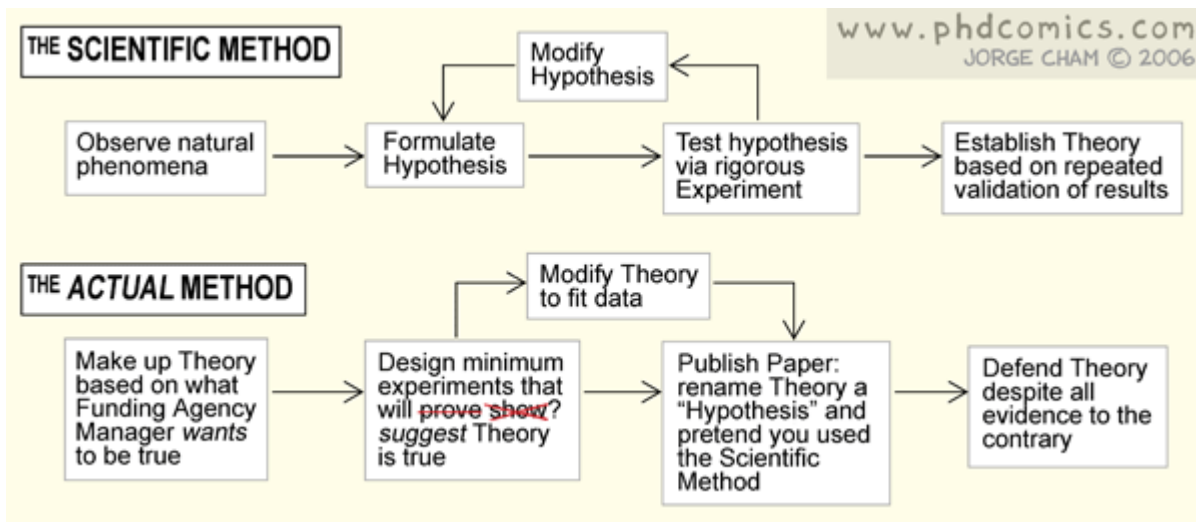
23) 15 points \_\_\_\_\_

Total (78 points)

\_\_\_\_\_ = \_\_\_\_\_%

$$\frac{E}{T} = \frac{N_{e1}E_1 - C_s}{1 + N_{e1}H_1}$$

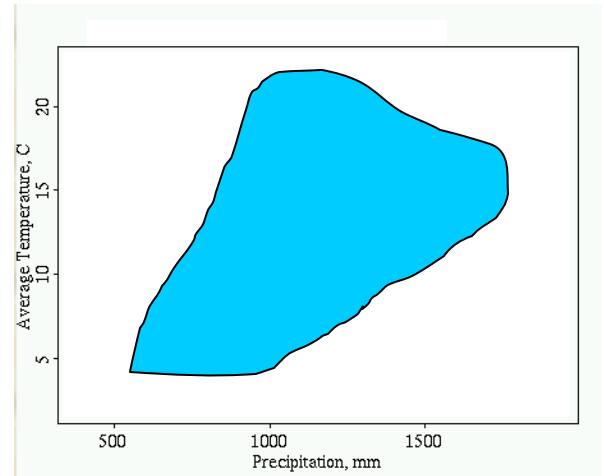
$$\frac{E}{T} = \frac{\sum N_{ei}E_i - C_s}{1 + \sum N_{ei}H_i}$$



Exam begins on next page

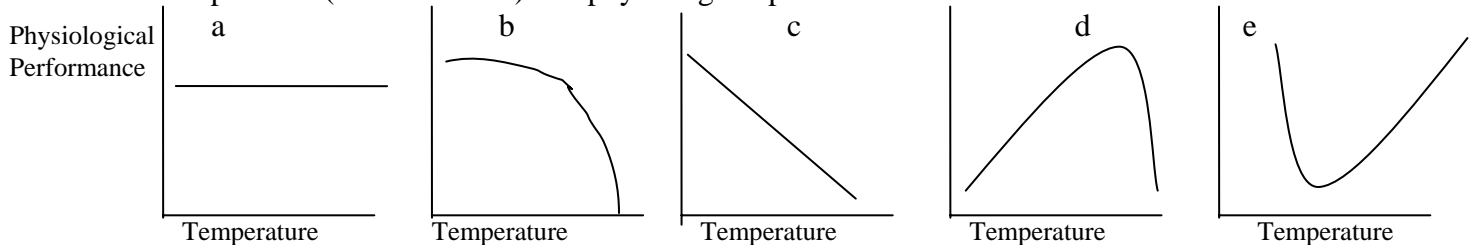
**Multiple Choice questions:** 2 points each. Please put your answers to this section on the Standardized Bubble Sheet. Feel free to use the question sheet for scratch work. Each question has only one correct answer. You will not be penalized for guessing on this section. Fill in your Answer Sheet carefully. Make sure that the number of the question matches the number whose bubble you're filling in!

- 1) In this graph the darkened region indicates the range of conditions that Little Brown Bats (*Myotis lucifugus*) can tolerate. Which of the following is the MOST correct interpretation of these data?
- This is a full description of the niche for *Myotis lucifugus*
  - Myotis lucifugus* tolerate average annual temperatures from ~5 - 22 C
  - Myotis lucifugus* tolerate moisture levels from ~550-1760 mm /year
  - Temperature tolerance for *Myotis lucifugus* depends on moisture availability, and moisture tolerance depends on temperature
  - The niche of *Myotis lucifugus* changes is multi-dimensional
- 2) The idea of a metapopulation is of most value in understanding which of the following:
- populations that disperse widely (travel long distances)
  - populations occurring in fragmented habitats
  - populations with narrow niche requirements
  - irruptive populations that occur only periodically
  - populations with broad niche requirements
- 3) Which of the following statements about small populations is most correct?
- They are more likely to acclimate to new conditions than are large populations
  - They are much less common than are large populations for most species
  - They are more likely to be small creatures than are large populations
  - They are more likely to go extinct than are large populations
  - They have smaller niches than do large populations
- 4) THIS QUESTION was poorly written, and was not graded.



- 5)
- 6) Direct interactions among individuals, such as root competition in plants, and territoriality in animals, often leads to which of the following types of dispersion?
- Random
  - Scaling
  - Regular
  - Aggravated
  - Clumped

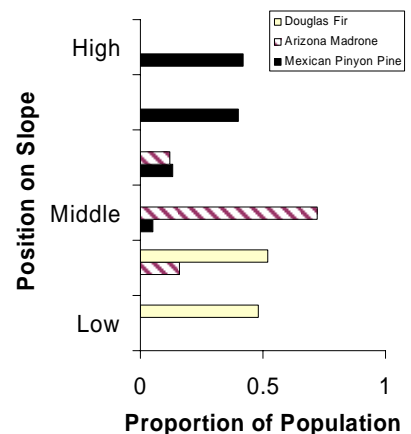
- 7) Which of the following curves describes the most common relationship between air temperature (from 0 to 50C) and physiological performance for most animals?



- 8) Which of the following is an example of Liebig's law of the minimum?
- The expansion of the distribution of House Sparrows (*Passer domesticus*) in North America each year is always above some minimal level.
  - Survival for Meadow Voles (*Microtus pennsylvanicus*) is near the minimum necessary to sustain the population
  - Populations of Emerald Ash Borer Beetles (*Agilus planipennis*) are well above the minimum acceptable level, allowing them to spread.
  - Physiological performance of Toads (*Bufo borealis*) is minimal at low temperatures.
  - Reproduction of White-Footed Mice (*Peromyscus leucopus*) is usually limited by food availability in meadows, but when they live in human houses reproduction is limited by availability of nest sites.

- 9) Robert Whittaker (1956) studied plant distributions along the environmental gradients presented by mountains in the desert. His data are shown in your book (regraphed to the right). Which of the following interpretations of his findings is most correct?

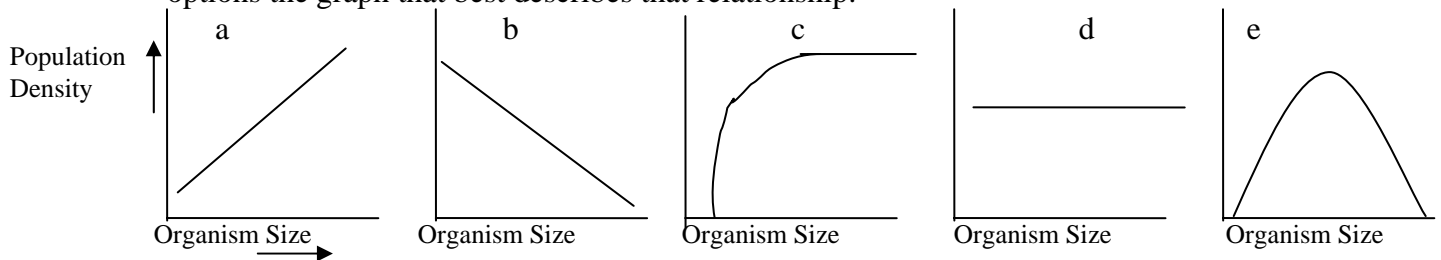
- At this scale, species show a clumped distribution
- Plant populations are not influenced by gradients because they are more influenced by constant conditions
- At large scales, plants are randomly distributed
- Physical and chemical variation along gradients result in regular distributions
- The niches of these plants do not overlap



10) Water will flow from the soil into a plant's roots as long as:

- The soil has a higher water potential than the plant.
- It is a shady day
- The plant is actively photosynthesizing
- Animals eat the plant
- There has been rain recently

11) Your book had a section explaining how population density and organism size (e.g., body mass) are generally related with each other. Choose from among the following options the graph that best describes that relationship.

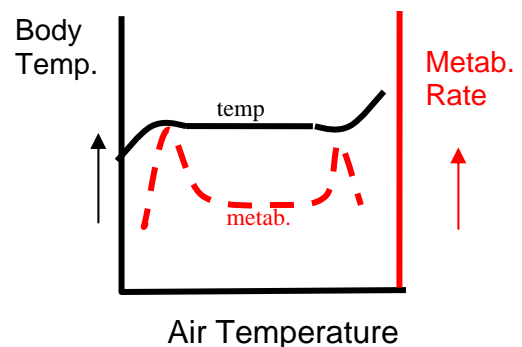


12) A scientist ecologist who studies ecology at the individual level would most likely study which of the following?

- physiological tolerances to the abiotic environment
- changes in numbers, resulting from births and deaths, of individuals belonging to a particular species in a particular place.
- the number and relative abundances of species living in a particular place
- transport of energy and materials at the global scale

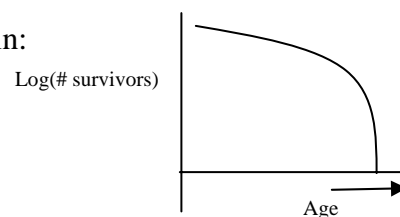
13) During your physiology class a friend brings in an odd animal that you have never seen before. As part of a class project, you place the animal in a small chamber and measure its body temperature and metabolic rate as you vary the chambers temperature. Your results are shown to the right. Which of the following statements is most correct, based on these results?

- This is a hot-blooded animal
- This is a poikilotherm
- There is a distinct thermal neutral zone
- This is consistent with optimal foraging theory
- This animal is hypoosmotic



14) This survivorship curve is most likely to be found in:

- Dall Sheep
- American Robins
- House flies



d) Mud turtles

15) In your study of squirrel ecology you decide to manipulate both the availability of nuts, and the availability of nestsites in the area around The University of Akron campus. After a year you census the squirrel population, and find the following results (average number of squirrels per plot):

Plots with nuts added: 11 squirrels

Plots with nestsites added: 20 squirrels

Plots with neither added: 10 squirrels

Plots with both added: : 40 squirrels

Which of the following statements best describes the results of this experiment?

- a) Squirrel populations are not limited by nuts or nestsites
- b) Squirrel niche requirements are met throughout eastern North America
- c) Squirrel habitats are not well supplied with nuts
- d) The niche of squirrels does not involve nuts or nestsites
- e) Squirrels show an interaction between their requirements for nuts and nestsites

16) Some birds save energy by allowing their body temperature to drop by a large amount over night. This is called:

- a) Endothermy
- b) Homeothermy
- c) Torpor
- d) Hypothermy
- e) Elastothermy

17) Your book uses the term PAR as an abbreviation for:

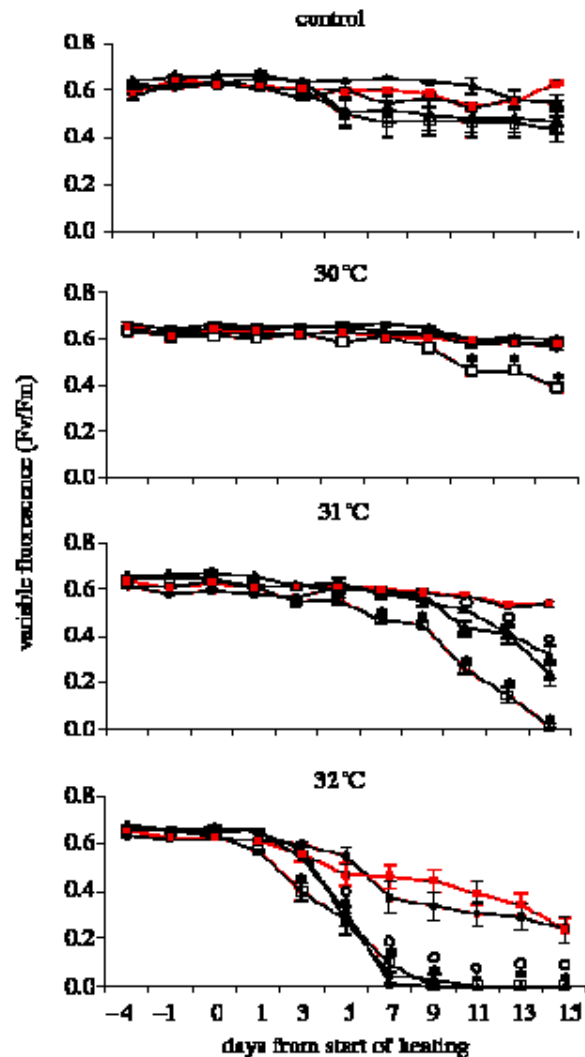
- a) Phosphorus Applied to Roots
- b) Population Average Reproduction
- c) Photosynthetically Active Radiation
- d) Peruvian Adiabatic Rainfall
- e) Protein After Recess

18) Laboratory and field experiments are complimentary approaches to addressing scientific questions. However, they differ in their experimental design. In laboratory experiments:

- a) the researcher attempts to keep all factors constant
- b) the researcher alters the variables considered unavailable in field experiments
- c) the researcher varies a single variable while holding all other variables constant
- d) the researcher allows natural variation in experimental factors to provide the experimental treatment
- e) most results are compromised due to isolating the experiment from its natural surrounding

19) In their study of corals, Ray Berkelmans and Madeline van Oppen (2006. Proceedings of the Royal Society B: Biological Sciences.273: 2305 – 2312) took small pieces of coral from several

locations across Australia's great barrier reef and grew them in tanks for several weeks. For the first 5 days they kept all the tanks at the control temperature of 27.5C. Then (at day '0') they began heating of the tanks to different temperatures: 27.5, 30, 31, or 32C). They had three replicate tanks for each temperature treatment. They used a fluorescent bioassay to measure the extent of coral 'bleaching'; low fluorescence values indicate bleaching. Their results are shown in the figure to the right. Each of the several lines in each panel indicate data from a different coral collection site.



a) (2 points) What hypothesis does this experiment test?

b) (3 points) Do these data reject or support the hypothesis?

c) (3 points). Is this a lab, field, or natural experiment? Why?

d) (3 points) How do these results relate to the idea of the niche?

20) 4 points. Please list **two** of the three main messages of “optimal foraging theory” that we listed in class.

21) (4 points) Explain the differences between the Hutchinsonian niche and the Eltonian niche

22) (4 points) Several times in class I mentioned that my pet kangaroo rat never drank any water, yet was perfectly healthy. What are **two** attributes that help this animal survive without drinking?

23) (6 points) This graph summarizes the response of hydroids (ocean-dwelling invertebrates) to copper concentration (ignore the equation).

- Briefly describe the main features of this graph
- Interpret the meaning of this graph

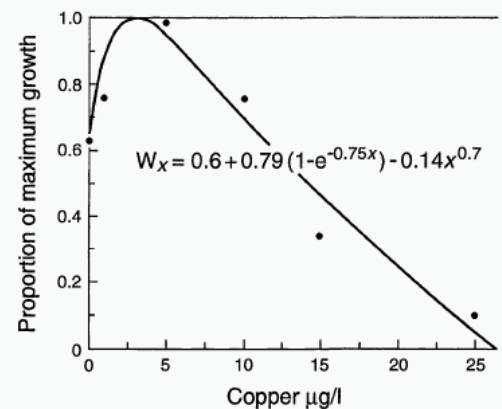


FIGURE 4. GROWTH OF A MARINE HYDROID COLONY OVER SIXTEEN DAYS AS A FUNCTION OF COPPER CONCENTRATION, FROM STEBBING (1981:51).

24) **15 points.** Pre-prepared review sheet question: Remember: your answer should be well-reasoned and well-written -- outline format is not acceptable (though you may outline the answer for your own benefit on the back of another page). Your answer should fit on this page.

*Arctic organisms must deal with extremely cold temperatures. List three different adaptations used to deal with the arctic cold, and explain how they meet the definition of adaptation. Be sure to explain whether and how these features affect the various avenues of heat transfer discussed in class in and your book.*