

There should be 9 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 few pages with short answer questions.

Please fill in your name and student ID on the front page of the bubble sheet (fill in the 'leading zeros').

FILL IN THE "TEST FORM" bubble in the lower right of the bubble sheet. You have **Test Form A**

The following equations and constants may be helpful:

$$H' = -\sum(p_i \ln(p_i))$$

$$D = 1/\sum p_i^2$$

$$\log S = \log c + z \log A$$

$$e = 2.72$$

$$N_t = N_0 e^{rt}$$

$$\pi = 3.14$$

$$R_p = LS \beta$$

$$dN/dt = rN(1-N/K)$$

Multiple Choice: ___/29 = _____/58

$$dN_1/dt = r_1N_1(1-N_1/K_1 - a_{12}N_2/K_1)$$

Question 39 _____/ 2

$$dN_2/dt = r_2N_2(1-N_2/K_2 - a_{21}N_1/K_2)$$

Question 40 _____/ 4

$$N = nM/x$$

Question 41, Prepared essay: _____/ 25

$$dN_h/dt = r_hN_h - pN_hN_p$$

$$dN_p/dt = cpN_hN_p - d_pN_p$$

$$PV = nRT$$

Total _____/87

$$N_t = \lambda^t N_0$$

$$\ln(2) = 0.69$$

$$\ln(1) = 0$$

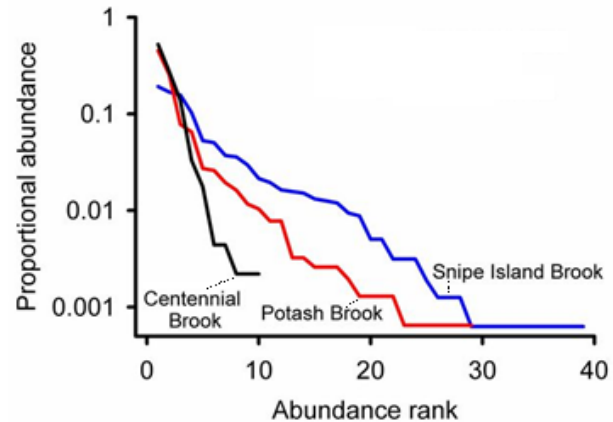
Xkcd.com



Multiple Choice questions: 2 points each. Please put your answers for this section on the 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. Make sure that the number of the question matches the number whose bubble you're filling in!

- 1) Here are some results from surveys of stream insects in northeastern Ohio. These streams differ in water flow: Snipe Island Brook has the highest flow rate, Centennial Brook has the lowest flow, and Potash Brook is in between. Which conclusion do these data support?

- Species composition increases in streams with larger flows
- Overall diversity decreases with flow rate
- Stream flow is not related to diversity
- Nitrogen cycling increases for larger streams
- Thermal tolerances become greater smaller streams

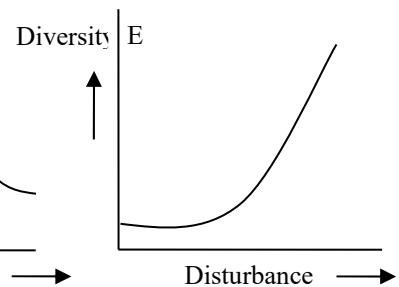
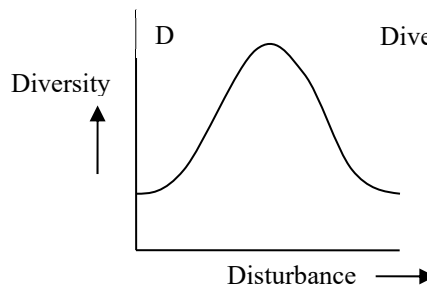
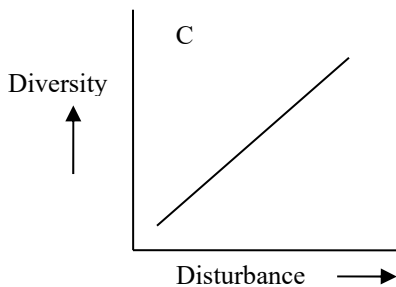
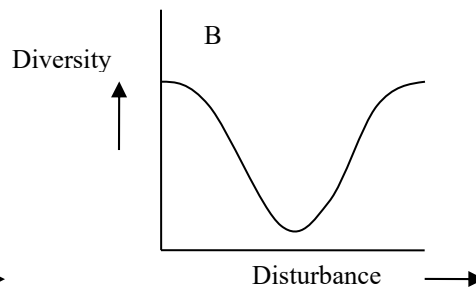
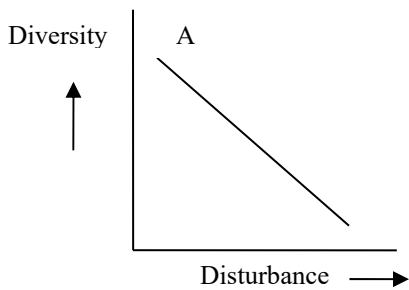


- 2) In the nitrogen cycle, which of the following is the primary means through which useable nitrogen is made available to living things in natural ecosystems?
- Nitrogen fixation through lightning
 - Nitrogen fixation by bacteria
 - Internal cycling
 - Uplift of sedimentary rocks
 - Spontaneous breakdown of atmospheric nitrogen
- 3) Regarding succession, Legumes contain nitrogen-fixing bacteria in their roots that increase soil nitrogen for use by other plant species. The effect of legumes on other plant species here is an example of which of the mechanisms of succession?
- inhibition.
 - tolerance.
 - suppression.
 - facilitation.
- 4) During a survey of fish in a river you notice an interesting pattern. The temperature of this river increases gradually from 10C upstream to 15C downstream. One fish species is found in the cooler section upriver, while the other is found in the warmer section downriver. Their distributions do not overlap. Why do these two species have nonoverlapping distributions?
- The two species have distinctive and nonoverlapping habitat requirements.
 - Each species competitively excludes the other from its section of the river.
 - Predation enforces this separation in the realized niche
 - It is impossible to answer this question without conducting further experimental studies

- 5) Most scientists expect that an increase of CO₂ in the atmosphere will ultimately lead to
- reduced carbon sequestration in terrestrial forests
 - decrease of the ocean's pH
 - a lower concentration of carbon in the ocean
 - lower global average temperature
- 6) Based on what you have learned in this class, which of the following islands should have the most species of bats?

Option	Island	Island Area (km ²)	Distance to mainland (km)
A	Key West	11.9	121
B	Matecumbe Key	4.3	32
C	Big Torch Key	2.3	88
D	Key Largo	55.1	13
E	Dry tortugas	0.9	131

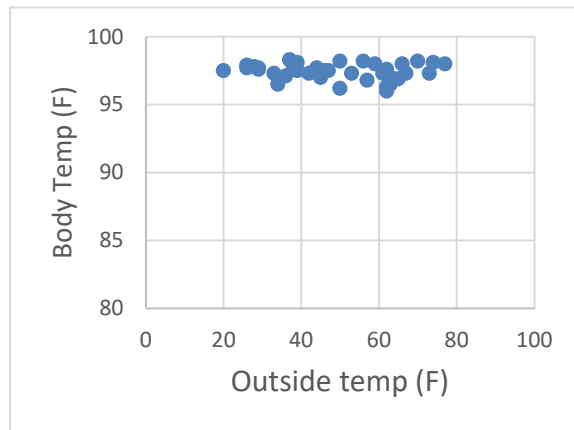
- 7) Which of these statements about the essential difference between ecology and environmentalism is most correct?
- One is a philosophy and the other is a thought process
 - Ecology is a branch of science, while environmentalism is a branch of politics
 - They are really the same things
 - Ecology concerns study of organisms, while environmentalism concerns study of organisms and their environment
 - Ecology focuses on policy while environmentalism focuses on basic principles
- 8) We have discussed the intermediate disturbance hypothesis in class. Which of the following graphs is the best representation of that hypothesis?



- 9) When a population grows according to the logistic model, at which of the following population sizes does dN/dt equal zero?
- $N = No \text{ ert}$
 - $N = r$
 - $N = K$
 - $N = K/2$
 - dN/dt can never be 0
- 10) Akron and many cities across the country have ‘combined sewer’ systems to deal with liquid waste. Intense rainstorms in such areas can cause a ‘combined sewer overflow’. Which of the following is the best description of the outcome of a combined sewer overflow event during a rainstorm?
- The sewage overflows into the streets.
 - Rainwater from the roads is diverted around the sewage treatment plant, while only sewage is treated at the sewage treatment plant
 - Raw sewage goes straight to the river without processing, bypassing the sewage treatment plant
 - The combined sewers overflow into the separate sewer basins, which hold the extra water until it can be processed
 - The sewage treatment plant increases processing speed and keeps up with the extra demand

- 11) During the COVID outbreak, Dr. Mitchell recorded his body temperature along with the ambient (outside) temperature. Which of the following statements about Dr. Mitchell best describes these data?

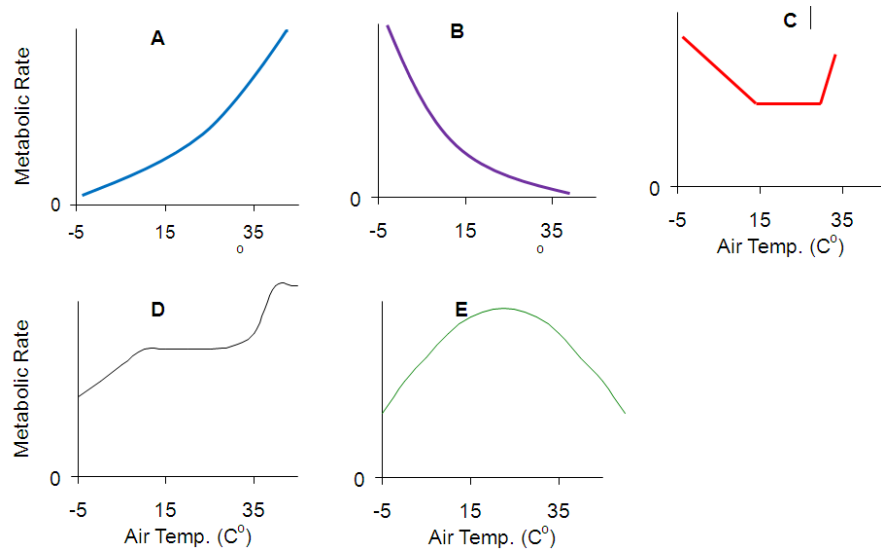
- He is undergoing torpor
- He is acting as a heterotherm
- He is acting as a poikilotherm
- He is acting as a homeotherm
- He is warm-blooded



- 12) During your first week of dental school, you’ve been asked to help in a study of the bacteria that inhabit human mouths. You discover that there are usually around 10 billion bacteria in each mouth. These population sizes stay fairly constant, except immediately after the teeth are brushed, when populations drop down to a few million, then return to the same normal level as before. This sort of pattern is most consistent with which of the following models of population growth?
- chaotic population growth
 - density independent population growth
 - logistic population growth
 - exponential population growth
 - geometric population growth

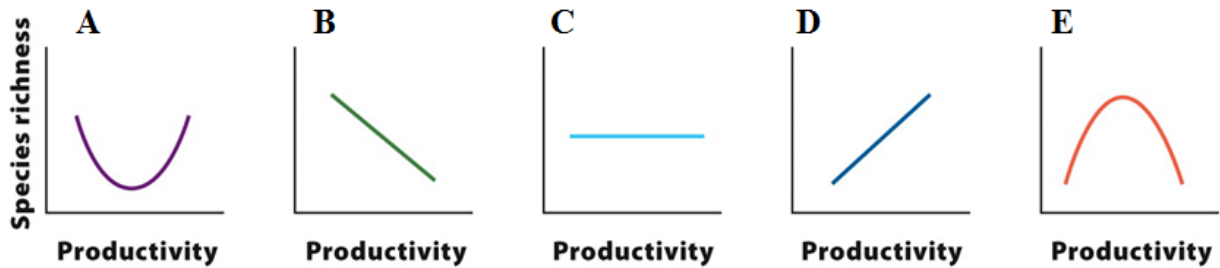
- 13) Nutrient-rich agricultural runoff into freshwater ecosystems
- reduces growth of algae.
 - deceases phytoplankton productivity.
 - causes accumulation of organic material.
 - increases the amount of available dissolved oxygen.
 - causes eutrophication.
- 14) There is strong evidence that the global concentration of carbon dioxide in the atmosphere is now higher than at any time in the last half million years. Which of the following is the reason for this increase cited in your book and in lecture?
- Increase in the gradual oxidation of elements in the earth's crust
 - Increased photosynthesis
 - Increased combustion of fossil fuels
 - Increased respiration and metabolism by the growing human population
 - Increased volcanic activity

- 15) In class we discussed Trevor, a toad that was found by Joel during a visit to the Rocky Mountains. Which of these graphs should best describe how Trevor's metabolic rate would change with air temperature in that situation?



- 16) As discussed in class, an important difference between energy and nutrients is that:
- Energy can undergo 'biomagnification', while nutrients cannot
 - Nutrients follow the laws of thermodynamics, while energy does not
 - Energy moves among different compartments of an ecosystem with few losses, while nutrients are constantly lost to detritivores and recycling activities
 - Energy moves through food chains, while nutrients do not.
 - Nutrients are regenerated and retained within an ecosystem, while energy is not
- 17) Dr. Anne Wiley of UA has used stable isotope analysis to do which of the following?
- Test for changes in trophic level for Hawaiian Petrels
 - Study pollinators in wetlands of Ohio
 - Confirm that earthworms are not native to Northeastern Ohio
 - Evaluate the effects of Bats on White nose fungus
 - Determine the influence of ants on elephants and acacia trees

18) Which of these graphs best represent the way that community diversity is generally related to natural variation in productivity, as explained in class and in the book?



19) Which of the following statements about extinction rates is correct?

- They are now well above the average for the last few hundred million years
- They are now about the same as the average for the last few hundred million years
- They are now well below the average for the last few hundred million years
- They cannot be estimated

20) In the meadows of Northeastern Ohio, crab spiders often prey on bees that visit flowers to get nectar. The spiders are:

- Mutualists
- Producers
- Primary consumers
- Secondary consumers
- Detritivores

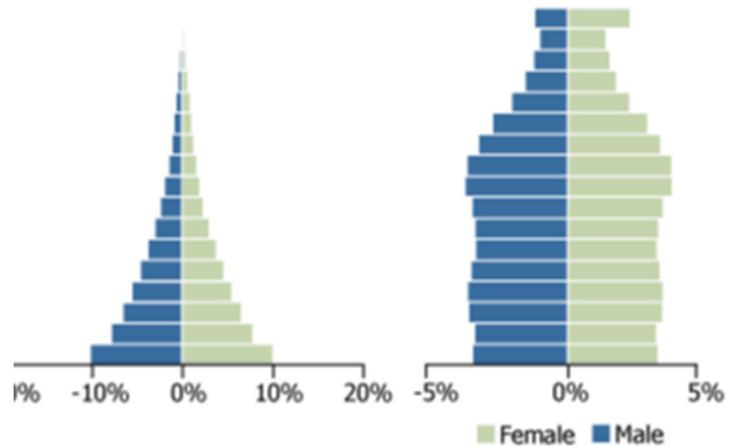
21) Diseases often exhibit cyclic outbreaks. In class we considered the possibility that this is because:

- host susceptibility varies systematically over time
- diseases have mutualistic interactions with disease vectors like mosquitoes
- disease-host interactions are a form of predator-prey interaction
- disease-host-interactions are a form of competitive interaction
- diseases have a circadian rhythm

22) If you were trying to save an endangered species that lived in a metapopulation, which actions would be most helpful in trying to increase the proportion of occupied patches?

- Limit dispersal to only a few patches.
- Decrease patch isolation.
- Increase the number of available patches.
- Create barriers around the metapopulation.

- 23) Which of the two human populations considered in this figure is most likely to have a lower population growth rate (r)?
- The one on the left
 - The one on the right
 - Neither – both are growing at maximum speed
 - Neither - both are shrinking
 - Neither- they should have equal values of r



- 24) Carbon dioxide with radioactive carbon was bubbled into an illuminated aquarium containing unfiltered pond water. In what order will radioactivity appear in various organisms in the aquarium?
- herbivores, producers, carnivores
 - herbivores, carnivores, producers
 - producers, herbivores, carnivores
 - producers, carnivores, herbivores
 - All organisms will take up radioactive carbon simultaneously.
- 25) When Robert Paine removed predatory starfish from rocky intertidal zone enclosures, some of the starfish's prey items became extinct. Which of the following are correct and reasonable interpretations of these findings?
- competition is not important in the rocky intertidal zone
 - desiccation limited some species, while crowding limited others
 - starfish typically balance competition of prey items by shifting their preference to less abundant prey
 - removal of predation allowed certain prey to increase so greatly that they competitively excluded other prey
 - predation is not density-dependent
- 26) Which of the following statements best describes the interaction between fire and ecosystems?
- Fire is unnatural in ecosystems and should be prevented.
 - The chance of fire in a given ecosystem is highly predictable over the short term.
 - Many kinds of plants and plant communities have adapted to frequent fires.
 - The prevention of forest fires has allowed more productive and stable plant communities to develop.
 - Chaparral communities have evolved to the extent that they rarely burn.

- 27) Some birds save energy by allowing their body temperature to drop by a large amount over night. This is called:
- a) Hypothermy
 - b) Homeothermy
 - c) Torpor
 - d) Endothermy
 - e) Elastothermy
- 28) In the Northern Hemisphere, the number of species of animals generally
- a) does not vary much
 - b) decreases from north to south.
 - c) decreases from east to west.
 - d) increases from east to west.
 - e) increases from north to south.
- 29) A hundred years ago Asian Carp (e.g., bighead carp) were only found in lakes and streams of China and nearby countries. However, Asian Carp were introduced to the US for fish farming in the 20th century, and have now spread through rivers and lakes of the central Midwest. They are likely to invade the Great Lakes of North America in the next few years. Based on this information, which of the following conclusions is justified?
- a) The fundamental niche of Asian Carp did not include the conditions found in the Great Lakes
 - b) The Asian Carp have expanded their niche
 - c) The distribution of the Asian Carp is decreasing.
 - d) The distribution of Asian Carp was limited by dispersal.
 - e) B and C
- 30) 2 points. What is the climax community for the Akron area?
- 31) 4 points. Why is decomposition of dead material important for ecosystems?