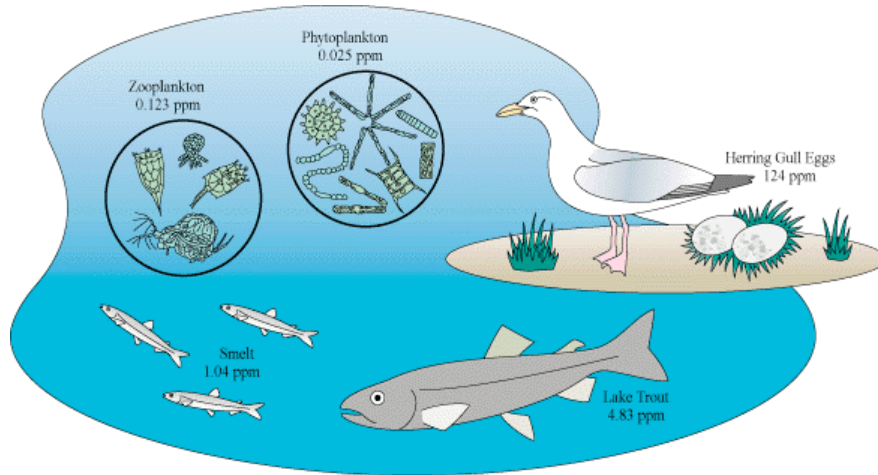


Question 23

Certain human-made organic chemicals present in the Great Lakes biologically accumulate in resident organisms. Even though these chemicals may be present in the water in only very low concentrations, organisms such as phytoplankton bioaccumulate these toxic chemicals at much higher concentrations than are found in the water. Bioaccumulation occurs at each step of the food chain. This process of increasing concentration of contaminants through the food chain is known as biomagnification.

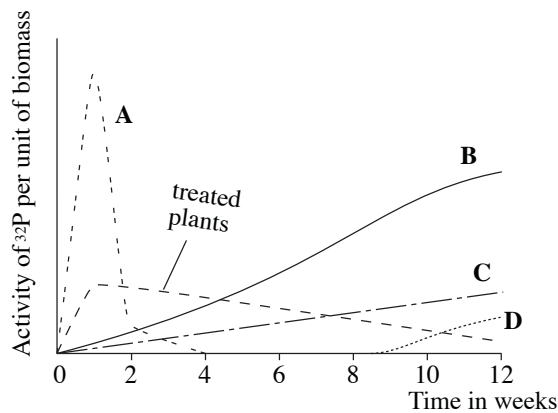


What trophic level does the Lake Trout feed at in the food web above?

- A. Trophic level 1
- B. Trophic level 2
- C. Trophic level 3
- D. Trophic level 4

Question 24

The graph shows the results of an investigation into the movement of phosphorus through an ecosystem. Plants were treated with phosphate in which the phosphorus was radioactive isotope (^{32}P). Over the next few weeks the level of radioactivity was measured in the treated plants, leaf-eating animals, sap-sucking animals, primary carnivores, and detritivores (feeders on dead plant matter). The results are shown below.

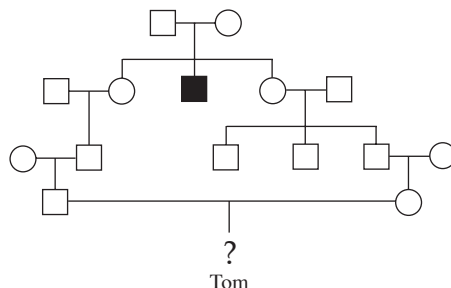


Changes in radioactivity in members of a community after treatment of plants with radioactive phosphorus (^{32}P).

Which curve represents the changes in radioactivity in animals feeding on dead plant material?

Question 25

The pedigree shows the inheritance of a rare recessive allele (since it is rare, assume that none of the people marrying into the family carries the allele). The individual showing the condition is shown in black; all others are phenotypically normal.



What is the probability that Tom will express the condition?

- A. 1/16
- B. 1/32
- C. 1/144
- D. 1/576

Question 26

During germination of a seed, energy reserves are used in respiration and growth. The table shows the changes in the mass of organic matter in the cotyledons (storage tissue), radicle (young root) and plumule (young shoot) of a bean seed during two weeks germination in the dark.

	Cotyledons	Radicle	Plumule
Initial mass	1.81 g.	0.02 g.	0.01 g.
Mass after 2 weeks	0.21 g.	0.12 g.	0.08 g.

How much organic matter is used in respiration?

- A. 1.77 g
- B. 1.41 g
- C. 0.43 g
- D. 1.6 g

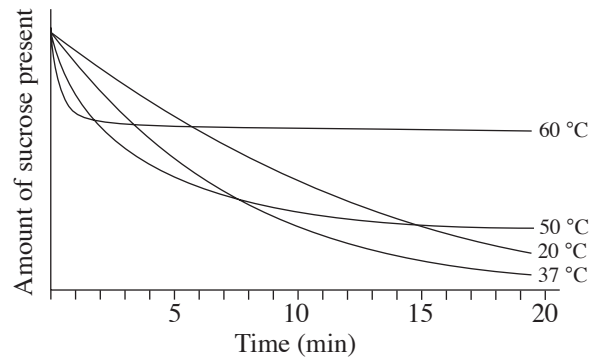
Question 27

The volume of blood ejected by each ventricle (pumping chamber) of the heart is the *stroke volume*. At rest, Bill's heart has a stroke volume of 80 cm^3 and beats at 60 beats per minute. While running up a hill, his heart rate increases to 180 beats per minute and his stroke volume increases to 100 cm^3 . By how many times does his heart output increase?

- A. 3.75 times
- B. 3.5 times
- C. 4 times
- D. 4.25 times

The following information applies to Questions 28 – 29

The graph shows the time course for the digestion of sucrose by the enzyme sucrase at four temperatures, all other conditions being the same.



Question 28

If the rate of the reaction were to be measured over 3 minutes, what would be the optimum temperature?

- A 60 °C
- B 50 °C
- C 37 °C
- D 20 °C

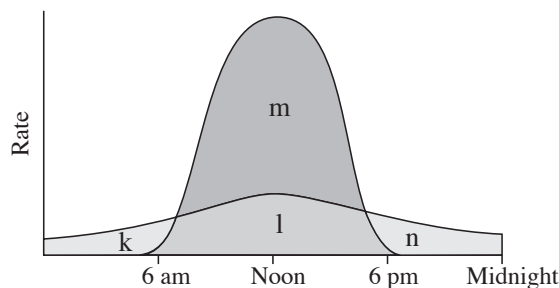
Question 29

The most likely reason for the shape of the curve for temperature B is that:

- A. the enzyme is being used up.
- B. the sucrose is being used up.
- C. the enzyme is being slowly denatured.
- D. none of the above.

Question 30

The graph shows the rates of photosynthesis and respiration by a plant over a 24-hour period.

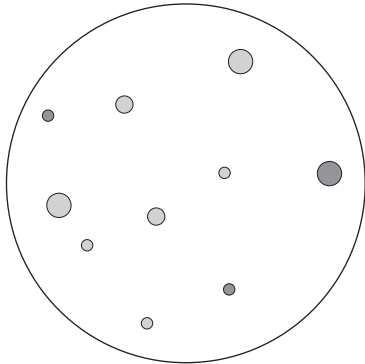


Which of the following areas would correctly indicate the *quantity* of organic matter accumulating over this 24 hour period?

- A. $k + l + m + n$
- B. $l + m$
- C. $m + n$
- D. $l + m - k - n$
- E. $m - k - n$

Question 31

Janice wanted to know how many kinds of bacteria were present in a rainwater storage tank, so she dipped a sterile wire loop in the water and smeared it over a sterile Petri dish containing nutrient agar jelly. After 36 hours the agar contained a number of colonies of bacteria, as shown in the diagram.

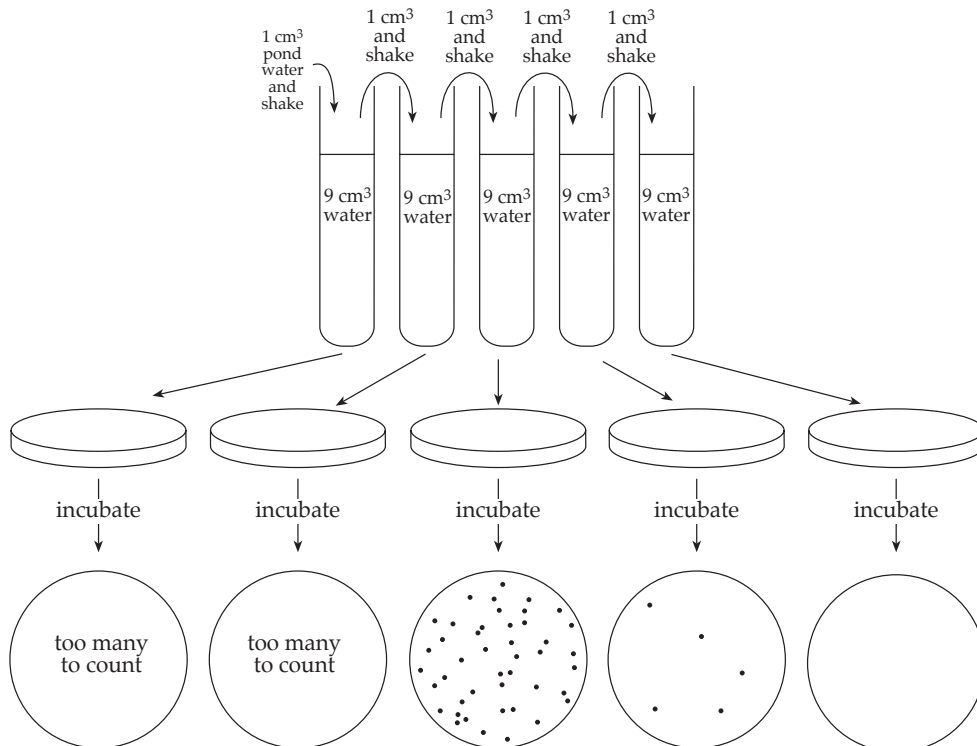


Assuming each colony had grown from a single bacterium, what is the minimum number of types of bacteria present on the agar?

- A. 2
- B. 3
- C. 4
- D. 5

Question 32

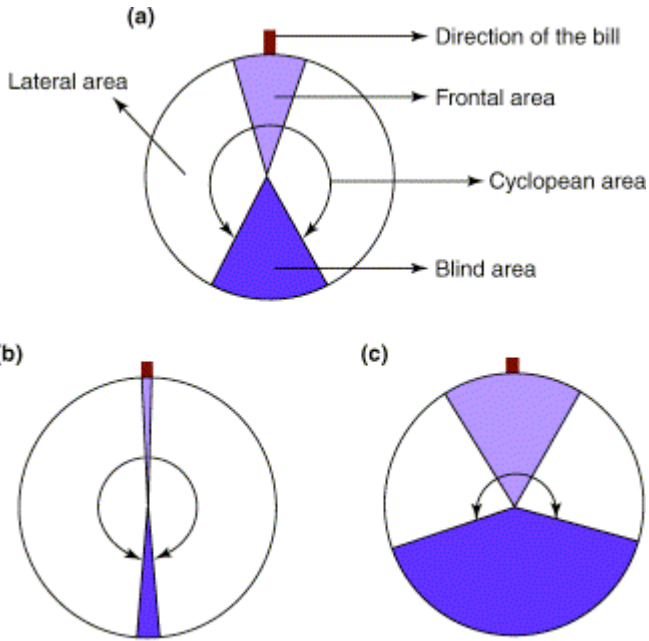
To estimate the number of bacteria per cm^3 of pond water, Sam used the technique of serial dilution. He took a measured 1 cm^3 sample of pondwater in a sterile pipette. He made up a series of sterile tubes, each containing 9 cm^3 of sterile water. As shown in the diagram, he added his 1 cm^3 sample of pondwater to the first tube and shook it, and transferred 1 cm^3 of solution to the second tube, and so on down the series. He transferred 1 cm^3 of the each of the liquid to a nutrient agar plate and, after 36 hours incubation, counted the colonies on each plate.



The best estimate of the number of bacteria per cm^3 of pondwater is:

- A. 44
- B. 440
- C. 4 400
- D. 44 000

Question 33



TRENDS in Ecology & Evolution

From: Fernandez-Juricic et al. (2004)

The eyes of most birds are aligned laterally, and each visual axis gives a monocular view. This lateral visual field serves to monitor predators and conspecifics, as well as to detect food at some distance. The frontal area, where vision from both eyes combine, allows binocular vision. The cyclopean area is the combination of the frontal and lateral visual fields.

Visual fields of birds have been categorized into three types, Types 1 – 3 which correspond to the diagrams a – c respectively.

The Barn Owl, *Tyto alba* is a night predator. Its visual field is likely to be:

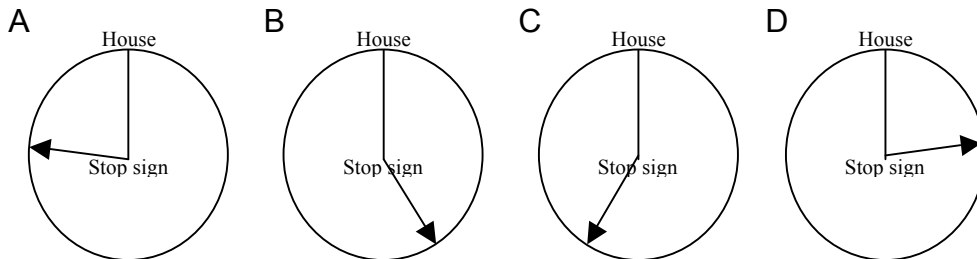
- A. Type 1
- B. Type 2
- C. Type 3
- D. None of the above, it has binocular vision.

Question 34



Imagine you are standing at the stop sign and facing the house.

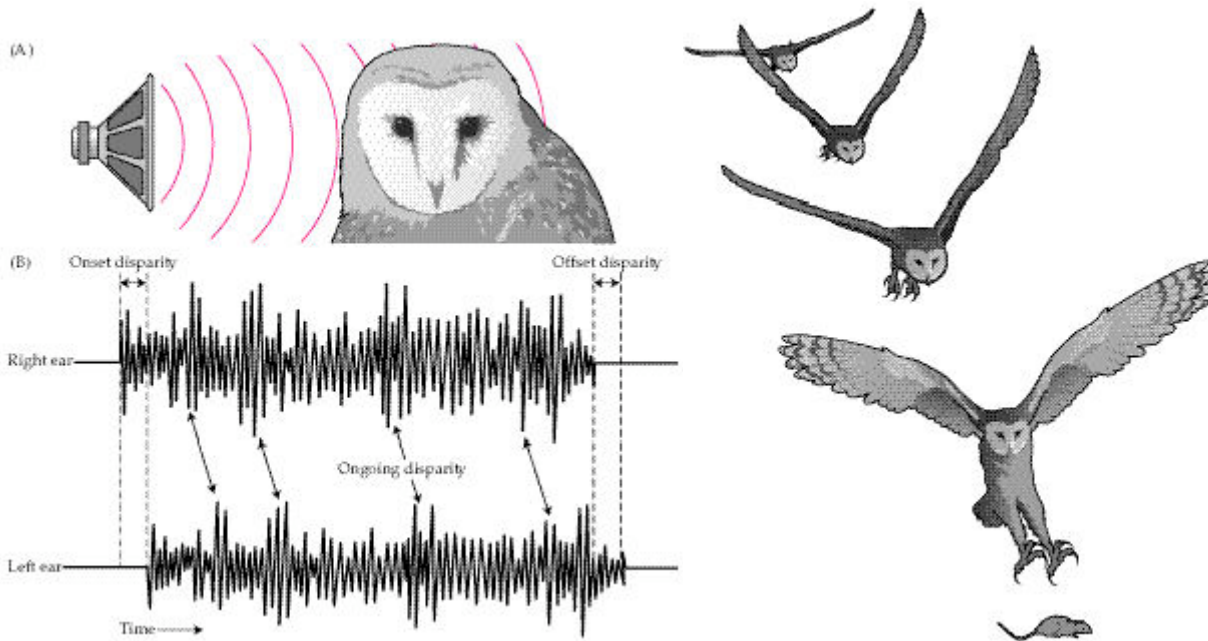
Which of the diagrams below (A – D) shows the correct direction to the tree?



The following information applies to Questions 35 – 36

Many owls, including the Barn Owl, *Tyto alba* are specialized for localizing the source of sounds and use these adaptations to locate their prey. The Barn Owl has facial discs that assist in sound localization. The conspicuous ruff serves as a sound collector and is very important in sound localization.

Question 35



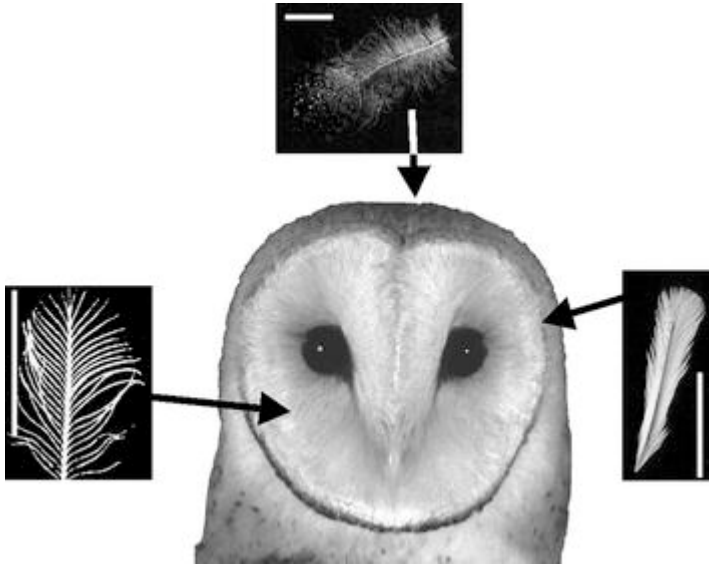
Source: kybele.psych.cornell.edu/~edelman/Psych-214-Fall-2002/pp-week1-2.html

Consider the information provided above about sound localization in the Barn Owl. What is the most likely explanation of how the Barn Owl determines the location of its prey?

- A. The owl uses the difference in the intensity of the sound between the two ears only.
- B. The owl uses both the differences in intensity and timing of sounds between the two ears.
- C. The owl uses differences in the timing of sounds between the two ears only.
- D. The owl uses differences in the offset disparity of sounds between the two ears and in the timing of the sounds.

Question 36

The photograph shows the three types of feathers found on the Barn Owl's head. The contour feather (*top*) is the typical contour feather found everywhere on the head and body except in the ruff. Auricular feathers (*left*) fill the ruff. This feather type has a reduced ramification so that it becomes acoustically transparent but still is effective in preventing the ruff from becoming dirty. Ruff Edge feathers (*right*) form the border of the ruff. This feather type is very densely ramified (branched) and acoustically dense. Scale bars 1 cm (From: von Campenhausen and Wagner 2006).



What is the most likely function of the Ruff Edge feathers?

- A. To protect the external opening of the ear.
- B. To reflect the sound towards the external opening of the ear located on the side of the head.
- C. To reflect and concentrate the sound towards the external opening of the ear located on the side of the head.
- D. To reflect and concentrate the sound towards the external opening of the ear located at the edge of the disc.

Question 37

Achillea lanulosa is an herbaceous plant that grows at a range of altitudes in California. The average height of the plants varies with altitude, ranging from over 70 cm at sea level to less than 20 cm at 3000 metres. To find out whether these differences are genetic or purely phenotypic, induced by the effect of altitude, which **TWO** of the following experiments would need to be performed?

- 1 Collect seeds from plants growing at various altitudes, germinate and grow them in the same kind of soil at the same altitude.
 - 2 Collect seeds from plants growing at the same altitude, germinate and grow them in the same kind of soil at different altitudes.
 - 3 Take cuttings from plants growing at various altitudes, germinate and grow them in the same kind of soil at the same altitude.
 - 4 Take cuttings from plants growing at the same altitude, germinate and grow them in the same kind of soil at different altitudes.
- A. 1 and 2
 - B. 2 and 3
 - C. 3 and 4
 - D. 1 and 4

The following information applies to Questions 38 – 39

In the human heart, the left side pumps oxygenated blood from the lungs to the rest of the body, and the right side pumps deoxygenated blood to the lungs from the rest of the body. Though the two sides appear in parallel, they are actually in series, so the volume of blood leaving the left side per minute equals the volume of blood entering the right side per minute. In the mammalian heart, blood supplying all parts of the body except the lungs leaves the left side of the heart via a single artery, the aorta, and returns to the right side of the heart via two large veins, the venae cavae.

Question 38

If, during vigorous exercise, the blood flow through the limb muscles were to double, the flow through the lungs would

- A. also double
- B. less than double
- C. more than double
- D. remain constant

Question 39

The average dimensions of the aorta and venae cavae at the point they connect with the heart, together with the velocity of blood flow in them is shown in the table, with one value left blank. For the venae cavae, the cross sectional area is the total value for both.

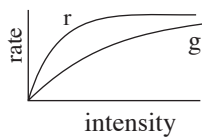
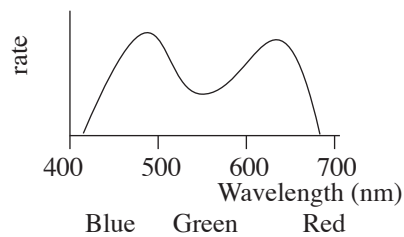
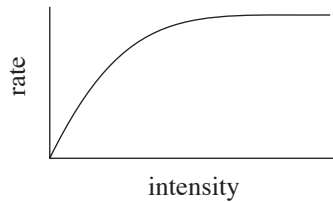
	Aorta	Venae Cavae
Cross Section area of cavity	4.5 cm ²	18 cm ²
Velocity of blood	—	10 cm min ⁻¹

The average velocity of blood flow in the aorta is:

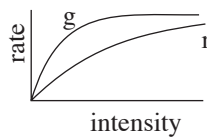
- A. 10 cm s⁻¹
- B. 20 cm s⁻¹
- C. 30 cm s⁻¹
- D. 40 cm s⁻¹

Question 40

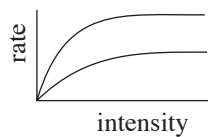
The upper two graphs show the effects of intensity of light and wavelength ('colour') on the rate of photosynthesis. Which of the lower graphs A-E shows the effect of light intensity on the rate of photosynthesis for red and green light?



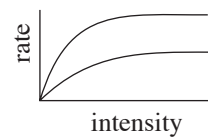
A



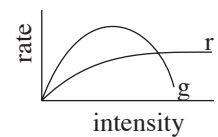
B



C



D



E