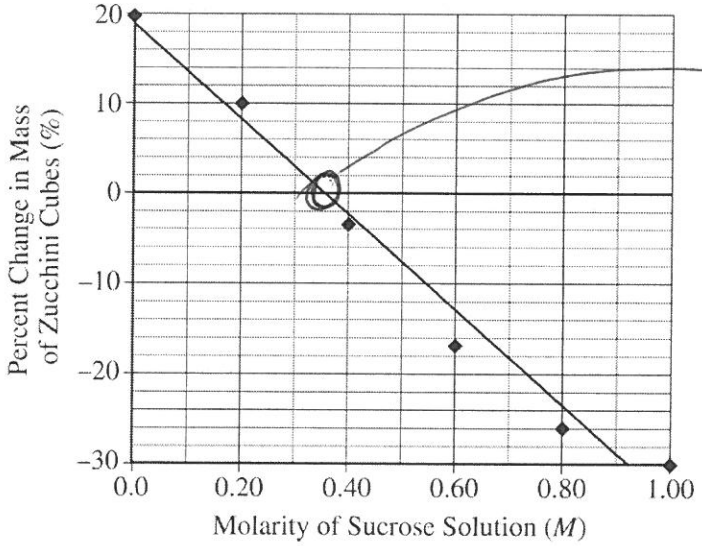
125. A zucchini squash was peeled and cut into six identical cubes. After being weighed, each cube was soaked in a different sucrose solution for 24 hours in an open container and at a constant temperature of 21°C. The cubes were then removed from the sucrose solutions, carefully blotted on paper towels, and weighed again. The percent change in mass (due to a net gain or loss of water) was calculated for each cube, and the results are shown in the graph below. A straight line is drawn on the graph to help in estimating results from other sucrose concentrations not tested.



$(C \approx 0.35)$

Using the straight line on the graph above, calculate the water potential (in bars) of the zucchini squash at 21°C. Give your answer to one decimal place.

$\Psi = \Psi_p + \Psi_s$

$\Psi = 0 + \Psi_s$ → Pressure potential of a solution in an open container is 0. See formula sheet.

$\Psi = \Psi_s$

$\Psi_s = -iCRT$ [solute potential formula]

$= -(1.0)CRT$ [Ionization constant = 1.0 for sucrose since it does not ionize in water.]

$= -(1.0)CR(21+273)$ [T = temp. in Kelvin (°C + 273)]

$= -(1.0)C(0.0831)(294)$ [R = pressure constant = 0.0831 liter bars/mole K]

$= -(1.0)(0.35)(0.0831)(294)$ [C = molar concentration = The point at which the best fit line (diagonal above) crosses the X-axis represents the molar concentration of sucrose with water potential that is equal to the squash tissue water potential.]

$\Psi = \Psi_s = -8.55$

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124. Biological communities containing a large number of species that are evenly distributed exhibit high species diversity—a concept that encompasses both species richness (the number of different species present) and relative abundance (the number of individuals of each species). One measure of species diversity is Simpson's index of diversity, which is represented by the following mathematical equation.

$$D_s = 1 - \frac{\sum n_i(n_i - 1)}{N(N-1)}$$

Where D_s = index of diversity for a community
N = total number of individuals of all species
n_i = number of individuals in each individual species

The following data were collected from a community of trees.

Species	Number of Individuals
1	20
2	34
3	4
4	10
Total	68

Calculate the Simpson's index of diversity for the community of trees. Enter your answer as a value between 0 and 1 to the nearest hundredth.

$$D_s = 1 - \frac{[20(20-1) + 34(34-1) + 4(4-1) + 10(10-1)]}{68(68-1)}$$

$$= 1 - \frac{20(19) + 34(33) + 4(3) + 10(9)}{68(67)}$$

$$= 1 - \frac{1604}{4556}$$

$$D_s = 1 - 0.35 = 0.65$$

(See next page for another measure of diversity.)

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Shannon-Weiner Diversity (H):

- another measure of species/community diversity that you might see.
- A higher value of H indicates a more diverse community.

$$H = -(p_A \ln p_A + p_B \ln p_B + p_C \ln p_C + p_D \ln p_D + \dots)$$

A, B, C, D... : species in the community

p_x : relative abundance of a species (i.e., the proportion of all individuals in the community represented by a species)

ln : natural logarithm

Using the data for #124 (2016 Practice Test):

$$H = -\left[\left(\frac{20}{68}\ln\frac{20}{68}\right) + \left(\frac{34}{68}\ln\frac{34}{68}\right) + \left(\frac{4}{68}\ln\frac{4}{68}\right) + \left(\frac{10}{68}\ln\frac{10}{68}\right)\right]$$

$$= -\left[0.294\ln(.294) + 0.5\ln(.5) + 0.059\ln(.059) + 0.147\ln(.147)\right]$$

$$= -\left[0.294(-1.224) + 0.5(-0.693) + 0.059(-2.83) + 0.147(-1.917)\right]$$

$$= -\left[-0.36 + -0.35 + -0.17 + -0.28\right]$$

$$= 0.36 + 0.35 + 0.17 + 0.28$$

$$\boxed{H = 1.16}$$