

Name: _____

Biology 3550
Physical Principles in Biology
Fall Semester 2017

Quiz 2
22 September 2017

Please write your name on each page.

Be sure to show your work and include correct units in all of your answers!

Be sure to report your answers with the correct number of significant figures, that is no more than for the least precise input value.

25 points total.

1. A physician is trying out a newly approved medication for a condition that eight of her patients suffer from. The results of clinical trials indicate that the medication leads to an improvement in 75% of the patients who try it. For the other 25%, the patients get neither better nor worse. She has prescribed the medication to all eight of the patients with the condition.

(a) (8 pts) Assuming that this physician's patients are typical of those who participated in the clinical trials, calculate the probabilities of the following:

- None of the patients improve.

- One of the patients improves.

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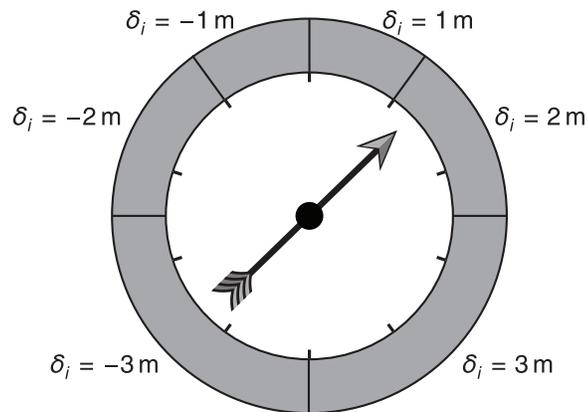
- Six of the patients improve.

- All of the patients improve.

(b) (5 pts) After a few months, the physician is pleasantly surprised to find that all eight of her patients have improved. Does this observation seem to contradict the results from the clinical trials? Explain why you think that it does or doesn't.

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2. A student has devised a special spinner to carry out some one-dimensional random walks, as illustrated below. The design of the spinner is shown below:



The spinner is equally likely to land at any position around the circle. But, the circle is divided up into the six shaded regions, and the region in which the pointer lands determines the change in x -position, δ_i , of the walker at each step, as indicated by the labels. The marks on the inner side of the shaded ring divide up the circle into ten equal parts.

- (a) (3 pts) From the drawing of the spinner, write out the probabilities of the six values of δ_i , from -3 to 3.

- (b) (3 pts) Calculate the average value of δ_i , $\langle \delta_i \rangle$.

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(c) (3 pts) Calculate the mean-squared change in position for each step, $\langle \delta_i^2 \rangle$.

(d) (3 pts) The student doesn't really believe all of the theory about random walks that he learned in class, so he plans to do a large number of random walks with this spinner, each consisting of 50 steps. He will then calculate the RMS distance between the starting and ending positions. What RMS distance does the theory predict?