Name: _____ Group _____

1) Every second on average, 5 neutrons, 3 gamma particles and 6 neutrinos hit the Earth in a certain location.
If we are only interested in the number of neutrons that hit the Earth at a certain location, answer the following questions.

a) Why is this story a Poisson situation? What is its parameter?

b) What is the probability that exactly 3 neutrons hit the Earth in the next second?

c) How many neutrons do you expect to hit the Earth in the next 4.5 seconds?

d) What is the probability that exactly 25 neutrons hit the Earth in the next 4.5 seconds?

e) What is the probability that there will be exactly 25 neutrons hitting the Earth in one out of the next three 4.5-second intervals? Hint: what distribution is this?

f) What is the probability that exactly 25 neutrons will hit the Earth from 1 pm to 1:00:04.5 (4.5 sections after 1 pm)?

g) What is the probability that exactly 30 particles hit the Earth in the next 2.5 seconds. Note we are interested in all of the particles now; not just the neutrons.

2) According to the Guinness Book of World Records (2005), the fastest pumpkin-carver on record, Steven Clarke, carved 42 pumpkins an hour. Assume this is his average rate. Let X be the number of pumpkins Steven carves in an hour. (We suppose that the carver can steadily maintain work at his record rate.)

a) Assume that this is a Poisson situation. What is the parameter?

b) What is the probability Steven will carve exactly 40 pumpkins in the next hour?

c) Given that he has carved at least 3 pumpkins in a 5-minute interval, what is the probability that he will carve at least 4 pumpkins during that 5-mimute interval?

d) Given the he carves fewer than 4 pumpkins in a 5-minute interval, what is the probability he carved fewer than 2 pumpkins during that 5-minute interval?

e) What is the expected number of pumpkins he can carve in 3 minutes at this pace?

3) Approximately 6.85 left-handed people are killed each day by using an object or machinery designed for right-handed people. Let X be the number of left-handed people killed this way in one day.

a) What values can X take? Why is this a Poisson situation? What is the parameter?

b) What is the probability that exactly 7 left-handed people will be killed using a right-handed object tomorrow?

c) What is the expected number of left-handed people killed using a right-handed object over the next week?

d) What is the standard deviation of the number of left-handed people killed using a right handed object over the next week?

e) What is the probability that at least 2 left-handed people will be killed using a right-handed object tomorrow?

f) Show the labeled graph for the mass of the number of left-handed people killed per 12-hours by objects designed for right-handed people.

g) Show the labeled graph of the CDF for left-handed people who die in 12 hours.

4) There are approximately 11,000 fish in the lake. Each fish has a 1 in 5500 chance of being albino. Let X be the number of albino fish.

a) Using the original distribution, what is the expected number of albino fish in the lake?

b) What approximation would you use. Why is this approximation appropriate?

c) What is the approximate probability that there will be exactly 4 albino fish in the lake?

d) Calculate the theoretical probability and compare to your result in part c). Hint: If your calculator can not perform the calculations, then use Wolfram Alpha."

e) Given that there are at least 2 albino fish in the lake, what is the probability that there are exactly 4? I would recommend that you use the approximation to do this problem, however, you may use the original distribution if you want.

5) Workers at a factory produce a toy with a defect about once every 4 hours on average. Each toy costs the factory approximately $7 in labor and supplies.

a) What is the expected number of toys with defects at the end of a 40-hour work week?

b) What is the standard deviation in the number of toys with defects at the end of a 40-hour work week?

c) What is the expected cost to the factory for toys with defects at the end of a 40-hour work week?

d) What is the standard deviation in cost to the factory for toys with defects at the end of the 40-hour work week?

e) What is the probability that there will be at least 2 defects in the next 4 hours?

f) What is the probability there will be exactly 5 defects in 24 hours?

f) What is the probability that there will be exact 5 defects in each of the next seven 24-hour periods.

g) What is the probability that there will be a total of 5 x 7 = 35 defects in the next week (168 hours)? Why is this answer different from part f).