Name: ____________

Probability Lab

True/False
Indicate whether the statement is true or false.

____ 1. A chance experiment is any activity or situation in which there is uncertainty concerning which of two or more possible outcomes will result.

____ 2. Any collection of possible outcomes of a chance experiment is called a sample space.

____ 3. An event consisting of exactly one outcome is called a simple event.

____ 4. The probability of an event E can always be computed using the formula,

$$P(E) = \frac{\text{number of outcomes favorable to E}}{\text{number of outcomes in the sample space}}$$

____ 5. The classical view of probability is based on the Law of Large Numbers.

____ 6. The event "A or B" consists of all of the outcomes in both of the events.

____ 7. Two events are said to be disjoint or mutually exclusive when they have no outcomes in common.

____ 8. If two events, A and B, are mutually exclusive, then $P(\text{A and B}) = P(A) \cdot P(B)$.

____ 9. Two events are independent if they cannot occur simultaneously.

Multiple Choice
Identify the choice that best completes the statement or answers the question.

____ 10. An airline reports that for a particular flight operating daily between Phoenix and Atlanta, the probability of an on-time arrival is 0.64. Give a relative frequency interpretation of this probability.
   a. In the long run, 0.64% of the time this particular flight that flies between Phoenix and Atlanta will arrive on time.
   b. In the long run, 36% of the time this particular flight that flies between Phoenix and Atlanta will arrive on time.
   c. In the long run, 64% of the time this particular flight that flies between Phoenix and Atlanta will arrive on time.
   d. In the long run, 64% of the time this particular flight that flies between Phoenix and Atlanta will not arrive on time.
   e. In the long run, 64% of the time this particular flight that flies between Phoenix and Atlanta will arrive earlier than expected.

____ 11. The faces of a twelve-sided die are numbered with the numbers 1 through 12. If you roll this die 600 times, how many nines do you expect to roll?
   a. about 67
   b. about 50
   c. about 60
   d. about 100
   e. none

____ 12. Suppose you want to estimate the probability that a patient will develop an infection while hospitalized at a particular hospital. In the past year, this hospital had 8,650 patients, and 812 of them developed an infection. What is the estimated probability that a patient at this hospital will develop an infection?

a. $P\left(\text{the patient develops an infection}\right) = \frac{1}{812}$

b. $P\left(\text{the patient develops an infection}\right) = \frac{1}{8,650}$

c. $P\left(\text{the patient develops an infection}\right) = \frac{812}{8,650}$

d. $P\left(\text{the patient develops an infection}\right) = \frac{5,738}{8,650}$

e. $P\left(\text{the patient develops an infection}\right) = \frac{812}{5,738}$

13. Suppose you want to estimate the probability that a randomly selected customer at a particular grocery store will pay by credit card. Over the past 3 months, 70,600 purchases were made, and 22,200 of them were paid for by credit card. What is the estimated probability that a randomly selected customer will pay by credit card?
a. 0.3144
b. 0.5391
c. 0.7233
d. 0.8548
e. 0.8633

14. A deck of 52 cards is mixed well, and 5 cards are dealt. It can be shown that (disregarding the order in which the cards are dealt) there are 2,598,960 possible hands, of which only 4 hands are royal flushes. (A royal flush is a hand consisting of 10, J, Q, K, and A, all of the same suit).

What is the probability that a hand will be a royal flush?

a. $\frac{48}{2.598,960}$

b. $\frac{4}{2.598,960}$

c. $\frac{4}{52}$

d. $\frac{2,598,956}{2.598,960}$

e. $\frac{(4)(52)}{2.598,960}$

15. Each time a class meets, the professor selects one student at random to explain the solution to a homework problem. There are 60 students in the class, and no one ever misses class. Luke is one of these students. What is the probability that Luke is selected both of the next two times that the class meets?
a. 0.00028
b. 0.03333
c. 0.5
d. 0.01724

e. 0.00015

16. U.S. Postal Service standards call for overnight delivery within a zone of about 60 miles for any first-class letter deposited by the last posted collection time. Two-day delivery is promised within a 600-mile zone, and three-day delivery is promised for distances over 600 miles. An accounting firm conducted an independent audit by "seeding" the mail with letters and recording on-time delivery rates for these letters. Suppose that the results of the study were as follows:

Letter Mailed To	Number of Letters Mailed	Number of Letters Arriving on Time
Los Angeles	650	525
New York	550	415
Washington, D.C.	450	405
Nationwide	7,000	6,220

Use the given information to estimate the probability of an on-time delivery in New York.

a. $\frac{405}{6,220} \approx 0.0651$

b. $\frac{415}{550} \approx 0.7545$

c. $\frac{415}{7,000} \approx 0.0593$

d. $\frac{525}{6,220} \approx 0.0844$

e. $\frac{415}{6,220} \approx 0.0667$

Short Answer

17. As every Girl Scout knows, statistics teachers seriously love Girl Scout Cookies. The number of boxes of GS cookies statistics teachers order, like all important decisions made by statistics teachers, is determined by independent rolls of a 4-sided fair die. If a one appears, 6 boxes are ordered; if any other number appears, 2 boxes are ordered.

a) What is the probability that a statistics teacher places an order for 2 boxes of Girl Scout cookies?

b) What is the probability that with two independently chosen statistics teachers will each order 6 boxes each?

c) What is the probability that for two independently chosen statistics teachers the first will order 6 boxes and the second will order 2 boxes?

d) What is the probability that for two independently chosen statistics teachers exactly one will order 6 boxes?

18. In order to ensure the safety of school classrooms the local Fire Marshall does an inspection at Thomas

Jefferson High School every month, looking for faulty wiring, overloaded circuits, etc. At TJHS the new Academic Wing has 5 math rooms, 10 science rooms, and 10 English rooms. The science rooms are divided into 8 biology and 2 chemistry rooms. Each month, the Fire Marshall randomly picks one of the rooms in the new wing to inspect each month. Define the following events:

S = the event the selected room is a science room
B = the event the selected room is a biology room
M = the event the selected room is a math room
E = the event the selected room is an English room
C = the event the selected room is a chemistry room

Calculate the probabilities of the events described below:

a) P(S)

b) P(M or E)

c) P(E or B)

d) P(S and not C)

19. A small manufacturing firm has 250 employees. Fifty have been employed for less than 5 years and 125 have been with the company for over 10 years. Suppose that one employee is selected at random from a list of the employees. For the following events, compute the probabilities requested below.

A = the event the selected employee has been with the firm less than 5 years

B = the event the selected employee has been with the firm $5 \leq x \leq 10$ years.

C = the event the selected employee has been with the firm over 10 years.

a) P(A)

b) P(C)

c) P(A or B)

d) P(A and C)

20. In a few sentences, explain the difference between conditional probability and "ordinary" (unconditional) probability.

21. The basketball team at North Snowshoe High is in a little bit of trouble. Two of their players have just fouled out on technicals, and due to the flu the coach only has 4 players to choose from: three forwards and a guard who doubles as the team statistician. In his haste, the coach will randomly choose two of the four to go into the game, and of course will do so without replacement. What is the probability that the team statistician will be selected?

22. Investigators recently reported the results a study designed to assess whether or not the herb, St. John's Wort is effective in treating moderately severe cases of depression. The study involved 338 subjects, randomly assigned to receive one of three treatments: St. John's Wort , Zoloft, or a placebo. The authors were primarily interested in whether St. John's Wort performed better than placebo and included Zoloft as a "way to measure how sensitive the trial was to detecting antidepressant effects." Their results are presented in the table below.

Response of Subjects vs. Treatment

	St. John's Wort	**Placebo**	**Zoloft**	**Total**
Full Response	27	37	27	91
Partial Response	16	13	26	55
No Response	70	66	56	192
Total	113	116	109	338

a) What is the probability that a randomly selected subject had no response?

b) What is the probability that a randomly selected subject was treated with Zoloft and had a full response?

c) What is the probability that a randomly selected subject had a full or partial response given that they were treated with St. John's Wort?

d) What is the probability that a randomly selected subject that didn't have a full response was treated with Placebo?

23. In the study in Exhibit 5-1, passengers were also classified by age:

Discontentment Felt When Seat-mate Used Common Armrest: Males and Females by Age

	Bothered	**Not bothered**	**Totals**
Females under 40	14	10	24
Males under 40	23	2	25
Females over 40	5	16	21
Males over 40	15	16	31
Totals	57	44	101

Suppose one of these passengers was randomly selected. Calculate the probability that:

a) The passenger is under 40, given that she is female.

b) The passenger was bothered, given that the passenger was over 40.

c) The passenger was male and over 40.

24. In November 2002, Janet Napolitano, a Democrat, was elected Governor of Arizona, defeating Republican Matt Salmon and Independent Richard Mahoney. This was a somewhat surprising outcome, since there are more registered Republicans than Democrats in the state. The table below presents the results of a sample of voters in the election. The number who voted for each of the candidates is presented in the rows, and the party affiliation of the voters is presented in the columns. Suppose that a voter is randomly chosen from these respondents. Use the information in the table to answer the questions below. In showing your work, define and use appropriate notation.

Voters who are registered as…				
Voted for…	**D**	**R**	**I**	**Totals**
Napolitano (D)	184	42	56	282
Salmon (R)	26	205	45	276
Mahoney (I)	6	5	31	42
Totals	216	252	132	600

a) What is the probability that a randomly chosen voter voted for Napolitano?

b) What is the probability that a randomly chosen voter is a registered Democrat?

c) What is the probability that a randomly chosen voter cast a vote for Napolitano, given that the selected voter is a Democrat?

d) Commenting on this election. A local reporter said, "Napolitano won because she attracted a larger share of crossover voters." (A crossover voter is defined as one who votes differently than his or her party affiliation). What is the probability that a randomly chosen voter cast a vote for Napolitano, given that he or she is a crossover voter?