SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Find the indicated probability.

1) If you flip a coin three times, the possible outcomes are HHH HHT HTH HTT THH THT TTH TTT. What is the probability of getting at least one head?

2) If two balanced die are rolled, the possible outcomes can be represented as follows.

\[
\begin{align*}
(1, 1) & \quad (2, 1) \quad (3, 1) \quad (4, 1) \quad (5, 1) \quad (6, 1) \\
(1, 2) & \quad (2, 2) \quad (3, 2) \quad (4, 2) \quad (5, 2) \quad (6, 2) \\
(1, 3) & \quad (2, 3) \quad (3, 3) \quad (4, 3) \quad (5, 3) \quad (6, 3) \\
(1, 4) & \quad (2, 4) \quad (3, 4) \quad (4, 4) \quad (5, 4) \quad (6, 4) \\
(1, 5) & \quad (2, 5) \quad (3, 5) \quad (4, 5) \quad (5, 5) \quad (6, 5) \\
(1, 6) & \quad (2, 6) \quad (3, 6) \quad (4, 6) \quad (5, 6) \quad (6, 6)
\end{align*}
\]

Determine the probability that the sum of the dice is 9.

3) A committee of three people is to be formed. The three people will be selected from a list of five possible committee members. A simple random sample of three people is taken, without replacement, from the group of five people. If the five people are represented by the letters A, B, C, D, E, the possible outcomes are as follows.

ABC
ABD
ABE
ACD
ACE
ADE
BCD
BCE
BDE
CDE

Determine the probability that C and D are both included in the sample.
Determine the number of outcomes that comprise the specified event.

4) The age distribution of students at a community college is given below.

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Number of students (f)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 21</td>
<td>2041</td>
</tr>
<tr>
<td>21–25</td>
<td>2118</td>
</tr>
<tr>
<td>26–30</td>
<td>1167</td>
</tr>
<tr>
<td>31–35</td>
<td>845</td>
</tr>
<tr>
<td>Over 35</td>
<td>226</td>
</tr>
</tbody>
</table>

A student from the community college is selected at random. The event A is defined as follows.

A = event the student is between 26 and 35 inclusive.

Determine the number of outcomes that comprise the event (not A).

5) The age distribution of students at a community college is given below.

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Number of students (f)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 21</td>
<td>2063</td>
</tr>
<tr>
<td>21–25</td>
<td>2142</td>
</tr>
<tr>
<td>26–30</td>
<td>1158</td>
</tr>
<tr>
<td>31–35</td>
<td>880</td>
</tr>
<tr>
<td>Over 35</td>
<td>204</td>
</tr>
</tbody>
</table>

A student from the community college is selected at random. The event A is defined as follows.

A = event the student is under 31

Determine the number of outcomes that comprise the event (not A).

6) The age distribution of students at a community college is given below.

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Number of students (f)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 21</td>
<td>2059</td>
</tr>
<tr>
<td>21–25</td>
<td>2139</td>
</tr>
<tr>
<td>26–30</td>
<td>1173</td>
</tr>
<tr>
<td>31–35</td>
<td>873</td>
</tr>
<tr>
<td>Over 35</td>
<td>223</td>
</tr>
</tbody>
</table>

A student from the community college is selected at random. The events A and B are defined as follows.

A = event the student is under 21
B = event the student is over 35

Determine the number of outcomes that comprise the event (A & B).
Find the indicated probability by using the general addition rule.

7) In one city, 50.8% of adults are female, 9.6% of adults are left-handed, and 5.1% are left-handed females. For an adult selected at random from the city, let

\[ F = \text{event the person is female} \]
\[ L = \text{event the person is left-handed}. \]

Find \( P(F \text{ or } L) \). Round approximations to three decimal places.

8) Of the 57 people who answered "yes" to a question, 9 were male. Of the 91 people who answered "no" to the question, 15 were male. If one person is selected at random from the group, what is the probability that the person answered "yes" or was male?

Obtain the probability distribution of the random variable.

9) When a coin is tossed four times, sixteen equally likely outcomes are possible as shown below:

\[
\begin{align*}
\text{HHHH} & \quad \text{HHHT} \quad \text{HHTH} \quad \text{HHTT} \\
\text{HTHH} & \quad \text{HTHT} \quad \text{HTTH} \quad \text{HTTT} \\
\text{THHH} & \quad \text{THHT} \quad \text{THTH} \quad \text{THTT} \\
\text{TTHH} & \quad \text{TTHT} \quad \text{TTTH} \quad \text{TTTT}
\end{align*}
\]

Let \( X \) denote the total number of tails obtained in the four tosses. Find the probability distribution of the random variable \( X \). Leave your probabilities in fraction form.

10) When two balanced dice are rolled, 36 equally likely outcomes are possible as shown below.

\[
(1, 1) \quad (1, 2) \quad (1, 3) \quad (1, 4) \quad (1, 5) \quad (1, 6) \\
(2, 1) \quad (2, 2) \quad (2, 3) \quad (2, 4) \quad (2, 5) \quad (2, 6) \\
(3, 1) \quad (3, 2) \quad (3, 3) \quad (3, 4) \quad (3, 5) \quad (3, 6) \\
(4, 1) \quad (4, 2) \quad (4, 3) \quad (4, 4) \quad (4, 5) \quad (4, 6) \\
(5, 1) \quad (5, 2) \quad (5, 3) \quad (5, 4) \quad (5, 5) \quad (5, 6) \\
(6, 1) \quad (6, 2) \quad (6, 3) \quad (6, 4) \quad (6, 5) \quad (6, 6)
\]

Let \( X \) denote the absolute value of the difference of the two numbers. Find the probability distribution of \( X \). Give the probabilities as decimals rounded to three decimal places.

11) The following table displays a frequency distribution for the number of living grandparents for students at a high school. For a randomly selected student in the school, let \( X \) denote the number of living grandparents of the student. Obtain the probability distribution of \( X \).

\[
\begin{array}{c|cccc}
\text{Number of living grandparents} & 0 & 1 & 2 & 3, 4 \\
\hline
\text{Frequency} & 37 & 83 & 151 & 206, 140
\end{array}
\]
12) If a fair coin is tossed 4 times, there are 16 possible sequences of heads (H) and tails (T). Suppose the random variable $X$ represents the number of heads in a sequence. Construct the probability distribution for $X$.

Find the specified probability.

14) A statistics professor has office hours from 9:00 am to 10:00 am each day. The number of students waiting to see the professor is a random variable, $X$, with the distribution shown in the table.

<table>
<thead>
<tr>
<th>$x$</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P(X = x)$</td>
<td>0.05</td>
<td>0.10</td>
<td>0.40</td>
<td>0.25</td>
<td>0.15</td>
<td>0.05</td>
</tr>
</tbody>
</table>

The professor gives each student 10 minutes. Determine the probability that a student arriving just after 9:00 am will have to wait no longer than 20 minutes to see the professor.

15) A statistics professor has office hours from 9:00 am to 10:00 am each day. The number of students waiting to see the professor is a random variable, $X$, with the distribution shown in the table.

<table>
<thead>
<tr>
<th>$x$</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P(X = x)$</td>
<td>0.05</td>
<td>0.10</td>
<td>0.40</td>
<td>0.25</td>
<td>0.15</td>
<td>0.05</td>
</tr>
</tbody>
</table>

The professor gives each student 10 minutes. Determine the probability that a student arriving just after 9:00 am will have to wait at least 30 minutes to see the professor.
16) There are only 8 chairs in our whole house. Whenever there is a party some people have nowhere to sit. The number of people at our parties (call it the random variable X) changes with each party. Past records show that the probability distribution of X is as shown in the following table. Find the probability that everyone will have a place to sit at our next party.

<table>
<thead>
<tr>
<th>x</th>
<th>P(X = x)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>0.05</td>
</tr>
<tr>
<td>6</td>
<td>0.05</td>
</tr>
<tr>
<td>7</td>
<td>0.20</td>
</tr>
<tr>
<td>8</td>
<td>0.15</td>
</tr>
<tr>
<td>9</td>
<td>0.15</td>
</tr>
<tr>
<td>10</td>
<td>0.10</td>
</tr>
<tr>
<td>&gt;10</td>
<td>0.30</td>
</tr>
</tbody>
</table>

Find the mean of the random variable.

17) The random variable X is the number of houses sold by a realtor in a single month at the Sentsom’s Real Estate office. Its probability distribution is given in the table.

<table>
<thead>
<tr>
<th>x</th>
<th>P(X = x)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.24</td>
</tr>
<tr>
<td>1</td>
<td>0.01</td>
</tr>
<tr>
<td>2</td>
<td>0.12</td>
</tr>
<tr>
<td>3</td>
<td>0.16</td>
</tr>
<tr>
<td>4</td>
<td>0.01</td>
</tr>
<tr>
<td>5</td>
<td>0.14</td>
</tr>
<tr>
<td>6</td>
<td>0.11</td>
</tr>
<tr>
<td>7</td>
<td>0.21</td>
</tr>
</tbody>
</table>

18) The random variable X is the number of golf balls ordered by customers at a pro shop. Its probability distribution is given in the table.

<table>
<thead>
<tr>
<th>x</th>
<th>P(X = x)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0.14</td>
</tr>
<tr>
<td>6</td>
<td>0.33</td>
</tr>
<tr>
<td>9</td>
<td>0.36</td>
</tr>
<tr>
<td>12</td>
<td>0.07</td>
</tr>
<tr>
<td>15</td>
<td>0.10</td>
</tr>
</tbody>
</table>

19) The random variable X is the number of people who have a college degree in a randomly selected group of four adults from a particular town. Its probability distribution is given in the table.

<table>
<thead>
<tr>
<th>x</th>
<th>P(X = x)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.4096</td>
</tr>
<tr>
<td>1</td>
<td>0.4096</td>
</tr>
<tr>
<td>2</td>
<td>0.1536</td>
</tr>
<tr>
<td>3</td>
<td>0.0256</td>
</tr>
<tr>
<td>4</td>
<td>0.0016</td>
</tr>
</tbody>
</table>

Find the mean of the binomial random variable.

20) According to a college survey, 22% of all students work full time. Find the mean for the random variable X, the number of students who work full time in samples of size 16.

21) A die is rolled 6 times and the number of times that two shows on the upper face is counted. If this experiment is repeated many times, find the mean for the random variable X, the number of twos.

22) On a multiple choice test with 14 questions, each question has four possible answers, one of which is correct. For students who guess at all answers, find the mean for the random variable X, the number of correct answers.

Find the standard deviation of the binomial random variable.

23) According to a college survey, 22% of all students work full time. Find the standard deviation for the random variable X, the number of students who work full time in samples of size 16.
24) The probability that a radish seed will germinate is 0.7. A gardener plants seeds in batches of 16. Find the standard deviation for the random variable $X$, the number of seeds germinating in each batch.

25) A company manufactures batteries in batches of 14 and there is a 3% rate of defects. Find the standard deviation for the random variable $X$, the number of defects per batch.

Use a table of areas to find the specified area under the standard normal curve.

26) The area that lies between 0 and 3.01

27) The area that lies to the left of 1.13

28) The area that lies between $-1.10$ and $-0.36$

Use a table of areas to obtain the shaded area under the standard normal curve.

29)

30)

31)

Use a table of areas for the standard normal curve to find the required $z$-score.

32) Find the $z$-score for which the area under the standard normal curve to its left is 0.96

33) Find the $z$-score for which the area under the standard normal curve to its left is 0.40

34) Find the $z$-score having area 0.09 to its left under the standard normal curve.
Find the indicated probability or percentage for the normally distributed variable.

35) The variable X is normally distributed. The mean is \( \mu = 60.0 \) and the standard deviation is \( \sigma = 4.0 \).
   Find \( P(X < 53.0) \).

36) The variable X is normally distributed. The mean is \( \mu = 15.2 \) and the standard deviation is \( \sigma = 0.9 \).
   Find \( P(X > 16.1) \).

37) The variable X is normally distributed. The mean is \( \mu = 22.0 \) and the standard deviation is \( \sigma = 2.4 \).
   Find \( P(19.7 < X < 25.3) \).

Find the specified percentile, quartile, or decile.

38) The lifetimes of lightbulbs of a particular type are normally distributed with a mean of 293 hours and a standard deviation of 12 hours. Find the first quartile, \( Q_1 \).

39) At one college, GPAs are normally distributed with a mean of 2.6 and a standard deviation of 0.6. Find the third quartile, \( Q_3 \).

40) The amount of Jen’s monthly phone bill is normally distributed with a mean of $65 and a standard deviation of $11. Find the first quartile, \( Q_1 \).

41) The annual precipitation for one city is normally distributed with a mean of 35.2 inches and a standard deviation of 3.3 inches. Find the 2nd decile.

42) Assume that women have heights that are normally distributed with a mean of 63.6 inches and a standard deviation of 2.5 inches. Find the value of the third quartile.

Provide an appropriate response.

43) In a recent survey, 83% of the community favored building more parks in their neighborhood. You randomly select 21 citizens and ask each if he or she thinks the community needs more parks. Decide whether you can use the normal distribution to approximate the binomial distribution. If so, find the mean and standard deviation. If not, explain why.

44) A recent survey found that 76% of all adults over 50 own cell phones. You randomly select 39 adults over 50, and ask if he or she owns a cell phone. Decide whether you can use the normal distribution to approximate the binomial distribution. If so, find the mean and standard deviation, If not, explain why.

45) A local rental car agency has 50 cars. The rental rate for the winter months is 60%. Find the probability that in a given winter month fewer than 35 cars will be rented. Use the normal distribution to approximate the binomial distribution.
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

46) A student answers all 48 questions on a multiple-choice test by guessing. Each question has four possible answers, only one of which is correct. Find the probability that the student gets exactly 15 correct answers. Use the normal distribution to approximate the binomial distribution.

A) 0.8577  
B) 0.0823  
C) 0.7967  
D) 0.0606
1) \( \frac{7}{8} \)
2) \( \frac{1}{9} \)
3) \( \frac{3}{10} \)
4) 4385
5) 1084
6) 0
7) 0.553
8) 0.486
9) 

\[ \begin{array}{c|c}
 x & P(X = x) \\
\hline
0 & \frac{1}{16} \\
1 & \frac{1}{4} \\
2 & \frac{3}{8} \\
3 & \frac{1}{4} \\
4 & \frac{1}{16} \\
\end{array} \]

10) 

\[ \begin{array}{c|c}
 x & P(X = x) \\
\hline
0 & 0.167 \\
1 & 0.278 \\
2 & 0.222 \\
3 & 0.167 \\
4 & 0.111 \\
5 & 0.056 \\
\end{array} \]

11) 

<table>
<thead>
<tr>
<th>Grandparents</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>x</td>
<td>P(X = x)</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>0</td>
<td>0.060</td>
</tr>
<tr>
<td>1</td>
<td>0.135</td>
</tr>
<tr>
<td>2</td>
<td>0.245</td>
</tr>
<tr>
<td>3</td>
<td>0.334</td>
</tr>
<tr>
<td>4</td>
<td>0.227</td>
</tr>
</tbody>
</table>

12) 

![Histogram of heads](image)
13)

14) 0.55
15) 0.45
16) 0.45
17) 3.60
18) 7.98
19) 0.80
20) 3.52
21) 1
22) 3.5
23) 1.66
24) 1.833
25) 0.638
26) 0.4987
27) 0.8708
28) 0.2237
29) 0.6424
30) 0.7198
31) 0.7580
32) 1.75
33) -0.25
34) -1.34
35) 0.0401
36) 0.1587
37) 0.7477
38) 284.96
39) 3.002
40) $57.63
41) 32.428 inches
42) 65.3 inches
43) cannot use normal distribution, \( nq = (21)(0.17) = 3.57 < 5 \)
44) use normal distribution, \( \mu = 29.64 \) and \( \sigma = 2.67 \).
45) \( P(x \leq 34.5) = 0.9032 \)
46) B