MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Express the null hypothesis and the alternative hypothesis in symbolic form. Use the correct symbol ($\mu$, $p$, $\sigma$) for the indicated parameter.

1) An entomologist writes an article in a scientific journal which claims that fewer than 7 in ten thousand male fireflies are unable to produce light due to a genetic mutation. Use the parameter $p$, the true proportion of fireflies unable to produce light.
   - A) $H_0: p > 0.0007$  
   - B) $H_0: p = 0.0007$  
   - C) $H_0: p < 0.0007$  
   - D) $H_0: p = 0.0007$

2) The manufacturer of a refrigerator system for beer kegs produces refrigerators that are supposed to maintain a true mean temperature, $\mu$, of 43°F, ideal for a certain type of German pilsner. The owner of the brewery does not agree with the refrigerator manufacturer, and claims he can prove that the true mean temperature is incorrect.
   - A) $H_0: \mu = 43^\circ$  
   - B) $H_0: \mu \leq 43^\circ$  
   - C) $H_0: \mu \neq 43^\circ$  
   - D) $H_0: \mu \geq 43^\circ$

3) A researcher claims that 62% of voters favor gun control.
   - A) $H_0: p = 0.62$  
   - B) $H_0: p < 0.62$  
   - C) $H_0: p \geq 0.62$  
   - D) $H_0: p > 0.62$

4) A cereal company claims that the mean weight of the cereal in its packets is at least 14 oz.
   - A) $H_0: \mu = 14$  
   - B) $H_0: \mu = 14$  
   - C) $H_0: \mu < 14$  
   - D) $H_0: \mu > 14$

Assume that the data has a normal distribution and the number of observations is greater than fifty. Find the critical $z$ value used to test a null hypothesis.

5) $\alpha = 0.05$ for a two-tailed test.
   - A) ±1.764  
   - B) ±1.645  
   - C) ±1.96  
   - D) ±2.575

6) $\alpha = 0.09$ for a right-tailed test.
   - A) ±1.34  
   - B) 1.96  
   - C) 1.34  
   - D) ±1.96

7) $\alpha = 0.05$ for a left-tailed test.
   - A) ±1.96  
   - B) -1.96  
   - C) -1.645  
   - D) ±1.645

Find the value of the test statistic $z$ using $z = \frac{\hat{p} - p}{\sqrt{\frac{pq}{n}}}$.

8) The claim is that the proportion of drowning deaths of children attributable to beaches is more than 0.25, and the sample statistics include $n = 681$ drowning deaths of children with 30% of them attributable to beaches.
   - A) 2.85  
   - B) 3.01  
   - C) 3.01  
   - D) 2.85
Use the given information to find the P-value. Also, use a 0.05 significance level and state the conclusion about the null hypothesis (reject the null hypothesis or fail to reject the null hypothesis).

9) With $H_1: p \neq 0.612$, the test statistic is $z = -3.06$.
   A) 0.0011; fail to reject the null hypothesis
   B) 0.0022; fail to reject the null hypothesis
   C) 0.0011; reject the null hypothesis
   D) 0.0022; reject the null hypothesis

10) With $H_1: p < 0.612$, the test statistic is $z = -1.68$.
   A) 0.0465; fail to reject the null hypothesis
   B) 0.9535; fail to reject the null hypothesis
   C) 0.0465; reject the null hypothesis
   D) 0.093; fail to reject the null hypothesis

11) With $H_1: p > 0.383$, the test statistic is $z = 0.41$.
   A) 0.6591; fail to reject the null hypothesis
   B) 0.3409; reject the null hypothesis
   C) 0.6818; reject the null hypothesis
   D) 0.3409; fail to reject the null hypothesis

Formulate the indicated conclusion in nontechnical terms. Be sure to address the original claim.

12) An entomologist writes an article in a scientific journal which claims that fewer than 12 in ten thousand male fireflies are unable to produce light due to a genetic mutation. Assuming that a hypothesis test of the claim has been conducted and that the conclusion is to reject the null hypothesis, state the conclusion in nontechnical terms.
   A) There is sufficient evidence to support the claim that the true proportion is less than 12 in ten thousand.
   B) There is not sufficient evidence to support the claim that the true proportion is greater than 12 in ten thousand.
   C) There is sufficient evidence to support the claim that the true proportion is greater than 12 in ten thousand.
   D) There is not sufficient evidence to support the claim that the true proportion is less than 12 in ten thousand.

13) A skeptical paranormal researcher claims that the proportion of Americans that have seen a UFO, $p$, is less than 2 in every ten thousand. Assuming that a hypothesis test of the claim has been conducted and that the conclusion is failure to reject the null hypothesis, state the conclusion in nontechnical terms.
   A) There is sufficient evidence to support the claim that the true proportion is less than 2 in ten thousand.
   B) There is sufficient evidence to support the claim that the true proportion is greater than 2 in ten thousand.
   C) There is not sufficient evidence to support the claim that the true proportion is greater than 2 in ten thousand.
   D) There is not sufficient evidence to support the claim that the true proportion is less than 2 in ten thousand.

14) A researcher claims that 62% of voters favor gun control. Assuming that a hypothesis test of the claim has been conducted and that the conclusion is failure to reject the null hypothesis, state the conclusion in nontechnical terms.
   A) There is not sufficient evidence to support the claim that 62% of voters favor gun control.
   B) There is sufficient evidence to support the claim that more than 62% of voters favor gun control.
   C) There is sufficient evidence to warrant rejection of the claim that 62% of voters favor gun control.
   D) There is not sufficient evidence to warrant rejection of the claim that 62% of voters favor gun control.
15) A cereal company claims that the mean weight of the cereal in its packets is at least 14 oz. Assuming that a hypothesis test of the claim has been conducted and that the conclusion is to reject the null hypothesis, state the conclusion in nontechnical terms.
   A) There is not sufficient evidence to warrant rejection of the claim that the mean weight is at least 14 oz.
   B) There is sufficient evidence to warrant rejection of the claim that the mean weight is less than 14 oz.
   C) There is not sufficient evidence to warrant rejection of the claim that the mean weight is less than 14 oz.
   D) There is sufficient evidence to warrant rejection of the claim that the mean weight is at least 14 oz.

Assume that a hypothesis test of the given claim will be conducted. Identify the type I or type II error for the test.

16) A medical researcher claims that 6% of children suffer from a certain disorder. Identify the type I error for the test.
   A) Reject the claim that the percentage of children who suffer from the disorder is equal to 6% when that percentage is actually 6%.
   B) Fail to reject the claim that the percentage of children who suffer from the disorder is equal to 6% when that percentage is actually 6%.
   C) Fail to reject the claim that the percentage of children who suffer from the disorder is equal to 6% when that percentage is actually different from 6%.
   D) Reject the claim that the percentage of children who suffer from the disorder is different from 6% when that percentage really is different from 6%.

17) The principal of a school claims that the percentage of students at his school that come from single-parent homes is 13%. Identify the type II error for the test.
   A) Fail to reject the claim that the percentage of students that come from single-parent homes is equal to 13% when that percentage is actually different from 13%.
   B) Fail to reject the claim that the percentage of students that come from single-parent homes is equal to 13% when that percentage is actually 13%.
   C) Reject the claim that the percentage of students that come from single-parent homes is equal to 13% when that percentage is actually less than 13%.
   D) Reject the claim that the percentage of students that come from single-parent homes is equal to 13% when that percentage is actually 13%.

18) A psychologist claims that more than 3.6% of adults suffer from extreme shyness. Identify the type II error for the test.
   A) Reject the claim that the percentage of adults who suffer from extreme shyness is equal to 3.6% when that percentage is actually greater than 3.6%.
   B) Reject the claim that the percentage of adults who suffer from extreme shyness is equal to 3.6% when that percentage is actually 3.6%.
   C) Fail to reject the claim that the percentage of adults who suffer from extreme shyness is equal to 3.6% when that percentage is actually less than 3.6%.
   D) Fail to reject the claim that the percentage of adults who suffer from extreme shyness is equal to 3.6% when that percentage is actually greater than 3.6%.
19) A skeptical paranormal researcher claims that the proportion of Americans that have seen a UFO is less than 1 in a thousand. Identify the type I error for the test.
   A) Reject the claim that the proportion of Americans that have seen a UFO is equal to 1 in a thousand when that proportion is actually less than 1 in a thousand.
   B) Fail to reject the claim that the proportion of Americans that have seen a UFO is equal to 1 in a thousand when that proportion is actually greater than 1 in a thousand.
   C) Reject the claim that the proportion of Americans that have seen a UFO is equal to 1 in a thousand when that proportion is actually 1 in a thousand.
   D) Fail to reject the claim that the proportion of Americans that have seen a UFO is equal to 1 in a thousand when that proportion is actually less than 1 in a thousand.

20) The principal of a middle school claims that the standard deviation of the test scores of the seventh-graders at his school is less than 14.7. Identify the type I error for the test.
   A) Fail to reject the claim that the standard deviation is equal to 14.7 when it is actually greater than 14.7.
   B) Reject the claim that the standard deviation is equal to 14.7 when it is actually less than 14.7.
   C) Reject the claim that the standard deviation is equal to 14.7 when it is actually 14.7.
   D) Fail to reject the claim that the standard deviation is equal to 14.7 when it is actually less than 14.7.

21) A manufacturer claims that the amounts of acetaminophen in a certain brand of cold tablets have a standard deviation of 3.3 mg. Identify the type II error for the test.
   A) Fail to reject the claim that the standard deviation is 3.3 mg when the standard deviation is actually equal to 3.3 mg.
   B) Fail to reject the claim that the standard deviation is 3.3 mg when the standard deviation is actually different from 3.3 mg.
   C) Reject the claim that the standard deviation is 3.3 mg when it is actually different from 3.3 mg.
   D) Reject the claim that the standard deviation is 3.3 mg when it is actually equal to 3.3 mg.

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

Identify the null hypothesis, alternative hypothesis, test statistic, P-value, conclusion about the null hypothesis, and final conclusion that addresses the original claim.

22) A supplier of digital memory cards claims that no more than 1% of the cards are defective. In a random sample of 600 memory cards, it is found that 3% are defective, but the supplier claims that this is only a sample fluctuation. At the 0.01 level of significance, test the supplier’s claim that no more than 1% are defective.

23) A poll of 1068 adult Americans reveals that 48% of the voters surveyed prefer the Democratic candidate for the presidency. At the 0.05 level of significance, test the claim that at least half of all voters prefer the Democrat.

24) According to a recent poll 53% of Americans would vote for the incumbent president. If a random sample of 100 people results in 45% who would vote for the incumbent, test the claim that the actual percentage is 53%. Use a 0.10 significance level.

25) In a clinical study of an allergy drug, 108 of the 202 subjects reported experiencing significant relief from their symptoms. At the 0.01 significance level, test the claim that more than half of all those using the drug experience relief.
26) The health of employees is monitored by periodically weighing them in. A sample of 54 employees has a mean weight of 183.9 lb. Assuming that \( \sigma \) is known to be 121.2 lb, use a 0.10 significance level to test the claim that the population mean of all such employees weights is less than 200 lb.

27) A random sample of 100 pumpkins is obtained and the mean circumference is found to be 40.5 cm. Assuming that the population standard deviation is known to be 1.6 cm, use a 0.05 significance level to test the claim that the mean circumference of all pumpkins is equal to 39.9 cm.

Test the given claim. Use the P-value method or the traditional method as indicated. Identify the null hypothesis, alternative hypothesis, test statistic, critical value(s) or P-value, conclusion about the null hypothesis, and final conclusion that addresses the original claim.

28) A simple random sample of 15-year old boys from one city is obtained and their weights (in pounds) are listed below. Use a 0.01 significance level to test the claim that these sample weights come from a population with a mean equal to 149 lb. Assume that the standard deviation of the weights of all 15-year old boys in the city is known to be 16.2 lb. Use the traditional method of testing hypotheses.

\[
\begin{align*}
147 & \\
138 & \\
162 & \\
151 & \\
134 & \\
189 & \\
157 & \\
144 & \\
175 & \\
127 & \\
164 & \\
\end{align*}
\]

29) The maximum acceptable level of a certain toxic chemical in vegetables has been set at 0.4 ppm. A consumer health group measured the level of the chemical in a random sample of tomatoes obtained from one producer. The levels, in ppm, are shown below.

\[
\begin{align*}
0.31 & \\
0.47 & \\
0.19 & \\
0.72 & \\
0.56 & \\
0.91 & \\
0.29 & \\
0.83 & \\
0.49 & \\
0.28 & \\
0.31 & \\
0.46 & \\
0.25 & \\
0.34 & \\
0.17 & \\
0.58 & \\
0.19 & \\
0.26 & \\
0.47 & \\
0.81 & \\
\end{align*}
\]

Do the data provide sufficient evidence to support the claim that the mean level of the chemical in tomatoes from this producer is greater than the recommended level of 0.4 ppm? Use a 0.05 significance level to test the claim that these sample levels come from a population with a mean greater than 0.4 ppm. Use the P-value method of testing hypotheses. Assume that the standard deviation of levels of the chemical in all such tomatoes is 0.21 ppm.

Assume that a simple random sample has been selected from a normally distributed population and test the given claim. Use either the traditional method or P-value method as indicated. Identify the null and alternative hypotheses, test statistic, critical value(s) or P-value (or range of P-values) as appropriate, and state the final conclusion that addresses the original claim.

30) A researcher wants to test the claim that convicted burglars spend an average of 18.7 months in jail. She takes a random sample of 11 such cases from court files and finds that \( \bar{x} \) = 21.5 months and \( s = 7.4 \) months. Test the claim that \( \mu = 18.7 \) months at the 0.05 significance level. Use the traditional method of testing hypotheses.

31) A public bus company official claims that the mean waiting time for bus number 14 during peak hours is less than 10 minutes. Karen took bus number 14 during peak hours on 18 different occasions. Her mean waiting time was 7.9 minutes with a standard deviation of 1.5 minutes. At the 0.01 significance level, test the claim that the mean waiting time is less than 10 minutes. Use the P-value method of testing hypotheses.
32) A manufacturer makes ball bearings that are supposed to have a mean weight of 30 g. A retailer suspects that the mean weight is actually less than 30 g. The mean weight for a random sample of 16 ball bearings is 28.4 g with a standard deviation of 4.5 g. At the 0.05 significance level, test the claim that the sample comes from a population with a mean weight less than 30 g. Use the traditional method of testing hypotheses.

33) A cereal company claims that the mean weight of the cereal in its packets is 14 oz. The weights (in ounces) of the cereal in a random sample of 8 of its cereal packets are listed below.

14.6  13.8  14.1  13.7  14.0  14.4  13.6  14.2

Test the claim at the 0.01 significance level.

Use the traditional method to test the given hypothesis. Assume that the population is normally distributed and that the sample has been randomly selected.

34) With individual lines at the checkouts, a store manager finds that the standard deviation for the waiting times on Monday mornings is 5.7 minutes. After switching to a single waiting line, he finds that for a random sample of 29 customers, the waiting times have a standard deviation of 4.9 minutes. Use a 0.025 significance level to test the claim that with a single line, waiting times vary less than with individual lines.

35) In one town, monthly incomes for men with college degrees are found to have a standard deviation of $650. Use a 0.01 significance level to test the claim that for men without college degrees in that town, incomes have a higher standard deviation. A random sample of 22 men without college degrees resulted in incomes with a standard deviation of $926.

36) Heights of men aged 25 to 34 have a standard deviation of 2.9. Use a 0.05 significance level to test the claim that the heights of women aged 25 to 34 have a different standard deviation. The heights (in inches) of 16 randomly selected women aged 25 to 34 are listed below. Round the sample standard deviation to five decimal places.

62.13   65.09   64.18   66.72   63.09   61.15   67.50   64.65
63.80   64.21   60.17   68.28   66.49   62.10   65.73   64.72