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

A hypothesis test is to be performed. Determine the null and alternative hypotheses.

1) In the past, the mean running time for a certain type of flashlight battery has been 9.6 hours. The manufacturer has introduced a change in the production method and wants to perform a hypothesis test to determine whether the mean running time has changed as a result.

A) \( H_0 : \mu = 9.6 \text{ hours} \)
   \( H_a : \mu > 9.6 \text{ hours} \)

B) \( H_0 : \mu \geq 9.6 \text{ hours} \)
   \( H_a : \mu = 9.6 \text{ hours} \)

C) \( H_0 : \mu = 9.6 \text{ hours} \)
   \( H_a : \mu \neq 9.6 \text{ hours} \)

D) \( H_0 : \mu \neq 9.6 \text{ hours} \)
   \( H_a : \mu = 9.6 \text{ hours} \)

2) The owner of a football team claims that the average attendance at games is over 81,100, and he is therefore justified in moving the team to a city with a larger stadium.

A) \( H_0 : \mu, \text{ the average attendance at games, is less than or equal to } 81,100 \)
   \( H_a : \mu, \text{ the average attendance at games, is greater than } 81,100 \)

B) \( H_0 : \mu, \text{ the average attendance at games, is less than } 81,100 \)
   \( H_a : \mu, \text{ the average attendance at games, is greater than or equal to } 81,100 \)

C) \( H_0 : \mu, \text{ the average attendance at games, is greater than } 81,100 \)
   \( H_a : \mu, \text{ the average attendance at games, is less than or equal to } 81,100 \)

D) \( H_0 : \mu, \text{ the average attendance at games, is greater than or equal to } 81,100 \)
   \( H_a : \mu, \text{ the average attendance at games, is less than } 81,100 \)

Classify the hypothesis test as two-tailed, left-tailed, or right-tailed.

3) At one school, the average amount of time that tenth-graders spend watching television each week is 21.6 hours. The principal introduces a campaign to encourage the students to watch less television. One year later, the principal wants to perform a hypothesis test to determine whether the average amount of time spent watching television per week has decreased from the previous mean of 21.6 hours.

A) Two-tailed
B) Left-tailed
C) Right-tailed

4) A health insurer has determined that the "reasonable and customary" fee for a certain medical procedure is $1200. They suspect that the average fee charged by one particular clinic for this procedure is higher than $1200. The insurer wants to perform a hypothesis test to determine whether their suspicion is correct.

A) Right-tailed
B) Two-tailed
C) Left-tailed

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

Provide an appropriate response.

5) You wish to test the hypotheses shown below.

\( H_0 : \mu = 40 \)
\( H_a : \mu > 40 \)

Would you be inclined to reject the null hypothesis if the sample mean turned out to be much smaller than 40? Explain your thinking.
6) Robert is conducting a hypothesis test concerning a population mean. The hypotheses are as follows.

\[ H_0 : \mu = 50 \]
\[ H_a : \mu > 50 \]

He selects a sample of size 35 and finds that the sample mean is 60. He then does some calculations and finds that for samples of size 35, the standard deviation of the sample means is 3.2. Do you think that he should reject the null hypothesis? Why or why not?

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

The graph portrays the decision criterion for a hypothesis test for a population mean. The null hypothesis is \( H_0 : \mu = \mu_0 \). The curve is the normal curve for the test statistic under the assumption that the null hypothesis is true. Use the graph to solve the problem.

7) A graphical display of the decision criterion follows.

Determine the rejection region.

A) 0.005
C) All z-scores that lie to the left of 2.575
B) All z-scores that lie to the right of 2.575
D) 2.575
8) A graphical display of the decision criterion follows.

Determine the significance level.

A) 0.01  B) 2.575
C) All z-scores that lie to the right of 2.575  D) 0.005

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

Construct a graph portra
gy

9) A hypothesis test for a population mean is conducted. The hypotheses are:

\[ H_0 : \mu = \mu_0 \]
\[ H_a : \mu \neq \mu_0 \]

The significance level is 0.01 and the critical values are -2.575 and 2.575. Sketch a normal curve displaying the decision criterion. This curve will represent the normal curve for the test statistic under the assumption that the null hypothesis is true. On your graph indicate the area in each tail, the critical values, the rejection region, and the nonrejection region.

10) A hypothesis test for a population mean is conducted. The hypotheses are:

\[ H_0 : \mu = \mu_0 \]
\[ H_a : \mu > \mu_0 \]

The significance level is 0.01 and the critical value is 2.33. Sketch a normal curve displaying the decision criterion. This curve will represent the normal curve for the test statistic under the assumption that the null hypothesis is true. On your graph indicate the area in the tail, the critical value, the rejection region, and the nonrejection region.
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

For the given hypothesis test, explain the meaning of a Type I error, a Type II error, or a correct decision as specified.

11) In the past, the mean running time for a certain type of flashlight battery has been 9.8 hours. The manufacturer has introduced a change in the production method and wants to perform a hypothesis test to determine whether the mean running time has increased as a result. The hypotheses are:

\[ H_0 : \mu = 9.8 \text{ hours} \]
\[ H_a : \mu > 9.8 \text{ hours} \]

Explain the meaning of a Type I error.

A) Concluding that \( \mu > 9.8 \) hours when in fact \( \mu = 9.8 \) hours
B) Concluding that \( \mu < 9.8 \) hours when in fact \( \mu > 9.8 \) hours
C) Concluding that \( \mu = 9.8 \) hours when in fact \( \mu > 9.8 \) hours
D) Concluding that \( \mu > 9.8 \) hours when in fact \( \mu > 9.8 \) hours

12) In 1990, the average math SAT score for students at one school was 500. Five years later, a teacher wants to perform a hypothesis test to determine whether the average SAT score of students at the school has changed from the 1990 mean of 500. The hypotheses are:

\[ H_0 : \mu = 500 \]
\[ H_a : \mu \neq 500 \]

Explain the meaning of a Type II error.

A) Failing to reject the hypothesis that \( \mu = 500 \) when in fact \( \mu \neq 500 \)
B) Concluding that \( \mu > 500 \) when in fact \( \mu = 500 \)
C) Concluding that \( \mu \neq 500 \) minutes when in fact \( \mu = 500 \)
D) Failing to reject the hypothesis that \( \mu = 500 \) when in fact \( \mu = 500 \)

13) At one school, the average amount of time that tenth-graders spend watching television each week is 21.6 hours. The principal introduces a campaign to encourage the students to watch less television. One year later, the principal wants to perform a hypothesis test to determine whether the average amount of time spent watching television per week has decreased. The hypotheses are:

\[ H_0 : \mu = 21.6 \text{ hours} \]
\[ H_a : \mu < 21.6 \text{ hours} \]

Explain the meaning of a correct decision.

A) Failing to reject the hypothesis that \( \mu = 21.6 \) hours when in fact \( \mu = 21.6 \) hours OR concluding that \( \mu < 21.6 \) hours when in fact \( \mu < 21.6 \) hours
B) Failing to reject the hypothesis that \( \mu = 21.6 \) hours when in fact \( \mu < 21.6 \) hours
C) Concluding that \( \mu > 21.6 \) hours when in fact \( \mu < 21.6 \) hours
D) Concluding that \( \mu < 21.6 \) hours when in fact \( \mu = 21.6 \) hours

Classify the conclusion of the hypothesis test as a Type I error, a Type II error, or a correct decision.

14) At one school, the average amount of time that tenth-graders spend watching television each week is 21 hours. The principal introduces a campaign to encourage the students to watch less television. One year later, the principal wants to perform a hypothesis test to determine whether the average amount of time spent watching television per week has decreased. The hypotheses are:

\[ H_0 : \mu = 21 \text{ hours} \]
\[ H_a : \mu < 21 \text{ hours} \]

Suppose that the results of the sampling lead to nonrejection of the null hypothesis. Classify that conclusion as a Type I error, a Type II error, or a correct decision, if in fact the mean amount of time, \( \mu \), spent watching television has not decreased.

A) Type I error
B) Correct decision
C) Type II error
15) A health insurer has determined that the "reasonable and customary" fee for a certain medical procedure is $1200. They suspect that the average fee charged by one particular clinic for this procedure is higher than $1200. The insurer wants to perform a hypothesis test to determine whether their suspicion is correct. The hypotheses are:

\[ H_0 : \mu = 1200 \]
\[ H_a : \mu > 1200 \]

Suppose that the results of the sampling lead to rejection of the null hypothesis. Classify that conclusion as a Type I error, a Type II error, or a correct decision, if in fact the average fee charged by the clinic is $1200.

A) Correct decision  B) Type II error  C) Type I error

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

Provide an appropriate response.

16) A student performs a hypothesis test for a population mean. The hypotheses are:

\[ H_0 : \mu = 10 \]
\[ H_a : \mu > 10 \]

The significance level is 0.05 and the test statistic falls in the nonrejection region. The student writes her conclusion as follows:

"The test statistic falls in the nonrejection region so it is safe to conclude that the null hypothesis is true; i.e., that \( \mu = 10 \)."

Is this an acceptable way to write the conclusion? If not, explain why not and rewrite the conclusion in an acceptable way.

17) A hypothesis test for a population mean is performed at the 0.01 significance level. The results are statistically significant at the 0.01 level. Explain the meaning of the term *statistically significant*. Do you think that the test statistic fell in the rejection or nonrejection region? Do you think that the null hypothesis was rejected?

18) A pharmaceutical company has a new drug which relieves headaches. However, there is some indication that the drug may have the side effect of increasing blood pressure. Suppose the drug company conducts a hypothesis test to determine whether the medication raises blood pressure. The hypotheses are:

\[ H_0 : \text{The drug does not increase blood pressure.} \]
\[ H_a : \text{The drug increases blood pressure.} \]

Do you think that for doctors and patients it is more important to have a small \( \alpha \) probability or a small \( \beta \) probability? Why? Do you think that the pharmaceutical company would prefer to have a small \( \alpha \) probability or a small \( \beta \) probability? Why?

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

A hypothesis test is to be performed for a population mean with null hypothesis \( H_0 : \mu = \mu_0 \). The test statistic used will be \( z = \frac{\bar{x} - \mu_0}{\sigma / \sqrt{n}} \). Find the required critical value(s).

19) \( \alpha = 0.08 \) for a two-tailed test.

A) \( \pm 2.575 \)  B) \( \pm 1.75 \)  C) \( \pm 1.764 \)  D) \( \pm 1.645 \)
20) Find the critical value(s) for a two-tailed test with $\alpha = 0.02$ and draw a graph that illustrates your answer.

A) -1.75, 1.75

B) -2.05, 2.05

C) -2.33, 2.33

D) -2.05
21) Find the critical value(s) for a right-tailed test with $\alpha = 0.07$ and draw a graph that illustrates your answer.

A) 1.81

B) -1.48

C) 1.48

D) 1.48

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

Perform a hypothesis test for the population mean. Assume that preliminary data analyses indicate that it is reasonable to apply the z-test.

22) The National Weather Service says that the mean daily high temperature for October in a large midwestern city is 56°F. A local weather service suspects that this value is not accurate and wants to perform a hypothesis test to determine whether the mean is actually lower than 56°F. A sample of mean daily high temperatures for October over the past 37 years yields $\bar{x} = 54°F$. Assume that the population standard deviation is 5.6°F. Perform the hypothesis test at the $\alpha = 0.01$ significance level.
23) A manufacturer makes steel bars that are supposed to have a mean length of 50 cm. A retailer suspects that the bars are running short. A sample of 56 bars is taken and their mean length is determined to be 51 cm. Using a 1% level of significance, perform a hypothesis test to determine whether the population mean is less than 50 cm. Assume that the population standard deviation is 3.6 cm.

24) A newspaper in a large midwestern city reported that the National Association of Realtors said that the mean home price last year was $116,800. The city housing department feels that this figure is too low. They randomly selected 51 home sales and obtained a sample mean price of $118,900. Assume that the population standard deviation is $3,700. Using a 5% level of significance, perform a hypothesis test to determine whether the population mean is higher than $116,800.

25) A researcher wants to check the claim that convicted burglars spend an average of 18.7 months in jail. She takes a random sample of 40 such cases from court files and finds that \( \bar{x} = 16.7 \) months. Assume that the population standard deviation is and 7.8 months. Test the null hypothesis that \( \mu = 18.7 \) at the 0.05 significance level.

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

A one-sample z-test for a population mean is to be performed. The value obtained for the test statistic, \( z = \frac{\bar{x} - \mu_0}{\sigma/\sqrt{n}} \), is given. The nature of the test (right-tailed, left-tailed, or two-tailed) is also specified. Determine the P-value.

26) A right-tailed test: \( z = 2.38 \)
   A) 0.9826  B) 0.9913  C) 0.0174  D) 0.0087

27) A two-tailed test: \( z = 1.31 \)
   A) 0.8098  B) 0.1902  C) 0.0951  D) 0.9049

28) A left-tailed test: \( z = -0.58 \)
   A) 0.5620  B) 0.4380  C) 0.2810  D) 0.7190

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

Perform a one-sample z-test for a population mean using the P-value approach. Be sure to state the hypotheses and the significance level, to compute the value of the test statistic, to obtain the P-value, and to state your conclusion.

29) In the past, the mean running time for a certain type of flashlight battery has been 8.5 hours. The manufacturer has introduced a change in the production method which he hopes has increased the mean running time. The mean running time for a random sample of 40 light bulbs was 8.7 hours. Do the data provide sufficient evidence to conclude that the mean running time of all light bulbs, \( \mu \), has increased from the previous mean of 8.5 hours? Perform the appropriate hypothesis test using a significance level of 0.05. Assume that \( \sigma = 0.5 \) hours.
30) In one city, the average amount of time that tenth-graders spend watching television each week is 21.6 hours. The principal of Birchwood High School believes that at his school, tenth-graders watch less television. For a sample of 28 tenth-graders from Birchwood High School, the mean amount of time spent watching television per week was 19.4 hours. Do the data provide sufficient evidence to conclude that for all tenth-graders at Birchwood High School, the mean amount of time spent watching television per week is less than the city average of 21.6 hours? Perform the appropriate hypothesis test using a significance level of 0.05. Assume that \( \sigma = 7.2 \) hours.

31) The forced vital capacity (FVC) is often used by physicians to assess a person's ability to move air in and out of their lungs. It is the maximum amount of air that can be exhaled after a deep breath. For adult males, the average FVC is 5.0 liters. A researcher wants to perform a hypothesis test to determine whether the average forced vital capacity for women differs from this value. The mean forced vital capacity for a random sample of 85 women was 4.8 liters. Do the data provide sufficient evidence to conclude that the mean forced vital capacity for women differs from the mean value for men of 5.0 liters? Perform the appropriate hypothesis test using a significance level of 0.05. Assume that \( \sigma = 0.9 \) liters.

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

Provide an appropriate answer.

32) A high school biology student wishes to test the hypothesis that hummingbird feeders can affect the mean mass of ruby-throated hummingbirds in the area surrounding the feeder. She captures and weighs several female specimens near a science museum where several feeders are located. She obtains the following masses in grams:

\[
\begin{align*}
4.2 & \quad 3.9 & \quad 3.6 & \quad 3.5 & \quad 3.9 & \quad 3.8 \\
3.8 & \quad 4.1 & \quad 3.9 & \quad 3.8 & \quad 3.2 & \quad 3.4
\end{align*}
\]

The student's hypotheses are:

\[H_0: \mu = 3.65 \text{ g} \]
\[H_a: \mu > 3.65 \text{ g} \]

Use technology to calculate \( P \), then determine if the data provide sufficient evidence to conclude that the mean mass is greater than that of the general female population. Test at the 5% significance level and assume the population standard deviation is 0.35 g.

A) \( P = 0.745; \) since \( P > \alpha \), accept the null hypothesis - the mass of hummingbirds in the area surrounding the feeders does not appear to be above normal.

B) \( P = 0.255; \) since \( P > \alpha \), reject the null hypothesis - the mass of hummingbirds in the area surrounding the feeders appears to be above normal.

C) \( P = 0.509; \) since \( P > \alpha \), reject the null hypothesis - the mass of hummingbirds in the area surrounding the feeders appears to be above normal.

D) \( P = 0.1418; \) since \( P > \alpha \), accept the null hypothesis - the mass of hummingbirds in the area surrounding the feeders does not appear to be above normal.

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

Preliminary data analyses indicate that it is reasonable to use a t-test to carry out the specified hypothesis test. Perform the t-test using the critical-value approach.

33) Use a significance level of \( \alpha = 0.05 \) to test the claim that \( \mu \neq 32.6 \). The sample data consists of 15 scores for which \( \bar{x} = 42.8 \) and \( s = 7.2 \).

34) A test of sobriety involves measuring the subject's motor skills. Twenty randomly selected sober subjects take the test and produce a mean score of 41.0 with a standard deviation of 3.7. At the 0.01 level of significance, test the claim that the true mean score for all sober subjects is equal to 35.0.
35) In tests of a computer component, it is found that the mean time between failures is 520 hours. A modification is made which is supposed to increase the time between failures. Tests on a random sample of 10 modified components resulted in the following times (in hours) between failures:

<table>
<thead>
<tr>
<th>Time (hours)</th>
<th>518</th>
<th>548</th>
<th>561</th>
<th>523</th>
<th>536</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>499</td>
<td>538</td>
<td>557</td>
<td>528</td>
<td>563</td>
</tr>
</tbody>
</table>

At the 0.05 significance level, test the claim that for the modified components, the mean time between failures is greater than 520 hours.

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

Provide an appropriate answer.

36) Use a significance level of \( \alpha = 0.05 \) to test the claim that \( \mu = 19.6 \). The sample data consists of 10 scores for which \( \bar{x} = 20.1 \) and \( s = 4.1 \). State the null and alternative hypotheses, compute the value of the test statistic, and find the P-value for the sample. State your conclusions about the claim.

A) \( H_0: \mu = 19.6 \)
   \( H_a: \mu \neq 19.6 \)
   Test statistic: \( t = 0.3856 \). P-Value: \( P = 0.70872 \). Reject \( H_0: \mu = 19.6 \). Since \( P > \alpha \), there is sufficient evidence to support the claim that the mean is different from 19.6.

B) \( H_0: \mu = 20.1 \)
   \( H_a: \mu \neq 20.1 \)
   Test statistic: \( t = 0.3856 \). P-Value: \( P = 0.70872 \). Accept \( H_0: \mu = 20.1 \). Since \( P > \alpha \), there is not sufficient evidence to support the claim that the mean is different from 20.1.

C) \( H_0: \mu = 19.6 \)
   \( H_a: \mu \neq 19.6 \)
   Test statistic: \( t = 0.3856 \). P-Value: \( P = 0.35436 \). Accept \( H_0: \mu = 19.6 \). Since \( P > \alpha \), there is not sufficient evidence to support the claim that the mean is different from 19.6.

D) \( H_0: \mu = 19.6 \)
   \( H_a: \mu \neq 19.6 \)
   Test statistic: \( t = 0.3856 \). P-Value: \( P = 0.70872 \). Accept \( H_0: \mu = 19.6 \). Since \( P > \alpha \), there is sufficient evidence to support the claim that the mean is different from 19.6.

E) \( H_0: \mu = 19.6 \)
   \( H_a: \mu \neq 19.6 \)
   Test statistic: \( t = 0.3856 \). P-Value: \( P = 0.70872 \). Accept \( H_0: \mu = 19.6 \). Since \( P > \alpha \), there is not sufficient evidence to support the claim that the mean is different from 19.6.

37) Out of 199 observations, 50% were successes. \( H_0: p = 0.43 \).

A) 1.995  
B) 0.002  
C) 1.291  
D) 1.723

38) A drug company claims that over 80% of all physicians recommend their drug. 1200 physicians were asked if they recommend the drug to their patients. 30% said yes. \( H_0: p = 0.8 \).

A) -38.97  
B) -56.29  
C) -86.60  
D) -43.30
SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Perform a hypothesis test for a population proportion using the critical value approach.

39) A manufacturer considers his production process to be out of control when defects exceed 3%. In a random sample of 85 items, the defect rate is 5.9% but the manager claims that this is only a sample fluctuation and production is not really out of control. At the 0.01 level of significance, do the data provide sufficient evidence that the percentage of defects exceeds 3%?

40) A supplier of 3.5" disks claims that no more than 1% of the disks are defective. In a random sample of 600 disks, 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, do the data provide sufficient evidence that the percentage of defects exceeds 1%?

41) In a clinical study of an allergy drug, 114 of the 203 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.

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

Find the P-value for the indicated hypothesis test.

42) A medical school claims that more than 28% of its students plan to go into general practice. It is found that among a random sample of 130 of the school's students, 39 of them plan to go into general practice. Find the P-Value for a test of the school's claim.

A) 0.3078  
B) 0.1635  
C) 0.3461  
D) 0.3058

43) In a sample of 88 children selected randomly from one town, it is found that 8 of them suffer from asthma. Find the P-value for a test of the claim that the proportion of all children in the town who suffer from asthma is equal to 11%.

A) 0.5671  
B) -0.2843  
C) 0.2843  
D) 0.2157

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

Perform a hypothesis test for a population proportion using the critical value approach.

44) A manufacturer considers his production process to be out of control when defects exceed 3%. In a random sample of 80 items, the defect rate is 5% but the manager claims that this is only a sample fluctuation and production is not really out of control. At the 0.01 level of significance, do the data provide sufficient evidence that the percentage of defects exceeds 3%?

45) A supplier of 3.5" disks claims that no more than 1% of the disks are defective. In a random sample of 600 disks, 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, do the data provide sufficient evidence that the percentage of defects exceeds 1%?
1) C
2) A
3) B
4) A
5) No. The alternative hypothesis is that the true mean is greater than 40. A sample mean much smaller than 40 does not provide evidence in favor of this alternative hypothesis. The null hypothesis should be rejected only if the sample mean turns out much larger than 40.
6) Answers will vary. Possible answer. Yes, he should reject the null hypothesis. If $H_0$ were true, it is not very likely that the sample mean would be as big as 60, since this is more than three standard deviations from 50. So the observed sample mean is inconsistent with the null hypothesis.
7) B
8) D
9) 
10) 
11) A
12) A
13) A
14) B
15) C
16) No; since the test statistic fell in the nonrejection region, the data did not provide evidence in favor of the alternative, \( \mu > 10 \). This does not mean that we can conclude that \( \mu = 10 \), only that we have no evidence against that hypothesis. In other words, one can talk of "failing to reject a null hypothesis", but not of "accepting" it.
17) "Statistically significant" means that the data provided evidence against the null hypothesis. So the test statistic fell in the rejection region and the null hypothesis was rejected.
18) For doctors and patients it is more important to have a small \( \beta \) probability. If the drug really does increase blood pressure, it is important to detect that. So the probability of a Type II error should be small. The pharmaceutical company may prefer to have a small \( \alpha \) probability since they would lose money if the test concluded that the drug increased blood pressure when in fact it didn't.
19) B
20) C
21) C
22) \( H_0 : \mu = 56° F \)
   \( H_a : \mu < 56° F \)
   Test statistic: \( z = -2.17 \).
   Critical value \( z = -2.33 \). Fail to reject \( H_0 : \mu = 56°F \). there is not sufficient evidence to support the claim that the mean is less than 56°F.
23) \( H_0 : \mu = 50 \) cm
   \( H_a : \mu < 50 \) cm
   Test statistic: \( z = 2.08 \).
   Critical value \( z = -2.33 \). Fail to reject \( H_0 : \mu = 50 \) cm. There is not sufficient evidence to support the claim that the mean length is less than 50 cm.
24) \( H_0 : \mu = 116,800 \)
   \( H_a : \mu > 116,800 \)
   Test statistic: \( z = 4.05 \).
   Critical value: \( z = 1.645 \). Reject \( H_0 : \mu = 116,800 \). There is sufficient evidence to support the claim that the mean is higher than \( 116,800 \).
25) \( H_0 : \mu = 18.7 \) months
   \( H_a : \mu \neq 18.7 \) months
   Test statistic: \( z = -1.62 \)
   Critical values: \( z = \pm 1.96 \). Fail to reject \( H_0 \). There is not sufficient evidence to warrant rejection of the claim that the mean is 18.7 months.
26) D
27) B
28) C
29) \( H_0 : \mu = 8.5 \) hours
   \( H_a : \mu > 8.5 \) hours
   \( \alpha = 0.05 \)
   \( z = 2.53 \)
   P-value = 0.0057
   Reject \( H_0 \). At the 5% significance level, the data provide sufficient evidence to conclude that the mean running time of all light bulbs, \( \mu \), has increased from the previous mean of 8.5 hours.
Answer Key
Testname: CH 8 SET 1

30) $H_0 : \mu = 21.6$ hours
   $H_a : \mu < 21.6$ hours
   $\alpha = 0.05$
   $z = -1.62$
   P-value = 0.0526
   Do not reject $H_0$. At the 5% significance level, the data do not provide sufficient evidence to conclude that for tenth-graders at Birchwood High School the mean amount of time spent watching television per week is less than 21.6 hours.

31) $H_0 : \mu = 5.0$ liters
   $H_a : \mu \neq 5.0$ liters
   $\alpha = 0.05$
   $z = -2.05$
   P-value = 0.0404
   Reject $H_0$. At the 5% significance level, the data provide sufficient evidence to conclude that the mean forced vital capacity for women differs from 5.0 liters.

32) $H_0 : \mu = 32.6$
   $H_a : \mu \neq 32.6$
   Test statistic: $t = 5.49$. Critical values: $t = \pm 2.145$. Reject $H_0$: $\mu = 32.6$. There is sufficient evidence to support the claim that the mean is different from 32.6.

33) $H_0 : \mu = 35.0$. $H_a : \mu \neq 35.0$.
   Test statistic: $t = 7.252$. Critical values: $t = -2.861, 2.861$. Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that the mean is equal to 35.0.

34) $H_0 : \mu = 520$ hours. $H_a : \mu > 520$ hours.
   Test statistic: $t = 2.61$. Critical value: $t = 1.833$. Reject $H_0$. There is sufficient evidence to support the claim that the mean is greater than 520 hours.

35) $H_0 : p = 0.03$. $H_a : p > 0.03$.
   $\alpha = 0.01$
   Test statistic: $z = 1.57$. Critical value: $z = 2.33$.
   Fail to reject the null hypothesis. There is not sufficient evidence at the 1% significance level to conclude that the percentage of defects exceeds 3%.

36) $H_0 : p = 0.01$. $H_a : p > 0.01$.
   $\alpha = 0.01$
   Reject the null hypothesis. There is sufficient evidence at the 1% significance level to conclude that the percentage of defects exceeds 1%.

37) $H_0 : p = 0.5$. $H_a : p > 0.5$.
   $\alpha = 0.01$
   Test statistic: $z = 1.75$. Critical value: $z = 2.33$.
   Fail to reject $H_0$. There is not sufficient evidence at the 1% significance level to support the claim that more than half of all those using the drug experience relief.

38) $H_0 : p = 0.1$. $H_a : p > 0.1$.
   $\alpha = 0.01$
   Test statistic: $z = 1.57$. P-value = 0.1472
   Fail to reject the null hypotheses. There is not sufficient evidence at the 1% significance level to conclude that the percentage of defects exceeds 3%.
45) \( H_0: p = 0.01 \quad H_a: p > 0.01 \).
\[ \alpha = 0.01 \]
Test statistic: \( z = 4.92 \). P-value = 0.0000 (to four decimal places)
Reject the null hypothesis. There is sufficient evidence at the 1% significance level to conclude that the percentage of defects exceeds 1%.