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

Malia buys a chocolate-strawberry-vanilla cake in Figure(i) for $14.00. She cuts the cake into six 60° wedges as shown in Figure (ii). Malia likes chocolate twice as much as vanilla and likes vanilla twice as much as strawberry.

1) What is the value of piece 3 to Malia?

Ned buys a chocolate-strawberry-vanilla cake in Figure (i) for $14.00. He cuts the cake into six 60° wedges as shown in Figure (ii). Ned values strawberry six times as much as chocolate. He does not value vanilla cake at all.

2) How much does Ned value piece 6?

Solve the problem.

3) Amy’s little brother Jimmy has eaten 40% of a chocolate cake. Amy, Brad, and Cecilia wish to equally divide the remainder of the cake. What percentage of the original cake would be considered a fair share to each?

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

4) Which of the following is a discrete fair division problem?
   A) Dividing a cheese pizza.
   B) Dividing an antique car collection.
   C) Dividing a gallon of ice cream.
   D) Dividing a tropical island.
   E) none of these
Carli and Dale want to divide fairly the chocolate-strawberry cake shown below using the divider-chooser method. The total cost of the cake was $18.00. Carli values strawberry and banana equally, but values chocolate twice as much as either of these put together. Dale values chocolate three times as much as he values strawberry. Further, he values strawberry twice as much as he values banana.

5) If Carli is the divider, which of the divisions shown below is consistent with Carli’s value system?  

A) Division 1  
B) Division 2  
C) Division 3  
D) all of these  
E) none of these

Three players (one divider and two choosers) are going to divide a cake fairly using the lone divider method. The divider cuts the cake into three slices ($s_1$, $s_2$, and $s_3$).

6) Suppose the choosers value the slices as follows:

<table>
<thead>
<tr>
<th></th>
<th>$s_1$</th>
<th>$s_2$</th>
<th>$s_3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chooser 1</td>
<td>30%</td>
<td>40%</td>
<td>30%</td>
</tr>
<tr>
<td>Chooser 2</td>
<td>32%</td>
<td>32%</td>
<td>36%</td>
</tr>
</tbody>
</table>

Which of the following is a fair division of the cake?

A) Chooser 1 gets $s_3$; Chooser 2 gets $s_2$; Divider gets $s_1$.  
B) Chooser 1 gets $s_2$; Chooser 2 gets $s_1$; Divider gets $s_3$.  
C) Chooser 1 gets $s_1$; Chooser 2 gets $s_2$; Divider gets $s_3$.  
D) Chooser 1 gets $s_2$; Chooser 2 gets $s_3$; Divider gets $s_1$.  
E) none of these
Solve the problem.

7) Sheila, Susan, and Rosie want to divide a cake fairly using the lone chooser method. The chooser, Rosie, was determined by drawing straws. Sheila and Susan agreed that Sheila would make the division of the cake. Assuming that each of them plays the game correctly, which of the following statements [A), B), C) or D)] cannot be true?

A) Rosie believes that her share is worth \( \frac{1}{3} \) of the cake; Susan believes that her share is worth \( \frac{1}{3} \) of the cake; Sheila believes that her share is worth \( \frac{1}{3} \) of the cake.

B) Rosie believes that her share is worth \( \frac{1}{3} \) of the cake; Susan believes that her share is worth \( \frac{1}{3} \) of the cake; Sheila believes that her share is worth \( \frac{1}{3} \) of the cake.

C) Rosie believes that her share is worth \( \frac{1}{3} \) of the cake; Susan believes that her share is worth \( \frac{1}{3} \) of the cake; Sheila believes that her share is worth \( \frac{1}{3} \) of the cake.

D) Rosie believes that her share is worth \( \frac{2}{3} \) of the cake; Susan believes that her share is worth \( \frac{2}{3} \) of the cake; Sheila believes that her share is worth \( \frac{1}{3} \) of the cake.

E) none of these

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

8) Allie and Burt agree to divide four items using the method of sealed bids. Their bids on each of the items are given in the following table.

<table>
<thead>
<tr>
<th>Item</th>
<th>Allie</th>
<th>Burt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 1</td>
<td>$1500</td>
<td>$1600</td>
</tr>
<tr>
<td>Item 2</td>
<td>$700</td>
<td>$800</td>
</tr>
<tr>
<td>Item 3</td>
<td>$300</td>
<td>$200</td>
</tr>
<tr>
<td>Item 4</td>
<td>$500</td>
<td>$200</td>
</tr>
</tbody>
</table>

In the final settlement, Allie got Item 3, Item 4, and $850 in cash. What was Burt's bid on Item 2?

Four players (A, B, C, and D) agree to divide the 12 items below using the method of markers. The players' bids are as indicated.

9) Item 8

10) Item 11

Solve the problem.

11) Based on the 2000 U. S. Census, Florida had a standard quota of 24.776. What percent of the U.S. population lived in Florida in 2000? (Use the fact that the House of Representatives has 435 seats.)

A small country consists of four states (State 1, State 2, State 3, and State 4). The total population of the country is 200,000. The standard quotas are \( q_1 =64.8, q_2 =89.9, q_3 =39.6, \) and \( q_4 =5.7 \) respectively.

12) The population of State 1 is ____________________.
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

The following question refers to a school district with three high schools. The total number of students in the district is 3000. The teachers within the district are apportioned to the high schools based on the schools' respective enrollments. The standard quota for each school is given in the following table.

<table>
<thead>
<tr>
<th>School</th>
<th>North High</th>
<th>Central High</th>
<th>South High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Quota</td>
<td>$\frac{18}{3}$</td>
<td>$\frac{51}{3}$</td>
<td>30</td>
</tr>
</tbody>
</table>

13) What does the standard divisor represent in this apportionment problem?  
   A) the number of students per teacher  
   B) the number of teachers required for 3000 students  
   C) the number of students per 100 teachers  
   D) the number of teachers per 100 students  
   E) none of these

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

The following question refers to a country with six states. There are 300 seats in the legislature and the percent of the population in each state is given in the table below.

<table>
<thead>
<tr>
<th>State</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of Population</td>
<td>14.25%</td>
<td>53.75%</td>
<td>5.35%</td>
<td>16.5%</td>
<td>6.25%</td>
<td>3.9%</td>
</tr>
</tbody>
</table>

14) Find State E's final apportionment under Hamilton's method.

The following question refers to a country with five states. There are 250 seats in the legislature, and the populations of the states are given in the table below.

<table>
<thead>
<tr>
<th>State</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population (in thousands)</td>
<td>250</td>
<td>875</td>
<td>4700</td>
<td>3825</td>
<td>350</td>
</tr>
</tbody>
</table>

15) Find the modified divisor and each state's apportionment under Jefferson's method.

A bus company operates four bus routes (A, B, C, and D) and 50 buses. The buses are apportioned among the routes on the basis of average number of daily passengers per route which is given in the following table.

<table>
<thead>
<tr>
<th>Route</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily average number of passengers</td>
<td>3194</td>
<td>9066</td>
<td>4548</td>
<td>8192</td>
</tr>
</tbody>
</table>

16) Find the apportionment of the buses among the routes using Adams's method.
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

17) Round the quota \( q = 6.47 \) using the Huntington-Hill rounding rules.
   A) 7  
   B) 8  
   C) 6  
   D) 42  
   E) 5
   
18) Which of the following apportionment methods can produce the Population paradox?
   A) Adams's method
   B) Hamilton's method
   C) Jefferson's method
   D) Webster's method
   E) none of these

19) In a certain apportionment problem, State X has a standard quota of 48.9. The final apportionment to State X is 47 seats. This is called
   A) a lower-quota violation.
   B) the Alabama paradox.
   C) the population paradox.
   D) an upper-quota violation.
   E) none of these

20) In a certain apportionment problem, State X has a standard quota of 48.9. The final apportionment to State X is 47 seats. Which of the following apportionment methods could NOT have produced this result?
   A) Adams's method
   B) Jefferson’s method
   C) Hamilton's method
   D) all of these
   E) none of these

21) A mother wishes to distribute 11 pieces of candy among her three children (Abe, Betty, and Cindy) based on the number of hours each child spends doing chores around the house. Using a certain apportionment method, she has determined that (based on 703 minutes work for Abe, 243 minutes work for Betty, and 54 minutes work for Cindy) that Abe is to get 8 pieces of the candy, Betty is to get 3 pieces, and Cindy is to get 0 pieces. However, just before she hands out the candy, she discovers that she forgot to include 86 minutes of work that Abe did, 12 minutes of work that Betty did, and 2 minutes of work that Cindy did. When she reapportions the 11 pieces of candy using the corrected times and using the same apportionment method, Abe ends up with 8 pieces, Betty with 2 pieces, and Cindy with 1 piece. This is an example of
   A) the population paradox.
   B) a violation of the quota rule.
   C) the Alabama paradox.
   D) the new states paradox.
   E) none of these
Answer Key
Testname:

1) $1.00
2) $0.50
3) 20%
4) B
5) B
6) D
7) C
8) $800
9) goes to C.
10) is left over.
11) 5.7%
12) 64,800.
13) A
14) A: 43; B: 161; C: 16; D: 49; E: 19; F: 12
15) State A: 6; State B: 22; State C: 118; State D: 96; State E: 8.
16) Route A: 7; Route B: 18; Route C: 9; Route D: 16
17) C
18) B
19) A
20) A
21) A