1. The Student Government secretary, and two teacher’s aides are ordering supplies. The supplies they need are listed in the table.

<table>
<thead>
<tr>
<th>Supplies</th>
<th>Secretary</th>
<th>Aide No. 1</th>
<th>Aide No. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notebooks</td>
<td>12</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Pens</td>
<td>8</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Paperclips</td>
<td>7</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

If a spiral notebook costs $2.25, a box of pens costs $4.50, and a box of paperclips costs $1.50, which of the following shows the use of matrices to find the total cost of supplies for each person?

\[
\begin{bmatrix}
12 & 8 & 7 \\
7 & 9 & 5 \\
8 & 2 & 4
\end{bmatrix}
\begin{bmatrix}
2.25 \\
4.50 \\
1.50
\end{bmatrix} =
\begin{bmatrix}
162.75 \\
170.25 \\
118.50
\end{bmatrix}
\]

\[
\begin{bmatrix}
12 & 8 & 7 \\
7 & 9 & 5 \\
8 & 2 & 4
\end{bmatrix}
\begin{bmatrix}
2.25 \\
4.50 \\
1.50
\end{bmatrix} =
\begin{bmatrix}
162.75 \\
170.25 \\
118.50
\end{bmatrix}
\]

\[
\begin{bmatrix}
12 & 8 & 7 \\
7 & 9 & 5 \\
8 & 2 & 4
\end{bmatrix}
\begin{bmatrix}
2.25 \\
4.50 \\
1.50
\end{bmatrix} =
\begin{bmatrix}
65.25 \\
72.00 \\
25.50
\end{bmatrix}
\]

\[
\begin{bmatrix}
12 & 8 & 7 \\
7 & 9 & 5 \\
8 & 2 & 4
\end{bmatrix}
\begin{bmatrix}
2.25 \\
4.50 \\
1.50
\end{bmatrix} =
\begin{bmatrix}
73.50 \\
63.75 \\
33.00
\end{bmatrix}
\]
2. Write the system of equations as a matrix equation. Then solve the system, if possible, by using a matrix equation. If not possible, classify the system.

\[
\begin{align*}
&x + 3y + 2z = 4 \\
&x - 3y - 2z = -6 \\
&2x + 6y + 4z = 8
\end{align*}
\]

[A] \[
\begin{bmatrix}
1 & -3 & 2 \\
-1 & -3 & 2 \\
2 & 3 & 4
\end{bmatrix}
\begin{bmatrix}
x \\
y \\
z
\end{bmatrix} =
\begin{bmatrix}
4 \\
-6 \\
8
\end{bmatrix};
(-1, -5, 7)
\]

[B] \[
\begin{bmatrix}
1 & 3 & 2 \\
1 & -3 & -2 \\
2 & 6 & 4
\end{bmatrix}
\begin{bmatrix}
x \\
y \\
z
\end{bmatrix} =
\begin{bmatrix}
4 \\
-6 \\
8
\end{bmatrix};
\text{inverse = 0};
\text{no solution}.
\]

[C] \[
\begin{bmatrix}
1 & 3 & 2 \\
1 & -3 & -2 \\
2 & 6 & 4
\end{bmatrix}
\begin{bmatrix}
x \\
y \\
z
\end{bmatrix} =
\begin{bmatrix}
4 \\
-6 \\
8
\end{bmatrix};
\text{dependent, infinitely many solutions}.
\]

[D] \[
\begin{bmatrix}
4 \\
-6 \\
8
\end{bmatrix}
\begin{bmatrix}
x \\
y \\
z
\end{bmatrix} =
\begin{bmatrix}
1 & 3 & 2 \\
1 & -3 & -2 \\
2 & 6 & 4
\end{bmatrix};
(0, 5, -5)
\]

3.

Which of the following is an Euler path through the graph above?

4. Explain why the graph below contains an Euler path, but not an Euler circuit.

[A] An Euler Circuit must not have any openings to the outside.
[B] An Euler Circuit must have all even vertices.
[C] An Euler Circuit must have direct connections between each pair of vertices.
[D] An Euler Circuit must have all odd vertices.

5. How would you best describe the path A, B, C, G, H, D, E, I, J, F, A in the graph below?

[B] An Euler Path.
[C] A Minimum Spanning Tree.  
[D] A Complete Graph.
6. \[ A \quad B \quad C \quad D \quad E \]
\[
\begin{bmatrix}
A & 0 & 0 & 1 & 1 & 1 \\
B & 0 & 0 & 1 & 0 & 1 \\
C & 1 & 1 & 0 & 1 & 1 \\
D & 1 & 0 & 1 & 0 & 1 \\
E & 1 & 1 & 1 & 1 & 1 \\
\end{bmatrix}
\]
For which of the following graphs is the above matrix a single-stage adjacency matrix?

[A] \hspace{1cm} [B] \hspace{1cm} [C] \hspace{1cm} [D]

7. A spinner is evenly divided into 9 equal areas and numbered from 1 through 9. What is the probability of spinning a number less than 4 in a single spin?

[A] \( \frac{2}{3} \) \hspace{1cm} [B] \( \frac{1}{3} \) \hspace{1cm} [C] \( \frac{5}{9} \) \hspace{1cm} [D] \( \frac{4}{9} \)

8. A lunch menu consists of 5 different kinds of sandwiches, 3 different kinds of soup, and 5 different drinks. How many choices are there for ordering a sandwich, a bowl of soup, and a drink?

[A] 13 \hspace{1cm} [B] 86,400 \hspace{1cm} [C] 75 \hspace{1cm} [D] 3

9. How many different arrangements can be made using all of the letters in the word MOVIE?

[A] 120 \hspace{1cm} [B] 5 \hspace{1cm} [C] 25 \hspace{1cm} [D] 100
10. A circular, rotating, serving tray has 5 different desserts placed around its circumference. How many different ways can all of the desserts be arranged on the circular tray?

- [A] 5040
- [B] 720
- [C] 120
- [D] 24

11. Two cards are drawn in succession and without replacement from a standard deck of 52 cards. How many sets of two cards are possible?

- [A] 296
- [B] 2386
- [C] 1326
- [D] 786

12. How many distinct committees of 15 people can be formed if the people are drawn from a pool of 24 people? Use factorials to express the answer.

- [A] \( \binom{24}{15} = \frac{24!}{8!15!} \)
- [B] \( \binom{24}{14} = \frac{24!}{9!14!} \)
- [C] \( \binom{24}{14} = \frac{24!}{8!16!} \)
- [D] \( \binom{24}{15} = \frac{24!}{9!15!} \)

13. Suppose you mix-up the cards below and choose one without looking. What is the probability of selecting neither “Y” nor “E”?

- [A] \( \frac{4}{7} \)
- [B] \( \frac{1}{3} \)
- [C] 1
- [D] \( \frac{3}{7} \)

14. Two cards are randomly selected from a standard 52-card deck. What is the probability of getting 2 diamonds or 2 face cards?

- [A] 0.130
- [B] 0.106
- [C] 0.108
- [D] 0.096

15. A coin is tossed and a number cube is rolled. What is the probability that the coin shows heads and the die shows 4?

- [A] \( \frac{1}{6} \)
- [B] \( \frac{1}{12} \)
- [C] \( \frac{2}{3} \)
- [D] \( \frac{1}{4} \)

16. If 2 blocks are randomly taken from a bag containing 6 blue blocks, 9 red blocks, and 7 yellow blocks, what is the probability of drawing a blue block and a red block?

- [A] \( \frac{9}{35} \)
- [B] \( \frac{6}{49} \)
- [C] \( \frac{9}{77} \)
- [D] \( \frac{2}{15} \)
17. In a bag there are 2 green jelly beans, 3 black jelly beans, and 6 yellow jelly beans. Once a jelly bean is drawn, it is not replaced. Find the probability of randomly drawing a green jelly bean and then a black jelly bean in two consecutive draws.

[A] $\frac{1}{11}$  
[B] $\frac{1}{22}$  
[C] $\frac{6}{121}$  
[D] $\frac{3}{55}$

18. Kyra and Paul tossed a coin 50 times and got heads 24 times. What is the experimental probability of tossing a tail using Kyra and Paul’s results?

[A] $\frac{12}{25}$  
[B] $\frac{12}{37}$  
[C] $\frac{13}{25}$  
[D] $\frac{13}{37}$

19. Write the first five terms of the sequence defined by the given recursive or explicit formula.

$t_1 = 4$, $t_2 = 1$

$t_{n+2} = 4t_{n+1} - 3t_n$

[A] 4, 1, 16, 67, 316  
[B] 4, 1, –16, 61, –196  
[C] 4, 1, –8, –35, –116  
[D] 4, 1, 4, 16, 64

20. Evaluate the sum: $\sum_{k=2}^{6}(3k - 2)$

[A] 46  
[B] 17  
[C] 51  
[D] 50

21. The average cost of an automobile in the U.S. in 1993 was $19,479. Since then, average increases have occurred at a rate of $1243 yearly. Write the general term for the arithmetic sequence modeling automobile costs, where $n = 1$ corresponds to 1993.

[A] $t_n = 1243 + 19,479n$  
[B] $t_n = 19,479 - 18,236n$  
[C] $t_n = 19,479 + 1243n$  
[D] $t_n = 18,236 + 1243n$

22. Use the given formula to find the first four terms of the arithmetic sequence.

$t_n = 59 - 3n$

[A] 53, 50, 47, 44  
[B] 56, 53, 50, 47  
[C] 56, –168, 504, –1512  
[D] 56, 59, 62, 65

23. Find the three arithmetic means between –3 and 25.

[A] 4, 11, 18  
[B] 4, 1, –2  
[C] 7, 13, 19  
[D] 7, 14, 21
24. A 50-row theater has 10 seats in the front row. The second row has 11 seats. If each row has one more than the row in front of it, how many seats are there in the theater?


25. Evaluate the sum.

\[ \sum_{k=1}^{40} (-3k - 4) \]


26. Write the first five terms of the geometric sequence using the given explicit formula.

\[ t_n = 4 \cdot \left( \frac{1}{5} \right)^n \]

[A] \( \frac{4}{5}, \frac{4}{25}, \frac{4}{125}, \frac{4}{625}, \frac{4}{3125} \)  [B] \( 4, \frac{4}{3}, \frac{2}{7}, \frac{4}{12}, \frac{1}{2} \)

[C] \( 4, \frac{4}{5}, \frac{4}{25}, \frac{4}{125}, \frac{4}{625} \)  [D] \( 4, 1, \frac{3}{5}, \frac{7}{15}, \frac{2}{5} \)

27. Write an explicit formula for the \( n \)th term of the geometric sequence.

\( \frac{5}{2}, \frac{25}{6}, \frac{125}{18}, \frac{625}{54}, \ldots \)

[A] \( t_n = \frac{5}{2} \left( \frac{5}{3} \right)^{n-1} \)  [B] \( t_n = \frac{2}{3} \left( \frac{5}{2} \right)^n \)  [C] \( t_n = \frac{5}{2} \left( \frac{5}{3} \right)^{n+1} \)  [D] \( t_n = \frac{5}{2} \left( \frac{5}{2} \right)^{n-1} \)

28. Find the two geometric means between 6 and 384.


29. Find the sum of the first 5 terms of the geometric series

\[ 10 + \frac{15}{2} + \frac{45}{8} + \frac{135}{32} + \ldots \]


30. Find the sum of the infinite geometric series, if it exists.

\( -4 - 3 - \frac{9}{4} - \frac{27}{16} - \frac{81}{64} - \ldots \)

31. Find the 9th and 10th entries in the row 12 of Pascal’s triangle.
   [A] 1716; 1287  [B] 792; 495  [C] 495; 220  [D] 330; 165

32. Use Pascal’s triangle to find the number of ways to choose 2 pens from 5 pens.
   [A] 10  [B] 5  [C] 6  [D] none of these

33. Use Pascal’s Triangle to determine the probability that you will get one green light in a row of five lights. Assume red and green are equally likely occurrences.
   [A] \(\frac{3}{16}\)  [B] \(\frac{1}{32}\)  [C] \(\frac{5}{16}\)  [D] \(\frac{5}{32}\)

34. Expand the binomial raised to a power.
   \((3a-b)^5\)
   [A] \(a^5 - 5a^4b - 10a^3b^2 - 10a^2b^3a - 5b^4 + b^5\)
   [B] \(243a^5 - 108a^4b + 270a^3b^2 - 90a^2b^3 + 15ab^4 - b^5\)
   [C] \(243a^5 - 405a^4b + 270a^3b^2 - 90a^2b^3 + 15ab^4 - b^5\)
   [D] \(a^5 + 5a^4b + 10a^3b^2 + 10a^2b^3a + 5b^4 + b^5\)

35. A bowler usually gets 21 strikes for every 30 balls she bowls. What is the probability that she will get exactly 6 strikes with her next 10 balls?
   [A] \(\approx 0.008\)  [B] \(\approx 0.2\)  [C] \(\approx 0.118\)  [D] \(\approx 0.04\)

36. Find the mean, the median, and mode of the data set: 21, 18, 20, 4, 25, 24, 19, 7, 15
   [A] \(\bar{x} = 19; 17; 18\)  [B] \(\bar{x} = 17; 19; 18\)
   [C] \(\bar{x} = 19; 17;\) no mode  [D] \(\bar{x} = 17; 19;\) no mode
37. A mail-order catalog offers 26 items for sale at the following prices: four items for $18, two items for $21, fourteen items for $25, and six items for $32. Prepare a frequency table showing the number of items offered at each price. Then use the table to find the average price for all 26 catalog items.

<table>
<thead>
<tr>
<th>Price</th>
<th>Number of Items</th>
<th>Product ($ \times \text{No.})</th>
</tr>
</thead>
<tbody>
<tr>
<td>$32</td>
<td>4</td>
<td>$128</td>
</tr>
<tr>
<td>$25</td>
<td>2</td>
<td>$50</td>
</tr>
<tr>
<td>$21</td>
<td>14</td>
<td>$294</td>
</tr>
<tr>
<td>$18</td>
<td>6</td>
<td>$108</td>
</tr>
</tbody>
</table>

average price = $22.31

<table>
<thead>
<tr>
<th>Price</th>
<th>Number of Items</th>
<th>Product ($ \times \text{No.})</th>
</tr>
</thead>
<tbody>
<tr>
<td>$32</td>
<td>4</td>
<td>$128</td>
</tr>
<tr>
<td>$25</td>
<td>2</td>
<td>$50</td>
</tr>
<tr>
<td>$21</td>
<td>14</td>
<td>$294</td>
</tr>
<tr>
<td>$18</td>
<td>6</td>
<td>$108</td>
</tr>
</tbody>
</table>

average price = $24.77

<table>
<thead>
<tr>
<th>Price</th>
<th>Number of Items</th>
<th>Product ($ \times \text{No.})</th>
</tr>
</thead>
<tbody>
<tr>
<td>$18</td>
<td>4</td>
<td>$72</td>
</tr>
<tr>
<td>$21</td>
<td>2</td>
<td>$42</td>
</tr>
<tr>
<td>$25</td>
<td>14</td>
<td>$350</td>
</tr>
<tr>
<td>$32</td>
<td>6</td>
<td>$192</td>
</tr>
</tbody>
</table>

average price = $24.00

<table>
<thead>
<tr>
<th>Price</th>
<th>Number of Items</th>
<th>Product ($ \times \text{No.})</th>
</tr>
</thead>
<tbody>
<tr>
<td>$18</td>
<td>4</td>
<td>$72</td>
</tr>
<tr>
<td>$21</td>
<td>2</td>
<td>$42</td>
</tr>
<tr>
<td>$25</td>
<td>14</td>
<td>$350</td>
</tr>
<tr>
<td>$32</td>
<td>6</td>
<td>$192</td>
</tr>
</tbody>
</table>

average price = $25.23
38. The relative frequency histogram below represents the age in years of the first 100 children to have their portraits taken at the “See What Develops” photography studio. What is the probability that the next child to have portraits taken will be between 1 and 2 years old?

![Relative Frequency Histogram]

- [A] 17%
- [B] 15%
- [C] 16%
- [D] 24%

39. Find the minimum and maximum values, \(Q_1\), \(Q_2\), and \(Q_3\) for the following data. Then use these values to draw a box-and-whisker plot.

33, 19, 23, 19, 27, 28, 31, 22, 21, 19, 33, 22, 30, 32, 22

- [A] minimum = 19; maximum = 35;
  \(Q_1 = 21; Q_2 = 26; Q_3 = 31\)

- [B] minimum = 19; maximum = 33;
  \(Q_1 = 21; Q_2 = 23; Q_3 = 31\)

- [C] minimum = 18; maximum = 33;
  \(Q_1 = 20; Q_2 = 26; Q_3 = 31\)

- [D] minimum = 19; maximum = 34;
  \(Q_1 = 21; Q_2 = 23; Q_3 = 32\)
40. Find the variance and the standard deviation for the following data.
   6, 19, 12, 17, 21, 4, 22, 18, 16
   [A] variance $\approx 36.22$; standard deviation $\approx 6.34$
   [B] variance $\approx 40.22$; standard deviation $\approx 6.02$
   [C] variance $\approx 36.22$; standard deviation $\approx 6.02$
   [D] variance $\approx 40.22$; standard deviation $\approx 6.34$

41. A company guarantees customer satisfaction on the purchase of a product, or the company will refund the purchase price of the product. Previous experience has shown that 9% of all purchases are returned. What is the probability that no more than 1 of the next 7 purchases will be returned?
   [A] $\approx 0.125$  [B] $\approx 0.013$  [C] $\approx 0.875$  [D] $\approx 0.987$

42. The personal savings of the Young Saver Club were normally distributed with a mean of $750 and a standard deviation of $62. What is the probability that a randomly selected saver has an account total between $874 and $936?
   [A] 0.6826  [B] 0.3413  [C] 0.0215  [D] 0.215

43. The table below shows voters' choices for class clown.

<table>
<thead>
<tr>
<th>First Choice</th>
<th>Second Choice</th>
<th>Third Choice</th>
<th>Fourth Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>KARL</td>
<td>LUIS</td>
<td>MONICA</td>
<td>BEN</td>
</tr>
<tr>
<td>22</td>
<td>14</td>
<td>16</td>
<td>19</td>
</tr>
</tbody>
</table>

Using the plurality-with-elimination method, who is selected class clown?
44. The table below shows voters' choices for class clown.

Using the pairwise comparison method, who is selected class clown?


45. The table below shows voters' choices for class clown.

Using the Borda count method, who is selected class clown?


46. The United Nations Security Council, which consists of the five nations noted in the table below, is considering allotting 52 delegates according to population. The apportionment methods being considered are also noted in the table.

Which method most favors the United States?

47. NASCAR has 26 security representatives assigned to four racetracks using the Hamilton apportionment method based on average attendance, as illustrated in the table below:

<table>
<thead>
<tr>
<th>Racetrack</th>
<th>Martinsville</th>
<th>Charlotte</th>
<th>Bristol</th>
<th>Texas</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance</td>
<td>17,000</td>
<td>110,000</td>
<td>72,000</td>
<td>93,000</td>
<td>292,000</td>
</tr>
<tr>
<td>Lower Quota: LQ</td>
<td>1</td>
<td>9</td>
<td>6</td>
<td>8</td>
<td>24</td>
</tr>
<tr>
<td>Hamilton</td>
<td>2</td>
<td>10</td>
<td>6</td>
<td>8</td>
<td>26</td>
</tr>
</tbody>
</table>

One extra security representative is to be added, bringing the total to 27. If the Hamilton method is used again, how will the security representatives be apportioned to the four racetracks?

[A] Charlotte will lose 1, because it has the most, and Martinsville and Bristol will each gain 1, because they have the fewest.

[B] Charlotte will gain 1 and the others will remain the same.

[C] Bristol will gain 1 and the others will remain the same.

[D] Bristol and Texas will each gain 1 and Martinsville will lose 1.