Consider the preference schedule below for questions 1-10.

<table>
<thead>
<tr>
<th>Number of voters</th>
<th>27</th>
<th>19</th>
<th>8</th>
<th>15</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Choice</td>
<td>B</td>
<td>A</td>
<td>D</td>
<td>C</td>
<td>A</td>
</tr>
<tr>
<td>2nd Choice</td>
<td>D</td>
<td>D</td>
<td>C</td>
<td>A</td>
<td>C</td>
</tr>
<tr>
<td>3rd Choice</td>
<td>A</td>
<td>C</td>
<td>A</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>4th Choice</td>
<td>C</td>
<td>B</td>
<td>B</td>
<td>B</td>
<td>B</td>
</tr>
</tbody>
</table>

1. Who wins using the plurality method?
   A) A, B) B, C) C, D) D, E) none of these
   1. B

2. Who wins using the Borda Count method?
   A) A, B) B, C) C, D) D, E) none of these
   2. D

3. Who wins using plurality with elimination?
   A) A, B) B, C) C, D) D, E) none of these
   3. C

4. Who wins using pairwise comparison?
   A) A, B) B, C) C, D) D, E) none of these
   4. A

5. A Condorcet candidate is
   A) A, B) B, C) C, D) D, E) none of these
   5. A

6. The majority winner is
   A) A, B) B, C) C, D) D, E) none of these
   6. E

7. Who comes in last using the extended plurality method?
   A) A, B) B, C) C, D) D, E) none of these
   7. D

8. Who comes in last using the extended Borda count ranking?
   A) A, B) B, C) C, D) D, E) none of these
   8. B

9. Who comes in third using the recursive plurality ranking?
   A) A, B) B, C) C, D) D, E) none of these
   9. A

10. Who comes in third using the recursive plurality with elimination ranking?
    A) A, B) B, C) C, D) D, E) none of these
    10. D
Consider the weighted voting system [25: 22, 12, 6, 3] for problems 11-12

11. The weight of the coalition \( \{ P_2, P_3, P_4 \} \) is
   A) 21, B) 22, C) 40, D) 25, E) none of these
   11. A

12. The Banzhaf power indices are
   A) 3/5, 1/5, 1/10, 1/10  B) 1/4, 1/4, 1/4, 1/4
   C) 2/5, 1/5, 1/5, 1/5  D) 7/10, 1/10, 1/10, 1/10
   12. D

Consider the weighted voting system [8: 6, 3, 2]

13. In how many sequential coalitions is player \( P_1 \) pivotal?
   A) 0, B) 1, C) 2, D) 4, E) none of these
   13. D

14. The Shapley-Shubik power distribution is
   A) 4/6, 1/6, 1/6  B) 1/2, 1/2, 1/2  C) 1/3, 1/3, 1/3
   D) 1/2, 1/3, 1/6  E) none of these
   14. A

15. In the weighted voting system [ q: 22, 12, 8, 4, 2 ], the smallest number that q can take on is
   A) 24, B) 25, C) 26, D) 27, E) none of these
   15. B

16. In the weighted voting system [21: 10, 8, 5, 3, 2] the number of coalitions is
   A) 32, B) 31, C) 120, D) 5, E) 50
   16. B

17. In the weighted voting system [21: 10, 8, 5, 3, 2] the number of sequential coalitions is
   A) 32, B) 31, C) 120, D) 5, E) 50
   17. C

18. \( 8 + 9 + \ldots + 60 = \)
   A) 77, B) 1830, C) 1802, D) 480, E) none of these
   18. C

19. A pizza house offers a choice of 2 different crusts, 2 different sauces and 9 different toppings. How many different 1 topping pizzas are possible?
   A) 13, B) 36, C) 18, D) 24, E) none of these
   19. B

20. \( 38!/36! \)
   A) 1368, B) 1406, C) 1240, D) 2, E) none of these
   20. B
1. $A: 2.27 + 4.19 + 4.8 + 3.15 + 2.4 = 119$
   $B: 4.27 + 1.16 + 1.8 + 1.15 + 1.2 = 152$
   $C: 1.27 + 2.19 + 3.8 + 4.15 + 2.8 = 155$
   $D: 3.27 + 3.19 + 4.8 + 2.15 + 2.2 = 204$

2. D (elim first) $27 + 19 + 8 + 15 = C$
   B  A  C  C  A
   A  C  A # C
   C  B  B  B  B

A elim next the B then C

4. A vs B $15 + 8 + 15 + 2 \not= 27$
   A vs C $27 + 19 + 2 \not= 8 + 15$
   A vs D $15 + 15 + 2 \not= 27 + 8$
   B vs C $27 \not= 12 + 8 + 15 + 2$
   B vs D $27 \not= 19 + 8 + 15 + 2$
   C vs D $15 + 2 \not= 27 + 19 + 8$

5. A vs all pairwise comparison

6. None

7. Extended plausibly B, A, C, D

8. Extended Borda D, A, C, B
9. **Plurality**

**B wins 1st** → 27 18 18 15 2 → **Draw A wins**

**Ranking B, D, A, C**

10. **C wins 1st plus w. elim**

**Draw** → 27 19 8 15 2 → A wins 2nd plus w. elim

**Ranking C, A, D, B**

11. **12 + 6 + 3 = 21**

12. **WinningCoal**

\[
\begin{array}{c}
\{P_1, P_2, 3\} \\
\{P_1, P_3, 3\} \\
\{P_1, P_2, 3\} \\
\{P_2, P_3, 3\} \\
\{P_4, P_2, 3\} \\
\{P_1, P_3, 3\} \\
\{P_3, P_4, 3\} \\
\{P_1, P_2, P_3, 3\} \\
\{P_1, P_2, P_4, 3\} \\
\{P_1, P_3, P_4, 3\} \\
\{P_1, P_2, P_3, 3\} \\
\{P_1, P_2, P_3, 3\} \\
\{P_1, P_2, P_3, 3\}
\end{array}
\]

**Player** | **Cat.** | **Index**
---|---|---
P_1 | 7 | 3/10
P_2 | 1 | 1/10
P_3 | 1 | 1/10
P_4 | 1/10 | 0
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>13. ( &lt;P_1 P_2 P_3&gt; ) ( &lt;P_2 P_3 P&gt; ) ( &lt;P_1 P_3 P&gt; ) ( &lt;P_3 P_1 P&gt; ) ( &lt;P_3 P_2 P&gt; ) ( &lt;P_1 P_2 P&gt; )</td>
<td>4 times</td>
</tr>
<tr>
<td>14. Index</td>
<td>4/6</td>
</tr>
<tr>
<td>( P_1 )</td>
<td>4</td>
</tr>
<tr>
<td>( P_2 )</td>
<td>1</td>
</tr>
<tr>
<td>( P_3 )</td>
<td>1</td>
</tr>
<tr>
<td>15. ( \frac{22 + 12 + 8 + 4 + 2}{2} = 24 )</td>
<td>( \frac{48}{2} = 24 )</td>
</tr>
<tr>
<td>16. 5 players</td>
<td>( 2^5 - 1 = 31 )</td>
</tr>
<tr>
<td>17. 5 players</td>
<td>( 5! = 120 )</td>
</tr>
<tr>
<td>18. ( 8 + 9 + \cdots + 60 = 1 + 2 + \cdots + 60 - (1 + \cdots + 7) = \frac{60 \cdot 61}{2} - \frac{7 \cdot 8}{2} )</td>
<td>( \frac{60 \cdot 61}{2} - \frac{7 \cdot 8}{2} = 1802 )</td>
</tr>
<tr>
<td>19. ( 2 \times 2 \times 9 = 36 )</td>
<td></td>
</tr>
<tr>
<td>20. ( \frac{391}{381} = 38.373635\cdots )</td>
<td>( 38.37 )</td>
</tr>
<tr>
<td>21. ( \frac{381}{361} = 36.35\cdots )</td>
<td>( 140.6 )</td>
</tr>
</tbody>
</table>