E. 2

compare + switch
if "out of order"

$\frac{N}{2}$ comparisons
Smallest if 1st half $\rightarrow$ scan 1st half for smallest

largest in 2nd half $\rightarrow$ scan 2nd half for largest

E. 6

Selection sort + stop after $m$ iterations
of outer loop

$(m-1) + (n-2) + (n-3) + \ldots + (n-m)$
\[
\frac{(n-1) + (n-2) + (n-3) + \ldots + (n-m)}{n + n + \ldots + n - (1 + 2 + 3 + \ldots + m)} = \frac{n \cdot (n-1)^m - m \cdot (m-1)}{2}
\]

\[
\frac{n \cdot m - m \cdot (m+1)}{2}
\]

**E. 12**

<table>
<thead>
<tr>
<th>Items</th>
<th>F</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(\Theta(n) \) Initialize to all False.

\(\Theta(n) \) For each integer \( i \), set \( \text{Item}[i] = \text{True} \).

\(\Theta(n) \) Scan items from 1 to \( kn \), if \( \text{Item}[i] = \text{False} \), put \( i \) in item array.

\(2k+1)n < \Theta(n)\)
E.25 \[ T(n) = c, 2^n. \]

Current computer \[ T(30) = c_{\text{old}} 2^{30} = 1 \text{ min}. \]

\[ c_{\text{old}} = \frac{1}{2^{30}} \text{ time to do loop once} \]

On new computer, \[ T(60) = c_{\text{new}} 2^{60} = 1 \text{ min}. \]

\[ c_{\text{new}} = \frac{1}{2^{60}} \]

\[ \frac{c_{\text{old}}}{c_{\text{new}}} = \frac{2^{30}}{1} = 2^{30} \text{ times faster!} \]
\( E \circ 26 \)

\[
\text{for } (i = 1; i \leq 1.5n; i++) \\
\quad \text{cout} < < i; \\
\text{for } (i = n; i > = 1; i--) \; \Theta (n) \\
\quad \text{cout} \; < < i;
\]

(a) \( n = 2 \) output: 12321  \\
\( n = 4 \) output: 1234564321  \\
\( n = 6 \) output: 123456789654321

(b) \( \Theta (1.5n) + \Theta (n) \in \Theta (n) \)
E. 27

\[ j = 1; \]
\[ \text{while } (j \leq \frac{n}{2}) \quad \exists \]
\[ i = 1; \]
\[ \text{while } (i \leq j) \quad \exists \]
\[ \text{cout} \ll j \ll \text{cout}; \]
\[ i++; \]
\[ j++; \]
\[ j++; \]

\[ n = 6 \quad \text{output:} \quad 11 \]
\[ 21 \]
\[ 22 \]
\[ 31 \]
\[ 32 \]
\[ 33 \]

\[ n = 8 \quad \text{output:} \quad 11 \]
\[ 21 \]
\[ 22 \]
\[ 31 \]
\[ 32 \]
\[ 33 \]
\[ 41 \]
\[ 42 \]
\[ 43 \]
\[ 44 \]

\[ n = 10 \quad \text{output:} \quad 11 \]
\[ 21 \]
\[ 22 \]
\[ 31 \]
\[ 32 \]
\[ 33 \]
\[ 41 \]
\[ 42 \]
\[ 43 \]
\[ 44 \]
\[T(n) = \left(\frac{n}{2} + 1\right) \frac{n}{4} = \frac{n^2}{8} + \frac{n}{4} \in \Theta(n^2)\]
\[ E \]

\[ i = n, \quad j = \frac{n}{2}, \quad \text{for} \quad i = \frac{n}{2} \]

\[ j = n, \quad j = \frac{n}{2}, \quad j = \frac{n}{4} \]

\[ 0 = n, \quad j = \frac{n}{2}, \quad j = n \]

\[ 1 + 2 + 3 + \ldots + \log_2 n \]

\[ \left( \log_2 + 1 \right) \left( \log_2 n \right) = \log_2 n \]

\[ \frac{2}{2} \]

\[ \log_2 n \]

\[ \Theta \left( \log_2^2 n \right) \]