For questions, refer to the Quiz page. Only the solutions are given below.

Q1: The de-multiplexer takes one single input data line and then switches it to any one of output lines one at a time. This is same when we use decoder with enable. The input data line is the enable. So whatever data is in enable is passed on to one of the outputs.

Answer: C

Q2: Remember, the question explicitly said that only the uncomplemented inputs are available. Hence B' is not freely available for XNOR, it has to be made using a mux.

Answer: C

Q3:

Answer: C
Q4: Answer: A

Q5:

<table>
<thead>
<tr>
<th>Level</th>
<th>Decoders</th>
<th>Output Enable</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>16</td>
<td>256</td>
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<tr>
<td>3</td>
<td>256</td>
<td>4096</td>
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<tr>
<td>4</td>
<td>4096</td>
<td>65536</td>
</tr>
</tbody>
</table>

Every level has 4 inputs making altogether 16 inputs.

Total number of decoders is $1 + 16 + 256 + 4096 = 4369$

Q6:

<table>
<thead>
<tr>
<th>Binary Inputs</th>
<th>Decoder Outputs a b c d e f g</th>
<th>7-Segment Display Outputs</th>
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</thead>
<tbody>
<tr>
<td>0 0 0 0</td>
<td>1 1 1 1 1 1 1 0</td>
<td>0</td>
</tr>
<tr>
<td>0 0 0 1</td>
<td>0 1 1 0 0 0 0 0</td>
<td>1</td>
</tr>
<tr>
<td>0 0 1 0</td>
<td>1 1 0 1 1 0 1 1</td>
<td>2</td>
</tr>
<tr>
<td>0 0 1 1</td>
<td>1 1 1 1 0 0 1 1</td>
<td>3</td>
</tr>
<tr>
<td>0 1 0 0</td>
<td>0 1 1 0 0 1 1 1</td>
<td>4</td>
</tr>
<tr>
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<td>1 0 1 1 0 1 1 1</td>
<td>5</td>
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<tr>
<td>0 1 1 0</td>
<td>1 0 1 1 1 1 1 1</td>
<td>6</td>
</tr>
<tr>
<td>0 1 1 1</td>
<td>1 1 1 0 0 0 0 0</td>
<td>7</td>
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<td>1 0 0 0</td>
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</tr>
<tr>
<td>1 0 0 1</td>
<td>1 1 1 1 0 1 1 1</td>
<td>9</td>
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CD AB →

<table>
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<tr>
<th></th>
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<th>11</th>
<th>10</th>
</tr>
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<tr>
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<tr>
<td>10</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Answer: A
Q7: Enable is 0 hence all values are 0

Answer: D

Q8: The question is asking for Shannon’s expansion on two variables. If we pick out $x_1, x_2$, all 4 combinations of $x_1, x_2$ must occur with the appropriate co-factor (which reflects whether complemented or uncomplemented version of $x_1, x_2$ are chosen). For example, for the $x_1x_2'$ term, the cofactor must have $x_1=1$ and $x_2=0$.

Answer: A

Q9: Try Shannon’s expansion with all three variables, $a, b$ and $c$.

$F = a'c + bc'$

Using $a$, $F = a(bc') + a'(bc'+c) = a(bc') + a'(b+c)$ This requires one inverter, one AND and one OR gate on top of a 2:1 mux.

Using $b$, $F = b(c'+a'c) + b'(a'c) = b(a'+c) + b'(a'c)$ This also requires one inverter, one AND and one OR gate on top of a 2:1 mux.

Using $c$, $F = c(a') + c'(b)$ which needs only one inverter and 2:1 mux.

Answer: 0,0,1