For the next five questions, your response will be one of the following:

A. Partial order but not a total order.
B. Partial order and a total order.
C. Strict order but not a total order.
D. Strict order and a total order.
E. Neither a partial order nor a strict order.

Select one of the five choices above that describes each of the following relations.

C. 1. The domain is $\mathbb{Z} \times \mathbb{Z}$, $(a, b)$ is related to $(c, d)$ if $a < c$ and $b < d$.

B. 2. The domain is the set of students on a wait list to get into a course. Student $x$ is related to student $y$ if student $x$ is at least as high on the list as $y$ (i.e., $x$ is not lower on the list than $y$).

A. 3. The domain is the set of positive integers. $x$ is related to $y$ if there is a positive integer $n$ such that $y = x \cdot n$.

C. 4. The domain is the set of all positive numbers. $x$ is related to $y$ if $\lfloor x/2 \rfloor < \lfloor y/2 \rfloor$.

E. 5. The domain is the set of all positive numbers. $x$ is related to $y$ if $\lfloor x/2 \rfloor \leq \lfloor y/2 \rfloor$.

The matrix below is an adjacency matrix for a graph $G$. The vertices are $\{1, 2, 3, 4\}$. The rows and columns of the matrix are numbered 1 through 4.

$$
\begin{bmatrix}
0 & 1 & 0 & 1 \\
0 & 1 & 1 & 0 \\
1 & 1 & 0 & 0 \\
1 & 0 & 1 & 0
\end{bmatrix}
$$

6. What is the set of edges going into vertex 2 in $G$ (i.e., the edges whose head is vertex 2 in $G$)?

A. $\{(2, 2), (3, 2)\}$
B. $\{(2, 2), (2, 3)\}$
C. $\{(1, 2), (2, 2), (3, 2)\}$
D. $\{(1, 2), (2, 2), (3, 2), (2, 3)\}$

7. What is row 2 of the adjacency matrix for $G^2$?

A. $\begin{bmatrix} 0 & 1 & 1 & 0 \end{bmatrix}$
B. $\begin{bmatrix} 1 & 1 & 1 & 0 \end{bmatrix}$
C. $\begin{bmatrix} 0 & 1 & 1 & 1 \end{bmatrix}$
D. $\begin{bmatrix} 0 & 1 & 0 & 1 \end{bmatrix}$

8. What is the set of edges going out of vertex 2 in $G^2$ (i.e., the edges whose tail is vertex 2 in $G^2$)?

A. $\{(1, 2), (2, 2), (3, 2)\}$
B. $\{(2, 1), (2, 2), (2, 3)\}$
C. $\{(2, 2), (2, 3)\}$
D. $\{(2, 2), (3, 2)\}$
9. In the Hasse diagram above, what are the minimal elements?
   A. \( \{h\} \)  
   B. \( \{c, b\} \)  
   C. \( \{e, h\} \)  
   D. \( \{b, c, e, h\} \)

10. In the Hasse diagram above, what is the set of elements that are comparable to \( a \)? The set you select should include all the elements that are comparable to \( a \) and not include any elements that are not comparable to \( a \).
   A. \( \{a, d, h\} \)  
   B. \( \{a, b, c, d\} \)  
   C. \( \{a, b, c, d, h\} \)  
   D. \( \{a, b, c, d, e, h\} \)

11. In the Hasse diagram above, what is the set of elements that are comparable to \( f \)? The set you select should include all the elements that are comparable to \( f \) and not include any elements that are not comparable to \( f \).
   A. \( \{e, f, g\} \)  
   B. \( \{e, f, g\} \)  
   C. \( \{c, e, f, g\} \)  
   D. \( \{c, d, e, f, g\} \)

12. For the directed graph \( G \) on the right, how many edges are in \( G^4 \)?
   A. 0  
   B. 2  
   C. 4  
   D. 10

13. For the directed graph \( G \) on the right, how many edges are going out of vertex \( C \) in \( G^\uparrow \)?
   A. 1  
   B. 3  
   C. 4  
   D. 5

14. Which of the following is not a topological sort of the vertices in \( G \)?
   A. \( C, B, F, A, E, J, H, D \)  
   B. \( B, C, F, A, J, E, H, D \)  
   C. \( C, B, F, J, E, H, D, A \)  
   D. \( \text{They are all topological sorts.} \)