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. Niether a partial order not a strict order.

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

- 1. The domain is $\mathbb{Z} \times \mathbb{Z}$. (a, b) is related to (c, d) if a < c and b < d.
- 3 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).
- 3. The domain is the set of positive integers. x is related to y if there is a positive integer n such that
- 4. The domain is the set of all positive numbres. x is related to y if $\lfloor x/2 \rfloor < \lfloor y/2 \rfloor$.
- 5. The domain is the set of all positive numbres. 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.

$$\left[\begin{array}{cccc} 0 & 1 & 0 & 1 \\ 0 & 1 & 1 & 0 \\ 1 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 \end{array}\right]$$

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.
$$\{(2,2),(2,3)\}$$

$$\bigoplus_{\text{D. } \{(1,2),(2,2),(3,2)\}} \{(1,2),(2,2),(3,2),(2,3)\}$$

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

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

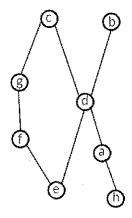
8. What is the set of edges going out of vertex 2 in G^2 (i.e. the edges whose tail is vertex 2 in G^2)?

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

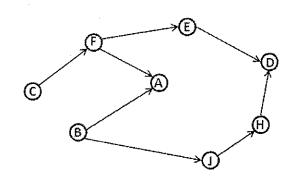
$$(B) \{(2,1), (2,2), (2,3)\}$$

C.
$$\{(2,2),(2,3)\}$$

D.
$$\{(2,2),(3,2)\}$$



Hasse diagram



Directed Acyclic Graph G

9. In the Hasse diagram above, what are the minimal elements?

B.
$$\{c, b\}$$

$$(c)$$
 $\{e,h\}$

$$\{b, c, e, h\}$$

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. $\{a, b, c, d, e, h\}$

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.
$$\{c, f, g\}$$

B.
$$\{e, f, g\}$$

$$\bigcirc \{c, e, f, g\}$$
D. $\{c, d, e, f, g\}$

D.
$$\{c, d, e, f, g\}$$

12. For the directed graph G on the right, how many edges are in G^4 ?

D. 10

13. For the directed graph G on the right, how many edges are going out of vertex C in G^+ ?

A. 1

B. 3

14. Which of the following is not a toppological sort of the vertices in G?

A.
$$C, B, F, A, E, J, H, D$$

C.
$$C, B, F, J, E, H, D, A$$

B.
$$B, C, F, A, J, E, H, D$$