

American Computer Science League

2020-2021 • Contest 4: Shorts • Senior Division

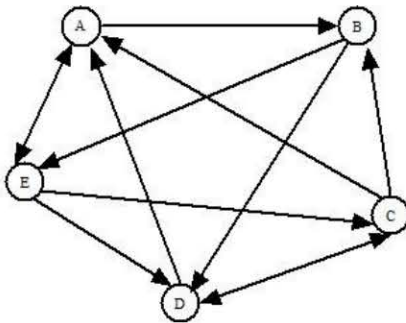
1. Graph Theory

Given the set of vertices $\{A, B, C, D\}$ and the set of directed edges $\{AB, AA, AC, AD, BA, BC, CC, DC\}$, how many paths are there of length 3?

- A. 21
- B. 22
- C. 25
- D. 26
- E. 28

2. Graph Theory

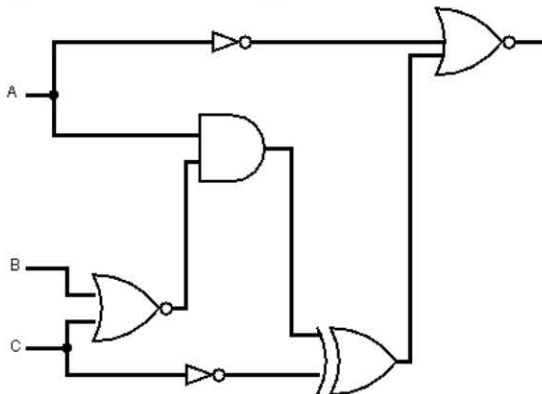
How many cycles are there in the following directed graph?



- A. 15
- B. 16
- C. 17
- D. 18
- E. 19

3. Digital Electronics

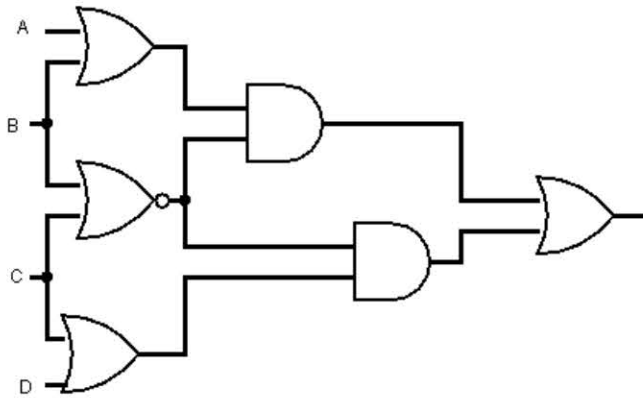
Identify the ordered triples that make the following circuit TRUE:



- A. $(1, *, 1), (1, 0, 0)$
- B. $(0, 1, 1), (1, 0, 0)$
- C. $(0, *, 1), (1, 0, *)$
- D. $(1, 1, 1), (0, 0, 0)$
- E. $(1, 0, 1), (*, 0, 0)$

4. Digital Electronics

Simplify the following to a Boolean expression that uses the fewest number of gates possible:



- A. $\overline{\overline{B}} \overline{\overline{C}} (C + D)$
- B. $\overline{\overline{B}} \overline{\overline{C}} (A + D)$
- C. $\overline{\overline{B}} \overline{\overline{C}} (A + C)$
- D. $\overline{\overline{B}} \overline{\overline{C}} (B + D)$
- E. $\overline{\overline{B}} \overline{\overline{C}} (A + B)$

5. Assembly Language

What is printed when the following program is executed?

N	DC	60	STOP	LOAD	S
	LOAD	N		ADD	F
TOP	SUB	=2		STORE	S
	BL	DONE		LOAD	P
	LOAD	=1		STORE	N
LOOP	ADD	=1		BU	TOP
	STORE	F	DONE	PRINT	S
	LOAD	N		END	
	DIV	F	S	DC	0
	STORE	P	F	DC	0
	MULT	F	P	DC	0
	SUB	N			
	BE	STOP			
	LOAD	F			
	BU	LOOP			

- A. 4
- B. 5
- C. 10
- D. 12
- E. 16

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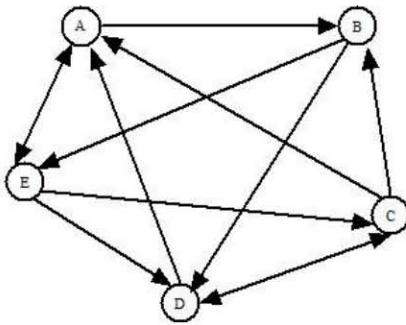
1. Graph Theory

给定顶点集合 $\{A, B, C, D\}$ 和有向边集合 $\{AB, AA, AC, AD, BA, BC, CC, DC\}$, 请问有多少条长度为 3 的路径?

- A. 21
- B. 22
- C. 25
- D. 26
- E. 28

2. Graph Theory

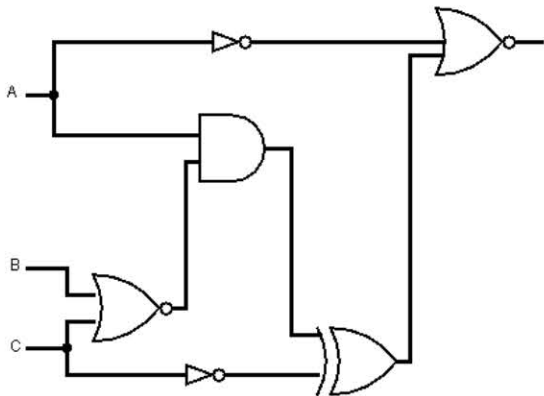
下面有向图中有多少个环?



- A. 15
- B. 16
- C. 17
- D. 18
- E. 19

3. Digital Electronics

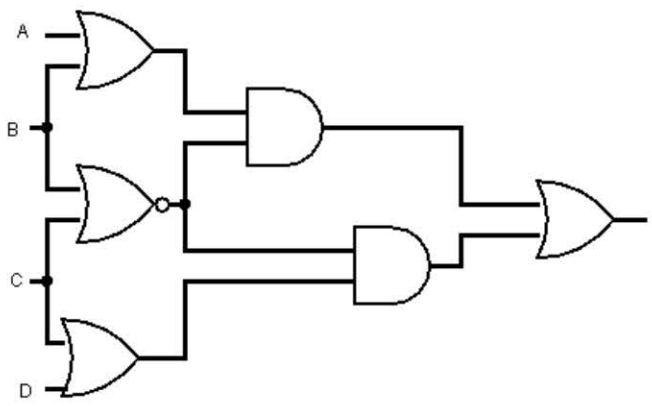
请找出可以使下述电路为真的有序三元组:



- A. $(1, *, 1), (1, 0, 0)$
- B. $(0, 1, 1), (1, 0, 0)$
- C. $(0, *, 1), (1, 0, *)$
- D. $(1, 1, 1), (0, 0, 0)$
- E. $(1, 0, 1), (*, 0, 0)$

4. Digital Electronics

将下方电路化简为布尔表达式，使得逻辑门数量最少。



- A. $\overline{\overline{B}}\overline{\overline{C}}(C + D)$
- B. $\overline{\overline{B}}\overline{\overline{C}}(A + D)$
- C. $\overline{\overline{B}}\overline{\overline{C}}(A + C)$
- D. $\overline{\overline{B}}\overline{\overline{C}}(B + D)$
- E. $\overline{\overline{B}}\overline{\overline{C}}(A + B)$

5. Assembly Language

执行下述程序会打印输出什么？

```
N      DC      60          STOP  LOAD  S
      LOAD    N              ADD    F
TOP    SUB     =2           STORE  S
      BL      DONE          LOAD   P
      LOAD    =1           STORE  N
LOOP   ADD     =1           BU     TOP
      STORE   F             DONE   PRINT S
      LOAD    N             END
      DIV     F             S      DC    0
      STORE   P             F      DC    0
      MULT    F             P      DC    0
      SUB     N
      BE      STOP
      LOAD    F
      BU      LOOP
```

- A. 4
- B. 5
- C. 10
- D. 12
- E. 16