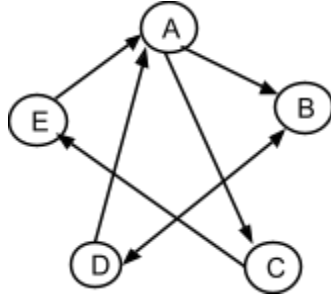


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1. Graph Theory

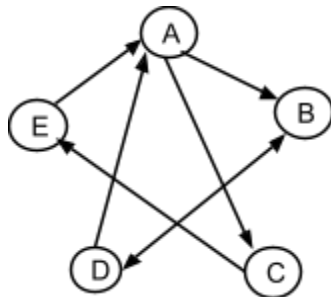
How many ordered pairs of vertices do not have paths of length 2 in the following directed graph? For example, (B,A) means from B to A. (This is the same graph as #2.)



- A. 12
- B. 14
- C. 15
- D. 16
- E. 20

2. Graph Theory

How many cycles are there in the directed graph below? (This is the same graph as #1.)



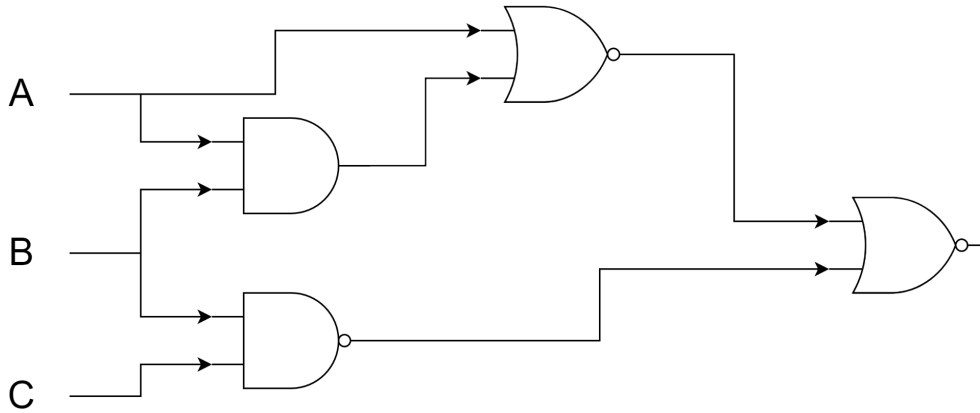
- A. 2
- B. 3
- C. 4
- D. 5
- E. 6

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3. Digital Electronics

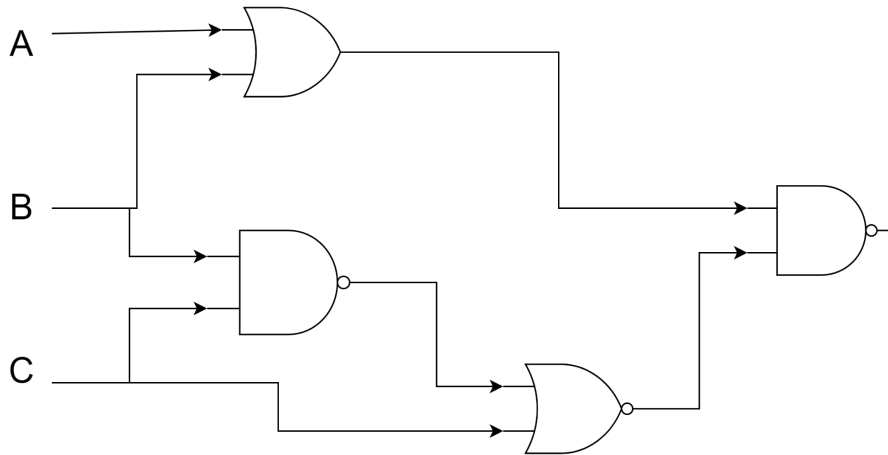
Simplify the Boolean expression represented by the following digital circuit:



- A. $A + B + C$
- B. $AB + C$
- C. $A + BC$
- D. ABC
- E. BC

4. Digital Electronics

How many ordered triples make the following digital circuit TRUE?



- A. 0
- B. 2
- C. 4
- D. 6
- E. 8

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5. What Does This Program Do? (Strings)

Define the functions `val(x)` to get the numeric value of a string and `str(x)` to make a numeric value into a string. For example, `val("9") = 9` and `str(9) = "9"`. What will be the output for the following program?

```
s = "639284510327493"
ans = ""
for x = 0 to len(s)-1
    v = val(s[x])
    if v < 5 then
        v = v * 2
    else
        v = int(v / 2)
    end if
    ans = str(v) + ans
next x
output ans
```

- A. 648346022844463
- B. 6483460210844463
- C. 142311002241413
- D. 364448220643846
- E. 658446023824563