

Answer

(Choose 1 answer)

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E

[Back](#)[Next](#)Let $a = 137 \bmod 31$ and $b = -137 \bmod 31$. Find $b - a$.

- A. 5
- B. -7
- C. 23
- D. -13
- E. 17

☐ I want to finish the exam.[Finish](#)[Exit](#)

Answer

☐ A☐ B☐ C☐ D

(Choose 1 answer)

(See picture)

A. (i)

B. None of the other choices is correct

C. (iii)

D. (ii)

[Back](#)[Next](#)

Determine the complexity of this algorithm in terms of the number of **comparisons**.

```
procedure thuattoan( $a_1, a_2, \dots, a_n$ : integers)
 $k := 0$ 
for  $i := 1$  to  $n$  do
    if  $a_i < 0$  then  $k := k + 1$ 
print( $k$ )
```

(i) $O(n)$ (ii) $O(\log n)$ (iii) $O(1)$ ☐ I want to finish the exam.[Finish](#)[Exit](#)

Answer

(Choose 1 answer)

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E

[Back](#)[Next](#)

Decode the message 110111010 encoded by the scheme

f: 10, p: 110, t: 1110.

- A. ptf
- B. fpt
- C. tpf
- D. pft
- E. None of the other choices is correct

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Answer

(Choose 1 answer)

☐ A

(See picture)

☐ B

A. 0 and 1

☐ C

B. 0 and 0

☐ D

C. 1 and 0

D. 1 and 1

[Back](#)[Next](#)Let a_1, a_2, \dots be the sequence
$$0, 1, 1, 0, 0, 0, 1, 1, 1, 1, \dots$$
Find a_{99} and a_{100} .☐ I want to finish the exam.[Finish](#)[Exit](#)

Answer

(Choose 1 answer)

☐ A

(See picture)

☐ B

A. 4

☐ C

B. 0

☐ D

C. 1

☐ E

D. 3

E. 2

[Back](#)[Next](#)

Find the smallest integer n such that the following function is $O(x^n)$

$$\lceil x \log x \rceil + \lfloor x + \log x \rfloor$$

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Answer

(Choose 1 answer)

☐ A

(See picture)

☐ B

A. 6

☐ C

B. 2

☐ D

C. None of the other choices is correct

☐ E

D. 12

E. 3

[Back](#)[Next](#)

Given $X = \{\emptyset, \{\emptyset\}, \{a, b\}, c\}$, $Y = \{x, \{z, z\}, x\}$.

How many one-to-one functions are there from Y to X ?

☐ I want to finish the exam.[Finish](#)[Exit](#)

Answer

(Choose 1 answer)

☐ A

(See picture)

☐ B

A. (iii)

☐ C

B. (i)

☐ D

C. (ii)

D. None of the other choices is correct

[Back](#)[Next](#)

Which of the following is a function?

(i) $f: \mathbf{N} \rightarrow \mathbf{N}, f(n) = \sqrt{n}$

(ii) $f: \mathbf{N} \rightarrow \mathbf{R}, f(n) = \sqrt{n}$

(iii) $f: \mathbf{R} \rightarrow \mathbf{N}, f(n) = \sqrt{n}$

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Answer

(Choose 1 answer)

☐ A

Find the length of the shortest path from a to z.

☐ B

A. None of the other choices is correct

☐ C

B. 13

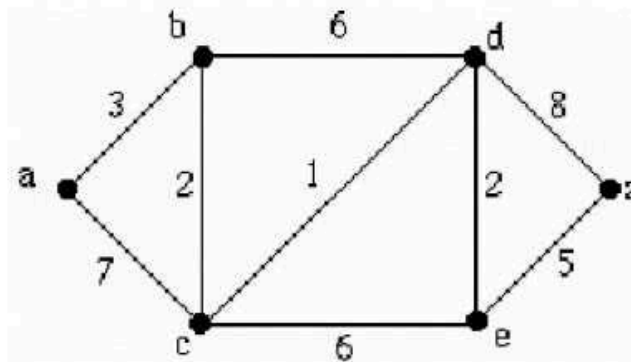
☐ D

C. 9

☐ E

D. 8

E. 11

[Back](#)[Next](#)☐ I want to finish the exam.[Finish](#)[Exit](#)

Answer

(Choose 1 answer)

- ☐ A
- ☐ B
- ☐ C
- ☐ D

[Back](#)[Next](#)

How many strings of three decimal digits have exactly two digits that are 4s?

- A. 27
- B. 28
- C. 29
- D. 30

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Answer

(Choose 1 answer)

☐ A☐ B☐ C☐ D☐ E

Which of the following is NOT a circuit in this graph ?
(See picture)

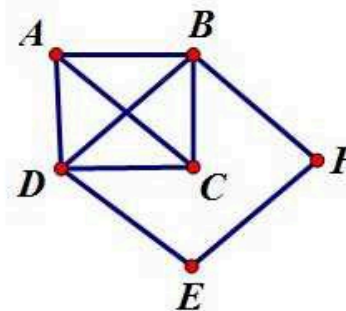
A. A - B - C - D - F - B - A

B. C - D - E - F - B - A - C

C. D - B - F - E - D

D. B - A - D - E - F - B

E. E - F - B - A - D - E

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Answer

(Choose 1 answer)

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E

[Back](#)[Next](#)

Consider the argument with the hypotheses:

" I will be happy if your project succeeds.
Your project can become successful only if you change the method."

and the conclusion:

" Therefore, if you change the method, then I will be very happy."

Choose the right answer.

- A. The argument is valid using hypothetical syllogism
- B. The argument is invalid
- C. The argument is valid using modus tollens
- D. The argument is valid using simplification
- E. The argument is valid using modus ponens

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[Finish](#)[Exit](#)

Answer

(Choose 1 answer)

☐ A

(See picture)

☐ B

A. (i)

☐ C

B. None of the other choices is correct

☐ D

C. (ii)

☐ E

D. (iv)

E. (iii)

[Back](#)[Next](#)

Let m, n be integers. Translate the sentence into a logical expression

“Each integer is either odd or even”

(i) $\forall m \forall n [(m=2n+1) \vee (m=2n)]$

(ii) $\forall m \exists n [(m=2n+1) \vee (m=2n)]$

(iii) $\exists m \exists n [(m=2n+1) \vee (m=2n)]$

(iv) $\exists m \forall n [(m=2n+1) \vee (m=2n)]$

☐ I want to finish the exam.[Finish](#)[Exit](#)

Answer

(Choose 1 answer)

☐ A

(See picture)

☐ B

A. None of the other choices is correct

☐ C

B. 3

☐ D

C. 6

☐ E

D. 8

E. 7

[Back](#)[Next](#)Let $m = 2^{10} + 2^9$.Find $3^m \bmod 11$.☐ I want to finish the exam.[Finish](#)[Exit](#)

Answer

☐ A☐ B☐ C☐ D☐ E

(Choose 1 answer)

(See picture)

A. None of the other choices is correct

B. (i)

C. (iii)

D. (iv)

E. (ii)

Back

Next

Given the set $S \subseteq \mathbb{Z}$ defined recursively as follows:

Basis step: $4, 6 \in S$,

Recursive step : If $m, n \in S$ then $\begin{cases} -m \in S \\ m+n \in S \end{cases}$.

Find S .

(i) $S = \{a \in \mathbb{Z} \mid a \text{ is divisible by } 2\}$

(ii) $S = \{a \in \mathbb{Z} \mid a \text{ is divisible by } 3\}$

(iii) $S = \{a \in \mathbb{Z} \mid a \text{ is divisible by } 4\}$

(iv) $S = \{a \in \mathbb{Z} \mid a \text{ is divisible by } 6\}$

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Answer

☐ A☐ B☐ C☐ D☐ E

(Choose 1 answer)

(See picture)

A. (iii)

B. None of the other choices is correct

C. (iv)

D. (ii)

E. (i)

Back

Next

Let

 $P(x) = \text{"x is a freshman"}$ $Q(x) = \text{"x takes Dmath 1"}$,

where the domain consists of all students in a university.

Translate the sentence into logical expression:

"Every freshman must take Dmath 1".

(i) $\forall x(P(x) \wedge Q(x))$

(ii) $\forall x(P(x) \rightarrow Q(x))$

(iii) $\exists x(P(x) \wedge Q(x))$

(iv) $\exists x(P(x) \rightarrow Q(x))$

☐ I want to finish the exam.

Finish

Exit

Answer

☐ A☐ B☐ C☐ D☐ E

(Choose 1 answer)

(See picture)

A. (iii)

B. None of the other choices is correct

C. (i)

D. (ii)

E. (iv)

[Back](#)[Next](#)

Find the postfix notation for the expression

$$(x-y)^2+x(y+5)$$

(i) $x y - 2 \uparrow x y 5 + * +$

(ii) $+ \uparrow - x y 2 * x + 5 y$

(iii) $x - y \uparrow 2 + x * y + 5$

(iv) $+ \uparrow - x y 2 * x + y 5$

☐ I want to finish the exam.[Finish](#)[Exit](#)

Answer

(Choose 1 answer)

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E

[Back](#)[Next](#)

Let $U = \{a, b, c, d, e, f, g, h, i, j\}$. Let P be the subset of U whose bit string representation is 1 the subset of U whose bit string representation is 0100110111. Find the intersection of P and

- A. $\{b, e, h, i\}$
- B. $\{b, e, h, i, j\}$
- C. $\{c, f, g, j\}$
- D. $\{c, f, g, h, j\}$
- E. None of the other choices is correct

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[Finish](#)[Exit](#)

Answer

(Choose 1 answer)

☐ A

(See picture)

☐ B

A. (ii)

☐ C

B. (iv)

☐ D

C. (iii)

☐ E

D. (v)

☐ F

E. (i)

[Back](#)[Next](#)

F. None of the other choices

Let p and q be propositions. Which proposition is logically equivalent to $\neg p \rightarrow q$?

(i) $\neg q \rightarrow p$ (ii) $p \rightarrow q$ (iii) $p \vee \neg q$ (iv) $p \vee q$ (v) $p \wedge q$ ☐ I want to finish the exam.[Finish](#)[Exit](#)

Answer

(Choose 1 answer)

☐ A☐ B☐ C☐ D☐ E

Using depth-first search to produce a spanning tree for the given simple graph, and assume that the vertices are ordered alphabetically. Choose the vertex A as the root of this spanning tree. What is the spanning tree that we obtain?

A. (i)

B. None of the other choices is correct

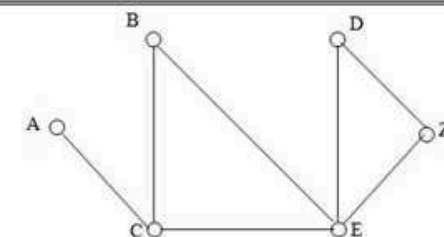
C. (iv)

D. (iii)

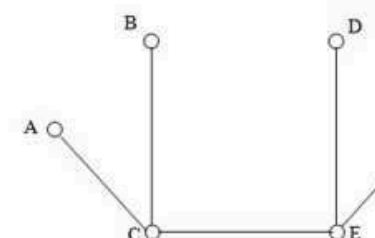
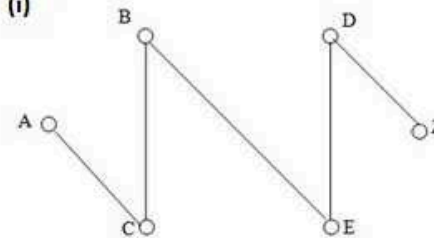
E. (ii)

Back

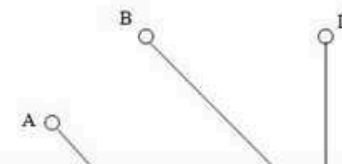
Next



(i)



(iii)

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Finish

Exit

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Answer

(Choose 1 answer)

☐

A

(See picture)

☐

B

A. None of the other choices is correct

☐

C

B. all $n > 2$ and odd☐

D

C. all $n > 2$ D. all $n > 2$ and even[Back](#)[Next](#)

For which $n > 2$ does the graph W_n have Euler circuits

☐ I want to finish the exam.[Finish](#)[Exit](#)

29

Answer

☐ A☐ B☐ C

(Choose 1 answer)

(See picture)

A. (i)

B. (ii)

C. (iii)

Back

Next

Find a proposition with the given truth table

p	q	?
T	T	F
T	F	F
F	T	T
F	F	T

(i) $(\neg p \wedge q) \vee (\neg p \wedge \neg q)$ (ii) $\neg p \wedge q$ (iii) $q \vee (\neg p \wedge \neg q)$ ☐ I want to finish the exam.

Finish

Exit

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Answer

☐ A☐ B☐ C☐ D

(Choose 1 answer)

(See picture)

A. (i)

B. (ii)

C. (iv)

D. (iii)

Back

Next

Let $T(n)$ be an increasing function such that $T(n) = 2T(n/2) + n$.
Choose the best answer.

(i) $T(n) = O(n)$ (ii) $T(n) = O(\log n)$ (iii) $T(n) = O(n^2)$ (iv) $T(n) = O(n^3)$ ☐ I want to finish the exam.

Finish

Exit

Answer

☐ A☐ B☐ C☐ D☐ E☐ F

Back

Next

(Choose 1 answer)

(See picture)

A. None of the other choices is correct

B. 7

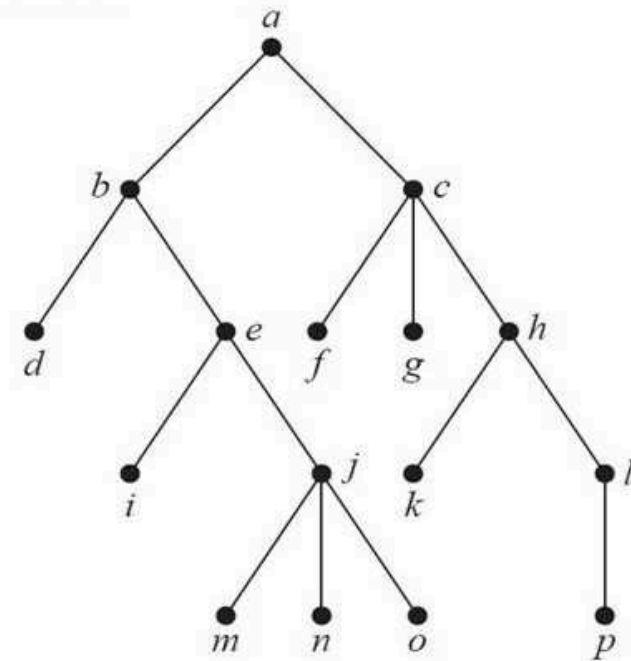
C. 11

D. 10

E. 9

F. 8

What is the position of the letter *f* when using the **inorder** traversal?

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Finish

Exit

26

Answer

(Choose 1 answer)

☐ A

(See picture)

☐ B

A. 516

☐ C

B. 625

☐ D

C. 1250

D. 1024

[Back](#)[Next](#)

Given the algorithm

Procedure LT(n, x : integer) $n = (a_k a_{k-1} \dots a_0)_2$ {the binary expansion of n } $p := 1$;for $i := 0$ to k do if $a_i = 1$ then $p := p * x$; $x := x * x$;Print(p)If $n = 5$, $x = 4$, what is the output of the algorithm?☐ I want to finish the exam.[Finish](#)[Exit](#)

27

Answer

(Choose 1 answer)

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E

Back

Next

Given the recursive algorithm that computes the n -th Fibonacci number

Procedure $F(n$: natural number)

If $n = 0$ then $F(n) := 0$

else

 If $n = 1$ then $F(n) := 1$

 else $F(n) := F(n-1) + F(n-2)$;

How many additions are used if $n = 6$?

- A. 8
- B. 7
- C. 9
- D. 12
- E. None of the other choices is correct

☐ I want to finish the exam.

Finish

Exit

Answer

(Choose 1 answer)

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E

[Back](#)[Next](#)

What is the average number of bits used for one character when using Huffman coding to encode the message "mathematic"?

- A. 2.8
- B. 2.2
- C. 2.6
- D. None of the other choices is correct
- E. 2.4

☐ I want to finish the exam.

[Finish](#)[Exit](#)

Answer

(Choose 1 answer)

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E

[Back](#)[Next](#)

How many edges in a full 3-ary tree with 101 leaves?

- A. 102
- B. 150
- C. None of the other choices is correct
- D. 101
- E. 97

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Answer

(Choose 1 answer)

☐ A

(See picture)

☐ B

A. (iv)

☐ C

B. (ii)

☐ D

C. (iii)

D. (i)

[Back](#)[Next](#)

Which graph has Hamilton circuits but no Euler circuits?

(i) K_4 (ii) Q_4 (iii) C_4 (iv) K_3 ☐ I want to finish the exam.[Finish](#)[Exit](#)

Answer

☐ A☐ B☐ C☐ D☐ E

(Choose 1 answer)

(See picture)

A. (i)

B. (iii)

C. (ii)

D. None of the other choices is correct

E. (iv)

[Back](#)[Next](#)

Find the binary expansion of 243

(i) $(11110010)_2$ (ii) $(11100010)_2$ (iii) $(11010011)_2$ (iv) $(11110011)_2$ ☐ I want to finish the exam.[Finish](#)[Exit](#)

20

Answer

(Choose 1 answer)

- ☐ A
- ☐ B
- ☐ C
- ☐ D

[Back](#)[Next](#)

How many divisions are needed when using Euclidean algorithm to find the greatest common divisor of 3135 and 3135?

- A. 4
- B. 5
- C. 6
- D. 7

☐ I want to finish the exam.

[Finish](#)[Exit](#)

21

Answer

(Choose 1 answer)

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E

Back

Next

Which number is congruent to 10 modulo 17?

- A. 90
- B. 80
- C. 85
- D. 95
- E. None of the other choices is correct

☐ I want to finish the exam.

Finish

Exit

Answer

(Choose 1 answer)

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E

[Back](#)[Next](#)

Which sequence can be the degree sequence of a simple graph?

- A. 2, 2, 3, 3, 4, 4
- B. 2, 2, 4, 4, 5, 5
- C. 0, 1, 2, 3, 4, 5
- D. 1, 1, 1, 2, 2, 2
- E. 1, 1, 2, 2, 4, 4, 6

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Answer

(Choose 1 answer)

☐ A

Given the Binary search algorithm (See picture)

☐ B☐ C☐ DIf input = 2, 4, 5, 7, 8, 9, 10, 13 and $x = 11$, after the third time of dividing into sublists, the sublist to be considered is _____

A. 10, 13

B. 13

C. 10

D. 9, 10

Back

Next

```
procedure Binarysearch( $a_1 < a_2 < \dots < a_n$ ,  $x$ : integer)
```

```
   $i := 1$ 
```

```
   $j := n$ 
```

```
  while ( $i \leq j$ )
```

```
     $m := \lfloor (i + j) / 2 \rfloor$ 
```

```
    if  $x > a_m$  then  $i := m + 1$ 
```

```
    else  $j := m$ 
```

```
  if  $x = a_i$  then location: =  $i$ 
```

```
  else location: = 0
```

☐ I want to finish the exam.

Finish

Exit

Answer

(Choose 1 answer)

☐ A

How many cut vertices and cut edges in this graph? (See picture)

☐ B

A. 6 and 6

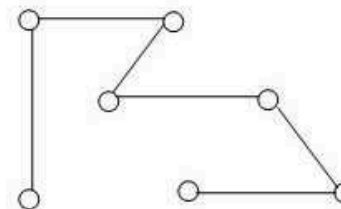
☐ C

B. 5 and 5

☐ D

C. 7 and 6

D. 5 and 6

[Back](#)[Next](#)☐ I want to finish the exam.[Finish](#)[Exit](#)

Answer

(Choose 1 answer)

☐ A

(See picture)

☐ B

A. 127

☐ C

B. 123

☐ D

C. 121

☐ E

D. 125

E. None of the other choices is correct

[Back](#)[Next](#)

Given a sequence $\{a_n\}$ satisfying the recurrence relation

$$a_0 = -1, a_n = a_{n-1} + 2^n \text{ for } n=1, 2, \dots$$

Find a_6 .

☐ I want to finish the exam.[Finish](#)[Exit](#)

Answer

(Choose 1 answer)

- ☐ A
- ☐ B
- ☐ C
- ☐ D

[Back](#)[Next](#)Find a if $\text{LCM}(a, 4200) = 58800$ and $\text{GCD}(a, 4200) = 280$.

- A. 11760
- B. 784
- C. 1960
- D. 3920

☐ I want to finish the exam.[Finish](#)[Exit](#)

Answer

(Choose 1 answer)

☐ A

(See picture)

☐ B

A. 28

☐ C

B. None of the other choices

☐ D

C. 26

☐ E

D. 27

E. 25

[Back](#)[Next](#)Find $f(5)$, if $f(n)$ is defined recursively by

$$f(0) = -1, f(1) = 2,$$

and

$$f(n+1) = f(n) + 5f(n-1) \text{ for } n=1, 2, 3, \dots$$

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Answer

- ☐ A
☐ B
☐ C
☐ D
☐ E

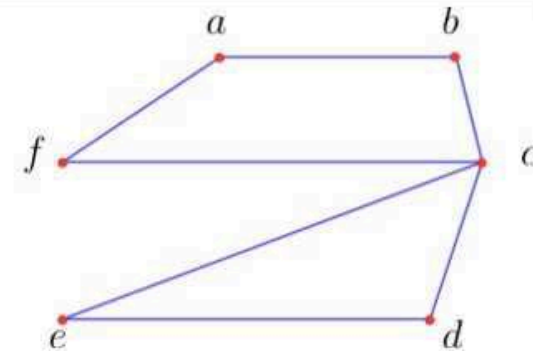
(Choose 1 answer)

(See picture)

- A. (iii)
 B. (ii)
 C. None of the other choices is correct
 D. (i)
 E. (iv)

Back

Next



The adjacency list to represent the given graph is

(i)

Vertex	Adjacent Vertices
<i>a</i>	<i>b, f</i>
<i>b</i>	<i>a, c</i>
<i>c</i>	<i>d, e, f</i>
<i>d</i>	<i>c, e</i>
<i>e</i>	<i>c, d</i>

(ii)

Vertex
<i>a</i>
<i>b</i>
<i>c</i>
<i>d</i>
<i>e</i>

Answer

☐ A☐ B☐ C☐ D☐ E

(Choose 1 answer)

(See picture)

A. (ii)

B. (iii)

C. (iv)

D. None of the other choices

E. (i)

Back

Next

Let $P(n)$ be the statement " $3n = 0$ ". The domain consists of all non-negative integers.

A proof of $\forall n P(n)$ is as follows:

- (i) $P(0)$ is clearly true.
- (ii) Assume that $P(0), \dots, P(k)$ are true for some non-negative integer k .
- (iii) Write $k+1 = i+j$ for some integers i, j with $0 \leq i, j \leq k$.
- (iv) We have:

$$3(k+1) = 3i + 3j = 0 + 0 = 0, \text{ as } P(i), P(j) \text{ are true. So } P(k+1) = 0. \text{ By strong induction, we conclude } \forall n P(n).$$

Which step is wrong in this proof?

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Finish

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10

Answer

(Choose 1 answer)

☐ A

(See picture)

☐ B

A. 3

☐ C

B. 2

☐ D

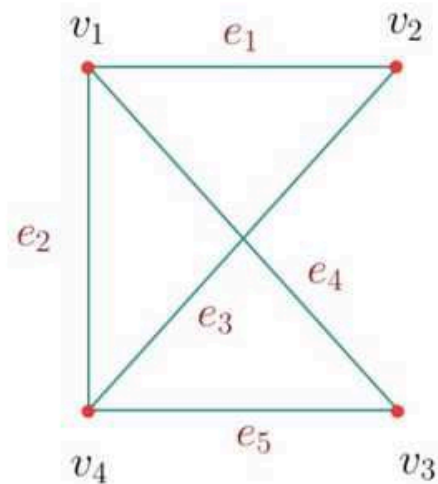
C. 1

D. 0

Back

Next

Let M be the incidence matrix of the given graph with rows indexed by v_1, v_2, v_3, v_4 , and the columns indexed by e_1, e_2, e_3, e_4, e_5 . What is the sum of the entries in the fourth row of M ?

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Answer

(Choose 1 answer)

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E

[Back](#)[Next](#)

Let G be a simple graph whose vertices are of degree 3. If G has 15 edges, how many vertices does G have?

- A. 10
- B. 20
- C. 5
- D. 25
- E. Such G does not exist

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[Finish](#)[Exit](#)

Answer

☐ A☐ B☐ C☐ D☐ E

(Choose 1 answer)

(See picture)

A. (iv)

B. (ii)

C. (iii)

D. (i)

E. None of the other choices is correct

[Back](#)[Next](#)

Find the negation of the proposition

$$\exists x \forall y (P(x, y) \rightarrow Q(x, y)).$$

(i) $\forall x \exists y (\neg P(x, y) \wedge Q(x, y))$

(ii) $\forall x \exists y (P(x, y) \wedge \neg Q(x, y))$

(iii) $\exists x \forall y (\neg P(x, y) \wedge Q(x, y))$

(iv) $\exists x \forall y (P(x, y) \wedge \neg Q(x, y))$

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7

Answer

☐ A☐ B☐ C☐ D☐ E

(Choose 1 answer)

(See picture)

A. None of the other choices is correct

B. h

C. g

D. g and h

E. f and g

Back

Next

Let $N = \{0, 1, 2, 3, \dots\}$.Which of the following functions are onto from N to N ?

$$f(n) = \left\lceil n - \frac{1}{2} \right\rceil$$

$$g(n) = \lfloor n \rfloor$$

$$h(n) = n+1$$

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8

Answer

(Choose 1 answer)

☐ A

(See picture)

☐ B

A. (iii)

☐ C

B. (i)

☐ D

C. (ii)

☐ E

D. (iv)

E. None of the other choices is correct

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Find the negation of the proposition

$$\exists x(P(x) \rightarrow Q(x))$$

(i) $\forall x(Q(x) \rightarrow P(x))$

(ii) $\forall x(\neg Q(x) \rightarrow P(x))$

(iii) $\forall x(\neg Q(x) \wedge P(x))$

(iv) $\forall x(\neg Q(x) \wedge \neg P(x))$

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Answer

(Choose 1 answer)

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E

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What is the maximum height of a full binary tree with 101 vertices?

- A. 50
- B. 100
- C. 6
- D. 101
- E. None of the other choices is correct

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4

Answer

(Choose 1 answer)

☐ A☐ B☐ C☐ D☐ E[Back](#)[Next](#)

What is the maximum height of a full binary tree with 101 vertices?

A. 50

B. 100

C. 6

D. 101

E. None of the other choices is correct

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4

Answer

(Choose 1 answer)

☐ A

(See picture)

☐ B

A. None of the other choices is correct

☐ C

B. 101100

☐ D

C. 001101

☐ E

D. 110000

E. 111101

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Find the value of the expression

$$(101101 \vee 110001) \oplus 001101$$

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Answer

☐ A☐ B☐ C☐ D

(Choose 1 answer)

(See picture)

A. {1, 2, 3, 4, 5}

B. {0, 1, 2, 3, 4, 5, 6}

C. {1, 2, 3, 4, 5, 8}

D. {1, 2, 3, 4, 5, 6, 8}

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Let

 $A = \{0, 2, 4, 6, 8, 10\}$, $B = \{1, 2, 3, 4, 5, 6\}$ and
 $C = \{1, 2, 3, 4, 5, 7, 8, 9\}$.Find $(A \cup B) \cap C$.☐ I want to finish the exam.[Finish](#)[Exit](#)

1

Answer

☐ A☐ B☐ C☐ D☐ E

(Choose 1 answer)

Using Prim's algorithm to find a minimal spanning tree. What is the list of edges chosen?

A. CE, BC, AB, DZ, EZ

B. CE, BC, AB, EZ, DZ

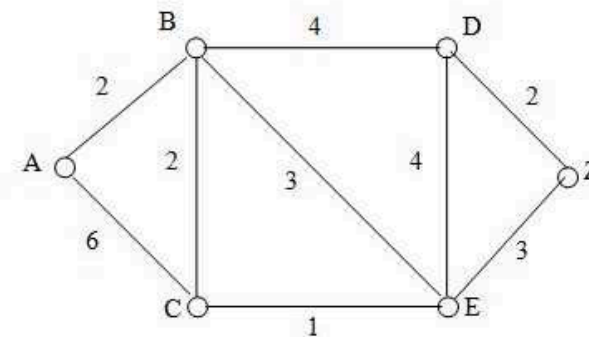
C. AB, BC, CE, BD, DZ

D. CE, BC, AB, BD, DZ

E. None of the other choices is correct

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Answer

☐ A☐ B☐ C☐ D

(Choose 1 answer)

(See picture)

A. (iii)

B. (iv)

C. (ii)

D. (i)

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Which of the following sets is the power set of

(i) $\{\emptyset, \{a\}, \{\emptyset, a\}\}$

(ii) $\{\emptyset, \{a\}, \{\emptyset\}, \{a, \emptyset\}\}$

(iii) $\{\emptyset, \{a\}, \{\emptyset\}, \{a, \{\emptyset\}\}\}$

(iv) $\{\emptyset, \{a, \emptyset\}\}$

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