QN=1

Let p, q be the propositions

p = "She is out of work"
q = "She spends less on clothes"

Translate the sentence into logical expression

"*Although she is out of work, she doesn't spend less on clothes.*"

(i) $p \rightarrow \neg q$

(ii) $p \wedge \neg q$

(iii) $p \vee \neg q$

(iv) $p \leftrightarrow \neg q$

(v) $\neg q \rightarrow p$

a.	(i)
b.	(ii)
c.	(iii)
d.	(iv)
e.	(v)

QN=2

Let

p = "You drive at more than 60km/h"
q = "you got a speeding ticket"

Translate the sentence into a logical expression

"*If you do not drive at more than 60km/h then you will not get a speeding ticket*"

(i) $\neg p \wedge \neg q$

(ii) $\neg p \rightarrow \neg q$

(iii) $\neg q \rightarrow \neg p$

(iv) $p \rightarrow \neg q$

a.	(i)
b.	(ii)
c.	(iii)
d.	(iv)
e.	None of the other choices is correct

QN=3	Let p and q be propositions. Which statements are INCORECT? (i) $p \rightarrow q \equiv q \rightarrow p$ (ii) $p \wedge q \equiv q \wedge p$ (iii) $p \vee q \equiv q \vee p$ (iv) $p \leftrightarrow q \equiv q \leftrightarrow p$
a.	(ii)
b.	(i)
c.	(iii)
d.	(iv)
e.	None of the other choices

QN=4

Let x represent a student of the university.

Let $F(x)$ = "x is a student of the Bussiness department",

$J(x)$ = "x knows computer language *Java*",

$R(x)$ = "x can speak *Russian*".

Translate the sentence into a logical expression

"Some student of the Bussiness department either can't speak *Russian*, or doesn't know *Java*"

(i) $\forall x(F(x) \rightarrow (\neg J(x) \vee \neg R(x)))$

(ii) $\forall x(F(x) \rightarrow (\neg J(x) \wedge \neg R(x)))$

(iii) $\exists x(F(x) \wedge (\neg J(x) \vee \neg R(x)))$

(iv) $\exists x(F(x) \vee (\neg J(x) \wedge \neg R(x)))$

a.	(iii)
b.	(i)
c.	(ii)
d.	(iv)
e.	None of the other choices

QN=5	Let x represent a student of the university. Let $F(x)$ = "x is a student of the Business department", $J(x)$ = "x knows the computer language *Java*", $R(x)$ = "x can speak *Russian*". Translate the sentence into a logical expression "Every student of the Bussiness department either can speak *Russian* or knows *Java*" (i) $\forall x(F(x) \rightarrow (J(x) \vee R(x)))$ (ii) $\forall x(F(x) \rightarrow (J(x) \wedge R(x)))$ (iii) $\exists x(F(x) \wedge (J(x) \vee R(x)))$ (iv) $\exists x(F(x) \vee (J(x) \vee R(x)))$
a.	(iv)
b.	(ii)
c.	(iii)
d.	None of the other choices
e.	(i)

QN=6	Let x, y represent all people in a university S(x) = "x is a student" F(x) = "x is a faculty" P(x, y) = "the faculty x taught the student y" Translate the logical expression into a sentence $\exists x\,(F(x) \wedge \forall y\,(S(y) \longrightarrow P(x,y)))$
a.	Some students was taught by all faculties
b.	Some faculties taught all students
c.	Each student was taught by some faculties
d.	Each faculty taught some students
e.	None of the other choices is correct

QN=7	Let P(x, y) = "x+y is divisible by 5" on the set {2, 4, 6, 7, 9}. Which propositions are TRUE? (i) $\forall x \forall y\, P(x,y)$ (ii) $\exists x \forall y P(x,y)$ (iii) $\forall x \exists y P(x,y)$ (iv) $\exists x \exists y\, P(x,y)$
a.	(i)
b.	(iii)
c.	(iv)
d.	None of the other choices is correct
e.	(ii)

QN=8	Determine whether each of these arguments is valid. (i) If x is a real number such that $x>2$, then $x^2>4$. Suppose that $x^2>4$. Then $x>2$. (ii) If x is a real number with $x<-2$, then $x^2>4$. Suppose that $x^2 \leq 4$. Then $x \geq -2$. (iii) If x is a real number with $x>2$, then $x^2>4$. Suppose that $x \leq 2$. Then $x^2 \leq 4$.
a.	(i)
b.	(ii)
c.	(iii)
d.	None of the other choices is correct

QN=9	Which of the following statements is true? (i) $\varnothing \in \{x\}$ (ii) $\{x\} \subseteq \{x\}$ (iii) $\{x\} \in \{x\}$ (iv) $\{x\} \subset \{x\}$
a.	(i)
b.	(ii)
c.	(iii)
d.	(iv)

QN=10	Given the universal set U = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}. Represent the subset {1, 2, 5, 7, 8, 10} by a bit string whose i-th bit is 1 if i belongs to that subset, and is 0 otherwise. What is that bit string?
a.	1100101101
b.	0011010010
c.	0110100110
d.	1001011001
e.	None of the other choices is correct

QN=11	Let A and B be sets such that $|B| = |A| - 2$. Assume that the set $A \times B$ has 360 elements. Find $|A|$.
a.	20
b.	18
c.	22
d.	25
e.	None of the other choices

QN=12	Let f: N→ N be a function defined by $f(n) = 2n+3$. Select the correct statement.
a.	f is one-to-one but not onto.
b.	f is onto but not one-to-one.
c.	f is a bijection.
d.	f is neither one-to-one nor onto.

QN=13	Let N = {0, 1, 2, …}. Let f, g be two functions from N to N with $f(x) = x^2 + 1$ và $g(x) = x + 1$ Which functions are one-to-one?
a.	None of the other choices is correct
b.	g
c.	f
d.	f and g

QN=14	Find the sum $\sum_{i=1}^{100} \left(\frac{i}{i+1} - \frac{i-1}{i} \right)$
a.	1
b.	1/101
c.	99/101

d.	100/101
e.	None of the other choices is correct

QN=15	Use the greedy algorithm to make change using quarters, dime, nickels, pennies for 87 cents. The total number of coins obtained is_____
a.	6
b.	9
c.	5
d.	7
e.	None of the other choices is correct

QN=16	Given the Insertion sort algorithm (See picture) If input = 3, 2, 4, 7, 1, 6, 5, after running the outer loop with i = 5, the order of the elements in the list is_____ Procedure **Insertionsort**($a_1, a_2, \ldots, a_n$: integer) for i = 2 to n do j: = 1 while $a_j < a_i$ j: = j+1 temp: = a_i for k := i down to j+1 a_k:= a_{k-1} a_j := temp
a.	1, 2, 3, 4, 7, 6, 5
b.	1, 2, 3, 4, 6, 7, 5
c.	1, 2, 3, 4, 7, 5, 6
d.	1, 2, 3, 7, 4, 6, 5

QN=17	Let $f(x) = x^2\log(x^2)$ and $g(x) = (x\log(x))^2$. Choose the correct statements: (i) $f(x) = O(g(x))$ (ii) $g(x) = O(f(x))$
a.	(i)
b.	(ii)
c.	Both (i) and (ii)
d.	None of the other choices is correct

QN=18	Determine the complexity of this algorithm in terms of the number of **comparisons**. **procedure thuattoan**($a_1, a_2 ..., a_n$: 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) $O(1)$
a.	(i)
b.	(iii)
c.	(ii)
d.	None of the other choices is correct

QN=19	Let a = 137 div 31 and b = -137 div 31. Find a + b.
a.	-1
b.	4
c.	0
d.	-2
e.	3

QN=20	By using the function f(p) = (3p+7) mod 26 the encrypted version of a message is BXMF. What was the original message?
a.	HELP
b.	GIUP
c.	YOTI
d.	SAVE
e.	None of the other choices is correct

QN=21	How many positive integers less than 13 that are relatively prime to 13?
a.	12
b.	11
c.	10
d.	13

QN=22	Select a value of p so that the three numbers 26, 55 and p are pairwise relatively prime.
a.	6
b.	15
c.	21
d.	39
e.	None of the above

QN=23	If Euclidean algorithm is used to find the greatest common divisor of 90 and 24, how many divisions are needed?
a.	3
b.	2
c.	4
d.	5
e.	None of the other choices is correct

QN=24	Convert BC1 in hexadecimal representation to binary representation.
a.	101111000001
b.	1011110001
c.	101111001001
d.	111111001

QN=25	Given that $1 + 3 + \ldots + (2n - 1) = n^2$ for all $n \geq 1$. Which of the following equations is true? (i) $1 + 3 + \ldots + (2k + 1) = k^2 + (2k + 1)$ (ii) $1 + 3 + \ldots + (2k + 1) = k^2 + 2$ (iii) $1 + 3 + \ldots + (2k + 1) = 1 + 2 + \ldots + (2k - 1) + 2$ (iv) $1 + 3 + \ldots + (2k + 1) = (k-1)^2 + (2k + 1)$
a.	(i)
b.	(ii)
c.	(iii)
d.	(iv)

QN=26	Find a recursive definition for the set of all positive integers NOT divisible by 3. (i) $1 \in S$, if $a \in S$ then $a+3 \in S$ and $a-3 \in S$ (ii) $1 \in S$, if $a \in S$ then $a+3 \in S$ (iii) $1, 2 \in S$, if $a \in S$ then $a+3 \in S$ and $a-3 \in S$ (iv) $1, 2 \in S$, if $a \in S$ then $a+3 \in S$
a.	(i)
b.	(ii)
c.	(iii)
d.	(iv)
e.	None of the other choices is correct

QN=27	Find a recursive definition for the set S = {(a, b)| a, b are positive integers and a+b is an even number} (i) (1, 1) ∈ S. If (a, b) ∈ S then (a+2, b+2) ∈ S (ii) (1, 1) ∈ S. If (a, b) ∈ S then (a, b+2) ∈ S, (a+2, b) ∈ S (iii) (1, 1) ∈ S. If (a, b) ∈ S then (a, b+2) ∈ S, (a+2, b) ∈ S (a+1, b+1) ∈ S (iv) (1, 1) ∈ S. If (a, b) ∈ S then (a+1, b+1) ∈ S
a.	(i)
b.	(ii)
c.	(iii)
d.	(iv)
e.	None of the other choices is correct

QN=28	Which of the following algorithms are recursive?
	
	(i) procedure ABC(n, P: integers)
	P:=0;
	for j:=1 to n
	begin
	if j mod 2 = 0 then P: = P – j;
	else P: = P + j;
	end
	
	(ii) procedure ABC(n, P: integer)
	P: = 1;
	for j :=1 to n
	begin
	if (j mode 2 = 0)
	P : = P+j
	else P : = P*j
	end

a.	None of them
b.	Only (i)
c.	Only (ii)
d.	Both of them

QN=29	Find the output of the recursive algorithm if input n = 5.
	
	procedure TT(n: integer);
	If n=1 then f(1):=2
	else f(n):=f(n-1)*n;

a.	120
b.	240
c.	360
d.	480
e.	None of the other choices

QN=30	How many positive integers not exceeding 100 and divisible by exactly one of 6 or 9?
a.	17
b.	22
c.	26
d.	27
e.	None of the other choices is correct

QN=31	Given $X=\{\varnothing, \{\varnothing\}, \{a, b\}, c\}$, $Y=\{x, \{z, z\}, x\}$. How many one-to-one functions are there from Y to X?
a.	6
b.	3
c.	12
d.	2
e.	None of the other choices is correct

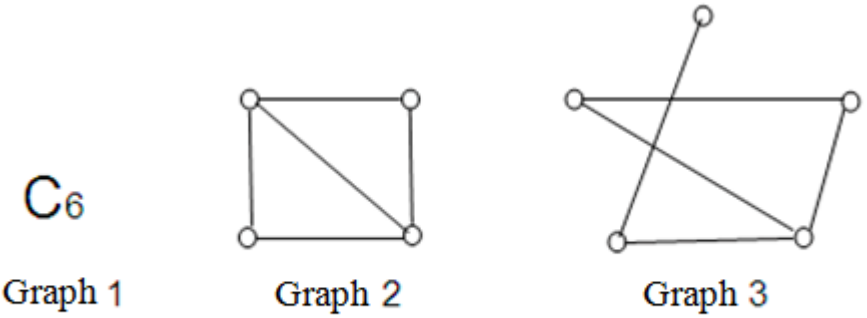
QN=32	A person deposited 10 millions VND in a saving account at the rate of 9% a year. After 10 years, how much money will be in the account? Round your answer to the nearest thousand VND.
a.	23,674,000 VND
b.	20,675,000 VND
c.	25,740,000 VND
d.	21,657,000 VND

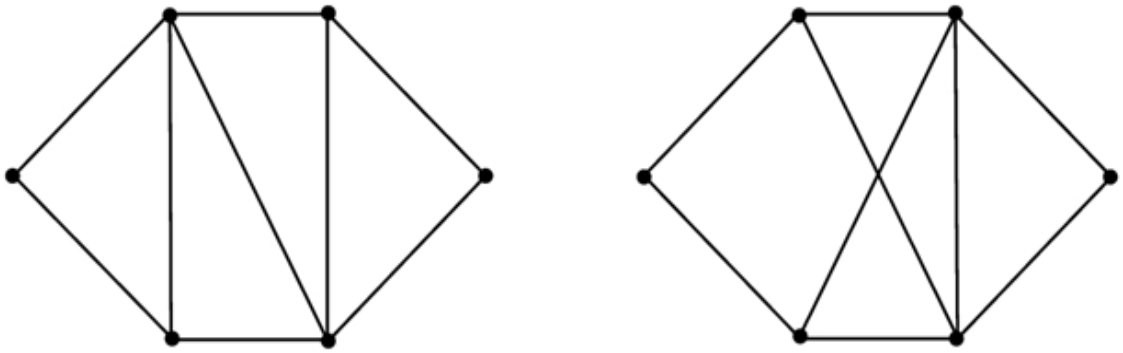
QN=33	Consider the following divide-and-conquer algorithm to find the maximal element in a sequence.
	
	procudure MXE($L = a_1, \ldots, a_n$)
	if n =1 then MXE(L) = a_1
	else
	begin
	m:=$\lfloor n/2 \rfloor$
	$L_1 = a_1, \ldots, a_m$
	$L_2 = a_{m+1}, \ldots, a_n$
	MXE(L) = max(MXE(L_1), MXE(L_2))
	end
	
	Let f(n) be the number of comparisons used in the algorithm. The recurrence relation of f(n) is as follows:
	$f(n) = a.\ f(n/2) + b$, with n even.
	Determine a+b.

a.	0
b.	1
c.	2
d.	3
e.	None of the other choices is correct

QN=34	Let G be a simple graph. The complementary graph of G is the graph G′ having the same set of vertices, and there is an edge connecting u and v in G′ if and only if there is no edge connecting u and v in G. If G has 10 vertices and 20 edges, how many edges does G′ have?
a.	25
b.	20
c.	70
d.	45
e.	None of the other choices is correct

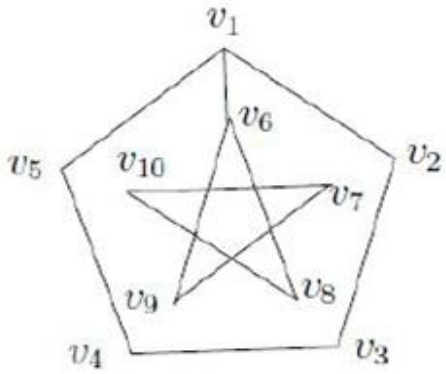
QN=35	Which graph is bipartite?

	
a.	Graph 2
b.	None of the other choices is correct
c.	Graph 1
d.	Graph 3

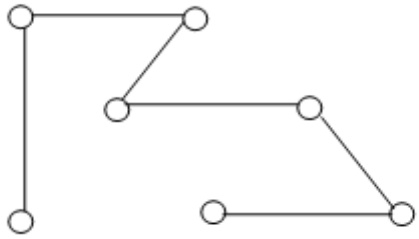
QN=36	Are these two graphs isomorphic? If not, what is the reason? 
a.	No, they are not isomorphic because in the graph on the left, each vertex of degree 2 is adjacent to a vertex of degree 4, and the graph on the right does not have that property
b.	No, they are not isomorphic because they do not have the same number of vertices of degree 3
c.	No, they are not isomorphic because they do not have the same number of degree 4
d.	Yes, they are isomorphic
e.	None of the other choices is correct

QN=37	

	Given 3 undirected multigraphs whose adjacency matrices are $(X)\begin{bmatrix}0&2&1\\2&0&1\\1&1&0\end{bmatrix}$ $(Y)\begin{bmatrix}0&2&1\\2&0&0\\1&0&0\end{bmatrix}$ $(Z)\begin{bmatrix}0&2&0\\2&0&1\\0&1&0\end{bmatrix}$ Choose the correct answer.
a.	None of the other choices is correct
b.	Z is isomorphic to X
c.	X is isomorphic to Y
d.	Y is isomorphic to Z

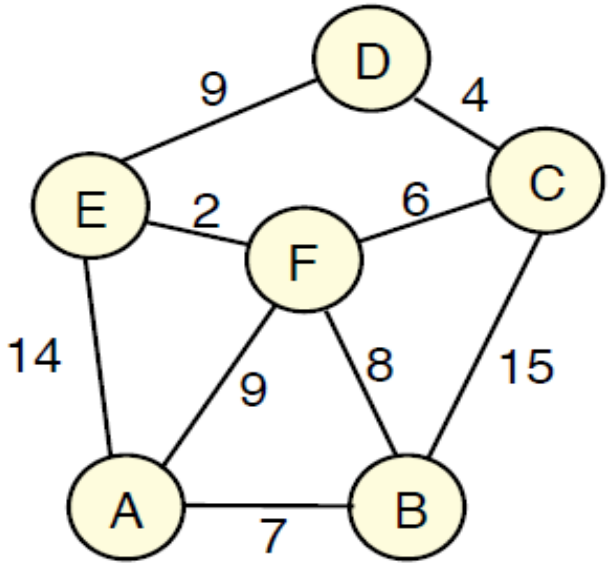
QN=38	Delete all the edges that are incident to v_6 to obtain a new graph. How many connected components in the new graph? 
a.	1
b.	3
c.	5
d.	4
e.	2
f.	None of the other choices is correct

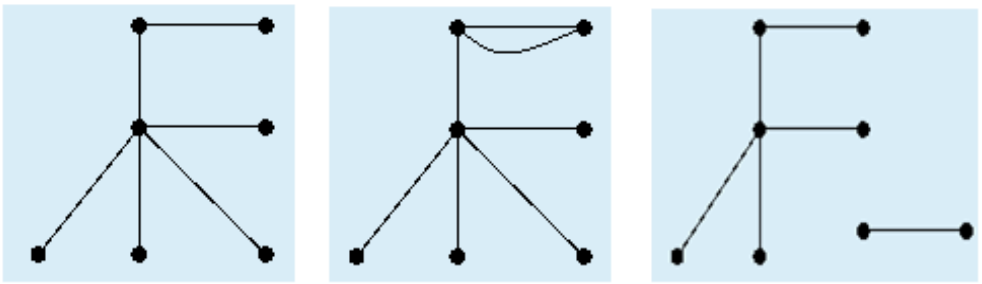
QN=39	How many cut vertices and cut edges in this graph? (See picture)

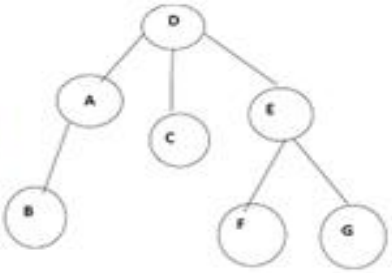
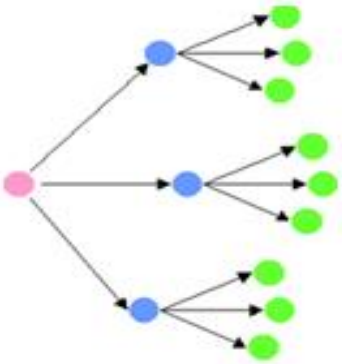
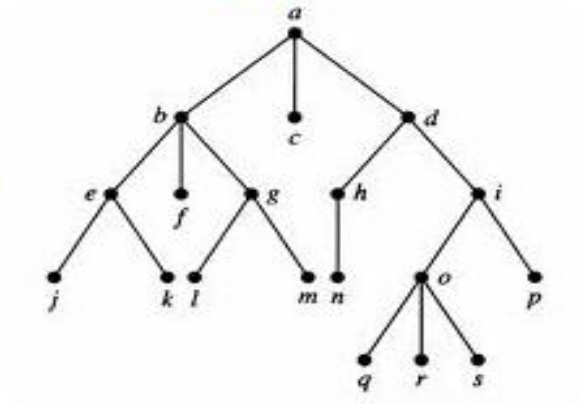
	
a.	5 and 6
b.	5 and 5
c.	7 and 6
d.	6 and 6

QN=40	Let S be the set of all graphs with degree sequence $[2, 2, 2, 2, 2, 2]$. Which of the following is TRUE: (i) $\exists G \in S$: G has an Euler circuit (ii) $\exists G \in S$: G has an Euler path, but no Euler circuits (iii) $\forall G \in S$: G has no Euler paths
a.	(i)
b.	(ii)
c.	(iii)
d.	None of the other choices

QN=41	Which graphs have Euler paths? (i) $K_{1,2}$ (ii) K_2 (iii) $K_{2,5}$ (iv) Q_3
a.	(i) and (ii)
b.	(iii)
c.	(iv)
d.	(i) and (iv)

QN=42	What is the next vertex chosen after A and B when using Dijktra's algorithm to find the shortest path from A to D in this weighted graph? 
a.	The vertex C
b.	The vertex E
c.	The vertex F
d.	None of the choice is correct.

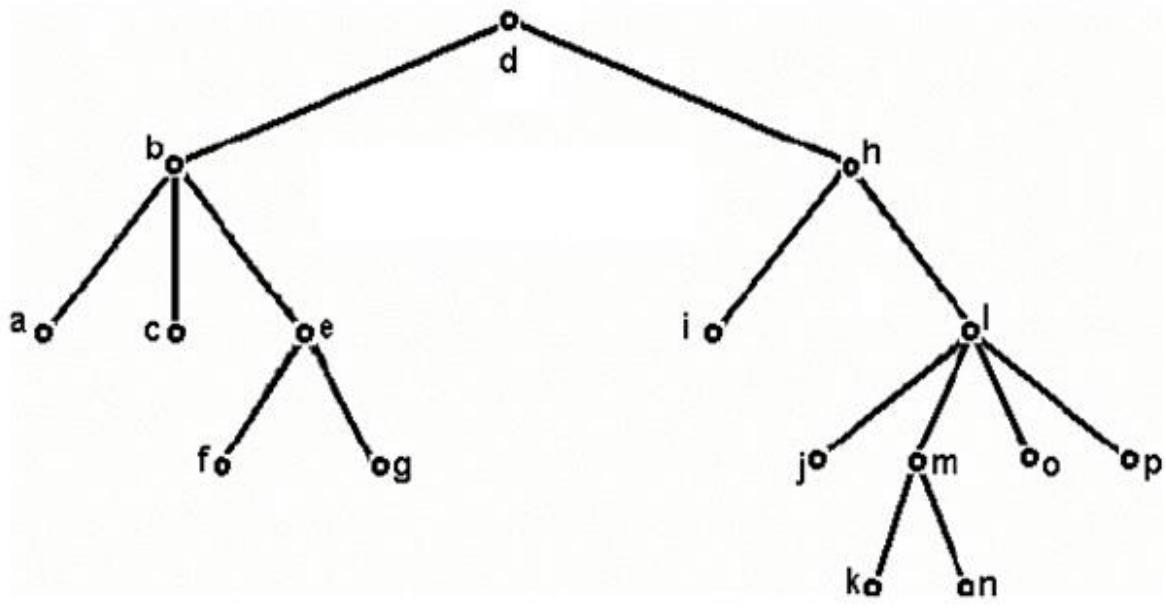
QN=43	Which graphs are trees? 
a.	(i)
b.	(ii)
c.	(iii)
d.	All of (i), (ii) and (iii)
e.	None of the other choices is correct

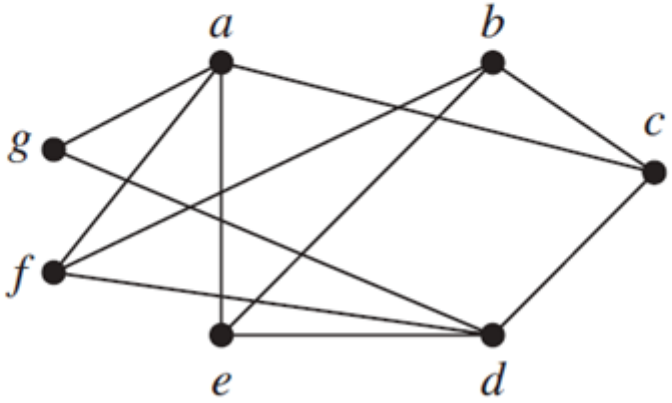
QN=44	Which rooted trees are full 3-ary? (i)  (ii)  (iii) 
a.	(ii)
b.	(i) and (iii)
c.	(ii) and (iii)
d.	(i), (ii) and (iii)
e.	None of the other choices is correct

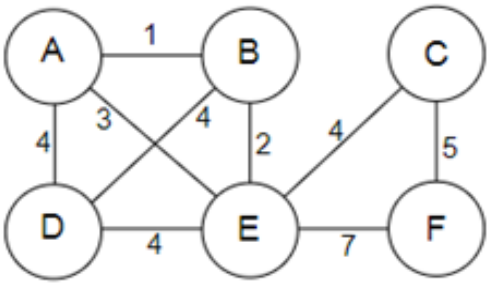
QN=45	How many comparisons are used to locate or add the word "pear" in the binary search tree for the list banana, peach, apple, pear, coconut, mango, papaya
a.	4
b.	2
c.	None of the other choices is correct
d.	3
e.	5

QN=46	To encode a message consisting of only the letters {a ,b, i, n, s, t}, we want to use the following prefix coding scheme a: 10, b: 01, i: 001, n: 110, s: 1111, t: (to be determined) Which of the following bit string could be used to encode the letter t?
a.	0001
b.	111
c.	100
d.	None of the other choices is correct
e.	1

QN=47	Find the postfix notation of the expression x+((x*y+x)/y)
a.	x x y * x + y / +
b.	x x y * + x y / +
c.	None of the other choices is correct
d.	+ + x * x y / x y

QN=48	Find the postorder traversal of the tree 
a.	a - c - f - g - e - b - i - j - k - n - m - o - p - l - h - d
b.	d - b - a - c - e - f - g - h - i - l - j - m - k - n - o - p
c.	a - b - c - f - e - g - d - i - h - j - l - k - m - n - o - p
d.	None of the other choices is correct

QN=49	If we do **breath-first** search to build a spanning tree starting from 'd', what are the last 3 edges we will add to the tree? We suppose that at each stage, if we have many choices, we will visit the vertices in the **reverse** alphabet order (for example, we will visit 'b' before 'a' if there are two choices 'a' and 'b'). 
a.	ac, ag, be
b.	ac, ag, bf
c.	ac, bc, ae
d.	cd, ag, bf
e.	bc, ae, ac
f.	cd, af, bc

QN=50	What is the total weight of a minimum spanning tree produced by the graph below? 
a.	14
b.	15
c.	16
d.	19