first name	last name		$\mathrm{id}\#$						
each question 8 marks	30 min	closed book	no devic	es		3 pag	\mathbf{ges}		page 1
1. (a) Explain why ar tree puzzle has cost	0		4	A E	3 (C D	E	4	

3

2

1

Α

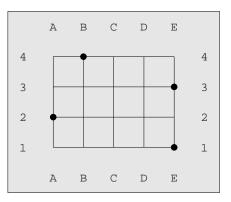
В

С

D

Е

(b) On the diagram, draw a min cost solution and write its cost.



3

2

1

first name	last	name	ic	l #	
each question 8 marks	30 min	closed book	no devices	3 pages	page 2
2. a) In the box, show this python program	-	from			
<pre>def collatz(n): print(n, end=': while n > 1: print(n, end= if n % 2 == (else: n = n*3 print(n)</pre>	=' ')): n = n /	/ 2			
for j in range(2, collatz(j)	,7): #from	2 to 6			

b) Prove or disprove (if you can): if the Collatz conjecture fails for some integer, and if x is the smallest such integer, then x is odd.

first name	last name		$\mathrm{id}\#$				
each question 8 marks	30 min	closed book	no devices	3 pages	page 3		
3. Explain why the runtime of ifib(n)			<pre>def ifib(n):</pre>				
is proportional to $\sum_{j=1}^{n} \lg(\text{ fib}(j))$.			a,b = 0,1				
			<pre>for _ in range(n):</pre>				
			a, $b = b$, $a+b$				
			return a				

first name	last name		$\mathrm{id}\#$:		
each question 8 marks	30 min	closed book	no devices	3 pages	page 1	
1. (a) Explain why an tree puzzle has cost	•	to this Steiner	А В 4	C D		

3

2

1

Α

В

С

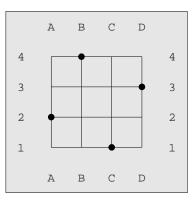
D

3

2

1

(b) On the diagram, draw a min cost solution and write its cost.

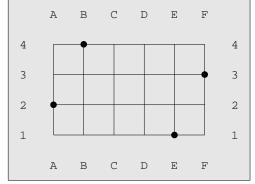


first name	las	t name	id	#	
each question 8 marks	30 min	closed book	no devices	3 pages	page 2
2. a) In the box, show this python program	-	from			
<pre>def collatz(n): print(n, end=': while n > 1: print(n, end= if n % 2 == (else: n = n*3 print(n)</pre>	=' ')): n = n /	7/2			
for j in range(3, collatz(j)	,7): #from	3 to 6			

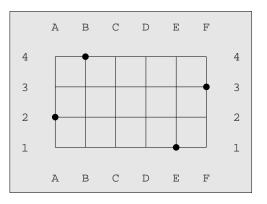
b) Prove or disprove (if you can): if the Collatz conjecture fails for some integer, and if y is the smallest such integer, then y is odd.

first name	last name		$\mathrm{id}\#$				
each question 8 marks	30 min	closed book	no devices	3 pages	page 3		
3. Explain why the runtime of ifib(n)			<pre>def ifib(n):</pre>				
is proportional to $\sum_{j=1}^{n} \lg(\text{ fib}(j))$.			a,b = 0,1				
			<pre>for _ in range(n):</pre>				
			a, $b = b$, $a+b$				
			return a				

first name	last name		$\mathrm{id}\#$		
each question 8 marks	30 min	closed book	no devices	3 pages	page 1
1. (a) Explain why	any solution	to this			
Steiner tree puzzle has cost at least 8.					



(b) On the diagram, draw a min cost solution and write its cost.



first name	las	t name			id#		
each question 8 marks	30 min	closed b	ook	no devic	es	3 pages	page 2
2. a) In the box, show	the output	from					
this python program	n.						
<pre>def collatz(n):</pre>							
<pre>print(n, end='</pre>	: ')						
while $n > 1$:							
print(n, end=	='')						
if n % 2 == (): n = n /	// 2					
else: $n = n * 3$	3 + 1						
print(n)							
for j in range(1	,7): #from	n 1 to 6					
collatz(j)							

b) Prove or disprove (if you can): if the Collatz conjecture fails for some integer, and if z is the smallest such integer, then z is odd.

first name	last name		$\mathrm{id}\#$				
each question 8 marks	30 min	closed book	no devices	3 pages	page 3		
3. Explain why the runtime of ifib(n)			<pre>def ifib(n):</pre>				
is proportional to $\sum_{j=1}^{n} \lg(\text{ fib}(j))$.			a,b = 0,1				
			<pre>for _ in range(n):</pre>				
			a, $b = b$, $a+b$				
			return a				