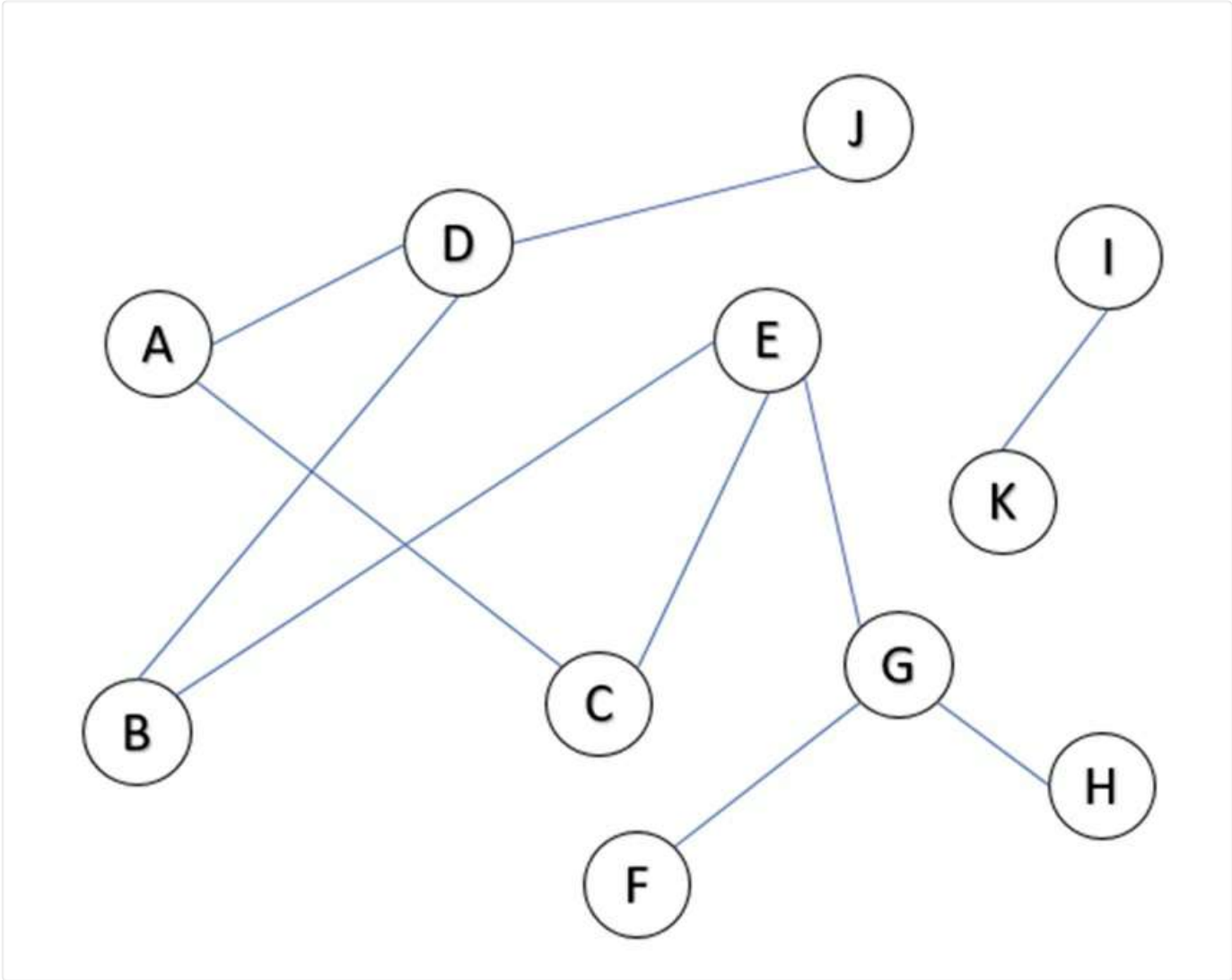


EN - Algorithmique avancée : Algorithmique et complexité (CCTL)

Question 1

Question à réponse unique

How many cycles are there in the graph?



Réponses incorrectes

	Réponse attendue	Réponse saisie	Réponse discordante	
A	<input type="checkbox"/>	<input type="checkbox"/>	Non	2
B	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Oui (+1)	1
C	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Oui (+1)	0
D	<input type="checkbox"/>	<input type="checkbox"/>	Non	3
E	<input type="checkbox"/>	<input type="checkbox"/>	Non	5

Question 2

Question à réponse unique

What is the order of the graph above?

Réponses correctes

	Réponse attendue	Réponse saisie	Réponse discordante	
A	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Non	11
B	<input type="checkbox"/>	<input type="checkbox"/>	Non	10
C	<input type="checkbox"/>	<input type="checkbox"/>	Non	13
D	<input type="checkbox"/>	<input type="checkbox"/>	Non	9
E	<input type="checkbox"/>	<input type="checkbox"/>	Non	12

Which of the following statements about the graph above is true?

Réponses correctes				
	Réponse attendue	Réponse saisie	Réponse discordante	
A	<input type="checkbox"/>	<input type="checkbox"/>	Non	(J, D, A, C, B, E, G, F) is an Eulerian chain
B	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Non	There is no Eulerian chain in this graph.
C	<input type="checkbox"/>	<input type="checkbox"/>	Non	(I, K) is an Eulerian chain
D	<input type="checkbox"/>	<input type="checkbox"/>	Non	(F, G, H) is an Eulerian chain
E	<input type="checkbox"/>	<input type="checkbox"/>	Non	(H, G, E, B, D, J) is an Eulerian chain

What is the correct definition of an Eulerian chain?

Réponses incorrectes				
	Réponse attendue	Réponse saisie	Réponse discordante	
A	<input type="checkbox"/>	<input type="checkbox"/>	Non	A chain is Eulerian if all its vertices have an odd degree.
B	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Oui (+1)	A chain is Eulerian when it passes through all the vertices of the graph only once.
C	<input type="checkbox"/>	<input type="checkbox"/>	Non	A chain is Eulerian when it contains each edge of the graph one and only one time.
D	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Oui (+1)	A chain is Eulerian if all its vertices have an even degree.
E	<input type="checkbox"/>	<input type="checkbox"/>	Non	A chain is Eulerian when it passes through all the vertices of the graph once and ends at its starting vertex.

Which of these problems can be modelled using graphs?

Réponses correctes				0 discordance
	Réponse attendue	Réponse saisie	Réponse discordante	
A	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Non	Calculating routes in a computer network to optimize use of Ethernet cable bandwidth
B	<input type="checkbox"/>	<input type="checkbox"/>	Non	Optimizing the loading of objects onto a truck
C	<input type="checkbox"/>	<input type="checkbox"/>	Non	Encrypting a message
D	<input type="checkbox"/>	<input type="checkbox"/>	Non	Maximizing the return on an investment portfolio by selecting investments according to their availability and yield.
E	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Non	Creating a seating plan that minimizes the number of people seated next to an enemy

Question 6

Question à réponse unique

How many vertices does the graph represented by the following adjacency list have, with vertex numbers starting at 1 (numerical answer)?

Head : 1, 2, 3, 6, 7, 8

Succ : 2, 1, 1, 3, 6, 3, 5

Réponses incorrectes

	Réponse attendue	Réponse saisie	Réponse discordante	
A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Oui (+1)	5
B	<input type="checkbox"/>	<input type="checkbox"/>	Non	4
C	<input type="checkbox"/>	<input type="checkbox"/>	Non	3
D	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Oui (+1)	6
E	<input type="checkbox"/>	<input type="checkbox"/>	Non	7

Question 7

Question à réponse unique

What are the successors of vertex 3 (in ascending number order, with a space between each number)?

Réponses correctes

	Réponse attendue	Réponse saisie	Réponse discordante	
A	<input type="checkbox"/>	<input type="checkbox"/>	Non	2 3 6
B	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Non	1 3 6
C	<input type="checkbox"/>	<input type="checkbox"/>	Non	1 6
D	<input type="checkbox"/>	<input type="checkbox"/>	Non	6 7 8
E	<input type="checkbox"/>	<input type="checkbox"/>	Non	2 3 6

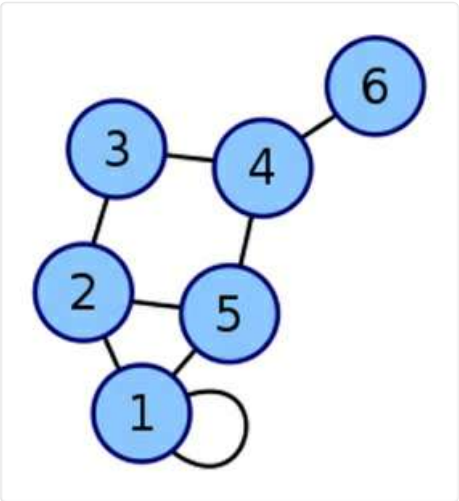
Consider the graph represented by the following adjacency matrix:

0	1	0	0	1
1	0	0	1	0
0	0	0	1	1
0	1	1	0	0
1	0	1	0	0

Quelles sont les affirmations vraies ?

Réponses correctes			0 discordance	
	Réponse attendue	Réponse saisie	Réponse discordante	
A	<input type="checkbox"/>	<input type="checkbox"/>	Non	The graph is not connected.
B	<input checked="" type="checkbox"/> INDISPENSABLE	<input checked="" type="checkbox"/>	Non	The graph is Eulerian.
C	<input type="checkbox"/>	<input type="checkbox"/>	Non	The graph is not Hamiltonian.
D	<input checked="" type="checkbox"/> INDISPENSABLE	<input checked="" type="checkbox"/>	Non	The average degree of the graph is 2.
E	<input type="checkbox"/>	<input type="checkbox"/>	Non	The graph is directed.


Check the true statement.




Réponses incorrectes				
	Réponse attendue	Réponse saisie	Réponse discordante	
A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Oui (+1)	This graph has a Hamiltonian chain.
B	<input type="checkbox"/>	<input type="checkbox"/>	Non	This graph is Eulerian.
C	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Oui (+1)	This graph has an Eulerian path.
D	<input type="checkbox"/>	<input type="checkbox"/>	Non	This graph has an Eulerian chain.
E	<input type="checkbox"/>	<input type="checkbox"/>	Non	This graph is Hamiltonian.

What are the color numbers of the following graphs?

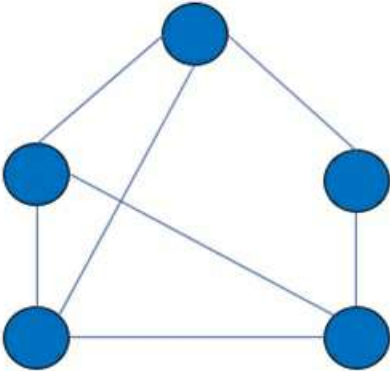
a)



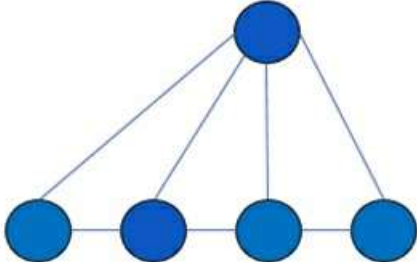
b)



c)



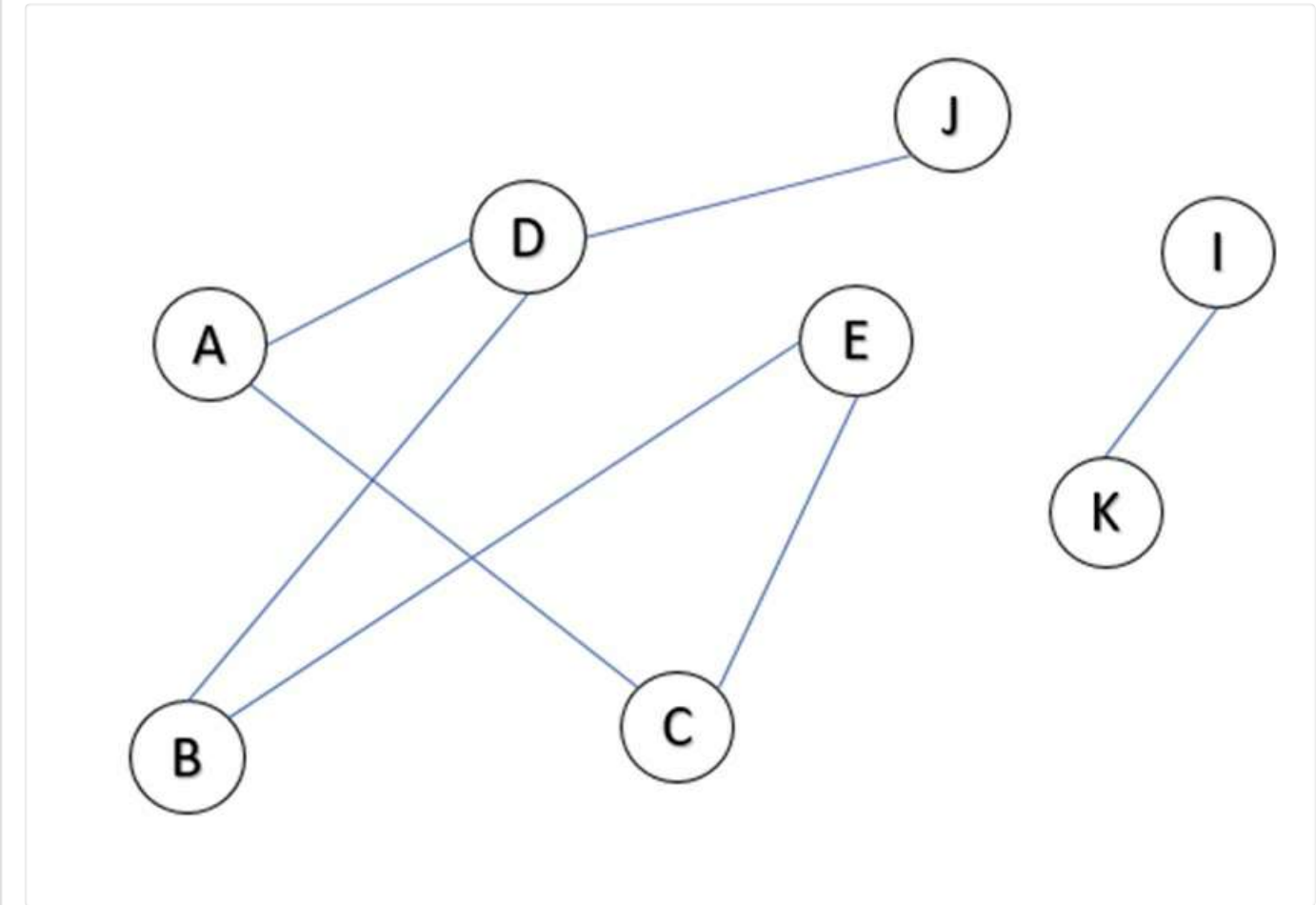
d)



Réponses incorrectes

	Réponse attendue	Réponse saisie	Réponse discordante	
A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Oui (+1)	a) 2 b) 3 c) 3 d) 3
B	<input type="checkbox"/>	<input type="checkbox"/>	Non	a) 2 b) 4 c) 2 d) 3
C	<input type="checkbox"/>	<input type="checkbox"/>	Non	a) 3 b) 2 c) 4 d) 3
D	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Oui (+1)	a) 2 b) 3 c) 3 d) 4
E	<input type="checkbox"/>	<input type="checkbox"/>	Non	a) 3 b) 3 c) 3 d) 4

How many edges must be added to this graph for it to be complete?



Réponses incorrectes

	Réponse attendue	Réponse saisie	Réponse discordante	
A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Oui (+1)	21
B	<input type="checkbox"/>	<input type="checkbox"/>	Non	19
C	<input type="checkbox"/>	<input type="checkbox"/>	Non	23
D	<input type="checkbox"/>	<input type="checkbox"/>	Non	25
E	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Oui (+1)	17

Which of these graphs corresponds to the following description: a directed graph whose vertices are the odd integers between 1 and 10 and whose arcs represent the relationship "being a divisor of".

Réponses correctes

	Réponse attendue	Réponse saisie	Réponse discordante	
A	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Non	

	Réponse attendue	Réponse saisie	Réponse discordante	
B	<input type="checkbox"/>	<input type="checkbox"/>	Non	
C	<input type="checkbox"/>	<input type="checkbox"/>	Non	
D	<input type="checkbox"/>	<input type="checkbox"/>	Non	
E	<input type="checkbox"/>	<input type="checkbox"/>	Non	

What is the time complexity of an algorithm?

Réponses incorrectes				
	Réponse attendue	Réponse saisie	Réponse discordante	
A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Oui (+1)	The number of elementary operations performed by the algorithm as a function of the input size
B	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Oui (+1)	The time needed to run an algorithm on a given machine
C	<input type="checkbox"/>	<input type="checkbox"/>	Non	The number of lines of code in the algorithm
D	<input type="checkbox"/>	<input type="checkbox"/>	Non	CPU load as a function of time
E	<input type="checkbox"/>	<input type="checkbox"/>	Non	The number of loops in the algorithm

What notation is commonly used to represent the worst-case time complexity of an algorithm?

Réponses correctes				
	Réponse attendue	Réponse saisie		Réponse discordante
A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Non
B	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Non
C	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Non
D	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Non
E	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Non

What is the complexity of the sequential search algorithm in an array? (The sequential search algorithm goes through the elements of the array one by one until it finds the element it's looking for.)

Réponses correctes				
	Réponse attendue	Réponse saisie		Réponse discordante
A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Non
B	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Non
C	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Non
D	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Non
E	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Non



Question 16

Question à réponse unique

The number of operations in the following program is:  
def factorial(n) :  
 if n == 0 :  
 return 1  
 return n\*factorial(n-1)

Réponses incorrectes

	Réponse attendue	Réponse saisie	Réponse discordante	
A	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Oui (+1)	n
B	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Oui (+1)	n+1
C	<input type="checkbox"/>	<input type="checkbox"/>	Non	2n
D	<input type="checkbox"/>	<input type="checkbox"/>	Non	2n+1
E	<input type="checkbox"/>	<input type="checkbox"/>	Non	$O(\frac{1}{n})$

Question 17

Question à réponse unique

The complexity of the *factorial(n)* function is said to be :

Réponses correctes

	Réponse attendue	Réponse saisie	Réponse discordante	
A	<input type="checkbox"/>	<input type="checkbox"/>	Non	Constant
B	<input type="checkbox"/>	<input type="checkbox"/>	Non	Logarithmic
C	<input type="checkbox"/>	<input type="checkbox"/>	Non	Quadratic
D	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Non	Polynomial
E	<input type="checkbox"/>	<input type="checkbox"/>	Non	Exponential

Question 18

Question d'association

Associate the following classes with their definitions.

Réponses incorrectes2 discordances

Élément à associer	Réponse attendue	Réponse saisie	Réponse discordante
The P class	The class of decision problems that can be solved in polynomial time	The class of decision problems that can be solved in polynomial time	Non
The NP class	The class of problems that can be solved in polynomial time by a non-deterministic Turing machine.	The class of problems that can be solved in polynomial time by a non-deterministic Turing machine.	Non
The NP-Hard class	This class of problems is at least as difficult as all the other problems in the NP class.	The class of problems for which no polynomial algorithm exists that can solve it, but for which a solution can be verified in polynomial time.	Oui (+1)
The NP-Complete class	The class of problems for which no polynomial algorithm exists that can solve it, but for which a solution can be verified in polynomial time.	This class of problems is at least as difficult as all the other problems in the NP class.	Oui (+1)

Question 19

Question à réponses multiples

To prove that a problem is NP-complete, simply :

Réponses incorrectes

1 discordance

	Réponse attendue	Réponse saisie	Réponse discordante	
A	<input type="checkbox"/>	<input type="checkbox"/>	Non	Find a polynomial algorithm to solve it.
B	<input checked="" type="checkbox"/> INDISPENSABLE	<input type="checkbox"/>	Oui (+1)	ove that it admits a polynomial verifier.
C	<input checked="" type="checkbox"/> INDISPENSABLE	<input checked="" type="checkbox"/>	Non	Find another problem B such that B is a known NP-complete problem.
D	<input type="checkbox"/>	<input type="checkbox"/>	Non	Prove that the problem belongs to P
E	<input type="checkbox"/>	<input type="checkbox"/>	Non	None of the proposed answers

Question 20

Question à réponse unique

How complex is the backpack problem?

Réponses incorrectes

	Réponse attendue	Réponse saisie	Réponse discordante	
A	<input type="checkbox"/>	<input type="checkbox"/>	Non	P
B	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Oui (+1)	NP
C	<input type="checkbox"/>	<input type="checkbox"/>	Non	NP-Hard
D	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Oui (+1)	NP-Complete
E	<input type="checkbox"/>	<input type="checkbox"/>	Non	None of the proposed answers

Question 21

Question à réponse unique

Which of the following problems is not in the NP-complete class?

Réponses incorrectes

	Réponse attendue	Réponse saisie	Réponse discordante	
A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Oui (+1)	Shortest route
B	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Oui (+1)	Hamiltonian circuit
C	<input type="checkbox"/>	<input type="checkbox"/>	Non	Classification
D	<input type="checkbox"/>	<input type="checkbox"/>	Non	Traveling salesman
E	<input type="checkbox"/>	<input type="checkbox"/>	Non	Max-SAT

A group of Year 3 students chat during a prosit outcome. Their exceptional tutor, a certain Romain Brunelot, notes down some of their assertions as they go along:  
3-SAT is NP-complete," says Emma.  
And I can add that a problem is NP-complete if and only if the validity and value of a solution can be verified in non-polynomial time," continues Marius.  
Conversely, any known solution of an NP problem can be verified in polynomial time," adds Karim.  
In any case, any NP problem is at most as difficult as the 3-SAT problem," retorts Clara.  
If we consider a problem X that is in NP, then X is in NP-Complete if and only if all other problems in NP can be transformed into X in polynomial time, concludes Camille.  
At the end of the prosit, Romain looks them straight in the eye. All the students look up, alarmed at the announcement he is about to make. Romain smiles slightly and breaks the silence by slowly telling them in a solemn tone:  
My young friends, one of you has given me an erroneous statement.  
Who is it?

Réponses correctes				
	Réponse attendue	Réponse saisie	Réponse discordante	
A	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Non	Marius
B	<input type="checkbox"/>	<input type="checkbox"/>	Non	Camille
C	<input type="checkbox"/>	<input type="checkbox"/>	Non	Clara
D	<input type="checkbox"/>	<input type="checkbox"/>	Non	Emma
E	<input type="checkbox"/>	<input type="checkbox"/>	Non	Karim

?				
Question 23				
Question à réponse unique				
If there exists a solution to the traveling salesman problem in a directed graph $G$ , then $G$ must contain:				
Réponses incorrectes				
	Réponse attendue	Réponse saisie	Réponse discordante	
A	<input type="checkbox"/>	<input type="checkbox"/>	Non	An Eulerian chain
B	<input type="checkbox"/>	<input type="checkbox"/>	Non	A Hamiltonian cycle
C	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Oui (+1)	An Eulerian path
D	<input type="checkbox"/>	<input type="checkbox"/>	Non	An Eulerian circuit
E	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Oui (+1)	A Hamiltonian circuit

Question 24

Question à réponse unique

We'll use the word **path** to refer to the answer to the previous question, so as not to give the answer.

Consider an integer  $k \geq 3$

Given an instance of the Travelling salesman, i.e. a directed graph  $G$  containing  $n$  vertices and a path, the verification that it is indeed a path of  $G$  and that its cost is less than  $k$  is done with complexity in:

Réponses incorrectes

	Réponse attendue	Réponse saisie	Réponse discordante	
A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Oui (+1)	$O(n^2)$
B	<input type="checkbox"/>	<input type="checkbox"/>	Non	$O(1)$
C	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Oui (+1)	$O(n)$
D	<input type="checkbox"/>	<input type="checkbox"/>	Non	$O(n!)$
E	<input type="checkbox"/>	<input type="checkbox"/>	Non	$O(0)$

Question 25

Question à réponse unique

Que peut-on déduire de la question précédente ?

Réponses incorrectes

	Réponse attendue	Réponse saisie	Réponse discordante	
A	<input type="checkbox"/>	<input type="checkbox"/>	Non	Traveling salesman reduces polynomially to the Hamiltonian Chain problem
B	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Oui (+1)	Traveling salesman is in NP
C	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Oui (+1)	Traveling salesman is in NP-hard
D	<input type="checkbox"/>	<input type="checkbox"/>	Non	Traveling salesman is in NP-complete
E	<input type="checkbox"/>	<input type="checkbox"/>	Non	Traveling salesman is outside NP and NP-hard

Question 26

Question à réponse unique

We know that the Traveling Salesman problem is at least as difficult as any problem in NP.

This statement and the answer to the previous question allow us to conclude that the problem Traveling Salesman:

Réponses incorrectes

	Réponse attendue	Réponse saisie	Réponse discordante	
A	<input type="checkbox"/>	<input type="checkbox"/>	Non	is in P
B	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Oui (+1)	is impossible to solve
C	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Oui (+1)	is in NP-complete
D	<input type="checkbox"/>	<input type="checkbox"/>	Non	is in NP-hard
E	<input type="checkbox"/>	<input type="checkbox"/>	Non	is outside NP and NP-hard

Question 27

Question à réponse unique

What is the purpose of the traveling salesman problem?

Réponses correctes

	Réponse attendue	Réponse saisie	Réponse discordante	
A	<input type="checkbox"/>	<input type="checkbox"/>	Non	Find the shortest path between two points.
B	<input type="checkbox"/>	<input type="checkbox"/>	Non	Find the longest path between two points.
C	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Non	Find the shortest route that visits each city once and returns to the starting point.
D	<input type="checkbox"/>	<input type="checkbox"/>	Non	Find the longest path that visits each city once and returns to the starting point.
E	<input type="checkbox"/>	<input type="checkbox"/>	Non	Find a path that visits each city once and returns to the starting point.

Question 28

Question à réponse unique

What is the symmetrical TSP problem?

Réponses incorrectes

	Réponse attendue	Réponse saisie	Réponse discordante	
A	<input type="checkbox"/>	<input type="checkbox"/>	Non	The TSP where the distances between each pair of cities are different
B	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Oui (+1)	The TSP where the distances between each pair of cities are the same
C	<input type="checkbox"/>	<input type="checkbox"/>	Non	The TSP where each city must be visited a certain number of times
D	<input type="checkbox"/>	<input type="checkbox"/>	Non	The TSP or the number of cities to visit is even
E	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Oui (+1)	None of the above

Question 29

Question à réponse unique

Which of the following problems is not in the NP-complete class?

Réponses incorrectes

	Réponse attendue	Réponse saisie	Réponse discordante	
A	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Oui (+1)	Shortest route
B	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Oui (+1)	Hamiltonian circuit
C	<input type="checkbox"/>	<input type="checkbox"/>	Non	Classification
D	<input type="checkbox"/>	<input type="checkbox"/>	Non	Traveling salesman