HO CHI MINH CITY UNIVERSITY OF TECHNOLOGY
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Revision for ILP session

Course: Mathematical Modeling
Duration: ... minutes   Exam Code: **1712**
Choose the best answer for each multiple-choice question and fill in the blank needed.

Question 1. For any linear integer programming problems Which of the following statements is FALSE?
(A) all variables are real. (B) all variables are integer. (C) some variables are integer.
(D) all variables are binary.

Question 2. Given a linear programming problem in the general form. Which statement below is true?
(A) Cannot convert to the standard form.
(B) Can convert to standard form, depending on the specific case.
(C) Can convert to standard form by removing some variables.
(D) Can convert to standard form by adding some variables.

Question 3. Which of the following constraints is not linear?
(A) $7x - 6y \leq 45$ (B) $2xy + x \geq 15$ (C) $x + y + 3z = 35$ (D) $2x + 10y \geq 60$

Question 4. To convert a constraint less than or equal to the standard form in the simplex algorithm we must

(A) add a new variable. (B) subtract a new variable.
(C) subtract or add a new variable depending on the problem MIN or MAX.
(D) A and B are true.

Question 5. A firm has 2 projects to implement. Suppose $X_i (i = 1, 2)$ is 1 if project i is implemented, and 0 otherwise. To ensure that 1 of 2 projects is implemented. Which of the following constraints represents this requirement?
(A) $X_1 - X_2 \leq 0$. (B) $X_1 - X_2 = 1$. (C) $X_1 + X_2 = 1$. (D) $X_1 + X_2 \leq 1$.

Question 6. When using the simplex method to solve the MAX problem, we find that when all the ratios(λ) in the row used to select the pivot elements are negative, then
(A) the solution is optimal. (B) the solution is unbounded.
(C) the solution is degenerate (D) the solution is infeasible

Question 7. The constraint

$$\sum_{3q-2}^{3q} \sum_{3p-2}^{3p} x_{ijk} = 1, \forall k = 1:n; p, q = 1:3$$

represents which condition in the Sudoku problem?
(A) Numbers 1 to 9 appear exactly once on each line. (B) No conditions at all.
(C) The numbers 1 to 9 appear exactly once on each 3x3 square.
(D) all answers are wrong.

Question 8. If a linear program has an optimal solution, then
(A) the feasible set is non-empty and the objective function is bounded.
(B) the objective function might not be bounded. (C) the feasible set can be empty.
(D) only feasible set is non-empty.

Question 9. In a linear program, which one of the following statements is true?
(A) Bounded feasible regions have both a minimum and a maximum value.
(B) Unbounded feasible regions have either a minimum or maximum value, never both.
(C) The minimum or maximum value of such objective functions always occurs at the vertex of the feasible region.
(D) all statements are true.

Question 10. A basic feasible solution of a linear program consists of

(A) all variables of zero. (B) basic variables of zero, non-basic variables of non-zero.

(C) basic variable of non-negative value, non-basic variables of zero.

(D) basic variables of zero, non-basic variables of positive value.

Question 11. If a linear program has an optimal solution, then the solution

(A) is a point of the interior of the feasible set.

(B) is an interior point of the boundary of the feasible set.

(C) does not belong to the feasible set. (D) is an extreme point of the feasible set.

Question 12. In the simplex method, the reduced cost of the objective function $r_N = c_N^T - c_B^T B^{-1} N$ is used to

(A) find a basic solution (B) give a conclusion about whether the feasible region is empty or not

(C) check the optimal condition at the basic feasible solution

(D) calculate an extreme point of the feasible region.

Question 13. In the simplex method, the reduced costs of the objective function at the basic variables are

(A) less than 0. (B) greater than 0. (C) equal to 0.

(D) greater than or equal to 0.

Question 14. For any linear programming problem,

I) If a linear programming problem has a solution at all, it will have a solution at some corner of the feasible region.

II) No point other than a corner of the feasible region can be a solution to an LP problem.

III) No point in the interior of the feasible region can be a solution to an LP problem.

Which of the above statements is/are TRUE?

(A) Only I. (B) I and II. (C) I and III. (D) I,II and III.

Question 15. For any linear programming problem,

I) Constraints can always be turned into equations by adding slack variables to the left-hand sides.

II) Constraints can always be turned into equations by subtracting surplus variables from the left-hand sides.

III) Constraints can always be turned into equations by adding or subtracting slack or surplus variables from the left-hand sides as appropriate.

Which of the above statements is/are TRUE?

(A) Only I. (B) I and II. (C) I,II and III. (D) Only III.

Question 16. Loan has 15 acres of arable land. She wants to grow wheat or corn on this land. The land can give a profit of 80 million VND/acre of wheat and 50 million VND/acre of corn. The labor and fertilizer used for each sample are listed in the table below

	wheat	corn
Labor	3	2
Fertilizer	3 quintals	10 quintals

Currently, there are 100 quintals of fertilizer available on the land and 30 workers are employed. Consider X and Y as the number of wheat and corn samples, respectively (assuming we only consider $X, Y \in N$). Then the possible value of X is

(A) 10 (B) 15 (C) 11 (D) 16

Question 17. Consider a linear program finding minimum which has the initial simplex tableau as below.

1	1	1	0	0	
x_1	x_2	x_3	x_4	x_5	Rhs
-1	1	2	0	0	2
1	0	-1	0	1	3
2	0	1	1	0	4
r_1	r_2	r_3	r_4	r_5	-2

Suppose that x_2, x_5, x_4 are basic variables. Then, the value of reduced cost r_i, for $i = 1, 2, 3, 4, 5$ should be

(A) $(-2, 0, 1, 0, 0)$ (B) $(0, 2, 1, 0, 0)$ (C) $(0, 1, 2, 0, 0)$ (D) $(2, 0, -1, 0, 0)$

Question 18. Let the linear programming

$$\min_{x_i} x_1 + x_3 - x_4$$

$$x_1 - x_3 = 1$$

$$x_3 + x_4 = 6$$

$$x_2 - 2x_3 = 3$$

$$x_i \geq 0, \text{ where } i = 1, 2, 3, 4$$

then, the point $(1, 3, 0, 6)$

(A) is a basic feasible solution but not an optimal solution.
(B) is an optimal solution.
(C) is not a basic feasible solution.
(D) is not in the feasible set.

Question 19. Consider a general linear program

$$\min_{x_1, x_2} -2x_1 + 3x_2$$

$$3x_1 + 4x_2 \leq 24,$$

$$7x_1 - 4x_2 \leq 16,$$

$$x_1, x_2 \geq 0.$$

Which one of followings can change the problem into standard form?

(A) $3x_1 + 4x_2 + x_3 = 24; 7x_1 - 4x_2 + x_4 = 16$, với $x_3, x_4 \leq 0$.
(B) $3x_1 + 4x_2 - x_3 = 24; 7x_1 - 4x_2 - x_4 = 16$, với $x_3, x_4 \geq 0$.
(C) $3x_1 + 4x_2 + x_3 = 24; 7x_1 - 4x_2 + x_4 = 16$, với $x_3, x_4 \geq 0$.
(D) $-3x_1 - 4x_2 + x_3 = 24; -7x_1 + 4x_2 + x_4 = 16$, với $x_3, x_4 \leq 0$.

Question 20. Consider the following linear program

$$\min_{x_i} 2x_1 - 3x_2 + 2x_3 - 2x_4$$

subject to

$$5x_1 + 2x_3 - 6x_4 = 5,$$

$$3x_2 - x_3 + 2x_4 = 5,$$

$$x_i \geq 0, \text{ where } i = 1, 2, 3, 4$$

Given non-basic variables x_2 and x_4, then the corresponding basic solution of the problem is

(A) $(3, 0, -5, 0)$, and also feasible.
(B) $(3, 0, -5, 0)$, and not feasible.
(C) $(0, 3, 0, -5)$, and also feasible.
(D) $(0, 3, 0, -5)$, and not feasible.

Question 21. Consider a linear program finding minimum which has the simplex tableau for basic variables $\{x_2, x_4, x_5\}$ as below.

1	1	1	0	0	
x_1	x_2	x_3	x_4	x_5	Rhs
-1	1	2	0	0	2
1	0	-1	0	1	3
2	0	1	1	0	4
2	0	-1	0	0	-f(x)

The new basic variables should be

(A) $\{x_2, x_5, x_4\}$.
(B) $\{x_3, x_5, x_4\}$.
(C) $\{x_2, x_3, x_4\}$.
(D) $\{x_2, x_5, x_3\}$.

Question 22. Consider a linear program finding minimum which has the simplex tableau for basic variables $\{x_2, x_5, x_4\}$ as below.

-2	3	0	0	
x_1	x_2	x_3	x_4	Rhs
3	4	1	0	24
7	-4	0	1	16
-2	3	0	0	0

Then, the pivot element (phần tử trục/xoay)

(A) can not be determined.

(B) $\overline{a}_{11} = 3$, with in-variable x_1 and out-variable x_3.

(C) $\overline{a}_{21} = 7$, with in-variable x_1 and out-variable x_4.

(D) $\overline{a}_{12} = 4$, with in-variable x_2 and out-variable x_3.

Question 23. Consider a linear programming

$$\min_{x_i} x - y$$
$$4x - 3y \leq 0$$
$$x + y \leq 10$$
$$x, y \geq 0$$

The feasible region is

(A) empty

(B) bounded

(C) unbounded

(D) all answers are false

Question 24. Consider a linear program finding minimum which has the simplex tableau for basic variables $\{x_2, x_4, x_5\}$ as below.

1	1	1	0	0	
x_1	x_2	x_3	x_4	x_5	Rhs
-1	1	2	0	0	2
1	0	-1	0	1	3
2	0	1	1	0	4
2	0	-1	0	0	-f(x)

Which one of the following statements is true?

(A) The optimal condition is not satisfied, continue to create a new tabular with the in-variable x_3

(B) the problem does not have a solution because the objective function is unbounded

(C) The optimal condition is not satisfied

(D) The optimal condition is not satisfied, continue to create a new tabular with the out-variable x_3

Question 25. An electronics firm decides to launch two models of a tablet, TAB1 and TAB2. The cost of making each device of type TAB1 is \$120 and the cost for TAB2 is \$160. The firm recognizes that this is a risky venture, so it decides to limit the total weekly production costs to \$4000. Also, due to a shortage of skilled labor, the total number of tablets that the firm can produce in a week is at most 30. The profit made on each device is \$600 for TAB1 and \$700 for TAB2. How should the firm arrange production to maximise profit?

(A) 20 tablets of model TAB1 and 10 of model TAB2.

(B) 15 tablets of model TAB1 and 15 of model TAB2.

(C) 20 tablets of model TAB1 and 15 of model TAB2.

(D) 15 tablets of model TAB1 and 10 of model TAB2.

Question 26. The first step in a branch and bound approach to solving integer programming problems is to

(A) change the objective function coefficients to whole integer numbers.

(B) graph the problem.

(C) solve the original problem using LP by allowing continuous noninteger solutions.

(D) compare the lower bound to any upper bound of your choice.

Question 27. In the branch and bound technique, what is the definition of the incumbent?

- (A) The upper bound of the objective function.
- (B) The lower bound of the objective function.
- (C) The best integer solution that we obtain at each step of branching and bounding.
- (D) None of the other choices is correct.

Question 28. When using the branch and bound method in integer programming maximization problem, the stopping rule for branching is to continue until

- (A) the objective function is zero.
- (B) the new upper bound is less than or equal to the lower bound or no further branching is possible.
- (C) the new upper bound exceeds the lower bound.
- (D) the lower bound reaches zero.

Question 29. In the branch and bound method of solving a linear programming problem with integer variables, if an optimal solution of a linear programming relaxation problem is an integer, then it is

- (A) a feasible solution of the original problem.
- (B) an optimal solution of the original problem.
- (C) an infeasible solution of the original problem.
- (D) a degenerate solution of the original problem.

Question 30. The relaxation in the branch-and-bound approach for solving a linear integer program performs to

- (A) assign all variables to zero.
- (B) assign all variables to one.
- (C) drop all integer variables.
- (D) drop integer constraint of variables.

Question 31. For any linear programming problem, To minimize c you can instead maximize $p = -c$.

(A) True. (B) False.

Question 32. For any linear programming problem, in a basic solution, some of the variables are 0.

(A) True. (B) False.

Question 33. In a feasible basic solution, all the variables (with the possible exception of the objective) are nonnegative.

(A) True. (B) False.

Question 34. You should always make sure that there are no negative numbers in the rightmost column (with the possible exception of the objective) before choosing a pivot.

(A) True. (B) False.

Question 35. When all the variables (with the possible exception of the objective) are nonnegative and all the numbers in the bottom row are nonnegative (with the possible exception of the rightmost) you are done with the simplex method.

(A) True. (B) False.