(1) True or False?

I. The optimal value attained by the objective function of the primal problem is the negative of the optimal value attained by the objective function of the dual problem.

II. If \( x < y \) then \( -y < -x \).

(a) both I and II are true
(b) I is true, II is false
(c) I is false, II is true
(d) both I and II are false

(2) A feasible region has five corner points:

(a) \((10, 0)\)
(b) \((6, 10)\)
(c) \((4, 12)\)
(d) \((0, 12)\)
(e) \((0, 0)\)

Which of these maximizes the objective function \( P = 7x + 5y \) ?
(3) Fill in the blank: In setting up the initial tableau, we first transform the system of linear inequalities into a system of linear equations using ________________.
(a) basic variables
(b) slack variables
(c) pivots
(d) the dual method
(e) NOTA

(4) Fill in the blank: When solving a standard maximization problem using the Simplex Method, all ________________ variables are set to zero.
(a) basic
(b) slack
(c) nonbasic
(d) non-optimal
(e) NOTA

For the next two questions, solve the following problem by the method of corners:
Maximize $P = 5x + y$ subject to
$$2x + y \leq 8$$
$$-x + y \geq 2$$
$$x \geq 0, y \geq 0$$

(5) In the solution, the value of $y$ is
(a) 0  (b) 2  (c) 4  (d) 6  (e) 8

(6) In the solution, the maximum value of $P$ is
(a) 2  (b) 8  (c) 10  (d) 14  (e) 20
The next two questions ask you to formulate (but not solve) the following linear programming problem:

A farmer uses two types of fertilizer. A 50-lb bag of Fertilizer A contains 8 lbs of nitrogen, 2 lbs of phosphorus, and 4 lbs of potassium. A 50-lb bag of Fertilizer B contains 5 lbs each of nitrogen, phosphorus, and potassium. The minimum requirements for an 80 acre field are 440 lbs of nitrogen, 260 lbs of phosphorus, and 360 lbs of potassium. A 50-lb bag of Fertilizer A costs $30 and a 50-lb bag of Fertilizer B costs $20. Let \( x \) = the number 50-lb bags of Fertilizer A \( y \) = the number of 50-lb bags of Fertilizer used to fertilize the field. What value of \( x \) and \( y \) should the farmer use to minimize his cost while still meeting the minimum requirements.

(7) Which of the following is **not** a constraint to the linear programming problem?
   (a) \( 8x + 5y \geq 440 \)
   (b) \( 4x + 5y \geq 360 \)
   (c) \( 2x + 5y \geq 260 \)
   (d) \( 30x + 20y \geq 80 \)
   (e) NOTA

(8) Which of the following is the function to be minimized?
   (a) \( C = 8x + 5y \)
   (b) \( C = 20x + 30y \)
   (c) \( C = 4x + 5y \)
   (d) \( C = 2x + 5y \)
   (e) NOTA

(9) Which of the following statements about the dual of the following minimization problem is false?
Minimize \( C = 12x + 4y + 8z \) subject to
\[
2x + 4y + z \geq 6 \\
3x + 2y + 2z \geq 2 \\
4x + z \geq 2 \\
x \geq 0, y \geq 0, z \geq 0
\]
   (a) The dual problem is a maximization
   (b) \( 2u + 3v + 4w \leq 12 \)
   (c) \( 4u + 2v + w \leq 4 \)
   (d) \( u + 2v + w \leq 8 \)
   (e) The objective function is \( 6u + 2v + 2w \)
(10) Convert the constraint $-x + 2y \geq 5$ to an inequality involving $\leq$:

(a) $x - 2y \leq -5$
(b) $x + 2y \leq 5$
(c) $x - 2y \leq 5$
(d) $x + 2y \leq -5$
(e) NOTA

For the next two problems solve the standard maximization problem that has the following tableau.

\[
\begin{pmatrix}
x & y & z & u & v & w & P \\ 
1 & 0 & 0 & 1 & -1 & 0 & 0 & | & 40 \\ 
2 & 1 & -1 & 0 & 1 & 0 & 0 & | & 40 \\ 
-3 & 0 & 2 & 0 & -1 & 1 & 0 & | & 40 \\ 
7 & 0 & -2 & 0 & 4 & 0 & 1 & | & 160 
\end{pmatrix}
\]

(11) The maximum is:

(a) 120  (b) 160  (c) 200  (d) 240  (e) NOTA

(12) In the optimal solution, the value of $z$ is:

(a) 0  (b) 20  (c) 40  (d) 60  (e) NOTA
(13) Suppose that the primal problem for a linear programming is a standard minimization and that the final simplex tableau for the dual maximization problem is

\[
\begin{pmatrix}
\begin{array}{ccccccc|c}
    u & v & w & x & y & z & P & \text{const} \\
    \frac{1}{2} & 0 & \frac{1}{2} & 1 & -\frac{1}{2} & 0 & 0 & 5 \\
    \frac{2}{3} & 1 & \frac{1}{2} & 0 & \frac{1}{2} & 0 & 0 & 3 \\
    4 & 0 & 3 & 0 & 1 & 1 & 0 & 10 \\
    2 & 0 & 0 & 0 & 2 & 0 & 1 & 12 \\
\end{array}
\end{pmatrix}
\]

What is the solution to the primal problem?
(a) \(x = 0, y = 2, z = 0, C = 12\)
(b) \(x = 5, y = 3, z = 10, C = 12\)
(c) \(x = 5, y = 0, z = 10, C = 12\)
(d) \(x = 5, y = 0, z = 10, C = -12\)
(e) NOTA

(14) Is more pivoting needed in the following simplex tableau?

\[
\begin{pmatrix}
    1/2 & 0 & 0 & 1 & 0 & 0 & -1 & 0 & -2 \\
    5 & 3 & 1 & 0 & 0 & 0 & 2 & 0 & 3 \\
    7 & -2 & 0 & 0 & 1 & 0 & -3 & 0 & 2 \\
    4 & 4 & 0 & 0 & 0 & 1 & -6 & 0 & 3 \\
    15 & -10 & 0 & 0 & 0 & 2 & 1 & 4 \\
\end{pmatrix}
\]

(a) Yes: Pivot about a 2
(b) Yes: Pivot about a 3
(c) Yes: Pivot about a 4
(d) Yes: Pivot about a -1
(e) No

(15) Determine the location of the next pivot point in the following Simplex tableau.

\[
\begin{pmatrix}
    x & y & z & u & v & w & P & \text{const} \\
    2 & 0 & 2 & 0 & 0 & 1 & 0 & 30 \\
    1 & 0 & \frac{1}{4} & 1 & -\frac{1}{4} & 0 & 0 & \frac{19}{4} \\
    \frac{1}{2} & 1 & \frac{3}{4} & 0 & \frac{1}{4} & 0 & 0 & \frac{21}{2} \\
    -1 & 0 & -\frac{3}{2} & 6 & \frac{3}{2} & 0 & 1 & 63 \\
\end{pmatrix}
\]

(a) row 2, column 1
(b) row 3, column 1
(c) row 1, column 3
(d) row 2, column 3
(e) row 3, column 3