MULTIMEDIA UNIVERSITY

STUDENT ID NO

- QUIZ -

PEM 2046 – ENGINEERING MATHEMATICS IV

THIRD TRIMESTER EXAMINATION, **2001 / 02 SESSION**

(1 Hour)

INSTRUCTIONS TO STUDENT

1. This Question paper consists of **7** pages with **20** questions only. Each question carries one mark.

2. Attempt **ALL** questions and write all your answers A, B, C or D in the column provided below.

Answer Column

Question	1	2	3	4	5
Answer	C	C	A	B	A

Question	6	7	8	9	10
Answer	D	D	A	D	C

Question	11	12	13	14	15
Answer	A	A	A	D	B

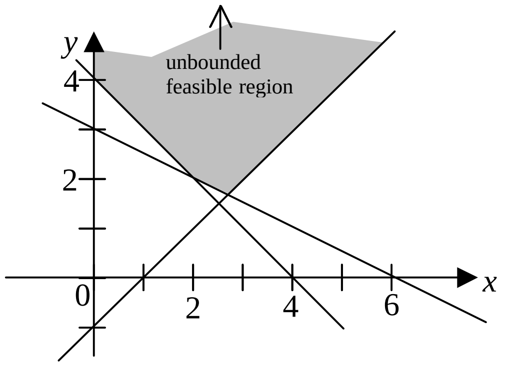
Question	16	17	18	19	20
Answer	D	C	A	A	D

For questions 1 to 2, consider the following linear programming problem.

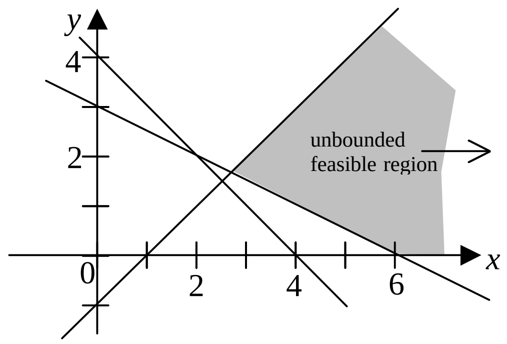
$$\begin{aligned} \text{Minimize} \quad & z = 4x + 3y \\ \text{subject to} \quad & 2x + y \ge 6 \\ & x + y \ge 4 \\ & x - y \le 1 \\ & x, y \ge 0. \end{aligned}$$

1. The feasible region is

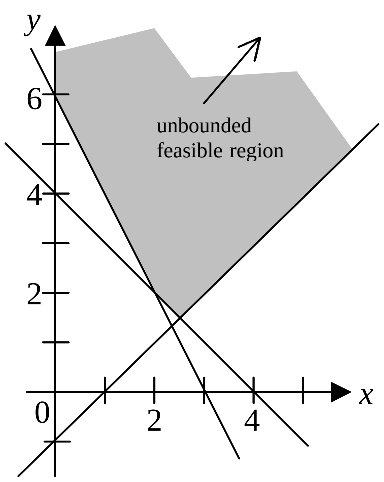
[A]



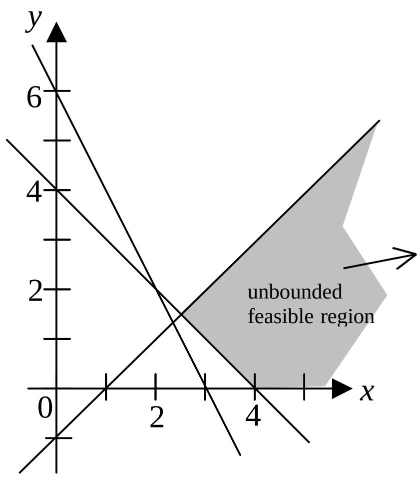
[B]



[C]



[D]

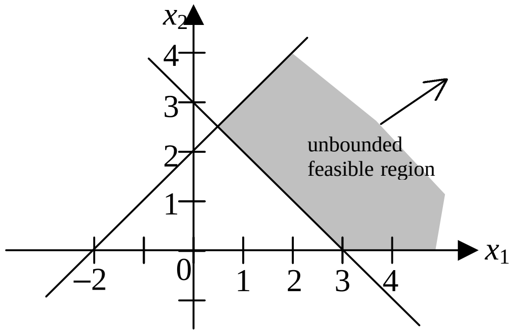


2. The optimal value is

[A] $20\frac{3}{9}$ [B] $14\frac{1}{2}$ [C] 14 [D] 12

Continue….

3. Given a feasible region as below:



For which of the following objective functions, the linear programming problem with the above feasible region possesses an unique optimal solution?

[A] maximize $z = -x_1 - 2x_2$ [B] minimize $z = -x_1 + x_2$
[C] maximize $z = x_1 + 2x_2$ [D] minimize $z = x_1 + x_2$

4. A basic solution is necessarily

[A] optimal [B] the intersection of hyperplanes.
[C] nondegenerate [D] feasible

5. If a solution is degenerate, it means

[A] some of the basic variables are zero
[B] infeasible
[C] some of the basic variables become infinity
[D] non-basic variables only take zero values

Continue….

For questions 6-9, consider the following linear programming problem in its standard form:

$$\begin{array}{ll} \text{Minimize} & z - 5x_1 + 20x_2 = 0 \\ \text{subject to:} & -2x_1 + 10x_2 + x_3 \qquad = 5 \\ & 2x_1 + \ \ 5x_2 \qquad + x_4 = 10 \\ & x_1, x_2, x_3, x_4 \geq 0 \end{array}$$

with x_3 and x_4 are the slack variables.

Applying the Simplex method to the above linear programming problem, at the optimal stage, the following table is obtained:

z	x_1	x_2	x_3	x_4	Solution
1	a	0	-2	0	-10
0	$\frac{-1}{5}$	b	$\frac{1}{10}$	0	$\frac{1}{2}$
0	3	0	c	1	$\frac{15}{2}$

6. The entering variable for the initial iteration is

[A] x_4 [B] x_1 [C] x_3 [D] x_2

7. What are the values of a, b and c?

[A] $a = -2$, $b = -2$, $c = 3$. [B] $a = -\frac{1}{2}$, $b = 1$, $c = -1$.
[C] $a = -2$, $b = 3$, $c = 2$. [D] $a = -1$, $b = 1$, $c = -\frac{1}{2}$.

8. The non-basic variables at the optimal stage are

[A] x_1 and x_3 only. [B] x_1 and x_2 only.
[C] x_2 and x_4 only. [D] x_2 and x_3 only.

9. The optimal value z is

[A] 15/2 [B] 5 [C] –12 [D] –10

Continue….

For questions 10 to 13, consider the following linear programming problem.

$$
\begin{array}{llll}
\text{Maximize} & z & & \\
\text{subject to} & 3x_1 + 2x_2 \leq 180 & & \text{(resource 1)} \\
& x_1 \qquad\ \leq 50 & & \text{(resource 2)} \\
& \qquad x_2 \leq 50 & & \text{(resource 3)} \\
& x_1, x_2 \geq 0. & &
\end{array}
$$

The final optimal tableau is given as below:

Basic	z	x_1	x_2	s_1	s_2	s_3	Solution
z	1	0	0	6	2	0	1180
x_2	0	0	1	0.5	–1.5	0	15
x_1	0	1	0	0	1	0	50
s_3	0	0	0	–0.5	1.5	1	35

where s_1, s_2 and s_3 are slack variables for the first, second and third constraints respectively.

10. The shadow price for resource 2 is

[A] 6 [B] 1 [C] 2 [D] 0

11. The decision maker decides to increase the availability of one of the resources. Which one of these resources should be given a priority?

[A] resource 1 [B] resource 3
[C] resource 2 [D] either resource 1 or 2

12. If the availability of the resources are changed from [180 50 50] to [200 50 60], the new optimal value is

[A] 1300 [B] 200 [C] 1500 [D] 250

13. Using the original model, if the objective coefficients for x_1 and x_2 are changed to 25 and 10 respectively, the new optimal value is

[A] 1400 [B] 1500 [C] 650 [D] 1875

Continue….

Questions 14 to 17 based on the following problem.

Consider a 8 m^3 box which is to be filled with 3 types of items, namely item-1, item-2 and item-3. The volume for each item is 1 m^3.

Let
u be the space available in the box in m^3 unit,
$f_j(u)$ be the maximum benefit earned if u m^3 space is available for item-j, item-(j+1), …, item-3, and
$d_j(u)$ be the units of item-j that must be carried in order to achieve $f_j(u)$ if u m^3 space is available for item-j, item-(j+1), …, item-3.

The dynamic programming with backward recursion has been used to determine the units of each item to be carried so as to achieve the maximum benefit without exceeding the box capacity. The values of $f_j(u)$ and $d_j(u)$ are obtained as below:

		u								
		0	1	2	3	4	5	6	7	8
Stage 3	$f_3(u)$	0	1	2	4	6	8	11	14	16
	$d_3(u)$	0	1	2	3	4	5	6	7	8
Stage 2	$f_2(u)$	0	1	3	5	6	8	11	15	16
	$d_2(u)$	0	0, 1	2	3	0, 3, 4	0	0	7	0, 7, 8
Stage 1	$f_1(u)$	-	-	-	-	-	-	-	-	16
	$d_1(u)$									0, 1, 6

14. What is the maximum benefit earned?

[A] 48 [B] 32 [C] 15 [D] 16

15. Which of the following is NOT the optimal policy?

[A] 8 units of item-2.
[B] 6 units of item-1 and 2 units of item-3.
[C] 8 units of item-3.
[D] 1 unit of item-1 and 7 units of item-2.

16. The benefit obtained by carrying 4 units of item-2 alone is

[A] 3 [B] 5 [C] 8 [D] 6

17. What is the optimal policy to achieve the maximum benefit if a 4 m^3 box is to be filled with item-2 and item-3 only?
[I] 1 unit of item-2 and 3 units of item-3 only.
[II] 2 units of item-2 and 2 units of item-3 only.
[III] 4 units of item-3 only.
[IV] 3 units of item-2 and 1 unit of itme-3 only.

[A] I, IV only [B] II, IV only
[C] III, IV only [D] none of the above

Continue….

For questions 18-20, consider the following nonlinear programming problem:

$$\begin{aligned} &\text{Maximize} && f = x + y^2 z \\ &\text{subject to:} && y^2 + z^2 = 2 \\ & && -x + z = 0 \\ & && x, y, z \geq 0. \end{aligned}$$

The Lagrangian is $L(x, y, z, l_1, l_2) = x + y^2 z - l_1(y^2 + z^2 - 2) - l_2(-x + z) = 0$.

18. Which of the followings is one of the critical points for $L(x, y, z, l_1, l_2)$?

[A] $(x, y, z) = (1, -1, 1)$ [B] $(x, y, z) = (1, \sqrt{2}, \sqrt{2})$
[C] $(x, y, z) = (\sqrt{2}, 0, -\sqrt{2})$ [D] $(x, y, z) = (\sqrt{2}, 1, \sqrt{2})$

19. The value of x and y at the optimal stage is

[A] $x = 1, y = 1.$ [B] $x = \sqrt{2}, y = 0.$
[C] $x = 1, y = \sqrt{2}.$ [D] $x = \sqrt{2}, y = 1.$

20. The optimal value is

[A] $1 + \sqrt{2}$ [B] $\sqrt{2}$ [C] 3 [D] 2

End of page.