Name:______________________________

$I \quad D$ $N \quad O$	:							0 1 10 30	0 2 9 20	$S \quad R$ $N \quad O$	

$Time$ $120 Min$	$Seat$: $No.$:				$Marks$ 125	$Marks$: $Secured$:			

NOTE: 1. The questions are not in any order of difficulty at all.

2. All questions carry equal number of marks.

3. Only the nonprogramable calculators are allowed.

4. All types of PAGERS, OR MOBILES ARE NOT ALLOWED to be with you during the examination.

5. Use an HB 2 pencil.

6. Use a good eraser. Do not use the eraser attached to the pencil.

7. Write your name, ID number and Section number on the examination paper and in the upper left corner of the answer sheet.

8. When bubbling your ID number and Section number, be sure that bubbles match with the number that you write.

9. The test Code Number is already typed and bubbled in your answer sheet. Make sure that it is the same as that printed on your question paper.

10. When bubbling, make sure that the bubbled space is fully covered.

11. When erasing a bubble, make sure that you do not leave any trace of penciling.

12. Count that the exam has Twenty-Five Questions and Sixteen Pages.

13. Please BUBBLE carefully only right answer letter $(A$ or B or C or D or $E)$ corresponding to the correct answer to each question in the enclosed computerized Omar Sheet, with pencil only.

14. Please do not leave any question unbubbled in the Answer Sheet.

15. Please check that the version of your question paper and the answer sheet enclosed with it matches correctly. The versions are 001, 002, 003, 004.

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Compound Interest Formulae: Future Value: $S = P(1+r)^n$,

Present Value: $P = S(1+r)^{-n}$.

Effective Interest Formula: $r_e = \left(1+\frac{r}{n}\right)^n - 1$.

Continuos Interest Formulae: Future value: $S = Pe^{rt}$, Present Value: $P = Ae^{-rt}$, Effective Interest Formula: $r_e = e^r - 1$.

Ordinary Annuity Formulae (End):

Future Value = $S = R.\left[\frac{(1+r)^n - 1}{r}\right]$.

Present Value = $A = R.\left[\frac{1-(1+r)^{-n}}{r}\right]$.

Annuity Due Formulae (Beginning):

Future Value = $S = R.\left[\frac{(1+r)^{n+1} - 1}{r} - 1\right]$.

Present Value = $A = R.\left[1 + \frac{1-(1+r)^{-n+1}}{r}\right]$.

Permutations: $P(n,r) = {}^nP_r = \frac{n!}{(n-r)!}$;

Combinations: $C(n,r) = {}^nC_r = \binom{n}{r} = \frac{n!}{r!\,(n-r)!}$; $\left(\begin{array}{cccccc} & & n & & & \\ n_1 & n_2 & n_3 & - & - & - & n_k \end{array}\right) = \frac{n!}{(n_1!).(n_2!).(n_3!)\dots(n_k!)}$;

$where\ n = n_1 + n_2 + n_3 + \dots + n_k$.

$\#(A \cup B) = \#(A) + \#(B) - \#(A \cap B)$.

1Q1. A company manufactures three items:

hunting jackets, all-weather jackets, and ski jackets.

It takes 3 hours of labor per dozen to produce hunting jackets,

2.5 hours per dozen to produce all-weather jackets,

and 3.5 hours per dozen to produce ski jackets.

The cost per dozen is \$ 26 for hunting jackets,

\$ 20 for all-weather jackets,

\$ 22 for ski jackets.

The profit per dozen is \$ 7.50 for hunting jackets,

\$ 9 for all-weather jackets,

and \$ 11 for ski jackets.

The company has 3200 hours of labor

and \$ 18000 in operating funds vaiable.

How many of each jacket should it produce to maximize profit P?

Let x = number of dozens of hunting jackets,

let y = number of dozens of all-weather jackets,

let z = number of dozens of ski jackets.

Set up the initial simplex tableau without solution.

$$A.\ \begin{bmatrix} x & y & z & s & t & P & : & Cnst \\ 3 & 2.5 & 3.5 & 1 & 0 & 0 & : & 3200 \\ 7.5 & 9 & 11 & 0 & 1 & 0 & : & 18000 \\ .. & .. & .. & .. & .. & .. & .. & ...... \\ -26 & -20 & -22 & 0 & 0 & 1 & : & 0 \end{bmatrix}$$

$$B.\ \begin{bmatrix} x & y & z & s & t & P & : & Cnst \\ 3 & 2.5 & 3.5 & 1 & 0 & 0 & : & 3200 \\ 26 & 20 & 22 & 0 & 1 & 0 & : & 18000 \\ .. & .. & .. & .. & .. & .. & .. & ...... \\ 7.5 & 9 & 11 & 0 & 0 & 1 & : & 0 \end{bmatrix}$$

$$C.\ \begin{bmatrix} x & y & z & s & t & P & : & Cnst \\ 3 & 2.5 & 3.5 & 1 & 0 & 0 & : & 3200 \\ 26 & 20 & 22 & 0 & 1 & 0 & : & 18000 \\ .. & .. & .. & .. & .. & .. & .. & ...... \\ -11 & -9 & -7.5 & 0 & 0 & 1 & : & 0 \end{bmatrix}$$

$$D.\ \begin{bmatrix} x & y & z & s & t & P & : & Cnst \\ 3 & 2.5 & 3.5 & 1 & 0 & 0 & : & 3200 \\ 26 & 20 & 22 & 0 & 1 & 0 & : & 18000 \\ .. & .. & .. & .. & .. & .. & .. & ...... \\ -7.5 & -9 & -11 & 0 & 0 & 1 & : & 0 \end{bmatrix}$$

$$E.\ \begin{bmatrix} x & y & z & s & t & P & : & Cnst \\ 3 & 3.5 & 2.5 & 1 & 0 & 0 & : & 3200 \\ 26 & 22 & 20 & 0 & 1 & 0 & : & 18000 \\ .. & .. & .. & .. & .. & .. & .. & ...... \\ -7.5 & -9 & -11 & 0 & 0 & 1 & : & 0 \end{bmatrix}$$

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2Q2. The Initial Simplex Table for the following Standard Maximum Linear Programing Problem:

Maximize $Z = x_1 + 3x_2 + x_3$

subject to the constraints:

$$\left\{ \begin{array}{ccccccc} 4x_1 & + & x_2 & + & x_3 & \leq & 372 \\ x_1 & + & 8x_2 & + & 6x_3 & \leq & 1116 \\ x_1 & , & x_2 & , & x_3 & \geq & 0 \end{array} \right. .$$

is given as follows:

$$\left[\begin{array}{cccccccc} x_1 & x_2 & x_3 & s_1 & s_2 & Z & : & Cnst \\ 4 & 1 & 1 & 1 & 0 & 0 & : & 372 \\ 1 & 8 & 6 & 0 & 1 & 0 & : & 1116 \\ .. & .. & .. & .. & .. & .. & .. & ...... \\ -1 & -3 & -1 & 0 & 0 & 1 & : & 0 \end{array} \right].$$

The Pivot is equal to $m_{22} = 8$ in the 2nd row and 2nd column:

Pivot on 8 to get the next simplex table:

$$A. \left[\begin{array}{cccccccc} x_1 & x_2 & x_3 & s_1 & s_2 & Z & : & Cnst \\ \frac{31}{8} & 0 & \frac{1}{4} & 1 & \frac{1}{8} & 0 & : & \frac{465}{2} \\ \frac{1}{8} & 1 & -\frac{3}{4} & 0 & -\frac{1}{8} & 0 & : & \frac{279}{2} \\ .. & .. & .. & .. & .. & .. & .. & ...... \\ -\frac{5}{8} & 0 & \frac{5}{4} & 0 & \frac{3}{8} & 1 & : & \frac{837}{2} \end{array} \right]$$

$$B. \left[\begin{array}{cccccccc} x_1 & x_2 & x_3 & s_1 & s_2 & Z & : & Cnst \\ \frac{31}{8} & 0 & \frac{1}{4} & 1 & \frac{1}{8} & 0 & : & \frac{465}{2} \\ -\frac{1}{8} & 1 & \frac{3}{4} & 0 & \frac{1}{8} & 0 & : & \frac{279}{2} \\ .. & .. & .. & .. & .. & .. & .. & ...... \\ \frac{5}{8} & 0 & -\frac{5}{4} & 0 & \frac{3}{8} & 1 & : & \frac{837}{2} \end{array} \right]$$

$$C. \left[\begin{array}{cccccccc} x_1 & x_2 & x_3 & s_1 & s_2 & Z & : & Cnst \\ \frac{31}{8} & 0 & \frac{1}{4} & 1 & -\frac{1}{8} & 0 & : & 465 \\ \frac{1}{8} & 1 & \frac{3}{4} & 0 & \frac{1}{8} & 0 & : & \frac{279}{2} \\ .. & .. & .. & .. & .. & .. & .. & ...... \\ -\frac{5}{8} & 0 & \frac{5}{4} & 0 & \frac{3}{8} & 1 & : & 837 \end{array} \right]$$

$$D. \left[\begin{array}{cccccccc} x_1 & x_2 & x_3 & s_1 & s_2 & Z & : & Cnst \\ \frac{31}{8} & 0 & \frac{1}{4} & 1 & \frac{1}{8} & 0 & : & \frac{465}{2} \\ \frac{1}{8} & 1 & -\frac{3}{4} & 0 & -\frac{1}{8} & 0 & : & \frac{279}{2} \\ .. & .. & .. & .. & .. & .. & .. & ...... \\ -\frac{5}{8} & 0 & \frac{5}{4} & 0 & \frac{3}{8} & 1 & : & \frac{837}{2} \end{array} \right]$$

$$E. \left[\begin{array}{cccccccc} x_1 & x_2 & x_3 & s_1 & s_2 & Z & : & Cnst \\ \frac{31}{8} & 0 & \frac{1}{4} & 1 & -\frac{1}{8} & 0 & : & \frac{465}{2} \\ \frac{1}{8} & 1 & \frac{3}{4} & 0 & \frac{1}{8} & 0 & : & \frac{279}{2} \\ .. & .. & .. & .. & .. & .. & .. & ...... \\ -\frac{5}{8} & 0 & \frac{5}{4} & 0 & \frac{3}{8} & 1 & : & \frac{837}{2} \end{array} \right]$$

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3Q3. A school cafeteria serves three foods for lunch, A, B, and C.

There is a pressure on the cafeteria director to reduce lunch costs.

Help the director by finding the quantities of each food that will minimize costs and still maintain the desired nutritional level.

The three foods have the following nutritional characteristics:

PER $UNIT$	$Food$ A	$Food$ B	$Food$ C
Protein $(grams)$	15	10	23
Carbohydrates (g)	20	30	11
Calories	200	160	160
Fat (grams)	10	5	6
Cost $(\$)$	1.40	1.00	1.50

A lunch must contain at least (minimum) 80 grams of protein,

at least (minimum) 95 grams of carbohydrates,

and at least (minimum) 1400 calories.

It must contain not more than 40 grams of fat.

How many units of each food should be served to minimize cost?

Let $x =$ Number of units of food A,

let $y =$ Number of units of food B,

and let $z =$Number of units of food C.

Set up the constraints in the form of system of linear inequalities to Minimize the cost

$C = 1.40x + y + 1.50z$

for the above Linear Programing Problem without solution.

$$A.\begin{cases} 15x + 10y + 23z \geq 80 \\ 20x + 30y + 11z \geq 95 \\ 200x + 160y + 160z \geq 1400 \\ 10x + 5y + 6z \leq 40 \\ x \geq 0,\ y \geq 0,\ z \geq 0 \end{cases}$$

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$$B.\begin{cases} 15x + 10y + 23z \leq 80 \\ 20x + 30y + 11z \leq 95 \\ 200x + 160y + 160z \leq 1400 \\ 10x + 5y + 6z \leq 40 \\ x \geq 0,\ y \geq 0,\ z \geq 0 \end{cases}$$

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$$C.\begin{cases} 15x + 10y + 23z \geq 95 \\ 20x + 30y + 11z \geq 80 \\ 200x + 160y + 160z \geq 1400 \\ 10x + 5y + 6z \leq 40 \\ x \geq 0,\ y \geq 0,\ z \geq 0 \end{cases}$$

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$$D.\begin{cases} 15x + 10y + 23z \geq 80 \\ 30x + 20y + 11z \geq 95 \\ 200x + 160y + 160z \geq 1400 \\ 10x + 6y + 5z \geq 40 \\ x \geq 0,\ y \geq 0,\ z \geq 0 \end{cases}$$

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$$E.\begin{cases} 15x + 10y + 23z \geq 80 \\ 20x + 30y + 11z \geq 95 \\ 160x + 200y + 160z \geq 1400 \\ 10x + 5y + 6z \geq 40 \\ x \geq 0,\ y \geq 0,\ z \geq 0 \end{cases}$$

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4Q4. The initial simplex table for the standard linear programing problem:

Maximize $Z = 22x_1 + 20x_2 + 18x_3,$ subject to

$$\begin{cases} 2x_1 + x_2 + 2x_3 \leq 100 \\ x_1 + 2x_2 + 2x_3 \leq 100 \\ 2x_1 + 2x_2 + x_3 \leq 100 \\ x_1 \geq 0, \ x_2 \geq 0, \ x_3 \geq 0 \end{cases}$$

is given by:

$$\begin{bmatrix} x_1 & x_2 & x_3 & s_1 & s_2 & s_3 & Z & : & Cnst \\ 2 & 1 & 2 & 1 & 0 & 0 & 0 & : & 100 \\ 1 & 2 & 2 & 0 & 1 & 0 & 0 & : & 100 \\ 2 & 2 & 1 & 0 & 0 & 1 & 0 & : & 100 \\ .. & .. & .. & .. & .. & .. & .. & .. & ...... \\ -22 & -20 & -18 & 0 & 0 & 0 & 1 & : & 0 \end{bmatrix}.$$

Pivot on $m_{11} = 2$ in the first row and first column to find the next simplex table:

$$A. \begin{bmatrix} x_1 & x_2 & x_3 & s_1 & s_2 & s_3 & Z & : & Cnst \\ 1 & 0.5 & 1 & 0.5 & 0 & 0 & 0 & : & 50 \\ 0 & 1.5 & 1 & -0.5 & 1 & 0 & 0 & : & 0 \\ 0 & 1 & -1 & -1 & 0 & 1 & 0 & : & 50 \\ .. & .. & .. & .. & .. & .. & .. & .. & ...... \\ 0 & -9 & 4 & 11 & 0 & 0 & 1 & : & 100 \end{bmatrix}$$

$$B. \begin{bmatrix} x_1 & x_2 & x_3 & s_1 & s_2 & s_3 & Z & : & Cnst \\ 1 & 0.5 & 1 & 0.5 & 0 & 0 & 0 & : & 50 \\ 0 & 1.5 & 1 & -0.5 & 1 & 0 & 0 & : & 50 \\ 0 & 1 & 1 & 1 & 0 & 1 & 0 & : & 0 \\ .. & .. & .. & .. & .. & .. & .. & .. & ...... \\ 0 & 9 & 4 & -11 & 0 & 0 & 1 & : & 1100 \end{bmatrix}$$

$$C. \begin{bmatrix} x_1 & x_2 & x_3 & s_1 & s_2 & s_3 & Z & : & Cnst \\ 1 & 0.5 & 1 & 0.5 & 0 & 0 & 0 & : & 50 \\ 0 & 1.5 & 1 & -0.5 & 1 & 0 & 0 & : & 50 \\ 0 & 1 & -1 & -1 & 0 & 1 & 0 & : & 0 \\ .. & .. & .. & .. & .. & .. & .. & .. & ...... \\ 0 & -9 & 4 & 11 & 0 & 0 & 1 & : & 1100 \end{bmatrix}$$

$$D. \begin{bmatrix} x_1 & x_2 & x_3 & s_1 & s_2 & s_3 & Z & : & Cnst \\ 1 & 0.5 & 1 & 0.5 & 0 & 0 & 0 & : & 50 \\ 0 & 1.5 & 1 & 0.5 & 1 & 0 & 0 & : & 50 \\ 0 & 1 & 1 & 1 & 0 & 1 & 0 & : & 0 \\ .. & .. & .. & .. & .. & .. & .. & .. & ...... \\ 0 & 9 & 4 & 11 & 0 & 0 & 1 & : & 1100 \end{bmatrix}$$

$$E. \begin{bmatrix} x_1 & x_2 & x_3 & s_1 & s_2 & s_3 & Z & : & Cnst \\ 1 & 0.5 & 1 & 0.5 & 0 & 0 & 0 & : & 50 \\ 0 & 1.5 & 1 & 0.5 & 1 & 0 & 0 & : & 50 \\ 0 & 1 & 1 & 1 & 0 & 1 & 0 & : & 0 \\ .. & .. & .. & .. & .. & .. & .. & .. & ...... \\ 0 & 9 & -4 & 11 & 0 & 0 & 1 & : & 2200 \end{bmatrix}$$

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5Q5. Convert the augmented matrix:

$$\left[\begin{array}{ccc|c} 2 & -4 & 12 & 20 \\ -1 & 3 & 5 & 15 \\ 3 & -7 & 7 & 5 \end{array}\right]$$

of the system of equations:

$$\begin{aligned} 2x - 4y + 12z &= 20 \\ -x + 3y + 5z &= 15 \\ 3x - 7y + 7z &= 5 \end{aligned}$$

to reduced row echelon form:

$$A. \left[\begin{array}{ccc|c} 1 & 0 & 0 & 60 \\ 0 & 1 & 0 & 25 \\ 0 & 0 & 0 & 0 \end{array}\right].$$

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$$B. \left[\begin{array}{ccc|c} 1 & 0 & 28 & 60 \\ 0 & 1 & 11 & 25 \\ 0 & 0 & 0 & 0 \end{array}\right]$$

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$$C. \left[\begin{array}{ccc|c} 1 & 0 & 0 & 60 \\ 0 & 1 & 0 & 25 \\ 0 & 0 & 1 & 1 \end{array}\right]$$

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$$D. \left[\begin{array}{ccc|c} 1 & 0 & 0 & 60 \\ 0 & 1 & 0 & 25 \\ 0 & 0 & 1 & 28 \end{array}\right]$$

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$$E. \left[\begin{array}{ccc|c} 1 & 0 & 0 & 60 \\ 0 & 1 & 0 & 25 \\ 0 & 0 & 1 & 11 \end{array}\right]$$

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6Q6.Dealer's Electric makes three kinds of monitors, A, B, and C, which must be manufactured and tested.

A requires 3 hours of manufacturing and 1 hour of testing;

B requires 4 hours of manufacturing and 2 hours of testing;

C requires 6 hours of manufacturing and 2 hours of testing.

The company has 285 hours for manufacturing and 115 hours for testing available.

Let x = number of type A,

let y = number of type B,

and let z = number of type C.

Set up the system of equations (without solution) that determine how many of each kind should be made so that a total of 70 monitors is produced.

$$A. \begin{cases} x + y + z = 115 \\ 3x + 4y + 6z = 285 \\ x + 2y + 2z = 70 \end{cases}$$

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$$B. \begin{cases} x + y + z = 70 \\ 3x + 2y + 2z = 285 \\ x + 4y + 6z = 115 \end{cases}$$

=====================

$$C. \begin{cases} x + y + z = 70 \\ 4x + 3y + 2z = 285 \\ x + 2y + 6z = 115 \end{cases}$$

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$$D. \begin{cases} x + y + z = 70 \\ 3x + 4y + 6z = 115 \\ x + 2y + 2z = 285 \end{cases}$$

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$$E. \begin{cases} x + y + z = 70 \\ 3x + 4y + 6z = 285 \\ x + 2y + 2z = 115 \end{cases}$$

7Q7. Set up the augmented matrix of the given standard minimum linear programing problem:

Minimize $W = 14x + 27y + 9z$,

subject to the constraints:

$$\begin{cases} 7x + 9y + 4z \geq 60 \\ 10x + 3y + 6z \geq 80 \\ 4x + 2y + z \geq 48 \\ x \geq 0, \quad y \geq 0, \quad z \geq 0 \end{cases}$$

and find the transpose of the matrix, and then set up the initial simplex table for the DUAL standard maximum linear programing problem.

$$A. \left[\begin{array}{ccccccc|c} 7 & 10 & 4 & 1 & 0 & 0 & 0 & 60 \\ 9 & 3 & 2 & 0 & 1 & 0 & 0 & 80 \\ 4 & 6 & 1 & 0 & 0 & 1 & 0 & 48 \\ .... & .... & .... & .. & .. & .. & .. & .. \\ -14 & -27 & -9 & 0 & 0 & 0 & 1 & 0 \end{array}\right]$$

$$B. \left[\begin{array}{ccccccc|c} 7 & 9 & 4 & 1 & 0 & 0 & 0 & 14 \\ 9 & 3 & 2 & 0 & 1 & 0 & 0 & 27 \\ 4 & 6 & 1 & 0 & 0 & 1 & 0 & 9 \\ .... & .... & .... & .. & .. & .. & .. & .. \\ -60 & -80 & -48 & 0 & 0 & 0 & 1 & 0 \end{array}\right]$$

$$C. \left[\begin{array}{ccccccc|c} 7 & 10 & 4 & 1 & 0 & 0 & 0 & 14 \\ 10 & 3 & 6 & 0 & 1 & 0 & 0 & 27 \\ 4 & 2 & 1 & 0 & 0 & 1 & 0 & 9 \\ .... & .... & .... & .. & .. & .. & .. & .. \\ -60 & -80 & -48 & 0 & 0 & 0 & 1 & 0 \end{array}\right]$$

$$D. \left[\begin{array}{ccccccc|c} 7 & 10 & 4 & 1 & 0 & 0 & 0 & 14 \\ 9 & 3 & 2 & 0 & 1 & 0 & 0 & 27 \\ 4 & 6 & 1 & 0 & 0 & 1 & 0 & 9 \\ .... & .... & .... & .. & .. & .. & .. & .. \\ -60 & -80 & -48 & 0 & 0 & 0 & 1 & 0 \end{array}\right]$$

$$E. \left[\begin{array}{ccccccc|c} 7 & 10 & 4 & 1 & 0 & 0 & 0 & 48 \\ 9 & 3 & 2 & 0 & 1 & 0 & 0 & 80 \\ 4 & 6 & 1 & 0 & 0 & 1 & 0 & 60 \\ .... & .... & .... & .. & .. & .. & .. & .. \\ -9 & -27 & -14 & 0 & 0 & 0 & 1 & 0 \end{array}\right]$$

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8Q8. Process Utilization. A company manufactures three types of toys, A, B, and C.

Each requires rubber, plastic, and aluminium as listed below:

TOY	Rubber	Plastic	Aluminium
A	2	2	4
B	1	2	2
C	1	2	4
Maximum Available	600	800	1400

The company has available 600 units of rubber, 800 units of plastic, and 1400 units of aluminium.

The company makes a profit of \$ 4, \$ 3, and \$ 2 on toys A, B, and C, respectively.

Let $x =$ Number of toys A,

let $y =$ Number of toys B, and

let $z =$ Number of toys C.

Assuming all toys manufactured can be sold, determine a production order so that profit

$P = 4x + 3y + 2z$

is maximum.

Set up the standard maximum linear programing problem and then write the initial simplex table without solution.

$$A.\left[\begin{array}{ccccccc|c} x & y & z & s_1 & s_2 & s_3 & P & Cnst \\ 2 & 1 & 1 & 1 & 0 & 0 & 0 & 1400 \\ 2 & 2 & 2 & 0 & 1 & 0 & 0 & 800 \\ 4 & 2 & 4 & 0 & 0 & 1 & 0 & 800 \\ .... & .... & .... & .. & .. & .. & .. & .. \\ -4 & -3 & -2 & 0 & 0 & 0 & 1 & 0 \end{array}\right]$$

$$B.\left[\begin{array}{ccccccc|c} x & y & z & s_1 & s_2 & s_3 & P & Cnst \\ 2 & 1 & 1 & 1 & 0 & 0 & 0 & 600 \\ 2 & 2 & 2 & 0 & 1 & 0 & 0 & 800 \\ 4 & 2 & 4 & 0 & 0 & 1 & 0 & 1400 \\ .... & .... & .... & .. & .. & .. & .. & .. \\ -2 & -3 & -4 & 0 & 0 & 0 & 1 & 0 \end{array}\right]$$

$$C.\left[\begin{array}{ccccccc|c} x & y & z & s_1 & s_2 & s_3 & P & Cnst \\ 2 & 1 & 1 & 1 & 0 & 0 & 0 & 600 \\ 2 & 2 & 2 & 0 & 1 & 0 & 0 & 800 \\ 4 & 2 & 4 & 0 & 0 & 1 & 0 & 1400 \\ .... & .... & .... & .. & .. & .. & .. & .. \\ -4 & -3 & -2 & 0 & 0 & 0 & 1 & 0 \end{array}\right]$$

$$D.\left[\begin{array}{ccccccc|c} x & y & z & s_1 & s_2 & s_3 & P & Cnst \\ 2 & 2 & 4 & 1 & 0 & 0 & 0 & 600 \\ 1 & 2 & 2 & 0 & 1 & 0 & 0 & 800 \\ 1 & 2 & 4 & 0 & 0 & 1 & 0 & 1400 \\ .... & .... & .... & .. & .. & .. & .. & .. \\ -4 & -3 & -2 & 0 & 0 & 0 & 1 & 0 \end{array}\right]$$

$$E.\left[\begin{array}{ccccccc|c} x & y & z & s_1 & s_2 & s_3 & P & Cnst \\ 2 & 1 & 1 & 1 & 0 & 0 & 0 & 600 \\ 2 & 2 & 2 & 0 & 1 & 0 & 0 & 800 \\ 4 & 2 & 4 & 0 & 0 & 1 & 0 & 1400 \\ .... & .... & .... & .. & .. & .. & .. & .. \\ 4 & 3 & 2 & 0 & 0 & 0 & 1 & 0 \end{array}\right]$$

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9Q9. A company will need \$ 240000 (Two hundred and forty thousands) cash to modernize machinery in 5 years time.

A financial institution will invest the company's money in a fund at 8 $\%$ interest compounded semiannually.

Determine the cash that must be deposited at present to meet this need.

The present value will be more than α dollars and less than β dollars and so this number of present value will be in the interval (α, β) .

Letter Choice	Possible Answer
$A \longrightarrow$	$(\alpha = 160000, \beta = 160500)$
$B \longrightarrow$	$(\alpha = 160500, \beta = 161000)$
$C \longrightarrow$	$(\alpha = 161000, \beta = 161500)$
$D \longrightarrow$	$(\alpha = 161500, \beta = 162000)$
$E \longrightarrow$	$(\alpha = 162000, \beta = 162500)$

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10Q10. Peter wants to deposit her savings at the end of every 3 (three) months so that he will have \$ 7500 available in four years.

The account will pay 8 $\%$ interest per annum, compounded quarterly.

How much should he deposit at the end of every quarter?

Find the interval (α, β) in which this required amount to be deposited by the end of each quarter may belong.

Letter Choice	Possible Answer
$A \longrightarrow$	$(\alpha = 350, \beta = 375)$
$B \longrightarrow$	$(\alpha = 375, \beta = 390)$
$C \longrightarrow$	$(\alpha = 390, \beta = 410)$
$D \longrightarrow$	$(\alpha = 410, \beta = 420)$
$E \longrightarrow$	$(\alpha = 420, \beta = 450)$

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11Q11. Find the amount (Future Value) of an annuity due which consists of 13 yearly payments of $\$ 150$ each, provided that the interest rate is 4 $\%$ compounded annually. This required amount of annuity is between α and β and so is in the open interval (α, β) :

Letter Choice	Possible Answer
$A \longrightarrow$	$(\alpha = 2560, \beta = 2580)$
$B \longrightarrow$	$(\alpha = 2580, \beta = 2600)$
$C \longrightarrow$	$(\alpha = 2600, \beta = 2610)$
$D \longrightarrow$	$(\alpha = 2610, \beta = 2620)$
$E \longrightarrow$	$(\alpha = 2620, \beta = 2650)$

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12Q12. A debt of \$ 3500 due in four years and $\$ 5000$ due in six years is to be repaid by a single payment of $\$ 1500$ now and three equal payments that are due each consecutive year from now.

If the interest rate is 7 $\%$ compounded annually, how much are each of the equal payments?

Hint: Let x be the amount of each of the equal payments.

0	1	2	3	4	5	6
Payment	Payment	Payment	Payment	Debt		Debt
1500	x	x	x	3500		5000

Find the equation of value at year 3 and solve for x :

Then x is between α and β and so x is in the open interval (α, β) :

Letter Choice	Possible Answer
$A \longrightarrow$	$(\alpha = 1700, \beta = 1710)$
$B \longrightarrow$	$(\alpha = 1710, \beta = 1720)$
$C \longrightarrow$	$(\alpha = 1720, \beta = 1730)$
$D \longrightarrow$	$(\alpha = 1730, \beta = 1740)$
$E \longrightarrow$	$(\alpha = 1740, \beta = 1750)$

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13Q13.If interest is compounded continuously, at what annual rate will a principal of P quadruple (4 times) in 30 years?

Letter Choice	Possible Answer
$A \longrightarrow$	$\frac{Ln30}{4}$
$B \longrightarrow$	$\frac{30}{Ln4}$
$C \longrightarrow$	$\frac{4}{Ln30}$
$D \longrightarrow$	$\frac{Ln4}{30}$
$E \longrightarrow$	$(30)(Ln4)$

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14Q14. A license plat number consists of three letters followed by three digits. (English Alpha-Bet has 26 letters).

Let m be different license plate numbers which can be formed if repetition of both letters and digits is allowed.

Let n be different license plate numbers which can be formed if repetition of both letters and digits is not allowed.

Then the sum $(m+n)$ of the two numbers m and n is equal to:

Letter Choice	Possible Answer
$A \longrightarrow$	35880000
$B \longrightarrow$	826373400
$C \longrightarrow$	180835200
$D \longrightarrow$	45697600
$E \longrightarrow$	28808000

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15Q15. Ten students apply for the position of grader in Mathematics.

One grader is to be assigned to each of four teachers.

In how many different ways can the four teachers be assigned a grader if no student grades for two different teachers?

Letter Choice	Possible Answer
$A \longrightarrow$	210
$B \longrightarrow$	5040
$C \longrightarrow$	5250
$D \longrightarrow$	10000
$E \longrightarrow$	1048576

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16Q16. Each day after class, Prof. Phrind invites three of his class members to join him at coffee at the Student Center.

He has 32 students in class.

How many days will it take for him to have coffee with all combinations (groups) of three students?

Letter Choice	Possible Answer
$A \longrightarrow$	29760
$B \longrightarrow$	11
$C \longrightarrow$	32768
$D \longrightarrow$	4960
$E \longrightarrow$	96

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17Q17. Tony receives a gift certificate to buy

3 different types of ties,

2 different shirts, and

one jacket at Sandy's Clothing.

The store has 29 different types of ties,

8 different styles of shirts,

and 15 different styles of jackets.

How many ways can he select his 3 different types of ties, 2 different styles of shirts, and one jacket?

Letter Choice	Possible Answer
$A \longrightarrow$	1534680
$B \longrightarrow$	21995
$C \longrightarrow$	23413440
$D \longrightarrow$	3697
$E \longrightarrow$	18416160

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18Q18. A voice teacher selects nine students from the class to sing for the trustees.

The class has 11 men and 12 women.

In how many ways can 9 students be selected and arranged in a row with 5 men in the middle and two women on each end?

1	2	3	4	5	6	7	8	9
W	W	M	M	M	M	M	W	W

Letter Choice	Possible Answer
$A \longrightarrow$	228690
$B \longrightarrow$	1129075200
$C \longrightarrow$	817190
$D \longrightarrow$	106920
$E \longrightarrow$	658627200

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19Q19. The Initial Simplex Table for the following Standard Maximum Linear Programing Problem

Maximize $P = 50x_1 + 80x_2 + 40x_3$

subject to the constraints:

$$\begin{cases} x_1 + x_2 + x_3 \leq 400 \\ 20x_1 + 20x_2 + 40x_3 \leq 10000 \\ 6x_1 + 8x_2 + 4x_3 \leq 3000 \\ x_1 , x_2 , x_3 \geq 0 \end{cases}.$$

is given as follows:

$$\begin{bmatrix} x_1 & x_2 & x_3 & s_1 & s_2 & s_3 & P & : & Cnst \\ 1 & 1 & 1 & 1 & 0 & 0 & 0 & : & 400 \\ 20 & 20 & 40 & 0 & 1 & 0 & 0 & : & 10000 \\ 6 & 8 & 4 & 0 & 0 & 1 & 0 & : & 3000 \\ .. & .. & .. & .. & .. & .. & .. & .. & ...... \\ -50 & -80 & -40 & 0 & 0 & 0 & 1 & : & 0 \end{bmatrix}.$$

The Pivot is equal to $m_{32} = 8$ in the 3nd rwo and 2nd column: Pivot on 8 to get the next table:

$$A. \begin{bmatrix} x_1 & x_2 & x_3 & s_1 & s_2 & s_3 & P & : & Cnst \\ \frac{1}{4} & 0 & \frac{1}{2} & 1 & 0 & -\frac{1}{8} & 0 & : & 25 \\ 5 & 0 & 30 & 0 & 1 & -\frac{5}{2} & 0 & : & 2500 \\ \frac{3}{4} & 1 & \frac{1}{2} & 0 & 0 & \frac{1}{8} & 0 & : & 375 \\ .. & .. & .. & .. & .. & .. & .. & .. & ...... \\ 10 & 0 & 0 & 0 & 0 & 10 & 1 & : & 30000 \end{bmatrix}$$

$$B. \begin{bmatrix} x_1 & x_2 & x_3 & s_1 & s_2 & s_3 & P & : & Cnst \\ \frac{1}{4} & 0 & \frac{1}{2} & 1 & 0 & \frac{1}{8} & 0 & : & 25 \\ 5 & 0 & 30 & 0 & 1 & \frac{5}{2} & 0 & : & 2500 \\ \frac{3}{4} & 1 & \frac{1}{2} & 0 & 0 & \frac{1}{8} & 0 & : & 375 \\ .. & .. & .. & .. & .. & .. & .. & .. & ...... \\ 10 & 0 & 0 & 0 & 0 & 10 & 1 & : & 30000 \end{bmatrix}$$

$$C. \begin{bmatrix} x_1 & x_2 & x_3 & s_1 & s_2 & s_3 & P & : & Cnst \\ \frac{1}{4} & 0 & \frac{1}{2} & 1 & 0 & -\frac{1}{8} & 0 & : & 375 \\ 5 & 0 & 30 & 0 & 1 & -\frac{5}{2} & 0 & : & 2500 \\ \frac{3}{4} & 1 & \frac{1}{2} & 0 & 0 & \frac{1}{8} & 0 & : & 25 \\ .. & .. & .. & .. & .. & .. & .. & .. & ...... \\ 10 & 0 & 0 & 0 & 0 & 10 & 1 & : & 30000 \end{bmatrix}$$

$$D. \begin{bmatrix} x_1 & x_2 & x_3 & s_1 & s_2 & s_3 & P & : & Cnst \\ 1 & 0 & \frac{1}{2} & 1 & 0 & -\frac{1}{8} & 0 & : & 25 \\ 20 & 0 & 30 & 0 & 1 & -\frac{5}{2} & 0 & : & 2500 \\ \frac{3}{4} & 1 & \frac{1}{2} & 0 & 0 & \frac{1}{8} & 0 & : & 375 \\ .. & .. & .. & .. & .. & .. & .. & .. & ...... \\ 10 & 0 & 0 & 0 & 0 & 10 & 1 & : & 30000 \end{bmatrix}$$

$$E. \begin{bmatrix} x_1 & x_2 & x_3 & s_1 & s_2 & s_3 & P & : & Cnst \\ \frac{1}{4} & 0 & \frac{1}{2} & 1 & 0 & -\frac{1}{8} & 0 & : & 25 \\ 5 & 0 & 30 & 0 & 1 & -\frac{5}{2} & 0 & : & 2500 \\ \frac{3}{4} & 1 & \frac{1}{2} & 0 & 0 & \frac{1}{8} & 0 & : & 375 \\ .. & .. & .. & .. & .. & .. & .. & .. & ...... \\ 10 & 0 & 0 & 0 & 0 & 10 & 1 & : & 13400 \end{bmatrix}$$

20Q20. Mr. Peter would like to invest a sum of money using one of the following options.

Which one of these options is the most profitable one for him to invest.

(Hint: Calculate effective interest rate for each option accurate upto at least four decimal places).

Letter Choice	Possible Answer
$A \longrightarrow$	22.1 % compounded continuously.
$B \longrightarrow$	22.2 % compounded daily.
$C \longrightarrow$	22.3 % compounded monthly.
$D \longrightarrow$	22.4 % compounded quarterly.
$E \longrightarrow$	22.4 % compounded semiannually.

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21Q21. Amy has 2 blue, 3 red, and 6 green books to arrange on a shelf horizontally.

In how many distinguishable ways can the books be arranged if books of the same color are identical and not distiguishable at all?

Letter Choice	Possible Answer
$A \longrightarrow$	39916800
$B \longrightarrow$	8640
$C \longrightarrow$	4620
$D \longrightarrow$	39925440
$E \longrightarrow$	51840

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22Q22. Julia is preparing a meal by combining three ingredients.

One unit of each ingredient provides the following quantities (in grams) of carbohydrates, fat, and protein.

	Protein (grams)	Carbohydrates (grams)	Fat (grams)
Ingredient A	3	3	1
Ingredient B	2	4	2
Ingredient C	4	5	1
Total	28	38	12

Ideally the meal should contain 28 grams of protein,

38 grams of carbohydrates,

and 12 grams of fat.

Set up a suitable system of equations to find the number of units of each ingredient should Julia use?

Let $x =$ Number of units of Ingredient A,

let $y =$ Number of units of Ingredient B,

let $z =$ Number of units of Ingredient C.

Then the system of equations is given by:

$$(A).\begin{cases} 3x + 3y + z = 28 \\ 2x + 4y + 2z = 38 \\ 4x + 5y + z = 12 \end{cases}$$

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$$(B).\begin{cases} 3x + 2y + 4z = 38 \\ 3x + 4y + 5z = 12 \\ x + 2y + z = 28 \end{cases}$$

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$$(C).\begin{cases} 4x + 2y + 3z = 28 \\ 5x + 4y + 3z = 38 \\ x + 2y + z = 12 \end{cases}$$

$$(D).\begin{cases} 3x + 2y + 4z = 12 \\ 3x + 4y + 5z = 28 \\ x + 2y + z = 38 \end{cases}$$

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$$(E).\begin{cases} 3x + 2y + 4z = 28 \\ 3x + 4y + 5z = 38 \\ x + 2y + z = 12 \end{cases}$$

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23Q23. If an investment of \$ 20000 earns interest at an annual rate of 9 % compounded continuously, then the future value (in dollars) of the investment SIX years from now is

Letter Choice	Possible Answer
$A \longrightarrow$	$20000\,(1.09)^{6}$
$B \longrightarrow$	$20000e^{0.54}$
$C \longrightarrow$	$20000\,(1.09)^{-6}$
$D \longrightarrow$	$20000e^{-0.54}$
$E \longrightarrow$	$\dfrac{e^{0.54}}{20000}$

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24Q24. If

$$\begin{cases} x_1 - x_2 - 3x_3 - 4x_4 = 3 \\ 3x_1 + x_2 - x_3 + 4x_4 = 5 \end{cases},$$

then use Matrix Reducion Method to solve the above system of equations in oder to find solution(s):

Choice	Possible Answer
A	$\begin{cases} x_1 = 3 - 6x_4, \\ x_2 = 4 - x_4, \\ x_3 = -2 + 3x_4, \\ x_4 = x_4 \end{cases}$
B	$\begin{cases} x_1 = 3 - 6x_4, \\ x_2 = 4 + x_4, \\ x_3 = -2 + 3x_4, \\ x_4 = x_4. \end{cases}$
C	$\begin{cases} x_1 = -1 + x_4, \\ x_2 = 3x_4, \\ x_3 = 6 + 2x_4, \\ x_4 = x_4. \end{cases}$
D	$\begin{cases} x_1 = -1 + x_3 - x_4, \\ x_2 = 4 + 2x_3 + x_4, \\ x_3 = x_3, \\ x_4 = x_4. \end{cases}$
E	$\begin{cases} x_1 = 2 + x_3, \\ x_2 = -1 - 2x_3 - 4x_4, \\ x_3 = x_3, \\ x_4 = x_4. \end{cases}$

25Q25. The maximum value of

$Z = x_1 - 2x_2 + 3x_3$

subject to constraints:

$$\begin{cases} 2x_1 + x_2 + 2x_3 \le 12 \\ x_1 - x_2 + x_3 \le 8 \\ x_1 \ge 0, \ x_2 \ge 0, \ x_3 \ge 0. \end{cases} \text{ is}$$

Letter Choice	Possible Answer
$A \longrightarrow$	6
$B \longrightarrow$	12
$C \longrightarrow$	18
$D \longrightarrow$	24
$E \longrightarrow$	30

Qn #	Master-Code	CODE 001	CODE 002	CODE 003	CODE 004	FINAL-CHECK
1	D	D	B	E	E	
2	E	E	C	C	C	
3	A	A	E	B	D	
4	C	C	B	B	E	
5	B	B	E	D	A	
6	E	E	C	E	C	
7	D	D	D	B	B	
8	C	C	E	D	E	
9	E	E	A	A	D	
10	C	C	C	E	C	
11	B	B	B	A	E	
12	B	B	E	B	C	
13	D	D	D	C	B	
14	E	E	C	E	B	
15	B	B	E	B	D	
16	D	D	C	E	E	
17	A	A	B	C	B	
18	E	E	B	D	D	
19	A	A	D	E	A	
20	B	B	E	A	E	
21	C	C	B	C	A	
22	E	E	D	B	B	
23	B	B	A	E	C	
24	E	E	E	D	E	
25	C	C	A	C	B	
Sum	125	125	125	125	125	125