LONDON METROPOLITAN UNIVERSITY

islington college
(इस्लिङ्टन कलेज)

Module Code & Module Title

MA4001NI Logic and Problem Solving

Assessment Weightage & Type

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Year and Semester

2021 Spring II

Student Name : Punam Thapa Magar

Group: C3

London Met ID : 20048968

College ID: NPO1CP4S210273

Assignment Due Date: 15th September- 2021

Assignment Submission Date: 15th September-2021

I confirm that I understand my coursework needs to be submitted online via Google classroom under the relevant module page before the deadline in order for my assignment to be accepted and marked. I am fully aware that late submission will be treated as non-submission and a marks of zero will be awarded.

Acknowledgements

In the preparation of my task, I needed to take the assistance and direction of some regarded people, who deserve my most profound gratitude. As the finishing of this assignment gave me much joy, I might want to show my appreciation to Mr Prakash Adhikari, Module pioneer, on Islington College for giving me a decent rules for assignment all through various counsels. I might want to extend my appreciation to every one of the people who have straightforwardly and in a roundabout way directed me in writing this assignment.

Furthermore, a thankyou to Mr Ashok Dhungana, our module chief for giving me the chance to leave on this undertaking. Many individuals, particularly my classmates who had help me and have offered important remark ideas which gave me a motivation to work on the nature of assignment.

Table of Contents

Problem 1 solutions: (Tax Calculations)

Introduction

A tax is a compulsory expense or monetary charge required by an administration on an individual or an association to gather income for public works giving the best offices and framework. The gathered fund is then used to finance diverse public consumption programs. In this project, excel tool was utilized to do the tax calculation process since we can utilize excel features like turn table and formulas to rapidly investigate the date and interpret the numbers quickly and efficiently. Similarly, ms excel accompanies a lot of plenty of built-in-function to work with information gave.

So, for the tax calculation in excel we are required to give the details of income, expenses, tax rate, tax amount and taxable amount left respectively. Applying the formula to an example, let us consider an individual with an income £ 55,000 and deduction was made with an average federal tax rate. Taxable income would come after subtracting annual income and total deduction for example (=E3-E9). Likewise, tax slab and income range are also used for the tax calculation.

Terms used in the tax calculation are given below:

Annual Income

Annual income is the amount of all pay apparent by a person in that year time span. Moreover, it is an aggregate sum of money earned in a calender year before taxes. Annual income is the income where deduction such as PF CIT and life insurance (E3,E6,E8) are deducted from the total income of the person.

Taxable Income

Taxable income is the sum used to copute how much tax an individual or an organization owes to the public authority in a given tax year. It is a distinction of annual income and total deduction for instance (E3-E9).

Tax Slab

The act, in this manner isolates income ranges and collects tax at various rate according to the isolation. These groups are consequently known as tax slab. The tax slab likewise differ dependent on age if the taxpayer is an individual and according to the order of entities. For example it is calculate by subtracting income range from higher limit to the lower limit.

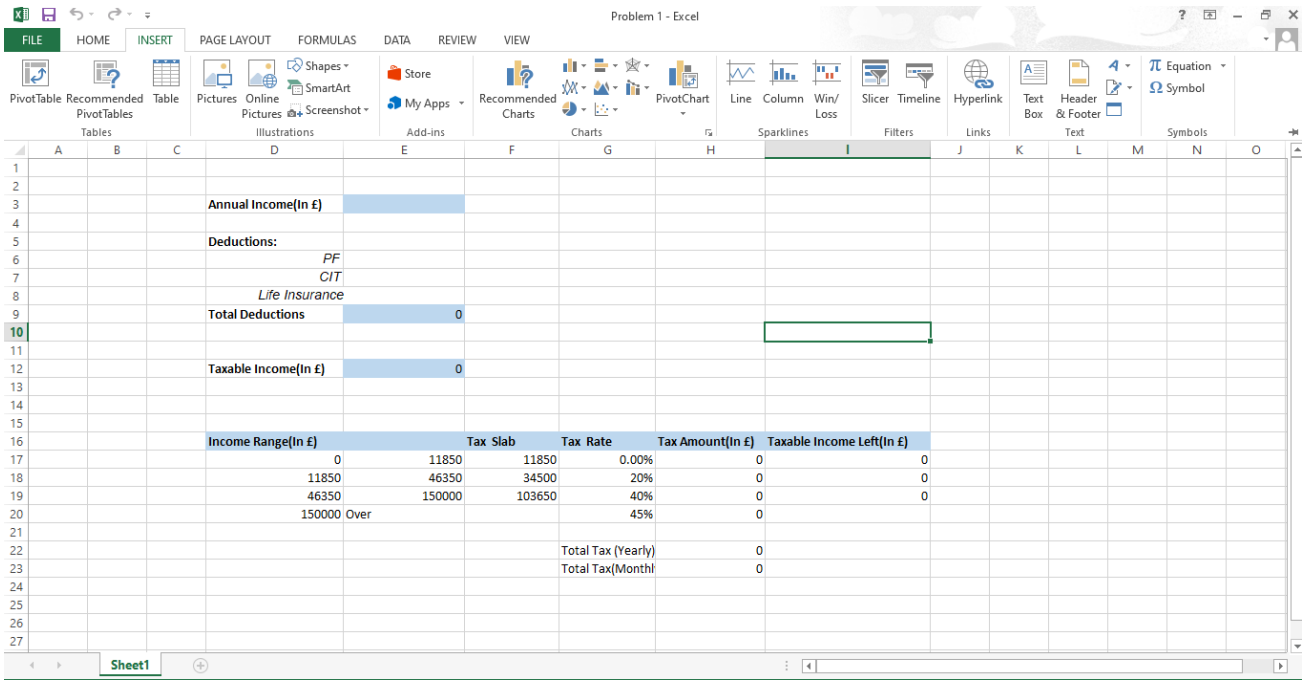
Tax Rate

A tax rate is a rate at which an individual or corporation is taxed. It is the level of a people available pay or a organizing's acquiring that is owed to state, federal, and at time, civil governments.

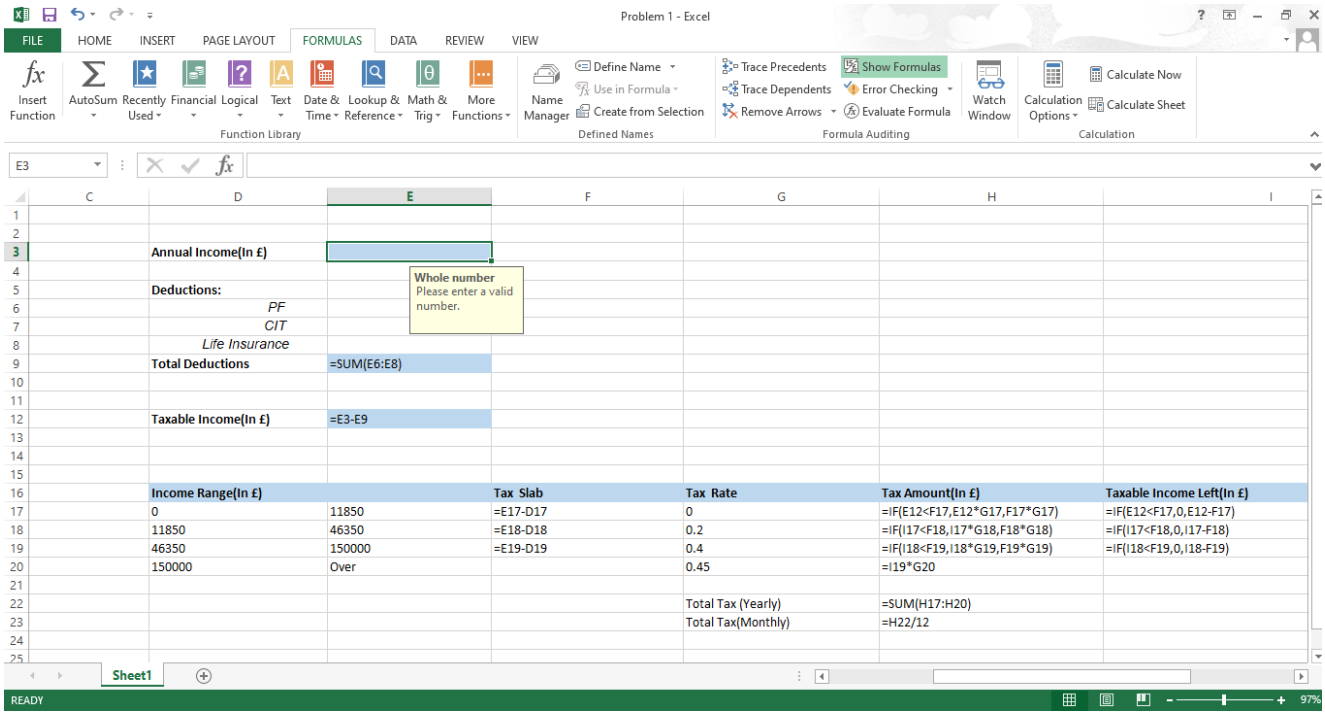
Taxable Amount

Taxable amount is the piece of a person's or an organization's pay used to ascertain how much tax they owe the public authority in a given assessment year.

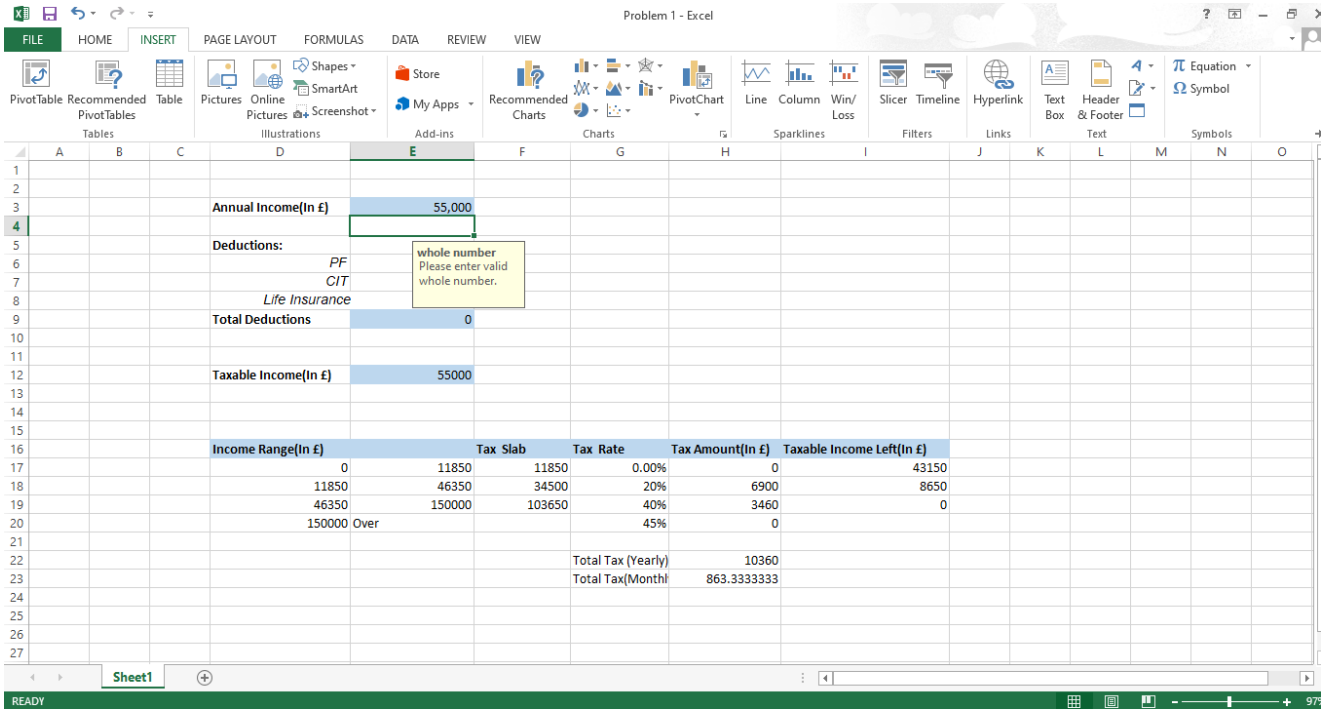
Screen shots for tax template



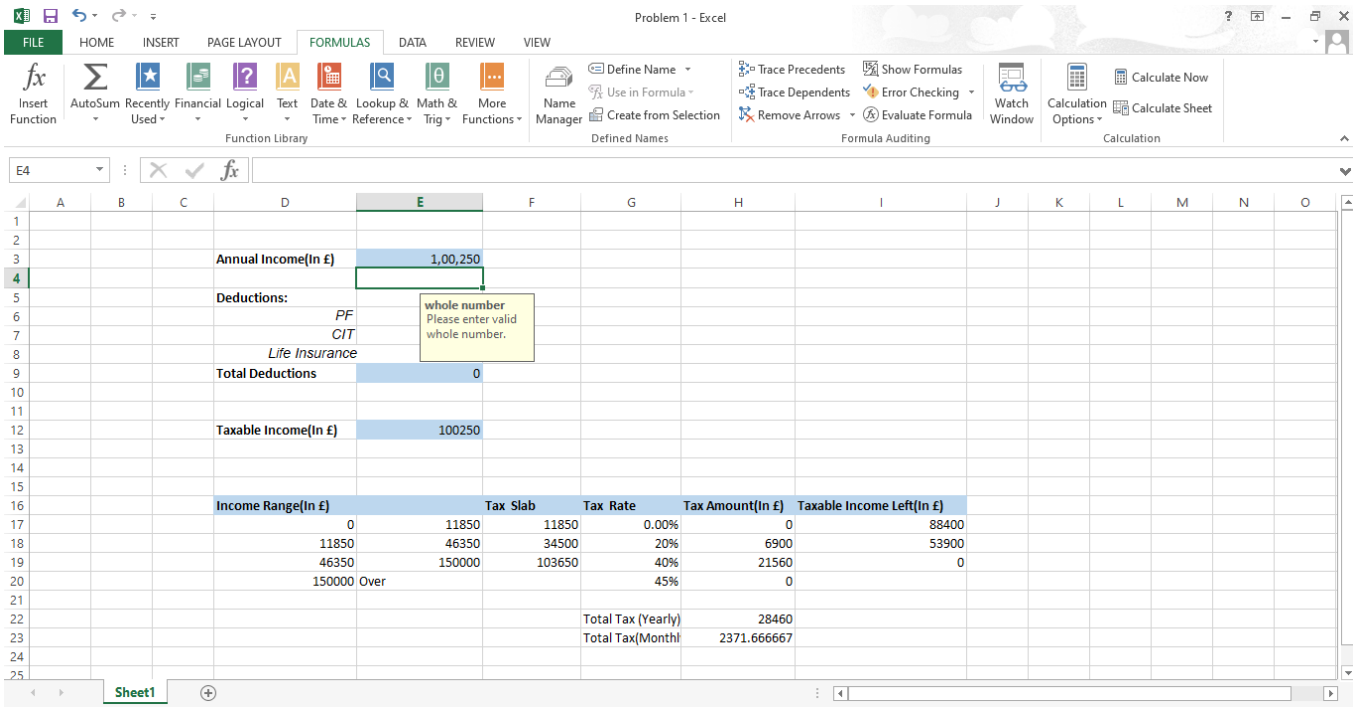
Screen shots for Formula



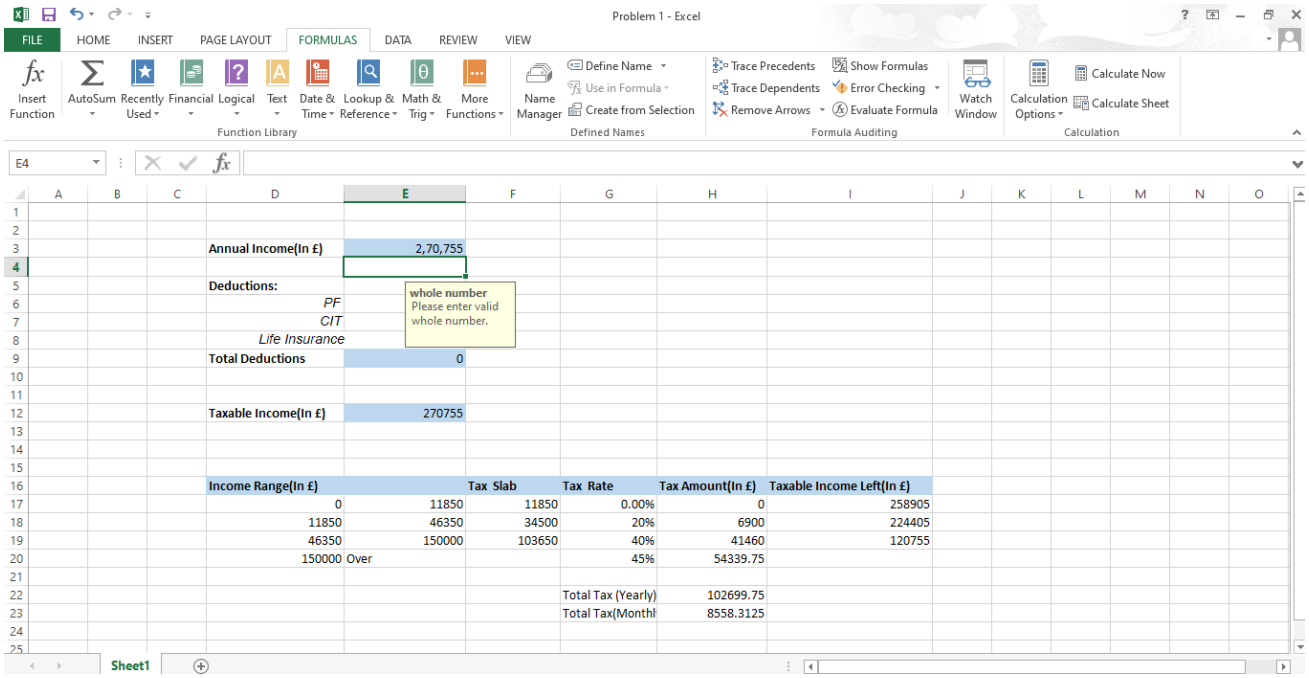
Screen shot of tax calculation for £55,000



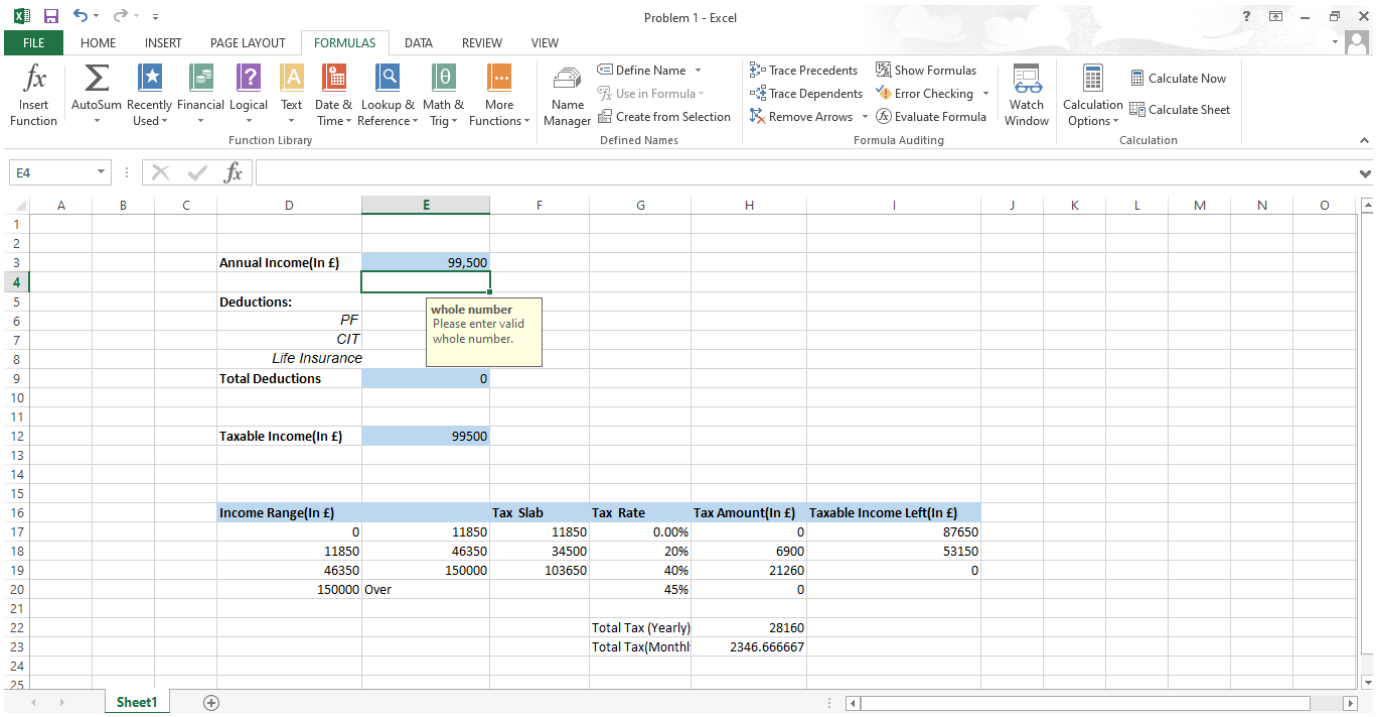
Screen shots of tax calculation for £100, 250



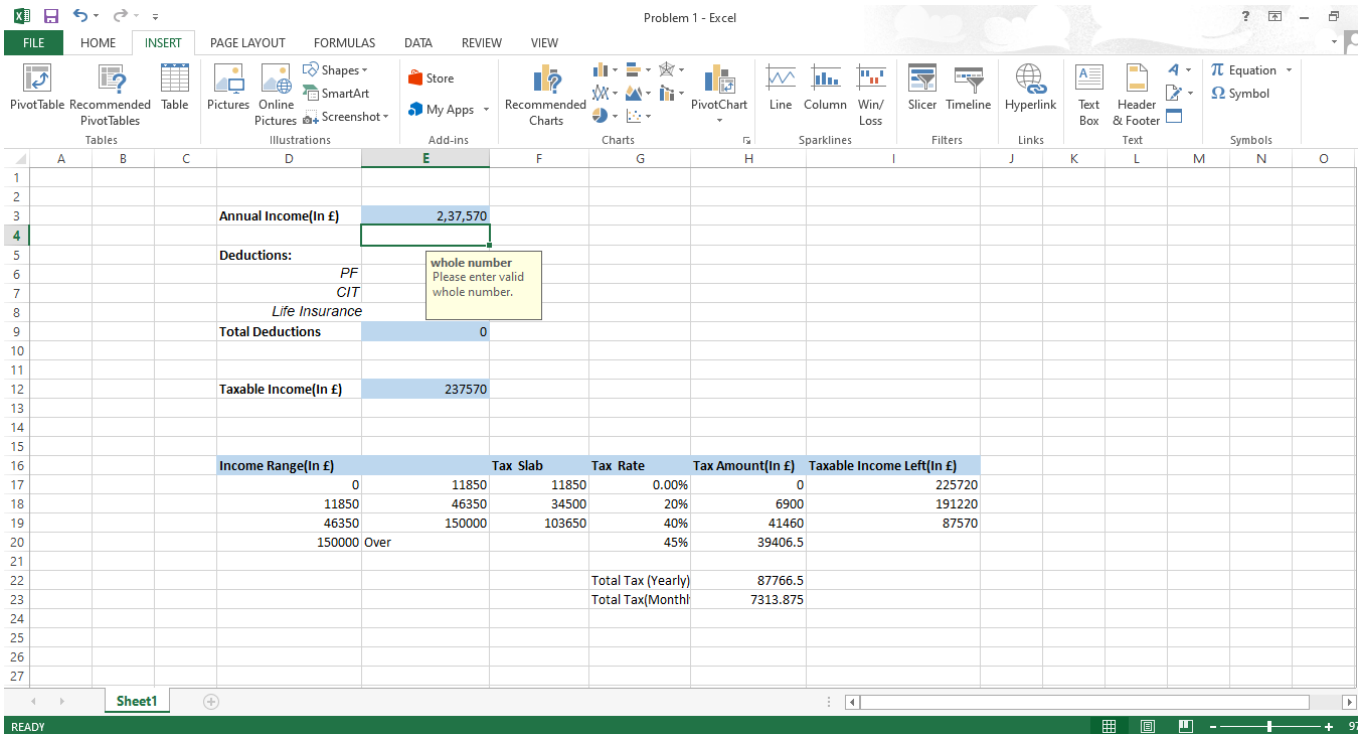
Screen shots of tax calculation for £ 270, 755



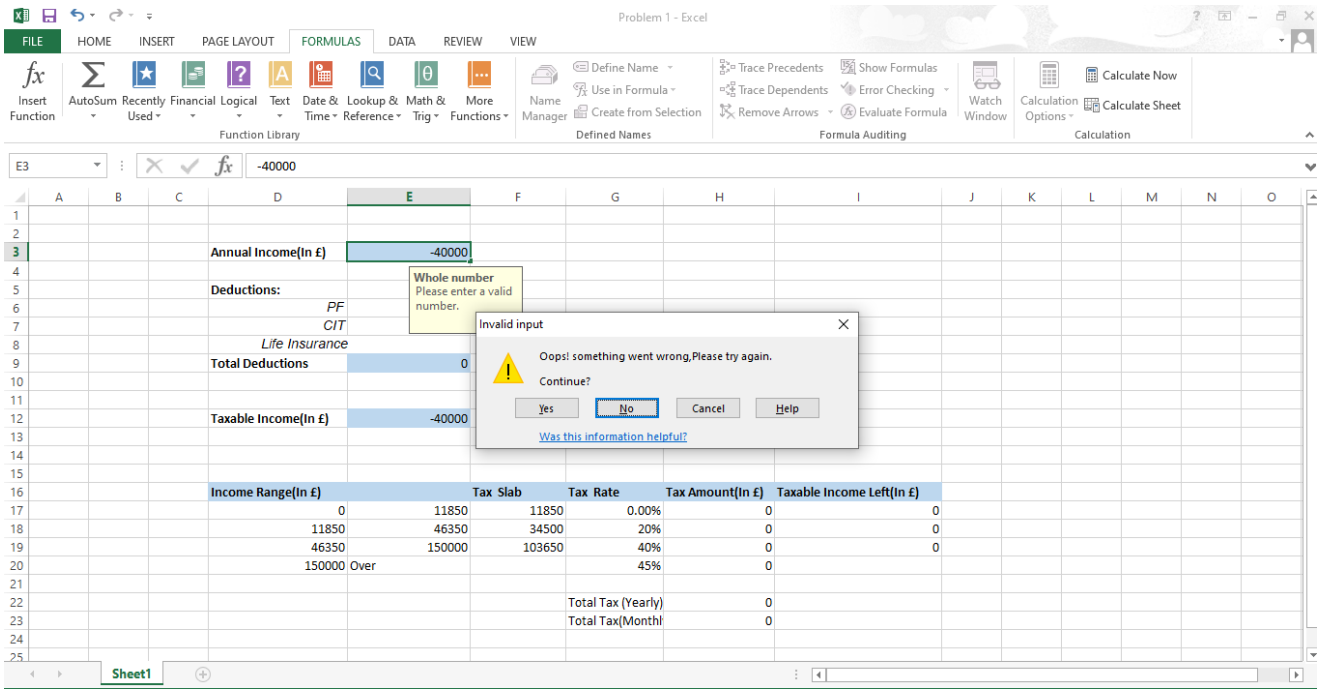
Screen shots of tax calculation for £ 99,500



Screen shots of tax calculation for £ 237,570



Screen shot of tax calculation for £ −40,000



To sum up, the taxable income were calculated using different terms like tax slab, tax rate and tax amount. Similarly, while giving negative income for example (-4000) we get the message saying please try again appears thus it means negative value for the annual income is not acceptable.

Problem 2: Part A solutions

Solution;

Problem Analysis,

	Olive oil(A)	**Vegetable peanut (B)**	**Olive vegetable peanut (C)**	**Production**
olive vegetable oil	6 oz	0 oz	3 oz	15000
vegetable peanut oil	6 oz	10 oz	7 oz	23000
olive vegetable peanut	0 oz	6 oz	2 oz	4000
Profit	$1.10	$0.70	$0.60	

Mathematical Formulation:

For Decision variable

Let X, Y, Z be the number of jars for olive vegetable oil, vegetable peanut oil and olive vegetable peanut respectively.

For Objective Function:

Total profit = 1.10X + 0.70Y + 0.60Z

Let C = 1.10X + 0.70Y + 0.60Z

Maximize C = 1.10X + 0.70Y + 0.60Z

For Constraints:

$6X + 3Z \leq 15000$ (Olive oil constraints)

$6X + 10Y + 7Z \leq 23000$ (Vegetable oil constraints)

$6Y + 2Z \leq 4000$ (Peanut oil constraints)

$X, Y, Z \geq 0$ (Non Negatively constraints)

Let S_1, S_2 and S_3 be the slack variables.

Now;

$6X + 3Z + S_1 = 15000$

$6X + 10Y + 7Z + S_2 = 23000$

$6Y + 2Z + S_3 = 4000$

$X, Y, Z, S_1, S_2, S_3 \geq 0$

Standard equation for simplex table:

$1Z – 1.0X – 0.70Y – 0.60Z + 0S_1 + 0S_2 + 0S_3 = 0$

$0Z + 6X + 0Y + 3Z + 1S_1 + 0S_2 + 0S_3 = 15000$

$0Z + 6X + 10Y + 7Z + 0S_1 + 1S_2 + 0S_3 = 23000$

$0Z + 0X + 6Y + 2Z + 0S_1 + 0S_2 + 1S_3 = 4000$

$X, Y, Z, S_1 + 0S_2 + 1S_3 \geq 0$

Simplex Table 1:

Highest Negative (Key column)

Row	C	X	Y	Z	S_1	S_2	S_3	Constant	Ratio
R_0	1	-1.10	-0.70	-0.60	0	0	0	0	—
R_1	0	6	0	3	1	0	0	15000	15000/6 = 2500
R_2	0	6	10	7	0	1	0	23000	23000/6 =3833.33
R_3	0	0	6	2	0	0	1	4000	4000/0 = ∞

Key element

Maximum Positive ratio (key Row)

Here X is the key column, R_1 is the key row and 6 is the key element.

Now, we must update key row (R_1), first using the formula,

Now; $R_1 = \frac{old\ R1}{key\ element}$

$= \frac{old\ R1}{6}$

0, 1, 0, 0.5, 0.167, 0, 0, 2500

We need to update rows until all the elements of R_0 are ≥ 0 for the maximization problem.

Similarly, we should update R_0, R_2 and R_3 using the formula,

New R_0 = old R_0 – (-1.10) × New R_1

= old R_0 + 1.10 × New R_1

New R_2 = old R_2 - 6 × New R_1

New R_3 = old R_3 - 0 × New R_1

old R_0 (+)	**1.10 × New R_1**	**New R_0**
1	0	1
−1.1	1.1	0
−0.7	0	−0.7
−0.6	0.55	−0.05
0	0.183	0.183
0	0	0
0	0	0
0	2750	2750

old R_2 (−)	**6 × New R_1**	**New R_2**
0	0	0
6	6	0
10	0	10
7	3	4
0	1	−1
1	0	1
0	0	0
23000	15000	8000

old R_3 (−)	**0 × New R_1**	**New R_3**
0	0	0
0	0	0
6	0	6
2	0	2
0	0	0
0	0	0
1	0	1
4000	0	4000

Simplex Table 2:

Highest Negative (Key Column)

Row	C	X	Y	Z	S_1	S_2	S_3	Constant	Ratio
R_0	1	0	−0.7	−0.05	0.183	0	0	2750	−
R_1	0	1	0	0.5	0.167	0	0	2500	2500/0 = ∞
R_2	0	0	10	4	−1	1	0	8000	8000/10 = 800
R_3	0	0	6	2	0	0	1	4000	4000/6 = 666.67

Key element

Minimum positive (Key Row)

Here, Y is the key column, R_3 is the key row and 6 is the key element.

Now, R_3 is the key row and should be updated first using formula;

New $R_3 = \frac{\text{old R3}}{\text{key element}}$

$= \frac{old\ R3}{6}$

0, 0, 1, 0.33, 0, 0, 0.167, 666.67

Similarly, we should update R_0, R_1 and R_2 using the formula,

New R_0 = old R_0 – (-0.7) × New R_3

= old R_0 + 0.7 × New R_3

New R_1 = old R_1 – 0 × New R_3

New R_2 = old R_2 – 10 × New R_3

old R_0 (+)	**0.7 × New R_3**	**New R_0**
1	0	1
0	0.112	0
-0.7	0.7	0
-0.05	0.23	0.18
0.183	0	0.183
0	0	0
0	0	0
2750	466.67	3216.67

old R_1 (-)	**0 × New R_3**	**New R_1**
0	0	0
1	0	1
0	0	0
0.5	0	0.5
0.167	0	0.167
0	0	1
0	0	0
2500	0	2500

old R_2(-)	**10 x New R_3**	**New R_2**
0	0	0
0	0	0
10	10	0
4	3.3	0.7
-1	0	-1
1	0	1
0	1.67	-1.67
8000	6666.7	7333.3

Simplex Table 3:

Row	**C**	**X**	**Y**	**Z**	**S_1**	**S_2**	**S_3**	**Constant**
R_0	1	0	0	0.18	0.183	0	0	3216.67
R_1	0	1	0	0.5	0.167	1	0	2500
R_2	0	0	0	0.7	-1	1	-1.67	7333.3
R_3	0	0	1	0.33	0	0	0.167	666.67

Here all the coefficient of variables in R0 row are all ≥ 0 so we reached the optimum solution.

Here, Maximum (C) = 3216.67

X = 2500,

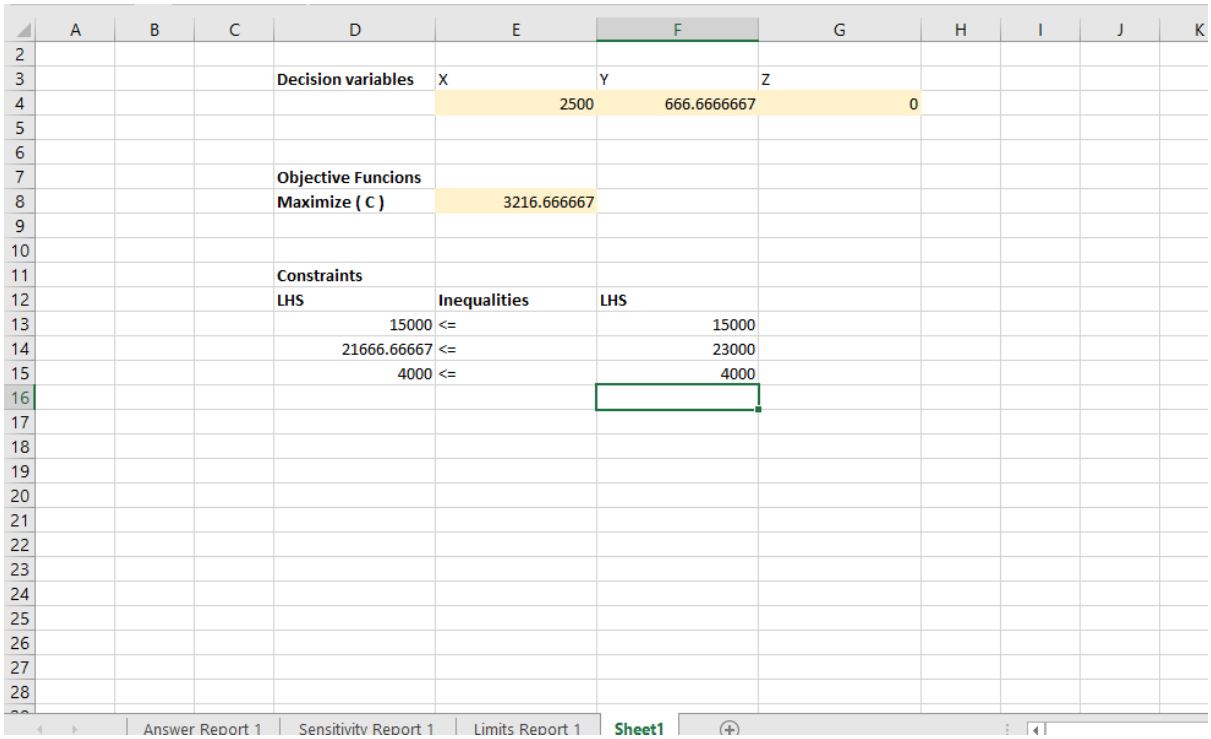
Y = 666.67,

Z = 0

Hence, the company should produce 2500 jars of olive vegetables, 666.67 jars of vegetable peanut oil and zero jars of olive-vegetable peanut in-order to make the maximize profit of $ 3216.67.

Excel solver solutions

Screen shots of showing template



	A	B	C	D	E	F	G	H	I	J	K
2											
3				**Decision variables**	X	Y	Z				
4					2500	666.6666667	0				
5											
6											
7				**Objective Funcions**							
8				**Maximize (C)**	3216.666667						
9											
10											
11				**Constraints**							
12				**LHS**	**Inequalities**	**LHS**					
13				15000	<=	15000					
14				21666.66667	<=	23000					
15				4000	<=	4000					
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											
26											
27											
28											

Answer Report 1 | Sensitivity Report 1 | Limits Report 1 | **Sheet1**

Screen shots of showing formula

	A	B	C	D	E	F	G	H
1								
2								
3				**Decision variables**	X	Y	Z	
4					2500	666.666666666667	0	
5								
6								
7				**Objective Funcions**				
8				**Maximize (C)**	=1.1*E4+0.7*F4+0.6*G4			
9								
10								
11				**Constraints**				
12				**LHS**	**Inequalities**	**LHS**		
13				=6*E4+0*F4+3*G4	<=	15000		
14				=6*E4+10*F4+7*G4	<=	23000		
15				=0*E4+6*F4+2*G4	<=	4000		
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								

Screen shots of Answer Report

Microsoft Excel 16.0 Answer Report
Worksheet: [Book1]Sheet1
Report Created: 14-09-2021 23:49:43
Result: Solver found a solution. All Constraints and optimality conditions are satisfied.
Solver Engine
Engine: Simplex LP
Solution Time: 0.047 Seconds.
Iterations: 2 Subproblems: 0
Solver Options
Max Time Unlimited, Iterations Unlimited, Precision 0.000001, Use Automatic Scaling
Max Subproblems Unlimited, Max Integer Sols Unlimited, Integer Tolerance 1%, Assume NonNegative

Objective Cell (Max)

Cell	Name	Original Value	Final Value
$E$8	Maximize (C) X	0	3216.666667

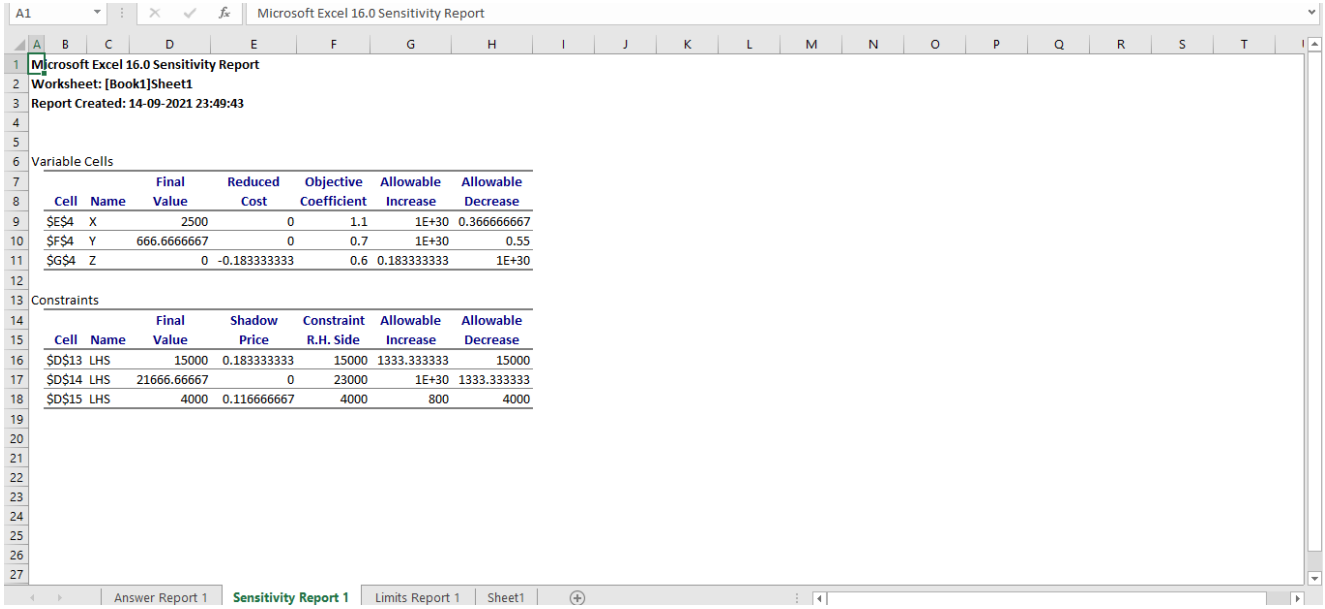
Variable Cells

Cell	Name	Original Value	Final Value	Integer
$E$4	X	0	2500	Contin
$F$4	Y	0	666.6666667	Contin
$G$4	Z	0	0	Contin

Constraints

Cell	Name	Cell Value	Formula	Status	Slack
$D$13	LHS	15000	$D$13<=$F$13	Binding	0
$D$14	LHS	21666.66667	$D$14<=$F$14	Not Binding	1333.333333
$D$15	LHS	4000	$D$15<=$F$15	Binding	0

Screen shot of Sensitivity Report



Microsoft Excel 16.0 Sensitivity Report

Microsoft Excel 16.0 Sensitivity Report
Worksheet: [Book1]Sheet1
Report Created: 14-09-2021 23:49:43

Variable Cells

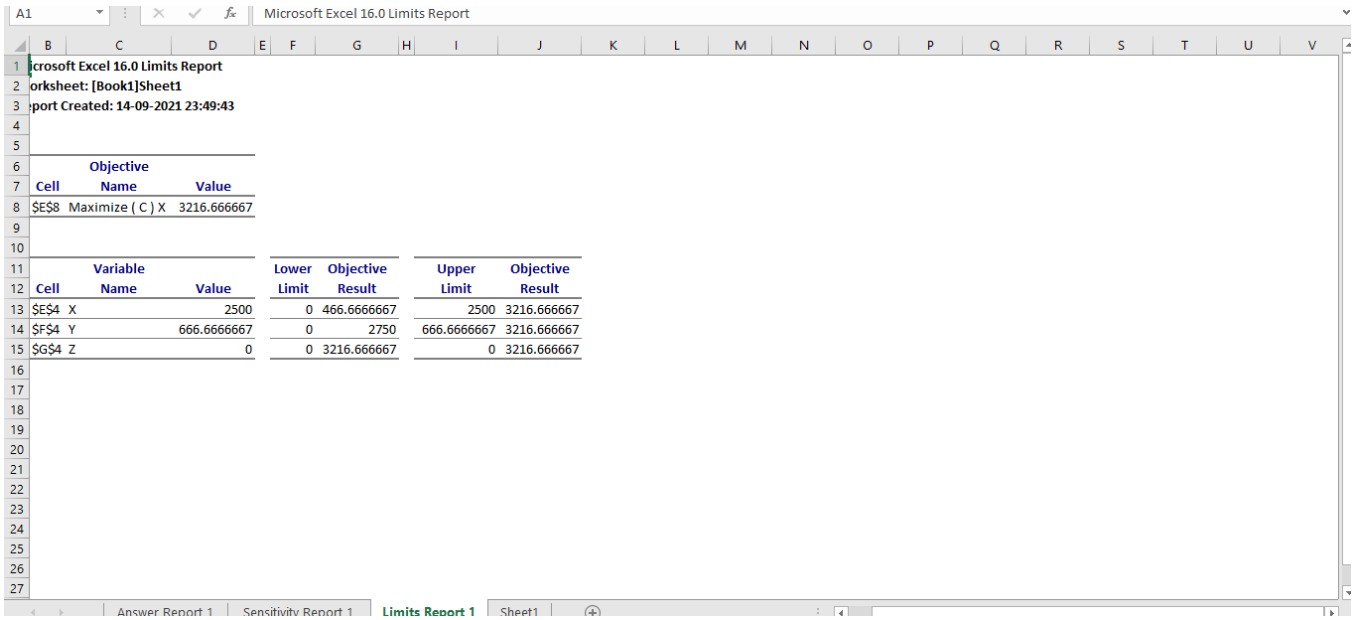
Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
$E$4	X	2500	0	1.1	1E+30	0.366666667
$F$4	Y	666.6666667	0	0.7	1E+30	0.55
$G$4	Z	0	-0.183333333	0.6	0.183333333	1E+30

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
$D$13	LHS	15000	0.183333333	15000	1333.333333	15000
$D$14	LHS	21666.66667	0	23000	1E+30	1333.333333
$D$15	LHS	4000	0.116666667	4000	800	4000

Answer Report 1 | Sensitivity Report 1 | Limits Report 1 | Sheet1

Screen shots of Limit Report



Microsoft Excel 16.0 Limits Report

crosoft Excel 16.0 Limits Report
orksheet: [Book1]Sheet1
port Created: 14-09-2021 23:49:43

Cell	Name	Objective Value
$E$8	Maximize (C) X	3216.666667

Cell	Variable Name	Value	Lower Limit	Objective Result	Upper Limit	Objective Result
$E$4	X	2500	0	466.6666667	2500	3216.666667
$F$4	Y	666.6666667	0	2750	666.6666667	3216.666667
$G$4	Z	0	0	3216.666667	0	3216.666667

Answer Report 1 | Sensitivity Report 1 | Limits Report 1 | Sheet1

To conclude, the company should produce 2500 jars of olive vegetables, 666.67 jars of vegetable peanut oil and zero jars of olive-vegetable peanut in-order to make the maximize profit of $ 3216.67

Memorandum

To: Oil Company

From: Punam Thapa Magar

Date: 15-09-2021

Sub: To maximize the profit and increase the quantity of oil containers.

In the meantime, Oil organization is the most prestigious organization in all nations. Olive vegetable oil, vegetable peanut oil and olive vegetable peanut oils are viewed as the most famous when contrasted with other oil like sunflower oil, mustard oil and so on and are generally liked by individuals. Interest for these oil are expanding hugely so with the expanding of demand, creation ought to likewise increment. Likewise we need to boost the benefit and it should create 2500 containers of olive vegetable, 666.62 containers of vegetable peanut oil and no containers of olive vegetable peanut to make the most extreme benefit to 3216.67.

Besides, while discussing the details of the oils, olive vegetable oil are the combination of two fundamental oil for example olive oil and vegetable oil. This give twofold advantage to the consumer when they use it and in like manner buyer can get fundamental supplements. Anyway so individuals may be sensitive to olive oil that is the reason, oil organization has the alternative of vegetable and peanut oil also, so the purchaser would be happy with their organization and their creation too. On top of that, oil company has its own imagination to make olive vegetable and peanut oil joining together. Alongside this, expansion of benefit likewise assumes an irreplaceable part in the company. In this way, benefit can be expand by creating certain quantities of oil containers. Nonetheless, for consumer wellbeing lapsed oil ought to be discarded so that individuals don't abuse about the company.

To wrap up, to acquire more we need to create more containers with quality oil so we can draw in our shopper to burn-through oil from our company ‘The oil company’.

Thanks and Regards

Punam Thapa Magar

Problem 2: Part B Solutions

Given;

Maximize, Z = 60X + 50Y

2X + 4Y = 80 → equation (i)

3X + 2Y → equation (ii)

Now;

From equation (i)

When, X = 0

2X + 4Y = 80

or, 2 x 0 + 4Y = 80

or, 4Y = 80

or, Y = 20

And,

When, Y = 0

2X + 4Y = 80

or, 2X + 4 x 0 = 80

or, 2X = 80

or, X = 40

Therefore, the passing points are (0, 20) and (40, 0) respectively.

Again,

Take (0, 0) as a testing point.

$2X + 4Y \leq 80$

or, $2 \times 0 + 4 \times 0 \leq 80$

or, $0 \leq 80$ (TRUE)

Next,

From equation (ii)

When, $X = 0$

$3X + 2Y = 60$

or, $3 \times 0 + 2Y = 60$

or, $2Y = 60$

or, $Y = 30$

And,

When, $Y = 0$

$3X + 2Y = 60$

or, $3X + 2 \times 0 = 60$

or, $3X = 60$

or, $X = 2$

Therefore, the passing points are (0, 30) and (20, 0) respectively.

Again,

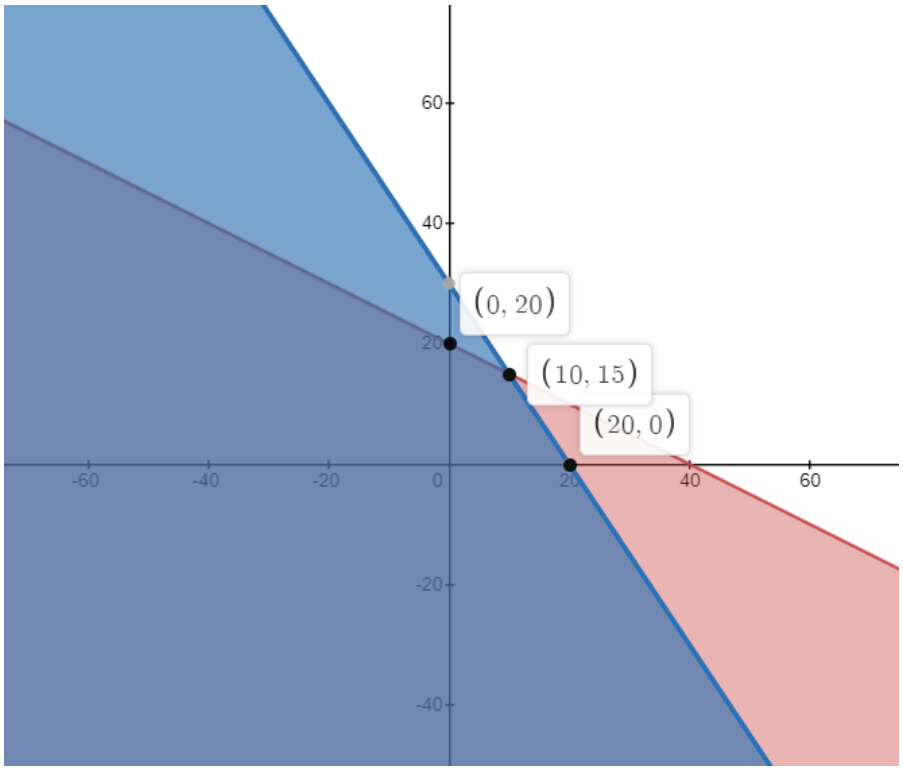
Take (0, 0) as a testing point

$3X + 2Y \leq 60$

or, $3 \times 0 + 2 \times 0 \leq 60$

or, $0 \leq 60$ (TRUE)

Graphical Solution



(Anon., n.d.)

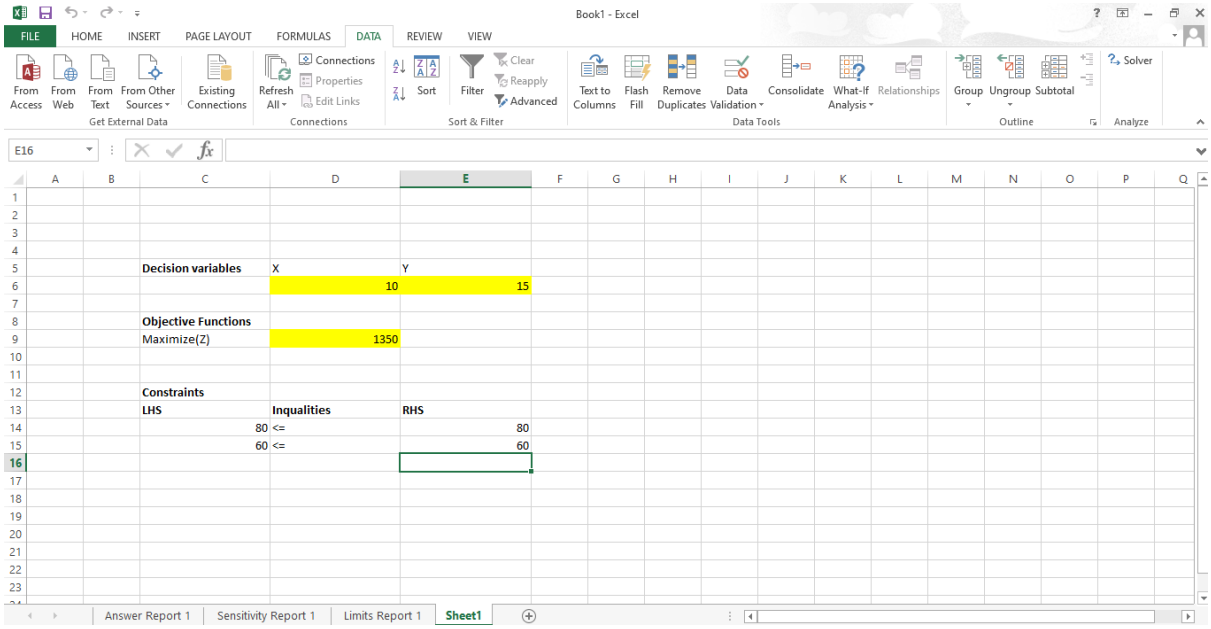
Hence, the feasible region is OABC

Points	X	Y	Z = 60X + 50Y
O(0, 0)	0	0	0
A(0, 20)	0	20	1000
B(10,15)	10	15	1350 (MAX)
C(20,0)	20	0	1200

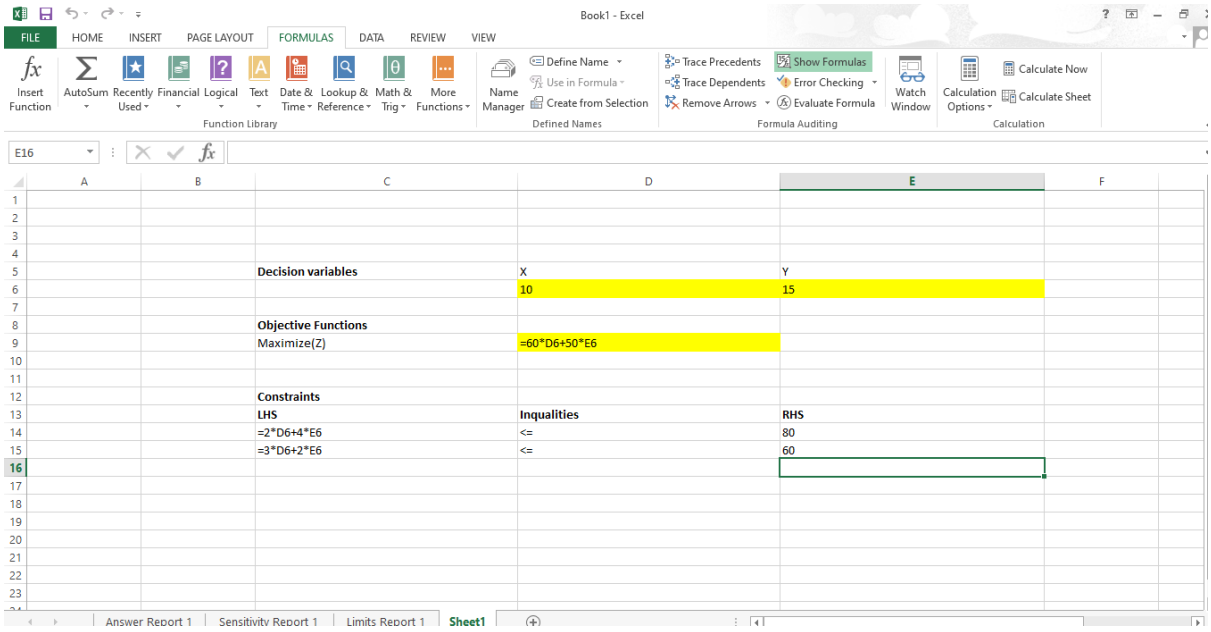
Therefore, the maximum value is 1350 at point B (10, 15).

Excel solver solutions

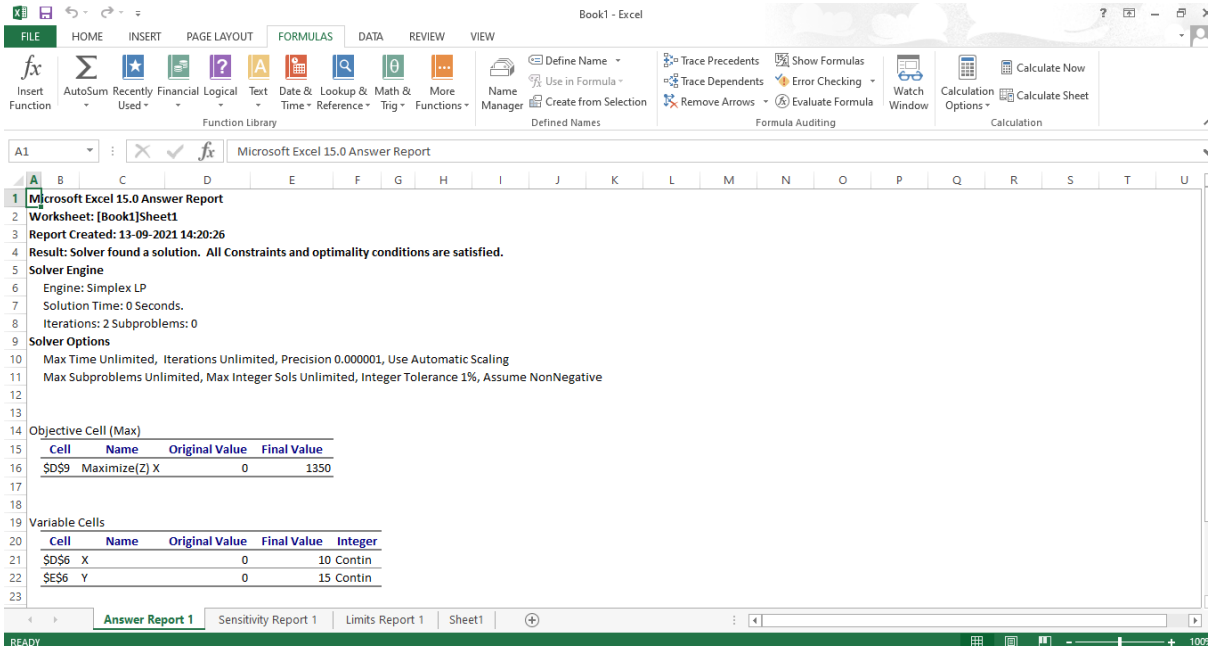
Screen shots of showing template



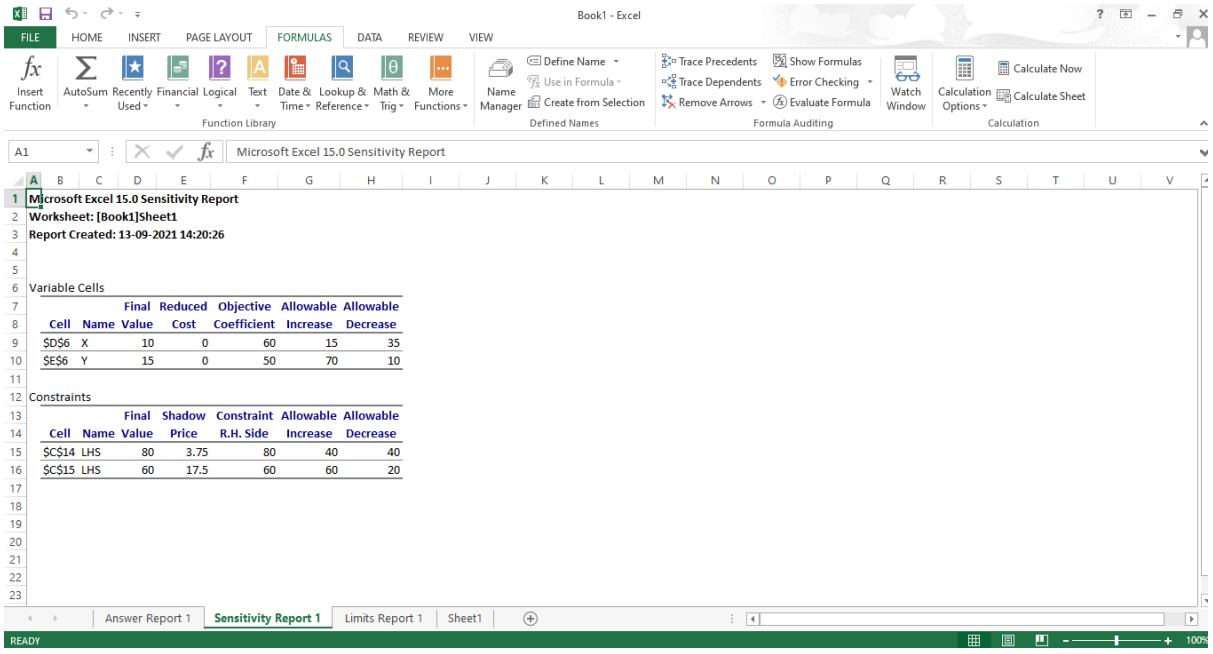
Screen shots of showing formula



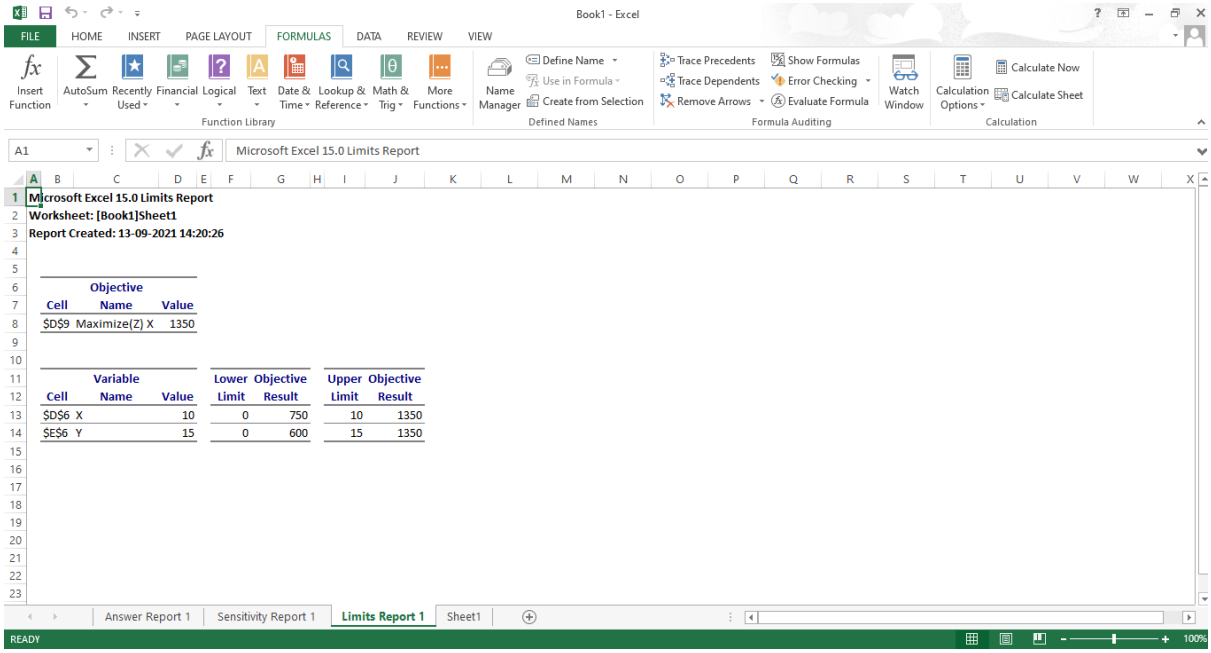
Screen shots of Answer Report



Screen shots of Sensitivity Report



Screen shots of Limit Report



Microsoft Excel 15.0 Limits Report
Worksheet: [Book1]Sheet1
Report Created: 13-09-2021 14:20:26

Objective		
Cell	Name	Value
$D$9	Maximize(Z) X	1350

Variable			Lower Limit	Objective Result	Upper Limit	Objective Result
Cell	Name	Value				
$D$6	X	10	0	750	10	1350
$E$6	Y	15	0	600	15	1350

Problem 3 solutions

Solution;

Given;

Fixed cost = £150

Variable cost per unit = £2x [since x is the number of items manufactured]

So;

Total cost = Fixed cost + Variable cost

= 150 + 2x

It is also given;

Price function P(x) = 30 – 0.2x

So;

Revenue function R(x) = Price x No of units

$= (30 - 0.2x) \times x$

$= 30x - 0.2x^2$

At break−even point;

Revenue = Cost

$30x - 0.2x^2 = 150 + 2x$

$0.2x^2 - 30x + 2x + 150 = 0$

$0.2x^2 - 28x + 150 = 0$

Comparing;

$0.2x^2 - 28x + 150 = 0$ with $ax^2 + bx + c = 0$

We get;

a = 0.2, b = − 28, c = 150

Using quadratic equation formula,

$$x_1 = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{-(-28) \pm \sqrt{(-28)^2 - 4 * 0.2 * 150}}{2 * 0.2}$$

$$= \frac{28 \pm \sqrt{784 - 120}}{0.4}$$

$$= \frac{28 + \sqrt{664}}{0.4}$$

$$= \frac{28 + 25.76}{0.4}$$

$$= 134.42$$

And;

$x_2 = \frac{-(-28) \pm \sqrt{(-28)^2 - 4*0.2*150}}{2 * 0.2}$

$= \frac{28 \pm \sqrt{784 - 120}}{0.4}$

$= \frac{28 - \sqrt{664}}{0.4}$

$= \frac{28 - 25.76}{0.4}$

$= 5.58$

For the corresponding values of x,

When,

$x_1 = 134.42,$

$y_1 = 150 + 2x$

$= 150 + 2 \times 134.4$

$= 418.841$

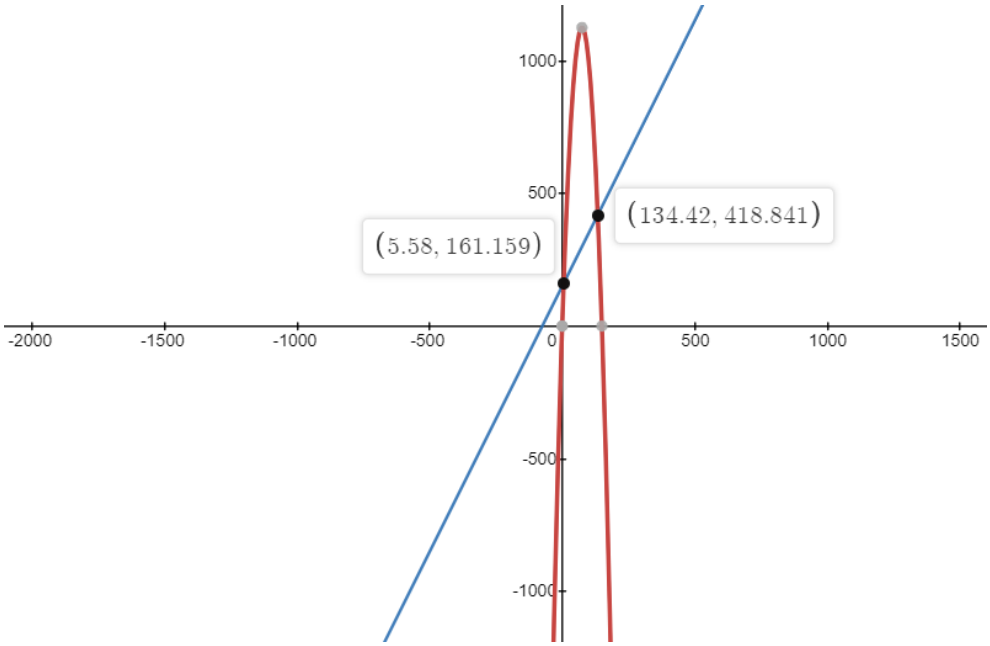
$x_2 = 5.58,$

$y_2 = 150 + 2x$

$= 150 + 2 \times 5.6$

$= 161.159$

By plotting the revenue and cost functions, obtain the break-even output level and corresponding price.



(Anon., n.d.)

The break-even points are (5.58, 168.159) and (134.42, 418.841)

Again;

The profit function is given by;

P(x) = R(x) – C(x) [Profit = Revenue – Cost]

$P(x) = (30x – 0.2x^2) – (150 + 2x)$

$P(x) = 30x – 0.2x^2 − 150 – 2x$

$P(x) = −0.2x^2 + 28x – 150$

Therefore, Profit function $P(x) = −0.2x^2 + 28x – 150$

i. To find the level production that maximize the profit.

Level of Production;

$$x = \frac{-b}{2a}$$

Where;

a = −0.2, b = 28

$$x = \frac{-28}{2 * (-0.2)}$$

x = 70

ii. The maximum profit is given by profit function when x = 70,

= P (70)

= $-0.2 \times (70)^2 + 28 \times (70) - 150$

= $-0.2 \times 4900 + 1960 - 150$

= −980 + 1960 −150

= £830

Hence, the maximum profit is £830.

Conclusion

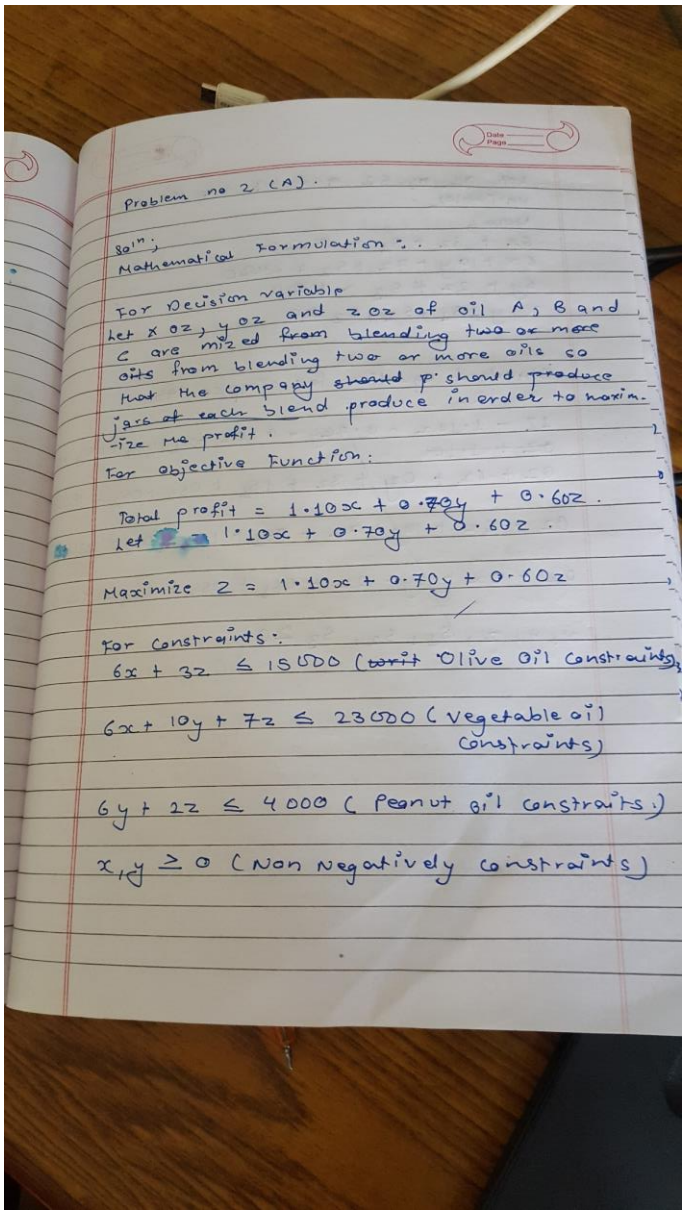
To whole up, this coursework was relegated to us for doing tax calculation and linear programming where two different tools were utilized namely excel for tax calculation and desmos for graphical method. While doing this coursework I needed to confront the challenged particularly in the simplex method as numerous mistakes occurred and I was new to the theme too I was exceptionally confounded. I was likewise somewhat confused in regards to the formulas used in the tax calculation process in excel .Yet in order to conquer the confusion and trouble, a lot pf explores were finished with respect to the applicable problems. Cent percent exertion was given to finish the undertaking allocated in this problem. Regular interaction with instructors, and going through the lecture slides and with acquiring sound information about different given problems. I likewise, became more acquainted with about the various terms and methods utilized in the problem, I knew about various terms alongside their capabilities.

Despite the fact that it was challenging and troublesome from the outset, the coursework was finished on schedule and submitted on time as well. I had the chance to learn numerous new things and themes which I knew about. It was decent encounter to foster a program utilizing excel and desmos and it was enjoyable to chip away at this project as well.

References

Anon., n.d. *desmos.* [Online]
Available at: https://www.desmos.com/
[Accessed 15 09 2021].

Evidence



Problem no 2 (A).

Soln;
Mathematical formulation;.

For Decision variable
Let x oz, y oz and z oz of oil A, B and C are mixed from blending two or more oils from blending two or more oils so that the company should produce jars of each blend produce in order to maximize the profit.

For objective Function:

Total profit = 1.10x + 0.70y + 0.60z.
Let 1.10x + 0.70y + 0.60z.

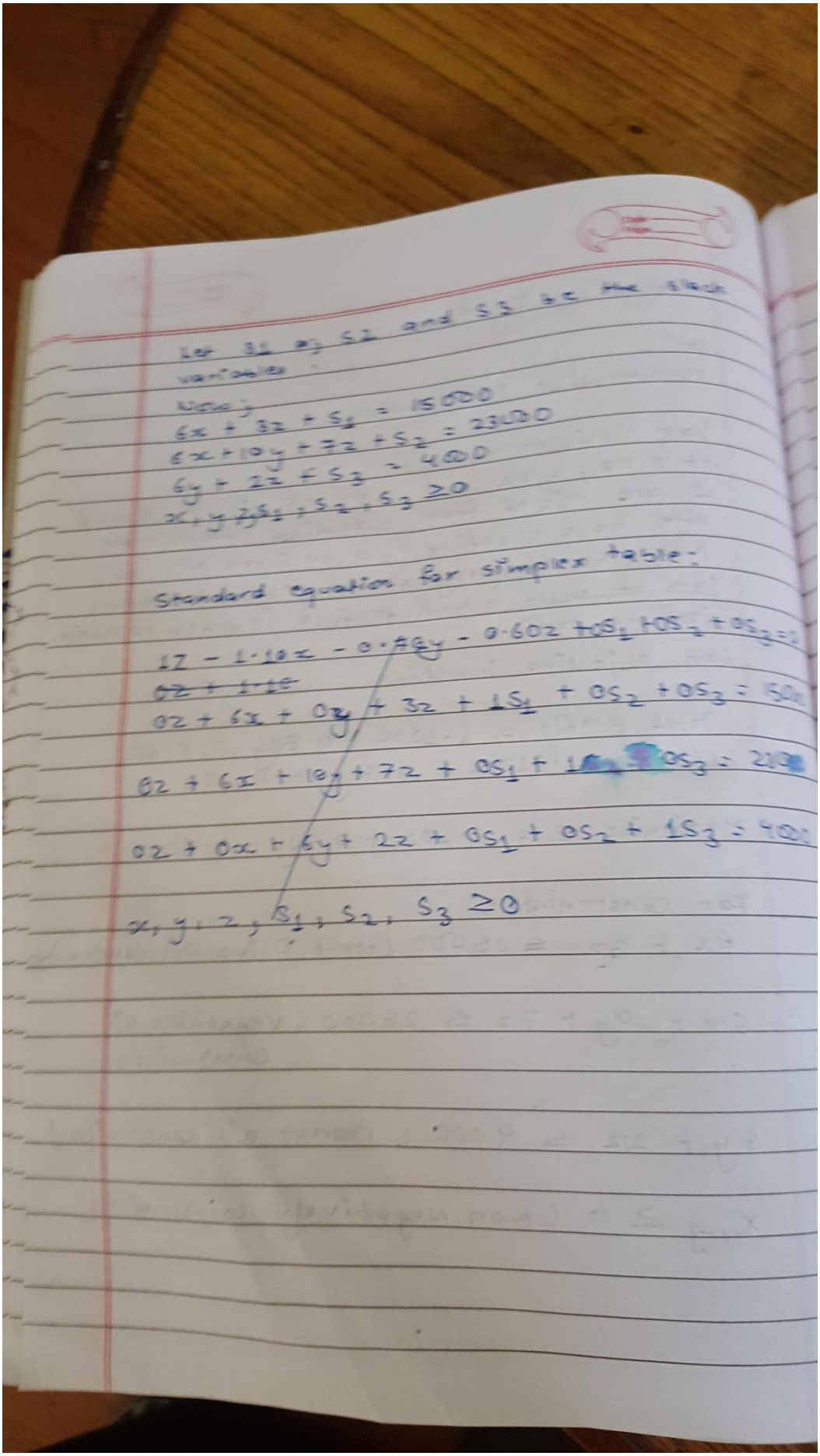
Maximize Z = 1.10x + 0.70y + 0.60z

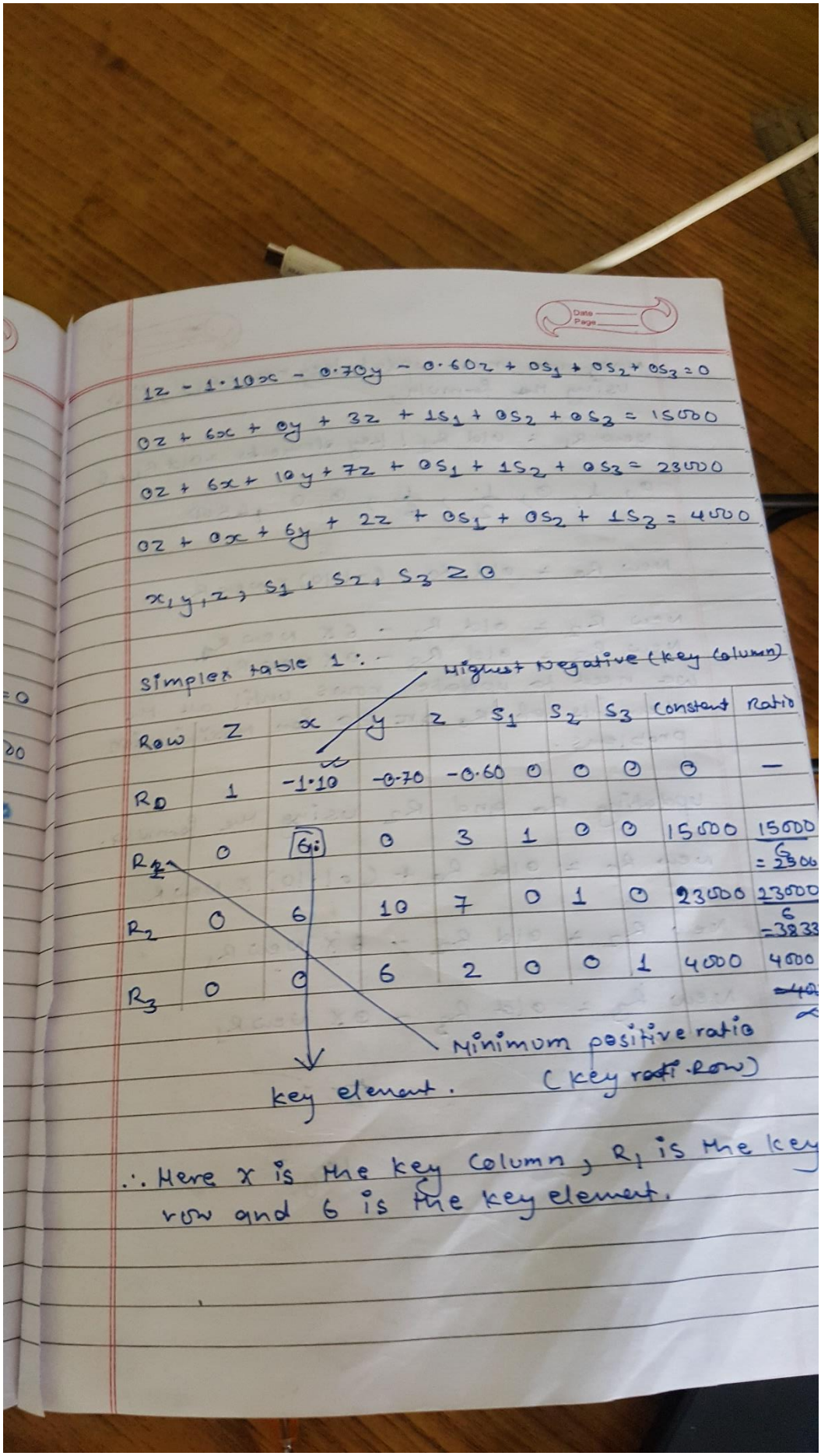
For constraints:
6x + 3z ≤ 15000 (~~corit~~ Olive Oil constraints)

6x + 10y + 7z ≤ 23000 (Vegetable oil constraints)

6y + 2z ≤ 4000 (Peanut oil constraints)

x, y ≥ 0 (Non Negatively constraints)


Let S1, S2 and S3 be the slack variables
Now,
6x + 3z + S1 = 15000
6x + 10y + 7z + S2 = 23000
6y + 2z + S3 = 4000
x, y, z, S1, S2, S3 ≥ 0
Standard equation for simplex table:
Z - 1.10x - 0.48y - 0.60z + 0S1 + 0S2 + 0S3 = 0
0z + 6x + 0y + 3z + 1S1 + 0S2 + 0S3 = 150
0z + 6x + 10y + 7z + 0S1 + 1S2 + 0S3 = 230
0z + 0x + 6y + 2z + 0S1 + 0S2 + 1S3 = 400
x, y, z, S1, S2, S3 ≥ 0



$1z - 1.10x - 0.70y - 0.60z + 0s_1 + 0s_2 + 0s_3 = 0$

$0z + 6x + 0y + 3z + 1s_1 + 0s_2 + 0s_3 = 15000$

$0z + 6x + 10y + 7z + 0s_1 + 1s_2 + 0s_3 = 23000$

$0z + 0x + 6y + 2z + 0s_1 + 0s_2 + 1s_3 = 4000$

$x, y, z, s_1, s_2, s_3 \geq 0$

simplex table 1 :

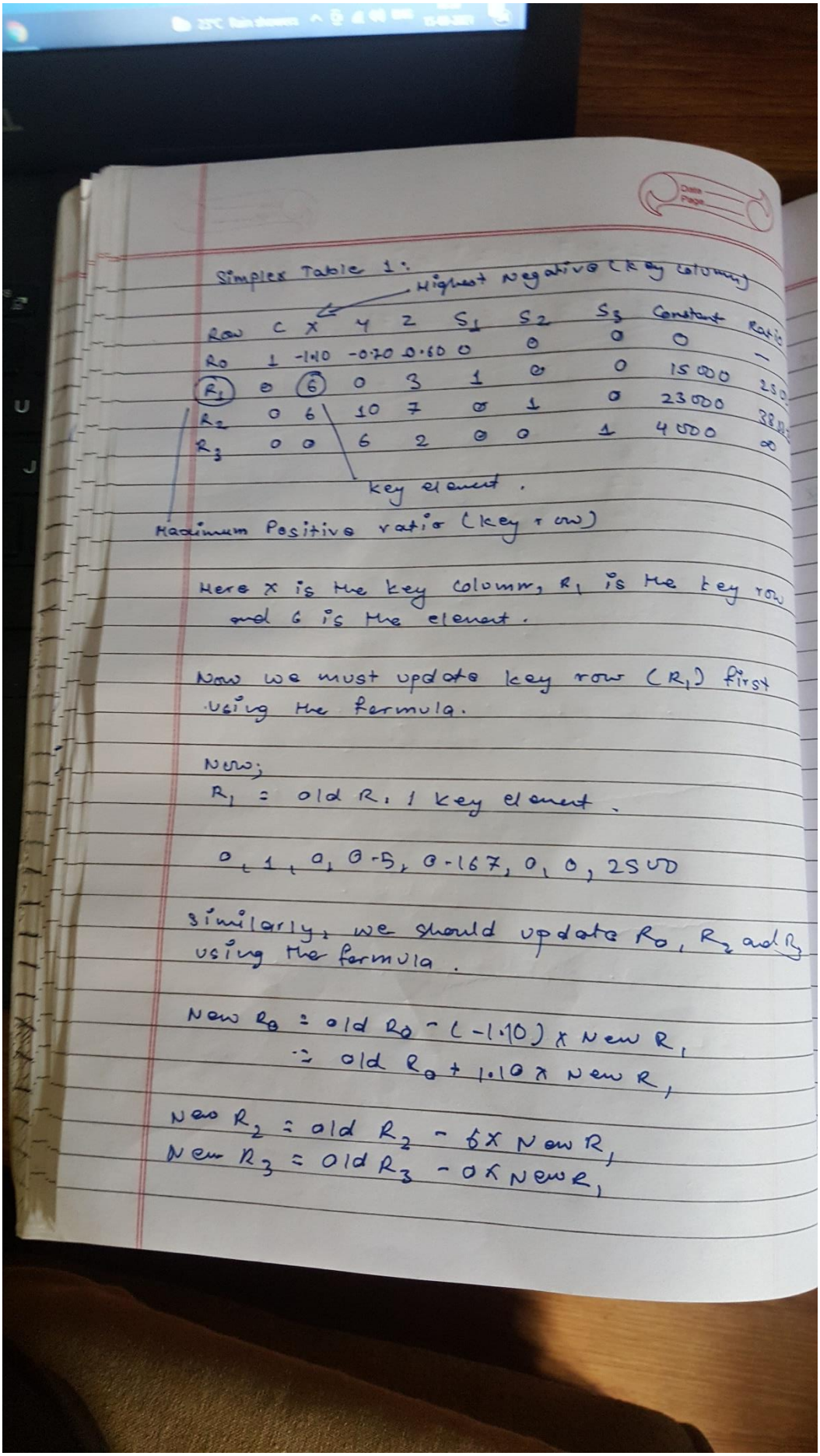
Highest negative (key column)

Row	Z	x	y	z	s_1	s_2	s_3	constant	Ratio
R_0	1	-1.10	-0.70	-0.60	0	0	0	0	—
R_1	0	6	0	3	1	0	0	15000	15000/6 = 2500
R_2	0	6	10	7	0	1	0	23000	23000/6 = 3833
R_3	0	0	6	2	0	0	1	4000	4000 = 400

Minimum positive ratio (key row)

key element.

∴ Here x is the key column, R_1 is the key row and 6 is the key element.



Simplex Table 1:

Highest Negative (Key column)

Row	C	X	Y	Z	S_1	S_2	S_3	Constant	Ratio
R_0	1	-1.10	-0.70	0.60	0	0	0	0	–
R_1	0	6	0	3	1	0	0	15000	2500
R_2	0	6	10	7	0	1	0	23000	3833.3
R_3	0	0	6	2	0	0	1	4000	∞

key element.

Maximum Positive ratio (key row)

Here X is the key column, R_1 is the key row and 6 is the element.

Now we must update key row (R_1) first using the formula.

New;

R_1 = old R_1 / key element.

0, 1, 0, 0.5, 0.167, 0, 0, 2500

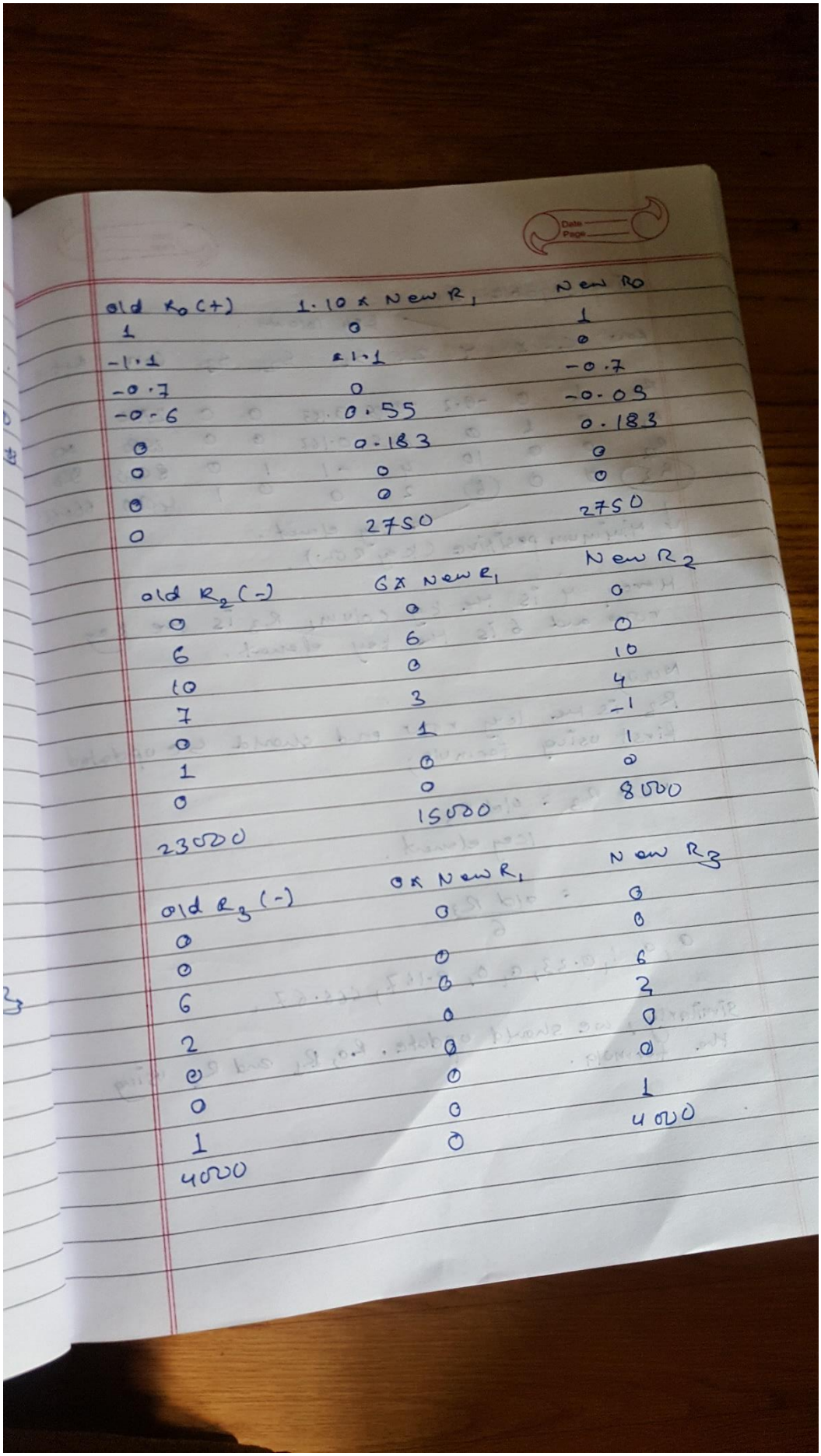
Similarly, we should update R_0, R_2 and R_3 using the formula.

New R_0 = old R_0 - (-1.10) × New R_1

∴ old R_0 + 1.10 × New R_1

New R_2 = old R_2 - 6 × New R_1

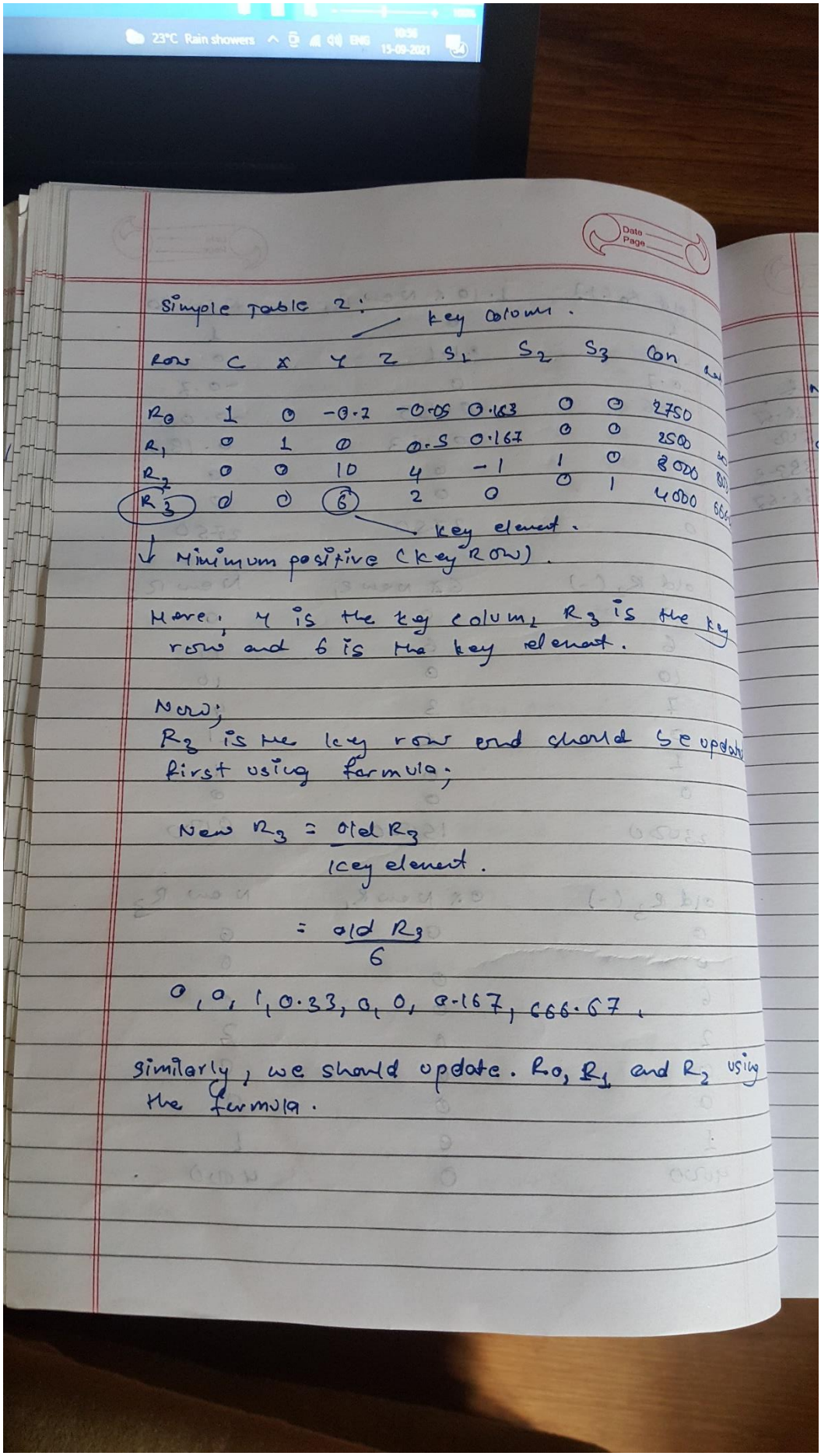
New R_3 = Old R_3 - 0 × New R_1



Old R_0 (+)	1.10 × New R_1	New R0
1	0	1
-1.1	-1.1	0
-0.7	0	-0.7
-0.6	0.55	-0.09
0	0.183	0.183
0	0	0
0	0	0
0	2750	2750

old R_2 (-)	6 × New R_1	New R_2
0	0	0
6	6	0
10	0	10
7	3	4
0	1	-1
1	0	1
0	0	0
23000	15000	8000

old R_3 (-)	0 × New R_1	New R_3
0	0	0
0	0	0
6	0	6
2	0	3
0	0	0
0	0	0
1	0	1
4000	0	4000



Simple Table 2:

key column.

Row	C	x	y	z	S_1	S_2	S_3	Con
R_0	1	0	-0.2	-0.05	0.163	0	0	2750
R_1	0	1	0	0.5	0.167	0	0	2500
R_2	0	0	10	4	-1	1	0	8000
R_3	0	0	6	2	0	0	1	4000

key element.

↓ Minimum positive (key ROW).

Here, y is the key column, R_3 is the key row and 6 is the key element.

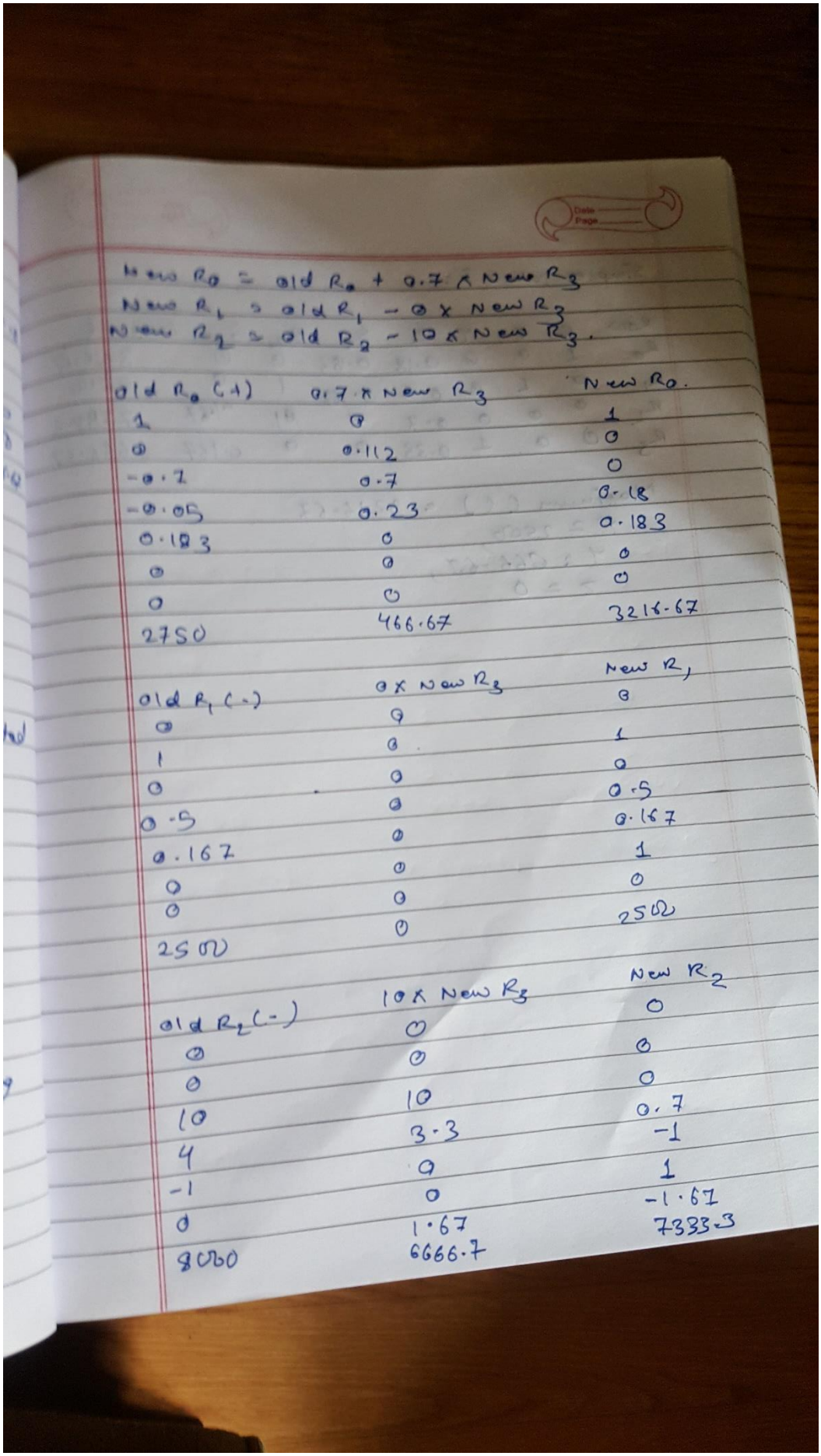
Now;
R_3 is the key row and should be updated first using formula;

$$\text{New } R_3 = \frac{\text{old } R_3}{\text{key element.}}$$

$$= \frac{\text{old } R_3}{6}$$

0, 0, 1, 0.33, 0, 0, 0.167, 666.67.

similarly, we should update. R_0, R_1 and R_2 using the formula.

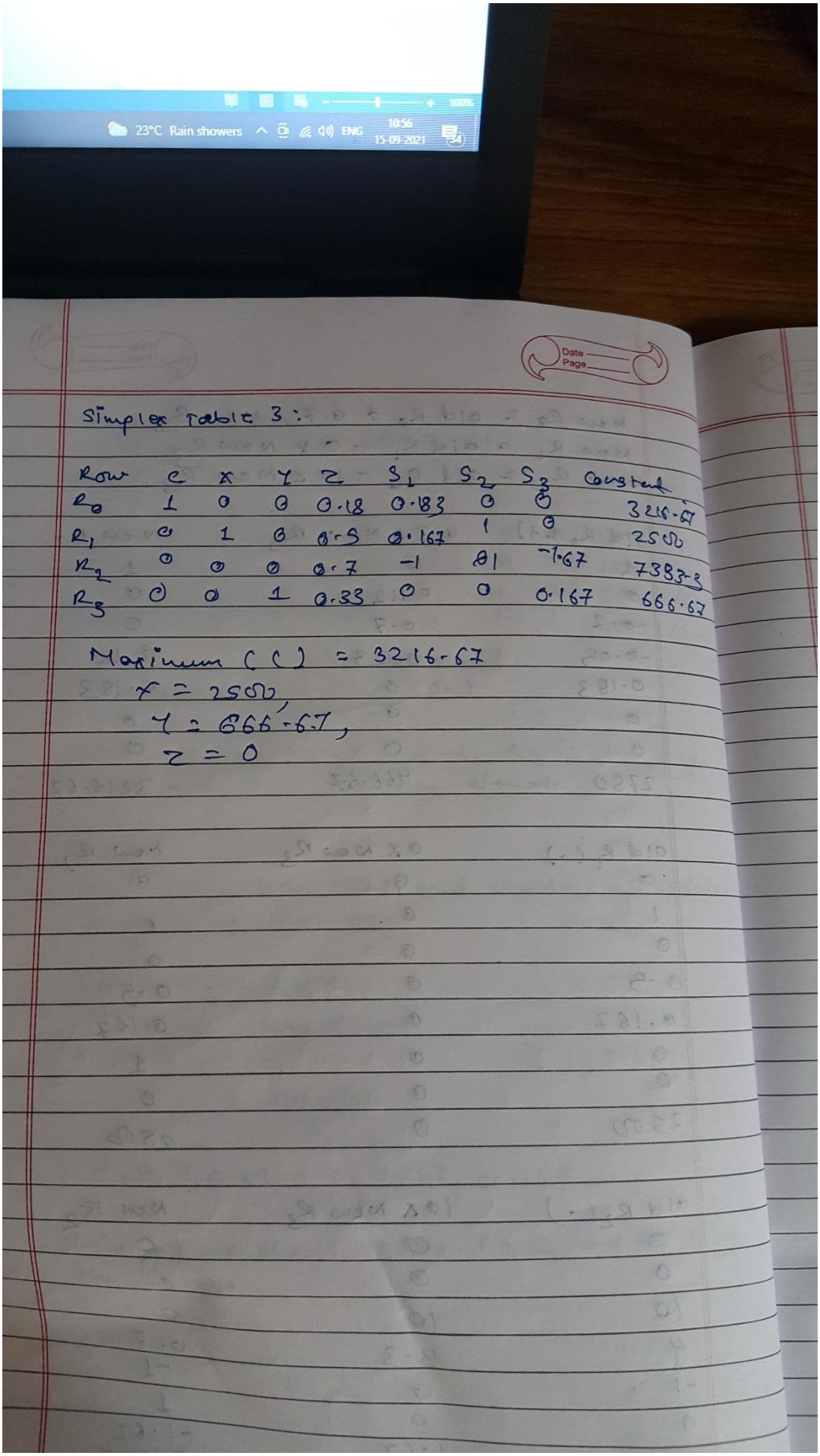


New R_0 = old R_0 + 0.7 × New R_3
New R_1 = old R_1 − 0 × New R_3
New R_2 = old R_2 − 10 × New R_3.

old R_0 (+)	0.7 × New R_3	New R_0.
1	0	1
0	0.112	0
−0.7	0.7	0
−0.05	0.23	0.18
0.183	0	0.183
0	0	0
0	0	0
2750	466.67	3216.67

old R_1 (−)	0 × New R_3	New R_1
0	0	0
1	0	1
0	0	0
0.5	0	0.5
0.167	0	0.167
0	0	1
0	0	0
250	0	250

old R_2 (−)	10 × New R_3	New R_2
0	0	0
0	0	0
10	10	0.7
4	3.3	−1
−1	0	1
0	1.67	−1.67
8000	6666.7	7333.3



Simplex table 3:

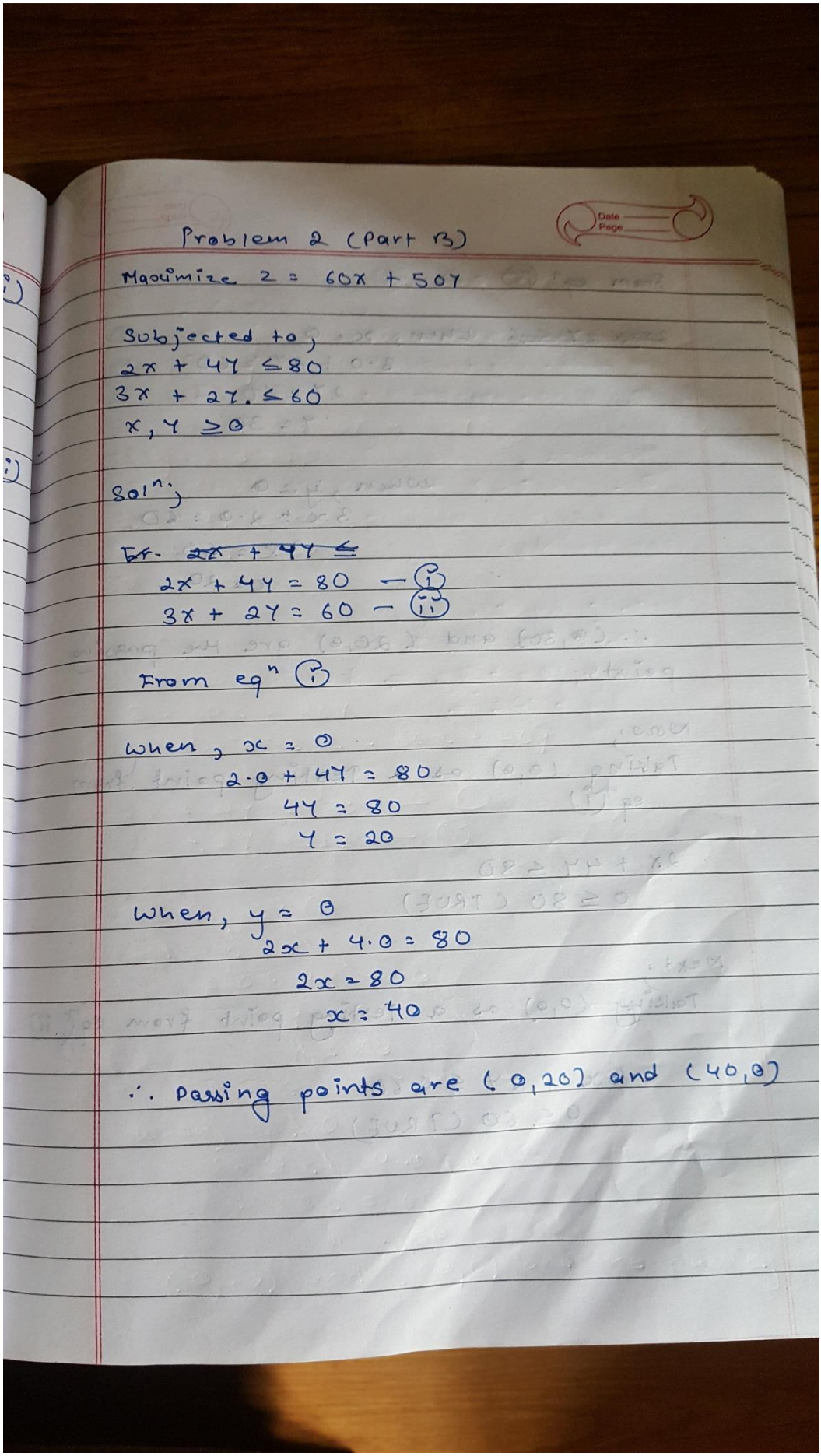
Row	C	X	Y	Z	S_1	S_2	S_3	Constant
R_0	1	0	0	0.18	0.183	0	0	3216.67
R_1	0	1	0	0.5	0.167	1	0	2500
R_2	0	0	0	0.7	−1	0	−1.67	7383.3
R_3	0	0	1	0.33	0	0	0.167	666.67

Maximum (C) = 3216.67

X = 2500,

Y = 666.67,

Z = 0



Problem 2 (Part B)

Maximize $Z = 60x + 50y$

Subjected to,

$2x + 4y \leq 80$

$3x + 2y \leq 60$

$x, y \geq 0$

Soln;

~~Er.~~ ~~$2x + 4y \leq$~~

$2x + 4y = 80$ — (i)

$3x + 2y = 60$ — (ii)

From eqn (i)

When, $x = 0$

$2 \cdot 0 + 4y = 80$

$4y = 80$

$y = 20$

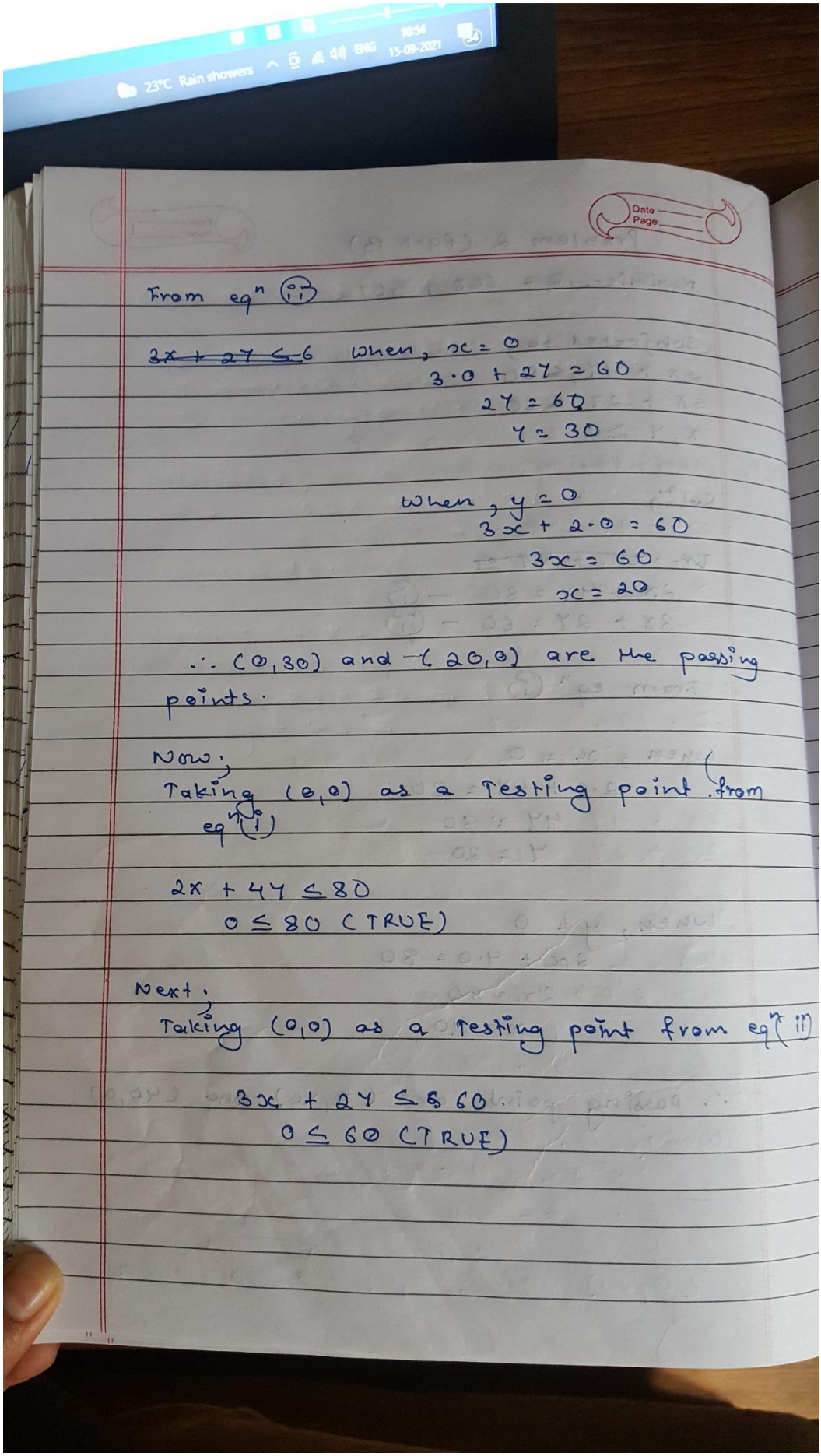
When, $y = 0$

$2x + 4 \cdot 0 = 80$

$2x = 80$

$x = 40$

∴ Passing points are $(0, 20)$ and $(40, 0)$



From eqn (i)

~~3x + 2y ≤ 60~~ When, x = 0

$3 \cdot 0 + 2y = 60$

$2y = 60$

$y = 30$

When, y = 0

$3x + 2 \cdot 0 = 60$

$3x = 60$

$x = 20$

∴ (0, 30) and (20, 0) are the passing points.

Now,

Taking (0, 0) as a Testing point from eqn (i)

$2x + 4y \leq 80$

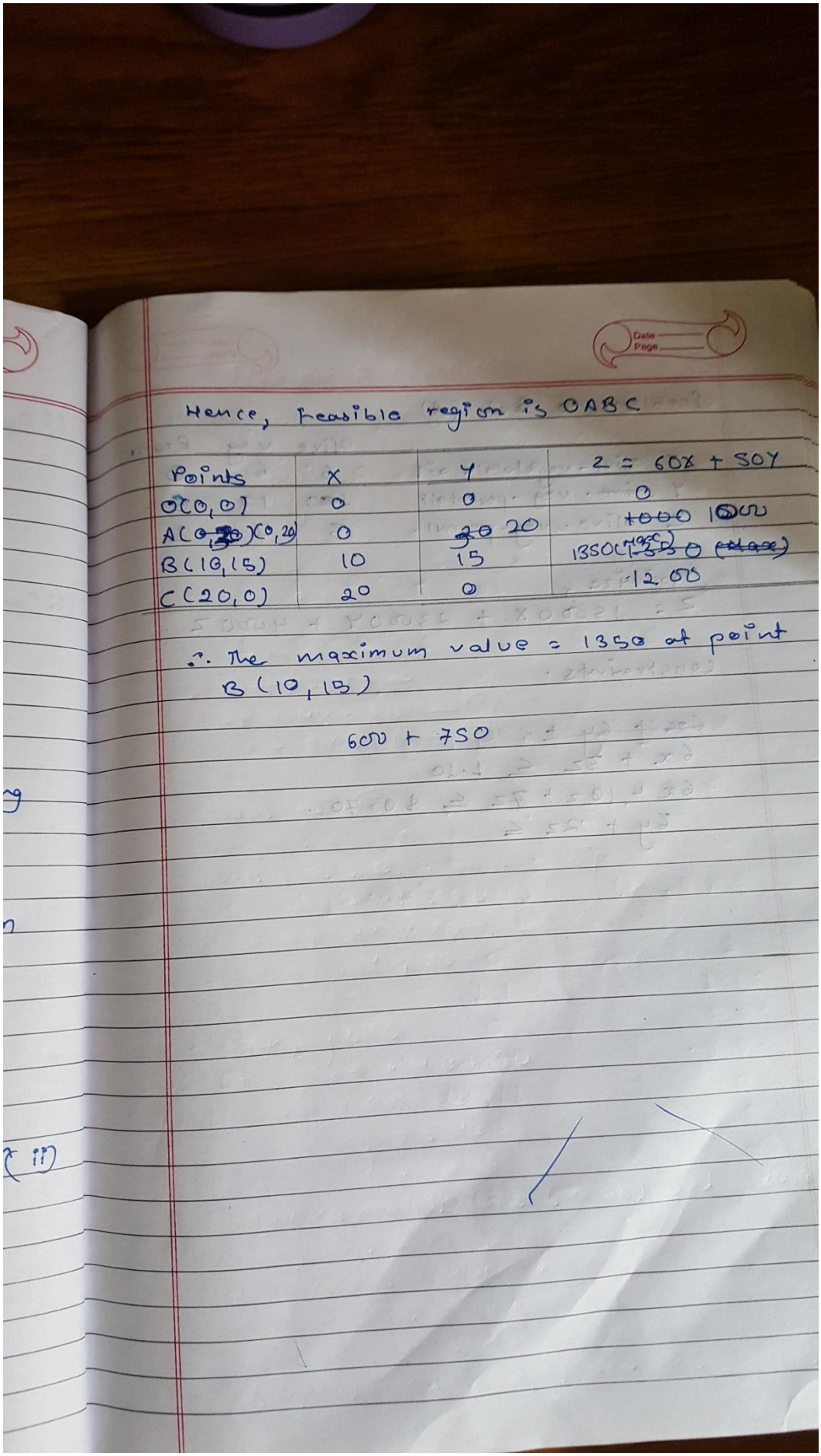
$0 \leq 80$ (TRUE)

Next,

Taking (0, 0) as a Testing point from eqn (ii)

$3x + 2y \leq 60$

$0 \leq 60$ (TRUE)

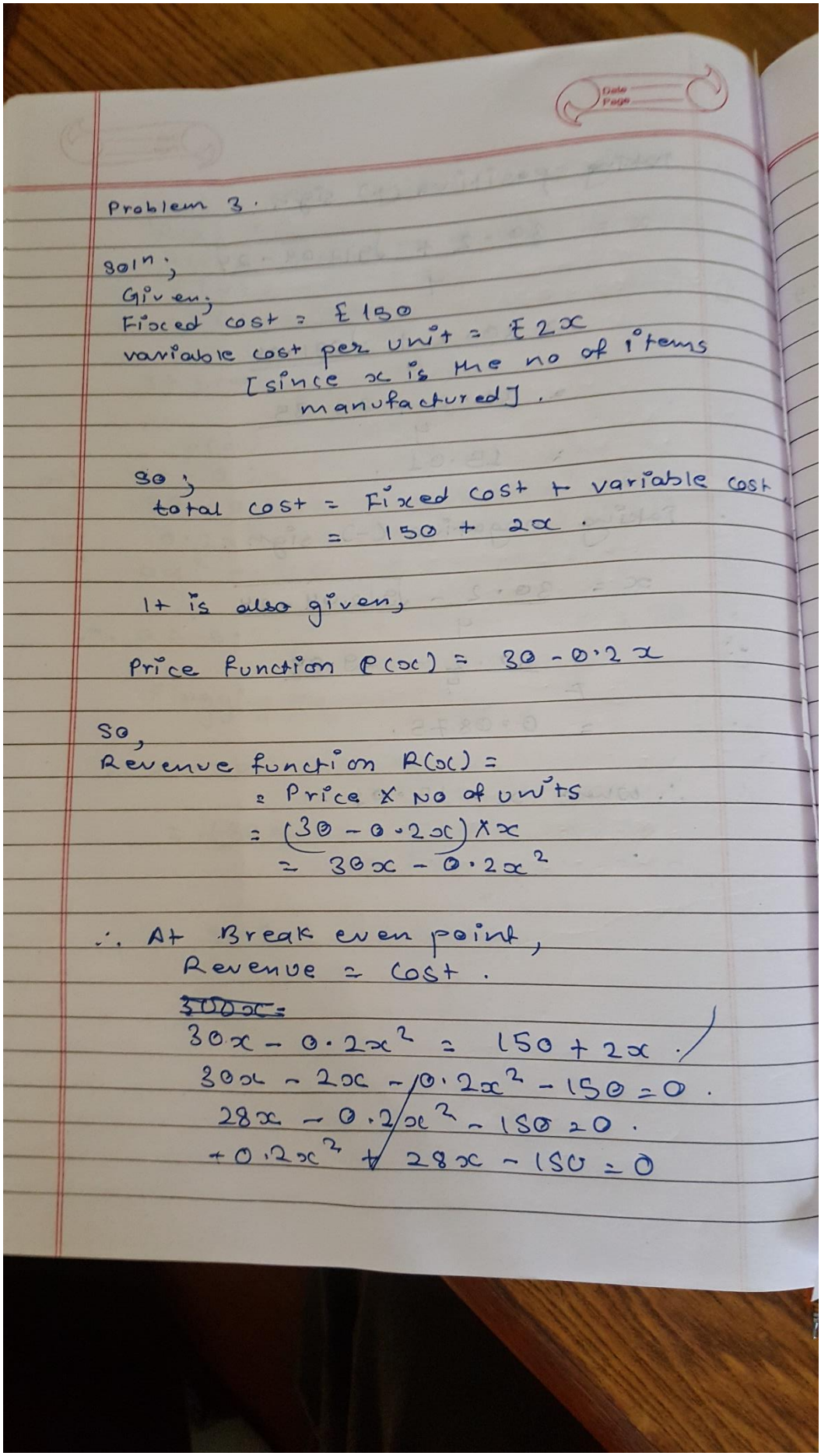


Hence, feasible region is OABC

Points	X	Y	Z = 60X + 50Y
O(0,0)	0	0	0
A(0,20)	0	20	1000
B(10,15)	10	15	1350
C(20,0)	20	0	1200

∴ The maximum value = 1350 at point B(10,15)

60(10) + 750



Problem 3.

Soln;
Given;
Fixed cost = £150
variable cost per unit = £2x
[since x is the no of items manufactured].

So;
total cost = Fixed cost + variable cost
= 150 + 2x.

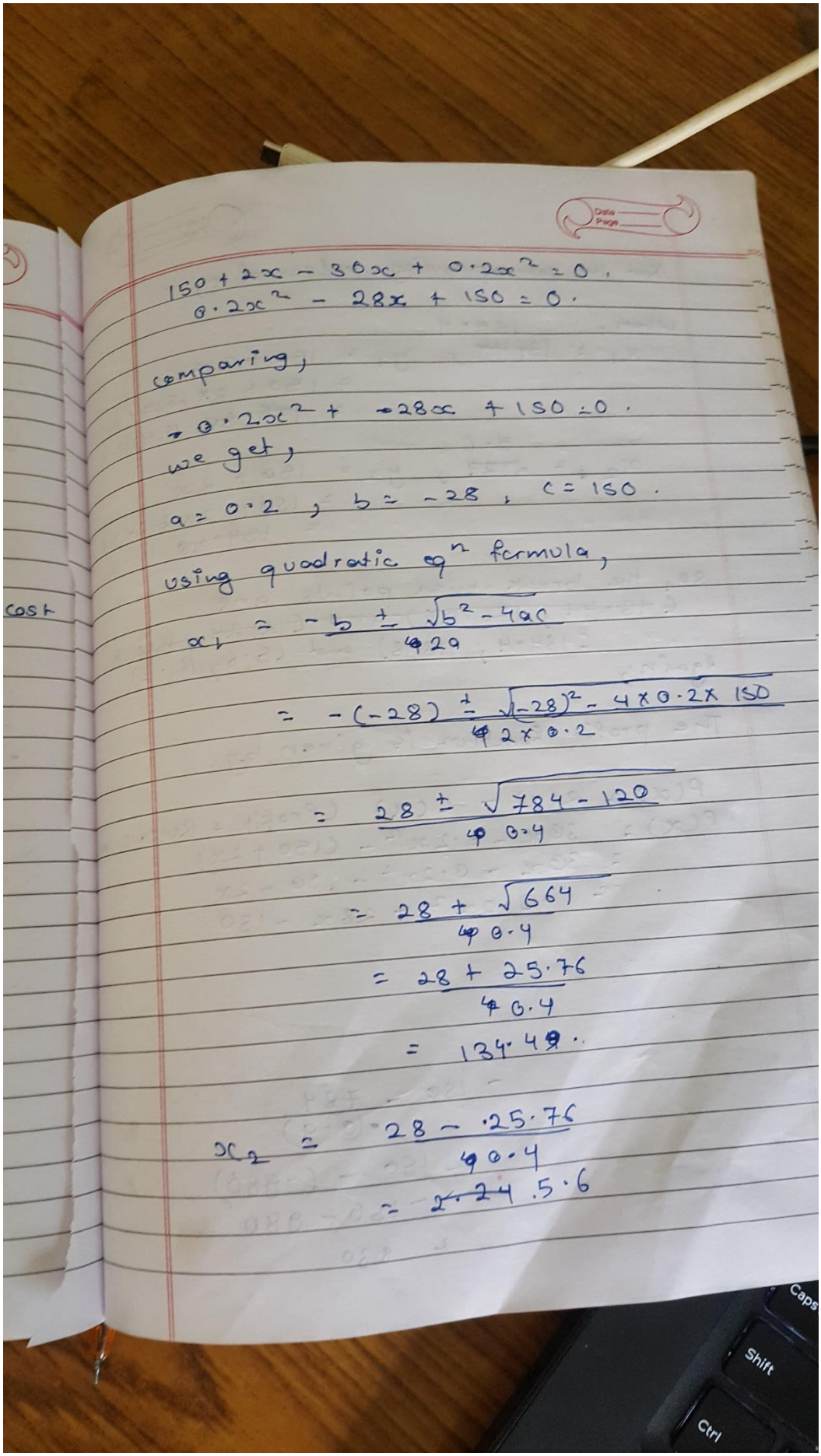
It is also given,

Price function P(x) = 30 - 0.2x

So,
Revenue function R(x) =
= Price X No of units
= (30 - 0.2x) X x
= 30x - 0.2x²

∴ At Break even point,
Revenue = cost.

~~300x =~~
30x - 0.2x² = 150 + 2x.
30x - 2x - 0.2x² - 150 = 0.
28x - 0.2x² - 150 = 0.
+0.2x² + 28x - 150 = 0



$150 + 2x - 30x + 0.2x^2 = 0$.

$0.2x^2 - 28x + 150 = 0$.

comparing,

$-0.2x^2 + -28x + 150 = 0$.

we get,

$a = 0.2$, $b = -28$, $c = 150$.

using quadratic eqⁿ formula,

$$x_1 = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{-(-28) \pm \sqrt{(-28)^2 - 4 \times 0.2 \times 150}}{2 \times 0.2}$$

$$= \frac{28 \pm \sqrt{784 - 120}}{0.4}$$

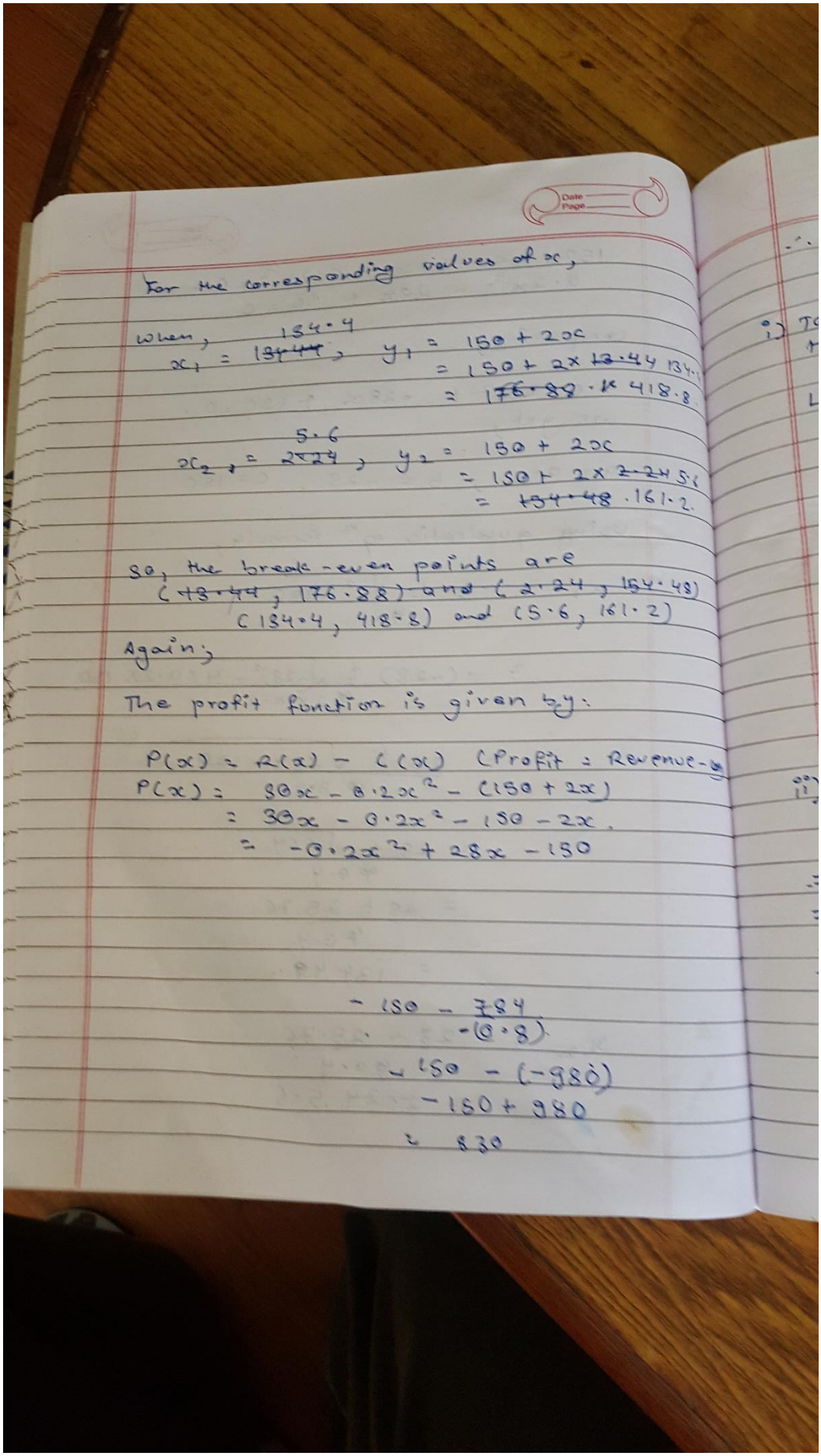
$$= \frac{28 + \sqrt{664}}{0.4}$$

$$= \frac{28 + 25.76}{0.4}$$

$$= 134.49.$$

$$x_2 = \frac{28 - 25.76}{0.4}$$

$$= 2.24 \,.\, 5.6$$



For the corresponding values of x,

When, $x_1 = 154.4$, $y_1 = 150 + 2x$
$= 150 + 2 \times 134.4$
$= 418.8$

$x_2 = 5.6$, $y_2 = 150 + 2x$
$= 150 + 2 \times 5.6$
$= 161.2$

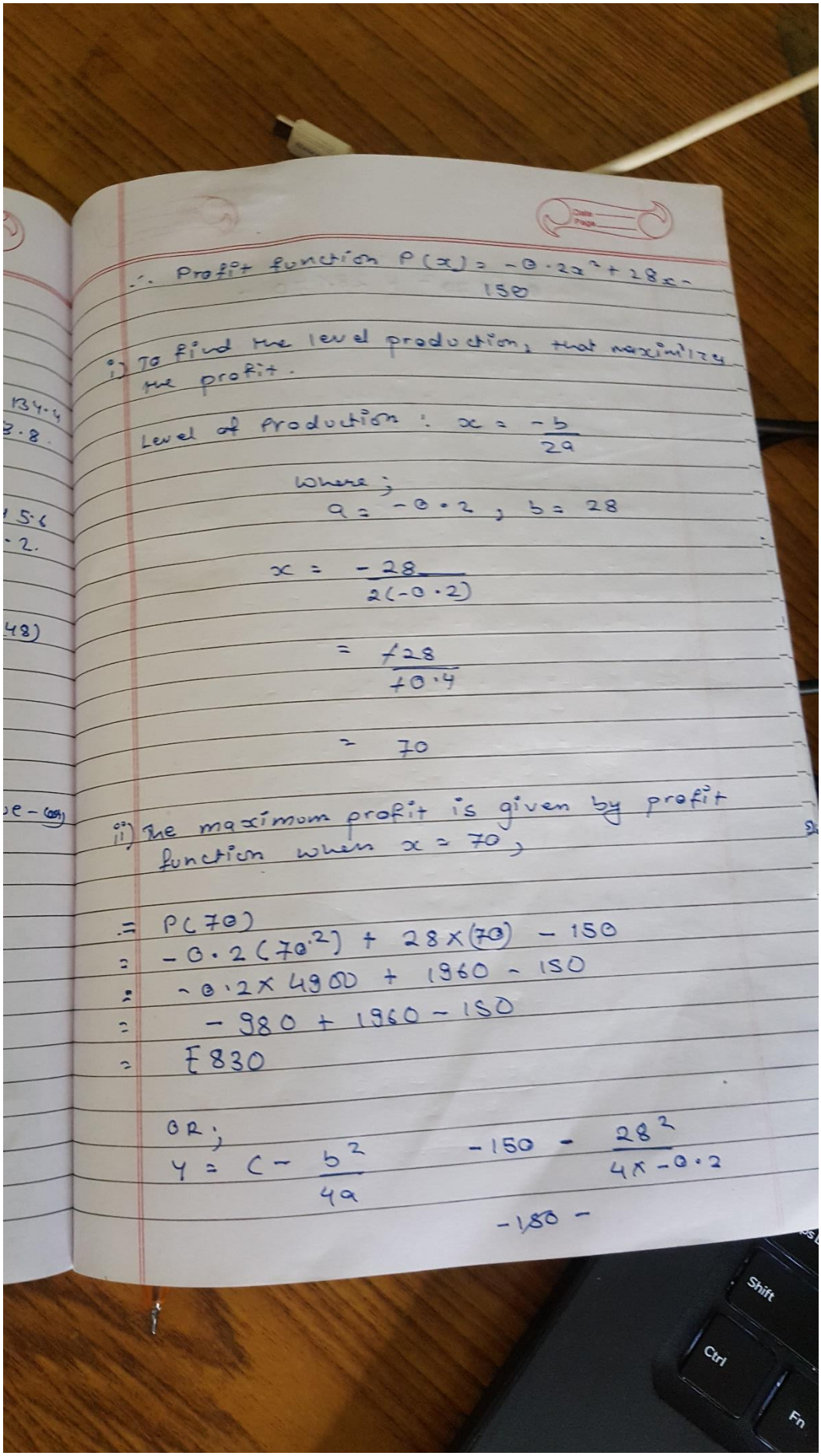
So, the break-even points are
$(134.4, 418.8)$ and $(5.6, 161.2)$

Again;

The profit function is given by:

$P(x) = R(x) - C(x)$ (Profit = Revenue -)
$P(x) = 30x - 0.2x^2 - (150 + 2x)$
$= 30x - 0.2x^2 - 150 - 2x$
$= -0.2x^2 + 28x - 150$

$= 150 - \frac{784}{-(0.8)}$
$= 150 - (-980)$
$= 150 + 980$
$= 830$



∴ Profit function $P(x) = -0.2x^2 + 28x - 150$

i) To find the level production, that maximizes the profit.

Level of Production : $x = \frac{-b}{2a}$

where;
$a = -0.2$, $b = 28$

$$x = \frac{-28}{2(-0.2)}$$

$$= \frac{-28}{-0.4}$$

$$= 70$$

ii) The maximum profit is given by profit function when $x = 70$,

$$\therefore P(70)$$
$$= -0.2(70^2) + 28 \times (70) - 150$$
$$= -0.2 \times 4900 + 1960 - 150$$
$$= -980 + 1960 - 150$$
$$= £830$$

OR;

$$Y = C - \frac{b^2}{4a} \qquad -150 - \frac{28^2}{4 \times -0.2}$$

$$-150 -$$