APPLIED MATHEMATICS – Code No. 241

MARKING SCHEME

CLASS - XII (2025 - 26)

(SET 1)

Q. No.	Questions	Marks
	SECTION-A	
1.	Answer A) **200kg** $C = -5\%$ $d = 10\%$ $m = 7\%$ $(d-m):(m-c) = 1:4$ Quantity sold at 10 % profit = $\frac{4}{5} \times 250 = 200$ Kg	1
2.	Answer C: **25 meters** Since Vijay is faster by 4 secs. ∴ he beats Samuel by $= \frac{100}{16} \times 4 = 25\ meters$	1
3.	Answer A) $-\frac{1}{2at^3}$ $\frac{dy}{dx} = \frac{dy/dt}{dx/dt} = \frac{2a}{2at} = \frac{1}{t} \Longrightarrow \frac{d^2y}{dx^2} = -\frac{1}{t^2} \times \frac{dt}{dx} = -\frac{1}{2at^3}$	1
4.	Answer D) **Irregular**	1
5.	Answer B) **₹40000** P=$\frac{R}{i}$ =$\frac{800}{0.02}$= 40000	1
6.	Answer A): $\boldsymbol{x + y > 2\sqrt{xy}}$ For distinct $x, y > 0; AM > GM \Longrightarrow \frac{x+y}{2} > \sqrt{xy} \Rightarrow x + y > 2\sqrt{xy}$	1
7.	Answer A) : **0** The summation of product of a_{ij} of 2nd column with corresponding c_{ij} of 3 column =0	1
8.	Answer C): $\boldsymbol{\int_a^b \lvert f(y)\rvert\, dy}$	1
9.	Answer B : **Inferior Quality** n = 26⟹ $\lvert t\rvert = 3.07 > t_{25}(0.05) = 2.06$	1
10.	Answer B) **33** n = 34 ⇒ $v = 34 - 1 = 33$	1
11.	Answer D) 4 $\lvert adj(A)\rvert = \lvert A\rvert^{n-1} \Longrightarrow \lvert \text{adj(A)}\rvert = (-2)^2 = 4$	1
12.	Answer B: **2 and 1**	1
13.	Option A) **5%**	1

	$i = \frac{r}{400}$. $P = \frac{R}{i} \Rightarrow 24000 = \frac{300\times400}{r} \Rightarrow r = \frac{120}{24} = 5\%$	
14.	Answer A) **no solution** If $\Delta = 0$ and at least $(one\ of\ \Delta_x,\ \Delta_y,\ \Delta_z) \neq 0$ The system of linear equations has no solution	1
15.	Answer A) **Feasible region**	1
16.	Answer B) **2,2** For Poisson distribution Mean = variance = $np = 20000 \times \frac{1}{10000} = 2$	1
17.	Answer: B) $\begin{bmatrix} \mathbf{4} & \mathbf{3} \\ \mathbf{-3} & \mathbf{0} \\ \mathbf{-1} & \mathbf{-2} \end{bmatrix}$ We have, $P = \begin{bmatrix} 3 & 4 \\ -1 & 2 \\ 0 & 1 \end{bmatrix}$ & $Q^T = \begin{bmatrix} -1 & 2 & 1 \\ 1 & 2 & 3 \end{bmatrix} \Rightarrow Q = \begin{bmatrix} -1 & 1 \\ 2 & 2 \\ 1 & 3 \end{bmatrix}$ So, $P - Q = \begin{bmatrix} 3 & 4 \\ -1 & 2 \\ 0 & 1 \end{bmatrix} - \begin{bmatrix} -1 & 1 \\ 2 & 2 \\ 1 & 3 \end{bmatrix} = \begin{bmatrix} 4 & 3 \\ -3 & 0 \\ -1 & -2 \end{bmatrix}$.	1
18.	Answer: C) **₹800** $n = 2\frac{1}{2}$ years $= 30$ months $I = ₹\ 20000 \times \frac{8}{100} \times \frac{5}{2} = ₹\ 4000$ EMI $= \frac{P+I}{n}$ $= ₹\ \left(\frac{20000+4000}{30}\right) = ₹\ 800$	1
	ASSERTION-REASON BASED QUESTIONS **(Questions number 19 and 20 are Assertion and Reason based questions carrying 1 mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the codes (A), (B), (C) and (D) as given below** **(A) Both (A) and (R) are true and (R) is the correct explanation of (A).** **(B) Both (A) and (R) are true but (R) is not the correct explanation of (A).** **(C) (A) is true but (R) is false.** **(D) (A) is false but (R) is true.**	
19.	Answer C) **(A) is true but (R) is false.**	1
20.	Answer D) **(A) is false but (R) is true**	1
	SECTION-B **[This section comprises of solution of very short answer type questions (VSA) of 2 marks each]**	
21.	A) $17 \equiv 7(mod\ 10)$ $17^2 \equiv 7^2(mod\ 10)$ $17^2 \equiv 49(mod\ 10)$ $17^2 \equiv 9(mod\ 10)$ $(17^2)^2 \equiv 9^2(mod\ 10)$ $17^4 \equiv 81(mod\ 10)$	½ ½

	$17^4 \equiv 1(mod\ 10)$ $(17^4)^4 \equiv 1^4(mod\ 10)$ $17^4 \equiv 1(mod\ 10)$ Therefore last digit of 17^{16} is 1.	½ ½
	OR	
	B) $4 - 2x \geq 3x + 19$ $-5x \geq 15$ $5x \leq -5$ $x \leq -3\ \ OR\ x \in (-\infty, -3)$	½ 1 ½
22.	(i) P (X =0) + P (X=1) + P (X =2) + P (X > 2) =1 k + 2k +3k + 0 =1 , 6k =1, k=1/6 ii) Mean=$\sum px = 0 \times \frac{1}{6} + 1 \times \frac{2}{6} + 2 \times \frac{3}{6} = \frac{4}{3}$.	½ ½ 1
23.	Here initial investment value is IV=₹5000 Final investment value FV=₹10500 No of years (n)=3 $\Rightarrow r = \left(\frac{FV}{IV}\right)^{\frac{1}{n}} - 1 = \left(\frac{10500}{5000}\right)^{\frac{1}{3}} - 1$ $= 1.2805 - 1 = 0.2805$ $CAGR = 28.05\%$	½ ½ ½ ½
24.	A) Given : n =150 and p = 1.4 % = 14 /1000 $\therefore\ \lambda = np = 150 \times \frac{14}{1000} = 2.1$ P(X =2) = $\frac{(\lambda^2 e^{-\lambda})}{2!} = \frac{4.41 \times 0.122}{2} = 4.41 \times 0.061 = 0.269$	½ ½ 1
	OR	
	B) Given : n=6 , p= 1/5 λ = 6/5 =1.2 P (X ≥ 2) = 1 - [P (X =0) + P (X=1)] $=1 - [\ e^{-\lambda} + \lambda e^{-\lambda}] = 1 - e^{-\lambda}(1 + \lambda) = 1 - e^{-1.2}\ (1 + 1.2)$ =1 – (0.301× 2.2) = 1 – 0.6622= 0. 3378.	½ ½ 1

25.	$D = \frac{C-S}{n}$ $\Rightarrow 2500 = \frac{25000-12500}{n}$ $\Rightarrow n = \frac{12500}{2500} = 5$ So, after 5 years the value of the machine will be half of its initial value. Value of machine after 6 years $= 25000 - 2500 \times 6 =$ ₹ $10{,}000$	1 ½ ½
	SECTION-C **[This section comprises of solution short answer type questions (SA) of 3 marks each]**	
26.	Let's denote the speed of the stream as 's' km/h. Downstream speed = (speed in still water) + (speed of the stream) = 15 + s km/h Upstream speed = (speed in still water) - (speed of the stream) = 15 - s km/h Time taken for downstream journey = distance/speed = 30/(15+s) hours Time taken for upstream journey = distance/speed = 30/(15-s) hours Total time taken = 4 hours 30 minutes = 4.5 hours 4.5 = 30/(15+s) + 30/(15-s) Solving for 's', we get s = 5 km/h Therefore, the speed of the stream is 5 km/h	½ ½ ½ ½ 1
27.	A) Given $f(x) = 2x^3 - 9x^2 + 12x - 5$ $f'(x) = 6x^2 - 18x + 12 = 6(x^2 - 3x + 2)$ $f'(x) = 6(x-1)(x-2)$ $f'(x) = 0 \Rightarrow x = 1$ *and* $x = 2$ *are the critical points.* The intervals are $(-\infty, 1)$; $(1,2)$; $(2, \infty)$ Increasing in $(-\infty, 1] \cup [2, \infty)$, Decreasing in $[1,2]$	1 ½ ½ 1
	OR	

	B) a) Average cost function $Avg(x) = \frac{C(x)}{x}$ $= \frac{x^2}{3} + x - 15 + \frac{3}{x}$ b) $C(x) = \frac{x^3}{3} + x^2 - 15x + 3.$ Marginal cost $= \frac{d}{dx}(\frac{x^3}{3} + x^2 - 15x + 3)$ $= x^2 + 2x - 15$ c) $MC(25) = 625 + 50 - 15$ $= ₹660$	1 1 1
28.	A) Let Rs. R be set aside biannually for 10 years in order to have ₹ 500,000 after 10 years Here S = 500,000. ; $n = 10 \times 2 = 20$ $i = \frac{5}{2\times100} = 0.025$ $R = \frac{iS}{(1+i)^n - 1} = \frac{0.025\times500,000}{(1.025)^{20}-1} = \frac{12,500}{1.6386-} = 19,574.07.$	½ 2 ½
	OR	

	B) **Face value C = ₹ 2,000** Coupon rate i_d = 10 % annually or 0.1 Therefore R = C x i_d = 2,000 x 0.1 = ₹ 200 No. of periods before redemption (n) = 5 Yield rate i= 11 % or 0.11 Therefore $V = R\left[\frac{1-(1+i)^{-n}}{i}\right] + C\ (1+i)^{-n}$ $= 200\left[\frac{1-(1+0.11)^{-5}}{0.11}\right] + 2000\ (1+0.11)^{-5}$ $= 200\left[\frac{1-(1.11)^{-5}}{0.11}\right] + 2000(1.11)^{-5}$ $= 200\left[\frac{1-0.593451}{0.11}\right] + 2000\ (0.593451)$ = 200 (3.6959) + 1186.902 = 739.18 + 1186.902 = 1926.08 Therefore, the value of the bond is ₹ 1,927.	½ 1 ½ 1
29.	Cistern filled by *A* and *B* in 5 minutes = $5\left(\frac{1}{12}+\frac{1}{15}\right) = \frac{3}{4}$ Unfilled part of the tank = $\frac{1}{4}$ Portion of cistern filled by *A*,*B* and *C* in 1 minute = $\frac{1}{12} + \frac{1}{15} - \frac{1}{20} = \frac{1}{10}$ So, $\frac{1}{4}$ of the tank will be filled in = $\frac{1}{4} \times 10$ = 2 mins 30 secs Total time taken to fill the tank = 5 + 2 mins 30 secs = 7 mins 30 secs	1 ½ ½ ½ ½
30.	$H_0 : \mu = 0.50$ mm and $H_1 : \mu \neq 0.50$ mm Thus two tailed test is applied under hypothesis H_0 $t = \frac{\overline{X}-\mu}{s} \times \sqrt{n-1} = \frac{0.53-0.50}{0.03} \times \sqrt{9} = 3$ Since t(=3) > $t_{0.025}$(2.262), the null hypothesis H_0 can be rejected. Hence we conclude that machine is not working properly.	½ 1 1 ½

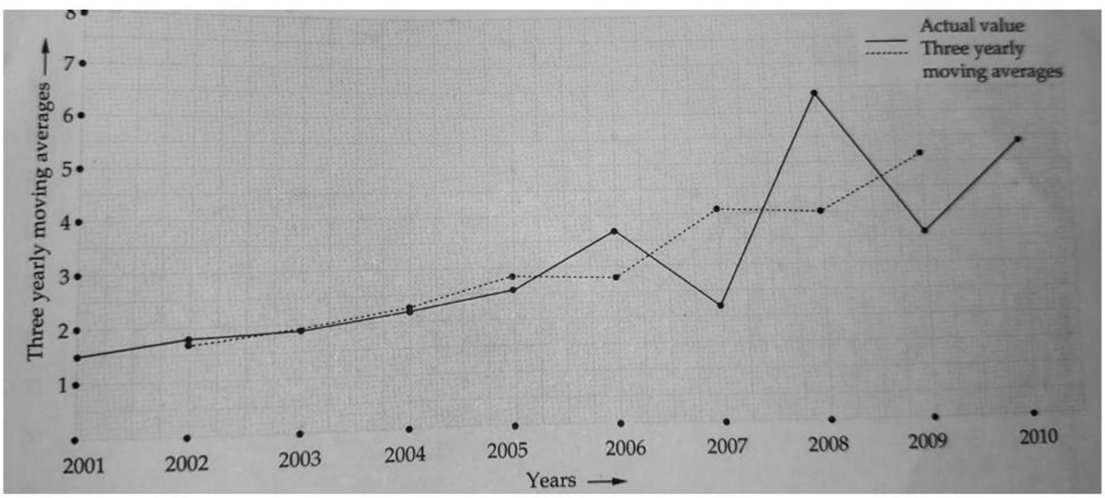
31.	Let the number of necklaces manufactured be x, and the number of bracelets manufactured be y. According to question, $x + y \le 25$ and $\frac{x}{2} + y \le 14$ The profit on one necklace is ₹ **100** and the profit on one bracelet is ₹ **300**. Let the profit (the objective function) be Z, which has to be maximized. Therefore, required LPP is Maximize $Z = 100x + 300y$ Subject to the constraints $x + y \le 25$ $\frac{x}{2} + y \le 14$ $x, y \ge 0$	1 ½ 1 ½
	SECTION-D **[This section comprises of solution of long answer type questions (LA) of 5 marks each]**	
32.	The matrix equation AX = B is $\begin{bmatrix} 1 & -1 & 1 \\ 2 & 1 & -3 \\ 1 & 1 & 1 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 4 \\ 0 \\ 2 \end{bmatrix}$ $\lvert A \rvert = 10$ adj A $= \begin{bmatrix} 4 & -5 & 1 \\ 2 & 0 & -2 \\ 2 & 5 & 3 \end{bmatrix}' = \begin{bmatrix} 4 & 2 & 2 \\ -5 & 0 & 5 \\ 1 & -2 & 3 \end{bmatrix}$ Here $A^{-1} = \frac{1}{10}\begin{bmatrix} 4 & 2 & 2 \\ -5 & 0 & 5 \\ 1 & -2 & 3 \end{bmatrix}$ So, $\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \frac{1}{10}\begin{bmatrix} 4 & 2 & 2 \\ -5 & 0 & 5 \\ 1 & -2 & 3 \end{bmatrix}\begin{bmatrix} 4 \\ 0 \\ 2 \end{bmatrix} = \begin{bmatrix} 2 \\ -1 \\ 1 \end{bmatrix}$ Thus, x = 2, y = – 1, z = 1 **OR**	½ 1 2 ½ 1

	Here, $|A| = -(-4-3) - (12+1) + 2(9-1)$ $= 7 - 13 + 16 = 10 \neq 0$ $\Rightarrow \text{adj}(A) = \begin{bmatrix} -7 & -13 & 8 \\ 2 & -2 & 2 \\ 3 & 7 & -2 \end{bmatrix}^T = \begin{bmatrix} -7 & 2 & 3 \\ -13 & -2 & 7 \\ 8 & 2 & -2 \end{bmatrix}$ Hence $A^{-1} = \frac{1}{10}\begin{bmatrix} -7 & 2 & 3 \\ -13 & -2 & 7 \\ 8 & 2 & -2 \end{bmatrix}$ $AA^{-1} = \frac{1}{10}\begin{bmatrix} -1 & 1 & 2 \\ 3 & -1 & 1 \\ -1 & 3 & 4 \end{bmatrix}\begin{bmatrix} -7 & 2 & 3 \\ -13 & -2 & 7 \\ 8 & 2 & -2 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$	1 2 ½ ½ 1
33.	Here $\boldsymbol{C = \frac{x^3}{3} - 7x^2 + 111x + 50}$ and $\boldsymbol{x = 100 - p}$ i.e., $\boldsymbol{p = 100 - x}$ (i) R, the revenue function is $\boldsymbol{R = px = (100 - x)x = 100\,x - x^2}$ (ii) Profit function $\boldsymbol{P(x) = R(x) - C(x)}$ $\boldsymbol{= (100\,x - x^2) - \left(\frac{x^3}{3} - 7x^2 + 111x + 50\right)}$ $\boldsymbol{= -\frac{x^3}{3} + 6x^2 - 11x - 50}$ (iii) $\boldsymbol{\frac{dP}{dx} = -x^2 + 12x - 11}$ For $\boldsymbol{P}$ to be maximum, $\boldsymbol{\frac{dP}{dx} = 0 \Rightarrow x = 1, 11}$ $\boldsymbol{\frac{d^2P}{dx^2} = -2x + 12 > 0}$ at $\boldsymbol{x = 1}$ and $\boldsymbol{< 0}$ at $\boldsymbol{x = 11}$ Thus $\boldsymbol{P}$ is maximum when $\boldsymbol{x = 11}$ Hence the profit maximizing level of output is 11 units. Hence, the profit maximising level of output is 11 units (iv) Maximum profit = $\boldsymbol{[P(x)]_{x=11}}$ $\boldsymbol{= -\frac{(11)^3}{3} + 6(11)^2 - 11(11) - 50}$ $\boldsymbol{= 111.33\ or\ 111}$	½ 1 ½ 1 1 1

34.	A)	3

Years	Working days lost in strikes (in lakhs)	Three yearly moving totals	Three yearly moving averages
2001	1.5	-	-
2002	1.8	5.2	1.73
2003	1.9	5.9	1.96
2004	2.2	6.7	2.23
2005	2.6	8.5	2.83
2006	3.7	8.5	2.83
2007	2.2	12.3	4.1
2008	6.4	12.2	4.06
2009	3.6	15.4	5.13
2010	5.4	-	

The graph of these moving averages 2



OR

B)

Here, number of observations $n = 11(odd\ number)$

Year (t)	Production (y)	$x = t_i - 1967$	x^2	xy
1962	2	-5	25	-10
1963	4	-4	16	-16
1964	3	-3	9	-9
1965	4	-2	4	-8
1966	4	-1	1	-4
1967	2	0	0	0
1968	4	1	1	4
1969	9	2	4	18
1970	7	3	9	21
1971	10	4	16	40
1972	8	5	25	40
Total	$\sum y = 57$	$\sum x = 0$	$\sum x^2 = 110$	$\sum xy = 76$

2

Year **1967** is taken as year of origin.

The normal equations are $\sum y = na + b\sum x$ and $\sum xy = a\sum x + b\sum x^2$ ½

Since, $\sum x = 0$ i.e., deviation from actual mean is zero,

we have $a = \frac{\sum y}{n} = \frac{57}{11} = 5.18$, $b = \frac{\sum xy}{\sum x^2} = \frac{76}{110} = 0.69$ 1

Therefore, the required equation of the trend line $y = 5.18 + 0.69x$

The trend values are 1 ½

1.73, 2.42, 3.11, 3.8, 4.49, 5.18, 5.87, 6.56, 7.25, 7.94, 8.63

35. Here P = ₹ 9,50,000, i = $\frac{15}{1200}$ = 0·0125 ½

n = 48 months

½

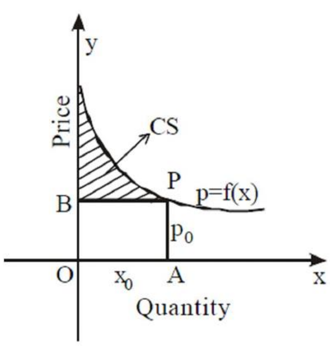
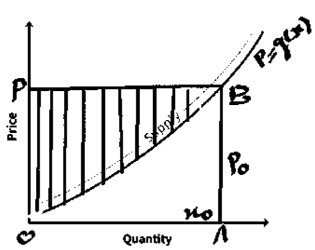
Using the reducing balancing method,

1

$$E = \frac{Pi}{1 - (1 + i)^{-n}} = \frac{9{,}5{,}0000 \times 0{\cdot}0125}{1 - (1 + 0{\cdot}0125)^{-48}}$$

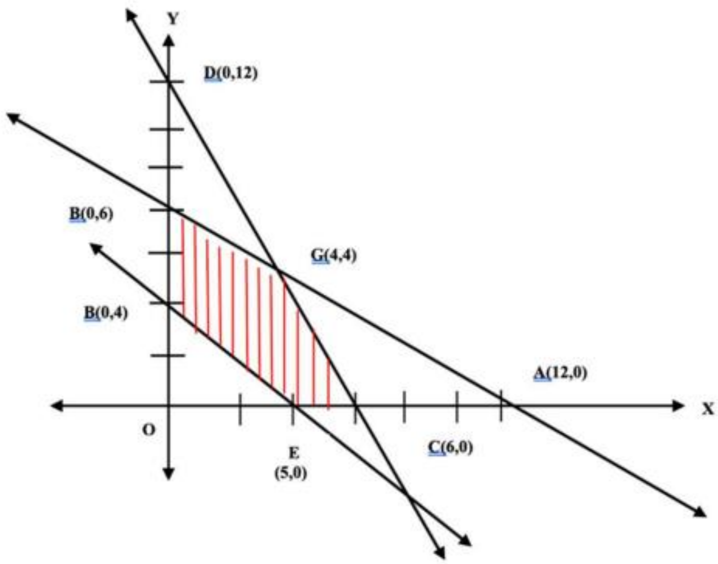
$$= \frac{11875}{1 - (1.0125)^{-48}}$$

1

	$= \frac{11875}{1-0.5508}$ $=₹26{,}435.88$ Total interest paid = n x EMI-P $=48 \times 26{,}435.88 - 950000$ $=₹3{,}18{,}922.24$	½ 1 ½
	SECTION-E **[This section comprises solution of 3 case- study based questions of 4 marks each with three sub parts of 1, 1 and 2 marks each respectively]**	
36.	i) $Z = \frac{X-\mu}{\sigma}$ ii) When $X = 25, Z = -0.80$ So, $P(X < 25) = P(Z < -0.8) = P(Z > 0.8)$ $= P(Z \geq 0) - P(0 \leq Z \leq 0.8)$ $= 0.5 - 0.2881 = 0.2119$ iii) A) When $X = 20, Z = -1.60$ When $X = 40, Z = 1.60$ $\therefore P(20 \leq X \leq 40) = P(-1.60 \leq Z \leq 1.60)$ $= P(-1.60 \leq Z \leq 0) + P(0 \leq Z \leq 1.60)$ $= 2P(0 \leq Z \leq 1.60)$ $= 2 \times 0.4452 = 0.8904$ Thus, out of 2000 students, the expected number of students getting marks between 20 and 40 = $2000 \times 0.8904 = 1780.8$ or 1781 OR $B)\quad P(X > 25) = 1 - P(X < 25)$ $= 1 - 0.2119 = 0.7881$ Number of students who get marks more than 25 = 0.7881×2000 $= 1576.2$ *or* 1576	1 1 2 2
37.	i)  ii)  iii)A)	1 1

	$$900 - x^2 = 2x^2 + 10x + 500$$ Rearrange the terms to form a quadratic equation: $$0 = 3x^2 + 10x - 400$$ Now, use the quadratic formula to solve for x: $$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$ $$x = \frac{-10 \pm \sqrt{10^2 - 4(3)(-400)}}{2(3)}$$ $$x = \frac{-10 \pm \sqrt{100 + 4800}}{6}$$ $$x = \frac{-10 \pm \sqrt{4900}}{6}$$ $$x = \frac{-10 \pm 70}{6}$$ Since the quantity cannot be negative, we use the positive value: $$x_e = \frac{-10 + 70}{6} = \frac{60}{6} = 10$$ So, the equilibrium quantity is 10 (thousand) tyres. Now, substitute the equilibrium quantity ($x_e = 10$) into either the demand or supply function to find the equilibrium price (p_e). Using the demand function: $$p_e = D(10) = 90 - \frac{10^2}{10} = 90 - \frac{100}{10} = 90 - 10 = 80$$ The equilibrium price is 80 (thousand) rupees per tyre. **OR** B) Given that, the demand function is $p = 25 - x - x^2$, $p_0 = 19$ $\therefore 19 = 25 - x - x^2$ $\Rightarrow x^2 + x - 6 = 0$ $\Rightarrow x = 2$ (or) $x = -3$ $\therefore x_0 = 2$ [demand cannot be negative] $\therefore p_0 x_0 = 19 \times 2 = 38$ $CS = \int_0^2 (25 - x - x^2)dx - 38 = 25x - \frac{x^2}{2} - \frac{x^3}{3} \Big|_0^2 - 38 = 50 - 2 - \frac{8}{3} - 38 = \frac{22}{3}$	1 1 1 1
38.	i) Let x and y be the number of units of items M and N respectively. We have : $x \geq 0, y \geq 0$ $x + 2y \leq 12 ; 2x + y \leq 12 ; \ x + \frac{5}{4}y \geq 5.$ Max Z = 600x + 400 y	2

ii)



1 ½

Corner Point	Z = 600x + 400y
E : (5,0)	3000
C : (6,0)	3600
G : (4,4)	**4000 (Maximum)**
B : (0,6)	2400
F : (0,4)	1600

½

Hence to get maximum profit 4 units of each item M and N are produced.