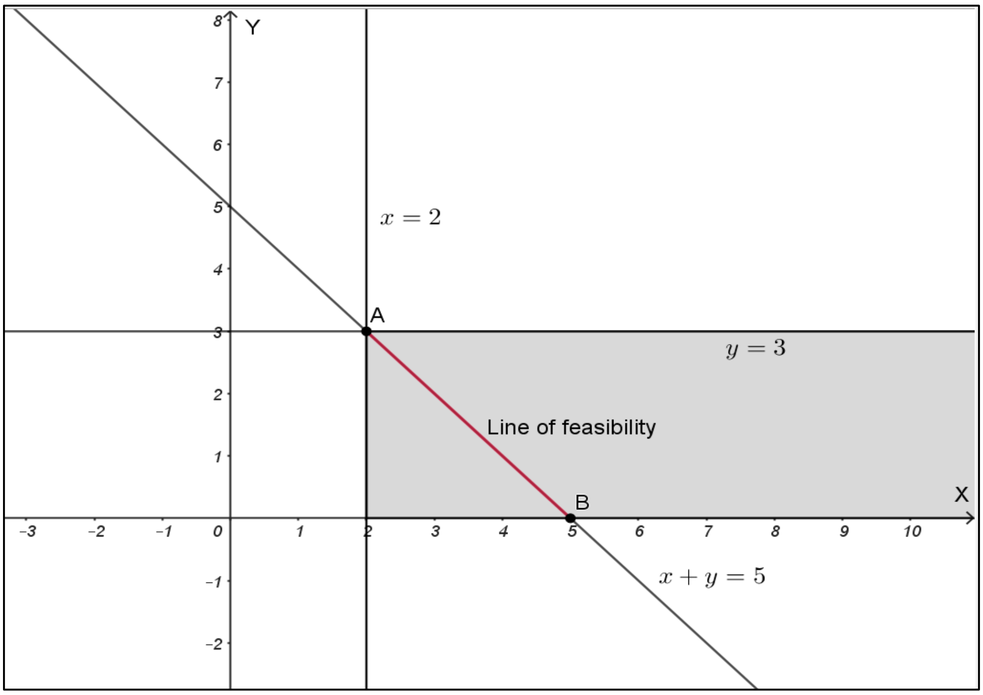
APPLIED MATHEMATICS (CODE-241)
MARKING SCHEME
CLASS- XII (2026-27)

SECTION – A (Solutions of MCQs of 1 Mark each)

Q. No.	ANS	HINTS/SOLUTIONS	Marks
1.	**(D)**	$\boldsymbol{a + c < b + c}$ Adding the same number to both sides of an inequality preserves the inequality, regardless of whether the added number is positive or negative.	**1**
2.	**(A)**	$\mathbf{5:2}$ • Vessel A (Milk fraction): $\frac{4}{4+5} = \frac{4}{9}$ • Vessel B (Milk fraction): $\frac{5}{5+1} = \frac{5}{6}$ • Target Mixture (Milk fraction): $\frac{5}{5+4} = \frac{5}{9}$ Required ratio $= \frac{\frac{5}{6} - \frac{5}{9}}{\frac{5}{9} - \frac{4}{9}} = \frac{5}{18} : \frac{1}{9} = 5 : 2$	**1**
3.	**(B)**	**64** A 3×3 symmetric matrix will be of the form $\begin{bmatrix} a & b & c \\ b & d & e \\ c & e & f \end{bmatrix}$ There are 6 unique entries in this matrix: a, b, c, d, e, f. Each of these entries can be either 1 or -1. ∴ Number of symmetric matrices will be $2^6 = 64$	**1**
4.	**(B)**	**450 km** Let d km be the length of the racecourse. Let S_A , S_B and S_C be the constant speeds of cars A, B and C respectively. $S_A : S_B = d : d - 45$, $S_B : S_C = d : d - 50$ and $S_A : S_C = d : d - 90$ Now, $\frac{S_A}{S_C} = \frac{S_A}{S_B} \times \frac{S_B}{S_C}$ $\Rightarrow \frac{d}{d-90} = \frac{d}{d-45} \times \frac{d}{d-50}$ $\Rightarrow (d-45)(d-50) = d(d-90) \quad \Rightarrow d^2 - 95d + 2250 = d^2 - 90d$ $\Rightarrow 5\,d = 2250 \quad \Rightarrow d = 450\ km$	**1**
5.	**(B)**	**2** $\frac{dy}{dx} = \frac{dy/dt}{dx/dt} = \frac{2t}{1/t} = 2t^2 \Rightarrow \frac{d^2y}{dx^2} = \frac{d}{dt}\left(\frac{dy}{dx}\right) \times \frac{dt}{dx} = 4t \times t = 4t^2$ $\Rightarrow \left.\frac{d^2y}{dx^2}\right]_{t=\frac{1}{\sqrt{2}}} = 2$	**1**

6.	(D)	**The future value of perpetuity is undefined.**	1
7.	(C)	**3** Here $y = (a+b)\log(x+c) - de^{x+k}$ can be written as $y = A\log(x+c) - de^{x}.\, e^{k}$ $\Rightarrow\ y = A\log(x+c) - Be^{x}$, where $a + b = A$ and $d.e^{k} = B$. Clearly the given differential equation has three arbitrary constants, so its order is 3	1
8.	(D)	$\boldsymbol{40(e^2 - e^1)}$ Increase in revenue $= \int_2^4 20e^{0.5x}dx = \frac{20\,e^{0.5x}}{0.5}\Big]_2^4 = 40\,(e^2 - e^1)$	1
9.	(C)	**Principal component increases and interest component decreases.**	1
10.	(B)	**8 %** $P = \frac{R}{i} \quad \Longrightarrow 40000 = \frac{3200}{i} \qquad \Longrightarrow i = 0.08$ $\Longrightarrow\ r = 0.08 = 8\,\%$	1
11.	(B)	$\boldsymbol{5e^{-5}}$ Mean rate per $100\ cm^2 = 2$ For $250\ cm^2$, mean $\lambda = \frac{2}{100} \times 250 = 5$ $P(X=1) = e^{-5} \times \frac{5^1}{1!} = 5e^{-5}$	1
12.	(D)	**Neither I nor II**	1
13.	(B)	**Y is more consistent than X** Variance measures spread/dispersion around mean. Lower Variance → More Consistent (as the values closer to mean) Higher Variance → Less Consistent (values more spread out) Since Y has lower variance, its values are more tightly clustered around the mean. So, Y is more consistent than X.	1
14.	(B)	**Minimum**	1
15.	(C)	**We are 99% confident that the calculated interval of (501.125, 508.875) grams contains the true mean weight $\boldsymbol{\mu}$.**	1
16.	(C)	$\boldsymbol{\frac{2}{3}}$ $2 \times 6_{C_4} \times p^4 \times q^2 = 3 \times 6_{C_3} \times p^3 \times q^3$ $\Longrightarrow 30\,p^4q^2 = 60\,p^3q^3$ $\Longrightarrow p = 2q$ $\Longrightarrow p = 2(1-p)$ $\therefore p = \frac{2}{3}$	1

17.	**(A)**	$\frac{1}{2}$ $\frac{P(X=r)}{P(X=n-r)} = \frac{{}^{n}C_{r}p^{r}q^{n-r}}{{}^{n}C_{n-r}p^{n-r}q^{r}} = \left(\frac{p}{q}\right)^{2r-n}$ which will be independent of n and r only when $\frac{p}{q} = 1$ i.e., $p = q = \frac{1}{2}$	**1**
18.	**(C)**	**A line segment**  The feasible region is the line segment $x + y = 5$.	**1**
19.	**(C)**	**Assertion (A) is true but Reason (R) is false.** $\lvert 2.\,adj\ (A)\rvert = 2^3\lvert adj(A)\rvert = 8\ \times 4^2 = 128$. So, Assertion is true, whereas Reason is false as $\lvert k\ A\rvert = k^n\ \lvert A\rvert$	**1**
20.	**(D)**	**Assertion (A) is false but Reason (R) is true.** Two distributions can have same mean but different variance. So, Assertion is false whereas Reason is true.	**1**

Section –B

[This section comprises of solution of very short answer type questions (VSA) of 2 marks each]

21(A).	As x is an odd integer so $x = 2n + 1$, where $n \in Z$ Now to show $x^2 \equiv 1(mod8)$ Consider, $(2n + 1)^2 = 4n^2 + 4n + 1 = 4n(n + 1) + 1 = 4(2m) + 1$ $\because$ product of two consecutive integers is always even $\Rightarrow x^2 = (2n + 1)^2 = 8m + 1 \equiv 1(mod8) \Rightarrow x^2 \equiv 1(mod8)$ $\because 8m + 1$ leaves remainder 1 when divided by 8.	**1** **1**
	OR	

21(B).	Given $(3)^{333} \equiv x\ (mod 11)$, to find x. We have, $3^5 \equiv 243\ (mod 11) \equiv 1\ (mod\ 11)$ $\Rightarrow 3^5 \equiv 1(mod 11) \quad \Rightarrow (3^5)^{66} \equiv 1^{66} mod 11 \equiv 1\ mod 11$ $\Rightarrow 3^{330} \equiv 1(mod 11) \quad \Rightarrow 3^{330} \times 3^3 \equiv 27(mod 11) \quad \Rightarrow 3^{333} \equiv 27(mod 11)$ $\Rightarrow 3^{333} \equiv 5(mod 11) \quad \therefore x = 5$	½ 1 ½
22.	Under linear depreciation, $D = \frac{C-S}{n}$ $\Longrightarrow D = \frac{120000-10000}{10}$ $\Longrightarrow D = \frac{110000}{10} = 11000$ The annual depreciation is ₹ 11000. By the end of 6 years the book value $= (C - 6D) = 120000 - 6(11000)$ $= ₹\ 54000$	½ ½ 1
23.	Distance covered upstream and downstream is 12 km each side. Let speed of man in still water be x km/h and speed of the stream is 4 km/h Then speed downstream $= (x + 4)$ km/h and speed upstream $= (x - 4)$ km/h According to question, $\frac{12}{x+4} + \frac{12}{x-4} = 4$ $\Longrightarrow \frac{1}{x+4} + \frac{1}{x-4} = \frac{1}{3} \quad \Longrightarrow \frac{x-4+x+4}{(x+4)(x-4)} = \frac{1}{3}$ $\Longrightarrow 6x = x^2 - 16 \quad \Longrightarrow x^2 - 6x - 16 = 0$ $\Longrightarrow (x - 8)(x + 2) = 0$ $\Longrightarrow x = 8$ or $x = -2$ but $x \neq -2 \quad \therefore x = 8$ km/h. Hence speed of man in still water is 8 km/h.	 ½ ½ ½ ½
24(A).	Given $P(X = 2) = P(X = 3)$ $\Longrightarrow e^{-m} \frac{m^2}{2!} = e^{-m} \frac{m^3}{3!}$ $\Longrightarrow 3m^2 = m^3$ $\therefore m = 3$ So, mean = variance = $m = 3$	 ½ 1 ½
	OR	
24 (B).	(i) Rate per 6 minutes $= 20 \times \frac{6}{60} = 2$ trains $\therefore m = 2$ (ii) Probability of exactly 2 trains $= (X = 2) = e^{-2} \frac{2^2}{2!}$ $= 2 \times 0.1353 = 0.2706$	½ ½ 1

25.	Equation of AB is $\frac{x}{6}+\frac{y}{6}=1$ i.e, $x+y=6$	½
	Equation of CD is $\frac{x}{8}+\frac{y}{4}=1$ i.e, $x+2y=8$	½
	Equation of EF is $\frac{x}{4}+\frac{y}{8}=1$ i.e, $2x+y=8$	½
	Constraints are: $x+y\le 6, x+2y\ge 8, 2x+y\ge 8$	½

Section –C

[This section comprises of solution of short answer type questions (SA) of 3 marks each]

26(A)	Given $S(t)=\frac{4t^2+1}{t}, t>0$	
	For finding intervals for increasing or decreasing let's find $S'(t)$.	
	$S(t)=\frac{4t^2+1}{t}=4t+\frac{1}{t}$	
	$\Rightarrow\ S'(t)=4-\frac{1}{t^2}=\frac{4t^2-1}{t^2}=\frac{(2t-1)(2t+1)}{t^2}$	**1**
	Now for decreasing: $S'(t)\le 0 \Rightarrow (2t-1)(2t+1)\le 0 \Rightarrow -\frac{1}{2}\le t\le \frac{1}{2}$	
	As $t>0$ $\therefore$ for $0<t\le\frac{1}{2}$, $S(t)$ is decreasing.	**1**
	⇒ for first half of the opening day, the price of the IPO decreased.	
	Now for increasing: $S'(t)\ge 0 \Rightarrow (2t-1)(2t+1)\ge 0$	
	$\Rightarrow t\le -\frac{1}{2}$ *and* $t\ge\frac{1}{2}$	
	As $t>0$ $\therefore$ for $t\ge\frac{1}{2}$, $S(t)$ is increasing.	**1**
	⇒ After the first half of the opening day, the price of the IPO kept increasing.	
	Hence, the stock price decreased for the first half of the opening day and then started increasing thereon.	
	OR	
26(B).	(i) $\frac{dP}{dt}=\frac{1}{2}(Q_d-Q_S)=\frac{1}{2}[(15-2P)-(3P-5)]=\frac{1}{2}(20-5P)$	
	$\Rightarrow \frac{dP}{dt}=\frac{1}{2}(20-5P)$	**1**
	(ii) Solving the differential equation by separating the variables	
	$\frac{dP}{20-5P}=\frac{1}{2}dt \Rightarrow \int\frac{1}{20-5P}dP=\frac{1}{2}\int dt+C$	½
	$\Rightarrow \frac{\log\|20-5P\|}{-5}=\frac{1}{2}t+C$	
	$\Rightarrow 2\log\|20-5P\|=-5t-10C$ (1)	½

	Now when $t = 0, P = 2$ $\Rightarrow 2\log\lvert 20-10\rvert = -10C \quad \Rightarrow -\frac{1}{5}\log 10 = C$ Using this in (1), we get $\quad 2\log\lvert 20-5P\rvert = -5t + 2\log 10$ $\Rightarrow 2\log\left(\frac{20-5P}{10}\right) = -5t \quad \Rightarrow \log\left(\frac{20-5P}{10}\right) = -2.5t \quad \Rightarrow \frac{20-5P}{10} = e^{-2.5t}$ $\Rightarrow 20-5P = 10e^{-2.5t} \quad \Rightarrow 20-10e^{-2.5t} = 5P$ $\Rightarrow P = 4-2e^{-2.5t} \quad \Rightarrow P = 2(2-e^{-2.5t})$	½ ½
27.	Converting the parameters to their quarterly values. Periods of interest (n) = 4 x 5 = 20, yield rate r = 6% so i = 6/400 = 0.015 Face value (F) = ₹1000 Annual coupon payment = 1000 x 4% = ₹40 Quarterly coupon payment = 40/4 = ₹10 Now redemption price = face value Purchase price of bond (P) = $C\left[\frac{1-(1+i)^{-n}}{i}\right] + R(1+i)^{-n} = 10\left[\frac{1-(1+0.015)^{-20}}{0.015}\right] + 1000(1+0.015)^{-20}$ $= 10\left[\frac{1-0.742}{0.015}\right] + 1000 \times 0.742$ $= 172 + 742 = ₹\,914$	½ ½ 1 1
28(A).	Let PV of the share is ₹ 100 then final value = 100 + 0.331 × 100 = ₹133.10 CAGR = $\left[\left(\frac{FV}{PV}\right)^{\frac{1}{n}} - 1\right] \times 100$ $\Longrightarrow 8.5 = \left[\left(\frac{133.10}{100}\right)^{\frac{1}{n}} - 1\right] \times 100 \quad \Longrightarrow 8.5 = \left[(1.331)^{\frac{1}{n}} - 1\right] \times 100$ $\Longrightarrow 1.085 = (1.331)^{\frac{1}{n}}$ $\Longrightarrow \log(1.085) = \frac{1}{n}\log(1.331) \qquad \Longrightarrow n = \frac{\log(1.331)}{\log(1.085)}$ $\Longrightarrow n = \frac{0.124}{0.035} = 3.5$ years (approx.) ∴ Required number of years = 3.5 years (approx.)	½ ½ 1 1
	OR	

28(B).	Capital requirement after n years = ₹ $45{,}000{,}000$ Annual payment into the sinking fund = ₹ $5{,}00{,}000$ $r = 15\% \implies i = 0.15$ Now sinking fund $S = P \times \frac{(1+i)^n - 1}{i}$ $\implies 45000000 = 500000 \times \frac{(1+0.15)^n - 1}{0.15}$ $\implies 90 \times 0.15 = [(1.15)^n - 1] \implies 13.50 = (1.15)^n - 1 \implies (1.15)^n = 14.5$ Applying log on both sides we get $n \log(1.15) = \log(14.5)$ $\implies n = \frac{\log(14.5)}{\log(1.15)} = \frac{1.161}{0.061} = 19.03$ years (approx.) So, the required number of years $= 19.03$ years (approx.)	½ ½ 1 1
29.	$A = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$ $A^2 = \begin{bmatrix} 5 & 4 \\ 4 & 5 \end{bmatrix}$ $A^3 = \begin{bmatrix} 13 & 14 \\ 14 & 13 \end{bmatrix}$ $\implies A^3 - 7A - 6\,I = \begin{bmatrix} 13 & 14 \\ 14 & 13 \end{bmatrix} - \begin{bmatrix} 7 & 14 \\ 14 & 7 \end{bmatrix} - \begin{bmatrix} 6 & 0 \\ 0 & 6 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ = O Now, $A^{-1} = \frac{1}{6}(A^2 - 7I) = \frac{1}{6}\left(\begin{bmatrix} 5 & 4 \\ 4 & 5 \end{bmatrix} - \begin{bmatrix} 7 & 0 \\ 0 & 7 \end{bmatrix}\right) = \frac{1}{6}\begin{bmatrix} -2 & 4 \\ 4 & -2 \end{bmatrix} = \begin{bmatrix} -1/3 & 2/3 \\ 2/3 & -1/3 \end{bmatrix}$	½ ½ 1 1
30.	Mean $(\mu) = 30$, standard deviation $(\sigma) = 6.25$ (i) For $X = 20, Z = \frac{20-30}{6.25} = -1.6$ For $X = 40, Z = \frac{40-30}{6.25} = 1.6$ $P(20 < X < 40) = P(-1.6 < Z < 1.6) = 2\,P(0 \le Z < 1.6)$ $= 2 \times 0.4452 = 0.8904$ ∴ Number of students = $2000 \times 0.8904 = 1780.8 \approx 1781$ students (ii) For $X = 25, Z = \frac{25-30}{6.25} = -0.8$ $P(X < 25) = P(Z < -0.8) = 0.5 - P(0 \le Z \le 0.8)$ $= 0.5 - 0.2881 = 0.2119$ ∴ Number of students = $2000 \times 0.2119 = 423.8 \approx 424$ students	1 ½ 1 ½
31.	$\bar{x} = 2080,\ \mu = 2200$ $n = 25, s = 280$ H_0: Null hypothesis : There is no significant difference between $\bar{x}$ and μ H_1: Alternate hypothesis : There is a significant difference between $\bar{x}$ and μ	½ ½

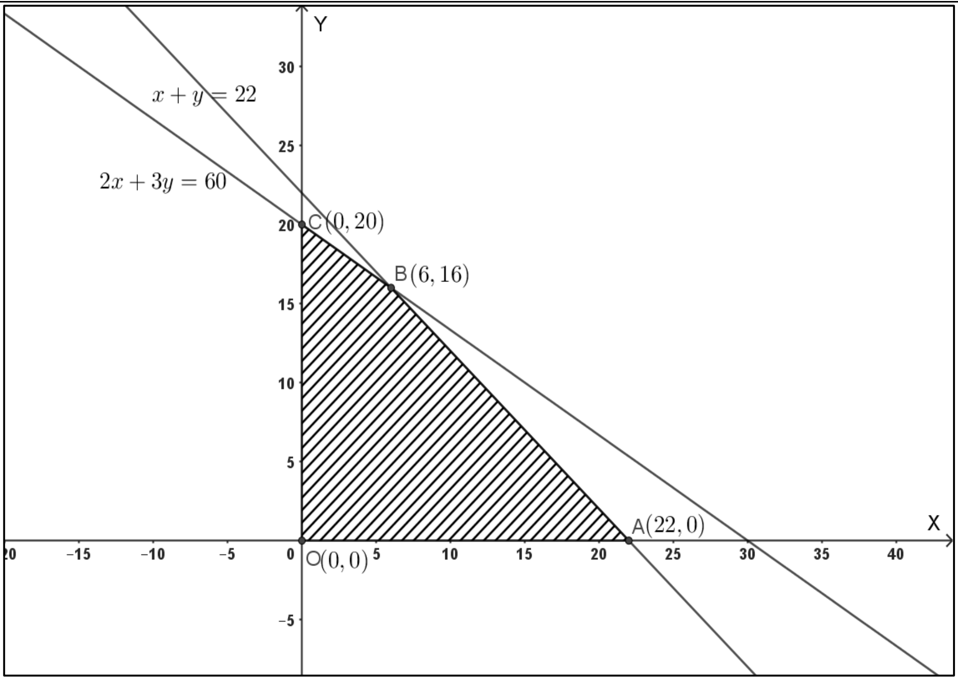
	$t = \frac{\bar{x}-\mu}{\frac{s}{\sqrt{n}}} = \frac{2080-2200}{\frac{280}{\sqrt{25}}} = -2.143$	**1**
	df $= 24$ and $t_{24}(0.025) = 2.064$	
	Since $\lvert t \rvert = 2.143 > 2.064$	**½**
	∴ Null hypothesis is rejected. So, nutritionist's claim is not valid.	**½**

Section –D

[This section comprises of solution of long answer type questions (LA) of 5 marks each]

32.	First, we use the demand function to calculate the revenue function	
	$p = 274 - x^2$	
	$R(x) = xp = x(274 - x^2) = 274x - x^3$ (1)	
	Marginal Revenue $(MR) = R'(x) = 274 - 3x^2$ (2)	**½**
	Marginal Cost $(MC) = 4 + 3x$ (given)	
	Let P be the profit	
	To calculate value of x for which P is maximum	
	Now,	
	$\frac{dP}{dx} = R'(x) - C'(x) = MR - MC = 274 - 3x^2 - 4 - 3x$ using (1) and (2)	
	$= 270 - 3x - 3x^2$	**1**
	For maximum profit, $\frac{dP}{dx} = 0$	
	$\Rightarrow 3(90 - x - x^2) = 0 \Rightarrow x = 9, -10$	
	but $x \neq -10$ so $x = 9$	**1**
	$\because \frac{d^2P}{dx^2} = 0 - 3 - 6x < 0$ at $x = 9$ $\therefore P$ is maximum at $x = 9$	
	When $x_0 = 9$ then $p_0 = 274 - 9^2 = 193$	**½**
	To find consumer surplus	
	C.S. $= \int_0^{x_0} p\, dx - x_0 p_0$	
	$= \int_0^9 [274 - x^2] dx - 9 \times 193$	**1**
	$= \left(274x - \frac{x^3}{3}\right)_0^9 - 1737 = 2223 - 1737 = ₹\,486$	**1**
33(A).	Let x, y and z respectively be the number of units of Cotton, Silk, and Wool that can be produced. For unit U_1, $\frac{x}{20} + \frac{y}{40} + \frac{z}{20} = 20$ i.e, $2x + y + 2z = 800$ For unit U_2, $\frac{x}{25} + \frac{y}{50} + \frac{z}{50} = 12$ i.e, $2x + y + z = 600$ For unit U_3, $\frac{x}{20} + \frac{y}{20} + \frac{z}{40} = 19$ i.e, $2x + 2y + z = 760$	**1½**

	Now, $D = \begin{vmatrix} 2 & 1 & 2 \\ 2 & 1 & 1 \\ 2 & 2 & 1 \end{vmatrix} = 2(1-2) - 1(2-2) + 2(4-2) = 2 \neq 0$ $D_x = \begin{vmatrix} 800 & 1 & 2 \\ 600 & 1 & 1 \\ 760 & 2 & 1 \end{vmatrix} = 800(1-2) - 1(600-760) + 2(1200-760) = 240$ $D_y = \begin{vmatrix} 2 & 800 & 2 \\ 2 & 600 & 1 \\ 2 & 760 & 1 \end{vmatrix} = 2(600-760) - 800(2-2) + 2(1520-1200) = 320$ $D_z = \begin{vmatrix} 2 & 1 & 800 \\ 2 & 1 & 600 \\ 2 & 2 & 760 \end{vmatrix} = 2(760-1200) - 1(1520-1200) + 800(4-2) = 400$ $\therefore x = \frac{D_x}{D} = 120, y = \frac{D_y}{D} = 160$ and $z = \frac{D_z}{D} = 200$ Hence, the firm can produce 120 units of Cotton, 160 units of Silk, and 200 units of Wool with the available time fully used.	½ ½ ½ ½ 1/2 1
	OR	
33(B).	$\mathrm{P} = \mathrm{E}^{-1}.\mathrm{C}$, where $\mathrm{E} = \begin{bmatrix} 2 & 1 & 1 \\ 1 & 0 & 1 \\ 0 & 2 & 1 \end{bmatrix}, \mathrm{C} = \begin{bmatrix} 52 \\ 36 \\ 35 \end{bmatrix}$ and let $\mathrm{P} = \begin{bmatrix} \mathrm{x} \\ \mathrm{y} \\ \mathrm{z} \end{bmatrix}$ $\lvert\mathrm{E}\rvert = 2(0-2) - 1(1-0) + 1(2-0) = -3 \neq 0 \;\therefore \mathrm{E}^{-1}$ exists $\mathrm{E}^{-1} = \frac{1}{\lvert\mathrm{E}\rvert}\begin{bmatrix} -2 & 1 & 1 \\ -1 & 2 & -1 \\ 2 & -4 & -1 \end{bmatrix} = \frac{1}{-3}\begin{bmatrix} -2 & 1 & 1 \\ -1 & 2 & -1 \\ 2 & -4 & -1 \end{bmatrix}$ $\Rightarrow \mathrm{P} = \begin{bmatrix} \mathrm{x} \\ \mathrm{y} \\ \mathrm{z} \end{bmatrix} = \frac{1}{-3}\begin{bmatrix} -2 & 1 & 1 \\ -1 & 2 & -1 \\ 2 & -4 & -1 \end{bmatrix}\begin{bmatrix} 52 \\ 36 \\ 35 \end{bmatrix} = \frac{1}{-3}\begin{bmatrix} -33 \\ -15 \\ -75 \end{bmatrix}$ $\Rightarrow \mathrm{x} = 11, \mathrm{y} = 5, \mathrm{z} = 25$ Now, $11 \rightarrow \mathrm{K}, 5 \rightarrow \mathrm{E}, 25 \rightarrow \mathrm{Y}$ So, the secret code word is ‘KEY’	½ ½ 1 1 1½ ½
34.	Let the number of local and hybrid goats be x and y respectively. Profit on a local goat = ₹ $(190 - 60)$ = ₹ 130 Profit on a hybrid goat = ₹ $(250 - 60)$ = ₹ 190 So, the LPP is Maximize $Z = 130x + 190y$ subject to $400x + 600y \leq 12000$ or $2x + 3y \leq 60$ $x + y \leq 22$ $x \geq 0, y \geq 0$	½ 1½



2 for correct graph

Corner Points	Value of Z
O (0,0)	0
A (22,0)	2860
B (0,20)	3800
C (6, 16)	3820 → Maximum value

1 for correct table

Hence the maximum weekly profit of ₹ 3,820 is obtained when the farmer buys 6 local goats and 16 hybrid goats.

35(A).

Year	Production	4 yearly moving total	4 yearly moving Average	Centered Total	Centered moving average
2015	86				
2016	92				
		376	94		
2017	98			192.25	96.125
		393	98.25		
2018	100			200.5	100.25
		409	102.25		
2019	103			207.25	103.625

4 yearly moving total → 1 mark

4 yearly moving average → 1½ marks

		420	105		
2020	108			211.75	105.875
		427	106.75		
2021	109			215.25	107.625
		434	108.5		
2022	107				
2023	110				

centered total → 1 mark

centered moving average → 1½ marks

OR

35(B). (i)

Year (x_i)	Volume in crores (Y)	$X = \frac{x_i - A}{0.5} = \frac{x_i - 2020.5}{0.5}$	X^2	XY
2018	2071	-5	25	-10355
2019	3134	-3	9	-9402
2020	4572	-1	1	-4572
2021	5554	1	1	5554
2022	8839	3	9	26517
2023	13462	5	25	67310
$n = 6$	$\sum Y = 37632$	$\sum X = 0$	$\sum X^2 = 70$	$\sum XY = 75052$

2½ for correct table

$a = \frac{\sum Y}{n} = \frac{37632}{6} = 6272$ **½**

$b = \frac{\sum XY}{\sum X^2} = \frac{75052}{70} = 1072.17$ (approx.) **½**

Required line is $Y = a + bX = 6272 + 1072.17\,X$ **½**

(ii) Estimate trend Value for 2025 $= 6272 + 1072.17 \times 9 = 15921.53$ crores **1**

Section –E

[This section comprises solution of 3 case- study/passage-based questions of 4 marks]

<table>
<tr><td>36.</td><td>
(i) Part of tank filled by pipe A and C in 1 hour = $\frac{1}{12} + \frac{1}{20} = \frac{2}{15}$
(ii) Part of tank filled by pipe A and B in 1 hour = $\frac{1}{12} + \frac{1}{15} = \frac{3}{20}$
(iii) (A) Tap A always remains open and tap B and C are open alternatively for 1 hour
So, Part of tank filled in 2 hours = $\frac{1}{12} + \frac{1}{15} + \frac{1}{12} + \frac{1}{20}$
$= \frac{2}{12} + \frac{1}{15} + \frac{1}{20} = \frac{17}{60}$
Now, part of tank filled after three full cycles (6 hours)
$= 3 \times \frac{17}{60} = \frac{17}{20}$
OR
(iii) (B) Part of tank filled in 2 hours = $\frac{1}{12} + \frac{1}{15} + \frac{1}{12} + \frac{1}{20}$
$= \frac{2}{12} + \frac{1}{15} + \frac{1}{20} = \frac{17}{60}$
Now, part of tank filled after three full cycles (6 hours) = $3 \times \frac{17}{60} = \frac{17}{20}$
Part of tank left to be filled = $1 - \frac{17}{20} = \frac{3}{20}$
In the 7th hour, tank filled by pipes A and B = $\frac{1}{12} + \frac{1}{15} = \frac{3}{20}$
which is same as the part of unfilled tank, so the tank will be filled completely at the end of 7th hour.
So, the part of unfilled tank at the end of 7 hours is 0.
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1

1

1

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<tr><td>37.</td><td>
(i) Total cost: $TC(x) = 80 + 2x + (0.08x)x$
$= 80 + 2x + 0.08x^2$
(ii) Average Cost: $AC(x) = \frac{\text{Total cost}}{x} = \frac{80}{x} + 2 + 0.08x$
(iii) (A) To minimize average cost, we differentiate $AC(x)$
$AC(x) = \frac{80}{x} + 2 + 0.08x$
$AC'(x) = \frac{-80}{x^2} + 0 + 0.08 = \frac{0.08x^2 - 80}{x^2}$
For minima $AC'(x) = 0$ and $AC''(x) > 0$
Now $AC'(x) = 0$
$\Rightarrow \frac{0.08x^2 - 80}{x^2} = 0 \Rightarrow x^2 - 1000 = 0 \Rightarrow x = \pm 10\sqrt{10}$
Since $x \neq -10\sqrt{10}$ $\therefore x = 10\sqrt{10}$ $\Rightarrow x = 10(3.2) = 32$
$AC''(x) = \frac{160}{x^3} > 0$, for all $x > 0$
So, for minimum average cost per floor 32 floors should be built.
OR
</td><td>
1
1

½

½
½
½
</td></tr>
</table>

	(iii) (B) For finding interval for strictly decreasing value of average cost we differentiate $AC(x)$ $AC(x) = \frac{80}{x} + 2 + 0.08\,x$ $AC'(x) = \frac{-80}{x^2} + 0 + 0.08 = \frac{0.08\,x^2 - 80}{x^2}$ For decreasing $AC'(x) \leq 0$ $\Rightarrow \frac{0.08\,x^2 - 80}{x^2} \leq 0 \Rightarrow x^2 - 1000 \leq 0$ as $x^2 > 0$ for all x. $\Rightarrow (x - 10\sqrt{10})(x + 10\sqrt{10}) \leq 0 \Rightarrow -10\sqrt{10} \leq x \leq 10\sqrt{10}$ Since $x > 0$ as number of floors can't be negative. $\therefore 0 < x \leq 10\sqrt{10} \Rightarrow 0 < x \leq 32$ So, for integral values of floors, the average cost decreases till the building of 32 floors.	½ ½ ½ ½
38.	Loan amount $= P = ₹\,(15{,}00{,}000 - 4{,}00{,}000) = ₹\,11{,}00{,}000$ $i = \frac{9}{12 \times 100} = 0.0075$, $n = 10 \times 12 = 120$ (i) under flat rate EMI = $P\left(i + \frac{1}{n}\right) = 1100000\left(0.0075 + \frac{1}{120}\right)$ $= 1100000(0.0075 + 0.0083) = 1100000 \times 0.0158 = ₹\,17{,}380$ (ii) EMI $= \frac{P \times i \times (1+i)^n}{(1+i)^n - 1}$ $= \frac{1100000 \times 0.0075 \times (1+0.0075)^{120}}{(1+0.0075)^{120} - 1}$ $= \frac{1100000 \times 0.0075 \times 2.451}{2.451 - 1} = 1100000 \times 0.0075 \times 1.69 = ₹\,13{,}942.50$	½ ½ 1 1 1