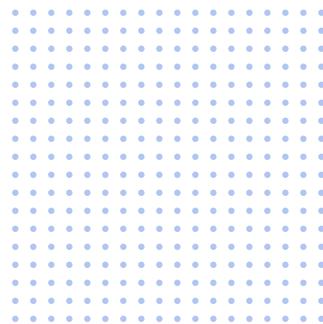




FOR CBSE CLASS 12 PREPARATION

CBSE Class 12 Sample Paper 2027 Solution (Marking Scheme) for Applied Maths

EXAM

CBSE Class 12

YEAR

2027

TYPE

Solutions

SUBJECT

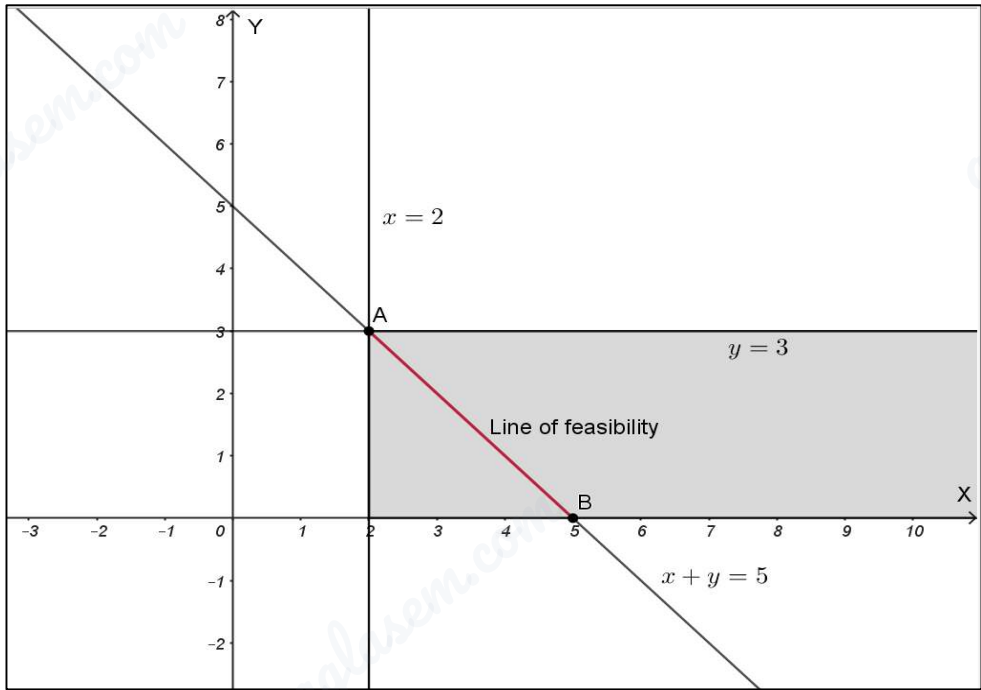
Maths

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)	$a + c < b + c$ 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)	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): $\frac{5}{5+4} = \frac{5}{9}$ $\text{Required ratio} = \frac{\frac{5}{6} - \frac{5}{9}}{\frac{5}{9} - \frac{4}{9}} = \frac{5}{18} : \frac{1}{9} = 5 : 2$	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. $\therefore$ 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, $\frac{S_A}{S_C} = \frac{S_A}{S_B} \times \frac{S_B}{S_C}$ $\Rightarrow \frac{d}{d - 90} = \frac{d}{d - 45} \times \frac{d}{d - 50}$ $\Rightarrow (d - 45)(d - 50) = d(d - 90) \Rightarrow d^2 - 95d + 2250 = d^2 - 90d$ $\Rightarrow 5d = 2250 \Rightarrow d = 450 \text{ km}$	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)	<p>3</p> <p>Here $y = (a + b)\log(x + c) - de^{x+k}$ can be written as $y = A \log(x + c) - de^x \cdot e^k$</p> <p>$\Rightarrow y = A \log(x + c) - Be^x$, where $a + b = A$ and $d \cdot e^k = B$.</p> <p>Clearly the given differential equation has three arbitrary constants, so its order is 3</p>	1
8.	(D)	<p>$40(e^2 - e^1)$</p> <p>Increase in revenue $= \int_2^4 20e^{0.5x} dx = \left[\frac{20 e^{0.5x}}{0.5} \right]_2^4 = 40 (e^2 - e^1)$</p>	1
9.	(C)	Principal component increases and interest component decreases.	1
10.	(B)	<p>8 %</p> <p>$P = \frac{R}{i} \Rightarrow 40000 = \frac{3200}{i} \Rightarrow i = 0.08$</p> <p>$\Rightarrow r = 0.08 = 8 \%$</p>	1
11.	(B)	<p>$5e^{-5}$</p> <p>Mean rate per $100 \text{ cm}^2 = 2$</p> <p>For 250 cm^2, mean $\lambda = \frac{2}{100} \times 250 = 5$</p> <p>$P(X = 1) = e^{-5} \times \frac{5^1}{1!} = 5e^{-5}$</p>	1
12.	(D)	Neither I nor II	1
13.	(B)	<p>Y is more consistent than X</p> <p>Variance measures spread/dispersion around mean.</p> <p>Lower Variance $\rightarrow$ More Consistent (as the values closer to mean)</p> <p>Higher Variance $\rightarrow$ Less Consistent (values more spread out)</p> <p>Since Y has lower variance, its values are more tightly clustered around the mean.</p> <p>So, Y is more consistent than X.</p>	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 μ .	1
16.	(C)	<p>$\frac{2}{3}$</p> <p>$2 \times 6_{C_4} \times p^4 \times q^2 = 3 \times 6_{C_3} \times p^3 \times q^3$</p> <p>$\Rightarrow 30 p^4 q^2 = 60 p^3 q^3$</p> <p>$\Rightarrow p = 2q$</p> <p>$\Rightarrow p = 2(1 - p)$</p> <p>$\therefore p = \frac{2}{3}$</p>	1

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

Section -B

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

21(A).	<p>As x is an odd integer so $x = 2n + 1$, where $n \in \mathbb{Z}$</p> <p>Now to show $x^2 \equiv 1 \pmod{8}$</p> <p>Consider, $(2n + 1)^2 = 4n^2 + 4n + 1 = 4n(n + 1) + 1 = 4(2m) + 1$</p> <p>$\therefore$ product of two consecutive integers is always even</p> <p>$\Rightarrow x^2 = (2n + 1)^2 = 8m + 1 \equiv 1 \pmod{8} \Rightarrow x^2 \equiv 1 \pmod{8}$</p> <p>$\therefore 8m + 1$ leaves remainder 1 when divided by 8.</p>	1 1
	OR	

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

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

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
	<p>Now for decreasing: $S'(t) \leq 0 \Rightarrow (2t-1)(2t+1) \leq 0 \Rightarrow -\frac{1}{2} \leq t \leq \frac{1}{2}$</p> <p>As $t > 0 \therefore$ for $0 < t \leq \frac{1}{2}$, $S(t)$ is decreasing.</p> <p>$\Rightarrow$ for first half of the opening day, the price of the IPO decreased.</p> <p>Now for increasing: $S'(t) \geq 0 \Rightarrow (2t-1)(2t+1) \geq 0$</p> $\Rightarrow t \leq -\frac{1}{2} \text{ and } t \geq \frac{1}{2}$ <p>As $t > 0 \therefore$ for $t \geq \frac{1}{2}$, $S(t)$ is increasing.</p> <p>$\Rightarrow$ After the first half of the opening day, the price of the IPO kept increasing.</p> <p>Hence, the stock price decreased for the first half of the opening day and then started increasing thereon.</p>	1
	OR	
26(B).	<p>(i) $\frac{dP}{dt} = \frac{1}{2}(Q_d - Q_s) = \frac{1}{2}[(15 - 2P) - (3P - 5)] = \frac{1}{2}(20 - 5P)$</p> $\Rightarrow \frac{dP}{dt} = \frac{1}{2}(20 - 5P)$	1
	<p>(ii) Solving the differential equation by separating the variables</p> $\frac{dP}{20-5P} = \frac{1}{2}dt \Rightarrow \int \frac{1}{20-5P} dP = \frac{1}{2} \int dt + C$	1/2
	$\Rightarrow \frac{\log 20-5P }{-5} = \frac{1}{2}t + C$	
	$\Rightarrow 2 \log 20 - 5P = -5t - 10C \quad (1)$	1/2

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

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

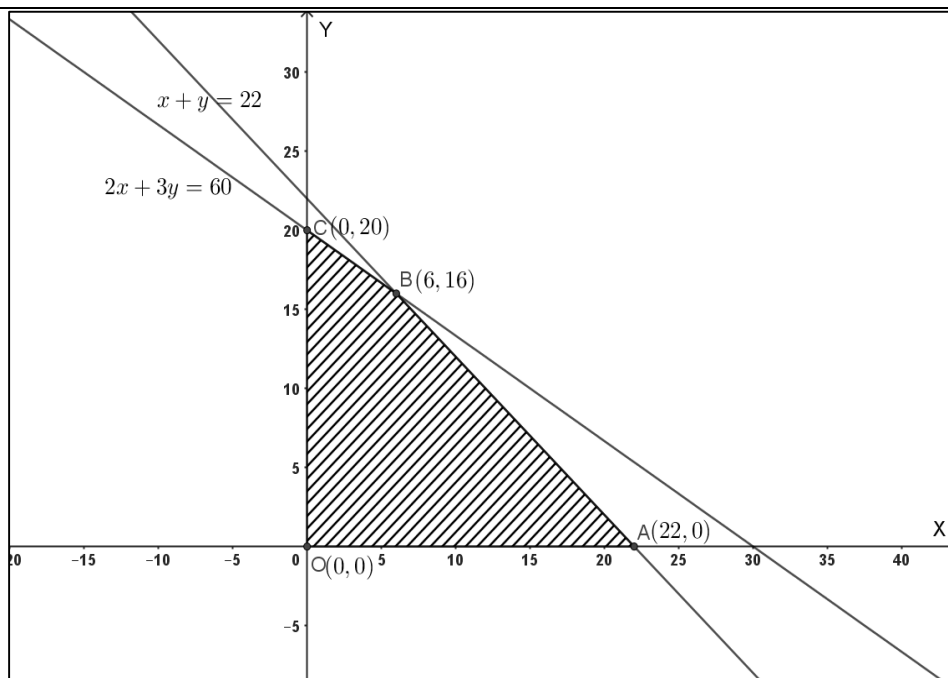
	$t = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}} = \frac{2080 - 2200}{\frac{280}{\sqrt{25}}} = -2.143$ <p>df = 24 and $t_{24}(0.025) = 2.064$</p> <p>Since $t = 2.143 > 2.064$</p> <p>$\therefore$ Null hypothesis is rejected.</p> <p>So, nutritionist's claim is not valid.</p>	<p>1</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p>
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Section –D

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

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

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



**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			centered total → 1 mark centered moving average → 1½ marks																																								
	2020	108			211.75	105.875																																									
			427	106.75																																											
	2021	109			215.25	107.625																																									
			434	108.5																																											
	2022	107																																													
	2023	110																																													
	OR																																														
35(B).	(i)																																														
	<table><tr><td>Year (x_i)</td><td>Volume in crores (Y)</td><td>$X = \frac{x_i - A}{0.5}$ $= \frac{x_i - 2020.5}{0.5}$</td><td>$X^2$</td><td>$XY$</td></tr><tr><td>2018</td><td>2071</td><td>−5</td><td>25</td><td>−10355</td></tr><tr><td>2019</td><td>3134</td><td>−3</td><td>9</td><td>−9402</td></tr><tr><td>2020</td><td>4572</td><td>−1</td><td>1</td><td>−4572</td></tr><tr><td>2021</td><td>5554</td><td>1</td><td>1</td><td>5554</td></tr><tr><td>2022</td><td>8839</td><td>3</td><td>9</td><td>26517</td></tr><tr><td>2023</td><td>13462</td><td>5</td><td>25</td><td>67310</td></tr><tr><td>$n = 6$</td><td>$\sum Y$ = 37632</td><td>$\sum X = 0$</td><td>$\sum X^2 = 70$</td><td>$\sum XY$ = 75052</td></tr></table>						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
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	$a = \frac{\sum Y}{n} = \frac{37632}{6} = 6272$				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]**

36.	<p>(i) Part of tank filled by pipe A and C in 1 hour = $\frac{1}{12} + \frac{1}{20} = \frac{2}{15}$</p> <p>(ii) Part of tank filled by pipe A and B in 1 hour = $\frac{1}{12} + \frac{1}{15} = \frac{3}{20}$</p> <p>(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 = $\frac{1}{12} + \frac{1}{15} + \frac{1}{12} + \frac{1}{20}$ $= \frac{2}{12} + \frac{1}{15} + \frac{1}{20} = \frac{17}{60}$</p> <p>Now, part of tank filled after three full cycles (6 hours) $= 3 \times \frac{17}{60} = \frac{17}{20}$</p> <p style="text-align: center;">OR</p> <p>(iii) (B) Part of tank filled in 2 hours = $\frac{1}{12} + \frac{1}{15} + \frac{1}{12} + \frac{1}{20}$ $= \frac{2}{12} + \frac{1}{15} + \frac{1}{20} = \frac{17}{60}$</p> <p>Now, part of tank filled after three full cycles (6 hours) = $3 \times \frac{17}{60} = \frac{17}{20}$</p> <p>Part of tank left to be filled = $1 - \frac{17}{20} = \frac{3}{20}$</p> <p>In the 7th hour, tank filled by pipes A and B = $\frac{1}{12} + \frac{1}{15} = \frac{3}{20}$</p> <p>which is same as the part of unfilled tank, so the tank will be filled completely at the end of 7th hour.</p> <p>So, the part of unfilled tank at the end of 7 hours is 0.</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1/2</p> <p>1/2</p> <p>1/2</p> <p>1/2</p>
37.	<p>(i) Total cost: $TC(x) = 80 + 2x + (0.08x)x$ $= 80 + 2x + 0.08x^2$</p> <p>(ii) Average Cost: $AC(x) = \frac{\text{Total cost}}{x} = \frac{80}{x} + 2 + 0.08x$</p> <p>(iii) (A) To minimize average cost, we differentiate $AC(x)$ $AC(x) = \frac{80}{x} + 2 + 0.08x$ $AC'(x) = \frac{-80}{x^2} + 0 + 0.08 = \frac{0.08x^2 - 80}{x^2}$ <p>For minima $AC'(x) = 0$ and $AC''(x) > 0$ Now $AC'(x) = 0$ $\Rightarrow \frac{0.08x^2 - 80}{x^2} = 0 \Rightarrow x^2 - 1000 = 0 \Rightarrow x = \pm 10\sqrt{10}$ <p>Since $x \neq -10\sqrt{10} \therefore x = 10\sqrt{10} \Rightarrow x = 10(3.2) = 32$ $AC''(x) = \frac{160}{x^3} > 0, \text{ for all } x > 0$ <p>So, for minimum average cost per floor 32 floors should be built.</p> <p style="text-align: center;">OR</p> </p> </p></p>	<p>1</p> <p>1</p> <p>1/2</p> <p>1/2</p> <p>1/2</p>

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