Class-12 APPLIED MATHS

Model 2 M.S. (2023-24)

1. a
2. b.
3. c
4. c
5. a
6. d
7. b
8. c
9. b
10. b
11. c
12. b
13. a
14. b
15. c
16. b
17. c
18. c
19. a
20. a

21. $I = \int \frac{2}{(x+1)x^2} dx$

$= \int \left(\frac{2}{x+1} + \frac{-2}{x} + \frac{2}{x^2} \right)$

$= 2\log|x+1| - 2\log|x|$

$+2 \frac{x^{-2+1}}{-2+1} + c$

$= 2\log\left|\frac{x+1}{x}\right| - \frac{2}{x} + c$

OR $I = \int_{-1}^{1} -(x-1)dx$

$+ \int_{1}^{3} (x-1)dx$

$+ \int_{-1}^{2} -(x-2)dx$

$+ \int_{2}^{3} (x-2)dx$

$= 0 + 2 + 4\frac{1}{2} + \frac{1}{2}$

$= 7$

22. $P = R + \frac{R}{i} = 3120\left(1 + \frac{1}{0.06}\right)$

$= 3120 + 52000$

$= 55120$

23. $\int \frac{1}{\sqrt{4+y^2}} dy = -\int x \log x \, dx$

$\log|y + \sqrt{y^2+4}|$
$= c + -\frac{x^2}{2}\log x - \frac{x^2}{4}$

$\log 2 = c - \frac{1}{4}$; $c = \frac{1}{4}\log 2$

$\log|y + \sqrt{y^2+4}| = \frac{1}{4}\log 2 - \frac{x^2}{2}\log x - \frac{x^2}{4}$

24. ₹10 interest on ₹90 for $\frac{1}{2}$ yr

$i = \frac{1}{9}$ half yearly.

$\therefore i = \frac{2}{9}$ c.p.a. ; $m = 2$

$r_e = \left(1 + \frac{1}{9}\right)^2 - 1 = \left(\frac{10}{9}\right)^2 - 1$

$= \frac{19}{81} = 23.45\%$ per annum

OR

$CAGR = \left[\left(\frac{550000}{300000}\right)^{\frac{1}{3}} - 1\right] \times 100$

$= \left[(1.833)^{1/3} - 1\right] \times 100$

$= (1.2239 - 1) \times 100$

$= 22.39\%$

25.

	P	Q	
C	$12x$	$3y$	≥ 240
Fe	$4x$	$20y$	≥ 460
Ch	$6x$	$4y$	≤ 300
A	$6x$	$3y$	

OF is $6x + 3y = Z$

Subject to the constraint $12x + 3y \geq 240$
$4x + 20y \geq 460$
$6x + 4y \leq 300$
$x, y \geq 0$

26. $\frac{n}{12} + \frac{n}{15} - \frac{n-6}{20} = 1$

$6n + 18 = 60$

$n = 7$ min

27. $P = \begin{array}{c c} & \begin{array}{ccc} M & W & C \end{array} \\ \begin{array}{c} A \\ B \end{array} & \begin{bmatrix} 4 & 4 & 4 \\ 2 & 2 & 2 \end{bmatrix} \end{array}$

$Q = \begin{array}{c c} & \begin{array}{cc} Cal & Prot \end{array} \\ \begin{array}{c} M \\ W \\ C \end{array} & \begin{bmatrix} 2400 & 45 \\ 1900 & 55 \\ 1800 & 33 \end{bmatrix} \end{array}$

$PQ = \begin{bmatrix} 4 & 4 & 4 \\ 2 & 2 & 2 \end{bmatrix} \begin{bmatrix} 2400 & 45 \\ 1900 & 55 \\ 1800 & 33 \end{bmatrix}$

$= \begin{bmatrix} 9600 + 7600 + 7200 & 180 + 220 + 132 \\ 4800 + 3800 + 3600 & 90 + 110 + 66 \end{bmatrix}$

$= \begin{array}{c c} & \begin{array}{cc} Cal & Prot \end{array} \\ \begin{array}{c} A \\ B \end{array} & \begin{bmatrix} 24400 & 532 \\ 12200 & 266 \end{bmatrix} \end{array}$

OR

Mark-A $18p_A - p_B = 87$

Mark-B $2p_A - 36p_B = -98$

$D = \begin{vmatrix} 18 & -1 \\ 2 & -36 \end{vmatrix}$; $D_{p_A} = \begin{vmatrix} 87 & -1 \\ -98 & -36 \end{vmatrix}$

$D_{p_B} = \begin{vmatrix} 18 & 87 \\ 2 & -98 \end{vmatrix}$

$D = -646 \neq 0$

$p_A = \frac{-3230}{-646} = 5$

$p_B = \frac{-1938}{-646} = 3$

28. $\frac{dP}{dt} \propto P \Rightarrow \frac{dP}{P} = k\,dt$

$\Rightarrow \log P = \lambda t + \cancel{\log} c$ ①

When

$\log 200000 = 1990\lambda + c$ ②

$\log 250000 = 2000\lambda + c$ ③

$10\lambda = \log\left(\frac{200000}{250000}\right) = \frac{1}{10}\log\frac{4}{5}$

using λ in ②

$c = \log 200000 - 199\log\frac{4}{5}$

using λ, c and $t = 2010$ in ①

we get

$P = \left(\frac{4}{5}\right)^{201} \times 200000 \times \left(\frac{5}{4}\right)^{199}$

$P = \frac{25}{16} \times 200000 = 312500$

29. $n=10,\ p=\frac{1}{2},\ q=\frac{1}{2}$

$P(X\le 3)=P(X=0)+P(X=1)+P(X=2)+P(X=3)$

$={}^{10}C_0\left(\frac{1}{2}\right)^{10}+{}^{10}C_1\left(\frac{1}{2}\right)^1\left(\frac{1}{2}\right)^9+\text{----}+{}^{10}C_3\left(\frac{1}{2}\right)^3\left(\frac{1}{2}\right)^7$

$=\left(\frac{1}{2}\right)^{10}\left[{}^{10}C_0+{}^{10}C_1+{}^{10}C_2+{}^{10}C_3\right]$

$=\left(\frac{1}{2}\right)^{10}\left[1+10+45+120\right]=\frac{176}{2^{10}}$

$N=100\times\frac{176}{2^{10}}=\frac{17600}{1024}$

$\simeq 17$

OR

$p=0.01125,\ n=12$

$\lambda=np=0.135$

$P(X=r)=\frac{(0.135)^r}{r!}e^{-0.135}$

where X is number of men aged 50yrs who will die within a year.

Req. probability

$=P(\text{atmost 1 man die within a year})$

$=P(X\le 1)$

$=e^{-0.135}+0.135\times e^{-0.135}$

$=1.135\times e^{-0.135}$

$=0.99166$

30. $H_0:\ \mu=1.84$

$H_1:\ \mu\ne 1.84$

$t_{cal}=\frac{\bar{x}-\mu}{\frac{s}{\sqrt{n}}}=\frac{1.85-1.84}{\frac{0.08}{\sqrt{16}}}$

$=0.5$

$t_{cal}<t_{crit}=2.131$

$\therefore H_0$ is accepted

There is no significant difference b/w sample mean and population mean.

Hence machine is working accurately.

31.

$S=100,000;\ n=10\times 2=20$

$i=\frac{5}{200}=0.025$

$R=\frac{0.025\times 10^5}{(1.025)^{20}-1}=\frac{2500}{0.6346}$

$=3,914.81$

32. $P=R-C$

$\frac{dP}{dx}=\frac{dR}{dx}-\frac{dC}{dx}=MR-MC$

$=-81+36x-3x^2$

$\frac{d^2P}{dx^2}=36-6x$

now $\frac{dP}{dx}=0\Rightarrow x=3,9$

$\frac{d^2P}{dx^2}<0$ at $x=9$

$\therefore x=9$

now $\frac{dP}{dx}=-81+36x-3x^2$

$P=-81x+18x^2-x^3+K$

when $x=0$; $P=0$

$K=0$

$\Rightarrow P=-81x+18x^2-x^3$

$\Rightarrow$ at $x=9$

$P=0.$

OR

(i) $D(x)=S(x)$

$x^2-6x+16=\frac{1}{3}x^2+\frac{4}{3}x+4$

$\Rightarrow x^2-11x+18=0$

$\Rightarrow x=2$ or 9 but $x=2$ as $x\le 5$

(ii) $CS=\int_0^2(x^2-6x+16)\,dx-8\times 2$

$=\left(\frac{x^3}{3}-3x^2+16x\right)_0^2-16$

$=\frac{20}{3}$

(iii) $PS=8\times 2-\int_0^2\left(\frac{1}{3}x^2+\frac{4}{3}x+4\right)dx$

$=16-\left[\frac{x^3}{9}+\frac{2}{3}x^2+4x\right]_0^2$

$=16-\left(\frac{8}{9}+\frac{8}{3}+8\right)=\frac{40}{9}$

33. $P=₹500,000;\ i=0.005$

$n=12\times 10=120$

(i) $A=\frac{P+I}{120}=\frac{500000+300000}{120}$

$=\frac{800000}{120}=₹6666.67$

(ii) $R=\frac{Pi}{1-(1+i)^{-n}}$

$=\frac{500,000\times 0.005}{1-(1.005)^{-120}}$

$=\frac{2500}{1-0.5496}=\frac{2500}{0.4504}$

$=₹5,551.$

34. $x+y+z=45$

$-x+z=8,\ x+z=2y$

$AX=B\Rightarrow$

$X=\begin{bmatrix}1&1&1\\-1&0&1\\1&-2&1\end{bmatrix}^{-1}\begin{bmatrix}45\\8\\0\end{bmatrix}$

$|A|=6\ne 0$

$\text{adj}A=\begin{bmatrix}2&-3&1\\2&0&-2\\2&3&1\end{bmatrix}$

$\begin{bmatrix}x\\y\\z\end{bmatrix}=\frac{1}{6}\begin{bmatrix}2&-3&1\\2&0&-2\\2&3&1\end{bmatrix}\begin{bmatrix}45\\8\\0\end{bmatrix}$

$x=11,\ y=15,\ z=19$

35.

Year	Prod.	x	x^2	xy	$y_c=a+bx$
2013	80	-3	9	-240	84
2014	90	-2	4	-180	86
2015	92	-1	1	-92	88
2016	83	0	0	0	90
2017	94	1	1	94	92
2018	99	2	4	198	94
2019	92	3	9	276	96
	630	0	28	56	

$a=\frac{\Sigma y}{n}=\frac{630}{7}=90$

$b=\frac{\Sigma xy}{\Sigma x^2}=\frac{56}{28}=2$

$y_{2022}=90+2(6)=102$

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36.

	$A(x)$	$B(y)$	
S	15	5	≤ 390
T	3	2	≤ 24
P	3500	8000	

O.F. $P = 3500x + 8000y$

Subject to constraints

$15x + 5y \le 390$

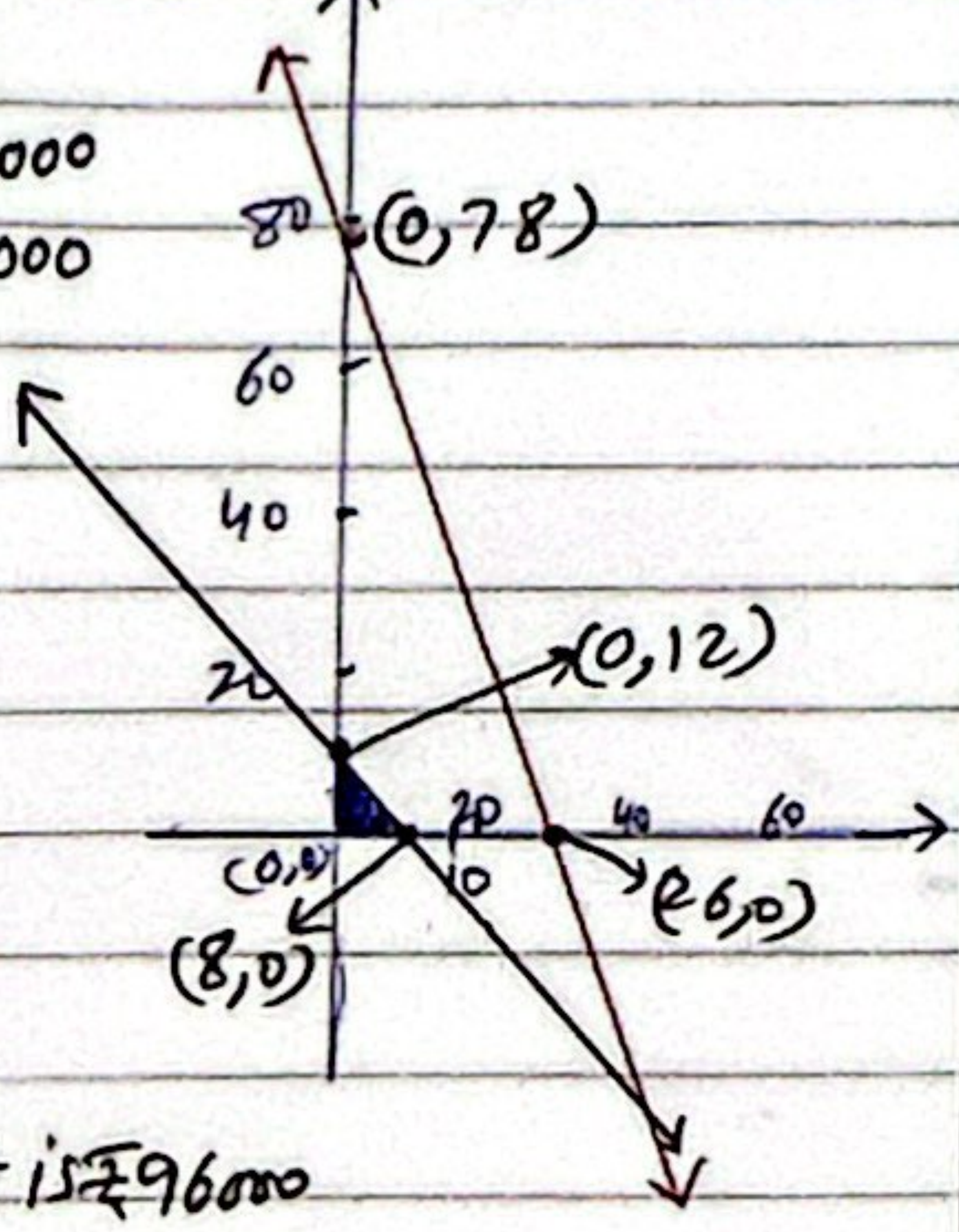
$3x + 2y \le 24$

and $x, y \ge 0$

$3x + y = 78 \quad (0,78), (26,0)$

$3x + 2y = 24 \quad (0,12), (8,0)$

C.P.	$P = 3500x + 8000y$
(0,0)	0
(8,0)	29000
(0,12)	96000



Max profit is ₹96000 at $x = 0$; $y = 12$

37. $\mu = 80$; $\sigma = 4$

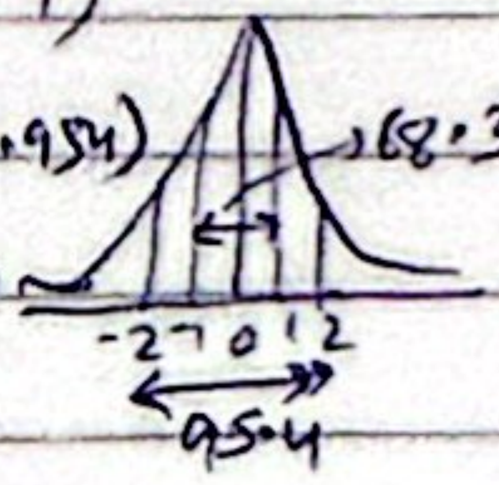
(i) $P(72 < X < 84) = P\left(\frac{72-80}{4} < Z < \frac{84-80}{4}\right)$

$= P(-2 < Z < 1)$

$= \frac{1}{2}(0.683) + \frac{1}{2}(0.954)$

$= 0.3415 + 0.4770$

$= 0.8185$



(ii) $P(Z > a) = 0.025$

$P(Z < a) = 0.975$

$\Rightarrow a = 1.96$

$\Rightarrow \frac{X - 80}{4} = 1.96$

$X = 80 + 7.84 = 87.84$

$= 88$

38

a) $(123 \times 217 \times 365) \bmod 11$

$= (2 \times 8 \times 2) \bmod 11$

$= 32 \bmod 11 = 10$

(b) $100 \equiv x \pmod 7$

$100 = 2 \bmod 7$

$\therefore x = 2$

(c) $(7^{291} \times 6^{500}) \bmod 10$

$= 7^{291} \bmod 10 \times 6^{500} \bmod 10$

$= ((7^2)^{145} \cdot 7) \bmod 10 \times \cancel{(2^{500} \times 3^{500}) \bmod 10}$

$= (-1)^{145} \cdot 7 \bmod 10 \times 6 \bmod 10$

$= (-7 \bmod 10) \cdot (6 \bmod 10)$

$= (3 \bmod 10) \cdot (6 \bmod 10)$

$= 18 \bmod 10 = 8$

OR

$(2^{100} + 1001) \bmod 10$

$2^5 \equiv 32 \bmod 10$

$2^5 \equiv 2 \bmod 10$

$(2^5)^5 \equiv 2^5 \bmod 10$

$2^{25} \equiv 2 \bmod 10$

$(2^{25})^4 \equiv 2^4 \bmod 10 = 16 \bmod 10 = 6$

$2^1 = 2$

$2^2 = 4$

$2^3 = 8$

$2^4 = 16$

$2^5 = 32$

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