



**BANGALORE SAHODAYA SCHOOLS COMPLEX ASSOCIATION  
PRE-BOARD EXAMINATION (2024-2025)**

**Grade XII**

**Class: - XII**

**SUBJECT: Applied Mathematics**

**Date: - 20.12.2024**

**Time: - 3 hours**

**Code - (241) SET-2**

**Marks: - 80**

**MARKING SCHEME**

**SECTION – A**

|     |    |                                                                                                                     |   |
|-----|----|---------------------------------------------------------------------------------------------------------------------|---|
| 1.  | A) | 0                                                                                                                   | 1 |
| 2.  | B) | 360 litres                                                                                                          | 1 |
| 3.  | B) | 38                                                                                                                  | 1 |
| 4.  | A) | A is a symmetric matrix                                                                                             | 1 |
| 5.  | D) | to each element of a row (or column) is added equi-multiples of the corresponding elements of another row or column | 1 |
| 6.  | C) | 289                                                                                                                 | 1 |
| 7.  | A) | -6/25                                                                                                               | 1 |
| 8.  |    | $\frac{1}{4}\log(x^4 + 1) + C$                                                                                      | 1 |
| 9.  | D) | 2.4                                                                                                                 | 1 |
| 10. | A) | 0.6826                                                                                                              | 1 |
| 11. | B) | (14.1775, 15.8225)                                                                                                  | 1 |
| 12. | A) | Null hypothesis: $H_0: \mu=150$ , Alternative hypothesis: $H_1: \mu \neq 150$                                       | 1 |
| 13. | A) | Trend                                                                                                               | 1 |
| 14. | C) | irregular variations                                                                                                | 1 |
| 15. | C) | the value of the perpetuity will increase                                                                           | 1 |
| 16. | B) | 30%                                                                                                                 | 1 |
| 17. | A) | Rs. 8,100                                                                                                           | 1 |
| 18. | B) | (5, 1)                                                                                                              | 1 |
| 19. | A) | Both Assertion and Reason are true, and the Reason is the correct explanation of the Assertion.                     | 1 |
| 20. | D) | The Assertion is false, but the Reason is true                                                                      | 1 |

**SECTION – B**

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                   |   |     |     |     |         |                                                                   |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|---|-----|-----|-----|---------|-------------------------------------------------------------------|
| 21. | $x = e^{\frac{x}{y}} \Rightarrow \log x = \log e^{\frac{x}{y}} \Rightarrow \log x = \frac{x}{y} \Rightarrow y \cdot \log x = x$ <p>Differentiate with respect to x, <math>y \cdot \frac{1}{x} + \log x \cdot \frac{dy}{dx} = 1</math></p> $\Rightarrow \frac{dy}{dx} = \frac{x - y}{x \cdot \log x}$                                                                                                                                 | $\left(\frac{1}{2}\right)$<br>$(1)$<br>$\left(\frac{1}{2}\right)$ |   |     |     |     |         |                                                                   |
| 22. | <p>Take <math>t = e + \log x \Rightarrow dt = \frac{dx}{x}</math>.</p> <p>Also</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td><math>x</math></td><td>1</td><td><math>e</math></td></tr> <tr><td><math>t</math></td><td><math>e</math></td><td><math>1 + e</math></td></tr> </table> $I = \frac{1}{3} \int_e^{1+e} t \, dt = \frac{1}{3} \left[ \frac{t^2}{2} \right]_e^{1+e} = \frac{1}{6} (1 + 2e).$ | $x$                                                               | 1 | $e$ | $t$ | $e$ | $1 + e$ | $\left(\frac{1}{2}\right)$<br>$\left(\frac{1}{2}\right)$<br>$(1)$ |
| $x$ | 1                                                                                                                                                                                                                                                                                                                                                                                                                                    | $e$                                                               |   |     |     |     |         |                                                                   |
| $t$ | $e$                                                                                                                                                                                                                                                                                                                                                                                                                                  | $1 + e$                                                           |   |     |     |     |         |                                                                   |
|     | Take $u = \log x$ and $dv = x^2 \, dx$ ,                                                                                                                                                                                                                                                                                                                                                                                             | $(1/2)$                                                           |   |     |     |     |         |                                                                   |

|     |                                                                                                                                                                                                                                                                  |                                         |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
|     | <p>we get <math>du = \frac{1}{x} dx</math> and <math>v = \frac{x^3}{3}</math></p> <p><math>\int x^2 \cdot \log x \, dx = \frac{x^3}{3} \cdot \log x - \int \frac{x^3}{3} \cdot \frac{1}{x} dx = \frac{x^3}{3} \left( \log x - \frac{1}{3} \right) + c</math></p> | (1/2)<br>(1)                            |
| 23. | <p><math>\mu = \bar{x} \pm M.E = 2000 \pm 1.669 \times \frac{100}{\sqrt{64}}</math></p> <p><math>= 2000 \pm 20.8625</math></p> <p><math>= (1979.1375, 2020.8625)</math></p>                                                                                      | (1)<br>(1)                              |
| 24. | <p><math>\text{Annual depreciation} = \frac{\text{original cost} - \text{scrap value}}{\text{useful life}}</math></p> <p><math>\text{useful life} = \frac{1,20,00,000 - 24,00,000}{8,00,000} = 12 \text{ years}</math></p>                                       | (1/2)<br>$\left(1 + \frac{1}{2}\right)$ |
|     | <p><math>\text{effective rate of return (per rupee)} = \left(1 + \frac{r}{100p}\right)^p - 1</math></p> <p><math>= (1.0225)^4 - 1 = 0.093</math></p> <p><math>\therefore \text{effective rate} = 9.3\%</math></p>                                                | (1/2)<br>(1)<br>(1/2)                   |
| 25. | <p>Maximise <math>Z = 30x + 40y</math></p> <p>Subject to the constraints</p> <p><math>2x + 3y \leq 120;</math></p> <p><math>3x + 2y \leq 100;</math></p> <p><math>x \geq 0, y \geq 0</math></p>                                                                  | (1/2)<br>(1/2)<br>(1/2)<br>(1/2)        |

#### SECTION – C

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                              |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
| 26. | <p>30% of <math>(x + 1725) &lt; 50\% \text{ of } 1725 &lt; 40\% \text{ of } (x + 1725)</math></p> <p><math>\Rightarrow 3x + 5175 &lt; 8625 &lt; 4x + 6900</math></p> <p><math>\Rightarrow 431.25 &lt; x &lt; 1150</math></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | (1)<br>(1)<br>(1)                                            |
|     | <p><math>5A + 3B + 2C = 0 \Rightarrow \begin{bmatrix} 45 &amp; 5 \\ 35 &amp; 40 \end{bmatrix} + \begin{bmatrix} 3 &amp; 15 \\ 21 &amp; 36 \end{bmatrix} + 2C = \begin{bmatrix} 0 &amp; 0 \\ 0 &amp; 0 \end{bmatrix}</math></p> <p><math>\Rightarrow C = \begin{bmatrix} -24 &amp; -10 \\ -28 &amp; -38 \end{bmatrix}</math></p>                                                                                                                                                                                                                                                                                                                                                                                                       | (2)<br>(1)                                                   |
| 27. | <p><math>A^2 = \begin{bmatrix} 9 &amp; 8 &amp; 8 \\ 8 &amp; 9 &amp; 8 \\ 8 &amp; 8 &amp; 9 \end{bmatrix}; 4A = \begin{bmatrix} 4 &amp; 8 &amp; 8 \\ 8 &amp; 4 &amp; 8 \\ 8 &amp; 8 &amp; 4 \end{bmatrix}; 5I = \begin{bmatrix} 5 &amp; 0 &amp; 0 \\ 0 &amp; 5 &amp; 0 \\ 0 &amp; 0 &amp; 5 \end{bmatrix}</math></p> <p><math>A^2 - 4A - 5I = \begin{bmatrix} 9 &amp; 8 &amp; 8 \\ 8 &amp; 9 &amp; 8 \\ 8 &amp; 8 &amp; 9 \end{bmatrix} - \begin{bmatrix} 4 &amp; 8 &amp; 8 \\ 8 &amp; 4 &amp; 8 \\ 8 &amp; 8 &amp; 4 \end{bmatrix} - \begin{bmatrix} 5 &amp; 0 &amp; 0 \\ 0 &amp; 5 &amp; 0 \\ 0 &amp; 0 &amp; 5 \end{bmatrix} = \begin{bmatrix} 0 &amp; 0 &amp; 0 \\ 0 &amp; 0 &amp; 0 \\ 0 &amp; 0 &amp; 0 \end{bmatrix}</math></p> | $\left(1 \frac{1}{2}\right)$<br>$\left(1 \frac{1}{2}\right)$ |
|     | <p><math>np + npq = 25 \rightarrow (1)</math></p> <p><math>(np)(npq) = 150 \rightarrow (2)</math></p> <p>solving (1) &amp; (2), we get: <math>q = \frac{2}{3}, p = \frac{1}{3}</math></p> <p>sub <math>p</math> &amp; <math>q</math> in (1) <math>\Rightarrow n = 45</math></p> <p>Number of trials = 45, probability of success = <math>\frac{1}{3}</math></p>                                                                                                                                                                                                                                                                                                                                                                       | (1/2)<br>(1)<br>(1/2)<br>(1)                                 |
| 28. | <p>Given <math>\mu = 75, \sigma = 4, Z = \frac{X-75}{4}</math></p> <p>(i) <math>P(X &lt; 65) = P(Z &lt; -2.5) = 0.0062</math></p> <p>(ii) <math>P(X &gt; 80) = P(Z &gt; 1.25) = 1 - P(Z &lt; 1.25) = 0.1056</math></p> <p>(iii) <math>P(70 &lt; X &lt; 85) = P(-1.25 &lt; Z &lt; 2.5)</math></p> <p><math>= P(Z &lt; 2.5) - P(Z &lt; -1.25)</math></p> <p><math>= 0.998 - 0.1056 = 0.8924</math></p>                                                                                                                                                                                                                                                                                                                                  | (1)<br>(1)<br>(1)                                            |

| 29.   | <table><tr><th>Month</th><th>4-monthly total</th><th>4-monthly average</th><th>4-monthly centered average</th></tr><tr><td>Jan</td><td></td><td></td><td></td></tr><tr><td>Feb</td><td>-2</td><td>-0.5</td><td></td></tr><tr><td>Mar</td><td>13</td><td>3.25</td><td>1.375</td></tr><tr><td>Apr</td><td>30</td><td>7.5</td><td>5.375</td></tr><tr><td>May</td><td>50</td><td>12.5</td><td>10</td></tr><tr><td>Jun</td><td>63</td><td>15.75</td><td>14.125</td></tr><tr><td>Jul</td><td>66</td><td>16.5</td><td>16.125</td></tr><tr><td>Aug</td><td>59</td><td>14.75</td><td>15.625</td></tr><tr><td>Sep</td><td>41</td><td>10.25</td><td>12.5</td></tr><tr><td>Oct</td><td>20</td><td>5</td><td>7.625</td></tr><tr><td>Nov</td><td></td><td></td><td></td></tr><tr><td>Dec</td><td></td><td></td><td></td></tr></table> | Month                        | 4-monthly total            | 4-monthly average | 4-monthly centered average | Jan |  |  |  | Feb | -2 | -0.5 |  | Mar | 13 | 3.25 | 1.375 | Apr | 30 | 7.5 | 5.375 | May | 50 | 12.5 | 10 | Jun | 63 | 15.75 | 14.125 | Jul | 66 | 16.5 | 16.125 | Aug | 59 | 14.75 | 15.625 | Sep | 41 | 10.25 | 12.5 | Oct | 20 | 5 | 7.625 | Nov |  |  |  | Dec |  |  |  | 1+1+1<br>(total<br>+<br>Average<br>+<br>Centered<br>average) |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|----------------------------|-------------------|----------------------------|-----|--|--|--|-----|----|------|--|-----|----|------|-------|-----|----|-----|-------|-----|----|------|----|-----|----|-------|--------|-----|----|------|--------|-----|----|-------|--------|-----|----|-------|------|-----|----|---|-------|-----|--|--|--|-----|--|--|--|--------------------------------------------------------------|
| Month | 4-monthly total                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 4-monthly average            | 4-monthly centered average |                   |                            |     |  |  |  |     |    |      |  |     |    |      |       |     |    |     |       |     |    |      |    |     |    |       |        |     |    |      |        |     |    |       |        |     |    |       |      |     |    |   |       |     |  |  |  |     |  |  |  |                                                              |
| Jan   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                              |                            |                   |                            |     |  |  |  |     |    |      |  |     |    |      |       |     |    |     |       |     |    |      |    |     |    |       |        |     |    |      |        |     |    |       |        |     |    |       |      |     |    |   |       |     |  |  |  |     |  |  |  |                                                              |
| Feb   | -2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | -0.5                         |                            |                   |                            |     |  |  |  |     |    |      |  |     |    |      |       |     |    |     |       |     |    |      |    |     |    |       |        |     |    |      |        |     |    |       |        |     |    |       |      |     |    |   |       |     |  |  |  |     |  |  |  |                                                              |
| Mar   | 13                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 3.25                         | 1.375                      |                   |                            |     |  |  |  |     |    |      |  |     |    |      |       |     |    |     |       |     |    |      |    |     |    |       |        |     |    |      |        |     |    |       |        |     |    |       |      |     |    |   |       |     |  |  |  |     |  |  |  |                                                              |
| Apr   | 30                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 7.5                          | 5.375                      |                   |                            |     |  |  |  |     |    |      |  |     |    |      |       |     |    |     |       |     |    |      |    |     |    |       |        |     |    |      |        |     |    |       |        |     |    |       |      |     |    |   |       |     |  |  |  |     |  |  |  |                                                              |
| May   | 50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 12.5                         | 10                         |                   |                            |     |  |  |  |     |    |      |  |     |    |      |       |     |    |     |       |     |    |      |    |     |    |       |        |     |    |      |        |     |    |       |        |     |    |       |      |     |    |   |       |     |  |  |  |     |  |  |  |                                                              |
| Jun   | 63                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 15.75                        | 14.125                     |                   |                            |     |  |  |  |     |    |      |  |     |    |      |       |     |    |     |       |     |    |      |    |     |    |       |        |     |    |      |        |     |    |       |        |     |    |       |      |     |    |   |       |     |  |  |  |     |  |  |  |                                                              |
| Jul   | 66                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 16.5                         | 16.125                     |                   |                            |     |  |  |  |     |    |      |  |     |    |      |       |     |    |     |       |     |    |      |    |     |    |       |        |     |    |      |        |     |    |       |        |     |    |       |      |     |    |   |       |     |  |  |  |     |  |  |  |                                                              |
| Aug   | 59                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 14.75                        | 15.625                     |                   |                            |     |  |  |  |     |    |      |  |     |    |      |       |     |    |     |       |     |    |      |    |     |    |       |        |     |    |      |        |     |    |       |        |     |    |       |      |     |    |   |       |     |  |  |  |     |  |  |  |                                                              |
| Sep   | 41                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 10.25                        | 12.5                       |                   |                            |     |  |  |  |     |    |      |  |     |    |      |       |     |    |     |       |     |    |      |    |     |    |       |        |     |    |      |        |     |    |       |        |     |    |       |      |     |    |   |       |     |  |  |  |     |  |  |  |                                                              |
| Oct   | 20                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 5                            | 7.625                      |                   |                            |     |  |  |  |     |    |      |  |     |    |      |       |     |    |     |       |     |    |      |    |     |    |       |        |     |    |      |        |     |    |       |        |     |    |       |      |     |    |   |       |     |  |  |  |     |  |  |  |                                                              |
| Nov   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                              |                            |                   |                            |     |  |  |  |     |    |      |  |     |    |      |       |     |    |     |       |     |    |      |    |     |    |       |        |     |    |      |        |     |    |       |        |     |    |       |      |     |    |   |       |     |  |  |  |     |  |  |  |                                                              |
| Dec   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                              |                            |                   |                            |     |  |  |  |     |    |      |  |     |    |      |       |     |    |     |       |     |    |      |    |     |    |       |        |     |    |      |        |     |    |       |        |     |    |       |      |     |    |   |       |     |  |  |  |     |  |  |  |                                                              |
| 30.   | $A = 3,30,000 - 20,000 = 3,10,000; \quad i = \frac{5}{100}; \quad n = 7$ $A = R \left[ \frac{(1+i)^n - 1}{i} \right]$ $\Rightarrow 3,10,000 = R \left( \frac{0.407}{0.05} \right)$ $\Rightarrow R = 38,083.53$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | (1/2)<br>(1/2)<br>(1)<br>(1) |                            |                   |                            |     |  |  |  |     |    |      |  |     |    |      |       |     |    |     |       |     |    |      |    |     |    |       |        |     |    |      |        |     |    |       |        |     |    |       |      |     |    |   |       |     |  |  |  |     |  |  |  |                                                              |
| 31.   | $CAGR = \left( \frac{FV}{PV} \right)^{\frac{1}{n}} - 1 \Rightarrow 8\% = \left( \frac{2,50,000}{1,00,000} \right)^{\frac{1}{n}} - 1$ $\Rightarrow n = \frac{\log(2.5)}{\log(1.08)} = 11.73 = 12 \text{ years(app)}$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | (1/2 + 1/2)<br>(2)           |                            |                   |                            |     |  |  |  |     |    |      |  |     |    |      |       |     |    |     |       |     |    |      |    |     |    |       |        |     |    |      |        |     |    |       |        |     |    |       |      |     |    |   |       |     |  |  |  |     |  |  |  |                                                              |
|       | (i) $P(1 - i)i = 7,20,000 \rightarrow (1);$<br>$P(1 - i)^2i = 6,48,000 \rightarrow (2)$<br>Dividing (2) by (1), $i = \frac{1}{10} \Rightarrow r = 10\%$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | (1)<br>(1)                   |                            |                   |                            |     |  |  |  |     |    |      |  |     |    |      |       |     |    |     |       |     |    |      |    |     |    |       |        |     |    |      |        |     |    |       |        |     |    |       |      |     |    |   |       |     |  |  |  |     |  |  |  |                                                              |
|       | (ii) $sub \ i = \frac{1}{10} \text{ in } (1) \Rightarrow P = 80,00,000$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | (1)                          |                            |                   |                            |     |  |  |  |     |    |      |  |     |    |      |       |     |    |     |       |     |    |      |    |     |    |       |        |     |    |      |        |     |    |       |        |     |    |       |      |     |    |   |       |     |  |  |  |     |  |  |  |                                                              |

#### SECTION – D

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                  |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| 32. | <p>Pipe A, B fills the tank in 12, 18 hours, and Pipe C empties the tank in 24 hours.</p> <p>Rate of Pipe A, B and C are <math>\frac{1}{12}, \frac{1}{18}</math> and <math>-\frac{1}{24}</math> tank per hour.</p> <p><b>Work Done in the First 3 Hours (Pipe A and Pipe B Open)</b></p> <p>Combined amount of A and B filled in 3 hours = <math>3 \times \frac{5}{36} = \frac{5}{12}</math></p> <p><b>Work Done in the Next 2 Hours (Pipe A, Pipe B, and Pipe C Open)</b></p> <p>Combined Amount of A, B and C filled in 2 hours = <math>2 \times \frac{7}{72} = \frac{7}{36}</math></p> <p><b>Work Done in the Next 1 Hour (Pipe B and Pipe C Open)</b></p> <p>Combined Amount of B and C filled in 1 hour = <math>1 \times \frac{1}{72} = \frac{1}{72}</math></p> <p><b>Work Done in the last 1 Hour (Only Pipe C Open)</b></p> <p>Pipe C empties the tank in 1 hour = <math>-\frac{1}{24}</math></p> <p><b>Work done at the end of 7 hours</b> = <math>\frac{5}{12} + \frac{7}{36} + \frac{1}{72} - \frac{1}{24} = \frac{7}{12}</math></p> <p>To determine how long it will take to fill the remaining <math>\frac{5}{12}</math> of the tank.</p> <p>Since Pipe C is emptying the tank at <math>-\frac{1}{24}</math> of the tank per hour, and no other pipes are filling the tank, the remaining of the tank will never be</p> | (1/2)<br>(1/2)<br>(1/2)<br>(1/2)<br>(1/2)<br>(1)<br>(1/2)<br>(1) |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|

|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                 |                 |           |     |          |     |          |     |          |     |                                                                                                         |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-----------------|-----------|-----|----------|-----|----------|-----|----------|-----|---------------------------------------------------------------------------------------------------------|
|               | filled, while only Pipe C is open. Therefore, the tank cannot be completely filled under these conditions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                 |                 |           |     |          |     |          |     |          |     |                                                                                                         |
| 33.           | <p>Let T be the temperature of the body of the victim and S be the room temperature.</p> $\frac{dT}{dt} = -k(T - S) \Rightarrow T = S + Ce^{-kt} \rightarrow (1)$ <p>At t = 0, S = 68, T = 85 from (1) <math>\Rightarrow C = 17</math>.</p> $\therefore T = 68 + 17e^{-kt} \rightarrow (2)$ <p>At t = 2, T = 78 from (2) <math>\Rightarrow k = -0.227</math></p> $\therefore T = 68 + 17e^{0.227t} \rightarrow (3)$ <p>At T = 98.6 from (3) <math>\Rightarrow t = 2.59</math> hours i.e., 2 hours 36 minutes (app)</p> <p>Time of death of the victim is 2 hrs 36 mins before 8:00 AM</p> <p style="text-align: right;">= 5:24 AM</p> | <p>(1)<math>\frac{1}{2}</math></p> <p>(1)</p> <p>(1)</p> <p>(1)</p> <p>(1/2)</p>                |                 |           |     |          |     |          |     |          |     |                                                                                                         |
|               | $\frac{dy}{dt} - \frac{t}{1+t^2}y = \frac{2t}{1+t^2}$ $\Rightarrow P = -\frac{t}{1+t^2} \text{ \& } Q = \frac{2t}{1+t^2},$ $I.F = \frac{1}{\sqrt{1+t^2}}$ <p>General solution is <math>\frac{y}{\sqrt{1+t^2}} = -\frac{2}{\sqrt{1+t^2}} + c \Rightarrow y = -2 + c\sqrt{1+t^2}</math></p> <p>When <math>y(0) = -1 \Rightarrow c = 1 \therefore y = -2 + \sqrt{1+t^2}</math></p> <p>Now <math>y(1) = -2 + \sqrt{1+1^2} = -2 + \sqrt{2}</math></p>                                                                                                                                                                                      | <p>(1/2)</p> <p>(1/2)</p> <p>(1)</p> <p>(1)<math>\frac{1}{2}</math></p> <p>(1)</p> <p>(1/2)</p> |                 |           |     |          |     |          |     |          |     |                                                                                                         |
| 34.           | <p>(i) <math>P(X = 5) = \frac{3^5 e^{-3}}{5!} = 0.101</math></p> <p>(ii) <math>P(X \leq 2) = P(X = 0) + P(X = 1) + P(X = 2)</math></p> $= \frac{3^0 e^{-3}}{0!} + \frac{3^1 e^{-3}}{1!} + \frac{3^2 e^{-3}}{2!} = 0.4233$ <p>(iii) <math>P(X &gt; 4) = 1 - P(X \leq 4)</math></p> $= 1 - (P(X = 0) + P(X = 1) + P(X = 2) + P(X = 3) + P(X = 4))$ $= 1 - 0.9836 = 0.0164$                                                                                                                                                                                                                                                              | <p>(1)</p> <p>(2)</p> <p>(2)</p>                                                                |                 |           |     |          |     |          |     |          |     |                                                                                                         |
| 35.           | <table><tr><td>Corner points</td><td><math>Z = 24x + 36y</math></td></tr><tr><td>A (10, 0)</td><td>240</td></tr><tr><td>B (2, 4)</td><td>192</td></tr><tr><td>C (1, 5)</td><td>204</td></tr><tr><td>D (0, 8)</td><td>288</td></tr></table> <p>The feasible region is unbounded region. The minimum value is 192.</p> <p>We draw the line <math>24x + 36y = 192</math> (i.e., <math>2x + 3y = 16</math>) and note that the half plane <math>2x + 3y &lt; 16</math> has no common point with the feasible region. So, Z has minimum value of 192 at the point (2, 4).</p>                                                               | Corner points                                                                                   | $Z = 24x + 36y$ | A (10, 0) | 240 | B (2, 4) | 192 | C (1, 5) | 204 | D (0, 8) | 288 | <p>Graph (1)<math>\frac{1}{2}</math></p> <p>Table (1)<math>\frac{1}{2}</math></p> <p>(1)</p> <p>(1)</p> |
| Corner points | $Z = 24x + 36y$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                 |                 |           |     |          |     |          |     |          |     |                                                                                                         |
| A (10, 0)     | 240                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                 |                 |           |     |          |     |          |     |          |     |                                                                                                         |
| B (2, 4)      | 192                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                 |                 |           |     |          |     |          |     |          |     |                                                                                                         |
| C (1, 5)      | 204                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                 |                 |           |     |          |     |          |     |          |     |                                                                                                         |
| D (0, 8)      | 288                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                 |                 |           |     |          |     |          |     |          |     |                                                                                                         |
|               | <p>Let x and y be the number of units of product 1 and product 2 respectively.</p> <p><i>objective function is maximise the profit, <math>Z = 120x + 100y</math></i></p> <p>Constraints are</p> $4x + 3y \leq 200;$ $3x + 4y \leq 180;$ $2x + 3y \leq 150;$ $x \leq 30;$ $y \leq 40;$                                                                                                                                                                                                                                                                                                                                                 | <p>Graph (1)<math>\frac{1}{2}</math></p> <p>(1)<math>\frac{1}{2}</math></p>                     |                 |           |     |          |     |          |     |          |     |                                                                                                         |

|                                                            |                      |                   |                        |
|------------------------------------------------------------|----------------------|-------------------|------------------------|
|                                                            | $x \geq 0, y \geq 0$ |                   | Table $(1\frac{1}{2})$ |
|                                                            | Corner points        | $Z = 120x + 100y$ |                        |
|                                                            | (30, 40)             | 7600              |                        |
|                                                            | (30, 30)             | 6600              |                        |
|                                                            | (20, 35)             | 5900              |                        |
|                                                            | (25, 30)             | 6000              |                        |
| Maximum profit is Rs. 7600 attained at the point (30, 40). |                      |                   | (1/2)                  |

#### SECTION – E

|     |                                                                                                                                        |     |
|-----|----------------------------------------------------------------------------------------------------------------------------------------|-----|
| 36. | (i) Circumference = $2\pi r \Rightarrow x = 2\pi r$                                                                                    | (1) |
|     | (ii) Area of the circle = $\frac{1}{4\pi}x^2$ sq.units                                                                                 | (1) |
|     | (OR)<br>Area of the square = $\frac{1}{16}(28 - x)^2$ sq.units                                                                         | (1) |
|     | (iii) Combined area = $\frac{1}{4\pi}x^2 + \frac{1}{16}(28 - x)^2$                                                                     |     |
|     | $\frac{dA}{dx} = \frac{x}{2\pi} - \frac{1}{8}(28 - x) = 0 \Rightarrow x = \frac{28\pi}{4+\pi}$ is the critical point.                  | (1) |
|     | $\frac{d^2A}{dx^2} = \frac{1}{2\pi} + \frac{1}{8} > 0$ . So, area is minimum when $x = \frac{28\pi}{4+\pi}$                            | (1) |
| 37. | (i) Let x and y denotes the length and breadth of the plot.<br>$(x - 45)(y + 45) = xy \Rightarrow x - y = 45 \rightarrow (1)$          | (1) |
|     | $(x - 20)(y - 10) = xy - 4600 \Rightarrow x + 2y = 480 \rightarrow (2)$                                                                | (1) |
|     | (ii) $\begin{bmatrix} 1 & -1 \\ 1 & 2 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 45 \\ 480 \end{bmatrix}$    | (1) |
|     | (iii) Area of the plot = $xy = (190)(145) = 27550 \text{ m}^2$                                                                         | (1) |
|     |                                                                                                                                        |     |
| 38. | (i) $EMI = \frac{P \times r \times (1+r)^n}{(1+r)^n - 1} = \frac{40,000 \times 0.01 \times 1.26824}{1.26824 - 1} =$<br>Rs. 1,888 (app) | (2) |
|     | (ii) Total payment at the end of 2 years = $24 \times 1,888 =$<br>Rs. 45,312(app)                                                      | (1) |
|     | (iii) Total interest paid at the end of 2 years<br>= Rs. 45,312 – Rs. 40,000<br>= Rs. 5,312(app)                                       | (1) |
|     |                                                                                                                                        |     |