# DIRECTORATE OF GOVERNMENT EXAMINATIONS, CHENNAI – 600 006
# HIGHER SECONDARY SECOND YEAR PUBLIC EXAMINATION – MAY 2022
# MATHEMATICS MARKING SCHEME – ENGLISH MEDIUM

## GENERAL INSTRUCTIONS

**Maximum Marks :90**

1. The answers given in the marking scheme are Text book and Solution book bound.

2. If a student has given any answer which is different from one given in the marking scheme, but carries the prescribed content meaning (rigorous) such answers should be given full credit with suitable distribution.

3. Follow the footnotes which are given under certain answer schemes.

4. If a particula stage is wrong and if the candidate writes the appropriate formula then award 1 mark for the formula (for the stage mark 2*). This mark (*) is attached with that stage. This is done with the aim that a student who did the problem correctly without writing the formula should not be penalized.

5. In the case of Part I, Part III and Part IV, if the solution is correct then award full mark directly. The stage mark is essential only if the part of the solution is incorrect.

6. Answers written only in Black or Blue ink should be evaluated.

## PART – I

1. One mark to write the correct option and the corresponding answer.
2. If one of them (answer or option) is wrong, then award zero mark only.

| Code A | | | Code B | | |
|---|---|---|---|---|---|
| **Q.No** | Option | Answer | **Q.No** | Option | Answer |
| **1.** | (b) | 1 | **1.** | (d) | $\frac{1}{10100}$ |
| **2.** | (c) | $F(x)$ is real valued decreasing function | **2.** | (d) | $\frac{1}{(x+1)^2}\,dx$ |
| **3.** | (d) | $\frac{1}{(x+1)^2}\,dx$ | **3.** | (a) | If $A$ is a square matrix of order $n$ and $\lambda$ is a sca ar then $Adj(\lambda A) = \lambda^n(Adj\ A)$ |
| **4.** | (d) | $\frac{1}{10100}$ | **4.** | (b) | 24 |
| **5.** | (d) | $\frac{\pi}{6}$ | **5.** | (c) | $\frac{2}{27}$ |
| **6.** | (a) | 19 | **6.** | (d) | $y = c\,e^{-\int p\,dx}$ |
| **7.** | (b) | $\frac{-q}{r}$ | **7.** | (a) | $x^2 + y^2$ |
| **8.** | (a) | $x^2 + y$ | **8.** | (a) | 19 |
| **9.** | (c) | **9** | **9.** | (c) | $\cot x$ |
| **10.** | (a) | 0 | **10.** | (a) | Multiplication |
| **11.** | (d) | $-3$ | **11.** | (c) | $F(x)$ is real valued decreasing function |
| **12** | (d) | $x^2 + y^2 + 6x + 8y + 16 = 0$ | **12.** | (c) | **9** |
| **13.** | (d) | $y = c\,e^{-\int p\,dx}$ | **13.** | (a) | 0 |
| **14.** | (c) | $\frac{2}{27}$ | **14.** | (b) | $\frac{-q}{r}$ |
| **15.** | (a) | $(1,0)$ | **15.** | (d) | $x^2 + y^2 + 6x + 8y + 16 = 0$ |
| **16.** | (a) | $\frac{\pi}{2}$ | **16.** | (b) | 1 |
| **17.** | (a) | Multiplication | **17.** | (a) | $\frac{\pi}{2}$ |
| **18.** | (a) | If $A$ is a square matrix of order $n$ and $\lambda$ is a scalar then $Adj(\lambda A) = \lambda^n(Adj\ A)$ | **18.** | (a) | $(1,0)$ |
| **19.** | (c) | $\cot x$ | **19.** | (d) | $\frac{\pi}{6}$ |
| **20.** | (b) | 24 | **20.** | (d) | $-3$ |

**Important Note for Part – II, Part – III and Part – IV**

In an answer to a question, between any two particular stages of marks (greater than one) if a student starts from a stage with correct step but reaches the next stage with a wrong result then suitable credits should be given to the related steps instead of denying the entire marks meant for the stage.

**PART – II**

<table>
<tr><th>Q.NO</th><th>CONTENT</th><th>MARKS</th></tr>
<tr><td>21.</td><td>$z = x + iy, \bar{z} = x - iy$<br>$Re(z) = \frac{z+\bar{z}}{2}$ and $Im(z) = \frac{z-\bar{z}}{2i}$</td><td>1<br>1</td></tr>
<tr><td>22.</td><td>$2 + \sqrt{3}$ is also a root<br>$x^2 - 4x + 1 = 0$</td><td>1<br>1</td></tr>
<tr><td>23.</td><td>$tany = \sqrt{3}$<br>$y = \frac{\pi}{3}$</td><td>1<br>1</td></tr>
<tr><td>24.</td><td>$\frac{dy}{dx} = 3x^2 - 6x + 1 = 1$<br>Required points are $(0\ -2)$ and $(2, -4)$</td><td>1<br>1</td></tr>
<tr><td>25.</td><td>$df = (2x + 3)\, dx$<br>$df = 0.7$</td><td>1<br>1</td></tr>
<tr><td>26.</td><td>$\frac{dy}{dx} = Ae^x - Be^{-x}$<br>$\frac{d^2y}{dx^2} - y = 0$</td><td>1<br>1</td></tr>
<tr><td>27.</td><td>$\frac{dy}{\sqrt{1-y^2}} = \frac{dx}{\sqrt{1-x^2}}$<br>$\text{in}^{-1} y = \sin^{-1} x + c$</td><td>1<br>1</td></tr>
<tr><td>28.</td><td>$k = \frac{1}{30}$</td><td>2</td></tr>
<tr><td>29.</td><td><table><tr><td>Values of random variable</td><td>0</td><td>1</td><td>2</td><td>3</td></tr><tr><td>Number of elements in the inverse images</td><td>1</td><td>3</td><td>3</td><td>1</td></tr></table></td><td>2</td></tr>
<tr><td>30.</td><td>$\left\lvert\frac{3(0)+6(0)+2(0)+7}{\sqrt{(3)^2+(6)^2+(2)^2}}\right\rvert = 1$<br>Distance from he origin to the plane $3x + 6y + 2z + 7 = 0$ is 1.</td><td>1<br>1</td></tr>
</table>

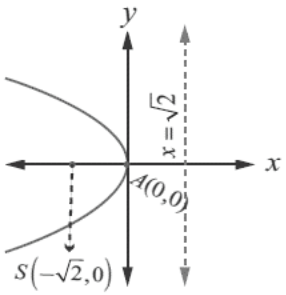
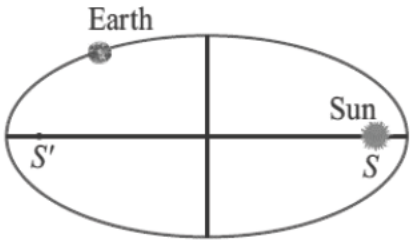
## PART – III

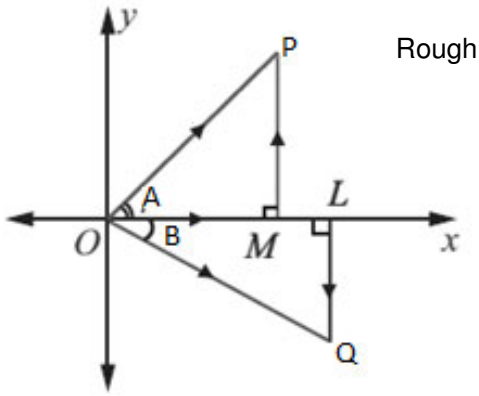
| Q. NO | CONTENT | MARKS |
|---|---|---|
| 31. | $\begin{vmatrix} 1 & 2 & -1 \\ 3 & -1 & 2 \\ 1 & -2 & 3 \end{vmatrix} = -8 \neq 0$ | 2 |
| | Rank of the matrix $= 3$ | 1 |
| | **Note:** Any other third order minor which does not vanish. One can do by rank Method | |
| 32. | $A^{-1} = \frac{1}{4}\begin{pmatrix} 2 & -2 \\ -3 & 5 \end{pmatrix}$ | 2 |
| | $x = -1\,, y = 4$ | 1 |
| 33. | $z_1 = 1 + i, z_2 = 10 - 8i, z_3 = 11 + 6i$ | |
| | $\lvert z_2 - z_1 \rvert = \sqrt{162}$ | 1 |
| | $\lvert z_3 - z_1 \rvert = \sqrt{125}$ | 1 |
| | $z_3$ is closer to $z_1$ | 1 |
| 34. | The other factor is $2x^2 - 7x + 3$ | 1 |
| | $x = \frac{1}{2}\,, 3$ | 2 |
| 35. | $\vec{r} \times \vec{F} = -\hat{\imath} - 2\hat{k}$ | 1 |
| | Magnitude of the torque = $\sqrt{5}$ | 1 |
| | Direction cosines of the torque $\left(\frac{-1}{\sqrt{5}}, 0, \frac{-2}{\sqrt{5}}\right)$ | 1 |
| 36. | $\lim_{x\to\infty} \frac{2 - \frac{3}{x^2}}{1 - \frac{5}{x} + \frac{3}{x^2}}$ | 2 |
| | $= 2$ | 1 |
| | **Note:** One can solve the problem by using L'Hopital Rule. | |
| 37. | $A = \pi r^2$ | 1 |
| | $dA \simeq 2\pi r\, dr$ | 1 |
| | $= 0.4\,\pi$ | 1 |

| | | |
|---|---|---|
| 38. | $\int_0^{\pi/3} \frac{secx\ tanx}{1+sec^2x}\ dx$ | |
| | $= \int_1^2 \frac{dz}{1+z^2} = [tan^{-1}z]_1^2$ | 2 |
| | $= tan^{-1}(2) - \frac{\pi}{4}$ | 1 |
| 39. | $*$ is a binary operation on $\mathbb{R}$. | 1 |
| | $3 * \left(\frac{-7}{15}\right) = 3 + \left(\frac{-7}{15}\right) + 3\left(\frac{-7}{15}\right) - 7$ | 1 |
| | $= \frac{-88}{15}$ | 1 |
| 40. | $(x+4)(x+1) + (y+2)(y+1) = 0$ | 2* |
| | $x^2 + y^2 + 5x + 3y + 6 = 0$ | 1 |

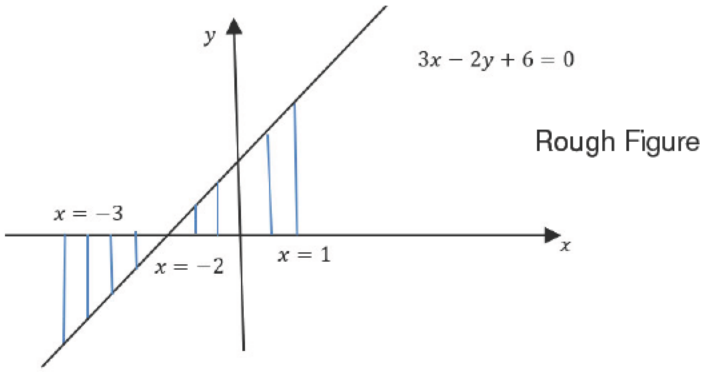
**PART – IV**

| Q. NO | CONTENT | MARKS |
|---|---|---|
| 41.(a) | $\Delta = 0$ | 3 |
| | Cramer's rule is not applicable | 2 |
| | **OR** | |
| 41.(b) | $f'(x) = 24x\ \ - 24x^3$ | 1 |
| | $f\ '(x) = 120x^4 - 72x^2$ | 1 |
| | $f''(-1) = f''(1) = 48$ | 1+1 |
| | $\therefore f(x)$ has local minimum attains at $-1$ and $1$ | 1 |
| 42.(a) | $\lvert x + iy + i\rvert = \lvert x + iy \quad 1\rvert$ | 1 |
| | $x^2 + (y+1)^2 = (x-1)^2 + y^2$ | 2 |
| | $x + y = 0$ | 2 |

| | | |
|---|---|---|
| | **OR** | |
| 42 (b) | $I = \int_0^a \frac{f(x)}{f(x)+f(a-x)}\,dx$ | 1 |
| | $I = \int_0^a \frac{f(a-x)}{f(a-x)+f(x)}\,dx$ | 2 |
| | $2I = \int_0^a dx = a$ | 1 |
| | $I = \frac{a}{2}$ | 1 |
| 43.(a) |   Rough Diagram | 1 |
| | Vertex $(0,0)$ | 1 |
| | $a = \sqrt{2}$ | 1 |
| | $y^2 = -4\sqrt{2}x$ | 2 |
| | **OR** | |
| 43.(b) | $\cot^{-1}\ 1) + \sin^{-1}\left(\frac{-\sqrt{3}}{2}\right) - \sec^{-1}\left(-\sqrt{2}\right)$ | |
| | $= \frac{\pi}{4} - \frac{\pi}{3} - \frac{3\pi}{4}$ | 3 |
| | $= -\frac{5\pi}{6}$ | 2 |
| 44.(a) |   Rough Diagram | 1 |
| | $a + c = 152 \times 10^6$ | 1 |
| | $a - c = 94.5 \times 10^6$ | 1 |
| | $2c = 575 \times 10^5$ | 1 |
| | Th st n e fro e sun to the other focus = $575 \times 10^5$ km | 1 |

| | | |
|---|---|---|
| | **OR** | |
| 44.(b) |  Rough Figure<br>$\overrightarrow{OP} = \cos A\,\hat{\imath} + \sin A\,\hat{\jmath}$<br>$\overrightarrow{OQ} = \cos B\,\hat{\imath} - \sin B\,\hat{\jmath}$<br>Remaining part | 1<br>1<br>1<br>2 |
| 45.(a) | $\vec{a} = 2\hat{\imath} + 2\hat{\jmath} + \hat{k}$<br>$\vec{b} = 9\hat{\imath} + 3\hat{\jmath} + 6\hat{k}$<br>$\vec{v} = 2\hat{\imath} + 6\hat{\jmath} + 6\hat{k}$<br>Vector equation of the plane is<br>$\vec{r} = (1-s)(2\hat{\imath} + 2\hat{\jmath} + \hat{k}) + s(9\hat{\imath} + 3\hat{\jmath} + 6\hat{k}) + t(2\hat{\imath} + 6\hat{\jmath} + 6\hat{k})$<br>OR<br>Cartesian equation of the plane is $3x + 4y - 5z - 9 = 0$ | 1+1+1<br>2* |
| | **OR** | |
| 45 (b) | $m_1 = 2, \quad m_2 = \frac{1}{2}$<br>$\tan\theta = \frac{3}{4}$<br>$\theta = \tan^{-1}\left(\frac{3}{4}\right)$ | 1+1<br>2*<br>1 |
| 46.(a) | (i) $P(X < 3) = \frac{1}{2}$<br>(ii) $P(2 < X < 4) = \frac{1}{2}$<br>(iii) $P(3 \leq X) = \frac{1}{2}$ | 1<br>2<br>2 |
| | **OR** | |

**46.(b)**




1

e u re Are $= -\int_{-3}^{-2} \frac{3x+6}{2}\,dx + \int_{-2}^{1} \frac{3x+6}{2}\,dx$ 2

$= \frac{15}{2}$ 2

**47.(a)**

$$\frac{dy}{1+y^2} = \frac{dx}{1+x^2}$$ 2

$$\int \frac{dy}{1+y^2} = \int \frac{dx}{1+x^2}$$ 1

$$\tan^{-1} y = \tan^{-1} x + c$$ 2

**OR**

**47.(b)**

| $p$ | $q$ | $r$ | $q \to r$ | $p \wedge q$ | $p \to (q \to r)$ | $(p \wedge q) \to r$ |
|---|---|---|---|---|---|---|
| T | T | T | T | T | T | T |
| T | T | F | F | T | F | F |
| T | F | T | T | F | T | T |
| T | F | F | T | F | T | T |
| F | T | T | T | F | T | T |
| F | T | F | F | F | T | T |
| F | F | T | T | F | T | T |
| F | F | F | T | F | T | T |

4

$$p \to (q \to r) \equiv (p \wedge q) \to r$$ 1

No e i) h o r rows and columns need not be same as in the scheme

ii l an m st ke in the table then award two marks for the table.