# Further Mathematics 9649 ANNEX

| Paper 1 | | |
|---|---|---|
| **QN** | **TOPIC** (***Pls Select***) | **ANSWERS** (***Exclude graphs and text answers***) |
| 1 | Numerical Methods | (b) 1.2 (c) 1.276 |
| 2 | Recurrence Relations | |
| 3 | Recurrence Relations | (a) $x_n = A\left(\frac{1+i}{2\sqrt{a}}\right)^n + B\left(\frac{1-i}{2\sqrt{a}}\right)^n$<br>(b) $x_n = \left(\frac{1}{\sqrt{6}}\right)^n \left(3\cos\left(\frac{n\pi}{4}\right) - \sin\left(\frac{n\pi}{4}\right)\right)$ (c) $\left(\frac{1}{2}, \infty\right)$ |
| 4 | Linear Algebra | (c) $\begin{pmatrix} -1 \\ 1 \\ 0 \\ 1 \end{pmatrix}$ (d) Least $k = 26$, $\begin{pmatrix} 0.80 \\ 1 \\ 1 \\ 0.44 \end{pmatrix}$ |
| 5 | Linear Algebra | (a) $\begin{pmatrix} b+a \\ b-a \end{pmatrix}$ (b) $\mathbf{A}^2 = \begin{pmatrix} b^2 & 0 \\ 0 & b^2 \end{pmatrix}$, $\mathbf{A}^{-1} = \frac{1}{b^2}\begin{pmatrix} a & b+a \\ b-a & -a \end{pmatrix}$<br>(c) $\mathbf{A}^n = \begin{cases} b^{n-1}\mathbf{A} & \text{if } n \text{ is odd} \\ b^n \mathbf{I}_2 & \text{if } n \text{ is even} \end{cases}$ |
| 6 | Conics | (a) $m = A + B\cos\alpha,\ n = B\sin\alpha$<br>(b)(ii) $\frac{1}{r} = \frac{e}{a}\cos\theta + \frac{1}{a}\cos(\theta - \alpha)$ |
| 7 | Complex Numbers | (a) $\text{Re}(z) = \left(\frac{k^2+1}{k}\right)\cos\theta,\ \text{Im}(z) = \left(\frac{k^2-1}{k}\right)\sin\theta$, $\frac{2k}{k^2+1}$<br>(b)(iii) $\frac{3\pi}{4}$ or $-\frac{3\pi}{4}$ (b)(iv) 5 |
| 8 | Linear Algebra | (d) $\mathbf{v} = \begin{pmatrix} \frac{2}{3} \\ \frac{1}{3} \\ 0 \end{pmatrix} + \lambda\begin{pmatrix} -3 \\ -4 \\ 1 \end{pmatrix}$ (f) $\left(\frac{1}{3}, \frac{2}{3}, \frac{1}{3}\right)$ |
| 9 | Apps of Integration (incl. polar) | (a) $y = 0, y = -\frac{\sqrt{3}}{3}x,\ y = -\sqrt{3}x,\ x = 0$ (b)(ii) 9.52 units$^2$<br>(c) 245 |
| 10 | Conics | (a) $e = \frac{R-r}{R+r}$ (b)(i) 11600 km (b)(ii) 4.85 hrs (c) 0.267 AU |
| 11 | FM P1 Q11 Topic | |
| 12 | FM P1 Q12 Topic | |

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|---|---|---|
| 13 | FM P1 Q13 Topic | |
| 14 | FM P1 Q14 Topic | |

## Paper 2

| QN | TOPIC (*Pls Select*) | ANSWERS (*Exclude graphs and text answers*) |
|---|---|---|
| 1 | Complex Numbers | |
| 2 | Linear Algebra | (c) 12 (d) $y=\frac{1}{\sqrt{3}}x$, $y=-\sqrt{3}x$ |
| 3 | Differential Equations | (i) $b=A\mathrm{e}^{-\alpha t}+B\mathrm{e}^{-\beta t}+\frac{1}{\alpha}$ (ii) $b=1.4\mathrm{e}^{-0.2t}+1.2\mathrm{e}^{-0.7t}+5$ (iii) 4.07 hours |
| 4 | Apps of Integration (incl. polar) | (ii) $\frac{\pi}{2}-\alpha$ (iii) $\tan(\theta+\alpha)$, $\alpha$ (iv) $\sec\alpha\left[\mathrm{e}^{\pi\cot\alpha}-1\right]$ |
| 5 | Numerical Methods | (a) $\frac{\alpha^2}{32}\left[\left(8\cos^2\alpha\right)+\left(\alpha^4-7\alpha^2+8\right)\cos^2\left(\frac{\alpha}{2}\right)\right]$ (b)(ii) $y(\alpha)=\frac{5}{4}-\frac{5}{4}\mathrm{e}^{-\alpha^2}-\frac{3}{4}\alpha^2+\frac{1}{8}\alpha^4$ |
| 6 | Hypo Testing & Confidence Intervals | 91.5 |
| 7 | Chi-square Tests | $p$-value = $9.37\times10^{-5}$, reject $\mathrm{H}_0$ |
| 8 | Continuous RV | (a) $\alpha$ (b) $2\gamma$ (d) $\frac{1}{\pi\left[1^2+\left(c-0\right)^2\right]}$, $\alpha=0,\gamma=1$ |
| 9 | Discrete RV | (iii) 0.110 (iv) 0.0294 (v) 148 seconds |
| 10 | Non-parametric Tests | (iii) $p$-value = 0.172, do not reject $H_0$ (iv) $T$ = 23, do not reject $H_0$ |
| 11 | FM P2 Q11 Topic | |
| 12 | FM P2 Q12 Topic | |
| 13 | FM P2 Q13 Topic | |
| 14 | FM P2 Q14 Topic | |