GCE Further Mathematics Advanced (9FM0)

Pearson Edexcel Level 3 GCE

Paper 1: Core Pure Mathematics 1 (9FM0/01) — June 2026 Mark Scheme Table

Question	Scheme	Marks	AO
1(a)	Applies matrix multiplication $M \times P$:	**M1**	1.1a
	$x'=k\cos\theta - k\sin\theta$ $y'=2$ $z' = k \sin \theta + k \cos \theta$		
	Coordinates of image are $(k \cos \theta - k \sin \theta, 2, k \sin \theta + k \cos \theta)$	**A1**	1.1b
1(b)	Substitute x' and z' into $x + z = 4$:	**M1**	2.1
	$(k \cos \theta - k \sin \theta) + (k \sin \theta + k \cos \theta) = 4 \Rightarrow 2k \cos \theta = 4$		
	Completes steps cleanly to show $k = 2 / \cos \vartheta = 2 \sec \vartheta$ *cso*	**A1***	1.1
1(c)	$4 = 2\sec \theta \Rightarrow \cos \theta = 1/2 \Rightarrow \theta = \pi/3$ **Rotation through 60° (or π/3) anticlockwise about the y-axis**	**B1**	b 2.2a
	(Total for Question 1 is 5 marks)	**5**	
2(a)	Finds $z^* = \lambda + 2i$ and $z^2 = (\lambda - 2i)^2 = \lambda^2 - 4 - 4\lambda i$	**M1**	1.1a
	Calculates $3z^* + z^2 = 3(\lambda + 2i) + \lambda^2 - 4 - 4\lambda i$	**M1**	1.1a
	Groups real and imaginary terms: $= (\lambda^2 + 3\lambda - 4) + i(6 - 4\lambda)$	**A1***	2.1
2(b)	Sets real part = 0 $\Rightarrow \lambda^2 + 3\lambda - 4 = 0 \Rightarrow (\lambda + 4)(\lambda - 1) = 0$	**M1**	3.1a
	Since $\lambda > 0$, rejects negative root to find $\lambda = 1$	**A1**	1.1
2(c)(i)	For $\lambda = 1, z = 1 - 2i$. Modulus $\lvert z \rvert = \sqrt{1^2 + (-2)^2} = \sqrt{5}$	**B1**	b
2(c)(ii)	Uses $\arg z = \arctan(y/x)$ in the fourth quadrant:	**M1**	1.1
	$\arg z = -1.12$ radians (to 3 sig figs)	**A1**	b
2(d)	Draws a correctly labeled single Argand diagram containing axes.	**M1**	1.1a
	Correctly plots z in Q4, z^* in Q1, and $3z^* + z^2 = 2i$ on the imaginary axis.	**A1**	1.1
	(Total for Question 2 is 10 marks)	**10**	b 1.1a
3(a)	Expands $(2r - 1)^3 = 8r^3 - 12r^2 + 6r - 1$	**M1**	1.1a 1.1
	Applies formulas: $8[n^2(n+1)^2/4] - 12[n(n+1)(2n+1)/6] + 6[n(n+1)/2] - n$	**M1**	1.2 b
	Factors out n and simplifies expression algebraically.	**A1**	2.1
	Obtains $2n$&sup4;$-n^2=n^2(2n^2-1)$. Hence $a = 2, b = -1$	**A1**	1.1
3(b)	Splits the summation interval: $\sum_{r=1}^{50} (2r-1)^3 - \sum_{r=1}^{5}(2r-1)^3$	**M1**	b
	$[50^2(2(50^2) - 1)] - [5^2(2(5^2) - 1)] = 12{,}497{,}500 - 1{,}225 = 12{,}496{,}275$	**A1**	3.1a
	(Total for Question 3 is 7 marks)	**7**	1.1 b

Question	Scheme	Marks	AO
4	Applies Mean Value theorem formula: *Mean=* $(1/(5-0)) \times \int [x^3 \sqrt{(25-x^2)}]\, dx$	M1	1.2
	Integrates via substitution or inspection: $\int x(25-x^2)(\text{^}-1/2)dx = -\sqrt{(25-x^2)}$	M1	1.1a
	Correct analytical antiderivative obtained:	A1	1.1
	Evaluates limits: $[-\sqrt{(0)} - (-\sqrt{25})] = 5$	M1	b
	Multiplies by $1/5$ to get Mean Value = 1	A1	2.1
	(Total for Question 4 is 5 marks)	**5**	1.1
5(a)	Writes down polynomial relationships for $16x^3 - 156x^2 + 260x + 75 = 0$:	B1	b 1.1
	(i) $\alpha + \beta + \gamma = 39/4$, (ii) $\alpha\beta + \alpha\gamma + \beta\gamma = 65/4$, (iii) $\alpha\beta\gamma = -75/16$	B1	b
5(b)	Uses substitution $\beta = 3\alpha$ to get $4\alpha + \gamma = 39/4 \Rightarrow \gamma = 39/4 - 4\alpha$	M1	1.1
	Substitutes into pair-sum equation and solves resulting quadratic equation.	A1	b
	Finds complete correct root set: $\alpha = 5/4$, $\beta = 15/4$, $\gamma = 19/4$	A1	3.1a
	(Total for Question 5 is 5 marks)	**5**	1.1
6(a)	Forms Auxiliary Equation: $m^2 + 4m + 148 = 0 \Rightarrow m = -2 \pm 12i$	M1	b 1.1a
	Writes down Complementary Function: $x\_CF = e(\text{^}-2t)(A \cos 12t + B \sin 12t)$	A1	1.1 1.1
	Finds Particular Integral: Try $x = k \Rightarrow 148k = 4440 \Rightarrow k = 30$	B1	b b
	States General Solution: $x = e(\text{^}-2t)(A \cos 12t + B \sin 12t) + 30$	A1	1.1
	Applies initial condition $t = 0, x = 28 \Rightarrow 28 = A + 30 \Rightarrow A = -2$	M1	b
6(b)	Finds value for first constant:	A1	1.1
	Differentiates general solution and uses initial speed boundary condition.	M1	b
	Finds $B = -1/3$ or contextually appropriate coefficient model formula.	A1	3.1
	(Total for Question 6 is 9 marks)	**9**	b
	Identifies Geometric Progresson with $a = e(\text{^}i\vartheta)$ and ratio $r = e(\text{^}2i\vartheta)$:	M1	1.1
7(i)	Applies sum formula: $S = e(\text{^}i\theta) * [1 - e(\text{^}20i\theta)] / [1 - e(\text{^}2i\theta)]$	M1	1.1a b
	Factors out exponential midpoints to arrive cleanly at $e(\text{^}10i\vartheta) \sin(10\vartheta) / \sin \vartheta$	A1*	2.1 2.1
	Constructs the infinite systemic series: $P + iQ = e(\text{^}i\vartheta) + (1/2)e(\text{^}3i\vartheta) + \ldots$	M1	1.1 3.2a
7(ii)	Identifies common ratio $r = (1/2)e(\text{^}2i\vartheta)$ and uses $S\_\infty = a / (1 - r)$	M1	b
	Expands and rationalizes the fractional complex expression.	A1	3.1a
	Confirms matching structures with target components cleanly.	A1	1.1a
	(Total for Question 7 is 7 marks)	**7**	2.1
	Uses the expression *(2 cos θ)&sup7; = (z + 1/z)&sup7;*	M1	1.1
8(a)	Applies Binomial Expansion completely across all 8 terms.	A1	b 1.1a
	Groups elements into paired components: $(zn\text{^} + 1/zn\text{^}) = 2 \cos(n\vartheta)$	M1	1.1
			b

2.1

Question	Scheme	Marks	AO
	Obtains *128 cos&sup7;θ = 2 cos 7θ + 14 cos 5θ + 42 cos 3θ + 70 cos θ*	**A1**	1.1
	Divides by 2 to yield target: $a = 1, b = 7, c = 21, d = 35$	**A1**	b
8(b)	Sets up volume formula mapping region boundaries: $V = \pi \int y^2 \, dx$	**M1**	1.1
	Applies substitution identity from part (a) inside integral.	**M1**	b
	Integrates trigonometric terms successfully term by term.	**A1**	3.1a
	Evaluates definite boundary limits accurately.	**M1**	1.1a
	Yields correct numerical volume response to 3 significant figures.	**A1**	2.1
	(Total for Question 8 is 12 marks)	**12**	1.1
9	Differentiates first rate expression: $d^2x/dt^2 = 5\, dy/dt$	**M1**	b 3.1a
	Substitutes *dy/dt* expression to decouple equation:	**M1**	3.2a 1.1a
	Obtains correct uniform second-order ODE for variable *x*.	**A1**	1.1b
	Solves the characteristic equation to locate system eigenvalues.	**M1**	1.1a
	Constructs complete correct complementary form function.	**A1**	1.1b
	Uses original formulas to derive matching solution step for *y(t)*.	**M1**	2.1
	Derives algebraic constants via initial boundaries.	**A1**	1.1b
	Applies mass values at initial timestamp.	**B1**	3.2b
	Isolates and computes the numerical values of both parameters.	**M1**	1.1a
	Assembles explicit equation systems for mass vector profiles over time.	**A1**	1.1b
	Interprets long-term tracking tendencies using calculus rules.	**A1**	2.2a
	Performs rigorous limit assessments as time parameter grows large.	**M1**	3.5c
	Arrives at exact matching chemical balance quantities.	**A1**	1.1b
	(Total for Question 9 is 15 marks)	**15**	