Assessment Schedule – 2008-

Calculus: Manipulate real and complex numbers, and solve equations (90638)

Evidence Statement

	Achievement Criteria	Q.	Evidence	Code	Judgement	Sufficiency
Achievement	Manipulate real and complex numbers, and solve equations.	ONE	$\frac{-18}{13}-\frac{11\sqrt{3}}{13}$	A1	Or equivalent. *Decimal to 3sf*	**Achievement:** **Four** of Code A **including** at least **One** of Code A1 **and** **One** of Code A2.
		TWO (a)	$x=1.5$	A2	Exact answer required.	
		(b)	$x=-\frac{p}{3}$	A2	Exact answer required.	
		THREE (a)(i)	$-7+11\text{i}$	A1	Or equivalent.	
		(a)(ii)	$\frac{-2}{5}-\frac{\text{i}}{5}$	A1	Or equivalent.	
		(b)	$2cis\frac{\pi}{2}$ or $2i$	A1	Or equivalent. *Accept if argument not simplified but must have zero real component.*	

	Achievement Criteria	Q.	Evidence	Code	Judgement	Sufficiency
Achievement with Merit	Solve more complicated equations.	FOUR	$\ln\frac{(3x-2)}{(x+3)} = \ln k^2$ $\frac{3x-2}{x+3} = k^2$ $3x-2 = k^2x+3k^2$ $x(3-k^2) = 3k^2+2$ $x = \frac{3k^2+2}{3-k^2}$	A1 (A2) M	Alternatives: $x = \frac{-11}{k^2-3} - 3$ or $x = \frac{11}{3-k^2} - 3$	**Merit:** Achievement **plus** **Two** of Code M **OR** **Three** of Code M.
		FIVE	$z^3 - pz^2qz - r = 0$ $(z-(2+3i))(z-(2-3i))(z-\alpha) = 0$ Multiplying constants: $(2+3i)(2-3i)(\alpha) = r$ $13\alpha = r$ $\therefore \alpha = \frac{r}{13}$ Or, equating coefficients: $p(z) = z3-(\alpha+4)z^2+(4\alpha+13)z-13\alpha$ $-13\alpha = -r \quad (1)$ $(\alpha+4) = p \quad (2)$ $4\alpha+13 = q \quad (3)$ $\therefore \alpha = \frac{r}{13} \quad or \quad \alpha = p-4$	A1 (A2) M	Multiplication of conjugates. ($z^2-4z+13$) or *-5-12i* and *-46-9i* Also accept: $\alpha = \frac{q-13}{4}$ *mei*	

	Achievement Criteria	No.	Evidence	Code	Judgement	Sufficiency
Achievement with Excellence	Solve problem(s) involving real or complex numbers.	SIX	$\sqrt{\frac{A.H}{2}}$ $= \sqrt{\frac{(x+y)}{4}.\frac{2}{\frac{1}{x}+\frac{1}{y}}}$ $= \sqrt{\frac{(x+y)}{4}.\frac{2xy}{(x+y)}}$ $= \sqrt{\frac{xy}{2}}$ so, $LHS = \sqrt{\frac{AH}{2}} - \sqrt{2}G + \frac{G}{\sqrt{2}}$ $= \frac{\sqrt{xy}}{\sqrt{2}} - \sqrt{2}\sqrt{xy} + \frac{\sqrt{xy}}{\sqrt{2}}$ $= \frac{2\sqrt{xy}}{\sqrt{2}} - \frac{2\sqrt{xy}}{\sqrt{2}}$ $= 0$ $= RHS \qquad QED$	(A1) M (M) E	*Error in logic, with correct algebra gets M_L*	**Excellence:** Merit **plus** code E **OR** Two of code E.
		SEVEN (a)	$z^3 = w$ $z^3 = wcis(0 + 2n\pi) \quad or \quad z^3 = wcis(\pi + 2n\pi)$ $z_1 = w^{\frac{1}{3}}cis(0) \qquad z_1 = w^{\frac{1}{3}}cis(\frac{\pi}{3})$ $z_2 = w^{\frac{1}{3}}cis(\frac{2\pi}{3}) \qquad z_2 = w^{\frac{1}{3}}cis(\pi)$ $z_3 = w^{\frac{1}{3}}cis(\frac{4\pi}{3}) \qquad z_3 = w^{\frac{1}{3}}cis(\frac{5\pi}{3})$	A1 (A2) M	Or equivalent. Conversion to polar form. *Must show 3 correct solutions.* *Accept positive or negative angles.* *Accept angle in degrees.*	
		(b)	$z^k = w$ $z^k = wcis(2n\pi),\ with\ k\ solutions$ $z_1 = w^{\frac{1}{k}}cis(0)$ $z_2 = w^{\frac{1}{k}}cis(\frac{2\pi}{k})$ $z_3 = w^{\frac{1}{k}}cis(\frac{4\pi}{k})$..... $z_k = w^{\frac{1}{k}}cis(\frac{2(n-1)\pi}{k})$ Geometric sequence, $r = cis(\frac{2\pi}{k})$ Sum = $\frac{z1(r^k - 1)}{r - 1}$ but $r^k = cis(2\pi) = 1$ Hence sum = 0	M E	Or equivalent.	

Judgement Statement

Achievement	Achievement with Merit	Achievement with Excellence
Manipulate real and complex numbers, and solve equations. $4 \times$ A including at least $1 \times$ A1 and $1 \times$ A2	Solve more complicated equations. Achievement plus $2 \times$ M OR $3 \times$ M	Solve problem(s) involving real or complex numbers. Achievement with Merit plus $1 \times$ E OR $2 \times$ E

The following Mathematics specific marking conventions may also have been used when marking this paper:

- Errors are circled.
- Omissions are indicated by a caret (^).
- **NS** may have been used when there was not sufficient evidence to award a grade.
- **CON** may have been used to indicate 'consistency' where an answer is obtained using a prior, but incorrect answer and **NC** if the answer is not consistent with wrong working.
- **CAO** is used when the 'correct answer only' is given and the assessment schedule indicates that more evidence was required.
- $\mathbf{M_L}$ indicates a logic error and the highest grade possible is an M as a result.
- **RAWW** indicates right answer, wrong working.
- **R** for 'rounding error' and **PR** for 'premature rounding' resulting in a significant round-off error in the answer (if the question required evidence for rounding).
- **U** for incorrect or omitted units (if the question required evidence for units).
- **MEI** may have been used to indicate where a minor error has been made and ignored.
- **IMS** indicates an incorrect mathematical statement.