

Q	Marking instructions	AO	Mark	Typical solution
9(a)	Write in a form to which the binomial expansion can be applied Must be of form $a\left(1 - \frac{x^2}{2}\right)^{\frac{1}{2}}$	3.1a	M1	$\sqrt{4 - 2x^2} = 2\left(1 - \frac{x^2}{2}\right)^{\frac{1}{2}}$ $\approx 2\left(1 + \frac{1}{2}\left(-\frac{x^2}{2}\right)\right)$ $\approx 2 - \frac{x^2}{2}$
	Completes rigorous argument to obtain correct expansion AG	2.1	R1	
9(b)	Compares their $\frac{x^2}{2}$ to 1 Condones incorrect inequality PI by $ -2x^2 < 4$	1.1a	M1	$\left -\frac{x^2}{2}\right < 1$ $\Rightarrow x < \sqrt{2}$
	Obtains correct range of values ACF	1.1b	A1	
9(c)	Explains that as 0.4 radians is small therefore $\cos x \approx 1 - \frac{x^2}{2}$ Must refer to 0.4 and small angle approximation for $\cos x$	2.4	E1	As 0.4 is small $\cos x \approx 1 - \frac{x^2}{2}$
	Uses half of their expansion from 9(a) as the integrand	1.1a	M1	$\int_0^{0.4} \sqrt{\cos x} \, dx \approx \int_0^{0.4} \sqrt{1 - \frac{x^2}{2}} \, dx$
	Integrates their expression with at least one term correct	1.1a	M1	$\approx \frac{1}{2} \int_0^{0.4} 2 - \frac{x^2}{2} \, dx$
	Obtains correct value must be at least five decimal places Condones $\frac{148}{375}$ CAO	1.1b	A1	$\approx \int_0^{0.4} 1 - \frac{x^2}{4} \, dx$ $\approx \left[x - \frac{x^3}{12} \right]_0^{0.4}$ $\approx 0.4 - \frac{0.4^3}{12}$ ≈ 0.39467
9(d)	States that 1.4 radians is not a small angle so the approximation is not valid Must refer to small angle approximation and 1.4 or State invalid as 1.4 is bigger than 0.664 NB 0.664 is the limiting value for approximation to be valid	2.4	E1	Since 1.4 is not a small angle the approximation is not suitable
	Total		9	