

Wave Function

- [SQA] 1. The displacement, d units, of a wave after t seconds, is given by the formula $d = \cos 20t^\circ + \sqrt{3} \sin 20t^\circ$.
- (a) Express d in the form $k \cos(20t^\circ - \alpha^\circ)$, where $k > 0$ and $0 \leq \alpha \leq 360$. 4
- (b) Sketch the graph of d for $0 \leq t \leq 18$. 4
- (c) Find, correct to one decimal place, the values of t , $0 \leq t \leq 18$, for which the displacement is 1.5 units. 3

part	marks	Unit	non-calc		calc		calc neut		Content Reference :		3.4
			C	A/B	C	A/B	C	A/B	Main	Additional	
(a)	4	3.4			4				3.4.1		Source 1991 Paper 2 Qu. 8
(b)	4	1.2			2	2			1.2.3		
(c)	3	2.3			1	2			2.3.1		

(a)	<ul style="list-style-type: none"> •¹ $k \cos 20t^\circ \cos \alpha^\circ + k \sin 20t^\circ \sin \alpha^\circ$ •² $k \cos \alpha^\circ = 1$ and $k \sin \alpha^\circ = \sqrt{3}$ •³ $k = 2$ •⁴ $\alpha = 60$
(b)	<ul style="list-style-type: none"> •⁵ endpoints: (0,1) or (18,1) •⁶ zeros: (7.5,0) and (16.5,0) •⁷ stationary points: (3,2) and (12,-2) •⁸ correct annotation of graph
(c)	<ul style="list-style-type: none"> •⁹ $2 \cos(20t - 60)^\circ = 1.5$ •¹⁰ $20t - 60 = 41.4 \Rightarrow t = 5.1$ •¹¹ $20t - 60 = -41.4 \Rightarrow t = 0.9$

- [SQA] 2. Find the maximum value of $\cos x - \sin x$ and the value of x for which it occurs in the interval $0 \leq x \leq 2\pi$.

6

Part	Marks	Level	Calc.	Content	Answer	U3 OC4
	6	A/B	CN	T14	max value $\sqrt{2}$ when $x = \frac{7\pi}{4}$	2000 P1 Q10
<ul style="list-style-type: none"> •¹ ss: use e.g. $k \cos(x + a)$ •² ic: expand chosen rule •³ pd: compare coefficients •⁴ pd: process •⁵ pd: process •⁶ ic: interpret trig expression 				<ul style="list-style-type: none"> •¹ e.g. use $k \cos(x + a)$ •² $k \cos x \cos a - k \sin x \sin a$ •³ $k \cos a = 1$ and $k \sin a = 1$ •⁴ $k = \sqrt{2}$ •⁵ $\tan a = 1, a = \frac{\pi}{4}$ (45° is bad form) •⁶ max. value = $\sqrt{2}$ when $x = \frac{7\pi}{4}$ (do not accept 45°) 		

[END OF QUESTIONS]