Question			Answer	Marks	AOs		Guidance
14	(a)		$h_{\max} = 5.15 + 3.4 \times 1 = 8.55$ $h_{\min} = 5.15 - 3.4 \times 1 = 1.75$ These are the correct h values for high and low tide	**B1** **[1]**	**3.4**	Choosing $\cos t = \pm 1$ to give both values must be seen Allow without further comment	Allow for using given h values to find $\cos t = \pm 1$ only if there is a comment that these are max and min values for cos$t$
14	(b)	(i)	When $t = 1$ $8.55 = 5.15 + 3.4\cos(a+b)$ So $\cos(a+b) = 1$ giving $a + b = 0$	**B1** **[1]**	**3.3**	Correctly relating high tide, $t = 1$ and cos 0	Accept 8.55 or $\cos t = 1$ as evidence of high tide
14	(b)	(ii)	Minimum when $(at+b) = 180°$ and $t = 7\frac{1}{3}$ So $\frac{22}{3}a + b = 180$	**B1** **[1]**	**3.3**	Condone the use 7.2 hours here	Allow for $1.75 = 5.15 + 3.4\cos\left(\frac{22}{3}a + b\right)$
14	(b)	(iii)	Solve simultaneously to give $a = 28.42$ to 2 dp	**M1** **A1** **[2]**	**3.3** **3.3**	Attempt to solve simultaneous equations: may be **BC** **AG** (value of b not needed here)	[$b = -28.42$]
14	(c)		Substitute $h = 3$ $3 = 5.15 + 3.4\cos(28.4t - 28.4)$ $\cos(28.4t - 28.4) = -\frac{43}{68}$ $28.4t - 28.4 = 129.2, \quad 230.8$ $t = 5.55, \quad 9.13$ He does not sail between 5.33 am and 9.08 am	**M1** **A1** **A1** **[3]**	**3.4** **3.4** **3.2a**	Attempting to solve trig equation or inequality At least one correct [decimal] value for t Both times correct. Need not convert to hours and minutes. Must indicate between these times	

Question			Answer	Marks	AOs		Guidance
14	(d)		EITHER The model predicts every high tide 8.55 m. The next high tide 8.91 is higher than that so not perfect model.	**B1** **E1** **[2]**	**3.4** **3.5b**	Allow for a comment about the maximum height being wrong. FT their values	
			OR Time difference between high tide and low tide is 6 hr 20 minutes, and between low tide and the next high tide is 5 hours and 40 minutes. The model gives these times as equal, so not perfect model	**B1** **E1** **[2]**		Allow for a comment that the time of the next high tide is wrong. FT their values	
			OR tide reaches 8.91 m when $\cos(at+b)=1.105$ which is impossible	**B1** **E1** **[2]**		Allow for a comment that the height predicted cannot reach 8.91 m. FT their values	
			OR When $t=12.983$ $h=8.35$ which is less than the given value of 8.91 m so the model in not suitable	**B1** **E1** **[2]**		Allow for a comment that the height predicted is not 8.91 m. FT their values	Allow for $t=13$ but not $t=12.59$