Question			Answer	Marks	AO	Guidance
15	(a)		vertical motion with $u\sin\theta$, $a = -g$, $s = 0$ $0 = u\sin\theta t - \frac{1}{2}gt^2$	M1	2.1	<i>suvat</i> equations used with $u\sin\theta$ leading to an expression for the time of flight. Do not allow for time to the top unless subsequently doubled.
			$t=0, \frac{2u\sin\theta}{g}$ horizontal distance <i>R</i> given by $t=\frac{2u\sin\theta}{g}, R=u\cos\theta \times \frac{2u\sin\theta}{g}$	M1	2.1	horizontal motion with $u\cos\theta$, $a=0$ and their expression for <i>t</i> soi Allow sin/cos interchange if consistent with their vertical equation
			$R = \frac{2u^2 \sin\theta \cos\theta}{g}$	A1	2.1	Convincing argument AG Note M0M1A0 for sin/cos interchange
			Alternative method Substitute $t = \frac{x}{u\cos\theta}$ to form equation of the trajectory $y = u\sin\theta \times \frac{x}{u\cos\theta} - \frac{1}{2}g\left(\frac{x}{u\cos\theta}\right)^2$	M1		Allow equivalent formula quoted
			Equate <i>y</i> to zero and attempt to rearrange	M1		Allow sin/cos interchange if consistent with their horizontal equation
			$R = \frac{2u^2 \sin\theta \cos\theta}{g}$	A1		Convincing argument AG
				[3]		

15	(b)	Max height H when $v_y = 0$			
		$0 = (u\sin\theta)^2 - 2gH$	M1	3.1b	<i>suvat</i> equation(s) with $v_y = 0$ leading to an equation for <i>H</i> not involving <i>t</i> . Allow sin/cos interchange if consistent with their (a)
		$H = \frac{u^2 \sin^2 \theta}{2g}$	A1	1.1b	correct expression for H
		Max height exceeds range when $\frac{u^2 \sin^2 \theta}{2g} > \frac{2u^2 \sin \theta \cos \theta}{g}$	M1	1.1a	Compares their H with given R Allow = used to find boundary value
		$\tan\theta > 4$	M1	1.1a	simplifies the inequality to an inequality for $tan\theta$ (or equation)
		$76.0^{\circ} < \theta [< 90^{\circ}]$	A1	1.1b	must be an inequality for θ . Do not penalise for omission of 90°
			[5]		