Question Number	Answer	Mark
4(a)	$24^2 = (-U)^2 + 2g \times 28.4$	M1A1
	(U =) 4.4	A1 (3)
	ALT 1: $28.4 = 24t - \frac{1}{2}gt^2 \Rightarrow t = \frac{142}{49}$ or 2	
	$24 = -U + g \times \frac{142}{49}$	M1A1
	(U =) 4.4	A1 (3)
	ALT 2: Using energy: $\frac{1}{2}m(24^2 - U^2) = mg \times 28.4$	M1A1
	(U =) 4.4	A1 (3)
4(b)	**ALT 1**: $4 = 12t - \frac{1}{2}gt^2$	M1
	t = 0.398022…. or 2.050957…	A1
	Difference of roots **OR** time to top = $\frac{12}{9.8} = 1.224$ **and** $2 \times (1.224 - 0.3980..)$	**dM**1
	Answer: 1.7 or 1.65 (s) Do **not** apply isw.	A1
	$4 = 6t - \frac{1}{2}gt^2$	M1
	No roots.	A1 (6)
	ALT 2: $v = \sqrt{12^2 - 2 \times 9.8 \times 4} = 8.099..$ so half time = $\frac{8.099..}{9.8}$ Or time from ground to 4 m given by $\frac{12 - 8.099..}{9.8}$	M1
	half time = 0.826.. or time from ground to 4 m = $0.3980..$	A1
	Total time = 2 × 0.826..	**dM**1
	Answer: 1.7 or 1.65 (s)	A1
	$v = \sqrt{6^2 - 2 \times 9.8 \times 4}$ **OR** $0 = 6^2 - 2 \times 9.8 \times h \Rightarrow h = 1.8..$	M1
	No real value **OR** 1.8.. < 4	A1 (6)
	ALT 3: $0 = 12^2 - 2 \times 9.8h$ so $h =$ 7.3469.. $(7.3469.. - 4) = \frac{1}{2} \times 9.8t^2$ **OR** $0^2 = v^2 - 2 \times 9.8 \times 3.3469 \Rightarrow v = 8.099..$ so half time = $\frac{8.099..}{9.8}$	M1
	half time, t = 0.826..	A1

	Total time = 2 × 0.826..	**dM**1
	Answer: 1.7 or 1.65 (s)	A1
	$v = \sqrt{6^2 - 2\times 9.8\times 4}$ **OR** $0 = 6^2 - 2\times 9.8\times h \Rightarrow h = 1.8..$	M1
	No real value **OR** 1.8.. < 4	A1 (6)
		(9)
	Notes	
4(a)	M1: Complete method to find an equation in *U* (or *u*) only. Condone sign errors. **ALT** M0: if they use the smaller of their two times.	
	A1: Correct equation in *U* only.	
	A1: cao. A0 for a fraction.	
4(b)	M1: Complete method to find a relevant time. Condone sign errors. M0 if use of 12 is not seen	
	A1: **One** correct relevant time (0.398022…. or 2.050957…) Allow rounded to 2sf or better	
	dM1: Complete method to find required time, dependent on M1	
	A1: cao	
	M1: Complete method to show it never reaches a height of 4 m again **N.B.** This is an independent M mark M0 if use of 6 is not seen.	
	A1: Correct relevant statement	