

Question Number	Scheme	Marks
<b>4(a)</b>	Max ht $v = 0$ . $v = u - gt \Rightarrow T = \frac{u}{g}$	M1A1 (2)
<b>(b)</b>	Max ht $H = ut + \frac{1}{2}at^2 = \frac{u^2}{g} - \frac{u^2}{2g} = \frac{u^2}{2g}$ * Given answer* Or use of $v^2 = u^2 + 2as$	M1A1 (2)
<b>(c)</b>	$-3 \times \frac{u^2}{2g} = ut - \frac{1}{2}gt^2$ $-3u^2 = 2ugt - g^2t^2$ $g^2t^2 - 2ugt - 3u^2 = 0$ , $gt = \frac{2u \pm \sqrt{4u^2 + 12u^2}}{2}$ $t = \frac{3u}{g} = 3T$	M1  DM1 A1 A1 (4)
<b>(c) alt</b>	$-4H = -\frac{1}{2}gt^2$ Total time $= T + \sqrt{\frac{8H}{g}} = T + \sqrt{\frac{8u^2}{2g^2}}$ $= T + 2T = 3T$	M1  DM1A1 A1 (4)
		[8]

#### Notes for Question 4

##### Question 4

In this question, condone sign errors in a *suvat* equation for the M mark, but a missing term is M0 or an incorrect term is M0. An incorrect *suvat* formula is M0

Allow use of symmetry of motion.

e.g. in (a), using  $v = u + at$ , either  $0 = u - gT$  or  $u = 0 + gT$

##### Question 4(a)

M1 for use of *suvat* to obtain an equation in  $T$ ,  $u$  and  $g$  only.

A1 for  $T = u/g$  correctly obtained.

##### Question 4(b)

M1 for use of *suvat* to obtain an equation in  $H$ ,  $u$  and  $g$  only.

A1 for  $H = u^2/2g$  correctly obtained (**given answer**)

##### Question 4(c) Watch out for $t/T$ confusion (N.B. if only $T$ 's used, M0DM0)

First M1 for a complete method to find the *total* time in terms of  $u$ ,  $g$ ,  $H$  or  $T$ :-

either:  $3H = -ut + \frac{1}{2}gt^2$

or:  $4H = \frac{1}{2}gt^2$  and  $t + T$

or:  $v^2 = u^2 + 6gH$  and  $v = -u + gt$ , with  $v$  eliminated

Second M1, **dependent on first M1**, for producing an expression, in terms of  $u$ ,  $g$ ,  $H$  or  $T$ , for the total time, by solving a quadratic

First A1 for any correct expression for the total time in terms of  $u$ ,  $g$ ,  $H$  or  $T$ .

Second A1 for  $3T$  cso