Year 1 Applied - Exam Questions SUVATS (Answers)

Q1.

Question	Scheme	Marks	AOs
(a)	$14.7 = -14.7 + 9.8T$ or $0 = 14.7T - \frac{1}{2} \times 9.8T^2$ or $0 = 14.7 - 9.8 \times \left(\frac{1}{2}T\right)$ oe	M1	3.4
	$T = 3$	A1	1.1b
		(2)	
(b)	$s_1 = \frac{(14.7+0)}{2} \times 1.5$ $(11.025 \text{ or } \frac{441}{40})$	M1	1.1b
	$s_2 = \frac{1}{2} \times 9.8 \times 2.5^2$ $(30.625 \text{ or } \frac{245}{8})$ **OR** $s_3 = 14.7 \times 1 + \frac{1}{2} \times 9.8 \times 1^2$ $(19.6 \text{ or } \frac{98}{5})$ **OR** $-s_3 = 14.7 \times 4 - \frac{1}{2} \times 9.8 \times 4^2$ (- 19.6) (allow omission of – on LHS)	M1	1.1b
	Total distance = $s_1 + s_2$ **OR** $2s_1 + s_3$	M1	2.1
	= 41.7 m or 42 m	A1	1.1b
		(4)	
(c)	e.g. Take account of the dimensions of the stone (e.g. allow for spin), do not model the stone as a particle, use a more accurate value for g	B1	3.5c
		(1)	
			(7 marks)

Notes:		If they use g = 9.81 or 10, penalise once for whole question.
a	M1	Complete method to find T, condone sign errors (M0 if they only find time to top)
	A1	$T = 3$ correctly obtained.
b	M1	Complete method to find one key distance
	M1	Correct method to find another key distance
	M1	Complete method to find the total distance
	A1	41.7 or 42 (after use of $g = 9.8$)
c	B1	B0 if there are incorrect extra refinements but ignore extra incorrect statements.

Q2.

Question Number	Scheme	Marks
(a)	$s = vt - \frac{1}{2}at^2$ $40 = 10 \times 5 - \frac{1}{2}a5^2$ $a = 0.8$	M1 A2 A1 (4)
(b)	Finding u ($= 6$) $s = ut + \frac{1}{2}at^2$ (A to M) $20 = 6t + \frac{1}{2}0.8t^2$ $t = \frac{-15 \pm \sqrt{225 + 200}}{2}$ $= 2.8$ or 2.81 or better	M1 M1 A1 **DM1** A1 (5)
	Alternative :	
	Finding v ($= \sqrt{68}$) $s = vt - \frac{1}{2}at^2$ (A to M) $20 = \sqrt{68}t - \frac{1}{2}0.8t^2$ $t = \frac{\sqrt{68} \pm \sqrt{68 - 32}}{0.8}$ $= 2.8$ or 2.81 or better	M1 M1 A1 **DM1** A1 (5)
	Alternative :	
	$s = vt_1 - \frac{1}{2}at_1^2$ (M to B) $20 = 10t_1 - \frac{1}{2}0.8t_1^2$ $t_1 = \frac{10 \pm \sqrt{100 - 32}}{0.8}$ $= 2.192$ $t = 5 - t_1 = 2.8$ or 2.81 or better	M2 A1 **DM1** A1 (5) **9**

	Notes	
(a)	First M1 for a complete method to produce a value for a. They may use two (or more equations) and solve for a.(see possible equations) A2 if all correct, A1A0 for one error Third A1 for 0.8 (m s^{-2}) Possible equations: $40 = 5u + \frac{1}{2}a.5^2$ $10^2 = u^2 + 2a.40$ $10 = u + 5a$ $40 = \frac{(u+10)}{2}.5$	
(b)	First M1 for attempt to find a value for u (This may have been done in part (a) but MUST be used in (b)) Second M1 for a complete method (may involve 2 or more *suvat* equations) for finding an equation in t *only* First A1 for a correct equation Third M1, **dependent** on previous M, for solving their equation for t Second A1 for 2.8 (s) or better or $\frac{5(2\sqrt{17}-6)}{4}$; $\frac{40}{6+2\sqrt{17}}$	

Q3.

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

Notes for Question

Question

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 (a)

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

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

Question (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 (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

Q4.

Question Number	Scheme	Marks
(a)	$v = u + at(\uparrow) \Rightarrow 0 = u - g(\frac{25}{14})$	M1 M(A)1
	$u = 17\frac{1}{2}$ *	A1
		(3)
(b)	$v^2 = u^2 + 2as(\uparrow) \Rightarrow 0^2 = 17.5^2 - 2gs$	M1
	$s = 15.6$ (m) or 16 (m)	A1
		(2)
(c)	$s = ut + \frac{1}{2}at^2(\uparrow) \Rightarrow 6.6 = 17.5t - \frac{1}{2}gt^2$	M1
	$4.9t^2 - 17.5t + 6.6 = 0$	A1
	$t = \frac{17.5 \pm \sqrt{(17.5^2 - 129.36)}}{9.8} = \frac{17.5 \pm 13.3}{9.8}$	DM1
	$t = 3.142..$ (22/7) or $0.428\ldots$(3/7)	A1
	$T = t_2 - t_1 = 2.71$ (2.7)	DM1 A1 (6)
	OR	
	$v^2 = u^2 + 2as(\uparrow) \Rightarrow v^2 = 17.5^2 - 2g\text{x}6.6$	
	$v = \pm 13.3$	
	$v = u + at(\uparrow) \Rightarrow \pm 13.3 = 17.5 - gt$	M1A1
	$t = \frac{17.5 \pm 13.3}{9.8}$	DM1
	$= 3.14..$ (22/7) or 0.428..(3/7)	A1
	$T = 3.14.. - 0.428.. = 2.71$ or 2.7	DM1 A1 (6)
	OR	
	$v^2 = u^2 + 2as(\uparrow) \Rightarrow v^2 = 17.5^2 - 2g\text{x}6.6$ or $0^2 = u^2 - 2g\text{x}(15.625 - 6.6)$	
	$v = 13.3$ $\quad u = 13.3$	
	$v = u + at(\uparrow) \Rightarrow 0 = 13.3 - gt$	M1 A1
	$t = \frac{13.3}{g}$	DM1 A1
	$T = 2\text{ x }\frac{13.3}{g} = 2.7$ or 2.71	DM1 A1 (6)
		11

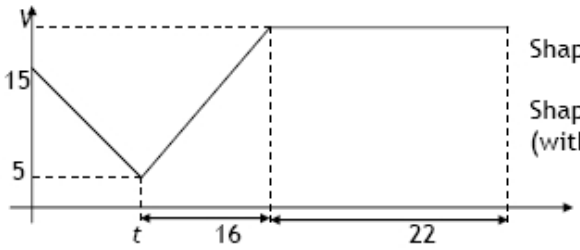
Q5.

Question Number	Scheme	Marks
(a)	$0^2 = u^2 - 2\text{x}9.8\text{x}40$ $u = 28 \text{ m s}^{-1}$ ** GIVEN ANSWER	M1 A1 A1 (3)
(b)	$33.6 = 28t - \frac{1}{2}9.8t^2$ $4.9t^2 - 28t + 33.6 = 0$ $t = \dfrac{28 \pm \sqrt{28^2 - 4\text{x}4.9\text{x}33.6}}{9.8}$ $= 4 \text{ s or } (1.7 \text{ s or } 1.71 \text{ s})$	M1 A1 M1 A1 A1 (5) **8**

Q6.

Question Number	Scheme	Marks
(a)	$-6.45 = u - 9.8 \times 0.75$ $0.9 = u$ **	M1 A1 A1 **(3)**
(b)	$0 = 0.81 - 2 \times 9.8 \times s$ $s = 0.041$ or 0.0413	M1 A1 **(2)**
(c)	$h = -0.9 \times 0.75 + 4.9 \times 0.75^2$ $h = 2.1$ or 2.08	M1 A1 A1 **(3)** **[8]**

Q7.

Question Number	Scheme	Marks
(a)	 Shape 'V' Shape for last 22s (with $V > 15$) Figures	B1 B1 B1 (3)
(b)	$\frac{1}{2}(15 + 5) \times t = 120$ $\Rightarrow t = 12 \rightarrow T = 12 + 16 + 22 = \underline{50\text{ s}}$	M1 M1 A1 (3)
(c)	$120 + \underline{\frac{1}{2}(V + 5).16} + 22V = 1000$ Solve: $30V = 840 \Rightarrow V = \underline{28}$	M1 B1 A1 DM1 A1 (5) **11**

Q8.

Question Number	Scheme	Marks
(a)	$(\uparrow) v^2 = u^2 + 2as$ $0 = 14.7^2 - 2 \times 9.8 \times s$ $s = 11.025$ (or 11 or 11.0 or 11.03) m Height is 60 m or 60.0 m **ft**	M1A1 A1 A1ft (4)
(b)	$(\downarrow) v^2 = u^2 + 2as$ $v^2 = (-14.7)^2 + 2 \times 9.8 \times 49$ $v = 34.3$ or 34 m s^{-1}	M1 A1 A1 (3)
(c)	$(\downarrow) v = u + at$ **OR** $(\downarrow) s = ut + \frac{1}{2}at^2$ $34.3 = -14.7 + 9.8t$ $\quad$ $49 = -14.7t + 4.9t^2$ $t = 5$ $\quad$ $t = 5$	M1 A1 A1 (3) **[10]**

Q9.

Question	Scheme	Marks	AOs
	Equation in t only	M1	2.1
	$-2 = 9t - \frac{1}{2} \leftrightarrow 10t^2$	A1	1.1b
	$5t^2 - 9t - 2 = 0 = (5t+1)(t-2)$	DM1	1.1b
	$T = 2$ (only)	A1	1.1b
		(4)	
			(4 marks)

Notes:

M1: Complete method to give equation in t only. This mark is for a complete method for the TOTAL time i.e. for finding sufficient equations, with usual rules, correct no. of terms in each equation but condone sign errors and g does not need to be substituted

A1: A correct equation **or** correct equations (e.g. if they find the speed, 11 ms^{-1}, when the ball strikes the ground and then use that to find the total time **or** if they split the time (e.g. 0.9s up and 1.1s down or 0.9s + 0.9s + 0.2s))

N.B. $g = 10$ must be substituted in all equations used.

DM1: Dependent on first M1, for solving a 3 term quadratic to find T **or** for solving their equations to find T **or** for solving their equations and adding their split times to find T

A1: $T = 2$ only (i.e. A0 if they give two times)

N.B. If solving a correct quadratic, the DM1 can be implied by a correct answer i.e. the method does not need to be shown, but if there is no method shown and the answer is wrong then award DM0 A0.