AS and A-level MATHS

Forces 1

Mark scheme

Specification content coverage: R1, R2, R3

Question	Solutions	Mark
1 (a)	$0 = 8^2 + 2(-10)s$	1
	$s = 3.2$ m	1
1 (b)	$v = 8 - 10 \times 0.3$	1
	$v = 5$ m s^{-1}	1
	upwards	1
1 (c)	$s = 8t - 5t^2$ Or find t when $v = 0$ and multiply by 2	1
	$0 = 8t - 5t^2$	1
	$t = \dfrac{8}{5} = 1.6$ seconds	1
2 (a)	$-5\mathbf{i} = 4\mathbf{a}$	1
	$\mathbf{a} = -\dfrac{5}{4}$ m s^{-2}	1
2 (b)	$\mathbf{F} = 0.8\left(-\dfrac{5}{4}\right) = -1$ N	1
		1
3 (a)	Four term equation of motion for the combined body	1
	$D - 500 - 900 = 1.2(600 + 800)$	1
	$D = 3080$ N	1
3 (b)	$3080 - 500 - T = 600 \times 1.2$ Or $T - 900 = 800 \times 1.2$	1
	$T = 1860$ N	1
4	N2L on A: $T = 3a$	1
	N2L on B: $7 - T = 5a$	1
	$a = 0.875$ m s^{-2}	1
	$T = 3 \times 0.875 = 2.625$ (2.63) N	1
5	First ball $s = 12t - 9.8t^2/2$	1
	$s = 12t - \dfrac{9.8t^2}{2}$	1
		1
	Second ball $s = 9(t - 2) - 9.8(t - 2)^2/2$	1

	$s = 9(t-2) - \dfrac{9.8(t-2)^2}{2}$ (or 2nd ball t, 1st $t+2$) $t = \dfrac{188}{83}$ (2.27) (or $t = \dfrac{22}{83}$, 0.27) $s = 2.04$ m	
6	When being pushed: $12 - 2 = 7a$, $a = \dfrac{10}{7}$	1
	$v = x$, $s = s \qquad x^2 = 2\left(\dfrac{10}{7}\right)s$	1
	When released: $-2 = 7a$, $a = -\dfrac{2}{7}$	1
	$u = x$, $s = 45 - s$ $0 = x^2 + 2\left(-\dfrac{2}{7}\right)(45-s)$, $x^2 = \dfrac{4}{7}(45-s)$	1
	$\dfrac{20s}{7} = \dfrac{180}{7} - \dfrac{4s}{7}$	
	$\dfrac{24s}{7} = \dfrac{180}{7}$, $s = 7.5$	1
	$7.5 = \dfrac{1}{2}\left(\dfrac{10}{7}\right)t^2$	1
	$t = \sqrt{10.5} = 3.24$ s	1