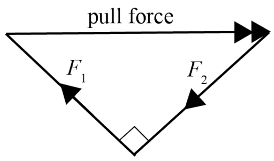
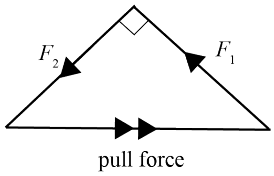
Assessment Schedule – 2018

Physics: Demonstrate understanding of mechanics (91171)

Evidence Statement

Q	Evidence	Achievement	Merit	Excellence
ONE (a)	Spring constant $= k = \frac{F}{x} = \frac{4.9}{0.05} = 98\ \text{N m}^{-1}$ or equivalent using other values from table. Spring constant = gradient $= \frac{\text{rise}}{\text{run}} = \frac{29.4}{0.3} = 98\ \text{N m}^{-1}$	Correct working and answer using data table or graph. Accept $100\ \text{N m}^{-1}$ if graph is used.		
(b)	 **OR**  $F_1 = 57\ \text{N} \pm 2\ \text{N}$. *Labels on vectors not required. Correct arrows are required*	Diagram drawn correctly OR $57\ \text{N} \pm 2\ \text{N}$.	Correct diagram and to correct scale (F_1 being 57 N and 5.7 cm).	
(c)	Method 1: If $k = 98\ \text{N m}^{-1}$ $E_p = ½\, k\, x^2 = 0.5 \times 98 \times 0.58^2 = 16.48\ \text{J}$ Total $= 16.48 \times 2 = 32.97\ \text{J} = 33\ \text{J}$ Method 2: $W = Fd = F_{avg}d = \frac{F_{peak}}{2}d = \frac{57}{2} \times 0.58 = 16.53\ \text{J}$ $\text{Total} = 16.53 \times 2 = 33\ \text{J}$	One energy value correct.	Both energy values correct. Accept carry error (CE) or poor rounding, using incorrectly calculated force from Q1(b) or spring constant from 1(a) with consistent working.	
(d)(i)	The idea of conservation of energy so E_p to E_k. Assume no energy loss. And $E_k = \frac{1}{2}mv^2$ etc OR $F = ma$, kinematic equation.	Stated E_p to E_k and in turn velocity. OR One correct answer to (ii), with explanation. OR Two correct descriptions for (ii) with no explanation.	Stated E_p to E_k and in turn velocity. AND One correct answer to (ii), with explanation. OR Two correct answers to (ii), with full explanation.	Stated E_p to E_k and in turn velocity. AND Two correct answers to (ii), with full explanation.
(ii)	To maximise speed you need to either: • Increase E_p by increasing extension linked to $E_p = \frac{1}{2}kx^2$ OR $W = Fd$. • Use a stiffer stretchy rubber linked to a higher k, so more E_p from $E_p = \frac{1}{2}kx^2$. • Decrease mass of balloon linked to $E_k = \frac{1}{2}mv^2$, lower m, means higher v.			

Not Achieved			Achievement		Achievement with Merit		Achievement with Excellence	
NØ	**N1**	**N2**	**A3**	**A4**	**M5**	**M6**	**E7**	**E8**
No response; no relevant evidence. (e.g. 0A)	Very little Achievement evidence. (e.g. 1A)	Some evidence at the Achievement level, but most is at the Not Achieved level. (e.g. 2A OR 1M)	A majority of the evidence is at the Achievement level. (e.g. 3A OR 1M + 1A)	Most evidence is at the Achievement level. (e.g. 4A OR 2A + 1M)	Some evidence is at the Merit level. (e.g. 1A + 2M or 3A + 1M)	A majority of the evidence is at the Merit level. (e.g. 3M OR 2A + 2M)	Evidence is provided for most tasks. The evidence at the Excellence level may have minor errors, or the evidence is weak. (e.g. 1E + 2M OR 1E + 1M + 2A)	Evidence is provided for most tasks and the evidence at the Excellence level is accurate. (e.g. 1E + 2M + 1A)

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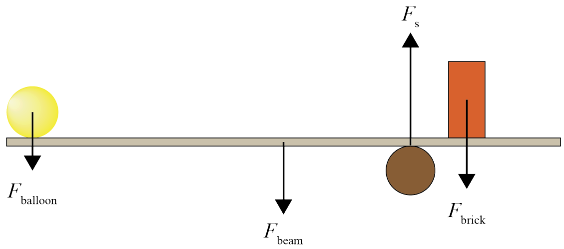
TWO (a)		THREE of the forces correct with labels OR all four forces correct with 2 labels		
(b)	$\Sigma\tau_{AC} = \Sigma\tau_C$ $F_{holder}\, d_{holder} + F_{beam}\, d_{beam} = F_{brick}\, m_{brick}$ $[(0.190 \times 9.8) \times 0.8] + [(0.3 \times 9.8) \times 0.25]$ $= [(m_{brick} \times 9.8) \times 0.07]$ $2.2246 = m_{brick} \times 0.686$ m_{brick} 3.24 kg = 3.2 kg	Calculation done but has not taken into account mass of the beam, so m_{brick} = 2.17 kg. OR one error	Correct answer and correct working.	
(c)	$\Delta p = F\Delta t = 20.0 \times 0.140 = 2.80$ kg m s^{-1} (SHOW Q) $\Delta p = p_f - p_i = m_{balloon}\, v_{balloon\ final} - (m_{balloon} \times 0)$ $2.80 = 0.180 v_{balloon} - 0$ $v_{balloon} = 15.6$ m s^{-1}	Correct working to show change in momentum but v wrong OR Correct v without showing working for Δp	All correct with complete working.	
(d)(i)	Point A	Point A OR ONE of: reduce force; increase collision time; increase collision distance; reduce acceleration	Point A AND logical argument with an omission or no appropriate formula etc. OR: Only (d)(ii) correct.	(d)(i) correct AND: Linked argument including an appropriate formula or statement about initial and final speed or kinetic energy or momentum, linked to reduction of force.
(ii)	Impulse argument: For Jimmy to reduce the <u>force</u> the balloon experiences, he needs to increase the collision time. Because the <u>Δp is fixed</u> ($p_f = 0$) as balloon stops and $p_i = mv$ and the mass and initial velocity remain unchanged, a longer collision time will reduce the force according to $F = \dfrac{\Delta p}{\Delta t}$, (reducing the chance of the balloon bursting). OR: Similar argument using $F = ma$: For Jimmy to reduce the <u>force</u> the balloon experiences, he needs to reduce the <u>acceleration ($F = ma$)</u> by increasing the collision time ($a = \dfrac{\Delta v}{\Delta t}$) because Δv is fixed. (A lower force, reduces the chance of the balloon bursting). OR Similar argument using $W = Fd$: For Jimmy to reduce the <u>force</u> the balloon experiences, he needs to <u>increase the distance</u> taken for the balloon to stop. The work done ($\Delta E = E_{k\ final} - E_{k\ initial}$) is fixed, So a longer stopping distance causes a lower force, (that reduces the chance of the balloon bursting).			

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THREE (a)	$v_{\text{horiz}} = \frac{d}{t} = \frac{21.0}{2.80} = 7.50\ \text{m s}^{-1}$	Correct answer.		
(b)	$v_{\text{i (horiz)}} = 7.50\ \text{m s}^{-1}$ (From (a) $\rightarrow$ allow carry errors) $v_{\text{f}} = v_{\text{i}} + at$ $v_{\text{i (vert)}} = v_{\text{f (vert)}} - at_{\text{(to top of flight)}}$ $v_{\text{i (vert)}} = 0 - (-9.8 \times 1.4) = 13.72\ \text{m s}^{-1}$ $v = \sqrt{v_{\text{horiz}}{}^2 + v_{\text{vert}}{}^2}$ $v = \sqrt{7.50^2 + 13.72^2} = 15.6\ \text{m s}^{-1}$	Correct $v_{\text{i (vert)}}$ OR Correct use of Pythagoras	Correct working and correct v.	
(c)	On Earth, the time to the top of flight is 1.4 seconds. On planet X, the time to the top of flight is longer (3.7 s). Assuming negligible air friction, with the same v_{horiz} of 7.5 m s^{-1}, will mean the range will be significantly increased (from 20.5 to 55.5 m).	Time of travel will increase (since a is a smaller value). OR (Goes higher) so travels further.	Correct answer with longer time, and therefore greater distance since ($d_{\text{H}} = v_{\text{H}} \times t$) (Time and range calculations not required.)	
(d)	$v_{\text{i (vert)}} = 10 \tan 35 = 7.0\ \text{m s}^{-1}$ (SHOW) Time in air: $v = \frac{d}{t} \rightarrow t = \frac{d_{\text{(horiz)}}}{v_{\text{(horiz)}}} = \frac{12.5}{10.0} = 1.25\ \text{s}$ $d_{\text{(vert)}} = v_{\text{i (vert)}}t + \frac{1}{2}a_{\text{(vert)}}t^2$ $d_{\text{(vert)}} = (7 \times 1.25) + \frac{1}{2}(-9.8 \times 1.25^2)$ $d_{\text{(vert)}} = 1.094\ \text{m} \approx 1.1\ \text{m}$ So yes, Jimmy will have his hands in the correct position to catch the balloon. Alternative working: $t_{\text{(to top of flight)}} = \frac{v_{\text{f}} - v_{\text{i}}}{a} = \frac{0-7}{-9.8} = 0.714\ \text{s}$ $d_{\text{(max height)}} = v_{\text{i}}t + \frac{1}{2}at^2 = (7 \times 0.714) + \frac{1}{2}(-9.8 \times 0.714^2) = 2.5$ $d_{\text{(travelled from top)}} = v_{\text{i}}t + \frac{1}{2}at^2 = 0 + \frac{1}{2}(-9.8 \times (1.25 - 0.714)^2)$ $= 1.406\ \text{m}$ $d_{\text{(height at 12.5 m)}} = 2.5 - 1.406 = 1.094\ \text{m} \approx 1.1\ \text{m}$	Correct $v_{\text{i (vert)}}$.	Correct $v_{\text{i (vert)}}$. AND One of: Correct time in air (1.25 s). OR Use of $d = v_{\text{i}}t + \frac{1}{2}at^2$ with omission. OR $d_{\text{max height}}$ OR Correct solution to second part without showing derivation of 7 m s^{-1}.	Full answer and correct working. AND Statement "Yes Jimmy can catch the balloon" or equivalent.

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Cut Scores

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0 – 7	8 – 13	14 – 19	20 – 24