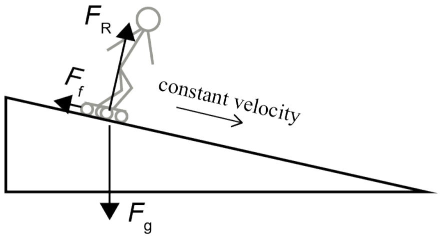
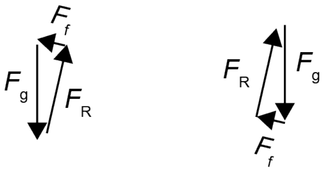
Assessment Schedule – 2017

Physics: Demonstrate understanding of mechanics (91171)

Evidence Statement

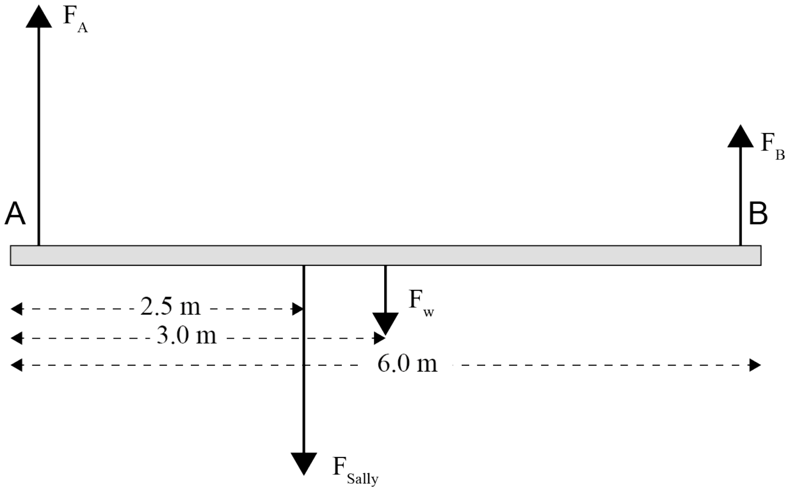
Q	Evidence	Achievement	Merit	Excellence
ONE (a)	Total momentum of the system is conserved, assumption, no external forces.	• Correct answer with correct assumption.		
(b)	$p_i = m_{Katy} v_{Katy} + m_{Aroha} v_{Aroha}$ $p_i = (65 \times 8.5) + (50 \times 6.0) = 552.5 + 300 = 852.5 = 850$ Kg m s^{-1} $p_i = p_f = v_{combined} \times (m_{Katy} + m_{Aroha})$ $852.5 = v_{combined} \times (65 + 50)$ $v_{combined} = 7.4$ m s^{-1}	• Correct formulae and correct substitution for total initial P and total final P. OR $P_{initial} = 853$ kg m s^{-1}	• Correct velocity.	
(c)	Solved using impulse: $\Delta P = P_f - P_i$ $\Delta P = (50 \times 7.4) - (50 \times 6)$ $\Delta P = 370 - 300$ $\Delta P = 70$ kg m s^{-1} $F = \frac{\Delta P}{\Delta t}$ $F = \frac{70}{2.5}$ $F = 28$ N Solved using Newton's second law: $\Delta v = v_f - v_i = 7.4 - 6.0 = 1.4$ m s^{-1} $a = \frac{\Delta v}{\Delta t} = \frac{1.4}{2.5} = 0.56$ m s^{-2} $F = ma = 50 \times 0.56 = 28$ N	• Correct value of ΔP or a calculated. OR Incorrect value of ΔP, but consequently correct answer for force. • Max of Achievement if calculated Katy's force, unless candidate states forces are of equal magnitude for both girls.	• Correct value of force. AND Correct change in momentum OR acceleration.	

(d)(i) (ii)	 accept forces drawn from the centre of mass  Possible force labels include: • reaction / support / normal force • weight / gravity / force.	• 2 forces labelled correctly, and in correct directions. Ignore size of the forces.	• For part (i), all forces labelled correctly, and in correct directions. Ignore size of the forces. • A closed vector diagram drawn with one error.	• All forces labelled correctly, and in correct directions in part (i). AND Correct diagrams, with correct labels and approximately correct sizes and directions. F_g must be vertically downwards.

Not Achieved			**Achievement**		**Achievement with Merit**		**Achievement with Excellence**	
NØ	**N1**	**N2**	**A3**	**A4**	**M5**	**M6**	**E7**	**E8**
No response; no relevant evidence.	Very little Achievement evidence.	Some evidence at the Achievement level, but most is at the Not Achieved level.	A majority of the evidence is at the Achievement level.	Most evidence is at the Achievement level.	Some evidence is at the Merit level.	A majority of the evidence is at the Merit level.	Evidence is provided for most tasks. The evidence at the Excellence level may have minor errors, or the evidence is weak.	Evidence is provided for most tasks and the evidence at the Excellence level is accurate.

Q	Evidence	Achievement	Merit	Excellence
TWO (a)	$F = mg = 55.0 \times 9.8 = 539 = 540$ N (2SF). Single arrow pointing downwards.	• Correct answer.		
(b)	$v_v = 8 \times \sin 70° = 7.5 \text{ m s}^{-1}$ $v_f = v_i + at \rightarrow 0 = 7.5 - 9.8t \rightarrow t = \frac{7.5}{9.8} = 0.77$ s	• V_v is calculated correctly. OR Incorrect V_v, but consequently correct time.	• Correct V_v. AND Correct time.	
(c)	Weight force on one spring = $\frac{540}{20} = 27$ N $k = \frac{F}{x} = \frac{27}{0.045} = 600 \text{ N m}^{-1}$ $E = \frac{1}{2} \times 600 \times 0.045 \times 0.045 = 0.61$ J Alternative answer: Energy stored = work done = $\frac{1}{2}Fd$ $\Delta E = \frac{1}{2} \times 27 \times 0.045 = 0.61$ J	• Correct spring constant calculated. OR Incorrect spring constant, but consequently correct energy value (12.1 J).	• Correct spring constant. AND Correct energy value. OR Correct answer and working using ΔE.	
(d)	The total momentum of the jumper has to become zero after landing, and ΔP will be the same for all jumps. So the force will depend on the duration of the compression. Springs can be made of a softer material, which decrease the spring constant. Springs will be compressed more and it will take longer time to be compressed. Springs can be made longer in length (thicker mattress), so the spring constant decreases and it takes longer time to compress the springs. Longer time means less force on the jumper, as the impulse will be the same. Any other correct suggestions.	• Two changes in the design suggested. OR One change is suggested and tries to give a reason.	• Two changes are suggested and only one correct explanation.	• Two changes are suggested with correct explanation.

Not Achieved			Achievement		Achievement with Merit		Achievement with Excellence	
NØ	**N1**	**N2**	**A3**	**A4**	**M5**	**M6**	**E7**	**E8**
No response; no relevant evidence.	Very little Achievement evidence.	Some evidence at the Achievement level, but most is at the Not Achieved level.	A majority of the evidence is at the Achievement level.	Most evidence is at the Achievement level.	Some evidence is at the Merit level.	A majority of the evidence is at the Merit level.	Evidence is provided for most tasks. The evidence at the Excellence level may have minor errors, or the evidence is weak.	Evidence is provided for most tasks and the evidence at the Excellence level is accurate.

Q	Evidence	Achievement	Merit	Excellence
THREE (a)	All 4 forces are labelled correctly, and have correct directions.  	• At least 3 forces are labelled correctly.		
(b)(i) (ii)	The sum forces (in any direction) must be zero, and the sum of the torques (about any point) must be zero. total $\tau_C = F_{Sally}\, d_{Sally} + F_{plank}\, d_{plank}$ $= (40 \times 9.8 \times 2.5) + (5 \times 9.8 \times 3) = 1127$ N m	• Both conditions of the equilibrium stated. OR Correct total torque. OR One condition stated AND one correct torque of the dancer or plank.	• Both conditions of the equilibrium stated. AND Correct total torque.	

(c)(i) (ii)	total τ_C = total τ_{anti} = 1127 N m $F_B \times 6 = (40 \times 9.8 \times 2.5) + (5 \times 9.8 \times 3)$ [From Q3(b)(ii)] $F_B \times 6 = 1127$ $F_B =$ 188 N Total downward force = (40 + 5) 9.8 = 441 $F_A = 441 - 188 = 253$ N The alternative method where torques are calculated about end B [$\tau = Fd \rightarrow 1519 = F \times 6$], is acceptable. The total downwards force ($F_w + F_{Sally}$) remains constant and the total upwards force ($F_A + F_B$) also remains constant (equal and opposite). As Sally moves towards point B, the upwards force Alf provides decreases (and the force Bert provides increases, due to net torque remaining zero).	• Correct substitution for total clockwise torque or total anticlockwise torque. OR Correct description for (c)(ii).	• F_A is given as 188 N. AND Correct explanation for (c)(ii).	• Correct answer. • AND Correct explanation.
(d)	$v = \frac{2\pi r}{t} = \frac{2\pi \times 0.6}{0.80} = 4.71 \text{ m s}^{-1}$ OR $v = \frac{2\pi r}{T} = \frac{5 \times 2\pi \times 0.6}{4.0} = 4.71 \text{ m s}^{-1}$ $F = \frac{mv^2}{r} = \frac{0.05 \times 4.71^2}{0.6} = 1.85 = 1.9 \text{ N}$	• Correct speed calculated. OR • Incorrect speed but consequently correct force.	• Correct velocity. AND Correct force.	

Not Achieved			Achievement		Achievement with Merit		Achievement with Excellence	
NØ	**N1**	**N2**	**A3**	**A4**	**M5**	**M6**	**E7**	**E8**
No response; no relevant evidence.	Very little Achievement evidence.	Some evidence at the Achievement level, but most is at the Not Achieved level.	A majority of the evidence is at the Achievement level.	Most evidence is at the Achievement level.	Some evidence is at the Merit level.	A majority of the evidence is at the Merit level.	Evidence is provided for most tasks. The evidence at the Excellence level may have minor errors, or the evidence is weak.	Evidence is provided for most tasks and the evidence at the Excellence level is accurate.