Assessment Schedule – 2019

Physics: Demonstrate understanding of mechanics (91171)

Evidence Statement

Q	Evidence	Achievement	Merit	Excellence
ONE (a)	$v_{vertical} = 22 \sin 30°$	• Substitution shown correctly		
(b)	• The (only) force experienced is the weight force / gravity (vertically downwards). • The ball decelerates until it reaches its maximum height, where its speed is 0, then accelerates downwards. • The horizontal speed is constant. • The path is parabolic (may be shown in diagram) (A only).	• One bullet point.	• Two different points, one of which must refer to force.	
(c)	Calculates E_k and relates this to E_p. $E_k = 0.5 \times 0.16 \times 22^2 = 38.72$ J Uses this value to calculate k. = 3441.77 (rounded to 3442 N m^{-1})	• Correct first bullet point or second point based on incorrect value for E_p. OR • Correct process but with either or both units unconverted.	• Correct value for k	
(d)	Uses $v_f = v_i + at$, with $g = 9.8$ $t = \frac{11-0}{9.8} = 1.12$ s $t = 1.12$ s for vertical motion up. Total $t = 2 \times 1.12 = 2.24$ s Calculates $v_{horizontal}$ as $v_{horizontal} = 22 \cos 30° = 19.05$ $d = vt = 2.24 \times 19.05 = 42.67$ m This is less than 44 m, so the pass falls short.	• Initial time calculated OR • Horizontal velocity calculated.	Achieved plus • Time doubled AND horizontal value of v calculated.	• Complete answer, including interpretation of distance calculated.

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)	$v = \frac{2\pi r}{T} = \frac{2\pi \times 0.5}{1.4} = 2.24 \text{ m s}^{-1}$	• Correct equation and substitution		
(b)	• $F = \frac{mv^2}{r} = \frac{0.04 \times 2.24^2}{0.5} = 0.40$ N • (The force supplied by) the tension in the string (is perpendicular to the velocity of the whistle and) provides the centripetal force / force towards the centre/unbalanced force perpendicular to the velocity (this keeps the whistle moving in a circle at a constant speed).	• Correct force calculated (evidence can be drawn from 2(c)). OR Valid explanation	• Correct force calculated (evidence can be drawn from 2(c)). AND Centripetal / perpendicular force linked to circular motion	
(c)	• The new force would be 0.08 N using Force = $\frac{mv^2}{r}$ with $v = 1$ m s^{-1}. • This would not be sufficient to keep the whistle in circular motion at the same radius, and so the whistle would move in a circle with a smaller radius. The string would drop down/ be more angled down	• New force calculated OR Statement that force decreases. OR Statement that whistle / string drops down.	• New force calculated. AND • Whistle would either fall out of circular motion or the radius would have to diminish.	
(d)(i) (ii)	• At least 4 forces correctly labelled. • $T_{ac} = (588 \times 0.25) + (98 \times 0.75) + (588 \times 0.6) = 147 + 73.5 + 352.8 = 573.3$ N m • $T_c = T_{ac}$ for bench to balance equilibrium. • Force at A = $\frac{\text{Torque}_{ac}}{\text{distance}} = \frac{573.3}{1.5} = 382.2$ N. • And F_b = sum of downward forces – F_a = 1274 – 382.2 = 891.8 N. • Sum of forces = 0, and sum of torques = 0 (A only) • The bench is uniform.	• At least four forces labelled correctly OR • Correct assumptions stated	• Achieved AND Anticlockwise torque calculated accurately.	• Complete answer – must include 4 correct forces, labelled.

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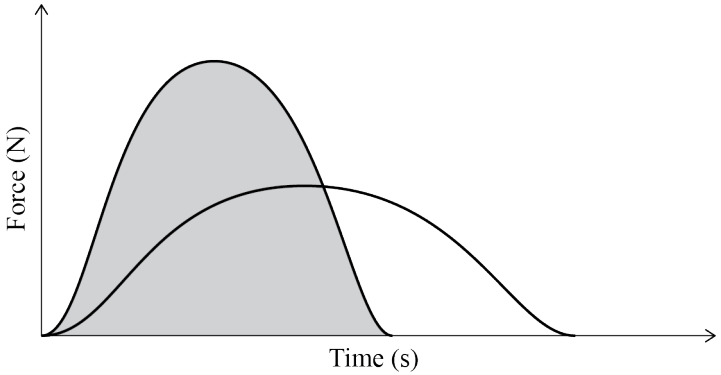
Q	Evidence	Achievement	Merit	Excellence
THREE (a)	There is a force from the stick to the ball, and an equal and opposite force from the ball to the stick	• Correct statement of Newton's third law.		
(b)	• Assumption is conservation of momentum / no external forces $\rho_{\text{before}} = \rho_{\text{after}}$ Initial momentum of ball = 0, so initial momentum is that of stick. $\rho_{\text{initial}} = 0.6 \times \overrightarrow{18} = \overrightarrow{10.8}$ $\rho_{\text{final}} = 0.6 \times \overrightarrow{12} + 0.16 v_{\text{ball}}$ $v_{\text{ball}} = \overrightarrow{22.5}\ \text{m s}^{-1}$	• Correct assumption. OR Total initial momentum	• Correct assumption. AND Correct final velocity.	
(c)	$\Delta\rho = m\Delta v = 0.16 \times 40 = 6.40\ \text{kg m s}^{-1}$ $F = \frac{\Delta\rho}{t} = \frac{6.4}{0.02} = 320\ \text{N}$ Allow approach using acceleration.	• Correctly calculates $\Delta\rho$ or calculates F by calculating $F = ma$ • Uses incorrect value for Δv of 20 m s^{-1} giving an incorrect F of 160 N.	• Uses impulse to calculate F correctly.	

(d)(i)		• Second line correctly drawn – areas under graphs must be approximately comparable. (Accept line not starting at $t = 0$ as long as it follows other criteria.) OR One other bullet point.	• TWO points.	• Comprehensive discussion, including correct graph line. Discussion must include more time / less force and same Δp.
(ii)	• Second graph has smaller peak force and spread over significantly longer time • Identifies the cushioning effect of the pads to increase the time for collision and reduce the force. • Because the change of momentum / impulse is the same. • Identifies less force will cause less damage and reduce the risk of injury (A only). • Explains the absorption of energy by the pads and the increase on time effect on the collision (A only).			

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Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 7	8 – 12	13 – 18	19– 24