

**Assessment Schedule – 2019****Physics: Demonstrate understanding of mechanics (91171)****Evidence Statement**

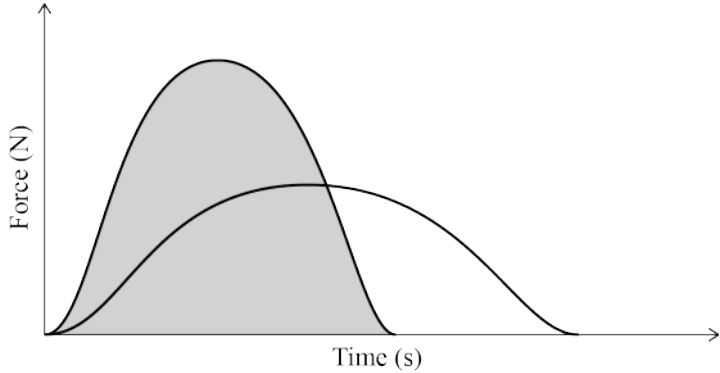
Q	Evidence	Achievement	Merit	Excellence
ONE (a)	$v_{\text{vertical}} = 22 \sin 30^\circ$	<ul style="list-style-type: none"> <li>Substitution shown correctly</li> </ul>		
(b)	<ul style="list-style-type: none"> <li>The (only) force experienced is the weight force / gravity (vertically downwards).</li> <li>The ball decelerates until it reaches its maximum height, where its speed is 0, then accelerates downwards.</li> <li>The horizontal speed is constant.</li> <li>The path is parabolic (may be shown in diagram) (A only).</li> </ul>	<ul style="list-style-type: none"> <li>One bullet point.</li> </ul>	<ul style="list-style-type: none"> <li>Two different points, one of which must refer to force.</li> </ul>	
(c)	<p>Calculates <math>E_k</math> and relates this to <math>E_p</math>.</p> $E_k = 0.5 \times 0.16 \times 22^2 = 38.72 \text{ J}$ <p>Uses this value to calculate <math>k</math>.</p> $= 3441.77 \text{ (rounded to } 3442 \text{ N m}^{-1}\text{)}$	<ul style="list-style-type: none"> <li>Correct first bullet point or second point based on incorrect value for <math>E_p</math>.</li> <li>OR</li> <li>Correct process but with either or both units unconverted.</li> </ul>	<ul style="list-style-type: none"> <li>Correct value for <math>k</math></li> </ul>	
(d)	<p>Uses <math>v_f = v_i + at</math>, with <math>g = 9.8</math></p> $t = \frac{11-0}{9.8} = 1.12 \text{ s}$ <p><math>t = 1.12 \text{ s}</math> for vertical motion up.</p> <p>Total <math>t = 2 \times 1.12 = 2.24 \text{ s}</math></p> <p>Calculates <math>v_{\text{horizontal}}</math> as <math>v_{\text{horizontal}} = 22 \cos 30^\circ = 19.05</math></p> $d = vt = 2.24 \times 19.05 = 42.67 \text{ m}$ <p>This is less than 44 m, so the pass falls short.</p>	<ul style="list-style-type: none"> <li>Initial time calculated</li> <li>OR</li> <li>Horizontal velocity calculated.</li> </ul>	<p>Achieved plus</p> <ul style="list-style-type: none"> <li>Time doubled AND horizontal value of <math>v</math> calculated.</li> </ul>	<ul style="list-style-type: none"> <li>Complete answer, including interpretation of distance calculated.</li> </ul>

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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)

Q	Evidence	Achievement	Merit	Excellence
TWO (a)	$v = \frac{2\pi r}{T} = \frac{2\pi \times 0.5}{1.4} = 2.24 \text{ m s}^{-1}$	<ul style="list-style-type: none"> <li>Correct equation and substitution</li> </ul>		
(b)	<ul style="list-style-type: none"> <li><math>F = \frac{mv^2}{r} = \frac{0.04 \times 2.24^2}{0.5} = 0.40 \text{ N}</math></li> <li>(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).</li> </ul>	<ul style="list-style-type: none"> <li>Correct force calculated (evidence can be drawn from 2(c)).</li> </ul> OR Valid explanation	<ul style="list-style-type: none"> <li>Correct force calculated (evidence can be drawn from 2(c)).</li> </ul> AND Centripetal / perpendicular force linked to circular motion	
(c)	<ul style="list-style-type: none"> <li>The new force would be 0.08 N using <math>\text{Force} = \frac{mv^2}{r}</math> with <math>v = 1 \text{ m s}^{-1}</math>.</li> <li>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</li> </ul>	<ul style="list-style-type: none"> <li>New force calculated</li> </ul> OR Statement that force decreases. OR Statement that whistle / string drops down.	<ul style="list-style-type: none"> <li>New force calculated.</li> </ul> AND <ul style="list-style-type: none"> <li>Whistle would either fall out of circular motion or the radius would have to diminish.</li> </ul>	
(d)(i) (ii)	<ul style="list-style-type: none"> <li>At least 4 forces correctly labelled.</li> <li><math>T_{ac} = (588 \times 0.25) + (98 \times 0.75) + (588 \times 0.6) = 147 + 73.5 + 352.8 = 573.3 \text{ N m}</math></li> <li><math>T_c = T_{ac}</math> for bench to balance equilibrium.</li> <li>Force at A = <math>\frac{\text{Torque}_{ac}}{\text{distance}} = \frac{573.3}{1.5} = 382.2 \text{ N}</math>.</li> <li>And <math>F_b = \text{sum of downward forces} - F_a = 1274 - 382.2 = 891.8 \text{ N}</math>.</li> <li>Sum of forces = 0, and sum of torques = 0 (A only)</li> <li>The bench is uniform.</li> </ul>	<ul style="list-style-type: none"> <li>At least four forces labelled correctly</li> </ul> OR <ul style="list-style-type: none"> <li>Correct assumptions stated</li> </ul>	<ul style="list-style-type: none"> <li>Achieved</li> </ul> AND Anticlockwise torque calculated accurately.	<ul style="list-style-type: none"> <li>Complete answer – must include 4 correct forces, labelled.</li> </ul>

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THREE (a)	There is a force from the stick to the ball, and an equal and opposite force from the ball to the stick	<ul style="list-style-type: none"> <li>• Correct statement of Newton’s third law.</li> </ul>		
(b)	<ul style="list-style-type: none"> <li>• Assumption is conservation of momentum / no external forces</li> </ul> $p_{\text{before}} = p_{\text{after}}$ Initial momentum of ball = 0, so initial momentum is that of stick. $p_{\text{initial}} = 0.6 \times 18 = 10.8$ $p_{\text{final}} = 0.6 \times 12 + 0.16v_{\text{ball}}$ $v_{\text{ball}} = 22.5 \text{ m s}^{-1}$	<ul style="list-style-type: none"> <li>• Correct assumption.</li> </ul> OR Total initial momentum	<ul style="list-style-type: none"> <li>• Correct assumption.</li> </ul> AND Correct final velocity.	
(c)	$\Delta p = m\Delta v = 0.16 \times 40 = 6.40 \text{ kg m s}^{-1}$ $F = \frac{\Delta p}{t} = \frac{6.4}{0.02} = 320 \text{ N}$ Allow approach using acceleration.	<ul style="list-style-type: none"> <li>• Correctly calculates <math>\Delta p</math> or calculates <math>F</math> by calculating <math>F = ma</math></li> <li>• Uses incorrect value for <math>\Delta v</math> of <math>20 \text{ m s}^{-1}</math> giving an incorrect <math>F</math> of 160 N.</li> </ul>	<ul style="list-style-type: none"> <li>• Uses impulse to calculate <math>F</math> correctly.</li> </ul>	

<p>(d)(i)</p>	 <p>(ii)</p> <ul style="list-style-type: none"> <li>• Second graph has smaller peak force and spread over significantly longer time</li> <li>• Identifies the cushioning effect of the pads to increase the time for collision and reduce the force.</li> <li>• Because the change of momentum / impulse is the same.</li> <li>• Identifies less force will cause less damage and reduce the risk of injury (A only).</li> <li>• Explains the absorption of energy by the pads and the increase on time effect on the collision (A only).</li> </ul>	<ul style="list-style-type: none"> <li>• Second line correctly drawn – areas under graphs must be approximately comparable. (Accept line not starting at <math>t = 0</math> as long as it follows other criteria.)</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>• One other bullet point.</li> </ul>	<ul style="list-style-type: none"> <li>• TWO points.</li> </ul>	<ul style="list-style-type: none"> <li>• Comprehensive discussion, including correct graph line. Discussion must include more time / less force and same <math>\Delta p</math>.</li> </ul>
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**Cut Scores**

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