

**Assessment Schedule – 2023**

**Science: Demonstrate understanding of aspects of mechanics (90940)**

**Evidence Statement**

Q	Evidence	Achievement	Merit	Excellence
ONE (a)	Constant speed (accept accelerate initially then constant speed).	<ul style="list-style-type: none"> <li>Correct answer.</li> </ul>		
(b)	$v = \frac{d}{t} = \frac{1}{4.0} = 0.25 \text{ m s}^{-1}$	<ul style="list-style-type: none"> <li>Correct answer.</li> </ul>		
(c)	One arrow upwards <b>labelled</b> air resistance equal in size and opposite in direction to gravity. (Do not accept THRUST)	<ul style="list-style-type: none"> <li>ONE arrow correctly labelled / or both arrows correct but not labelled</li> </ul>	<ul style="list-style-type: none"> <li><b>BOTH</b> arrows correct size and direction and labels.</li> </ul>	
(d)	Since gravity and air resistance are equal and opposing forces, the $F_{\text{net}}$ is zero so velocity is constant and the acceleration zero.	<ul style="list-style-type: none"> <li><math>F_{\text{net}} = 0</math>/ forces are balanced</li> <li>Velocity constant./ acceleration is zero</li> </ul>	<ul style="list-style-type: none"> <li><math>F_{\text{net}}</math> is zero/balanced, so velocity is constant/ <math>F_{\text{net}}</math> is balanced so acceleration is zero</li> </ul>	<ul style="list-style-type: none"> <li><math>F_{\text{net}}</math> is zero so therefore the acceleration is zero and velocity is constant (<math>F_{\text{net}} = ma</math>; <math>F_{\text{net}}</math> is 0, so <math>a</math> must be 0).</li> </ul>
(e)	Accelerating.	<ul style="list-style-type: none"> <li>Correct answer.</li> </ul>		
(f)	Gradient = rise / run $4 \text{ m s}^{-1} (\pm 0.4)$	<ul style="list-style-type: none"> <li>Attempts gradient = rise / run, incorrect answer.</li> </ul>	<ul style="list-style-type: none"> <li>Gradient = rise / run; correct answer.</li> </ul>	
(g)	<p style="text-align: center;"><b>Speed / time for feather's fall with air removed</b></p>	<ul style="list-style-type: none"> <li>Rising straight line.</li> </ul>	<ul style="list-style-type: none"> <li>Straight line that starts from zero, incorrect gradient.</li> </ul>	<ul style="list-style-type: none"> <li>Correct gradient + straight line on speed / time graph + starts from zero.</li> </ul>

(h)	One arrow downwards labelled gravity or $F_g$ , or weight	<ul style="list-style-type: none"> <li>TWO arrows with ONE arrow downwards labelled gravity.</li> </ul>	<ul style="list-style-type: none"> <li>ONLY One arrow downwards labelled gravity. Or two arrows drawn with the labelled downward arrow longer</li> </ul>	
(i)	Gravity is the only force, the $F_{net}$ / weight is downwards, so the acceleration is downwards with the same magnitude.	<ul style="list-style-type: none"> <li>Accelerating /FN is not zero</li> </ul>	<ul style="list-style-type: none"> <li>The <math>F_{net}</math> net/ unbalanced cause the feather to accelerate</li> </ul>	<ul style="list-style-type: none"> <li>The <math>F_{net}</math> net/ unbalanced force so the acceleration is downwards (Mention downwards once)</li> </ul>

N0	N1	N2	A3	A4	M5	M6	E7	E8
No response; or no relevant evidence.	ONE Achievement point.	TWO Achievement points.	THREE Achievement points.	FOUR Achievement points.	THREE Merit points.	FOUR Merit points.	TWO Excellence points.	THREE Excellence points,

Q	Evidence	Achievement	Merit	Excellence
TWO (a)	Scarlett $F = m \times 10$ $F = 55 \times 10$ $F = 550 \text{ N}$ Angus $F = 70 \times 10$ $F = 700 \text{ N}$ (or 1250N – answer only)	<ul style="list-style-type: none"> <li>One correct answer. (working and units not required.)</li> </ul>		
(b)	$W_{\text{Scarlett}} = F \times d$ $W_{\text{Scarlett}} = 550 \times 8.5$ $W_{\text{Scarlett}} = 4675 \text{ J}$ $W_{\text{Angus}} = 700 \times 8.5$ $W_{\text{Angus}} = 5950 \text{ J}$ (OR 106 25 J – answer only)	<ul style="list-style-type: none"> <li>Attempts to use <math>W = Fd</math> with incorrect <math>F</math> for one person.</li> </ul> OR Correct answer no working / equation.	<ul style="list-style-type: none"> <li>Correct answer AND show working / equation for one person.(unit not required)</li> </ul>	
(c)	$\text{Power} = \frac{W}{t}$ $\text{Power}_{\text{Scarlett}} = \frac{4675}{9}$ $= 519 \text{ W}$ $\text{Power}_{\text{Angus}} = \frac{5950}{12}$ $= 495.8 \text{ W}$ <p>Angus does more work than Scarlett because they both travel a distance of 8.5, but he has more weight force; Scarlett does less work but uses more power because she does her work in less time.</p>	<ul style="list-style-type: none"> <li>Uses correct power equation.</li> </ul> OR Calculates an incorrect answer using correct numbers.	<ul style="list-style-type: none"> <li>M2 Correct answer for power and use of equation for one person.</li> <li>M3 Correct explanation of who was the more powerful. (Scarlett is more powerful because she does this in less time.)</li> </ul>	<ul style="list-style-type: none"> <li>E1 Correct calculations power for both climbers. (unit required)</li> </ul> AND Scarlett is more powerful. AND Power related to the climber's time. (climbed faster or in less time)

<p>(d)</p>	<p>Scarlett  <math>E_p = E_k</math>  <math>4675 = 4675</math>  <math>E_k = \frac{1}{2}mv^2</math>  <math>v = 13 \text{ m s}^{-1}</math></p> <p>Angus  <math>E_p = E_k</math>  <math>5950 = 5950</math>  <math>E_k = \frac{1}{2}mv^2</math>  <math>v = 13 \text{ m s}^{-1}</math></p> <p>Both hit the water at the same speed, because on Earth, neglecting air resistance, all objects accelerate at <math>g = 10 \text{ m s}^{-2}</math>. So Angus is incorrect.</p>	<ul style="list-style-type: none"> <li>Writes <math>E_p = E_k</math>. / <math>E_k = 4675</math></li> <li>Writes correct equation for <math>E_k</math>.</li> <li>Angus is incorrect.</li> </ul>	<ul style="list-style-type: none"> <li><math>170 \text{ m s}^{-1}</math> with working. (forgot to <math>\sqrt{v}</math>) / correct answers for one person)</li> <li>Both hit the water at the same speed because on Earth, (neglecting air resistance), all objects accelerate at the same rate / (<math>g = 10 \text{ m s}^{-2}</math>.)</li> </ul>	<ul style="list-style-type: none"> <li>Correct answer for speed for both.(including units)</li> </ul> <p>AND</p> <p>Explanation that all things accelerate to the earth at the same rate (or shows mass cancels through calculations).</p> <p>AND</p> <p>Angus is incorrect.</p>
<p>(e)</p>	<p>Air resistance opposes motion, causing some of the kinetic energy to be transformed to heat due to the movement of air particles against the people, so the people do not reach <math>13 \text{ m s}^{-1}</math> / this speed.</p>	<ul style="list-style-type: none"> <li>Mention friction / air resistance.</li> <li><i>Energy is lost.</i></li> </ul>	<ul style="list-style-type: none"> <li><math>E_k</math> is lost to heat or sound due to air resistance,.</li> <li><math>E_k</math> is lost so therefore speed is reduced.</li> </ul>	<ul style="list-style-type: none"> <li><math>E_k / E_p</math> is lost to heat or sound due to air resistance of person moving against the air so therefore the speed is reduced.</li> </ul>

N0	N1	N2	A3	A4	M5	M6	E7	E8
No response; or no relevant evidence.	ONE Achievement point.	TWO Achievement points.	THREE Achievement points.	FOUR Achievement points.	THREE Merit points.	FOUR Merit points.	TWO Excellence points, with minor omission.	THREE Excellence points.

Q	Evidence	Achievement	Merit	Excellence
THREE (a)	Mass is the amount of matter. Weight is the force of gravity applied on a mass inside a gravitational field AND weight differs depending upon mass and the size of the gravitational field. ( $F = m \times g$ or $F = m \times a$ )	<ul style="list-style-type: none"> <li>States that mass is amount of matter.</li> </ul> OR <ul style="list-style-type: none"> <li>States that weight is force of gravity (on a mass).</li> </ul>	<ul style="list-style-type: none"> <li>States that mass is amount of matter. Whereas weight is the force of gravity on a mass and this does change (or similar comparison).</li> </ul>	
(b)	$F = m \times a$ $= 150 \times 10$ $= 1500 \text{ N}$	<ul style="list-style-type: none"> <li>Correct answer (working units not required).</li> </ul>		
(c)	$P = \frac{F}{A}$ $= \frac{1500}{0.08}$ $= 18750 \text{ N m}^{-2}$ (or 18 750 Pa)	<ul style="list-style-type: none"> <li>Correct equation and answer using 150 as <math>F</math> or using 1 leg.</li> </ul>	<ul style="list-style-type: none"> <li>Correct answer.</li> </ul>	
(d)(i)  (ii)	$F = mg + ma = 1500 + (150 \times 7)$ $= 2550 \text{ N}$ $P = \frac{F_{\text{total}}}{A}$ $= \frac{F_1 + F_2}{0.08}$ $= \frac{1500 + 1050}{0.08}$ $= \frac{2550}{0.08}$ $= 31\,875 \text{ N m}^{-2}$ $= 31875 \text{ Pa}$	<ul style="list-style-type: none"> <li><math>F = ma</math> <math>= 150 \times 7</math> <math>= 1050 \text{ N}</math></li> <li>Attempts to use correct formula.</li> </ul>	<ul style="list-style-type: none"> <li>Uses correct pressure equation with correct F and wrong area.</li> </ul>	<ul style="list-style-type: none"> <li>Full answer (with unit).</li> </ul>

(e)	Pressure is higher because the force is higher and the area is kept constant. The total force applied to the ground is higher because it includes the addition of weight and the force required to accelerate the moa upwards.	<ul style="list-style-type: none"> <li>• Force is higher.</li> <li>• Area is constant.</li> </ul>	<ul style="list-style-type: none"> <li>• When force is higher, the pressure increases. (can use an equation)</li> <li>• The force is larger due to the two downward forces being added together.</li> </ul>	<ul style="list-style-type: none"> <li>• When force is higher, due to an upwards acceleration combined with the weight force the pressure increases but the area stays the same.</li> </ul>
(f)	To cut leaves and twigs a large pressure is required. The force can be smaller, because the area of the beak is so small the pressure is high. OR The force remains constant and since the area is small the pressure is high.	<ul style="list-style-type: none"> <li>• Sharp beaks have small area.</li> </ul>	<ul style="list-style-type: none"> <li>• Sharp beaks have a small area, which results in a large pressure.</li> </ul>	<ul style="list-style-type: none"> <li>• Sharp beaks have a small area, which results in a large pressure. Which means a smaller force is required (to cut the branch). (mention all three variables)</li> </ul>

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No response; or no relevant evidence.	ONE Achievement point.	TWO Achievement points.	THREE Achievement points.	FOUR Achievement points.	THREE Merit points.	FOUR Merit points.	TWO Excellence points.	THREE Excellence points.

### Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 7	8 – 13	14 – 18	19– 24