Assessment Schedule – 2024

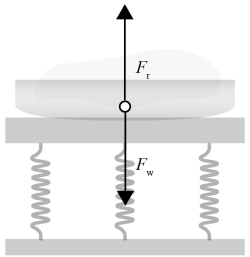
Physics: Demonstrate understanding of mechanics (91171)

Evidence Statement

Q	Evidence	Achievement	Merit	Excellence
ONE (a)	Arrow labelled F_c, or Friction, or F pointing into the centre of the circle.	• Correct answer.		
(b)(i)	$F_c = \frac{mv^2}{r} \Rightarrow 15 = \frac{10 \times 0.87^2}{r} \Rightarrow r = 0.50 \text{ m}$	• 0.50 m OR	• Calculation and explanation correct.	
(ii)	The dog will move in a straight line at a constant speed, as there is no force acting on it.	Velocity remains unchanged. OR F_c is lost.		
(c)	$p = mv = 0.87 \times 10 = 8.7 \text{ kg m s}^{-1}$ Because the dog comes to a stop $\Delta p = 8.7 \text{ kg m s}^{-1}$ $\Delta p = F \times t \Rightarrow 8.8 = 2F$ $\Rightarrow F = 4.4 \text{ N}$ By increasing the time to stop, the force on the dog is lowered. This means less harm to the dog. If the time to stop = 0.1 s, then the force would be 87 N.	• $p = 8.7 \text{ kg m s}^{-1}$ OR Force would be less.	• $F = 4.4$ N AND Force would be less.	• $F = 4.4$ N AND Full explanation.

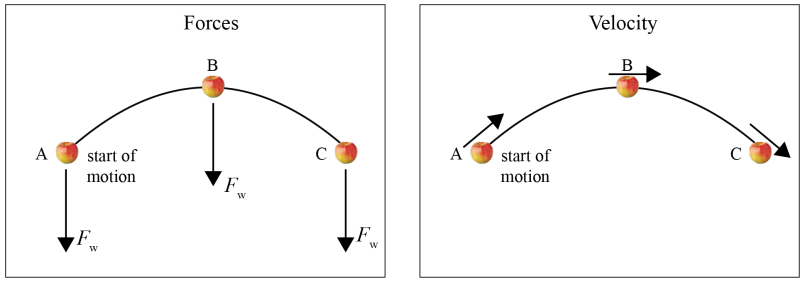
(d)	Jono's dog has initial p: $p = mv = 1.1 \times 10 = \overleftarrow{11}\ \text{kg m s}^{-1}$ Neighbour's dog has initial p: $p = mv = \overrightarrow{12}v\ \text{kg m s}^{-1}$ Total momentum before they collide: $p = \overleftarrow{11} + \overrightarrow{12}v$ Total momentum after the collision: $p = mv = 22 \times 0.3 = \overrightarrow{6.6}\ \text{kg m s}^{-1}$ Total p before = total after $\overleftarrow{11} + \overrightarrow{12}v = \overrightarrow{6.6}$ $\Rightarrow \overrightarrow{12}v = \overrightarrow{6.6} - \overleftarrow{11} = \overrightarrow{6.6} + \overrightarrow{11} = \overrightarrow{17.6} \Rightarrow v = 1.5\ \text{m s}^{-1}$	• Any momentum calculated relevant to solving the problem.	• $\overleftarrow{11}\ \text{kg m s}^{-1}$ AND $\overrightarrow{6.6}\ \text{kg m s}^{-1}$ AND Recognition that momentum is conserved.	• Correct answer.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No evidence	1a	2a 1m	3a 1m + 1a 1e + 1a 1e	4a 1m + 3a 1m + 2a 2m 1e + 2a	2m +2a 2m + 1a 1e + 3a 1e + 1m	3m +1a 3m 2e 1e + 2m 1e + 1m + 2a 1e + 1m + 1a	2e + 1m 2e + 2a 2e + 1a 1e + 2m + 1a	2e+ 1m + 1a

Q	Evidence	Achievement	Merit	Excellence
TWO (a)	 with the flour	• Arrows labelled correctly and same size.		
(b)	$F = mg = 0.11 \times 9.8 = 1.078$ N For the system: $F = kx \Rightarrow 1.078 = k \times 0.01 \Rightarrow 107.8$ N m^{-1} For one spring: $k = \frac{107.8}{3} = 35.93 = 36$ N m^{-1}	• Correct spring constant for three springs (whole system).	• Correct spring constant for one spring.	
(c)	The vertical height gained is the same in both cases, so the energy gained / work done is the same. The ramp is longer than the stairs, so the force required by Jono will be less going up the ramp than the stairs. Because it takes less time to go up the ramp, Jono has more power going up the ramp.	ONE of: • Work / energy gained is the same. • More force up the stairs. • More power up the ramp.	• TWO linked statements.	• Complete comparison.

(d)(i) (ii)	The clockwise torques equal the anti-clockwise torques. The upwards forces = the downwards forces Torques about point B Anti-clockwise torque: $F_w$ginger $= 9.8 \times 0.03 = 0.294$ N $\tau = F \times d$ $= 0.294 \times 0.25 = 0.0735$ N m $F_w$base $= 9.8 \times 0.370 = 3.63$ N $\tau = 3.626 \times 0.2 = 0.725$ N m $F_w$salt $= 9.8 \times 0.5 = 4.9$ N $\tau = 4.9 \times 35 \times 10^{-2} = 1.72$ N m Total anticlockwise $\tau = 0.725 + 0.0735 + 1.72 = 2.51$ N m Clockwise torque $= 0.4 \times T_A$ Clockwise = anticlockwise, so $0.4 \times T_A = 2.51$ and $T_A = 6.28$ N The required force in wire A is greater than its maximum value, so the spice rack will fall down.	• Conditions stated. OR Any one torque calculated correctly.	• Correct method, one minor error. OR Conditions stated and one tension force calculated correctly.	• Full answer including a conclusion.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No evidence	1a	2a 1m	3a 1m + 1a 1e + 1a 1e	4a 1m + 3a 1m + 2a 2m 1e + 2a	2m +2a 2m + 1a 1e + 3a 1e + 1m	3m +1a 3m 2e 1e + 2m 1e + 1m + 2a 1e + 1m + 1a	2e + 1m 2e + 2a 2e + 1a 1e + 2m + 1a	2e+ 1m + 1a

Q	Evidence	Achievement	Merit	Excellence
THREE (a)	$v_f = v_i + at \Rightarrow 0.56 + a \times 4 \Rightarrow a = -0.14 \text{ m s}^{-2}$	• Correct answer, accept $\pm 0.14 \text{ m s}^{-2}$		
(b)	$v_x = 5 \times \cos 40° = 3.8 \text{ m s}^{-1}$ $v_y = 5 \times \sin 40° = 3.2 \text{ m s}^{-1}$	• Calculated either value: $5 \times \cos 40° = 3.8 \text{ m s}^{-1}$ $5 \times \sin 40° = 3.2 \text{ m s}^{-1}$ But not identified as v_{vert} and v_{hoz} (or wtte).	• Both values correctly calculated and identified.	
(c)(i) (ii) (iii)	Projectile motion or parabolic.  Horizontal velocity remains constant. Vertical velocity has constant acceleration downwards due to gravity.	• Correctly identified type of motion. (i) OR Three equal vertical force arrows labelled at A, B, and C. (ii) OR Three velocity vectors correct (ii) OR Constant horizontal velocity throughout. (iii) OR Vertical velocity has constant acceleration downwards due to gravity. (iii)	• TWO of - Correctly identified type of motion (i). - Point (ii) (all arrows correct). - Point (iii) (complete answer).	• Complete explanation of projectile motion, including diagram.

(d)	$v_x = 3.8\ \text{m s}^{-1}$ $v_y = 3.2\ \text{m s}^{-1}$ Time to maximum $v_f = v_i + at \Rightarrow 0 = 3.2 - 9.8t \Rightarrow t = 0.33\ \text{s}$ Maximum height calculated using: $d = v_i + \frac{1}{2}at^2 = 3.2 \times 0.33 - \frac{1}{2} \times 9.8 \times 0.33^2 = 0.52\ \text{m}$ or $v_f^2 = v_i^2 + 2ad \Rightarrow 0 = 3.2^2 - 2 \times 9.8d \Rightarrow d = 0.52\ \text{m}$ So height is 0.52 m total $t = 2 \times 0.33 = 0.66$, therefore horizontal $d = 0.66 \times 3.8 = 2.5\ \text{m}$ So the apple will make the distance without hitting the roof.	• Time = 0.33 or 0.66 s found. OR Vertical height calculated.	• Range calculated.	• Both maximum height and range found, and answer justified. (Accept a justification that infers the apple may be too high for Tony to catch.)

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No evidence	1a	2a 1m	3a 1m + 1a 1e + 1a 1e	4a 1m + 3a 1m + 2a 2m 1e + 2a	2m +2a 2m + 1a 1e + 3a 1e + 1m	3m +1a 3m 2e 1e + 2m 1e + 1m + 2a 1e + 1m + 1a	2e + 1m 2e + 2a 2e + 1a 1e + 2m + 1a	2e+ 1m + 1a

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 07	08– 13	14 – 18	19– 24