Assessment Schedule – 2023

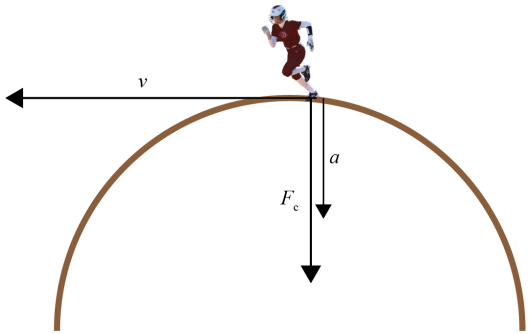
Physics: Demonstrate understanding of mechanics (91171)

Evidence Statement

Q	Evidence	Achievement	Merit	Excellence
ONE (a)	$v_f = v_i + at$ $5.45 = 0 + a \times 6.61$ $a = 0.825 \text{ m s}^{-2}$	• This is a show question, correct substitution must be shown.		
(b)(i)	$d = v_i t + \frac{1}{2}at^2 = 0 + \frac{1}{2} \times 0.825 \times 6.61^2$ $d = 18.0 \text{ m}$	• Correct calculation. OR (ii).	• Correct calculation plus assumption.	
(ii)	Player may not run in a straight line.			
(c)(i)	Impulse is change in momentum.	• (i) Change in momentum. OR (ii) Δp correct OR (iii) F decreases as t increases.	• (ii) Δp correct. OR (iii) Explain the effect of catching with a relaxed arm and a padded glove.	• (i) Change in momentum. AND (ii) Δp correct. AND (iii)explain the effect of catching with a relaxed arm and a padded glove.
(ii)	Calculation: $\Delta p = mv_f - mv_i$ $= 0.18 \times 0 - 0.18 \times 44.4$ $= 7.99 \text{ kg m s}^{-1}$ $F = \frac{\Delta p}{t} = \frac{7.99}{0.51} = 15.7 \text{ N}$			
(iii)	Having a relaxed arm increases the time it takes to stop the ball, or glove compresses when a ball is caught – this also increases the time to stop the ball. For the same momentum / impulse/ change in momentum, the increased time for the catcher will reduce the force of impact, (so less likely to cause injury or drop the catch). (Accept correct argument using deceleration.)			

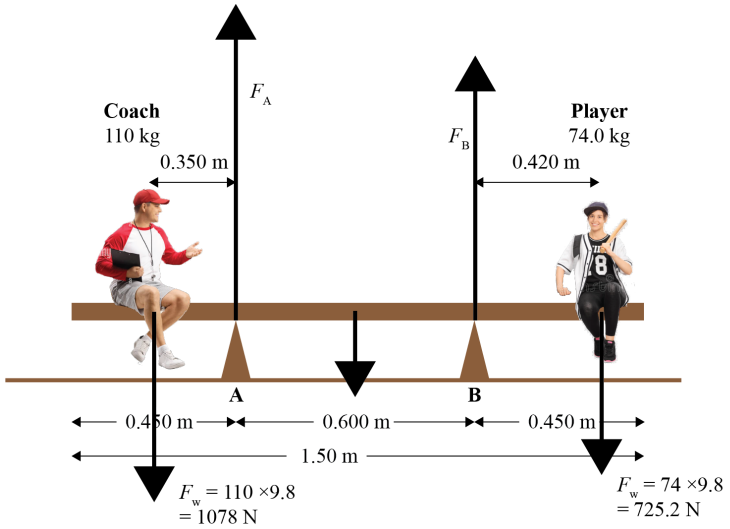
(d)(i)	Momentum is conserved.	• Momentum is conserved. OR Any correct momentum calculated.	• Correct method with one error.	• Complete answer.
(ii)	$p_f = (m_1 + m_2) \times v_f = 110 \times \vec{2} = \overrightarrow{220}$ kg m s^{-1} $p_i = \overrightarrow{50v_i} + \overleftarrow{60 \times 0.4} = \overrightarrow{50v_i} + \overleftarrow{24}$ $p_i = p_f$ $\overrightarrow{50v_i} + \overleftarrow{24} = \overrightarrow{220}$ $\overrightarrow{50v_i} = \overrightarrow{244}$ $v_i = 4.88$ m s^{-1}			

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 1e + 2a	2m 2m + 2a 2m + 1a 1e + 1m 1e + 3a	3m 3m + 1a 2e 1e + 1m + 2a 1e+ 1m + 1a 1e + 2m	2e + 1m 2e + 2a 2e + 1a 1e + 2m + 1a	2e +1m + 1a

Q	Evidence	Achievement	Merit	Excellence
TWO (a)	$F_c = \frac{mv^2}{r} = \frac{55 \times 7^2}{15}$ $F_c = 179.7,\ F_c = 180$ N	• Working shown and correct answer.		
(b)		• TWO out of three correctly **labelled** and drawn.	• All THREE correctly labelled and drawn.	
(c)(i) (ii)	Friction. • Velocity is a vector (it has size and direction). • Acceleration is a change in velocity. • Speed is constant, but because direction is changing, so too is the velocity, so it is accelerating.	• Friction . OR ONE point from (ii).	• TWO linked points from (ii).	• Friction. AND Full answer to (ii) with clear links.
(d)	• (F_c is provided by friction force created between shoes and the ground.) • If the ground is muddy, this force will reduce. • (If wet and slippery), the runner will no longer have enough F_c to move in a circle, and will move off at a tangent / move in a circle with a larger radius.	• ONE point.	• TWO points.	• FULL answers.

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 1e + 2a	2m 2m + 2a 2m + 1a 1e + 1m 1e + 3a	3m 3m + 1a 2e 1e + 1m + 2a 1e+ 1m + 1a 1e + 2m	2e + 1m 2e + 2a 2e + 1a 1e + 2m + 1a	2e +1m + 1a

Q	Evidence	Achievement	Merit	Excellence
THREE (a)	$v_v = v\sin\theta$ $= 22\sin 35 = 12.6$ m s^{-1}	• Show question – must see substitution. (accept 22cos 55)		
(b)	$v_f = 0$ $v_f^2 = v_i^2 + 2ad$ $0 = 12.6^2 - 2\times 9.8\times d$ $d = 8.1 \Rightarrow$ height $= 1.6 + 8.1 = 9.7$ m	• 8.1 m. OR Adds 1.6 m to any calculated *d*.	• Correct answer.	
(c)(i) (ii)	Force arrows downwards, and all the same size on diagram. • Forces: There is no horizontal force. There is a constant downwards vertical force due to gravity. • Acceleration: There is no horizontal acceleration. There is constant downwards acceleration due to gravity. • Horizontal velocity: There is constant horizontal velocity. • Vertical velocity: Vertical velocity starts at 12.6 m s^{-1} upwards and slows to 0 at the maximum height, and then constantly increases downwards. (The ball hits the ground faster than it left the bat.)	• (i) OR TWO correct but unlinked statements.	• Statements that correctly link all three of *F, a*, and *v* for either horizontal or vertical motion	• Correct force arrows on diagram. AND Statements that correctly link all three of *F, a*, and *v* for both horizontal and vertical motion.

(d)	 Taking torques about point B: $0.42 \times 725.2 + 0.6F_a = 40 \times 9.8 \times 0.3 + 0.95 \times 1078$ $F_a = 1395 = 1400$ N $F_a + F_b = 2195.2$, so $F_b = 800$ N.	• Five correct arrows (labels not required). OR Any correct torque about B calculated.	• Diagram correct. AND Correct method with one minor error. OR One support force correct.	• Complete 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 1e + 2a	2m 2m + 2a 2m + 1a 1e + 1m 1e + 3a	3m 3m + 1a 2e 1e + 1m + 2a 1e+ 1m + 1a 1e + 2m	2e + 1m 2e + 2a 2e + 1a 1e + 2m + 1a	2e +1m + 1a

Cut Scores

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