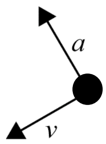
Assessment Schedule – 2008

Physics: Demonstrate understanding of mechanics (90255)

Evidence Statement

Q		Achievement	Achievement with Merit	Achievement with Excellence
ONE (a)	$d = \frac{(v_f + v_i)}{2}$ $d = \frac{(6+8)}{2} \times 3$ $d = 21\,\text{m}$ OR valid alternative.	2 Correct answer.		
	d = 20 to 1 s.f.	1 1 sig. fig.		
(b)	Kinetic → Heat (+ Sound)	1 Correct answer.		
(c)	$E_K = ½ mv^2$ $E_K = ½ \times 65 \times 8.0^2$ $E_K = 2080$ J	2 Correct answer.		
(d)	$p = mv$ $p = 65 \times 8$ $p = 520$ kg m s^{-1}	2 Correct answer.		
	Unit kg m s^{-1} or Ns	1 Correct unit.		
(e)	$v = 6 + 4 = 10$ m s^{-1}	2 Correct answer.		
(f)	For Louise to travel at a constant speed, all forces acting on her must be balanced, hence the net force acting on her is zero. OR If Louise is travelling at a constant speed then her acceleration must be zero, hence according to Newton's second law, $F = ma$, her net force must be zero.	1 Net force = 0N OR All forces are balanced / in equilibrium.	1 Links constant speed to balanced forces, hence $F_{net} = 0$ N OR Links constant speed to $a = 0$ m s^{-2}, hence $F_{net} = 0$ N.	
(g)	The only FORCE on the ball is gravity. This is down and constant the whole time. This means the ACCELERATION is constant and downwards even at the top. The VELOCITY is upwards, decreasing, then zero at the top, then downwards increasing.	1 ONE correct idea.	1 Any TWO correct ideas.	1 All THREE ideas clearly explained, AND showing clear understanding of the force/accel at the top, OR equal but opposite velocity at the bottom.

(h)	$\Delta v = 12 - (-8) = 20$ (right positive) $a = \frac{\Delta v}{\Delta t} = \frac{20}{0.10} = 200\ \text{m s}^{-1}$ $F = ma = 0.45 \times 200$ $F = 90\ \text{N}$ OR $\Delta p = 0.45(12 - (-8)) = 9.0$ (right positive) $F = \frac{\Delta p}{\Delta t} = \frac{9.0}{0.10}$ $F = 90\ \text{N}$	[2] Determines the correct magnitude of the change in velocity or change in momentum (using initial – final).	[2] Correct working and determines Δv using $v_{final} - v_{initial}$ then calculates the acceleration OR Correct working and determines Δp using $p_{final} - p_{initial}$ OR All correct except makes an error in the determination of the change in *v* or *p* or the conversion of mass.	[2] Correct working and answer.
(i)	90 N to the left. OR –90 N to the right.	[1] Force and direction are correct and consistent with respect to sign.		
TWO (a)		[1] Velocity vector must be tangential on Tahi or the edge of the merry-go-round. Acceleration vector must act from Tahi toward the centre.		
(b)	Centripetal acceleration.	[1] Correct answer.		
(c)	$a = \frac{v^2}{r} = \frac{1.5^2}{3} = 0.75\ \text{m s}^{-2}$	[2] Correct answer.		
(d)	There must be a force acting towards the centre of the circle as Tahi is constantly changing direction. If Tahi is constantly changing direction then he is accelerating and acceleration requires a force. OR There must be a force acting towards the centre of the circle as he is constantly changing direction. Without a force Tahi would travel in a straight line tangent to the circle.	[1] The force acts towards the centre (don't accept centripetal or inward). OR A force is needed to change the direction of Tahi. *(Don't accept keep going in a circle.)* OR Without a force Tahi would travel in a straight line (tangent to the circle).	[1] Links a centre acting force TO a constant change in the direction. OR That without a centre acting force Tahi would travel in a straight line tangent to the circle.	[1] Fully correct answer.
(e)	For Rua to halve the period he must make the merry-go-round spin at twice the speed as $v = \frac{d}{t}$. As $F = \frac{mv^2}{r}$ if the speed doubles, then the centripetal force is quadrupled assuming that the mass and radius remain constant.	[1] Qualitative answer identifying that the force increases.	[1] Quantitative answer with valid formulaic reasons.	[1] Fully quantitative answer stating quadruple the force, justified using relevant formula or stating the assumptions that mass and / or radius remain constant.

(f)	Inelastic means kinetic energy is not conserved / is lost.	[1] Correct answer.		
(g)	Principle of conservation of energy $E_{P\ \text{at top}} = E_{K\ \text{at bottom}}$ then $E_{P\ \text{at top}} = mgh = 55 \times 9.8 \times 4.0$ $E_{P\ \text{at top}} = 2156$ $E_{K\ \text{at bottom}} = 2156$ $v = \sqrt{\frac{2 \times 2156}{55}}$ $\frac{1}{2} mv^2 = 2156$ $v = \sqrt{\frac{2 \times 2156}{55}}$ $v = 8.85 \text{ m s}^{-1}$ or $v = \sqrt{2gh}$ $v = \sqrt{2 \times 9.8 \times 4.0}$ $v = 8.85 \text{ m s}^{-1}$ THEN Principle of Conservation of momentum $p_{\text{before}} = p_{\text{after}}$ $m_T v_T = (m_T + m_R) v_{TR}$ $55 \times 8.85 = (55 + 65) v_{TR}$ $486.99 = 120\ v_{TR}$ $v_{TR} = \frac{486.99}{20} = 4.06 \text{ m s}^{-1}$	[2] Correctly determines E_P.	[2] Correctly working and determines initial velocity.	[2] Correct working and answer.
(h)	Momentum is NOT conserved, as there is an external force due to gravity acting on him resulting in an increase in his momentum / velocity.	[1] Momentum is not conserved as there is an external force (the system is not isolated). OR Momentum is not conserved as Tahi's speed/momentum increases.	[1] Momentum is not conserved as there is an external force hence Tahi's speed / momentum increases.	
(i)	$\sin 37° = \frac{F_v}{1500}$ $\quad$ $\cos 53° = \frac{F_v}{1500}$ $F_v = 1500 \times \sin 37°$ $\quad$ $F_v = 1500 \times \cos 53°$ $F_v = 902.7 \text{ N}$	[2] Correct working.		

(j)	$\tau_C = \tau_{AC}$ $(F_t \times 3) + (343 \times 1.5) = 900 \times 3$ $3F_t + 514.5 = 2700$ $3F_t = 2185.5$ $F_t = 728.5$ N	2 Determines a correct torque.	2 Correct working and answer.	
(k)	$F_h = 95\cos45°$ $F_h = 67.18$ $F_{net} = 67.18 - 35 = 32.18$ N $a = \frac{F}{m} = \frac{32.18}{76} = 0.42 \text{ m s}^{-2}$	2 Calculates the horizontal force component due to rope. OR Incorrectly determines the net force, then goes on to find a = 0.79 m s^{-2}	2 Correct working and determines the net force.	2 Correct working and answer.
(l)	$k = \frac{F}{x} = \frac{95}{0.01} = 9\ 500 \text{ N m}^{-1}$ $E = ½ kx^2$ $E = ½ \times 9\ 500 \times 0.01^2$ $E = 0.475$ J	2 Determines E_P using incorrect unit (full working must be shown).	2 Correct working and determines spring constant.	2 Correct working and answer.
(m)	The ball lands in the same place relative to Rua. The ball has an initial horizontal velocity. There are no horizontal forces acting on the ball in flight so it keeps moving at the same horizontal speed as the trolley and lands where it left.	1 Lands in same place "relative to" Rua.	1 Lands in same place because it keeps moving horizontally at the same/constant speed as Rua. OR Lands in same place because there are no horizontal forces acting on Rua or the ball	1 Lands in same place because it keeps moving horizontally at the same/constant speed as Rua as there are no horizontal forces acting on Rua or the ball.
(n)	$v_f = v_i + at$ $-9.8 = 9.8 - 9.8t$ $t = 2.0$ s	2 Correctly determines the time to maximum height.	2 Correct working and answer.	

Judgement Statement

Achievement	Achievement with Merit	Achievement with Excellence
5 × A1	4 × A1 + 3 × M1	4 × A1 + 2 × M1 + 2 × E1
5 × A2	4 × A2 + 3 × M2	4 × A2 + 2 × M2 + 2 × E2