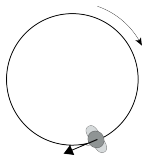
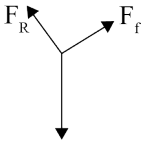
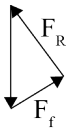
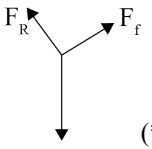
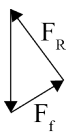
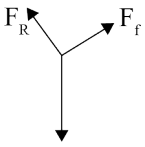
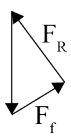
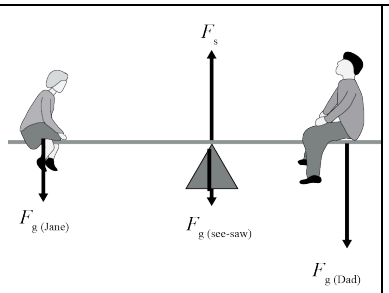
Assessment Schedule – 2013

Physics: Demonstrate understanding of mechanics (91171)

Evidence Statement

	Achievement	Merit	Excellence
ONE (a)			
(b)	$v = \frac{2\pi r}{T} = \frac{2\pi \times 4}{15} = 1.68 \text{ m s}^{-1}$ OR Used incorrect value of "v" to calculate F_c	$F_c = \frac{mv^2}{r} = \frac{65 \times 1.68^2}{4} = 45.6 \text{ N}$ = 46 N ***Use R for rounding error*	
(c)	$v_f = v_i + at$ $0 = v_i - 2.5 \times 4.2$ $v_i = 10.5 ms^{-1}$	Added (44.1 +22.05)to get incorrect answer of **66.15 m** **circle + sign* *OR* *Assumed v_i =0 and worked out answer.*	$d = v_i t + \frac{1}{2} at^2$ $d = 10.5 \times 4.2 - \frac{1}{2} \times 2.5 \times 4.2^2$ d = 44.1 – 22.05 d = 22.05 m OR $d = \frac{v_f - v_i}{2} t$ $d = \frac{10.5 + 0}{2} \times 4.2$ $d = 22.05 \text{ m}$
(d)	ONE OF: • Net force = 0. • Reaction force acts at 90° to surface. • Friction acts upwards along surface.  • Closed triangle to show balanced forces with correct labels 	TWO OF: • Net force = 0. • Reaction force acts at 90° to surface AND Friction acts upwards along surface.  (** No contradictory vectors) • Closed triangle to show balanced forces with correct labels 	ALL OF: • Net force = 0. • Reaction force acts at 90° to surface AND Friction acts upwards along surface.  • Closed triangle to show balanced forces with correct labels. Or shows that sum of horizontal and vertical components add to zero. 

TWO (a)	 All four vectors correct without labels. OR three correct vectors labelled.	All four vectors correctly drawn and labelled. $\boldsymbol{F_s}$ **must be larger**.	
(b)	$(30\times9.8\times1.5)+F\times1.5$ $=72\times9.8\times1.5$ **441** $\times F\times 1.5 =$ **1058** OR (**450** $+F\times 1.5 =$**1080**) OR **294** $+F_s =$ **705.6** OR Taking moments / calculating torques wrt to Dad's end: $(30 \times 9.8 \times 3.0) + (60 \times 9.8 \times 1.5) - (F_S \times 1.5) = 0$ where F_S is the support force at the pivot when Dad's end is on the ground $882 + 882 = 1.5\ F_S$ hence $F_S = 1764 \div 1.5 =$ **1176 N**	$F\times1.5$ $=72\times9.8\times1.5-30\times9.8\times$ $F\times1.5=1058.4-441.0$ $F\times1.5=617.4$ OR $(F \times 1.5 = 630)$ OR Total F_{UP} = total F_{DOWN} $F_S + F_{GROUND}$ $= (30 \times 9.8) + (60 \times 9.8) + (72 \times 9.8)$ $= 294 + 588 + 706$ $=$ **1588 N**	$F=\frac{617.4}{1.5}=411.6$ N OR (F = 420 N) OR Hence F_{GROUND} = 1588 – 1176 = **412 N**
(c)	TWO of: • The only unbalanced force acting on the ball is the force of gravity. • Gravity acts downwards. • This unbalanced force causes the ball to decelerate or accelerate downwards. • Velocity at the top is zero.	The only unbalanced force acting on the ball is **gravity**, which acts downwards. This causes the ball to **decelerate** or accelerate downwards. Hence the ball slows down to **a stop** when it reached maximum height.	
(d)	$v_{horizontal} = 6.5\cos60 = 3.25$ m s^{-1} OR $v_{vertical} = 5.63$ m s^{-1} ***Watch out for values being swapped around.*	$v_{horizontal} = 6.5\cos60 = 3.25$ m s^{-1} AND $v_{vertical} = 5.63$ m s^{-1} AND $t=\frac{d}{v}\rightarrow\frac{3.0}{3.25}=0.923$ s OR Time to reach max height = 0.57s, so max height =1.6m, so will go only 1.85 m across and so will not go through hoop.	$d=v_it+\frac{1}{2}at^2$ $d=5.63\times0.923-0.5\times9.8\times0.923^2$ $d=1.02m$ This is less than 1.35 m hence ball will not go through hoop. OR Vertical velocity at 1.35 m height v = 2.29 ms-1 Time taken for v_f to reach 2.29ms^{-1} $v_f=v_i+at$ $\pm2.29=5.63-9.8t$ $t=\frac{5.63\pm2.29}{9.8}=0.808$ s *or* 0.34 s

			Horizontal distance travelled in 0.808s or 0.34 s or 1.12 m This is less than 3.00 m, so ball will not go through the hoop.
THREE (a)	$p = mv$ $p = 305 \times 2.4 = 732$ kg m s^{-1} $p = 730$ kg m s^{-1} OR Accept **both** done separately (576 kgms^{-1} and 156 kgms^{-1})		
(b)	ONE OF: • Rubber bumpers reduce the force. • By increasing the time of impact. • Since change in momentum is the same. OR • Rubber bumpers move a distance when compressed, • so for the same amount of work done or energy changed, or the same change in velocity, acceleration is decreased due to longer time • less force is used.	TWO OF: • Rubber bumpers reduce the force. • By increasing the time of impact. • Since change in momentum is the same. OR • Rubber bumpers move a distance when compressed, • so for the same amount of work done or energy changed, or the same change in velocity, acceleration is decreased due to longer time • less force is used.	Rubber bumpers reduce the force. The rubber compresses to increase the time of impact. Since change in momentum is the same. OR • Rubber bumpers move a distance when compressed, • so for the same amount of work done or energy changed, or the same change in velocity, acceleration is decreased due to longer time • less force is used.
(c)	Momentum is conserved $(240 + 65)\ 2.4 \rightarrow + (240 + 58)2.7 \leftarrow = (480 + 65 + 58)v$ $732 \rightarrow + 804.6 \leftarrow = 603v$ OR Solved without adding mass of cart $156 - 156.6 =$ **0.6** **OR** Gets 2.5 ms^{-1} by adding	$732 \rightarrow + 804.6 \leftarrow = 603v$ $72.6 \leftarrow = 603v$ *OR* *Found velocity without taking mass of cart into consideration* *($v = 4.9 \times 10^{-3}$ ms^{-1})*	$v = 72.6 / 603 = 0.12$ m s^{-1} $\leftarrow$
(d)(i)	$E_p = \frac{1}{2}kx^2$ $E_p = \frac{1}{2} \times 78000 \times 0.15^2$ $E_p = 877.5$ J $E_p = 880$ J		

(ii)	$E_p = 877.5$ J $F = kx = 78000 \times 0.15$ $F = 11700$ N OR average force = 5850 N OR 9360 with no units	$I = F\Delta t$ $I = 11700 \times 0.80$ $I = 9360$ N s OR I = 4680 N s OR I = 1463 kgms^{-1}	

For each question:

N0	N1	N2	A3	A4	M5	M6	E7	E8
No evidence	1a	2a	3a	4a	3a+1m	2a + 2m	2m + 1e	1m+2e

***Other combinations are possible, but to get M5 or M6 at least one merit question should be correct. To get E7 or E8 at least one excellence question should be correct.*

Judgement Statement

	Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
Score range	0 – 7	8 – 14	15 – 19	20 – 24