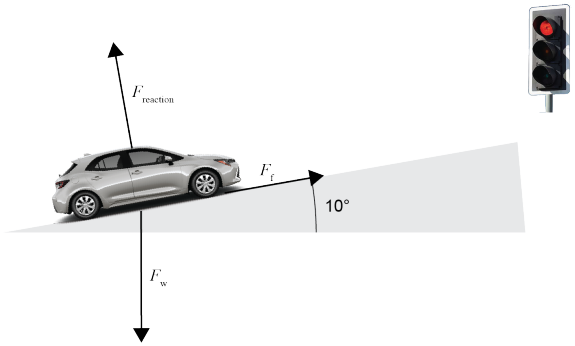
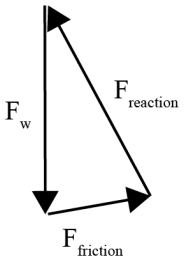
Assessment Schedule – 2020

Physics: Demonstrate understanding of mechanics (91171)

Evidence Statement

Q	Evidence	Achievement	Merit	Excellence
ONE (a)	$v_f = v_i + at$ $v_f = 0 + (4.2 \times 0.6) = 2.5$ m s^{-1}	• This is a show question.		
(b)(i)		• Correct labelled force diagram.	• Correct labelled vector diagram with obvious right angle.	
(ii)				
(c)	$F_w = 1600 \times 9.8 = 15\,680$ N $F_{friction} = F_w \sin 10° = 2722 = 2700$ N	• Correct F_w.	• Correct working.	

(d)	Converts speeds to m s^{-1} 50 km h^{-1}=13.89 m s^{-1} 20 km h^{-1} = 5.56 m s^{-1} Distance travelled in 2.3 s: $d = \frac{v_i + v_f}{2} t = \frac{13.89 + 5.56}{2} \times 2.3 = 22.4$ m This is more than 15 m. So can't slow down in time OR $v_f^2 = v_i^2 + 2ad$ $5.56^2 = 13.89^2 + (2 \times a \times 15)$ $a = -5.40$ m s^{-2} $v_f = v_i + at$ In order to slow to 20 km h^{-1} in 15 m, it would take t = 1.5 s. This is too short a time for safe braking. Therefore, it is not possible.	• ONE correct calculation that could lead to a correct solution, e.g. correctly changes both speeds to m s^{-1}.	• ONE error.	• Correct answer with explanation / interpretation.

Not Achieved			Achievement		Achievement with Merit		Achievement with Excellence	
NØ	**N1**	**N2**	**A3**	**A4**	**M5**	**M6**	**E7**	**E8**
No response; no relevant evidence.	Very little Achievement evidence.	Some evidence at Achievement level, but most is at Not Achieved level.	A majority of the evidence is at the Achievement level.	Most evidence is at Achievement level.	Some evidence is at Merit level.	A majority of the evidence is at Merit level.	Evidence is provided for most tasks. The evidence at Excellence level may have minor errors, or the evidence is weak.	Evidence is provided for most tasks. The evidence at Excellence level is accurate.
–	1a	2a	3a	4a	1m + 3a	2m + 2a	1e + 2m	1e + 2m + 1a

Q	Evidence	Achievement	Merit	Excellence
TWO (a)	Arrow towards centre.	• Correct answer.		
(b)	$a = \frac{v^2}{r} = \frac{12^2}{25} = 5.76 \text{ m s}^{-2}$ Unbalanced inward force created by friction causes inward acceleration	• Correct calculation. OR Unbalanced inward force created by friction causes inward acceleration.	• BOTH correct	
(c)	If the car hits ice / oil / gravel / wet road / or tyre condition • this will change the friction forces and either reduce or increase centripetal force • and so direction will change due to change in unbalanced forces.	• ONE factor that causes reduction in friction.	• external factor named PLUS Reduced friction leads to reduced F_c resulting in tangential motion	
(d)	$\Delta p = F\Delta t$ $\Delta p = p_f - p_i$ $= 0 - 12 \times 1600 = -19\,200$ $F_{\text{crumple}} = \frac{19\,200}{0.8} = 24\,000\ N$ Without crumple zone: $F_{\text{no crumple}} = \frac{19200}{0.2} = 96\,000\ N$ So crumple zone collapses and increases time for collision, and the force from the seatbelts on the occupants is reduced (only ¼ as much).	• Correct momentum change. OR ONE correct force. OR Explanation of crumple zone.	• BOTH correct forces.	• Correct values. AND Justify how crumple zone works, including statement that Δp is the same in both situations.

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Q	Evidence	Achievement	Merit	Excellence
THREE (a)	All torques and all forces are balanced	• Correct answer.		
(b)	$13 \times 30\,000 \times 9.8 + 1600 \times 9.8 \times x = 26 \times 160\,000$ $3\,8222\,000 + 15\,680x = 4\,160\,000$ $x = 21.6$ m from support force A.	• A correct torque.	• Correct distance.	
(c)	$F = kx$ Double m means double the force, which means double x, as k is constant.	• Double m.	• Double m and fully justified.	
(d)(i)	$50\,000 = k \times 1.8$ $k = 27\,777.8$ $E = \frac{1}{2}kx^2 = \frac{1}{2} \times 27\,777.8 \times 1.8^2$ $= 45\,000$ J $E = \frac{1}{2}mv^2$ $45\,000\text{ J} = \frac{1}{2} \times 1600v^2$ $v = 7.5\text{ m s}^{-1}$	• k found. OR Energy conserved.	• v found. OR E found and assumption stated.	• Correct answer with assumption.
(ii)	Energy is conserved. Assumes all the energy from the spring is transferred to the car. OR no energy lost to accelerating the spring.			

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Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 7	8 – 13	14 – 19	20 – 24