Assessment Schedule – 2005

Physics: Demonstrate understanding of mechanics (90255)

Evidence Statement

Q	Evidence	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
1(a)	$v_i = 0$ $v_f = 13.9$ $t = 10$ $a = \frac{\Delta v}{\Delta t} = \frac{13.9}{10}$	[2]Correct substitution. (MUST show some working)		
1(b)	$F = ma = 1357 \times 1.4 = 1900$ N	[2]Correct answer.		
1(c)	This force is less than the total driving force.	[1]Less		
1(d)	The force calculated in (b) is the net (unbalanced, resultant) force. In addition, force is needed to overcome resistance caused by friction between the body and air / engine parts.	[1]Extra force needed to overcome friction. **OR** Correct explanation in terms of energy.	[1]Extra force needed to overcome friction due to air resistance / engine.	
1(e)	$P = \frac{W}{t} = \frac{E_K}{t} = \frac{\frac{1}{2}mv^2}{t} = \frac{1357 \times 14^2}{2 \times 10}$ $= 1.3 \times 10^4$ **OR** $d = \frac{1}{2}at^2 = \frac{1}{2} \times 1.4 \times 10^2 = 70$ $P = \frac{W}{t} = \frac{F \times d}{t} = \frac{1900 \times 70}{10}$ $= 1.3 \times 10^4$ **OR** $v_{ave} = \frac{13.9}{2} = 6.95$ $P = F \times v_{ave} = 1900 \times 6.95$ $P = 1.3 \times 10^4$	[2]Correct approach such as a realisation that they need to find the kinetic energy of the car, and an attempt to do so. **OR** Showing an attempt to calculate distance travelled as a precursor to the second method. (eg use of d = vt). **OR** Showing an attempt to calculate average velocity as a precursor to using P = Fv.	[2]Correct answer for : energy **OR** work **OR** average velocity **OR** candidate follows correct process throughout but (eg) uses a wrong value in substitution eg uses 50 kmh^{-1} instead of 14 ms^{-1}.	[2]Correct answer.
	W **OR** watts **OR** kW **OR** Js^{-1} (Nms^{-1} etc)	[1]Correct unit.		
1(f)(i)	Two vectors drawn to scale in correct directions. V_i or 12 ms^{-1} V_f or 16 ms^{-1} Horizontal arrow 6 cm (squares) long and vertical arrow 8 cm (squares). Whether they touch or not is irrelevant.	[1]Vectors correctly drawn & labelled with arrows and names or values. (Accept if student has rotated grid through 90° ONLY if labelled with correct directions or with a new compass rose).		

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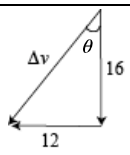
1(f) (ii)	Vectors drawn thus. 	[2] Correct fully labeled diagram. **OR** Correct change in velocity. **OR** Correct angle shown on diagram or given as a bearing or compass direction.	[2] Any TWO correct of velocity, angle or diagram.	[2] Diagram and answers all correct.
1(f) (iii)	$\Delta v = \sqrt{16^2 + 12^2} = 20 \text{ m s}^{-1}$			
1(f) (iv)	$\tan\theta = \frac{12}{16} = 0.75$ Hence $\theta = 37^o$ W of S (bearing 217°)			
1(g) (i)	Arrow on car pointing in towards the centre of the circle at right angles to the direction of travel.	[1] Arrow drawn correctly.		
1(g) (ii)	$F = \frac{mv^2}{r} = \frac{1357 \times 25^2}{40} = 2.1 \times 10^4 \text{ N}$	[2] Correct answer.		
	Answer written with 1 or 2 sig figs.	[1] Answer written appropriately.		
1(g) (iii)	The car would slide in a straight line **at a tangent** to the direction that it was travelling **at a constant speed**. There is no longer any friction between the tyres and the road to provide the **centripetal force** needed to maintain the car moving in a circular path.	[1] **EITHER** travels (in a straight line) at a tangent to the circle. **OR** Travels at a constant speed. **OR** Absence of friction means that there is no centripetal force holding it to its circular path.	[1] Any two different and correct ideas.	[1] Completely correct answer.
1(h) (i)	Weight = 357 × 10 = 3570 N $F = \frac{3570}{4} = 892.5 \text{ N}$ $x = \frac{F}{k} = \frac{892.5}{2.26 \times 10^4} = 0.0395 \text{ m}$	[2] Correct approach but: weight not calculated **AND** does not divide by 4.	[2] Correct approach but weight not divided by 4 **OR** calculation done using mass but correctly dividing by 4.	[2] Correct answer.
1(h) (ii)	$E_P = \frac{1}{2}kx^2 = \frac{1}{2} \times 2.26 \times 10^4 \times 0.12^2$ = 162.72 J = 160 J	[2] Correct answer.		
2(a)	$p_i = p_f$ $m_i v_i = m_f v_f$ $1200 \times v = (1200 + 1500) \times 4$ $\Rightarrow v = \frac{2700 \times 4}{1200} = 9.0 \text{ ms}^{-1}$	[2] Correct expression for p_i. **OR** Correct calculation of combined momentum after the collision.	[2] Correct answer.	
2(b)	Momentum	[1] Correct answer.		

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2(c)	No external forces were acting / isolated system	[1]Correct answer.		
2(d)	$m\Delta v = F\Delta t$ $1200 \times (9.0 - 4.0) = F \times 0.50$ $\Rightarrow F = \frac{1200 \times 5}{0.50} = 1.2 \times 10^4$ N **OR** $1500 \times 4.0 = F \times 0.50$ $\Rightarrow F = \frac{1500 \times 4}{0.50} = 1.2 \times 10^4$ N **OR** $a = \Delta v \div \Delta t = 4\text{-}0/0.50 = 8.0$ ms^{-2} $F = ma = 1500 \times 8.0 = 12\,000$ N	[2]Any reasonable attempt TO APPLY Newton's Second Law.	[2]Correct calculation of **EITHER** the momentum lost by the car **OR** the momentum gained by the van **OR** the acceleration of the van **OR** the deceleration of the car.	[2]Correct answer.
2(e)	(Eg) Crumple zones, airbags, seat belts, collapsible steering wheel, all reduce the average force exerted on the driver during the impact by increasing the time taken for the driver to come to rest.	[1]TWO correct features named (Note: *not* ABS brakes). Can accept head restraints or side intrusion bars here – but explanations differ)	[1]Achievement *plus:* these features reduce the force on the driver. OR Increase the stopping time.	[1]Achievement *plus* BOTH the force decreases because the stopping time increases.
2(f)	$E_{K(\text{before})} = \frac{1}{2}mv^2 = \frac{1}{2} \times 1200 \times 9.0^2$ $= 48600$ J $E_{K(\text{after})} = \frac{1}{2}mv^2 = \frac{1}{2} \times 2700 \times 4.0^2$ $= 21\,600$ J Kinetic energy is lost so the collision is inelastic.	[2]Correct calculation of kinetic energy before **OR** after the collision.	[2]Correct calculation of BOTH kinetic energies (consequential).	
		[1]States inelastic collision because the car and the van stick together (but no relevant calculation).	[1]Calculates BOTH E_K but does not compare **AND** states that collision is inelastic.	[1]Compares kinetic energy $E_{K(\text{before})} > E_{K(\text{after})}$ **AND** links clearly to lost E_K hence collision is inelastic.
3(a)	The forces are equal in size because the balloon is rising at a steady speed, thus there is no unbalanced force acting on it.	[1]Forces are equal.	[1]Achievement *plus* constant speed means no unbalanced force.	
3(b)	Vertically $v_i = 0$ $a = 10$ $d = 320$ $d = v_i t + \frac{1}{2}at^2$ $320 = 0 + \frac{1}{2} \times 10 \times t^2$ $64 = t^2$ $t = 8$ Horizontally $d = vt = 25 \times 8 = 200$ m	[2]Correct calculation of time to ground.	[2]Correct answer.	

Judgement Statement

Criterion 1

Achievement	Achievement with Merit	Achievement with Excellence
FIVE opportunities answered at Achievement level or higher. 5 × A1	SEVEN opportunities answered with TWO at Merit level or higher, and FIVE at Achievement level. 2 × M1 + 5 × A1	EIGHT opportunities answered with ONE at Excellence level and TWO at Merit level and FIVE at Achievement level. 1× E1 + 2 × M1 + 5 × A1

Criterion 2

Achievement	Achievement with Merit	Achievement with Excellence
FIVE opportunities answered at Achievement level or higher. 5 × A2	NINE opportunities answered with FOUR at Merit level or higher, and FIVE at Achievement level. 4 × M2 + 5 × A2	TWELVE opportunities answered with THREE at Excellence level and FOUR at Merit level and FIVE at Achievement level. 3 × E2 + 4 × M2 + 5× A2