Question			Answer	Marks	Guidance
1	(a)	(i)	**any one from:** fewer pedestrians / cyclists killed compared to car occupants (1) fewer pedestrians / cyclists killed compared to previous year(s) (1)	1	**allow** ratio or proportion going down **ignore** descriptions of graph eg trend or graph is down / negative correlation **ignore** answers which simply reword the question **ignore** references to pedestrian : cyclist ratio
		(ii)	**any two from:** data does not distinguish pedestrians from cyclists (1) total numbers of deaths for cars not shown (1) total numbers of deaths for pedestrians not shown (1) total numbers of deaths for cyclists not shown (1)	2	 **allow** 'ratio of cyclist deaths compared to pedestrian deaths not known' (2) **allow** 'total number of deaths for each group unknown' (2)
	(b)		**any two from:** longer time (to stop) (1) less acceleration (1) less force produced (1) **but** lower rate of change of momentum produced (2)	2	 eg 'Slow down the speed of the passengers more slowly' (1) **allow** slow down = longer time unless answer shows otherwise eg slow down the change of momentum (1) eg the change in momentum takes longer (1) **but** slow down the rate of change of momentum (0) (as you cannot 'slow down a rate') **allow** reduce the rate of change of momentum (2) **ignore** references to energy **but** energy absorbed (0) over a longer time (1)
			Total	**5**	

Question			Answer	Marks	Guidance
2			**Level 3: (5 – 6 marks)** Answer gives a clear and detailed explanation in terms of the affect of the factors of; more speed, road conditions and alcohol on thinking distance **and** braking distance **and** the application to stopping distance **and** road safety. If road safety is not addressed award the lower mark. Quality of written communication does not impede communication of the science at this level. **Level 2: (3 – 4 marks)** Answer gives a correct explanation how two factors affect stopping distance **or** braking **or** thinking and how any increase can lead to a greater chance of a crash or accident. If there is no mention of crashes or accidents award the lower mark. Quality of written communication partly impedes communication of the science at this level. **Level 1: (1 – 2 marks)** Simple explanation of how one of the factors affects thinking **or** braking distance. Answers may refer to reaction time without mention of thinking distance. Quality of written communication impedes communication of the science at this level. **Level 0: (0 marks)** Insufficient or irrelevant science. Answer not worthy of credit.	6	**This question is targeted up to grade C** **Indicative scientific points may include:** **more / higher speed** • will increase thinking distance • greater distance travelled at higher speed for the same thinking time • speed will increase braking distance as more KE will need to be absorbed by the brakes • **allow** longer to stop if answers refer to speed assume it means more speed unless there is a later contradiction **road conditions** • rain / snow / ice / wet leaves / gravel will increase braking distance • reduced friction due to less grip / friction / slippery road • no affect on thinking distance • going downhill increases braking distance **ignore** references to visibility eg fog **alcohol** • will increase thinking distance as slower • reactions give a longer thinking distance • braking distance is unaffected • stopping distance increased • **allow** increase reaction time / don't react as quick / reduces concentration (levels) **ignore** references to other distractions eg mobile phones **road safety** link the increased stopping distance to reduction in road safety with an indication of greater chances of accidents or crashes or collisions.

Question			Answer	Marks	Guidance
					ignore increased load or more passengers in answer **allow** higher level answers at level 3 **eg** wet road has less friction so less force gives less deceleration **higher level quantitative relationships** **eg** thinking distance changes linearly but braking distance depends on v^2
			Total	**6**	

Question			Answer	Marks	Guidance
3	(a)		15[1]	1	
	(b)		(car) **C** (no mark) and max 3 from marking points any other choice from **D E F** max 2 from marking points **because of** windows open or roof box (causing increased drag) [1] **linked** to idea of more KE / energy needed **or** engine / car having to do more work / engine has to work harder [1] **then max one for the link to one of the following additional factors** higher speed / changing speed a lot / accelerating more [1] different driving styles / frequent braking / electrical equipment in use [1] different terrain or road surface [1]	3	**use ✓'s in this question** **ignore** references to emissions throughout question **allow** just more energy or power needed from engine or car **allow** examples eg fog lights / radio used **allow** examples eg driven on hills eg driven over roads with poor grip
			Total	**4**	

Question	Answer	Marks	Guidance
4	**[Level 3]** Explanation of the reasons for having crumple zones in a car including ideas about force reduced or lower rate of change of momentum. A more detailed description of the method(s) of testing or the use of the data or retesting should be included. Quality of written communication does not impede communication of the science at this level. (5–6 marks) **[Level 2]** Ideas of longer time of collision or lower acceleration or transfer of energy resulting in reduction of injury. Some reference to testing should be included. Quality of written communication partly impedes communication of the science at this level. (3–4 marks) **[Level 1]** Idea of changing shape and protecting occupants or reduce injuries in a crash may be included **or** mentions simple points in the testing process. Quality of written communication impedes communication of the science at this level. (1–2 marks)	6	**This question is targeted up grade C** **Indicative scientific points at Level 3 may include:** • idea of spreading the momentum change on passenger • longer time collision time to transfer momentum • retest with new design feature • measure forces on test dummies • how crumple zones protect dummies • crumple zone design or placement improved • collection and analysis of data from actual crashes • video crash tests **allow higher level answers at level 3** • forces reduced due to increased stopping / collision distance or time • lower acceleration (of driver or passenger) • spreading change in momentum over longer time reduces forces on driver or passenger and reduces potential injury **Indicative scientific points at Level 2 may include :** • longer time collision time or distance produced • idea of transfer of car or driver's energy • injuries in a crash are due to rapid deceleration of parts of the body • features are to reduce injuries to driver or passenger • measurements made on test dummies • assessment of effectiveness of crumple zones • new improved design fitted to car **Indicative scientific points at Level 1 may include:** • features change shape in a crash • features absorb energy in a crash • crash simulation • 'dummy' driver / passengers used • crumple zones examined

Question			Answer	Marks	Guidance
			[Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)		**throughout answer** **ignore** slows down impact or force **ignore** absorbs force or impact **Use the L1, L2, L3 annotations in Scoris; do not use ticks.**
			Total	**6**	

Question			answer	Marks	Guidance
5	(a)		**Z** is most economical / more fuel efficient / best fuel consumption / lowest fuel costs [1] (idea that) Trevor has read fuel consumption data the wrong way around / back to front / 16.1 or **X** is the worst consumption / least km per lr / ORA [1] **and one from** **least environmental harm**; **Y** quietest or gives out less **noise** pollution or least dB **and** is best in terms of lowest CO_2 or greenhouse gas emissions or pollution **given out or emitted** [1] **OR** **Z** is close (to **Y**) in terms of low(er) noise pollution **and** CO_2 or greenhouse gas emissions or pollution **given out or emitted** [1]	3	**use ✓'s in this question** **allow** car with biggest engine or highest top speed or **V** has low or poor fuel consumption **/** AW OR **X** is least fuel efficient / AW [1] **allow** choice of **Y** because of high km/hr / close to **Z** fuel consumption / small engine size [1] **allow** most economical or fuel efficient cars go further on a litre of petrol **allow** car with biggest engines or highest top speed or acceleration (figures) or **V** has highest CO_2 emissions / pollutes most **and** is noisier or noisiest / AW **ignore** references to pollution on its own **allow** a correctly reasoned choice eg choose **Z** because it is fairly quiet **and** has close to the lowest CO_2 emissions [1] eg he should choose **Z** as it has the best fuel economy **and** is fairly quiet and has close to the lowest CO_2 emissions [2] **ignore** references to pollution on its own
	(b)	(i)	12 (kW) [2] **but if answer is incorrect** (500 x 850) ÷ 35 or 12143 or 12.1(43) [1]	2	**allow** 12000 – 12200 [1] **allow** power = (force x distance) ÷ time [1] **ignore** number of decimal places if answer is left in watts [1]

Question			Answer	Marks	Guidance
5	b	(ii)	**any one from** car **V because** it has biggest engine size [1] car **V because** it has the highest top speed / speed of 210 (km/hr) [1] car **V because** it has highest acceleration [1]	1	 **allow** 201 (km/hr) /engine size 1800 (cm^3) / 5 seconds to reach 90 km/hr as these clearly indicate **V** **allow V because** it has the highest power
	(c)		**driver: any one from** need to recharge battery / need a charging point / AW [1] limited range / problems of recharging or refuelling [1] limited top speed / lower performance [1] no pollution or harmful gases at point of use **/** given out [1] more economical to run [1] could be no congestion charge [1] **pedestrians: any one from** dangers from more vehicles on roads / in city centres [1] accident danger increased because the cars are quiet / difficult to hear [1] idea of less noise pollution [1] no pollution or harmful gases at point use / given out [1] danger from vehicle on pavement **if** scooter/ Segway is named [1]	2	**use ✓'s in this question** **allow** scooter type carries only one person [1] **allow idea** using electric cars still produces pollution / gases / CO_2 when electricity is produced **allow** idea of burning fossil fuels to produce electricity or electricity is made in a power station / power stations produce pollution **only award point of use mark once** **ignore** vehicle purchase cost **allow** lower speeds safer for pedestrians if the low speed mark is not gained for the driver response **allow** idea of less emissions to breath in if pollution mark not awarded in driver response **only award point of use mark once**
			Total	**8**	

Question			Answer	Marks	Guidance
6	(a)		30 (m/s) scores (2) **but if answer is incorrect** 75 ÷ (0.5 x 5) or 150 ÷ 5 scores or 75 ÷ 2.5 (1)	2	
	(b)		**any two from:** braking may not (always) leave a skid mark (1) (more or less) tread may affect skidding / AW (1) wet / icy / slippy road (may affect friction) (1) (more / less) weight of / load in car (1) (so) length of skid mark is not the same as braking distance (1)	2	eg ABS brakes may not leave a skid mark (1) eg Non ABS cars may skid more (1) **but** some cars have ABS (0) **allow** may have started braking before he skidded (1) **ignore** references to reaction (time / distance) **ignore** road and brake conditions unless qualified eg Worn brakes / bad road conditions (0)
	(c)	(i)	(KE) doubles (with double the mass) / AW (1)	1	
		(ii)	(KE) quadruples / AW (1)	1	
		(iii)	braking distance quadruples / AW (1)	1	
			Total	**7**	