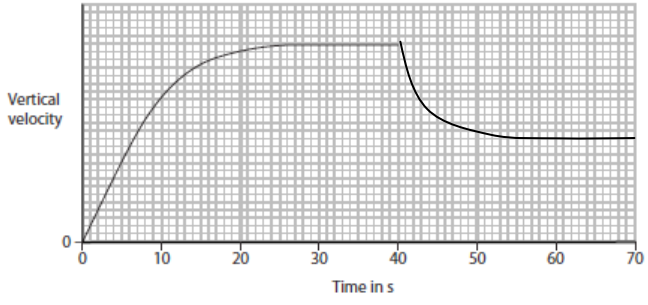
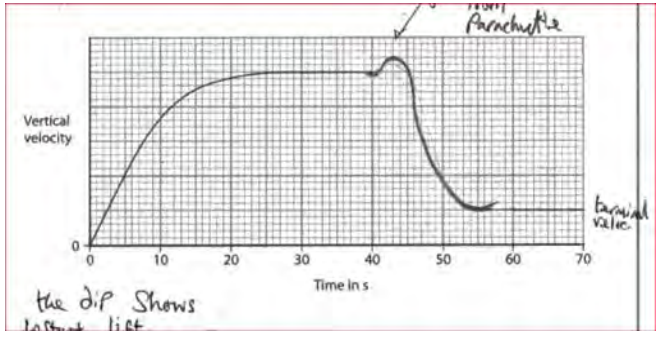
Question number			Answer	Notes	Marks
1	(a)	(i)	Weight = mass x g;	allow in accepted symbols ignore units, triangle eqns	1
		(ii)	700; N / newton(s);	 ignore kg m/s^2	1 1
	(b)		*EXPANATIONS (not descriptions)* Any **four** from: MP1. Weight / resultant force downwards; MP2. so at first (skydiver) accelerates; MP3. but drag increases with speed; MP4. hence resultant force decreases; MP5. so acceleration then decreases; MP6. so forces eventually balanced; MP7. causing terminal velocity;	 allow suitable labels on graph drag = weight allow constant speed for terminal velocity but not maximum speed	4

Question number			Answer	Notes	Marks
	(c)		Arrow up labelled drag / air resistance/air friction; Arrow down labelled weight; arrows approximately equal length;	independent marks Judged by eye throughout No requirement for arrows to be attached to centre of mass	3
	(d)		mooth reduction in velocity; to a new lower terminal/constant positive velocity; e.g.	any line or curve except along the t = 40 s line Ignore attempts to show effects of opening the parachute or reaching the ground	2
					

Total 12 marks

Question number	Answer	Notes	Marks
2 (a) (i)	Gradient of graph / attempt; Answer; Unit; e. 2 / 1.26 1.6 m/s^2	 ALLOW value truncated or correctly rounded from 1.587301587... (no sf penalty)	1 1 1
(ii)	Area under graph / attempt; Answer; e. ½ x 1.26 x 2 1.26 (m)		1 1
(b)	Moon has less <u>mass</u> (than Earth) / Moon has lower density (than Earth) / ORA for either;	IGNORE 'Moon is smaller'	1
(c)	ANY FOUR of Feather is lighter / has less mass / weighs less; reaches terminal velocity / drag = weight; earlier / sooner / before hammer; (because) smaller (drag) force needed; (so) average velocity of feather is lower / falls slower;	 IGNORE surface area	4
		Total	**10**

Question number	Answer	Notes	Marks
3 (a)	(stopping distance =) thinking distance + braking distance	Could be reversed	1
(b)	Any two of: as speed increases / car goes faster, the (thinking/braking/stopping) distance increases; as thinking distance increases so does braking distance; difference in pattern between thinking/braking distances identified; e. increase in thinking distance < increase in braking distance / increase in thinking distance is linear or proportional / increase (in braking / stopping) is non linear / WTTE	Ignore references to time Allow use of values from graph Reject: thinking distance proportional to braking distance	2
(c)	30 (m)	ALLOW any value from 28 to 32 m	1

Question number	Answer	Notes	Marks
3 (d)	use the minimum / lowest values obtained	REJECT find the average	1
(e) (i)	thinking distance – no change; depends on speed/ driver / reaction (time)		2
(ii)	braking distance – increase; less friction/ less grip	Ignore reference to time e.g. takes longer Ignore skidding, sliding, slippery road	2

Question number	Answer	Notes	Marks
4 (a)	78 seen; = 78 / 60; 1.3;	 acceleration = (final v – starting v)/time; CORRECT ANSWER WITH NO WORKING = (3)	3
(b)	air resistance (when moving); increases as velocity / speed increases; reducing resultant force;	ACCEPT drag IGNORE wind resistance IGNORE friction with ground 'friction' alone needs qualification REJECT 'reaches terminal velocity'	3

Question number	Answer	Notes	Marks
5 (a) (i)	upward force label = lift/eq; downward arrow drawn same size as up arrow; downward force arrow labelled as weight/eq;	allow upthrust (normal) reaction judge by eye do not accept unqualified 'gravity' ignore horizontal forces/arrows	(3)
(ii)	any two from: MP1. speed remains (almost) constant /does not reduce (as much); MP2. (because) friction reduced/eq; MP3. (because of cushion of) air lifts the car;	allow KE for speed RA allow for MP3 (because) the car does not touch the track Ignore idea that air pushes glider idea that speed increases unqualified 'travels further'	(2)
(b) (i)	(average) speed = <u>distance</u> ; time	accept standard abbreviations rearrangements	(1)
(ii)	substitution; evaluation; e.g. 8.3/0.314 26 (cm/s)	ignore the POT until evaluation 26.4 (cm/s)	(2)
(iii)	314 (ms) ;	Allow 0.314 s Accept answer in standard form, number and unit required Allow this mark if the working shows that time has been calculated by 8.3/26 (=0.319 or 0.32)	(1)

Total for Question 5 = 9 marks

Question number	Answer	Notes	Marks
6 (a) (i)	gravitational potential energy = mass x gravitational field strength x height;	ALLOW standard symbols (m x g x h) DO NOT ALLOW 'gravity' for g	1
(ii)	substitution into correct equation; calculation; e. g.p.e. = 2000 x 10 x 128 2.56 (MJ)	answer given to at least 3 sf Allow J if correct (2560 000)	1 1
(b) (i)	2.56 (MJ);	Value from (a) (ii) / 2.6 MJ	1
(ii)	They are <u>equal</u> / k.e. = work done;		1
(iii)	work done = force x distance;	ALLOW standard symbols	1
(iv)	Substitution into correctly rearranged equation; Calculation; e. d = W / F = 2 560 000 / 32 000 80 (m)	Allow ecf for value of energy stated in (a) (ii) or (b) (i)	1 1

Question Number	Answer		Marks
6 (c)	Any TWO from (Windy) – (extra) drag / air resistance / friction; more energy wasted (overcoming friction); (Wet) – less friction / no friction / slippier / less traction / less grip; less energy transferred to car (at launch);	ANSWERS SHOULD REFER TO THE SITUATIONS GIVEN	2
		Total	**10**