Question number	Answer	Notes	Marks
1 (a) (i)	moment = force x (perpendicular) distance (from the pivot);	ACCEPT Moment = F x d or correct rearrangement REJECT moment = force x distance moved REJECT 'm' or 'M' for 'moment'	1
(ii)	Substitution in correct equation; Calculation; Consistent Units; e.g. If calculated in metres 7 x 0.04; 0.28 or 0.3; Nm; e.g. If calculated in centimetres 7 x 4; 28 or 30; Ncm;	Correct final value = 2 irrespective of working ACCEPT newton metres, N.m REJECT 'nm', 'NM', J, N/m ACCEPT newton centimetres, N.cm REJECT 'ncm', 'NCM', J, N/cm	3
(b)	Length/distance to pivot of lever R less than lever A / closer to pivot; ORA So more (force) needed to cause the same moment; ORA (i.e. if force was the same, moment would be less)	ACCEPT Less than 0.04 m IGNORE 'less leverage' ACCEPT appropriate use of equation / Force = 14 N ACCEPT Overcoming friction for one mark IGNORE references to principle of moments (stated or implied) REJECT 'momentum' for 'moment'	2

Total 6 Marks

Question number	Answer	Notes	Marks
2 (a) (i)	Terminal (velocity);		1

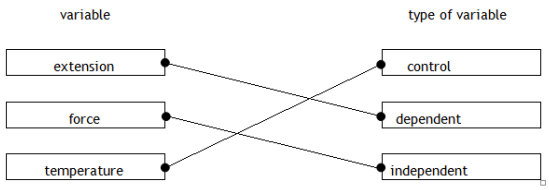
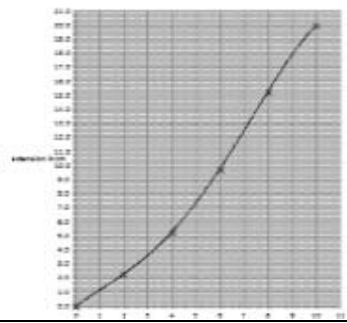
(ii)	upward force = downward force / forces balanced / no resultant force / resultant force = 0;
	reference to F = ma / reference to (Newton's) 1st or 2nd Law;
	no acceleration / acceleration = 0;
		IGNORE descriptions of *reaching* terminal velocity	3

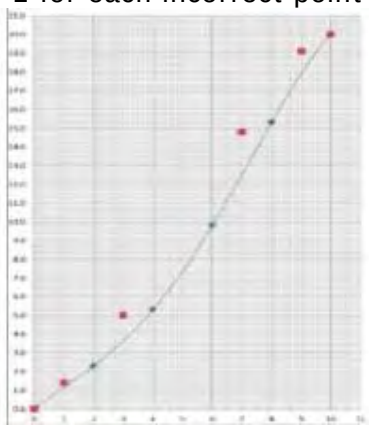
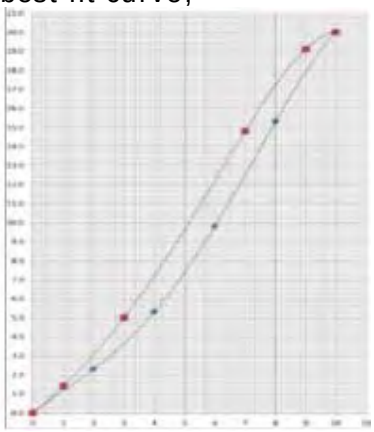
(iii)	faster speed / higher velocity / fell more quickly; Any one of – smaller (surface) area; Initially less resistive force / air resistance / drag; different time (to reach terminal velocity); less deceleration (before reaching terminal velocity);	NOT ACCEPT '<u>no</u> air resistance' IGNORE upthrust	2
(b)	(Stopping distance) increased / further / longer; Suitable reason, e.g. Since less braking force / air resistance / drag / takes longer to decelerate / reduced deceleration / smaller resultant force;	IGNORE references to 'longer time' must be comparative, e.g. less / slower / longer	2

Total 8 Marks

Question number	Answer	Notes	Marks
3 (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 = $\frac{\text{distance}}{\text{time}}$;	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 3 = 9 marks

Question number	Answer	Notes	Marks
4 (a) (i)	MP1. means of securing one end of elastic band; MP2. ruler; MP3. weights;		(3)
(ii)	extension linked to dependent force linked to independent temperature linked to control  all three correct;; any one correct;		(2)
(iii)	any two from: determine length without weights; determine length with 12 N; subtraction to get extension;	allow find difference in lengths	(2)
4 (b)(i)	any two suggestions from:- MP1. unloading and loading at same intervals; MP2. filling in the (large) gap in the unloading data; MP3. more readings (where curve is most pronounced); MP4. increase the range of loads;	ignore repeat and average allow 'go up in ones'	(2)
(ii)	best fit curve; 		(1)

4 (b)(iii)	4 points plotted correctly;; -1 for each incorrect point 		(2)
(iv)	best fit curve; 		(1)
(v)	a discussion to include any three points: MP1. does not obey Hooke's law; MP2. because graph is not linear throughout; MP3. Hooke's law requires extension directly proportional to force; MP4. it does show elastic behavior; MP5. because it returns to its original length; MP6. data points quoted to support other MP;	MP1 should only be awarded if there is an attempt at an explanation	(3)

Total for Question 4 = 16 marks

Question number	Answer	Notes	Marks
5 (a)	Terminal (velocity / speed);	allow bald 'terminal'	1
(b)	Any four of - MP1. weight acts downwards; MP2. drag/friction acts upwards; MP3. Idea that forces are balanced; MP4. reference to $f_{(R)} = ma$; MP5. Idea that when forces are balanced then acceleration is zero; MP6. constant velocity = no acceleration;	ignore • motion before terminal velocity • gravity allow • force of gravity • air resistance • acts to oppose motion • drag = weight • force up = force down • no resultant force Allow answers in terms of N I forces may be shown on diagram	4

Total 5 marks

Question number			Answer	Notes	Marks
6	(a)	(i)	starting height (of the toy car);		1
		(ii)	a positive correlation between the 2 key variables, eg The higher the (starting) height, the faster the (final) speed / speed at bottom;	NB response needs to mention both key variables	1
	(b)		use a ruler or a set square ; further detail; e. held vertically check for zero error thickness of board taken into account avoid parallax errors	Allow suitably labelled diagram drawn in the space below perpendicular to bench	2

Question number			Answer	Notes	Marks
6	(c)	(i)	any one of the following ideas; o speed might have increased / changed on slope o car might have accelerated o other forces could be acting hence (she has) calculated the average speed;	accept slowed down ignore timing errors	2
		(ii)	any **three** from: MP1. Suitable equipment / method chosen; MP2. Detail of measuring the distance; MP3. Detail of measuring the time; MP4. Detail of experimental set-up; MP5. Speed at bottom = 2 x total distance ÷ total time (assuming constant acceleration from rest) / idea of doubling; allow MP5 independent of other marks	*Acceptable approaches, e.g.* - Light gate and data logger computer; Placed at end of ramp; With interrupter of some description on toy car; OR Attach ticker tape to car; Find the part of the tape that matches end of the ramp; Work out distance over time for a small section; OR Film with video camera; With scale marked in background; Measure from frame by frame playback; OR motion sensor(near bottom of ramp); facing up the ramp; readings taken at the bottom;	Max 3

Question number			Answer	Notes	Marks
6	(d)		Any three of timing variation; distance variation /accuracy of starting position; friction effect; poor 'launch';	Acceptable ideas include- error from starting / stopping stopclock / effect of reaction time (IGNORE 'human error') car not running straight/ramp not even effect of (rolling) friction effect of air resistance/drag friction not constant car pushed at start car hits side of ramp ignore different car/changing slope height	Max 3

Total 12 marks