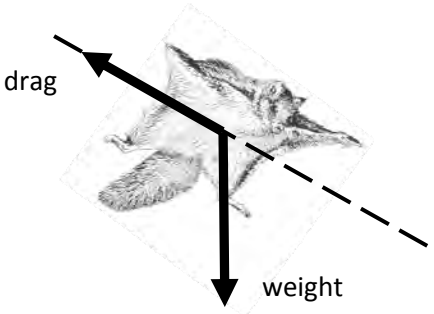
Question number			Answer	Notes	Marks
1	(a	Clip diagram	Any **five** from: **Basic plan** – MP1. Add (known value) masses one at a time; MP2. Measure length of the spring; MP3. Find extension; **Results** – MP4. Draw graph with suitable named axes; **Accuracy** – MP5. Detail of spring measurement, e.g. measure from same part each time/ fiducial marker; MP6. Make sure spring stationary before reading; MP7. repeat readings by taking off masses; MP8. Check value of masses on a balance; MP9. Check ruler vertical or parallel to spring/ hold ruler in clamp / avoid parallax errors;	allow suitable labelled additions to diagram Force or load or mass against extension or length	5
1	(b)		MP1. straight line only; MP2. axes labelled force/weight and extension; MP3. DOP line through origin;	units not needed, any orientation allow for 2 marks max: graph of force and length, st line with intercept	3
	(c)		returns to original length / shape; when (stretching) force is removed;		2

Total 10 marks

Question number	Answer	Notes	Marks
2 (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
2 (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**

Question number	Answer	Notes	Marks
3 (a) (i)	gravitational potential energy = mass × g × height	Allow abbreviations e. g.p.e. = mgh for g/gravitational field strength reject 'gravity'	1
(ii)	Substitution into correct equation; Evaluation; e.g. g.p.e. = 0.19 × 10 × 17 = 32 (J)	32.3 (J) (or 31.6 J when g = 9.8 ms^{-2}) allow 32300 for 1 mark	2
(iii)	Value same as for (a)(ii)	Allow "the same"	1
(b) (i)	Judge by eye **Weight** shown acting downwards; Drag shown acting against motion;  	NB NO label = no mark Allow abbreviations for labels e.g W, mg ignore gravity	2
(ii)	k.e. = ½ × mass × velocity^2	Allow abbreviations e.g. k.e. = ½mv^2	1
(iii)	Substitution into correct equation; Evaluation; e.g. k.e. = ½ × 0.19 × 13^2 = 16 (J)	(16.055) 16055 gets 1 mark	2
(iv)	**A** an unbalanced force acts on the squirrel		1

Total 10 marks

Question number	Answer	Notes	Marks
4 a	a moon orbits a <u>planet</u>; a planet orbits a star (/the Sun) ;	Ignore • comments about eccentricity, oval, plane of orbit, time of orbit etc	1 1
b	Substitution; Evaluation; Unit (to **match** the value of v); e.g. $V = \frac{(2 \times \pi \times 385000)}{27} = \frac{2\ 417\ 800}{27}$ 90 000 km/day	Note value of π used may vary time values and corresponding approximate speeds are 27 days…….. 89 600 km/days 648 hours…….. 3 731 km/ hours 38 880 mins……. 62 km/min 2 332 800 s…… 1.04 km/s allow answers which round to 89 600 Accept suitable **matching** units	1 1 1 1
c i	$E=1/2\ mv^2$;	Accept • rearranged equation • equation in words	1
ii	substitution ; Mass converted to kg ; 47.(33…..) seen;	allow sub of mass as 50 g 1.496 or 1.5 seen gets 2 marks	3
d i	44(J) ;		1
ii	GPE = mgh;	Accept • rearranged equation • equation using (all the) words Allow for 'g' • gravitational field strength but NOT gravity	1

iii	Substitution and rearrangement; Calculation ; $\frac{12}{0.05 \times 1.6}$ 150 (m)	POT error loses 1 mark e.g. 0.15 (m) gets 1 mark	2
e	any Two from: • Value of g lower(on the Moon)/RA; • lack of air resistance (on the Moon)/RA; • Time of flight greater;	ignore • 'no gravity' allow • less gravity • drag for air resistance	2

(Total for Question 4 = 15 marks)