Question	Answer	Marks	Guidance
1 a	7 minutes scores [3] **but if answer incorrect or incomplete then:** $\frac{1{,}680{,}000 \times 2}{8{,}000}$ or 420 scores [2] **but if no marks scored then:** either use of correct average speed, 4000 or 210 or 3.5 minutes scores [1]	3	7 **seconds** scores [2] **Ignore** units
b i	**lower speed** (than 8000m/s) then: - centripetal / gravitational force too high (to stay in this orbit) [1] - rocket may fall / move or spiral to Earth [1] **higher speed** (than 8000m/s) then: - centripetal / gravitational force too low (to stay in this orbit) [1] - rocket may move away from Earth / spiral out of orbit [1] (idea of) higher stable orbits experience lower gravitational force or lower speed / ORA [1]	3	**Eg.** rocket may fall as centripetal / gravitational force is too big [2] **eg.** rocket may move away as centripetal / gravitational force is too small [2] **allow** any idea that correct speed needed to allow correct angle of re-entry to avoid overheating [1]

Question	Answer	Marks	Guidance
ii	(+/-) 4 (m/s^2) scores [3] **but if answer is incorrect then:** (+/-) $\frac{(120^2 - 2000^2)}{2 \times 5 \times 10^5}$ [2] **Or if no other marks scored then** evidence of correct substitution into $v^2 = u^2 + 2as$ **or** evidence of **rearranged** formula: $\frac{v^2 - u^2}{2s}$ [1]	3	**allow** 3.99 **/** 3.9856 (m/s^2) [3]
c i	share expertise / knowledge / data / workload interpretations of evidence [1] check / test / compare (each other's) results [1]	1	**Eg.** work / ideas can be shared [1] **Eg.** more data collected [1] **Eg.** more / different jobs can be done (at same time) [1] **Eg**. Idea of international collaboration / sharing cost [1]
ii	other scientists can check or test or verify findings / develop ideas or theories / use or compare the data / improve knowledge or education / more data available / credit or acknowledgement of work [1]	1	**allow** (idea of) peer review [1]
	Total	**11**	

Question	Answer	Marks	Guidance
2 a	Maximum range (achieved) at 45^0 [1] **BUT** Range rises with angle until 45^0 then falls [2]	2	**Ignore** references to height eg 'the further away from 45^0 the lower the range scores' [2] **if no marks awarded:** **allow EITHER** 'rises and falls' **OR** 'as the angle increases the range decreases' [1] eg 'range goes up and then goes down' [1]
b	90^0 [1]	1	**allow** vertical / AW [1] **allow** suitable annotation of the diagram
c i	Parabolic / parabola [1]	1	**ignore** curve / arc / arch on its own **ignore** trajectory
ii	(Vertical / upward) velocity decreases [1] Acceleration (remains) constant / AW [1]	2	Mark points independently: eg. vertical velocity and acceleration are reduced for a maximum of [1] eg. vertical velocity and acceleration are constant for a maximum of [1]
iii	no effect (by gravity) / AW [1]	1	**Allow** doesn't (change) [1] **Allow** (Stays) constant [1]
	Total	**7**	

Question			Answer	Marks	Guidance
3	(a		cruising speed = 10 (m/s) (2) **but if answer is incorrect** 30 = (v/2) x 6 **or** (2 x 30) ÷ 6 or 60 ÷ 6 (1) **then** if a correct calculation is given: Samuel / he is not correct (it is twice as fast) (1)	3	If answer says that cruising speed = 30 / 6 = 5 **AND** that Sam is correct (1). **OR** **allow** Samuel has calculated the **average speed** (5m/s) (1)
	(b)		between 0 and X is longer time than between Y and Z / AW / ORA (1) between 0 and X is lower acceleration than between Y and Z / AW / ORA (1) between 0 and X is acceleration but between Y and Z is deceleration or negative acceleration (1)	2	**allow** it is getting faster between O and X **but** slower between Y and Z (1) **ignore** just acceleration between Y and Z. **ignore** 'faster' acceleration / deceleration **allow** correct calculations to illustrate the marking points. Eg. 10/6 (1.67) compared to 10/2 (-5) (2) **allow** ecf for a correct calculation. Eg. 5/6 (0.83) compared to 5/2 (-2.5) (2) **allow** deceleration is 3 times greater / AW (2)

Question			Answer	Marks	Guidance
	(c)	(i)	108000 (W) (2) **but if answer is incorrect** (6000 + {8 x 600}) x 10 or (6000 + 4800) x 10 or 10800 x 10 (1)	2	**allow** ecf for incorrect cruising speed in 1(a)
		(ii)	1100 (kg) (2) **but if answer is incorrect** (6000 + {8 x 600}) ÷ 9.8 or (6000 + 4800) ÷ 9.8 or 10800 ÷ 9.8 (1)	2	1102.(0408) (1)
			Total	**9**	