Question number	Answer	Notes	Marks
3 (a)	planet;		1
(b)	comet;	accept planet	1
(c)	substitution into given formula; conversion of 35 days into seconds; evaluation; e.g. $v = 2 \times \pi \times 1.5 \times 10^{11} / (35 \times 24 \times 60 \times 60)$ $v = 310\,000$ m/s	 allow full credit for 2.6927937×10^{10} if unit changed to m/day. 311665.93(7)8 Answer for incorrect/no conversion of days→ seconds 2.69etc x 10^{10} scores 2 -1 for POT error	3

(Total for Question 3 = 5 marks)

Question number	Answer	Notes	Marks
6 (a)	17 (degrees);	Allow in range 15-19 degrees	1
(b)	refractive index = sin(i) / sin (r);	accept n or η for refractive index accept any valid rearrangement	1
(c)	substitution; evaluation of either sine correctly; evaluation; e.g. refractive index = sin(29)/sin(17) refractive index = 0.484…/0.292… refractive index = 1.7	allow ecf from (a) 0.48480962/0.292371705 1.6581961	3

(Total for Question 6 = 5 marks)

Question number	Answer	Notes	Marks
7 (a) (i)	as pressure increases, volume decreases; pattern statement relating to gradient; e.g. 'at a decreasing rate'	ORA 'inversely proportional' scores 2 marks.	2
(ii)	pressure = depth × gravitational field strength × density;	allow recognised symbols e.g. P or p for pressure d or h for depth ρ for density reject d for density, reject gravity for g	1
(iii)	substitution; evaluation; e.g. pressure = 0.22 × 10 × 1080 pressure = 2 400 (Pa)	Accept use of g=9.8(1) (N/kg) 2376 (Pa) -1 for POT error provided *g* is used	2
(iv)	103 000 (Pa)	accept 103 400 (Pa) allow ECF	1
(v)	substitution into given formula; rearrangement; evaluation; e.g $p_1 \times V_1 = p_2 \times V_2$ 101 000 × 0.084 = 103 000 x V_2 V_2 = 0.082 (cm^3)	allow ECF from (iv) e.g. 98624 gives 0.086 (cm^3) 0.082368932 -1 for POT error	3
(b)	vertical arrow upwards labelled upthrust; vertical arrow downwards labelled weight; upthrust > weight;	 ignore drag reject this mark if there are more than two arrows	3

(Total for Question 7 = 12 marks)

Question number	Answer	Notes	Marks
10 (a)	236 – (97 + 135); x = 4;	answer of 4 scores 2	2
(b)	(fission) releases neutrons; neutrons can be captured by other uranium **nuclei**; (these nuclei) then undergo fission;		3
(c)	evidence of halving of 72 (kBq); evidence of four half-lives required; e.g. count rate after 4 half-lives is 4.5 (kBq) evidence that four half-lives is equivalent to 60 million years;		3
(d)	Any FIVE from: MP1 Idea of strong containers; MP2 idea that containers can't rust; MP3 idea that rust-proof containers expensive/difficult to manufacture; MP4 reference to security of waste site; MP5 reference to dilution in sea water; MP6 reference to leakage into water table;	 accept idea of a location that prevents rust accept low earthquake risk	5

(Total for Question 10 = 13 marks)