(b)	(i)	period represented by 4 squares; correct use of x-scale; correct evaluation; e.g. period = 4 squares period = 4 × 5.0 ($\times 10^{-3}$) period = 20 ms = 2.0 × 10^{-2} (s)	 allow ECF from wrong number of squares if clear in working -1 POT error answer of 0.01, 0.04 (s) scores 2 marks allow 0.02 (s)	3
	(ii)	substitution into given formula; correct evaluation; e.g. frequency = 1 / 0.02 frequency = 50 (Hz)	allow ECF from (i)	2

Total for Question 2 = 10 marks

Question number	Answer	Notes	Marks
3 (a)	neutral particle has same number of protons and electrons; positive particle has more protons than electrons;	ignore neutral particle has no charge allow positive particle has lost electrons reject positive particle has gained protons	2
(b)	(sulfur particles are) attracted to negative plate/repelled by positive plate; (sulfur) particles experiences a (resultant) <u>force</u> (to the right);	accept correct use of "like charges repel" or "unlike charges attract"	2
(c) (i)	D – (into the page); A is incorrect because the force, direction of travel and magnetic field must be at right angles to each other B is incorrect because the force, direction of travel and magnetic field must be at right angles to each other C is incorrect because this would result in a force in the opposite direction to that shown		1
(ii)	substitution into given formula; rearrangement; evaluation; e.g. $2.9 \times 10^8 = (2 \times \pi \times 1.1(\times 10^3)) \div$ orbital period orbital period = $(2 \times \pi \times 1.1(\times 10^3)) \div 2.9 \times 10^8$ (orbital period =) 2.4×10^{-5} (s)	-1 for POT error allow $2.383\ldots \times 10^{-5}$ (s)	3

Total for Question 3 = 8 marks

Question number			Answer	Notes	Marks
6	(a)	(i)	**angle** of incidence;	ignore incident ray	1
		(ii)	recognising 67 (degrees) as anomalous; evaluation of a mean; e.g. mean angle = (22 + 23) / 2 = 23 (degrees)	allow 1 mark if anomalous result included e.g. 37, 37.3… (degrees) allow 22, 22.5 (degrees)	2
		(iii)	n calculated for multiple angles; mean value obtained **for n**; OR idea of graph plotted of sin(i) against sin(r); n found from gradient of (sin(i)-sin(r)) graph;		2
	(b)	(i)	substitution into n = sin(i) ÷ sin(r) ; evaluation; e.g. refractive index = sin(82) ÷ sin(47) (refractive index =) 1.4	 1.3 scores 1 mark only allow 1.35…	2
		(ii)	sin(c) = 1/n;	allow any correct rearrangement	1
		(iii)	substitution and rearrangement; evaluation; e.g. c = $\sin^{-1}(1/1.7) = \sin^{-1}(0.588…)$ (critical angle =) 36 (degrees)	 allow 36.03… (degrees)	2
	(c)		light undergoes TIR; (because) angle (of incidence) is greater than critical angle;		2

Total for Question 6 = 12 marks