Question Number	Answer	Acceptable answers	Mark
1 (a) (i)	A gained electrons		**(1)**

Question Number	Answer	Acceptable answers	Mark
1 (a) (ii)	An explanation linking any two of the following Friction (1) (Causes) hair to lose electrons(to the comb) (1) Hair has an (overall) positive charge (1)	Reject positive electrons and movement of positive charge Rubbing (hair with comb) Electrons transfer/move (Ignore atoms) Eg electrons transfer to hair as comb rubs hair gains 2 marks	**(2)**

Question Number	Answer	Acceptable answers	Mark
1 (a) (iii)	An indication that negative charges have been repelled (by the comb) (1)	An arrow/label clearly indicating to the bottom of the foil Correct separation of positive and negative charges minus signs shown less than half-way up the foil	**(1)**

Question Number	Answer	Acceptable answers	Mark
1 (b)	An explanation linking the following points excess charge is removed /comb does not become charged /gain charge/static electricity (1) it/charge moves through the metal/comb(1)	No credit for both have the same charge so repel Accept electrons for charge Charge is earthed/flows (in)to ground/off comb/into Vicky Metal is a conductor credit they are both neutral/have no charge with 1 mark	**(2)**

Question Number		Indicative Content	Mark
QWC	*)	A description / comparison/ explanation / etc including some of the following points • paint particles have the same charge • like charges repel • Particles repel each other • So spread out (more)/form a (fine) mist • Even layers • Improved finish • Opposite charge(is induced) on object • Paint particles are attracted to metal object • To parts not in direct line of spray/back of object • Need not move the sprayer to reach back • Takes less time • Uses less paint/ less paint wasted. • Uncharged paint forms large droplets/runs (off object) Allow reverse arguments for uncharged paint Accept an explanation that includes the idea that there is attraction between charged and uncharged/neutral/earthed objects	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description that contains one or two points and possibly has a number of inaccuracies e.g. even layer....paint is attracted to object OR uses less paint • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple description that links two points • e.g. particles repel each other which makes them spread out OR They are attracted to the metal object because it has the opposite charge. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	

3	**5 - 6**	• a detailed description that links two points about repulsion and links two points about attraction of charges OR a statement that links two points about charged paint together with a comment about uncharged paint. e.g. particles have the same charge and repel each other (which makes them spread out to form even layers) AND they are attracted to the metal object OR particles have the same charge and repel each other but uncharged paint would form big drops. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Question Number	Answer	Acceptable answers	Mark
2 (a)	C		**(1)**

Question Number	Answer	Acceptable answers	Mark
2 a(ii)	In the cloud : reason 3 (1) At the tower: reason 2 (1)		**(2)**

Question Number	Answer	Acceptable answers	Mark
2 a(iii)	An explanation linking • the charge was neutralised (1) • by a transfer/flow of electrons (1)	Discharged/ becomes zero gained electrons / negative charge	**(2)**

Question Number	Answer	Acceptable answers	Mark
2 (b)	substitution (1) 52 = 2600 x time transposition time = 52 / 2600 (1) evaluation 0.02 (s) (1)	T = Q / I Full marks for correct answer even if no working is evident	**(3)**

Question Number	Answer	Acceptable answers	Mark
2 (c)	An explanation linking two of the following • charges flow through the metal wire • to the ground / earth • preventing build-up of (excess) charge (2)	mention of earthing discharged / neutral all objects at the same potential	**(2)**

Question number	Answer	Mark
3(a)(i)	B	(1)

Question number	Answer	Additional guidance	Mark
3(a)(ii)	• label to indicate that balloon Q has a positive charge (1) • label to indicate that balloon R has a negative charge (1)	accept responses showing appropriate +/− signs or worded label	(2)

Question number	Answer	Additional guidance	Mark
3(b)(i)	An explanation that combines identification – knowledge (1 mark) and reasoning/justification – understanding (2 marks): • use of a conductor to connect between aircraft and ground (1) • allowing negative charge to move onto the aircraft (1) • therefore neutralising the positive charge(s) (1)	accept (copper) wire accept earth for ground	(3)

Question number	Answer	Additional guidance	Mark
3(b)(ii)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (2 marks): • there is friction between aircraft and air (1) • which causes electron transfer between aircraft and air (1)	accept idea of air rubbing against wings ignore "charge" "static" do not allow (for second mark) idea of protons moving	**(2)**

Question number	Answer	Additional guidance	Mark
3(c)	equating energy in both equations (1) E = weight × height = power × time rearrangement (1) time = $\frac{(\text{weight} \times \text{height})}{\text{power}}$ substitution and answer (1) time = 230 000 × $\frac{4.7}{1600}$ time = 680 (s)	allow answers which round to 680, e.g. 675.6	**(3)**

Question number	Answer	Mark
4(a)(i)	The earth wire discharges the aircraft to prevent sparking which could ignite the fuel/cause a fire	(1)

Question number	Answer	Additional guidance	Mark
4(a)(ii)	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (1 mark): • friction between aircraft and air (1) • causes electron transfer between aircraft and air (1)	accept idea of air rubbing against wings ignore 'charge' and 'static' do not allow (for second mark) idea of protons moving	(2)

Question number	Answer	Additional guidance	Mark
4(b)	Equating energy in both equations (1) E = weight × height = power × time Rearrangement (1) time = $\frac{(\text{weight} \times \text{height})}{\text{power}}$ Substitution and evaluation (1) time = 230 000 × $\frac{4.7}{1600}$ time = 680 (s)	allow answers which round to 680, e.g. 675.6	**(3)**

Question number	Answer	Mark
4(c)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • (negatively charged) door attracts (positively charged) paint (droplets) (1) Plus any **one** of the following: • therefore (positively charged) paint (droplets) follow lines of force and coat both sides of the car door (1) • since electric field (or lines of force) directed towards the (car) door, then positive paint will move to the door (1) • as electric field (or lines of force) touches all parts of the (car) door hence the positive paint will coat all parts of the door (1)	**(2)**