	Differences • resistance of **A** decreases with temperature but resistance of **B** increases with temperature (1) • for **A**, (largest slope/rate of change) is at lower temperature but for **B**, (largest slope/rate of change) is at higher temperature(s) (1) • for **B**, resistance is constant below 50°C but for **A** resistance is roughly constant above 60°C (1)	accept (smallest slope/rate of change) for A is at higher temperature but (smallest slope/rate of change) for B is at lower temperature	

Question number	Answer	Mark
3(c)(ii)	B	**(1)**

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) $\text{time} = \frac{(\text{weight} \times \text{height})}{\text{power}}$ Substitution and evaluation (1) $\text{time} = 230\,000 \times \frac{4.7}{1600}$ 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)**

Question number	Answer	Additional guidance	Mark
5(a)	evidence that anomalous reading excluded (1) evaluation (1) average length = 20.31 (mm)	accept 101.57 (÷5) for first mark accept 20.314 (mm)	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(a)(i)	positive / + /plus /+ve /positively (charged)	accept poor spelling of positive	**(1)**

Question Number	Answer	Acceptable answers	Mark
2(a)(ii)	An explanation linking **two** from the following points • repulsion / repels (1) • (because) same charge (1) • (force) greater than gravity (1)	independent mark positive charges repel each other (2) both positive so repel(2) positive ball attracted to negative lid (2)	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(b)	An explanation linking the following points • electrons move (1) • from ground to lid (1)	negative charge moves to neutralise positives	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(c)	An explanation linking the following points • discharged /earthed so falls(1) • charged again/at plate so rises/repels (1)	pulled down by gravity reached the plate and process repeats ignore direction of charge flow – already assessed	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(d)	**B**		**(1)**

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

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

Question Number	Answer	Acceptable answers	Mark
4 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)**

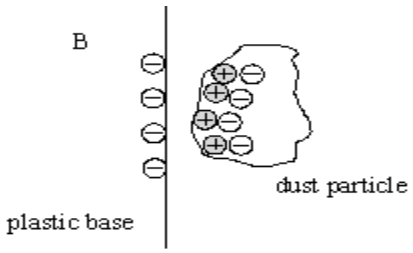
Question Number	Answer	Acceptable answers	Mark
4 (b)	substitution (1) 52 = 2600 x time transposition time = 52 / 2600 (1) evaluation 0.02 (s) (1)	T = Q / I Full marks for correct answer even if no working is evident	**(3)**

Question Number	Answer	Acceptable answers	Mark
4 (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	Acceptable answers	Mark
1(a)(i)	B electrons		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(a)(ii)	An explanation linking (negative) electrons transfer (1) because of friction/from cloth (to base) (1)	 negative charge (reject protons and positive charge for this mp) moves cloth loses {electrons/negative charge} (to base) = 2	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(a)(iii)	A suggestion to include charge (any) could move through cup /metal (1) (cup is) earthed (1)	 cup/metal is a conductor ignore metal is not an insulator to {earth/ ground} / {to/ through} student's hand	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(a)(iv)	B  		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(b)	A description to include the situation which caused the charge separation (1) where the spark travelled {from or to}(1)	examples when refuelling, spark between end of {fuel/pipe} and vehicle =2 spark {between/from /to} person comb/clothes/metal handle and, when combing hair/removing clothing/opening door = 2 lightning flash, between cloud and cloud/plane/ground, =2 ignore between plug and socket/jump leads	**(2)**

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

Question Number	Answer	Acceptable answers	Mark
2(b)	An explanation linking • (Force of) attraction (1) • (plates have) opposite charge (to dust) (1)	Plates have a positive charge Ignore different charge	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(c)(i)	transferred to plate / lost (1)	neutral / become discharged	**(1)**

Question Number	Answer	Acceptable answers	Mark
2(c)(ii)	An explanation linking any two of • Metal is a conductor (1) • Electrons / (negative) charge moves (through the plates/ wire) (1) • Towards the voltage supply / earth /ground (1)	Metal not an insulator Plates / charges are earthed	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(d)	Substitution: $Q = 1.2 \times 10^{-3} \times 40$ (1) Evaluation: 0.048 or 4.8×10^{-2} (1) C / coulombs (1)	Give 2 marks for correct answer with no working shown Unit mark is independent Allow for 1 mark 48 (with incorrect or no units) Allow for 2 marks 48 C Allow for all 3 marks 48 mC	**(3)**

Total for Question 2 = 9 marks

Question Number	Answer	Acceptable answers	Mark
1(a)(i)	**A -** negative charge has moved from the cloth to the rod		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(a)(ii)	An explanation linking they repelled (1) (strips had) like charge (1)	 push away same (type of) charge	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(b)(i)	An explanation linking any **two** from charges are separated (1) possibility of a spark (1) ignite the fuel (1)	ignore ref to electric shock pd between plane and ground cause fire / explosion	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(b)(ii)	An explanation linking **three** from Metals are (good) conductors (1) Electrons/(negative) charge can flow through wire (1) charge goes from/to the ground / earth (1) discharge the tank/aircraft/pipes (1)	 Reject flow of positive charge for this mark plane is earthed/grounded charge does not build up/dissipates Allow no pd between plane and ground so no spark possible for 2 marks	**(3)**

(Total for Question 1 = 8 marks)