Mark Scheme

Q1.

Question Number:	Answer	Mark
	A  **The only correct answer is A** ***B*** *is not correct because the arrows are in the wrong direction* ***C*** *is not correct because the field is not circular* ***D*** *is not correct because the field is not circular*	**(1)** AO 1 1

Q2.

	Answer	Acceptable answers	Mark
	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)**

Q3.

Question Number	Answer	Additional guidance	Mark
	An explanation that includes any three of the following points :- ground is charged (by induction) (1) charge on ground is positive (1) electric field builds up (between cloud and ground) (1) air is ionised (1) electrons travel to the ground/positive ions travel to the cloud (1)	May be seen on diagram Award two marks for 'the ground is positively charged' allow electric charge or voltage or potential difference for electric field air becomes a conductor allow charge for ions	**(3)**

Q4.

Question Number	Answer	Additional guidance	Mark
(i)	An explanation that combines:- rub the rod with a cloth (1) (so)electrons (1) are moved (from rod to cloth) (1)	 allow clean off the rod or friction (with the rod) allow negative charges for electrons movement of positive charges can only score the first mark 'electrons are positive' can score a maximum of one mark movement of unnamed charges can score third mark	(3)

Question Number	Answer	Mark
(ii)	**B** R  **B** is the only correct answer. **A** is incorrect because ball Q is coated with a conducting material but is uncharged, a negative charge will be induced on it and it will be attracted not repelled by a positively charged rod. **C** is incorrect because ball S is an insulator and is uncharged and will not be repelled by a positively charged rod. **D** is incorrect because ball T has a negative charge and will be attracted not repelled by a positively charged rod.	(1)

Q5.

Question Number:	Answer	Additional guidance	Mark
(i)	An explanation linking: sphere A has an electric field (1) sphere B is in it (1)	both spheres have electric fields the electric fields interact/overlap ignore nature of force; e.g. repulsion	(2) AO 2 2

Question Number:	Answer	Additional guidance	Mark
(ii)	a description to include: as the distance increases the force (on the sphere B) decreases (1) the greatest change is at smallest distances (1)	 negative correlation non-linear gradient changes allow named non-linear functions such as exponential / inversely proportional in this context reference to inverse square law scores 2 marks	(2) AO 3 1a AO 3 1b

Q6.

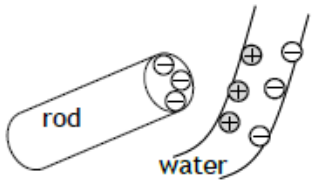
	Answer	Acceptable answers	Mark
(i)	An explanation linking • (friction/it) produces charges (at the end of the pipe) (1) • charge jumps to fuel tank (1) • (charge/friction) causes a spark (1) • can cause a fire /explosion (1)	 static (electricity) builds up	(2)
(ii)	An explanation linking • (excess) charge / electrons (1)	 static charge discharged/ neutralised	(2)

	• Removed/ conducts away (1)	discharge current scores both marks	

Q7.

Question Number	Answer	Acceptable answers	Mark
(i)	**A** positive : equal (1)		**(1)**

Question Number	Answer	Acceptable answers	Mark
(ii)	An explanation linking negative charge(s)/electrons (1) (move/ transfer) {to (plastic) rod / to it / from cloth} (1)	Any reference to positive charges, positive electrons or protons moving scores zero marks for question ignore contradictions to Q i.e. cloth is negatively charged attract is insufficient for transfer e.g. {rod /it} gains/gets electrons (from cloth) for 2 marks the cloth loses electrons (to the rod) for 2 marks	**(2)**

Question Number	Answer	Acceptable answers	Mark
(iii)	B 		**(1)**

Question Number	Answer	Acceptable answers	**Mark**
(iv)	a suggestion including: plastic rod has {become neutral/ discharged/no longer charged/not negatively charged (anymore)} OR {charge/electrons} {transferred/ taken} from rod (to/by the water) (1)	Any reference to positive charges, positive electrons or protons moving scores zero marks for question accept the rod loses its charge/ electrons OR rod is 'earthed'/ 'grounded' ignore has same charge as water the water removes/washes away the electrons/charge	**(1)**

Q8.

Question Number	Answer	Mark
	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 6 marks** **dangers**	**(6)**
	• friction as fuel flows through pipe • build-up of (electrostatic) charge • potential difference between nozzle and plane • causes spark • explosion or fire **use of metal wire** • potential is the same on both objects • no electric field • earths excess charge • constant safe discharge • no imbalance of electrons	

Descriptor
• No rewardable material.
• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Level	Mark	Additional Guidance	General additional guidance – the decision within levels Eg - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	Additional guidance Two unlinked statements	Possible candidate responses make a spark/ explosion/fire there is static electricity fuel is flammable metal wires conduct charge(electricity) could get an electric shock
Level 2	3–4	Additional guidance Limited explanation **linking** facts about dangers OR **linking** facts about why using metal wires is safer	Possible candidate responses A spark is produced because there is a build up of static charge (electricity) or build up of static charge prevented(electricity)because the metal wire takes the charge to earth(ground)
Level 3	5–6	Additional guidance Detailed explanation about dangers AND why using metal wires is safer (one may be stronger than the other but both should feature for level 3)	Possible candidate responses Spark is caused by the build up of charge (static electricity) AND the build up is prevented by the metal wire taking the charge to earth (ground)

Q9.

Question Number:	Answer	Additional guidance	Mark
(i)	an explanation linking 3 of the following: friction (between cloth and comb) (1) transfer of electrons / charge {from plastic comb / on to the cloth} (1) electrons carry a negative charge (1) leaving **excess** positive charge on the comb (1)	reference to positive electrons or positive charge moving loses that mark point electrons/charges are rubbed off comb (on to cloth) leaving cloth with negative charge more protons than electrons (on the comb)	**(3)** AO 2 1

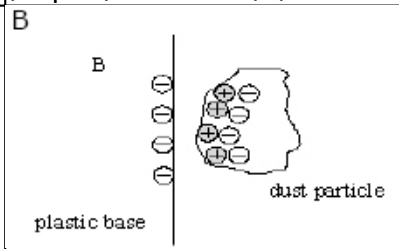
Question Number:	Answer	Additional guidance	Mark
(ii)	an explanation linking: a negative charge is induced (1) on the part of the paper closest to the comb (1) opposite charges attract (1)	 allow a clear description of induction ignore references to positive charge being moved in this context only force of attraction sufficient to pick up the pieces of paper	**(3)** AO 2 1

Q10.

	Answer	Acceptable answers	Mark
(i)	☒ **D** an equal positive charge		**(1)**
(ii)	an explanation linking any two of friction (between cloth and balloon) (1)	charge/electrons move	**(2)**

	transfer of electrons (1) (electrons/negative charges move) from cloth to balloon (1)	accept balloon gains electrons from the cloth for 2 marks	
(iii)	a description including **two** from the following: • balloon becomes discharged (1) • metal /cabinet is a conductor (1) • electrons {move through / on to} metal / cabinet (1)	 earthed / neutral (negative) charge for electrons accept electrons move to earth for 2 marks	**(2)**
(iv)	(surface of) wall (becomes) positively charged /charged by induction (1)	charges on the wall separate charge closest to the surface of the wall is opposite to the charge on the balloon	**(1)**

Q11.

	Answer	Acceptable answers	Mark
(a)(i)	B electrons		**(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)**
(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)**
(a)(iv)	B  		**(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	**(2)**

		between plug and socket/jump leads	

Q12.

	Answer	Acceptable answers	Mark
(a)	an explanation linking: balloons repel (1) (because) they have like charges (1)	balloons repulse / push away (from each other/to the side) same charge / both positive / both negative accept like charges repel for 2 marks	**(2)**
(b)(i)	☒ **D** an equal positive charge		**(1)**
(b)(ii)	an explanation linking any two of friction (between cloth and balloon) (1) transfer of electrons (1) (electrons/negative charges move) from cloth to balloon (1)	charge/electrons move accept balloon gains electrons from the cloth for 2 marks	**(2)**
(b)(iii)	a description including **two** from the following: • balloon becomes discharged (1) • metal /cabinet is a conductor (1) • electrons {move through / on to} metal / cabinet (1)	earthed / neutral (negative) charge for electrons accept electrons move to earth for 2 marks	**(2)**
(b)(iv)	(surface of) wall (becomes) positively charged /charged by induction (1)	charges on the wall separate charge closest to the surface of the wall is opposite to the charge on the balloon	**(1)**

Q13.

Question Number	Answer	Acceptable answers	Mark
(a)	repel (1) charge (1) positive (1) electrons (1)		**(4)**

Question Number	Answer	Acceptable answers	Mark
(b)(i)	An explanation linking any **three** from the following: • Droplets have same charge (1) • (droplets) repel (one another) (1) • (This produces) a fine spray/mist (1) • attraction between droplets and plant (1) • This improves coverage OR Spray covers whole [leaf /plant] top and underside of leaf/ gives a fine coating/ even coat (1) • Less spray used/wasted/ falls onto soil (so saves money) (1)	Ignore references to attracting or repelling insects. ignore droplets are positive /negative droplets spread out (produce an) even spray droplets attracted to negative/opposite charge (on plant) or spray will stick to leaves/plant better/more chance of spray landing on/hitting plant or spray (lands) evenly on plant none is wasted/Less will run off the leaves/Same amount of spray will cover a larger area(so saves money)	**(3)**

Question Number	Answer	Acceptable answers	Mark
(b)(ii)	10 minutes = 600 seconds (1) substitution 0.008 x 600 (1) evaluation 4.8 (C) (1) Ignore any unit given by the candidate	 ECF from their time eg 2 marks for 0.08 if their time is 10 0.8/8/8.0/80 gains 1 mark (bod POT error) Power of ten error max of 2 marks eg 480 gains 2 marks Award 3 marks for correct answer, no working No power of ten error mark if answer less than 0.008 as probably dividing Award 2 marks for 0.08, no working	 **(3)**

(Total for Question =10 marks)

Q14.

	Answer	**Acceptable answers**	**Mark**
(a)(i)	negative (1)		**(1)**
(a)(ii)	(much) smaller than a neutron (1)		**(1)**
(b)(i)	An explanation linking • (friction/it) produces charges (at the end of the pipe) (1) • charge jumps to fuel tank (1) • (charge/friction) causes a spark (1) • can cause a fire /explosion (1)	static (electricity) builds up	**(2)**
(b)(ii)	An explanation linking • (excess) charge / electrons (1) • Removed/ conducts away (1)	static charge discharged/ neutralised discharge current scores both marks	**(2)**

		Indicative Content	

QWC	***(c)**	An explanation etc. including some of the following po • static electricity • opposites charges attract • charges are different • induced charges • charges separate • charges move • electrons move • electrons move towards a positive charge / ba Allow credit for a correct explanation for an ef not given in the question. Allow credit for sepa charge being shown on a diagram.	
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited explanation. Explains the effect is caused by charges. e.g. the charge on the balloon pulls the water; the charge on the rod attracts the bits of paper; the balloon is rubbed to give it charge; opposites attract; positive and negative attract; • 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 explanation. Explains an effect is caused by opposite charges attracting or like charges repelling. e.g. the charge on the balloon is opposite to the charge on the water so they attract; the positive charges on the balloon attract negative charges on the girl's hair; • 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 explanation. Explains the effect is caused by induction, charge separation or moving electrons which leads to attraction between opposite charges. e.g. the electrons have been moved off the balloon so it has a positive charge and attracts the negative charge on the hair; the balloon has a positive charge and induces a negative charge on the stream of water which attracts it; • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Total marks for question = 12