Static Electricity

Total marks:21

Q1.

Complete the following sentences using words from the box below.

electrostatic	friction	gravitational	magnetic

(i) The force that keeps the Earth in orbit around the sun is
..... attraction.

(1)

(ii) The force that opposes motion between two surfaces is
..... .

(1)

(iii) The force that can move small pieces of paper towards a plastic comb is ..... attraction.

(1)

(Total for question = 3 marks)

Q2.

Two small objects, P and Q, are each given an electric charge.

Figure 3 represents the electric fields around the objects, P and Q.

Figure 3

(i) Use information from Figure 3 to give **two** differences between the charge on P and the charge on Q.

(2)

1 .....

.....

2 .....

.....

(ii) Object P and object Q are held near to each other so that their electric fields interact with each other.

State the effect that the electric field of object Q has on object P.

(1)

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.....

(Total for question = 3 marks)

Q3.

* This question is about electrostatic charges and the forces between them.

Figure 16 shows some apparatus that can be used to show that like charges repel and unlike charges attract.

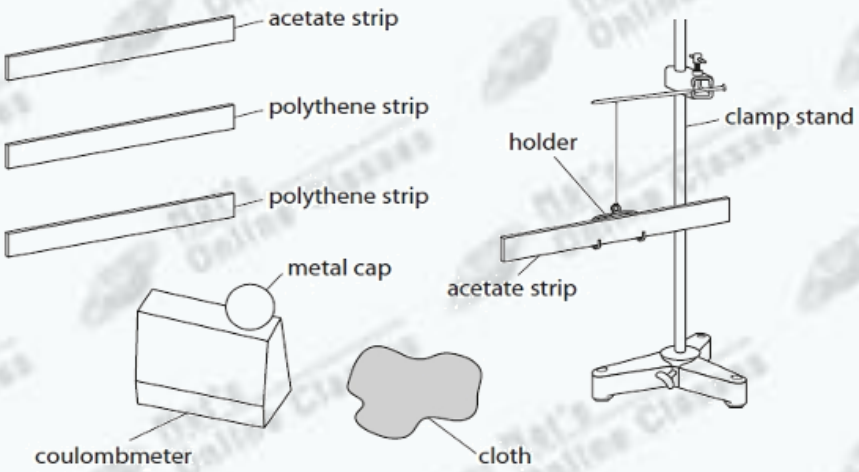

Figure 16

An acetate strip can be charged positively.

A polythene strip can be charged negatively.

A coulombmeter can be used to measure charge and whether the charge is positive or negative.

Explain how you would use the apparatus in Figure 16 to show that like charges repel and unlike charges attract.

(6)

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(Total for question = 6 marks)

Q4.

This question is about static electricity.

Figure 26 shows a plastic block and a metal disc with an insulating handle.

The top surface of the plastic block has a negative charge.

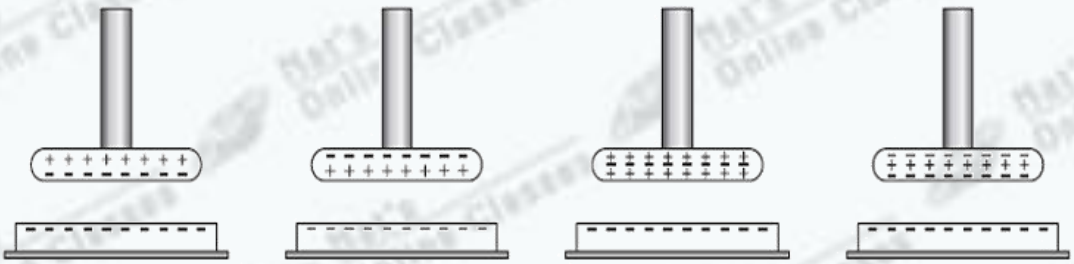
The metal disc has no overall electric charge.

Figure 26

A student uses the insulating handle to hold the metal disc above the plastic block.

(i) Which of these diagrams shows how the charge is distributed on the metal disc?

(1)



☒ A ☐ B ☐ C ☐ D

(ii) The student keeps holding the metal disc above the charged plastic block and taps the metal disc with a finger.

This earths the metal disc for a short time.
Explain why the disc now has an overall positive charge.

(2)

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(iii) Figure 27 shows the charges on part of the metal disc and the plastic block.

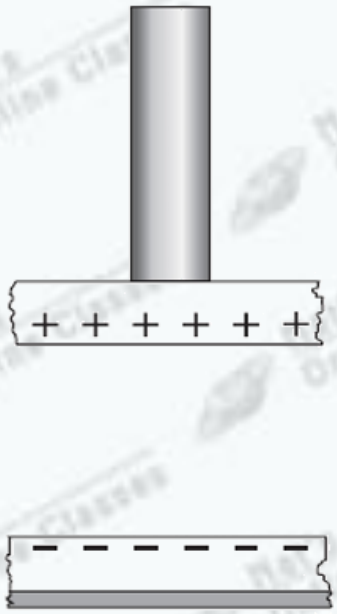

Figure 27

On Figure 27, draw lines to show the shape and direction of the electric field between the metal disc and the plastic block.

(2)

(Total for question = 5 marks)

Q5.

Figure 20 shows two metal spheres.

Metal sphere A is fixed to a table.
Metal sphere B can be moved.

Metal sphere B is placed at a short distance from metal sphere A.

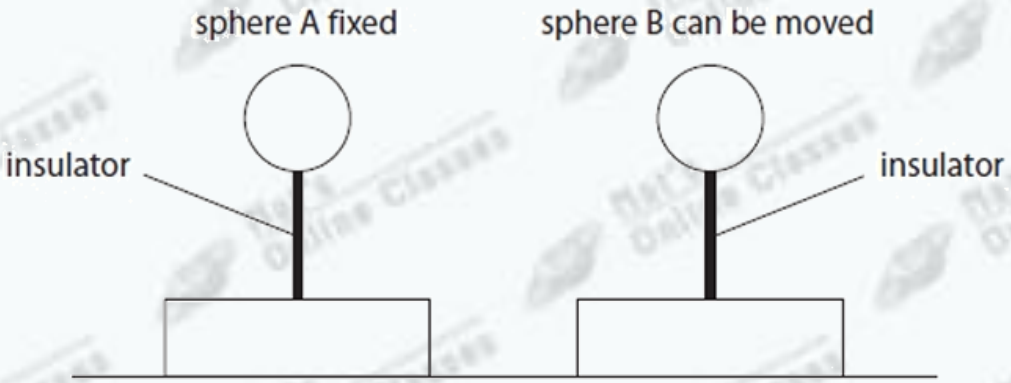

Figure 20

Both spheres are insulated from the table and given a negative charge.

The force between the charged spheres is measured.

(i) Explain, in terms of electric fields, why a force is exerted on sphere B.

(2)

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.....

(ii) Sphere B is moved and the force between the spheres is measured at several different distances.

Figure 21 is a graph of force on sphere B against distance between the centres of the spheres.

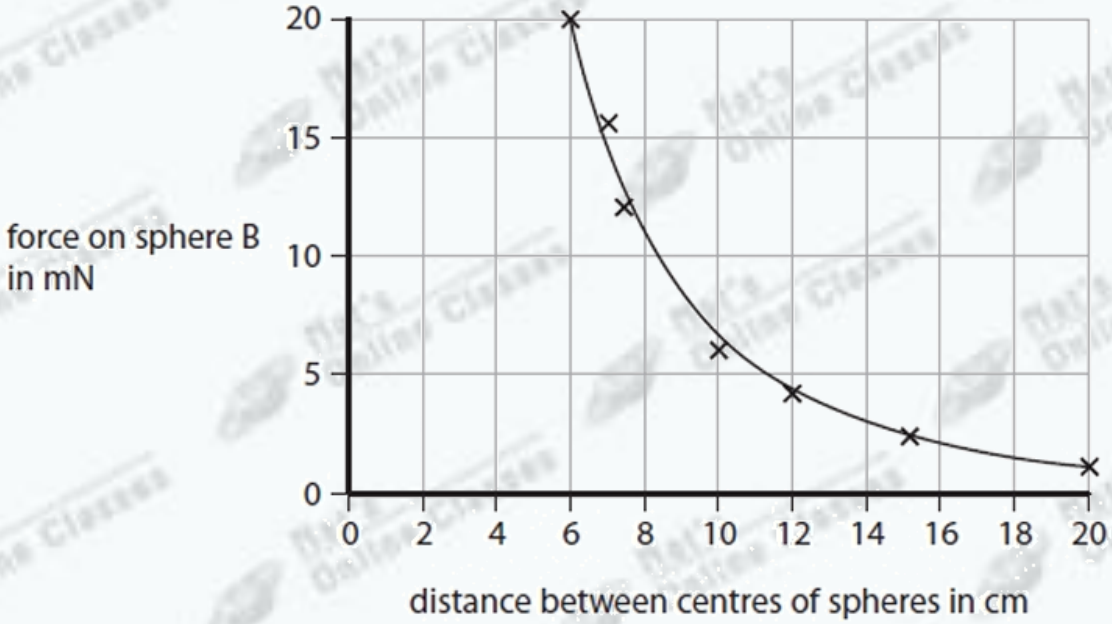

Figure 21

Describe how the force on sphere B varies with the distance between the centres of the spheres.

(2)

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(Total for question = 4 marks)

Mark scheme:

Q1.

Question number	Answer	Mark
	(i) gravitational (1) (ii) friction (1) (iii) electrostatic (1)	(3) AO1

Q2.

Question number	Answer	Additional guidance	Mark
(i)	(size of) charge on Q is greater than (size of charge) on P (1) P has (overall) negative charge and Q has (overall) positive charge (1)	in any order Q has more charge / stronger field than P accept abbreviations such as +'ve, -'ve charge on P is opposite to charge on Q	(2) AO3

Question number	Answer	Additional guidance	Mark
(ii)	(force of) attraction on (object) P from (object) Q (1)		(1) AO1

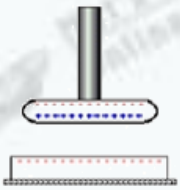
Q3.

Question number	Indicative content	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. **AO2 (strand 2) (6 marks)** 1. rub a strip with the cloth 2. test to see its charge (positive or negative) by rubbing against the coulombmeter 3. place the strip in the holder 4. charge another strip by friction (rubbing) 5. test its charge with the meter 6. bring the second strip up towards the one in the holder; either attracts or repels 7. repeat 1-6 with another charged strip 8. repeat steps 1-3, but then charge an acetate strip, again detecting the sign of its charge, as before 9. bring the charged acetate (+) strip up to the charged polythene (-) strip; the one in the stirrup should now be attracted / move towards the other	**(6)** **AO2**

Level	Mark	Descriptor
	0	• No awardable content
Level 1	1-2	• The explanation attempts to link and apply knowledge and understanding of scientific enquiry, techniques and procedures, flawed or simplistic connections made between elements in the context of the question. • Lines of reasoning are unsupported or unclear. (AO2)
Level 2	3-4	• The explanation is mostly supported through linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, some logical connections made between elements in the context of the question. • Lines of reasoning mostly supported through the application of relevant evidence. (AO2)
Level 3	5-6	• The explanation is supported throughout by linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, logical connections made between elements in the context of the question. • Lines of reasoning are supported by sustained application of relevant evidence. (AO2)

Level	Mark	Additional Guidance	General additional guidance – the decision within levels e.g. - 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 A limited explanation with at least two steps of a suitable procedure	Possible candidate responses rub a strip with the cloth / give it a charge place the strip in the holder explains consequent attraction / repulsion
Level 2	3–4	Additional guidance Partially complete explanation of a suitable procedure with at least three steps and some purpose indicated	Possible candidate responses As above with bring a second strip up towards the one in the holder either attracts or repels repeated with like / unlike charges use of coulombmeter
Level 3	5–6	Additional guidance Detailed explanation of a suitable procedure with most steps and a clear logic in what is being proposed	Possible candidate responses As above with test charge with the meter to see if it's (+) or (-) detailed use of acetate / polythene strips with purpose

Q4.

Question number	Answer	Additional guidance	Mark
(i)	B  A and D are incorrect because a negative charge cannot induce a negative charge C is incorrect because the disc is insulated so negative charge cannot be removed		(1)

Question number	Answer	Additional guidance	Mark
(ii)	an explanation linking: electrons / negative charges have flowed (1) from the metal disc / to the student / to earth/ground (1)	reject positive charge moving for first mark	(2)

Question number	Answer	Additional guidance	Mark
(iii)	at least three straight lines joining disc and plastic (1) arrow(s) from disc towards plastic (1)	judge by eye ignore curved lines at edge do not award mark if there are arrows in both directions	(2)

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