

NAME: \_\_\_\_\_

MARK:  $\frac{\quad}{65}$

When calculating numerical answers, show your working or reasoning clearly. Give final answers to **three** significant figures and include appropriate units where applicable.

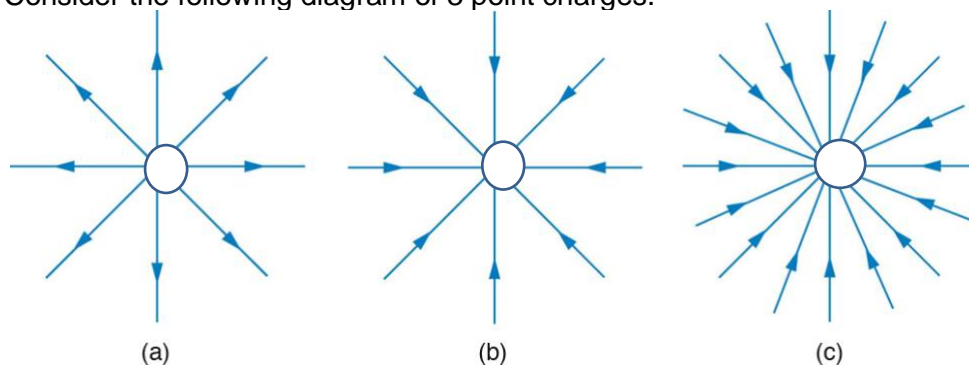
**Multiple Choice**

[4]

1. (a) When a hard rubber rod is given a negative charge by rubbing it with wool:
  - A. positive charges are transferred from rod to wool
  - B. negative charges are transferred from wool to rod
  - C. positive charges are transferred from wool to rod
  - D. negative charges are transferred from rod to wool
  - E. negative charges are created and stored on the rod
- (b) A negatively charged insulating rod is brought close to an object that is suspended by a string. If the object is repelled from the rod, we can conclude:
  - A. The object is positively charged
  - B. The object is negatively charged
  - C. The object is an insulator
  - D. The object is a conductor
- (c) Two charges are repelling each other with a force magnitude  $F$ . If each charge doubled and the distance between the charges becomes four times the original distance, determine the new magnitude of the force. Show your working in the space provided.
  - A.  $\frac{1}{2} F$
  - B.  $4 F$
  - C.  $2 F$
  - D.  $16 F$
  - E.  $\frac{1}{4} F$

Working:

2. (a) Consider the following diagram of 3 point charges.



- (i) Show the polarity of the charges on the diagram.

[2]

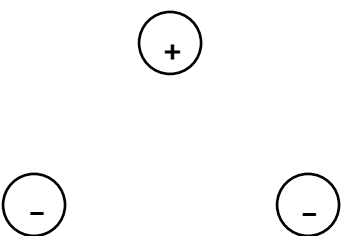
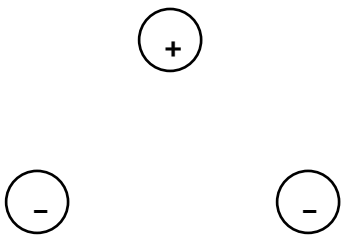
(ii) What can be concluded about the magnitude of the 3 charges? Explain. [1]

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(b) Draw the electric field distribution around the following arrangement of 3 point charges [3]

| Working diagram   | Resultant diagram  |
|---|--|
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(c) Explain the characteristics of the picture of the charge distribution shown below. [3]



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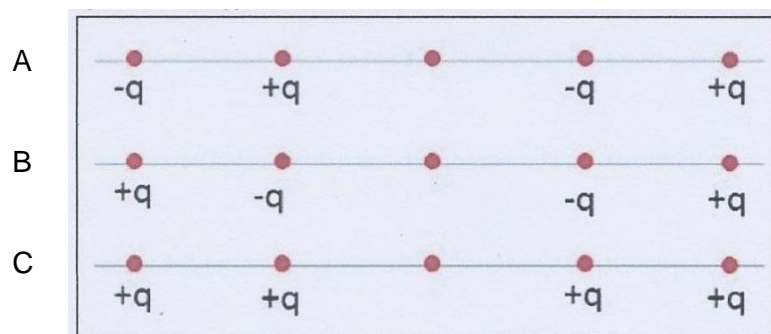
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3. Evaluate the sketch below, assuming that the dot in the centre of each line is the same charge for each arrangement. The arrangements do not interact with each other and the charges are evenly spaced.

Space for working



- (a) Determine which central charge has the greatest net force acting on it. [2]

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- (b) Determine the direction of the net force on the central charge from (a) if it is positive. [1]

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4. A student rubs a balloon on their jumper and then holds it near the fur of their cat, as shown below.



- (a) Explain why the balloon can cause the cat's hair to stand up. [A diagram may be useful.] [4]

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(b) Why would the cat's hair be more likely to stand up on a dry day than on a wet day? [2]

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5. A strong lightning bolt strikes a tree and transfers 25.0 C of charge to Earth.

(a) How many electrons are transferred? [2]

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(b) If the transfer through the tree takes 4.00 ms, what current flows through the tree? [2]

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6. (a) A body having a negative charge of  $-6.00 \mu\text{C}$  exerts an **attractive** force of 65.0 N on a second charged body that is 5.00 cm away. What is the magnitude and polarity of the second charge? [3]

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- (b) The charged bodies in (a) then make contact and are returned to the same distance apart. Determine the new force between them. [3]

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7. Point R is 0.400 m from a  $-2.00 \times 10^{-5}$  C charge. Find the electric field intensity at point R. [3]

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8. The electric field in a particle accelerator has a magnitude of  $4.50 \times 10^5$  NC<sup>-1</sup>. How much work is done to move a proton 25.0 cm through that field? [3]

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9. (a) When you apply a potential difference of 125 V between two parallel plates, the field between them is  $4.25 \times 10^3 \text{ Vm}^{-1}$ . How far apart are the plates? [2]

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- (b) A proton is released from the positive plate. At what speed will it be travelling as it reached the negative plate? Show your working clearly. [3]

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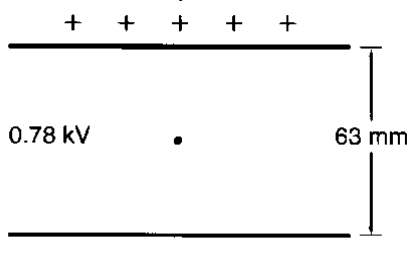
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10. In an oil drop experiment, a drop with a mass of  $2.22 \times 10^{-15} \text{ kg}$  was suspended motionless when the potential difference between the plates that were 630 mm apart was 0.780 kV.



- (a) On the diagram above draw the electric field between the parallel plates. [2]
- (b) (i) What was the charge of the drop? Show your working clearly. [4]

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- (ii) Does the oil drop have a deficiency or an excess of electrons? Explain briefly. [2]

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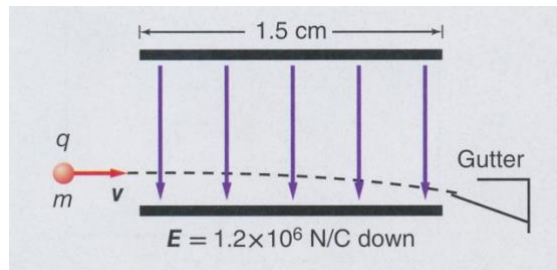
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- (c) If the voltage of the bottom plate is  $-100\text{ V}$ , what is the potential of the top plate? [1]

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11. In an ink-jet printer, drops of ink are given a certain amount of charge before they move between two large, parallel plates. The plates deflect the charged ink particles as shown in Figure below. The plates have an electric field of  $E = 1.20 \times 10^6\text{ N/C}$  between them and are  $1.50\text{ cm}$  long. Drops with a mass  $m = 0.100\text{ ng}$  and a charge  $q = 1.00 \times 10^{-16}\text{ C}$  are moving horizontally at a speed,  $v = 15.0\text{ m/s}$ , parallel to the plates.



- (a) What is the vertical force on the drops? [2]

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- (b) What is their vertical acceleration? [2]

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- (c) How long are they between the plates? [2]

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