Unit 19 · Electric Charges

WORKSHEET

Full marks 37

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 37

1 Key words [4]

Fill in the blanks with words from the box. Two words in the box are not needed. Each blank carries 0.5 mark.

conductor	**conservation**	**discharging**	**dispersion**	**electrons**	**induction**	**proton**
quantized	**relative permittivity**	**superposition**				

An object becomes negatively charged when it gains _____. The total charge of an isolated system never changes: this is the law of _____ of charge. Every charge is a whole number of lumps of e, so charge is said to be _____. A material in which charge moves freely is a _____. Bringing a charged rod near a conductor, without touching it, can charge the conductor by _____. Removing the charge from an object by touching it is called _____. The ratio $\varepsilon/\varepsilon_0$ is a medium's _____. When several charges act on one charge, the net force is the vector sum of their separate forces: this is the principle of _____.

2 Match the columns [2]

Match each material in Column A with its charge carriers in Column B. One item in Column B is not needed. Each pair carries 0.5 mark.

Column A		Column B
1. metals	☐	**a.** positive and negative ions
2. salt solution	☐	**b.** free electrons
3. a gas after a spark	☐	**c.** electrons and holes
4. silicon (a semiconductor)	☐	**d.** protons
		e. ions and electrons

3 Multiple choice [5]

Choose the correct option for each of the following questions.

i. A polythene rod rubbed with wool becomes negatively charged. The wool: [1]

a. stays uncharged
b. becomes negative, with the same charge as the rod
c. becomes positive, with a charge equal in size to the rod's
d. becomes positive, with a much smaller charge than the rod's

ii. Which of these could NOT be the charge on an oil drop? [1]

a. 3.2×10^{-19} C **b.** 4.8×10^{-19} C
c. 2.4×10^{-19} C **d.** 1.6×10^{-18} C

iii. Two point charges attract each other with a force of 12 N. If both charges are doubled and the distance between them is also doubled, the force becomes: [1]

a. 3 N **b.** 12 N

c. 24 N **d.** 48 N

iv. The SI unit of the permittivity of free space, ε_0, is: [1]

a. $\mathrm{N\,m^2/C^2}$ **b.** $\mathrm{C^2/(N\,m^2)}$

c. $\mathrm{N/C}$ **d.** $\mathrm{C/m^2}$

v. Two charged spheres, each of radius 2 cm, have their surfaces 6 cm apart. The distance r to use in Coulomb's law is: [1]

a. 6 cm **b.** 8 cm

c. 10 cm **d.** 4 cm

4 Very short answers [3]

Write very short answers to the following questions.

a. Name the charge carriers in a solution of common salt in water. [1]

b. State Coulomb's law in words. [1]

c. How many electrons make up a charge of one coulomb? [1]

5 Short answers [6]

Write short answers to the following questions.

a. On dry winter days in Kathmandu, people often get small shocks from door handles. Why are such shocks rare in the monsoon? [2]

b. Explain why salt dissolves in water but not in air, using the relative permittivity of water (about 80). [2]

c. Jenisha touches a positively charged metal sphere with an identical uncharged metal sphere, both on insulating stands, and then separates them. What charge does each sphere have now? Explain. **[2]**

6 Long answer **[4]**

Write a long answer to the following question.

Describe, with labelled diagrams, how a single metal sphere on an insulating stand can be given a positive charge using a negatively charged rod, without touching the sphere with the rod. Why must the finger be taken away before the rod?

7 Numerical problems **[10]**

Solve the following problems. Show your working. Take $k = 1/(4\pi\varepsilon_0) = 9.0 \times 10^9$ N m^2/C^2 and $e = 1.6 \times 10^{-19}$ C.

a. A plastic comb run through dry hair gains a charge of -3.2 nC. How many electrons has it gained, and by how much has its mass increased? (Mass of an electron 9.11×10^{-31} kg.) **[3]**

Answer:

b. Three point charges sit at the corners of a right-angled triangle. C = +2.0 μC is at the right angle; A = +4.0 μC is 30 cm to the west of C, and B = −6.0 μC is 40 cm to the north of C. Find the size and direction of the net force on C. **[4]**

Answer: _____

c. Two identical small metal spheres carry charges of +6.0 μC and −2.0 μC, with their centers 20 cm apart. Find the force between them. They are made to touch and then put back at the same distance. Find the new force. **[3]**

Answer: _____

8 Think **[3]**

A rubbed plastic comb picks up small pieces of uncharged paper. If the paper has no charge, why is it attracted? And why does it often jump away again a moment after touching the comb?

9 Activity: Which charges attract?

(not marked)

You need a plastic ruler or comb, a strip of plastic from a carry bag, a balloon, a woollen cloth and some tissue paper. Rub each object with the wool. Hang the plastic strip from a thread, then bring each rubbed object near it in turn.

Rubbed object brought near the hanging strip	Attracts or repels?	Charge on the object (+ or −)
a second rubbed plastic strip		
rubbed balloon		
rubbed plastic comb		
the wool cloth itself		
small pieces of tissue paper (not rubbed)		

What does the wool cloth's behavior tell you about where its charge came from?