Year 11 Physics

Electrostatics Assignment ***SOLUTIONS***

1.

a) They have the same magnitude of charge

b) They have the same mass

c) About 1833 times heavier

d)

Objects naturally have charge on them, however they are net neutral because they have the same number of positive and negative charges.
When one object takes electrons (negative charge) from another object, it becomes negatively charged and the other object because positively charged.

/2

e)

-ve to +ve attract, while -ve to -ve and +ve to +ve repel.

/2

2.

Coulomb's Law is $F = k\frac{q_1 q_2}{r^2}$

F is the force between the two charged objects
q_1 and q_2 are the charges on each object
r is the distance between the objects
k is the electrostatic constant (or Coulomb force constant)

/4

3.

a)

Decrease a charge magnitude and the force will decrease; increase a charge magnitude and the force will increase. /1

b)

Decrease the distance and the force will increase significantly, increase and the force will decrease significantly. /2

4. $q_1 = +1\times10^{-4}$C $\quad q_2 = +1\times10^{-5}$C $\quad d = 2$m $\quad$ F=?

$$F = k\frac{q_1 q_2}{d^2}$$

$$= 8.99\times10^9 \times \frac{1\times10^{-4}\times1\times10^{-5}}{2^2}$$

$$= 2.25\text{N}$$

The two charged objects will experience a force of 2N (1 s.f.) repulsion. /3

5.

The molecules on the ceiling polarise, forming dipoles with the electrons closer to the balloon than the protons. The attraction is therefore greater than the repulsion. /2

6.

a) $q_1 = +3.0\times10^{-3}$C $\quad q_2 = -4.2\times10^{-3}$C $\quad d = 10$m $\quad$ F=?

$$F = k\frac{q_1 q_2}{d^2}$$

$$= 8.99\times10^9 \times \frac{3.0\times10^{-3}\times4.2\times10^{-3}}{10^2}$$

$$= 1132\text{N}$$

The force which acts between them is 1100N (2 s.f.) attraction. /3

b) $q_1 = +3.0\times10^{-3}$C $\quad q_2 = -4.2\times10^{-3}$C $\quad d = 5.0$m $\quad$ F=?

$$F = k\frac{q_1 q_2}{d^2}$$

$$= 8.99\times10^9 \times \frac{3.0\times10^{-3}\times4.2\times10^{-3}}{5^2}$$

$$= 4531\text{N}$$

The force which acts between them is $\frac{4531}{1132}$ = 4 times greater (1 s.f.) /2

c)

$q_1 = +3.0\times10^{-3}$C $\quad q_2 = -4.2\times10^{-3}$C $\quad d = 2.5$m $\quad$ F=?

$$F = k\frac{q_1 q_2}{d^2}$$

$$= 8.99\times10^9 \times \frac{3.0\times10^{-3}\times4.2\times10^{-3}}{2.5^2}$$

$$= 18124\text{N}$$

The force which acts between them is $\frac{18124}{4531}$ = 4 times greater (1 s.f.) /2

d)

When you halve the distance, the force is quadrupled. This is the effect of the inverse squared proportionality. /2

Total /30