Submission Form

Fill up the following slots with appropriate content. You must submit the content of this document from this page only.

1. Your Name : Shihab Muhtasim
2. Your ID: 21301610
3. Your Section : 8
4. Experiment No: 01
5. Experiment Title: Verifying the inverse square nature of Coulomb's law and determining the value of Coulomb's constant, "k".
6. **You must write your ID in each of the graphs you insert here.**

7. **Table 1**: both charges are **positive**

$Q_1 = 9\ \mu C$

$Q_2 = 8\ \mu C$

Sl:	Distance ***r*** ***(m)***	$log(r)$	$\frac{1}{r^2}$	**Magnitude of Electrostatic force** | $\boldsymbol{F_E}$ | $= F_E$ **(N)**	$log(F_E)$
1.	0.014	-1.854	5102.041	3301.549	3.518
2.	0.02	-1.69	2500	1617.759	3.208
3.	0.026	-1.585	1479.29	957.254	2.981
4	0.032	-1.495	976.56	631.937	2.8
5	0.038	-1.42	692.52	449.133	2.652
6.	0.044	-1.356	516.53	334.248	2.524
7.	0.050	-1.3	400	258.841	2.413
8.	0.056	-1.25	318.87	206.347	2.314
9.	0.062	-1.2	260.14	168.341	2.226
10	0.068	-1.167	216.26	139.945	2.145

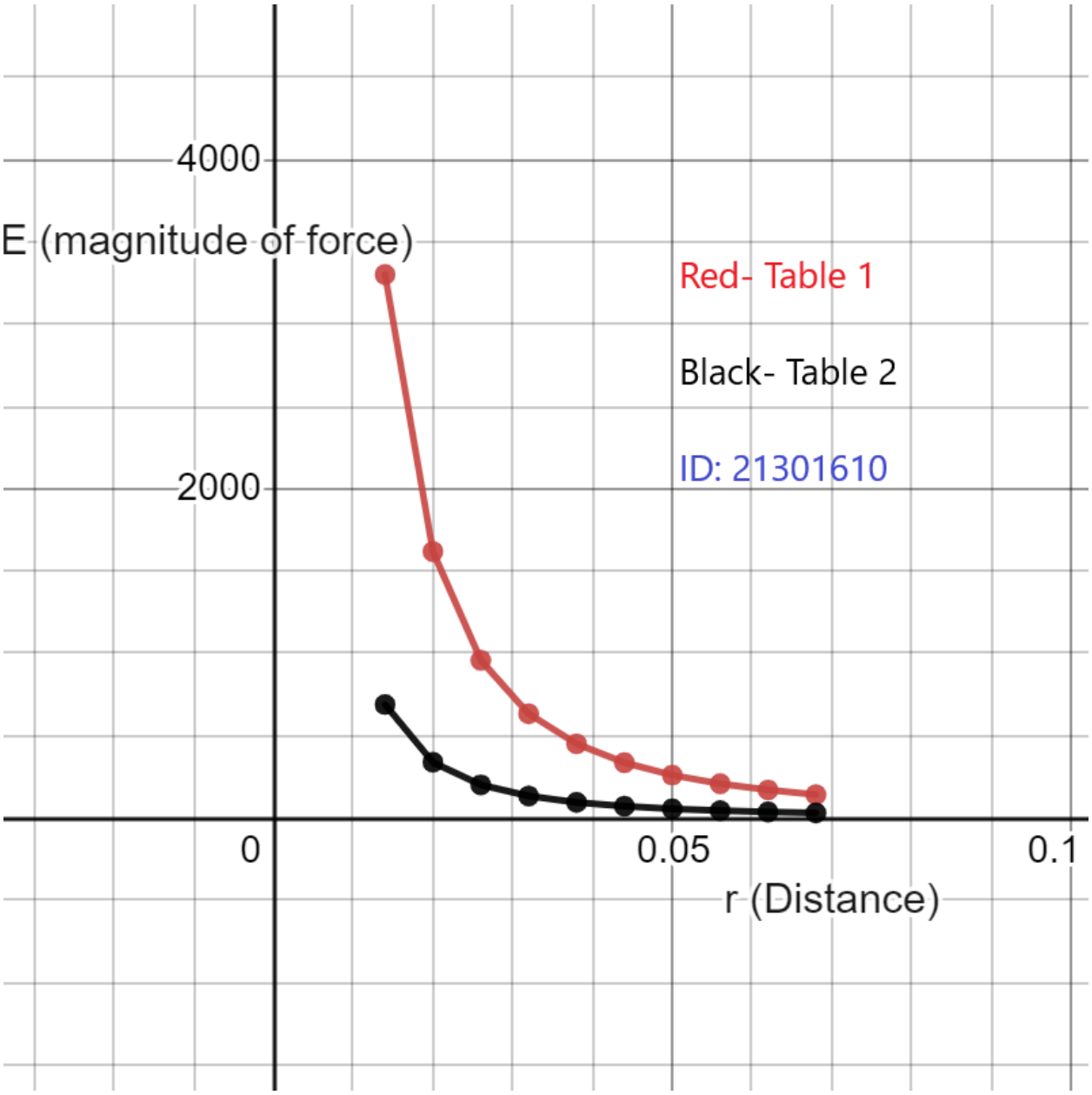
8. **Table 2:** one of the charges is **positive** and another is **negative.**

$Q_3 = 5\ \mu C$

$Q_4 = -3\ \mu C$

Sl:	Distance ***r*** ***(m)***	$log(r)$	$\frac{1}{r^2}$	**Magnitude of Electrostatic force | F_E | = F_E (N)**	$log(F_E)$
1.	0.014	-1.854	5102.041	687.823	2.837
2.	0.02	-1.69	2500	337.033	2.527
3.	0.026	-1.585	1479.29	199.428	2.299
4	0.032	-1.495	976.56	131.654	2.119
5	0.038	-1.42	692.52	93.361	1.97
6.	0.044	-1.356	516.53	69.635	1.8428
7.	0.050	-1.3	400	53.925	1.7317
8.	0.056	-1.25	318.87	42.989	1.63
9.	0.062	-1.2	260.14	35.071	1.5449
10	0.068	-1.167	216.26	29.155	1.464

9. Draw F_E (magnitude of force) vs r (separation between the point charges) graph that is you plot r along the x axis and F_E along the y axis. **(Recall: magnitude of a non-zero vector is always a positive number**.) For two tables you will get two curves. You can draw into one curve if you want. But the graph must be clearly visible. Dots on graphs without any line joining them, will not be accepted. Insert the **graph-1** as image here:



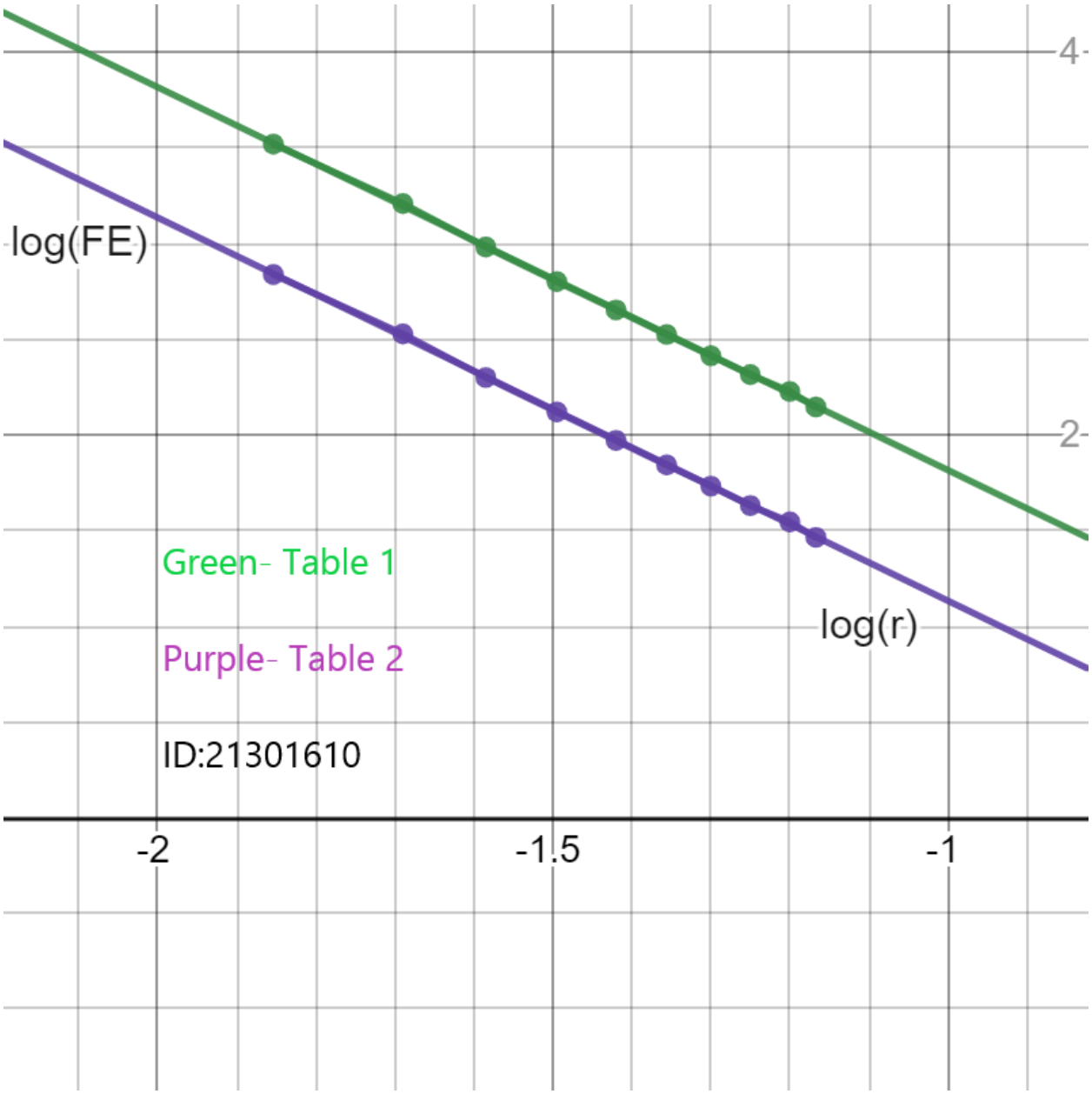
10. Draw $log(F_E)$ vs $log(r)$ graph that is you plot $log(r)$ along the x axis and $log(F_E)$ along the y axis. For two tables you will get two lines. Find the slope from both of the straight lines you get.

    Slope from line 1 : -1.99897

    Slope from line 2 : -2.00003

    Mean slope : -1.9995

Insert the **graph-2** here:



11. Draw the magnitude of Electrostatic Force, F_E vs inverse square distance, $1/r^2$ curve. You plot $(1/r^2)$ along the x axis and F_E along the y axis. You will get two straight lines for each table. Find the slope of each line. **If slopes carry any units, you must also write it.**

    Slope from line 1 : 0.647077 N.m^2

    Slope from line 2 : 0.134813 N.m^2

    For each table, you have a pair of charges. Calculate k for each table: **[As k is a positive constant, we take modulus of the right side for the calculation of k.]**

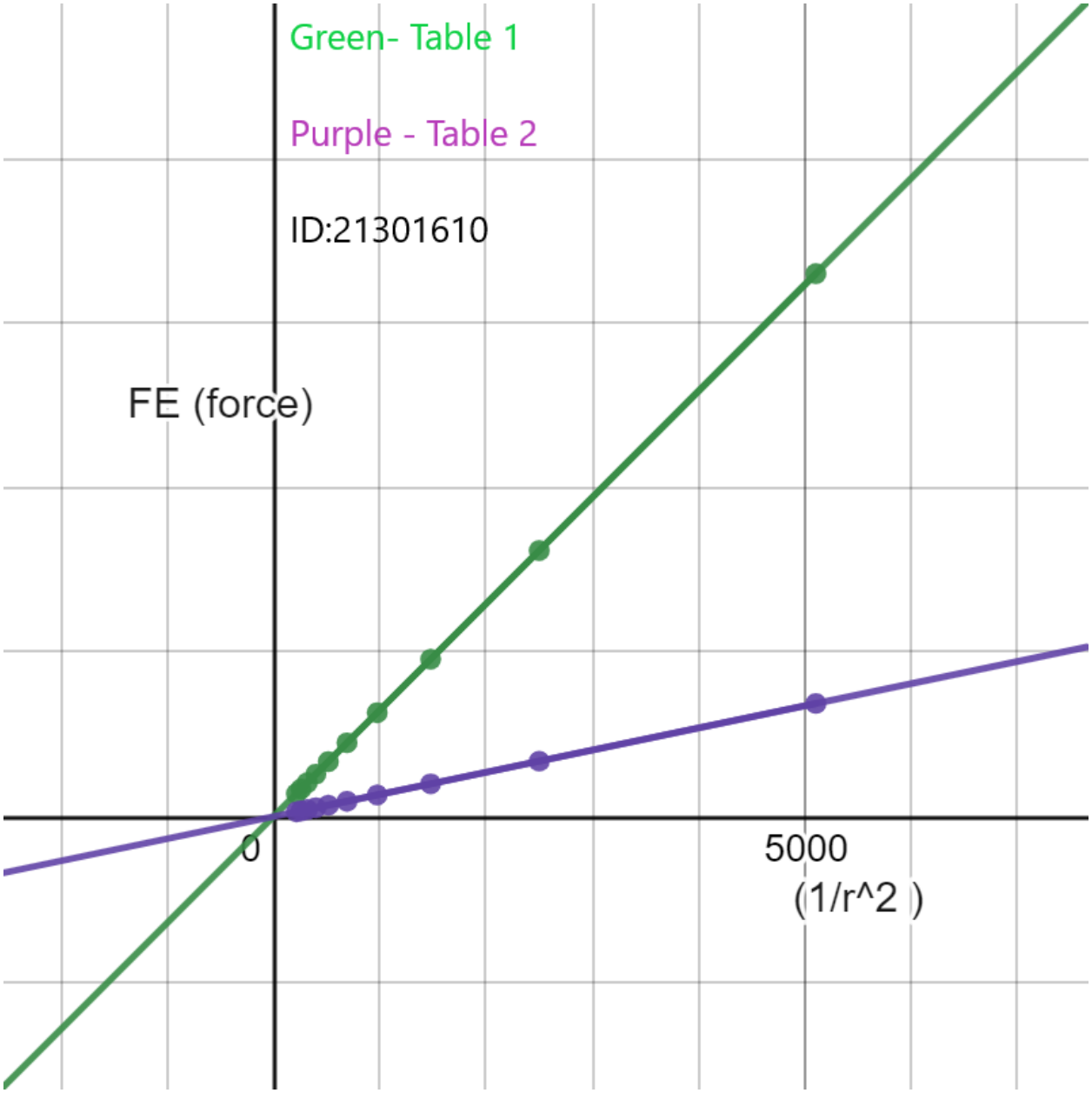
    $k \quad = |\, slope \,/\, (product\ of\ charges)|$

    k from line 1: 8987180556 N.m^2/C^2

    k from line 2: 8987533333 N.m^2/C^2

    Mean k : 8987356945 N.m^2/C^2

Insert the **graph-3** here:



Discussion Questions: You are ***strongly*** encouraged to use your **own words** to describe your thoughts. **Any kind of plagiarism (such as copying and pasting from other students' lab-reports) will not be accepted and will be subject to disciplinary action according to BracU policy.**

12. **Please briefly** discuss which result in our experiment helped us deduce that electrostatic force is an inverse square law.

    Hint: i) recognize which graph/dataset gives you the exponent of r . ii) use Coulomb's electrostatic force formula to verify this.

13. Say you have two protons which are 1m apart. The mass of a proton is, m_p = 1.67 * 10^-27 kg and charge is, q_p = 1.6 * 10^-19 C. Newton's constant, G_N = 6.67 * 10^-11 N m^2 kg^-2 and Coulomb constant, k = 8.987 * 10^9 N m^2 C^-2. Calculate this ratio:
    Gravitational force between the protons / Electrostatic force between the protons.

    What can you conclude from this?

    Discuss here:

    12. The result from graph 2 plotting $log(F_E)$ vs $log(r)$ helped us deduce that electrostatic force is an inverse square law. In the graph as $log(r)$ decreases $log(F_E)$ increases. According to Coulomb's law, FE is directly proportional to 1/r^2 which proves if the force increases, distance r will decrease and if distance (r) decreases the force will increase. Likewise the graph of $log(F_E)$ vs $log(r)$ gives us a visual understanding of the inverse square nature of Coulomb's law as force increases with the decreasing distance and vice versa. Moreover From the graph we can get $log(F_E)$=-2 $log(r)$ + $log(c)$ where c is any constant. Solving this equation:

    $F_E = c/r^2$

    or $F_E \propto 1/r^2$ which reflects Coulomb's electrostatic force formula.

Hence, graph of $log(F_E)$ vs $log(r)$ helped us deduce that electrostatic force is an inverse square law.

13. Gravitational force between the protons = $1.860*10^{-64}$ N

Electrostatic force between the protons = $2.30*10^{-28}$ N

Gravitational force between the protons / Electrostatic force between the protons= $8.0845*10^{-37}$

From this ratio we can conclude that the Electrostatic force is much greater than the Gravitational Force .