PART A: MULTIPLE CHOICE (10 MARKS)

Choose the best response in each case and place your answer in the appropriate space on your answer sheet.

1. The equation for finding k, the constant in Coulomb's Law, is:

   (a) $k = \frac{F\sqrt{d}}{q_1 q_2}$ (b) $k = \frac{Fd^2}{q_1 q_2}$

   (c) $k = \frac{Fd}{q_1 q_2}$ (d) $k = \frac{Fq_1 q_2}{d^2}$

2. Two metal spheres, having charges of 4.0×10^{-6} C and 2.0×10^{-6} C, are 30 cm apart. What is the electrical force between them?

   (a) 80 N (b) 8.0 N
   (c) 0.80 N (d) 0.0080 N

3. Two small spheres, X and Y, are arranged as shown in the following diagram. The sign and magnitude of the charge on each sphere is shown.

   $+6.0 \times 10^{-6}$ C -7.5×10^{-6} C
   X ☺ ☹ Y
   |---------- d = 3.0 cm ----------|

   What is the size and nature of the electrical force between the two charged spheres?

   (a) 300 N (repulsion) (b) 300 N (attraction)
   (c) 450 N (repulsion) (d) 450 N (attraction)

4. The diagram below represents charged spheres X, Y, and Z equally spaced apart in a straight line. X and Y have identical charges. Z has a charge equal in magnitude but opposite in sign to that of X and Y. If the electric force of X on Y is 1.0 N, what is the magnitude of the net electric force exerted on Y?

   X Y Z
   ◯ ◯ ◯

   (a) zero (b) 2.0 N
   (c) 4.0 N (d) 8.0 N

5. Two point charges attract each other with a force of F when they are a distance d part. The charge on one of the spheres is reduced to 0.75 of its original value and the original distance between them is increased by a factor of 3. What is the new force between them?

   (a) 9/64 F (b) 3/32 F
   (c) 1/12 F (d) 1/36 F

6. If the separation r between a positive test charge and a positive point charge is increased by an experimenter, the force F on the test charge will:

   (a) decrease according to $F \propto 1/r$
   (b) increase according to $F \propto 1/r$
   (c) decrease according to $F \propto 1/r^2$
   (d) increase according to $F \propto 1/r^2$

7. When comparing the force of attraction between an electron and a proton due to the electric force and gravity, it can be concluded that:

   (a) the gravitational force is a lot weaker.
   (b) the electric force is a lot weaker.
   (c) the two types of forces are the same.
   (d) they cannot be compared.

8. A charge R is placed to the right of charge S. The sign and magnitude of each charge is shown.

   S R
   ☺ ☹
   -1 Q +2 Q

   Where must a charge T of magnitude +1 Q be placed, if the net electrical force on T is to be zero?

   (a) Only to the left of S along a line passing through S and R.
   (b) Somewhere between S and R along a line passing through S and R.
   (c) Only to the right of R along a line passing through S and R.

9. The electric field of a negative point charge may be correctly represented by:

   (a) equally spaced counterclockwise concentric circles.
   (b) equally spaced parallel lines.
   (c) symmetrical lines radiating away from the point charge.
   (d) symmetrical lines radiating toward the point charge.

10. The magnitude of the electric field due to a small charged object is 12 N/C at a distance of 6.0 m from the charge. The field 3.0 m away from the charge is:

    (a) 48 N/C (b) 36 N/C
    (c) 4.0 N/C (d) 3.0 N/C

PART A: MULTIPLE CHOICE (10 MARKS)

1	2	3	4	5	6	7	8	9	10

PART B: MATCH (5 MARKS)

1	2	3	4	5

Match the definition from the 1st column to the best term in the 2nd column and place the matching letter in the appropriate space above.

1. The work done per unit charge between two locations.
2. A sensitive instrument for measuring the twisting forces in metal wires, consisting of an arm suspended from a fibre.
3. Law which states that the force between charges at rest is proportional to the magnitudes of the charges and inversely proportional to the square of the distance between them.
4. The quotient of the gravitational force and the magnitude of the test mass at a given point in a field.
5. The force between charges at rest.

A) Coulomb's constant
B) Coulomb's law
C) electric field intensity
D) electric field
E) electric potential difference
F) electrostatic force
G) gravitational field intensity
H) magnetic field intensity
I) test charge
J) torsion balance

PART C: SHORT ANSWER (6 MARKS)

Answer the following questions in the space provided.

1. Two identical metal spheres, each with positive charge "q", are separated by a centre-to-centre distance "r". What effect will each of the following changes have on the magnitude of the electric force "F" exerted on each sphere by the other? Express your answer as a multiplier.

{1} (a) The distance between the two spheres is doubled. _____

{1} (b) The distance between the two spheres is decreased to 1/3. _____

{1} (c) Both charges are tripled. _____

{1} (d) One of the charges becomes negative. _____

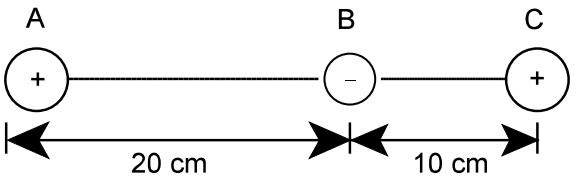
{2} (e) One sphere is touched by identical neutral sphere, which is then taken far away and the distance is decreased to 2/5. _____

PART D: PROBLEMS (24 MARKS)

Answer the following questions on a separate sheet of paper. You may use the back of this sheet if you wish.

{7} 1. Two charged spheres, 3.0 cm apart, repel each other with a force of 2.4×10^{-8} N. Determine the magnitude and sign of the charge on each, if one has twice the charge (of the same sign) as the other.

{9} 2. Charged spheres A and B are fixed in position, as shown, and have charges of +4.0 μC and -2.5 μC, respectively. Calculate the net force on sphere C, whose charge is +6.4 μC.



{8} 3. Two neutral spheres are attached to two identical springs and separated by 8.0 cm as shown. When a charge of 2.5×10^{-6} C is placed on each sphere, the distance between the spheres doubles. Calculate the force constant "k" of the springs. Be sure to include a FBD of one of the spheres! (Hint: $F_E = F_Q$)