Student #: _____ Student Name: _____

Physics 12 Homework Unit 4: Force Fields

_____ 1. The Earth and the moon apply a gravitational force to each other. Which of the following statements is true?

(a) Earth applies a greater force on the moon than the moon exerts on Earth.
(b) Earth applies a smaller force on the moon than the moon exerts on Earth.
(c) Earth applies a force on the moon, but the moon does not exert a force on Earth.
(d) Earth does not apply a force on the moon, but the moon exerts a force on Earth.
(e) The force Earth applies to the moon is equal and opposite to the force the moon applies to Earth.

_____ 2. Two electric charges experience an attractive force. What happens to that force if the charge of one of the objects is tripled and the charge of the other object is doubled? (Assume the distance between the objects stays the same.)

(a) The force doubles.
(b) The force triples.
(c) The force is five times greater.
(d) The force is six times greater.
(e) The force is thirty-six times greater.

_____ 3. Two masses exert a gravitational force F on each other. If one of the masses is doubled, and the distance between the masses is tripled, the new force between them is

(a) $6F$
(b) $2F/3$
(c) $2F/9$
(d) $3F/2$
(e) $4F/9$

_____ 4. Calculate the ratio of electric to gravitational forces between an electron and a proton.

(a) 4.41×10^{-40}
(b) 1
(c) 9.8
(d) 1.35×10^{20}
(e) 2.27×10^{39}

_____ 5. There are four charged objects: A, B, C, and D. Object A is charged positively. Object A is attracted to Object B. Object B is repelled from Object C. Object C is attracted to Object D. What are the charges on Objects B, C, and D?

(a) B is negative, and C and D are positive.
(b) B and C are positive, and D is negative.
(c) B, C, and D are positive.
(d) B, C, and D are negative.
(e) B and C are negative, and D is positive.

_____ 6. An electron and a proton are separated by 1.50×10^{-10} m. If they are released, which one will accelerate at a greater rate, and what is the magnitude of that acceleration?

(a) The electron; 1.12×10^{22} m/s^2
(b) The proton; 1.12×10^{22} m/s^2
(c) The electron; 6.13×10^{18} m/s^2
(d) The proton; 6.13×10^{18} m/s^2
(e) They both accelerate at the same rate; 1.02×10^{-8} m/s^2

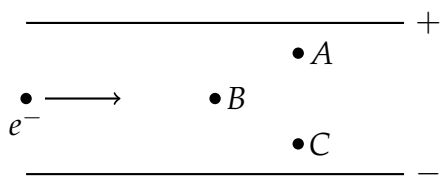
_____ 7. Two identical spheres are initially neutral. Sphere A obtains a charge of -1.28×10^{-13} C by induction and grounding, while Sphere B remains neutral. How does the mass of Sphere A compare with that of Sphere B?

(a) Each sphere has the same mass.
(b) Sphere A has 7.29×10^{-25} kg more mass than Sphere B.
(c) Sphere B has 7.29×10^{-25} kg more mass than Sphere A.
(d) Sphere A has 1.34×10^{-21} kg more mass than Sphere B.
(e) Sphere B has 1.35×10^{-21} kg more mass than Sphere A.

_____ 8. An electron is placed between two charged parallel plates as shown below. Which of the following statements are true:

I. The electrostatic force is greater at A than at B.
II. The work done from A to B to C is the same as the work done from A to C.
III. The electrostatic force is the same at points A and C.
IV. The electric field strength decreases as the electron is repelled upward.

(a) I and II
(b) I and III
(c) II and III
(d) II and IV
(e) III and IV



_____ 9. A charge moves in a circular orbit of radius R due to a uniform magnetic field. If the velocity of the charge is doubled, the orbital radius will become

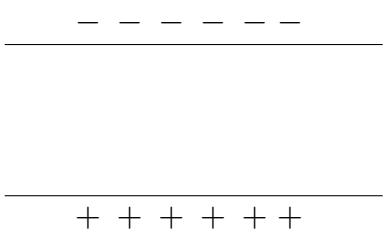
(a) $2R$
(b) R
(c) $R/2$
(d) $4R$
(e) $R/4$

_____ 10. Inside a solenoid, the magnetic field:

(a) is zero
(b) decreases along the axis
(c) increases along the axis
(d) is uniform
(e) cannot be determined

11. Draw diagrams showing the following:
    (a) Electric field around a stationary charge

    (a) Electric field between two parallel plates



    (c) Magnetic field around a bar magnet

    (d) Magnetic field around a straight conductor that has a current travelling to the right

12. A positively charged particle is fixed in place, unable to move. Another charged particle is brought near and released.
    (a) Which way does it move?
    (b) What happens to the force, acceleration, and velocity on the moving particle as it moves?
    (c) What happens to the charge's electric potential energy as it moves?

13. How is the electric field between parallel plates different from the electric field of a point charge?

14. There are two situations in which it is possible for a charged particle to be in a magnetic field but not experiencing a magnetic force. What are they?

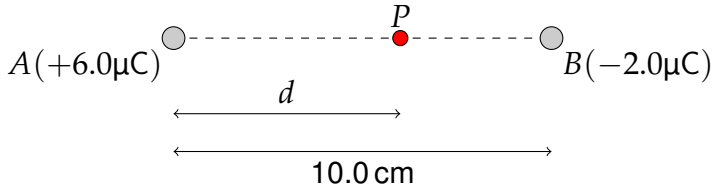
15. Does a magnetic field cause an increase in kinetic energy of a charged particle? Why or why not?

16. Physicist Robert Millikan used an **oil drop experiments** to discover the elementary charge, by suspending charged oil drops inside a known electric field (between two parallel plates). In an experiment replicating Millikan's oil drop experiment, a pair of parallel plates placed 0.0020 m apart and the top plate is positive. When the potential difference across the plates is 240.0 V, an oil drop of mass 2.0×10^{-14} kg gets suspended between the plates.
    (a) Draw a free-body diagram for the charge.
    (b) What is the charge on the oil drop?
    (c) Is there an excess or deficit of electrons on the oil drop?
    (d) How many electrons are in excess or deficit?

17. A positive charge of 3.2×10^{-5} C experiences a force of 4.8 N to the right when placed in an electric field. What is the magnitude and direction of the electric field at the location of the charge?

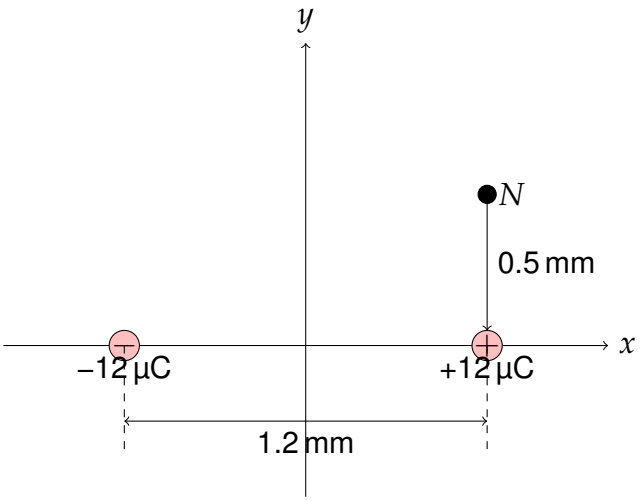
18. Find the electric potential energy stored between charges of $+2.6$ µC and –3.2 µC placed 1.60 m apart. (This is equivalent to the *work done* by bringing the two charges from $r = \infty$ to 1.60 m.)

19. Charge $A(+6.0\mu C)$ is separated 10.0 cm from charge $B(-2.0\mu C)$. At what location along the line that passes through the two charges will the total electric potential be zero?



20. The potential gradient between two parallel plates 2.0 cm apart is 2.0×10^3 V/m.
    (a) What is the potential difference between the plates?
    (b) What is the electric field intensity between the plates?

21. An **electric dipole** is a pair of particles whose charges are equal and opposite. It resembles many molecules. One such case is shown in the diagram below. Two particles with charges $+12$ µC and –12 µC are 1.2 mm apart along the x-axis. What is the electric field (magnitude and direction) at point N?



22. A test charge of $+5.0$ µC experiences a force of 2.0 $\times$ 10^3 N [S] when placed at the midpoint of two oppositely charge parallel plates. Assuming that the plates are electrically isolated and have a distance of separation of 8.0 mm, what will be the force experienced by a different charge of –2.0 µC, located 2.0 mm from the negative plate?

23. A positive ion, having a charge of 3.20×10^{-19} C, enters at the extreme left of the parallel plate assembly associated with the velocity selector and **mass spectrometer** shown in class.

    (a) If the potential difference across the simple accelerator is 1.20×10^{3} V, what is the kinetic energy of the particle as it leaves through the hole in the right plate?

    (b) The parallel plates of the velocity selector are separated by 12.0 mm and have an electric potential difference across them of 360.0 V. If a magnetic field of strength 0.100 T is applied at right angles to the electric field, what is the speed of the particles that will be selected to pass on the mass spectrometer?

    (c) When these particles then enter the mass spectrometer, which shares a magnetic field with the velocity selector, the radius of the resulting circular path followed by the particles is 6.26 cm. What is the mass of the charged particles?

24. A small latex sphere experiences an electric force of 3.6×10^{-14} N when suspended halfway between a pair of large metal plates, which are separated by 48.0 mm. There is just enough electric force to balance the force of gravity on the sphere.

    (a) What is the mass of the sphere?
    (b) What is the potential difference between the plates, given that the charge on the sphere is 4.8×10^{-19} C?