1) The charge carried by one electron is \( e = -1.6 \times 10^{-19} \) C. The number of electrons necessary to produce a charge of \(-1.0\) C is
   A) \(6.3 \times 10^{18}\).
   B) \(6.3 \times 10^9\).
   C) \(1.6 \times 10^9\).
   D) \(1.6 \times 10^{19}\).
   E) none of the above

2) An atomic nucleus has a charge of \(+40e\). An electron is \(10^{-9}\) m from the nucleus. What is the force on the electron?
   A) 3.7 nN  
   B) 6.8 nN  
   C) 1000 C  
   D) 2.9 nN  
   E) 9.2 nN

3) The force of attraction between a \(-40.0\) \(\mu\)C and \(+108\) \(\mu\)C charge is 4.00 N. What is the separation between these two charges?
   A) 2.49 m  
   B) 2.10 m  
   C) 1.13 m  
   D) 3.67 m  
   E) 3.12 m

4) Two coins carry identical charges. These two coins are lying 2.50 m apart on a table. If each of these coins experiences a force of 2.00 N, how large is the charge on each coin?
   A) 26.1 \(\mu\)C  
   B) 52.2 \(\mu\)C  
   C) 5.22 \(\mu\)C  
   D) 6.67 \(\mu\)C  
   E) 2.61 \(\mu\)C

5) Two point charges, initially 2.0 cm apart, experience a 1.0–N force. If they are moved to a new separation of 8.0 cm, what is the electric force between them?
   A) 4.0 N  
   B) 16 N  
   C) 2.0 N  
   D) 1/4 N  
   E) 1/16 N

6) Three point charges are located at the following positions: \(Q_1 = 2.00\) \(\mu\)C at \(x = 1.00\) m; \(Q_2 = 3.00\) \(\mu\)C at \(x = 0\); \(Q_3 = -5.00\) \(\mu\)C at \(x = -1.00\) m. What is the magnitude of the force on the 3.00–\(\mu\)C charge?
   A) \(8.10 \times 10^{-2}\) N  
   B) \(5.40 \times 10^{-2}\) N  
   C) 0.135 N  
   D) 0.158 N  
   E) 0.189 N
7) \( Q_1 = 6.0 \text{ nC} \) is at (0.30 m, 0); \( Q_2 = -1.0 \text{ nC} \) is at (0, 0.10 m); \( Q_3 = 5.0 \text{ nC} \) is at (0, 0). What is the direction of the net force on the 5.0 nC charge?
   A) 56° above -x axis
   B) 34° above -x axis
   C) along the -x axis
   D) 56° above +x axis
   E) 34° above +x axis

8) Three point charges of magnitudes \(+4.0 \mu\text{C}, -5.0 \mu\text{C},\) and \(-9.0 \mu\text{C}\) are placed on the \(x\)-axis at \(x = 0 \text{ cm}, x = 40 \text{ cm},\) and \(x = 120 \text{ cm},\) respectively. What is the force on the \(-9.0 \mu\text{C}\) charge due to the other two charges?
   A) -0.41 N  B) 0.64 N  C) 0.41 N  D) 0.55 N  E) -0.55 N

9) Two point charges of magnitudes \(+5.00 \mu\text{C}, +7.00 \mu\text{C}\) are placed along the \(x\)-axis at \(x = 0 \text{ cm}, x = 100 \text{ cm},\) respectively. Where must a third charge be placed along the \(x\)-axis so that it does not experience any net force because of the other two charges?
   A) 50 cm  B) 91.2 cm  C) 45.8 cm  D) 4.58 cm  E) 9.12 cm

10) What are the magnitude and direction of the electric field at a distance of 1.50 m from a 50.0-nC charge?
    A) 200 N/C away from the charge
    B) 200 N/C toward from the charge
    C) 20 N/C away from the charge
    D) 20 N/C toward from the charge
    E) 10 N/C away from the charge

11) A force of 6.0 N acts on a charge of 3.0 \(\mu\text{C}\) when it is placed in a uniform electric field. What is the magnitude of this electric field?
    A) 18 MN/C  B) 0.50 MN/C  C) 1.0 MN/C  D) 130 MN/C  E) 2.0 MN/C

12) Two point charges of \(+40.0 \mu\text{C}\) and \(-10.0 \mu\text{C}\) are separated by a distance of 20.0 cm. A \(+7.00 \mu\text{C}\) charge is placed midway between these two charges. What is the electric force acting on this charge because of the other two charges?
    A) 3.15 N directed towards the negative charge
    B) 3.15 N directed towards the positive charge
    C) 315 N directed towards the negative charge
    D) 315 N directed towards the positive charge
    E) 0.453 N directed towards the negative charge

13) An electron is held up against the force of gravity by the attraction of a fixed proton some distance above it. How far above the electron is the proton?
    A) 3.7 m  B) 4.6 m  C) 2.3 m  D) 1.5 m  E) 5.1 m
14) A particle with a charge of 4.0 μC has a mass of 5.0 × 10⁻³ kg. What electric field directed upward will exactly balance the weight of the particle?
   A) 8.2 × 10² N/C  
   B) 5.1 × 10⁶ N/C  
   C) 4.1 × 10² N/C  
   D) 4.4 × 10⁴ N/C  
   E) 1.2 × 10⁴ N/C

15) Two point charges of +5.00 μC and +8.00 μC are placed inside a cube of edge length 0.100 m. The net electric flux due to these charges is given by
   A) 0.450 × 10⁶ Nm²/C  
   B) 1.47 × 10⁶ Nm²/C  
   C) 4.20 × 10⁶ Nm²/C  
   D) 3.80 × 10⁶ Nm²/C  
   E) 0.340 × 10⁶ Nm²/C

16) Charge q₁ is inside a closed Gaussian surface; charge q₂ is just outside the surface. Does the electric flux through the surface depend on q₁? Does it depend on q₂? Explain.

17) Find the net charge of a system consisting of 3.9 × 10⁷ electrons.

18) Two point charges, the first with a charge of +3.13 × 10⁻⁶ C and the second with a charge of -4.47 × 10⁻⁶ C are separated by 25.5 cm. (a) Find the magnitude of the electrostatic force experienced by the positive charge. (b) Is the magnitude of the force experienced by the negative charge greater than, less than, or the same as that experienced by the positive charge? Explain.

19) A point charge q = -0.35 nC is fixed at the origin. Where must an electron be placed in order for the electric force acting on it to be exactly opposite to its weight? (Let the y axis be vertical and the x axis be horizontal.)

20) Point charges, q₁ and q₂ are placed on the x axis, with q₁ at x = 0 and q₂ at x = d. A third point charge, +Q, is placed at x = 3d/4. If the net electrostatic force experienced by the charge +Q is zero, how are q₁ and q₂ related?

21) An object with a charge of -3.6 μC and a mass of 0.012 kg experiences an upward electric force, due to a uniform electric field, equal in magnitude to its weight. (a) Find the direction and magnitude of the electric field. (b) If the electric charge on the object is doubled while its mass remains the same, find the direction and magnitude of its acceleration.
Answer Key
Testname: PHYS 102 ADDITIONAL EXERCISES ON CHAPTER 19

1) A
2) E
3) E
4) B
5) E
6) E
7) A
8) C
9) C
10) A
11) E
12) C
13) E
14) E
15) B

16) The electric flux through the Gaussian surface depends on \( q_1 \). In general, the electric flux through a surface depends on the charge that is enclosed by the surface. Because charge \( q_2 \) is outside the Gaussian surface, however, it has no effect whatsoever on the total electric flux through the surface.

17) \(-6.2 \times 10^{-12} \text{ C}\)

18) (a) 1.93 N; (b) The magnitude of the electrostatic force depends upon the product of the charges of both particles, so the negative charge experiences a force magnitude which is the same as that experienced by the positive charge.

19) 240 km above \( q \)

20) \( q_1 = 9q_2 \)

21) (a) \((-3.3 \times 10^4 \text{ N/C})\hat{y}\); (b) \((9.81 \text{ m/s}^2)\hat{y}\)