Physics II

Chapters 16 and 17
Field Strength $\mathbb{E}$, Potential V, and Potential Energy U for Particles
Fall 2016

IMPORTANT: Except for multiple-choice questions, you will receive no credit if you show only an answer, even if the answer is correct. Always show in the space on your answer sheet some sketches, words, or equations which clearly justify your answer. Show the equations you use and the values substituted into them whenever equations are necessary. If you go from a formula directly to an answer without showing the values used, you will lose points. Points will also be deducted for missing or erroneous units.

Each individual answer is weighted roughly evenly throughout the exam.

Name ____

$F = mg$	$F = q\mathbb{E}$	$\mathbb{E} = \frac{\Delta V}{\Delta x}$
$EPE = qV$	volume $V = \frac{4}{3}\pi r^3$	$\rho = \frac{m}{V}$
$\mathbb{E} = k\frac{q_s}{r^2}$	$F = q_v\mathbb{E}$	$F = k\frac{q_1 q_2}{r^2}$
$V = k\frac{q_s}{r}$	$U = q_v V$	$U = k\frac{q_1 q_2}{r}$
$\mu = 10^{-6}$	$e = 1.6 \times 10^{-19}$ C	$\mathrm{u} = 1.66 \times 10^{-27}$ kg
	$m_e = 9.11 \times 10^{-31}$ kg	

1. Two charged objects attract each other with a certain force. If the charges on both objects are doubled with no change in separation, the force between them

   (a) halves.
   (b) doubles.
   (c) quadruples.
   (d) increases, but we can't say how much without knowing the distance between them.

2. Two charges are separated by a distance d and exert mutual attractive forces of F on each other. If the charges are separated by a distance of d/3, what are the new mutual forces?

   (a) F/3
   (b) F/9
   (c) 3F
   (d) 9F

3. Two charged objects attract each other with a force F. What happens to the force between them if one charge is doubled, the other charge is tripled, and the separation distance between their centers is reduced to one-fourth its original value? The force is now equal to

   (a) 24F.
   (b) 16F.
   (c) 96F.
   (d) (3/8)F.

4. An electron and a proton are separated by a distance of 1.0 m. What happens to the magnitude of the force on the proton if a second electron is placed next to the first electron?

   (a) It goes to zero.
   (b) It will not change.
   (c) It quadruples.
   (d) It doubles.

5. An electron and a proton are separated by a distance of 1.0 m. What happens to the magnitude of the force on the first electron if a second electron is placed next to the proton?

   (a) It does not change.
   (b) It becomes zero.
   (c) It doubles.
   (d) It is reduced to half.

6. An electron and a proton are separated by a distance of 1.0 m. What happens to the size of the force on the proton if the electron is moved 0.50 m closer to the proton?

   (a) It increases to 4 times its original value.
   (b) It decreases to one-half its original value.
   (c) It increases to 2 times its original value.
   (d) It decreases to one-fourth its original value.

7. At twice the distance from a charged particle, the strength of the electric field

   (a) is one-fourth its original value.
   (b) is twice its original value.
   (c) is four times its original value.
   (d) is one-half its original value.

8. 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) 6.8 nN
   (b) 2.9 nN
   (c) 9.2 nN
   (d) 3.7 nN
   (e) 1000 C

9. Two charged particles, separated by 1.5 cm, have charge values of 2.0 and -4.0 μC, respectively. What is the magnitude of the electric force between them?

   (a) 160 N
   (b) 320 N
   (c) 360 N
   (d) 400 N

10. Two charged particles, 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) 1/16 N
   (c) 1/4 N
   (d) 16 N

11. Two charged particles of $+3.0\ \mu$C and -7.0 μC are placed at x = 0 and x = 0.20 m. What is the magnitude of the electric field at the point midway between them?

   (a) 4.5×10^6 N/C
   (b) 3.6×10^6 N/C
   (c) 1.8×10^6 N/C
   (d) 9.0×10^6 N/C

12. A stationary electron is accelerated through a potential difference of 500 V. What is the velocity of the electron afterward?

   (a) 1.3×10^7 m/s
   (b) 1.3×10^6 m/s
   (c) 2.6×10^6 m/s
   (d) 2.6×10^7 m/s

13. A proton, initially at rest, is accelerated through an electric potential difference of 500 V. What is the kinetic energy of the proton?

   (a) 500 J
   (b) 8.0×10^{-17} J
   (c) zero
   (d) 1.6×10^{-19} J

14. If a Cu^{2+} ion drops through a potential difference of 12 V, it will acquire a kinetic energy (in the absence of friction) of A) 12 eV. B) 24 eV. C) 3.0 eV. D) 6.0 eV.

15. What is the potential at a distance of 5.0×10^{-10} m from a nucleus of charge +50e?

   (a) 120 V
   (b) 170 V
   (c) 210 V
   (d) 140 V

16. Two 3.00 μC charges are at the ends of a meter stick. Find the electrical potential for the center of the meter stick.

   (a) 1.08×10^5 V
   (b) 5.40×10^4 V
   (c) 2.70×10^4 V
   (d) zero

17. A 5.0-nC charge is at (0, 0) and a -2.0-nC charge is at (3.0 m, 0). If the potential is taken to be zero at infinity, what is the electric potential at point (0, 4.0 m)?

   (a) 3.6 V
   (b) 11 V
   (c) 15 V
   (d) 7.7 V

18. A 5.0-nC charge is at (0, 0) and a -2.0-nC charge is at (3.0 m, 0). If the potential is taken to be zero at infinity, what is the electric potential energy of a 1.0-nC charge at point (0, 4.0 m)?

   (a) 3.6×10^{-9} J
   (b) 7.7×10^{-9} J
   (c) 1.1×10^{-8} J
   (d) 1.5×10^{-8} J

19. A 5.0-nC charge is at (0, 0) and a -2.0-nC charge is at (3.0 m, 0). If the potential is taken to be zero at infinity, what is the work required to bring a 1.0-nC charge from infinity to point (0, 4.0 m)?

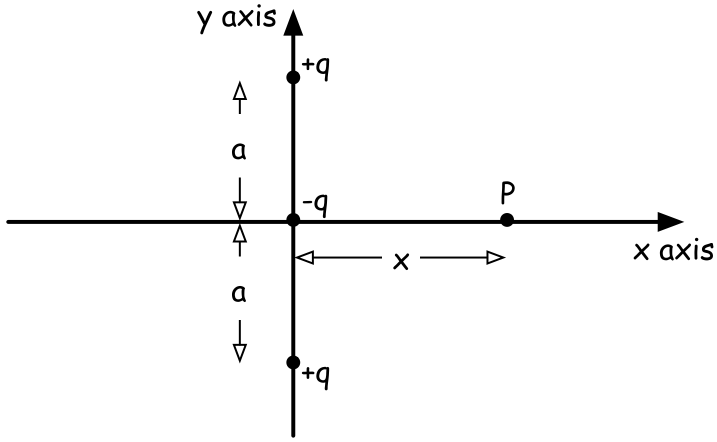
   (a) 1.1×10^{-8} J
   (b) 1.5×10^{-8} J
   (c) 7.7×10^{-9} J
   (d) 3.6×10^{-9} J

20. An alpha particle (charge $+2e$, mass 6.64×10^{-27} kg) moves head-on at a fixed gold nucleus (charge $+79e$). If the distance of closest approach is 2.0×10^{-10} m, what was the initial speed of the alpha particle?

   (a) 4.6×10^6 m/s
   (b) 4.6×10^5 m/s
   (c) 2.3×10^5 m/s
   (d) 2.3×10^6 m/s

21. How much energy is necessary to place three charges, each of 2.0 μC, at the corners of an equilateral triangle of side 2.0 cm?

   (a) 6.7 J
   (b) 5.4 J
   (c) 4.5 J
   (d) 7.6 J



1. Three electrically charged particles are arranged along the y-axis as shown above. No other charged matter is close enough to affect this system in any significant way.

   The value of q is 2.0 μC.

   The value of "a" is 3.0 cm.

   The value of "x" is 4.0 cm.

   (a) Determine the electrical potential energy of this system.

   -1.8 J

   (b) Determine the strength of the electric field at point P.

   $\mathbb{E} = 270,000$ N/C

2. The mode by which the nucleus of the radioactive isotope uranium-238 decays is the so-called "alpha decay:" ${}^{238}_{92}\mathrm{U} \rightarrow {}^{234}_{90}\mathrm{Th} + {}^{4}_{2}\mathrm{He}$. Immediately after the alpha decay occurs the two daughter nuclei, thorium-234 and helium-4, are 62×10^{-15} m apart and have negligible speed. The thorium nucleus remains nearly at rest after the decay; its own recoil speed is negligible. But how fast will the helium nucleus be moving when it is very far away?

   $v = 1.4 \times 10^7$ m/s