Name:

Your code is: AABFAG

Put your name here:

Keep this exam **CLOSED** until advised by the instructor.

Fill out the bubble sheet: last name, first initial, student number, section number and **code**.

---

60 minute long closed book exam.

A two-sided 8.5 by 11 handwritten help sheet is allowed.

When done, hand in your **bubble sheet** and your **exam**.

Possibly useful constants:

- $k_e = 8.99 \times 10^{9}$ Nm^2/C^2
- $\epsilon_0 = 8.85 \times 10^{-12}$ As/(Vm)
- $\mu_0 = 4\pi \times 10^{-7}$ Vs/(Am)
- $c = 3.00 \times 10^{8}$ m/s
- $g = 9.81$ m/s^2
- $e = 1.60 \times 10^{-19}$ C
- $m_e = 9.11 \times 10^{-31}$ kg
- $m_e c^2 = 0.511$ MeV
- $h = 6.63 \times 10^{-34}$ Js
- $h = 4.14 \times 10^{-15}$ eVs
- hc = 1240 eVnm
- $\sigma = 5.67 \times 10^{-8}$ $W/(m^2K^4)$
- Wien's constant = 2.898×10^{-3} Km
- $R_H = 1.097 \times 10^{7}$ 1/m
- $E_0 = 13.6$ eV
- $a_0 = 0.529$ Angstrom
- 1 eV = 1.60×10^{-19} J
- 1 AMU (1 u) = 931.494 MeV/c^2 = 1.67×10^{-27}kg
- $\times$ Field directly into page.
- $\bullet$ Field directly out of page
- 1 pico (p) = 10^{-12}

Two positive point charges both with an electric charge of **Q** are at a distance of **d** from each other. The magnitude of the force between the charges is **F**. Select True or False for the following statements.

3 pt

▷ If one of the charges is doubled in size, then the magnitude of the force doubles.

1. **A**◯ True **B**◯ False

3 pt

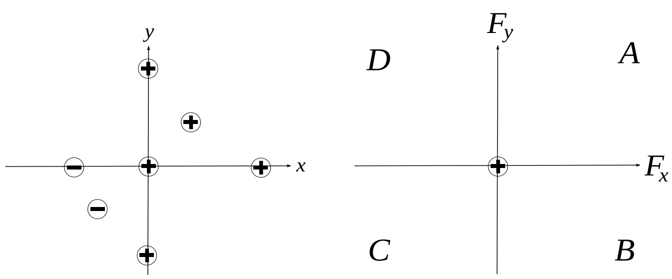
▷ If both of the charges are halved in size, then the magnitude of the force remains the same.

2. **A**◯ True **B**◯ False

3 pt

▷ If the distance between the charges is halved, then the magnitude of the force increases by a factor of four.

3. **A**◯ True **B**◯ False



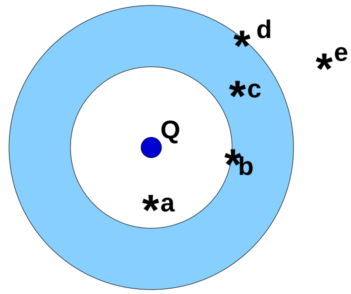
6 pt

The left diagram above shows seven charges of equal magnitude. Determine the direction of the total force on the charge at the origin due to all the other charges. Into which quadrant does the total force vector point? Choose the quadrant A, B, C or D as indicated in the right diagram.

▷

4. **A**◯ A **B**◯ B **C**◯ C **D**◯ D

12 pt Consider a thick spherical conducting shell with NO net charge. A point charge +Q is placed at its center as shown in the figure.



Select True or False for the following statements.

▷ The electric field at **a** is zero.

5. **A**◯ True **B**◯ False

▷ The electric field at **e** is zero.

6. **A**◯ True **B**◯ False

▷ The electric field at **c** is zero.

7. **A**◯ True **B**◯ False

▷ The inner surface of the shell carries a charge -Q.

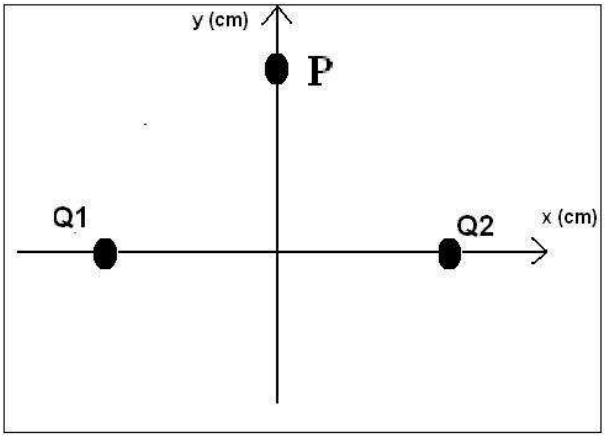
8. **A**◯ True **B**◯ False

11 pt To recharge a 15.0 V battery, a battery charger must move 3.69×10^5 C of charge from the negative terminal to the positive terminal. How much work is done by the battery charger?

(in J)

9. **A**◯ 5.535×10^6 **B**◯ 8.026×10^6
C◯ 1.164×10^7 **D**◯ 1.687×10^7
E◯ 2.447×10^7 **F**◯ 3.548×10^7
G◯ 5.144×10^7 **H**◯ 7.459×10^7

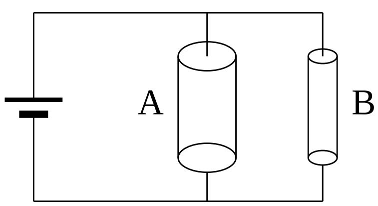
Consider the two charges on the x-axis in the diagram below. Each charge is 19 cm from the origin, Q1= 1.74 μC and Q2= 9.09 μC.



11 pt What is the electric potential at point **P** on the y-axis a distance of 67 cm from the origin (in V)?

10. **A**◯ 1.40×10^5 **B**◯ 1.58×10^5 **C**◯ 1.79×10^5 **D**◯ 2.02×10^5 **E**◯ 2.28×10^5 **F**◯ 2.58×10^5 **G**◯ 2.91×10^5 **H**◯ 3.29×10^5

The picture shows a battery connected to two cylindrical wires in parallel. Both wires are made out of the same material and are of the same length, but the diameter of wire **A** is twice the diameter of wire **B**.



3 pt Choose the correct answer.

11. **A**◯ The resistance of wire B is half as large as the resistance of wire A.
B◯ The resistance of wire B is one quarter as large as the resistance of wire A.
C◯ The resistance of wire B is equal to the resistance of wire A.
D◯ The resistance of wire B is twice as large as the resistance of wire A.
E◯ The resistance of wire B is four times as large as the resistance of wire A.

3 pt Choose the correct answer.

12. **A**◯ The voltage drop across wire B is one quarter as large as the voltage drop across wire A.
B◯ The voltage drop across wire B is twice as large as the voltage drop across wire A.
C◯ The voltage drop across wire B is four times as large as the voltage drop across wire A.
D◯ The voltage drop across wire B is half as large as the voltage drop across wire A.
E◯ The voltage drop across wire B is equal to the voltage drop across wire A.

3 pt Choose the correct answer.

13. **A**◯ The power dissipated in wire B is 4 times as large as the power dissipated in wire A.
B◯ The power dissipated in wire B is one quarter as large as the power dissipated in wire A.
C◯ The power dissipated in wire B is 16 times as large as the power dissipated in wire A.
D◯ The power dissipated in wire B is equal to the power dissipated in wire A.
E◯ The power dissipated in wire B is 1/16 as large as the power dissipated in wire A.

A parallel plate capacitor with plate separation d is connected to a battery. The capacitor is fully charged to Q Coulombs and a voltage of V. (C is the capacitance.) Answer the following questions regarding the capacitor charged by a battery. For each statement below, select True or False.

3 pt

▷ After being disconnected from the battery, decreasing d increases C.
14. **A**◯ True **B**◯ False

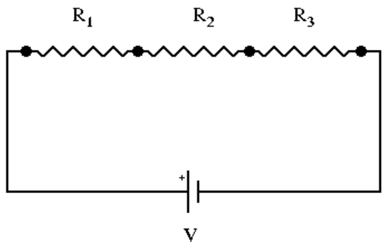
3 pt

▷ With the capacitor connected to the battery, increasing d decreases Q.
15. **A**◯ True **B**◯ False

3 pt

▷ With the capacitor connected to the battery, inserting a dielectric between the plates of the capacitor will decrease Q.
16. **A**◯ True **B**◯ False

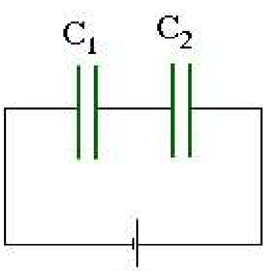
11 pt In the circuit below R_1 = 25, R_2 = 18, R_3 = 156 Ω, and V = 100 V. What is the magnitude of the voltage drop in volts across the R_2 resistor?



17.A◯ 5.648 **B**◯ 6.608 **C**◯ 7.731
D◯ 9.045 **E**◯ 10.583 **F**◯ 12.382
G◯ 14.487 **H**◯ 16.950

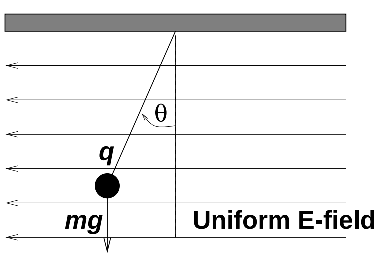
---

11 pt



In the capacitor arrangement shown C_1 = 89 mF and C_2 = 46 mF. If a voltage of V = 109 volts is applied, what is the energy stored (J) in the capacitor C_1?

18.A◯ 20.453 **B**◯ 23.930 **C**◯ 27.998
D◯ 32.758 **E**◯ 38.327 **F**◯ 44.842
G◯ 52.466 **H**◯ 61.385



11 pt
As shown in the figure above, a ball with a mass of 0.720 g and positive charge of q=32.4 μC is suspended on a string of negligible mass in a uniform electric field. We observe that the ball hangs at an angle of θ=22.0° from the vertical. What is the magnitude of the electric field?
(in `N/C`*)*

19.A◯ 8.808×10^1 **B**◯ 1.031×10^2
C◯ 1.206×10^2 **D**◯ 1.411×10^2
E◯ 1.650×10^2 **F**◯ 1.931×10^2
G◯ 2.259×10^2 **H**◯ 2.643×10^2

