Name:

Your code is: AAAAAA

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^{2}K^4)
- Wien's constant $= 2.898 \times 10^{-3}$ Km
- $R_H = 1.097 \times 10^7$ 1/m
- $E_0 = 13.6$ eV
- $a_0 = 0.529$ Angstrom
- 1 eV $= 1.60 \times 10^{-19}$ J
- 1 AMU (1 u) $= 931.494$ MeV/c^2 $= 1.67 \times 10^{-27}$kg
- $\times$ Field directly into page.
- $\bullet$ Field directly out of page
- 1 pico (p) $= 10^{-12}$

12 pt 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.

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

1. **A**◯ True **B**◯ False

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

2. **A**◯ True **B**◯ False

▷ If the distance between the charges is doubled, then the magnitude of the force doubles.

3. **A**◯ True **B**◯ False

10 pt A parallel plate capacitor is charged up to a potential difference of 140 V. An electron is held on the negative plate and then it is released from rest. What is the kinetic energy of the electron when it hits the positive plate?
(in eV*)*

4. **A**◯ 4.59×10^1 **B**◯ 6.66×10^1 **C**◯ 9.66×10^1
D◯ 1.40×10^2 **E**◯ 2.03×10^2 **F**◯ 2.94×10^2
G◯ 4.27×10^2 **H**◯ 6.19×10^2

12 pt

Figure 1

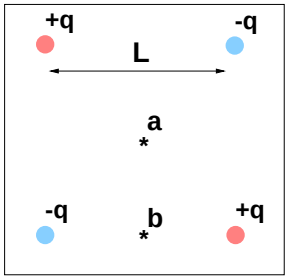
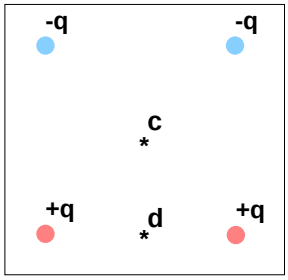


Figure 2



Consider two separate systems, each with four charges of magnitude **q** arranged in a square of length L as shown above. Points **a** and **c** are in the center of their squares while points **b** and **d** are half way between the lower two charges. Select True or False for the following statements.

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

5. **A**◯ True **B**◯ False

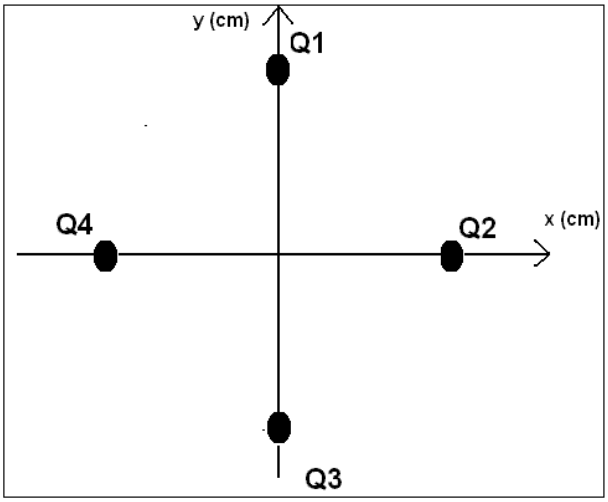
▷ The direction of the electric field at **b** is to the left.

6. **A**◯ True **B**◯ False

▷ The electric field at **a** is NOT zero.

7. **A**◯ True **B**◯ False

Consider the system of four charges in the diagram below. Each charge is 43 cm from the origin. Q1= 9.02 μC, Q2= 9.02 μC, Q3= 9.02 μC and Q4= -9.02 μC



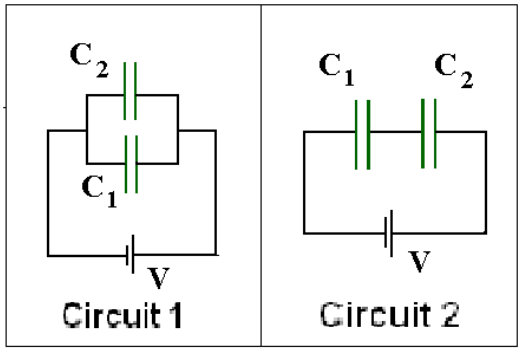
9 pt What is the electric potential at the origin in V?

8. **A**◯ 1.24×10^5 **B**◯ 1.80×10^5 **C**◯ 2.60×10^5
D◯ 3.78×10^5 **E**◯ 5.47×10^5 **F**◯ 7.94×10^5
G◯ 1.15×10^6 **H**◯ 1.67×10^6

9 pt What is the magnitude of the electric field at the origin in N/C?

9. **A**◯ 5.48×10^5 **B**◯ 6.41×10^5 **C**◯ 7.51×10^5
D◯ 8.78×10^5 **E**◯ 1.03×10^6 **F**◯ 1.20×10^6
G◯ 1.41×10^6 **H**◯ 1.65×10^6

9 pt Consider the two circuits in the diagram below. Each circuit shows two capacitors and a battery. C_1 and C_2 are capacitances and V is a voltage.



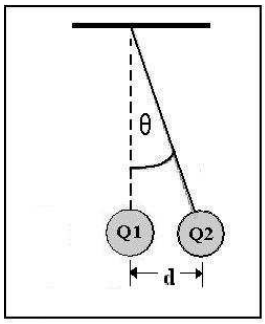
For each statement below, select True or False.

▷ C_2 is greater than the equivalent capacitance of circuit 2.
10. **A**◯ True **B**◯ False

▷ The energy stored in the capacitors in circuit 1 is greater than the energy stored in the capacitors in circuit 2.
11. **A**◯ True **B**◯ False

▷ The equivalent capacitance of circuit 2 is less than the equivalent capacitance of circuit 1
12. **A**◯ True **B**◯ False

A charge Q1 = -34.20 μC is fixed in place as shown in the diagram below. A second charge Q2 is attached to a massless string which makes an angle of 23° with respect to the vertical. Q2 is not moving (and not accelerating) and is located d = 45.50 cm directly to the right of Q1. Q2 has a mass of 9.2 kg.



10 pt What is the magnitude of the charge on Q2 (in μC)?

13.**A**◯ 2.29×10^1 **B**◯ 2.59×10^1 **C**◯ 2.93×10^1
D◯ 3.31×10^1 **E**◯ 3.74×10^1 **F**◯ 4.22×10^1
G◯ 4.77×10^1 **H**◯ 5.39×10^1

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3 pt

▷ The sign of charge Q2 is positive.
14. **A**◯ True **B**◯ False

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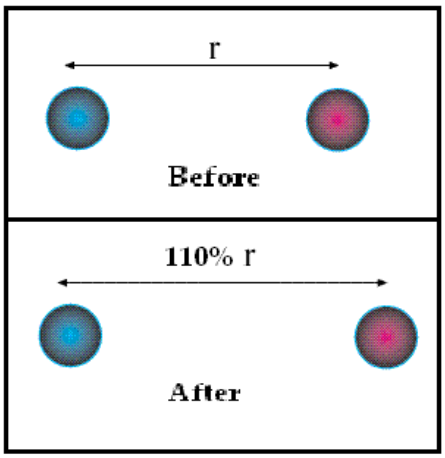
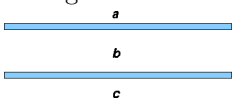
4 pt



When the distance between the centers of two charged spheres is increased by 10%, how much does the magnitude of the electric force on one of the spheres change?

15. **A**◯ The force must increase by about 5%.
B◯ The force must increase by 10%.
C◯ The force must decrease by about 5%.
D◯ The force must increase by about 20%.
E◯ You have to know the details on the charge on the spheres to answer.
F◯ The force must decrease by about 20%.
G◯ If the two spheres both have the same sign charge, the force decrease about 20%, but if they have opposite charge it increases by about 20%.
H◯ The force must decrease by 10%.
I◯ If the two spheres both have the same sign charge, the force increase about 20%, but if they have opposite charge it decrease by about 20%.

12 pt Consider two uniformly charged plates as shown in the figure below. The magnitudes of the charges are equal.



Select True or False for each of the following statements.

▷ If both plates are negatively charged, the electric field at **c** points towards the top of the page.

16. **A**◯ True **B**◯ False

▷ If both plates are oppositely charged, there is no electric field at **b**.

17. **A**◯ True **B**◯ False

▷ If both plates are oppositely charged, there is no electric field at **a**.

18. **A**◯ True **B**◯ False

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10 pt A parallel plate capacitor has an area of 627 cm^2, the plates are separated by 0.15 mm and the region between the plates is filled with a material having a dielectric constant of 165. A battery is used to charge the capatior to 228 volts. How much energy (in J) is stored in the capacitor?

19.**A**◯ 6.74×10^{-3} **B**◯ 8.97×10^{-3} **C**◯ 1.19×10^{-2}
D◯ 1.59×10^{-2} **E**◯ 2.11×10^{-2} **F**◯ 2.81×10^{-2}
G◯ 3.73×10^{-2} **H**◯ 4.96×10^{-2}