Name:

Your code is: AABADC

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 = 3.00×10^8 m/s
- e = 1.60×10^{-19} C
- $m_e = 9.11 \times 10^{-31}$ kg
- $m_e c^2 = 0.511$ MeV
- h = 6.63×10^{-34} Js
- h = 4.14×10^{-15} eVs
- hc = 1240 eVnm
- $\sigma = 5.67 \times 10^{-8}$ W/(m^{2}K^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

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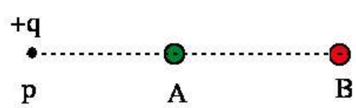
9 pt An ion has 99 neutrons, 81 protons and 78 electrons. What is the net charge in Coulombs on the ion?

1.A◯ 2.7×10^{-19} **B**◯ 3.6×10^{-19} **C**◯ 4.8×10^{-19}
D◯ 6.4×10^{-19} **E**◯ 8.5×10^{-19} **F**◯ 1.1×10^{-18}
G◯ 1.5×10^{-18} **H**◯ 2.0×10^{-18}



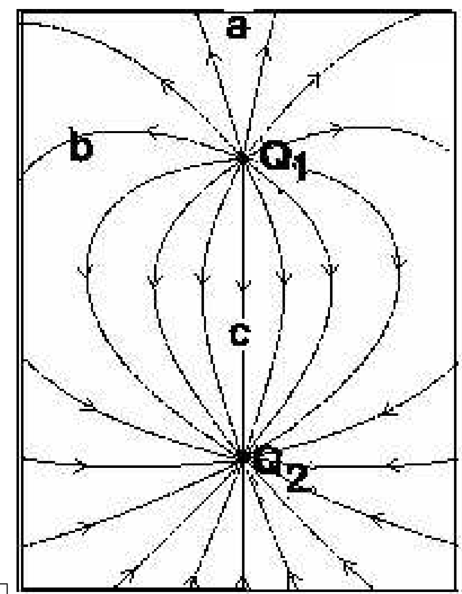
12 pt
A positive point charge +q is placed at point p to the left of two charges, A and B. The net force on +q is found to be zero. Select True or False for the following statements.

▷ A and B must both have the same sign of charge.
2. **A**◯ True **B**◯ False

▷ If the magnitude of charge A is doubled and the magnitude of charge B is doubled, the force on +q will be non-zero.
3. **A**◯ True **B**◯ False

▷ If the sign of +q is reversed to -q, the force on -q would be zero.
4. **A**◯ True **B**◯ False

▷ A must have the opposite sign of B and be greater in magnitude.
5. **A**◯ True **B**◯ False



9 pt
The figure above shows the electric field in the plane of two point charges. For each statement below, select True or False.

▷ The size of Q_1 is larger than the size of Q_2.
6. **A**◯ True **B**◯ False

▷ A + charge at **c** would accelerate toward the top of the page.
7. **A**◯ True **B**◯ False

▷ Q_1 is positive.
8. **A**◯ True **B**◯ False

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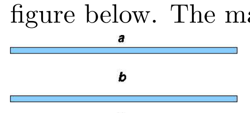
9 pt Consider two uniformly charged plates as shown in the figure below. The magnitudes of the charges are equal.

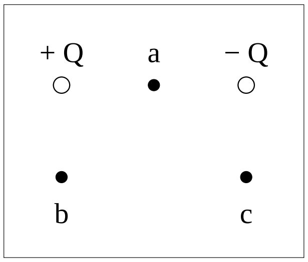


Select True or False for each of the following statements.

▷ If both plates are positively charged, the electric field at **c** points towards the top of the page.
9. **A**◯ True **B**◯ False

▷ If both plates are positively charged, there is no electric field at **a**.
10. **A**◯ True **B**◯ False

▷ If both plates are oppositely charged, there is no electric field at **b**.
11. **A**◯ True **B**◯ False



9 pt Two point charges of equal size but with opposite signs are held at a fixed distance from each other as shown in the figure. Point "**a**" is exactly halfway between the point charges. Point "**b**" and point "**c**" are under the point charges respectively. Select True or False for the following statements.

▷ The electric potential at point "**a**" is positive.
12. **A**◯ True **B**◯ False

▷ The electric potential at point "**b**" is positive.
13. **A**◯ True **B**◯ False

▷ The magnitude of the electric field at point "**a**" is zero.
14. **A**◯ True **B**◯ False

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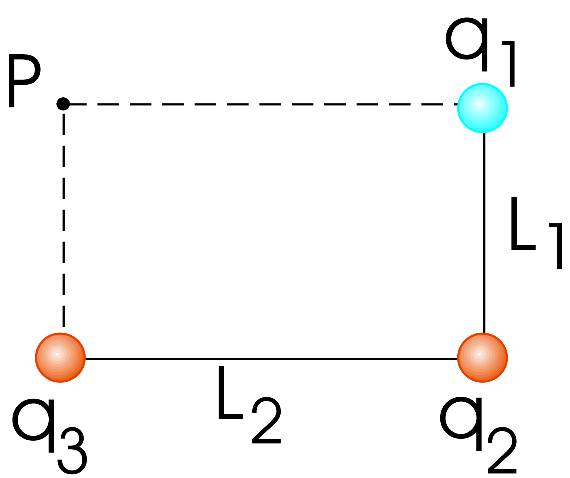
9 pt Find the potential at point P for the rectangular grouping of charges as shown in the figure.



Use the following data: q_1 = -8.61 μC, q_2 = 12.6 μC, q_3 = 8.61 μC, L_1 = 0.233 m and L_2 = 0.373 m.
(in `V`*)*

15.A◯ 2.07×10^5 **B**◯ 2.34×10^5 **C**◯ 2.65×10^5
D◯ 2.99×10^5 **E**◯ 3.38×10^5 **F**◯ 3.82×10^5
G◯ 4.32×10^5 **H**◯ 4.88×10^5

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9 pt An electron is moved from point A to point B in a uniform electric field and gains 4.52×10^{-15} J of electrostatic potential energy. Calculate the magnitude of the electrostatic potential difference between the two points.
(in `V`*)*

16.A◯ 1.96×10^4 **B**◯ 2.21×10^4 **C**◯ 2.50×10^4
D◯ 2.82×10^4 **E**◯ 3.19×10^4 **F**◯ 3.61×10^4
G◯ 4.08×10^4 **H**◯ 4.61×10^4

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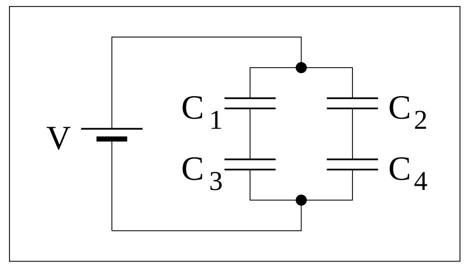
9 pt In the circuit shown in the figure the voltage of the battery is 13.0 V, and the capacitors have the following capacitances: C_1 = 1.51 mF, C_2 = 2.29 mF, C_3 = 3.04 mF, C_4 = 5.02 mF.



What is the equivalent capacitance of the four capacitors?
(in `mF`*)*

17.A◯ 1.06 **B**◯ 1.32 **C**◯ 1.65 **D**◯ 2.07
E◯ 2.58 **F**◯ 3.23 **G**◯ 4.03 **H**◯ 5.04

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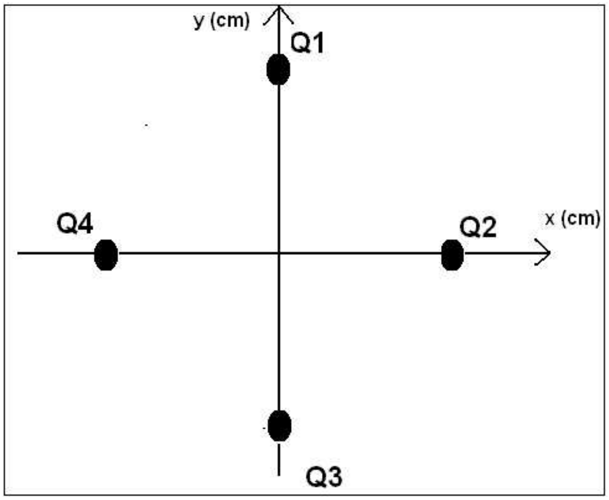
9 pt A capacitor consisting of two parallel plates, separated by a distance d is initially charged to a voltage of 3.4 V. The battery is then disconnected from the capacitor. For each statement below, select True or False.

▷ If the battery is disconnected, and then the distance d between the plates is decreased, the voltage across the capacitor will decrease.
18. **A**◯ True **B**◯ False

▷ Increasing the distance d after disconnecting the battery will decrease the electrical energy stored in the capacitor.
19. **A**◯ True **B**◯ False

▷ If the battery is disconnected, and then the distance d between the plates is decreased, the amount of charge stored on either plate of the capacitor will change.
20. **A**◯ True **B**◯ False

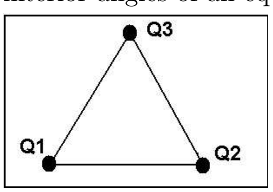
$\boxed{8\ pt}$ Consider the system of four charges in the diagram below. Each charge is 11 cm from the origin.



If Q1= 4.2 μC, Q2= 6.9 μC, Q3= 4.2 μC and Q4= -4.2 μC what is the magnitude of the electric field at the origin in N/C?

21.A◯ 1.29×10^6 **B**◯ 1.87×10^6 **C**◯ 2.71×10^6
D◯ 3.93×10^6 **E**◯ 5.69×10^6 **F**◯ 8.26×10^6
G◯ 1.20×10^7 **H**◯ 1.74×10^7

$\boxed{8\ pt}$ The figure shows three charges Q1, Q2 and Q3 fixed in place at the corners of an equilateral triangle. The length of each side of the triangle is 19.0 cm. Recall that all of the interior angles of an equilateral triangle are 60 °.



For Q1 = 22.30 μC, Q2 = -22.30 μC, and Q3 = 4.80 μC find the net electrostatic force acting on charge Q3.
(in `N`*)*

22.A◯ 1.67×10^1 **B**◯ 1.95×10^1 **C**◯ 2.28×10^1
D◯ 2.67×10^1 **E**◯ 3.12×10^1 **F**◯ 3.65×10^1
G◯ 4.27×10^1 **H**◯ 5.00×10^1
