Linnemann,

James T

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

Fill out the bubble sheet: last name, first initial, student number, section number. Leave the code area empty.

One hour long closed book exam.

One 8.5 by 11 handwritten help sheet is allowed.

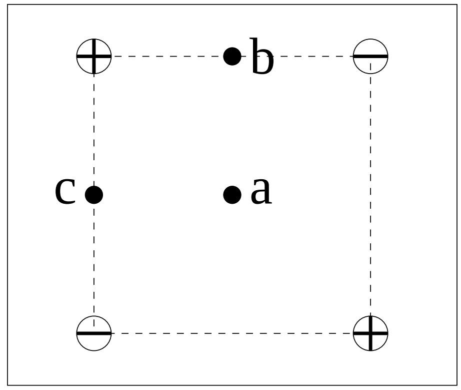
When done, hand in your **bubble sheet**, and your **exam**.

Thank you and good luck!

Posssibly useful constants:

- $k_e = 8.99 \times 10^9$ Nm^2/C^2
- $\epsilon_0 = 8.85 \times 10^{-12}$ C^2/Nm^2
- $e = 1.60 \times 10^{-19}$ C

Four point charges equal in magnitude are arranged at the corners of a square as shown in the figure.



8 pt What is the direction of the electric field at point **a**?

1. **A**◯ To the right.
B◯ Down (to the bottom of the page).
C◯ To the left.
D◯ Up (to the top of the page).
E◯ The electric field is zero at this point.

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8 pt What is the direction of the electric field at point **b**?

2. **A**◯ The electric field is zero at this point.
B◯ Down (to the bottom of the page).
C◯ To the right.
D◯ Up (to the top of the page).
E◯ To the left.

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8 pt Select the only true statement about the electric potential at points **a**, **b** and **c**.

3. **A**◯ The electric potential equals zero at points **a** and **c** but not at **b**.
B◯ The electric potential equals zero at points **a** and **b** but not at **c**.
C◯ The electric potential equals zero at none of these points.
D◯ The electric potential equals zero at points **a**, **b** and **c**.
E◯ The electric potential equals zero at point **a** but not at **b** or **c**.

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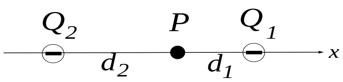
6 pt The figure shows two point charges. Calculate the magnitude of the electric field at point P. Use the following data: Q_1= - 1.80 μC, Q_2= - 1.50 μC, d_1= 1.50 m, d_2= 1.70 m.



(in `N/C`*)*

4.A◯ 8.29×10^2 **B**◯ 1.20×10^3 **C**◯ 1.74×10^3
D◯ 2.53×10^3 **E**◯ 3.66×10^3 **F**◯ 5.31×10^3
G◯ 7.70×10^3 **H**◯ 1.12×10^4

6 pt Calculate the size of the force on a charge Q = +1.60 μC placed at P due to the two charges from the previous problem.
(in `N`*)*

5.A◯ 1.92×10^{-3} **B**◯ 2.79×10^{-3} **C**◯ 4.04×10^{-3}
D◯ 5.86×10^{-3} **E**◯ 8.50×10^{-3} **F**◯ 1.23×10^{-2}
G◯ 1.79×10^{-2} **H**◯ 2.59×10^{-2}

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6 pt A uniform electric field of magnitude 249 V/m is directed in the positive x direction. A -11.4 μC charge moves from the origin to the point (x, y) = (16.8cm, 45.6 cm). What was the change in the potential energy of this charge?
(in `J`*)*

6.A◯ 2.18×10^{-4} **B**◯ 2.54×10^{-4} **C**◯ 2.98×10^{-4}
D◯ 3.48×10^{-4} **E**◯ 4.08×10^{-4} **F**◯ 4.77×10^{-4}
G◯ 5.58×10^{-4} **H**◯ 6.53×10^{-4}

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6 pt To recharge a 15.0 V battery, a battery charger must move 4.13×10^5 C of charge from the negative terminal to the positive terminal. How much work is done by the battery charger?
(in `J`*)*

7.A◯ 4.658×10^6 **B**◯ 6.195×10^6
C◯ 8.239×10^6 **D**◯ 1.096×10^7
E◯ 1.457×10^7 **F**◯ 1.938×10^7
G◯ 2.578×10^7 **H**◯ 3.429×10^7

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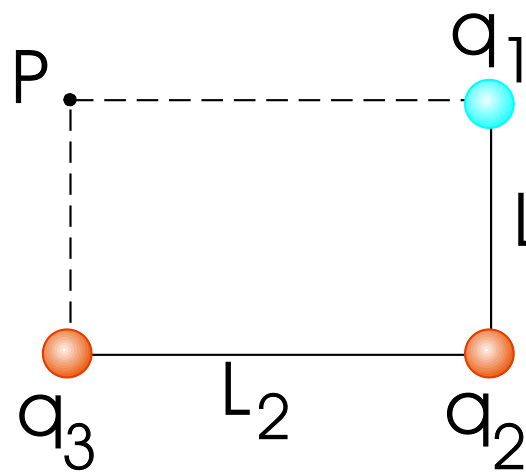
6 pt Find the potential at point P for the rectangular grouping of charges as shown in the figure.



Use the following data: q_1 = -7.36 μC, q_2 = 13.8 μC, q_3 = 7.36 μC, L_1 = 0.192 m and L_2 = 0.359 m.
(in `V`*)*

8.A◯ 8.40×10^4 **B**◯ 1.12×10^5 **C**◯ 1.49×10^5
D◯ 1.98×10^5 **E**◯ 2.63×10^5 **F**◯ 3.50×10^5
G◯ 4.65×10^5 **H**◯ 6.19×10^5

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6 pt A parallel-plate capacitor has an area of 4.07 cm^2, and the plates are separated by 1.21 mm with air between them. It stores a charge of 497 pC. What is the potential difference across the plates of the capacitor?
(in `V`*)*

9.A◯ 7.10×10^1 **B**◯ 9.44×10^1 **C**◯ 1.26×10^2
D◯ 1.67×10^2 **E**◯ 2.22×10^2 **F**◯ 2.95×10^2
G◯ 3.93×10^2 **H**◯ 5.22×10^2

6 pt

What is the magnitude of the uniform electric field in the region between the plates?
(in `V/m`*)*

10.A◯ 3.32×10^4 **B**◯ 4.41×10^4 **C**◯ 5.86×10^4
D◯ 7.80×10^4 **E**◯ 1.04×10^5 **F**◯ 1.38×10^5
G◯ 1.84×10^5 **H**◯ 2.44×10^5

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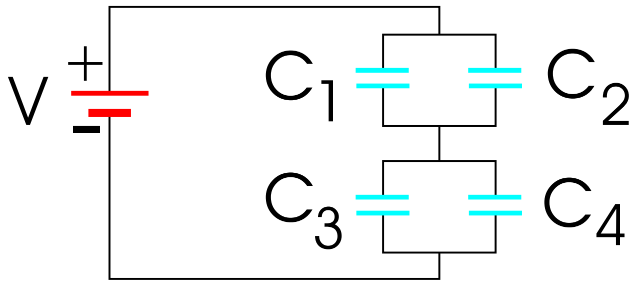
6 pt In the circuit shown in the figure the potential difference across the battery is 15.0 V, and the capacitors have the following capacitances: C_1 = 2.61 mF, C_2 = 5.51 mF, C_3 = 7.25 mF, C_4 = 3.16 mF.



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

11.A◯ 4.56 **B**◯ 5.70 **C**◯ 7.13
D◯ 8.91 **E**◯ 1.11×10^{1} **F**◯ 1.39×10^{1}
G◯ 1.74×10^{1} **H**◯ 2.18×10^{1}

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6 pt An electron accelerates across the plates of a capacitor in 1.36 μs. The plates are separated by 1.54 mm. What current does the motion of this electron represent?
(in A*)*

12.A◯ 2.13×10^{-14} **B**◯ 2.83×10^{-14}
C◯ 3.76×10^{-14} **D**◯ 5.00×10^{-14}
E◯ 6.65×10^{-14} **F**◯ 8.85×10^{-14}
G◯ 1.18×10^{-13} **H**◯ 1.56×10^{-13}

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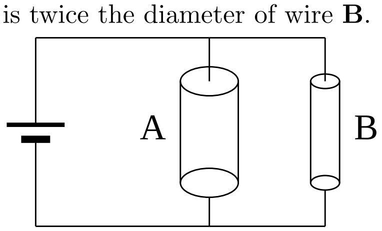
6 pt The electric motor of a Prius produces 34.1 kW of power. This power is supplied by a 580 V battery. What current is flowing in the electrical system?
(in A*)*

13.A◯ 2.68×10^{1} **B**◯ 3.14×10^{1} **C**◯ 3.67×10^{1}
D◯ 4.29×10^{1} **E**◯ 5.03×10^{1} **F**◯ 5.88×10^{1}
G◯ 6.88×10^{1} **H**◯ 8.05×10^{1}

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**.



8 pt Choose the correct answer.

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

8 pt Choose the correct answer.

15. A◯ The voltage drop across wire B is half as large as the voltage drop across wire A.
B◯ The voltage drop across wire B is one quarter 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 equal to the voltage drop across wire A.
E◯ The voltage drop across wire B is twice as large as the voltage drop across wire A.