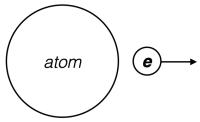
PHYS 2140 Name:_____

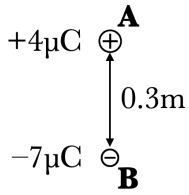
September 24, 2025 **Exam 1B** 11 questions, 70 points

[2] 1. _____ If a neutral atom loses an electron, it becomes
A) negatively charged **B)** positively charged



2. Consider a charge $q_A = +4\times10^{-6}$ C which is 0.3 m above a charge $q_B = -7\times10^{-6}$ C.

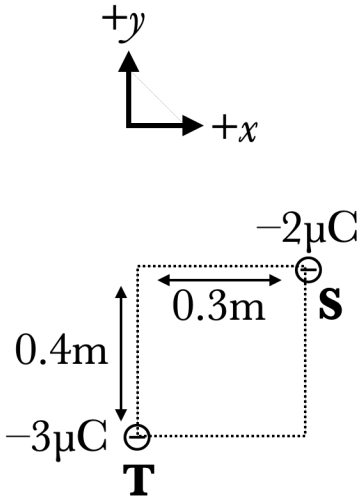
[2] (a) _____ Which charge feels the greater force?
A) charge A **B)** charge B
C) both feel the same force



[2] (b) _____ In what direction does charge B feel a force?
A) upward **B)** downward

[4] (c) What is the magnitude $|\vec{F}|$ of the force that charge B feels?

3. Consider a charge $q_S = -2 \times 10^{-6}\,\text{C}$ on the upper-right corner of a 0.3 m by 0.4 m rectangle. A $q_T = -3 \times 10^{-6}\,\text{C}$ charge is on the lower-left corner of the rectangle, as shown. We want to find the force on the charge q_T.



[4] (a) _____ Which of these is $\vec{d}$, the vector from the source to the target?

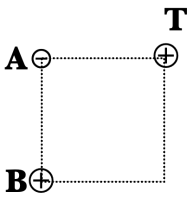
A) $0.3\hat{x} + 0.4\hat{y}$ **B)** $-0.3\hat{x} + 0.4\hat{y}$
C) $0.3\hat{x} - 0.4\hat{y}$ **D)** $-0.3\hat{x} - 0.4\hat{y}$

[4] (b) _____ What's the magnitude $|\vec{F}|$ of the force on T?

A) 0.11 N **B)** 0.22 N **C)** 0.43 N **D)** 0.64 N

[4] 4. _____ Consider three charges on a rectangle as shown. If the force on charge T from charge A is $\vec{F}_A = -5\hat{x}$, and the force on T from B is $\vec{F}_B = 3\hat{x} + 4\hat{y}$, what is the magnitude of the net force on T: $|F_T|$. (Hint: don't overthink this!)

A) 0 N **B)** 2 N **C)** 4.5 N **D)** 8.9 N **E)** 10 N



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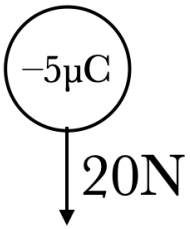
5. _____ A $-5\,\mu$C charge feels a force of 20 N downward in an electric field. What is the electric field it experiences?

A) 2.5×10^{-7} N/C $\uparrow$ **B)** 1×10^{-4} N/C $\uparrow$ **C)** 4×10^{6} N/C $\uparrow$
D) 2.5×10^{-7} N/C $\downarrow$ **E)** 1×10^{-4} N/C $\downarrow$ **F)** 4×10^{6} N/C $\downarrow$



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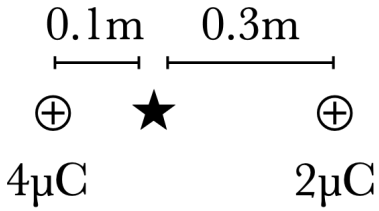
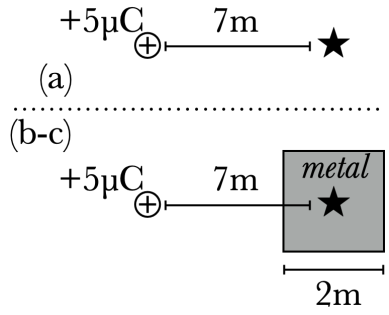
6. What is the electric field at the star between these two charges? Give your answer with at least two significant digits.

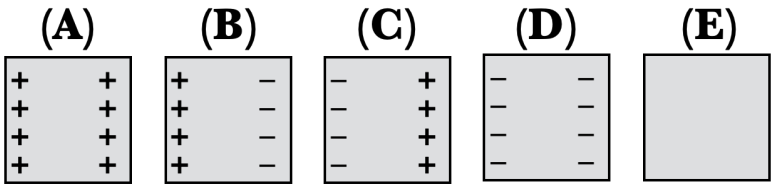


7. Consider a $+5\,\mu$C source charge.

4 (a) What is the electric field at the star, 7 meters away? Include magnitude AND direction (i.e. left, right, etc)



2 (b) _____ Now suppose a neutral metal cube with a side of 2 meters is centered on the star. How does charge distribute itself on the surface of the cube?



2 (c) _____ Compared to your answer in part (a), the electric field at the star inside the cube

A) is stronger **B)** is the same
C) is weaker but not zero **D)** is zero

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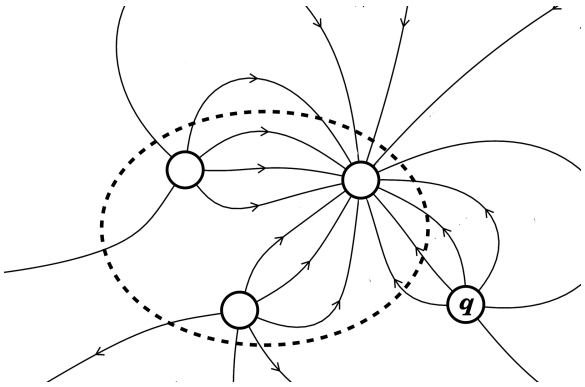
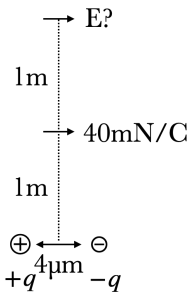
8. _____ The figure shows some field lines created by the charges shown. A Gaussian (i.e. imaginary) surface is drawn on the figure. If the charge q in the figure is equal to $+6\,\mu$C, then the total charge inside the Gaussian surface is

A) $+3\,\mu$C **B)** $+6\,\mu$C **C)** $+18\,\mu$C
D) $-3\,\mu$C **E)** $-6\,\mu$C **F)** $-18\,\mu$C



9. Consider two charges, $+q$ and $-q$, which are 4 microns apart. The electric field a distance 1 meter above the center of these charges is 40 mN/C. (Yes, a meter is much larger than a micron.)



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(a) _____ What is the electric field 2 meters above the center of these charges?

A) 80 mN/C **B)** 40 mN/C **C)** 20 mN/C **D)** 10 mN/C **E)** 5 mN/C

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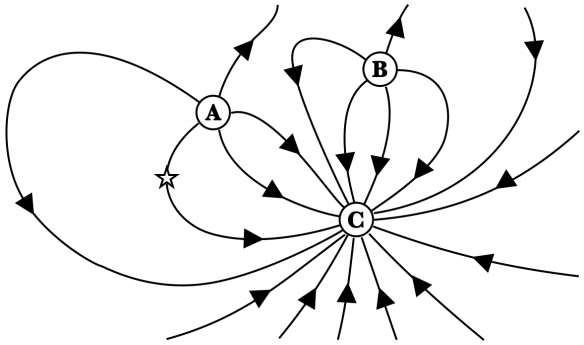
(b) What is the name of this charge configuration?

10. Consider the field lines created by these three charges: A, B, and C.



4 (a) _____ Which charge or charges are positive?

A) A **B)** B **C)** C
D) A&B **E)** A&C **F)** B&C
G) All of them **H)** None of them

4 (b) _____ Which charge has the largest magnitude $|q|$?

A) A **B)** B **C)** C

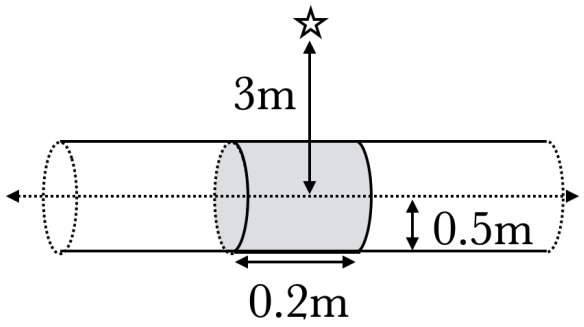
4 (c) _____ In which direction does the electric field at the star point?

A) $\uparrow$ **B)** $\nearrow$ **C)** $\rightarrow$ **D)** $\searrow$ **E)** $\downarrow$

4 (d) _____ The total charge of these three charges is

A) negative **B)** zero **C)** positive

11. This figure shows an infinite cylindrical shell with a charge density of $4\,\mu\text{C/m}^2$ and a radius of $R = 0.5\,\text{m}$.



2 (a) _____ What symbol should we use to represent this charge density?

A) λ **B)** σ **C)** ρ

4 (b) _____ What is the total charge of a section of the cylinder that is 0.2 m wide with a surface area of $0.628\,\text{m}^2$?

A) $0.16\,\mu\text{C}$ **B)** $0.64\,\mu\text{C}$ **C)** $2.51\,\mu\text{C}$ **D)** $6.4\,\mu\text{C}$

3 XC (c) What is the electric field at the star, a distance of 3 m from the axis of the cylinder? Include magnitude AND direction.