Name:_____

Physics 2140

Sample Exam 1

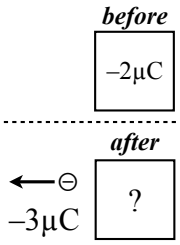
2025

- Turn off your cellphone.
- Do not cheat, and avoid the appearance of impropriety.
- Materials permitted: one sheet of notes and a calculator.
- This test contains 11 questions and 54 points.
- Ask questions when confused! Remain seated and raise your hand.
- Partial credit is available **everywhere.**
- Show your work!
- Watch the blackboard for any corrections or clarifications.
- Remember units!
- Vectors should be given in component form: $2\hat{x} - 3\hat{y}$, $2\hat{i} - 3\hat{j}$, $\langle 2, -3 \rangle$, etc.
- Use the blank (_____) for your answer when there is one.
- Circle your answer when there isn't a blank.
- Geometric formulae, fundamental constants, and metric prefixes are free for the asking.
- When done, do not stand right outside the door talking about the exam. Please proceed to MH1005 for the lecture during the second hour.
- I will post a notice on the website when the grades are available.

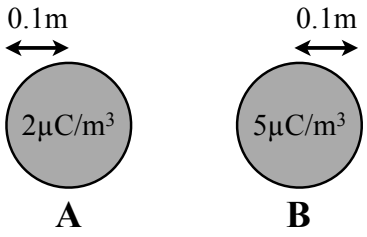
Good luck!

3 1. _____ Consider a box with a net charge of $-2\,\mu$C. If $-3\,\mu$C is removed from the box, the box's net charge becomes

A) $-5\,\mu$C **B)** $-1\,\mu$C **C)** $+1\,\mu$C **D)** $+5\,\mu$C



2. Two positively charged solid spheres, each with 10 cm radius, sit side by side. Sphere A has a charge density of $\rho = 2\,\mu\text{C/m}^3$; sphere B has a charge density of $\rho = 5\,\mu\text{C/m}^3$.



3 (a) _____ What force does sphere A feel, due to sphere B?

A) Force to the left ← **B)** Force to the right →

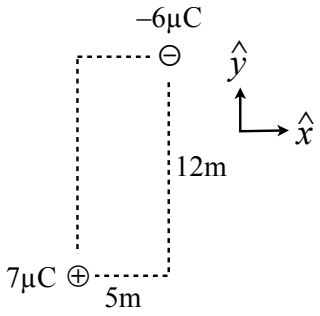
3 (b) _____ Which sphere feels a greater force?

A) Sphere A **B)** Sphere B **C)** Both feel the same force

3 (c) Find the total charge Q on sphere A.

The surface area of a sphere is $4\pi R^2$ and the volume of a sphere is $\frac{4}{3}\pi R^3$.

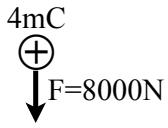
3. In the figure shown, find the force on the $+7\,\mu$C charge, in component form (i.e. something like $2\hat{x} + 3\hat{y}$). For partial credit, draw $\vec{d}$.



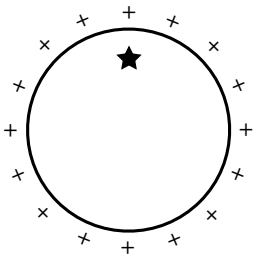
4. A $+4 \times 10^{-3}$ C charge feels an electric *force* of 8000 N downward.

(a) _____ The electric field at the charge's location points
A) upward **B)** downward

(b) Find the magnitude $\left|\vec{E}\right|$ of the electric field at the charge's location.



5. Consider a target inside a spherical shell with a uniform positive surface charge density.



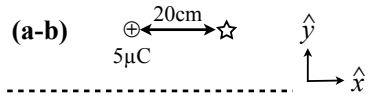
(a) _____ The electric field at the star
A) points up **B)** is zero **C)** points down

(b) _____ If I place a negative charge at the star, it feels
A) an upward force **B)** a downward force **C)** no force

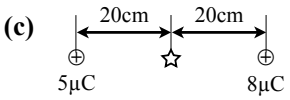
6. Consider a target 0.2 m to the right of a 5×10^{-6} C charge.

2 (a) _____ What is the direction of $\vec{E}$ at the star?
A) $\leftarrow$ **B)** $\rightarrow$

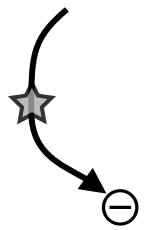
3 (b) Find the electric field $\vec{E}$ (in component form) at the star.



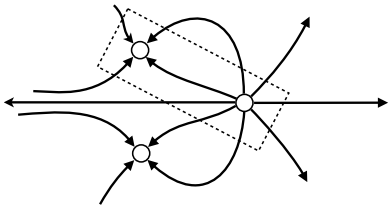
3 (c) Now add an 8×10^{-6} C charge 0.2 m to the right of the star. What is the electric field at the star now?



3 7. _____ The figure shows a negative charge, and an electric field line going into that charge. The electric field at the star points in what direction?
A) $\uparrow$ **B)** $\searrow$ **C)** $\downarrow$ **D)** $\nwarrow$



8. The figure shows the electric field lines of three source charges.

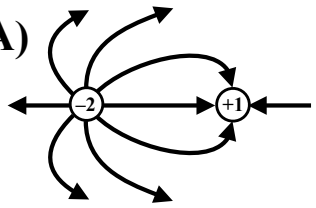


2 (a) _____ The net flux through the dotted rectangle is
A) positive **B)** zero **C)** negative

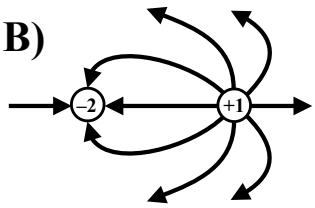
2 (b) _____ The net charge of all three charges is
A) positive **B)** zero **C)** negative

3 9. _____ Consider two charges: a $-2\,\mu$C charge on the left, and $+1\,\mu$C charge on the right. Which of the following shows the correct electric field lines of these two charges?

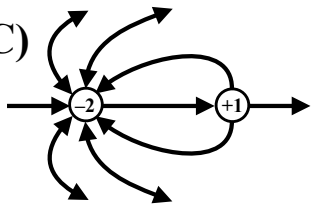
A)



B)

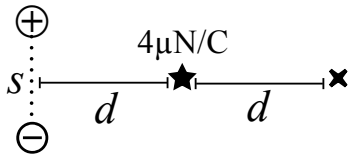


C)



D) None of these.

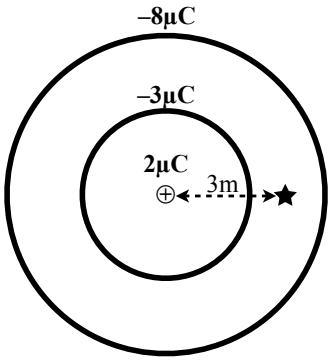
10. The figure shows a dipole, where the two charges are a distance s apart. The electric field d to the right of the dipole is $4\,\mu$N/C. Assume that d is much larger than s.



3 (a) _____ The direction of the electric field at the star points
A) ↑ **B)** → **C)** ↓ **D)** ←

3 (b) _____ What is the magnitude of the electric field $2d$ from the dipole (at the X)?
A) $4\,\mu$N/C **B)** $2\,\mu$N/C **C)** $1\,\mu$N/C **D)** $0.5\,\mu$N/C

11. Consider two concentric spherical shells. The outer shell has a radius of 4 m, and a net charge of $-8\,\mu$C spread evenly on its surface. The inner shell has a radius of 2 m and a net charge of $-3\,\mu$C spread evenly on its surface. At the center of both spheres is a $2\,\mu$C point charge. I'm interested in the electric field at the star.



2 (a) _____ The field at the star
A) points to the left **B)** is zero **C)** points to the right

2 (b) _____ The field at the star is the same as that 3 m from a point charge q, where $q =$
A) $-1\,\mu$C **B)** $2\,\mu$C **C)** $-3\,\mu$C **D)** $7\,\mu$C **E)** $-9\,\mu$C