



## Center for Academic Resources in Engineering (CARE) Peer Exam Review Session

PHYS 212 – University Physics: Electricity and Magnetism

### Mid-semester Review Worksheet

---

*The problems in this review are designed to help prepare you for your upcoming exam. Questions pertain to material covered in the course and are intended to reflect the topics likely to appear in the exam. Keep in mind that this worksheet was created by CARE tutors, and while it is thorough, it is not comprehensive. In addition to exam review sessions, CARE also hosts regularly scheduled tutoring hours.*

---

Tutors are available to answer questions, review problems, and help you feel prepared for your exam during these times:

Session 1:

Can't make it to a session? Here's our schedule by course:

<https://care.grainger.illinois.edu/tutoring/schedule-by-subject>

Solutions will be available on our website after the last review session that we host.

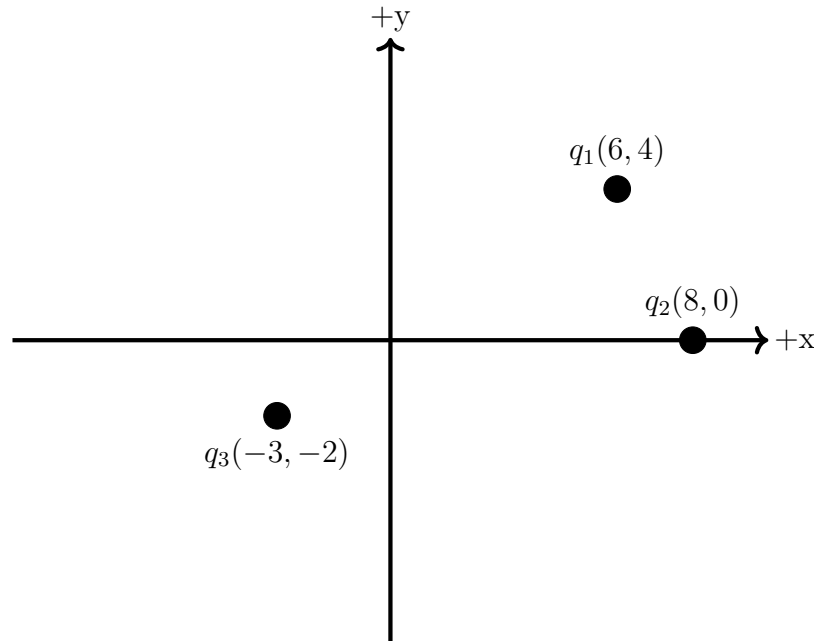
Step-by-step login for exam review session:

1. Log into Queue @ Illinois: <https://queue.illinois.edu/q/queue/848>
2. Click “New Question”
3. Add your NetID and Name
4. Press “Add to Queue”

**Please be sure to follow the above steps to add yourself to the Queue.**

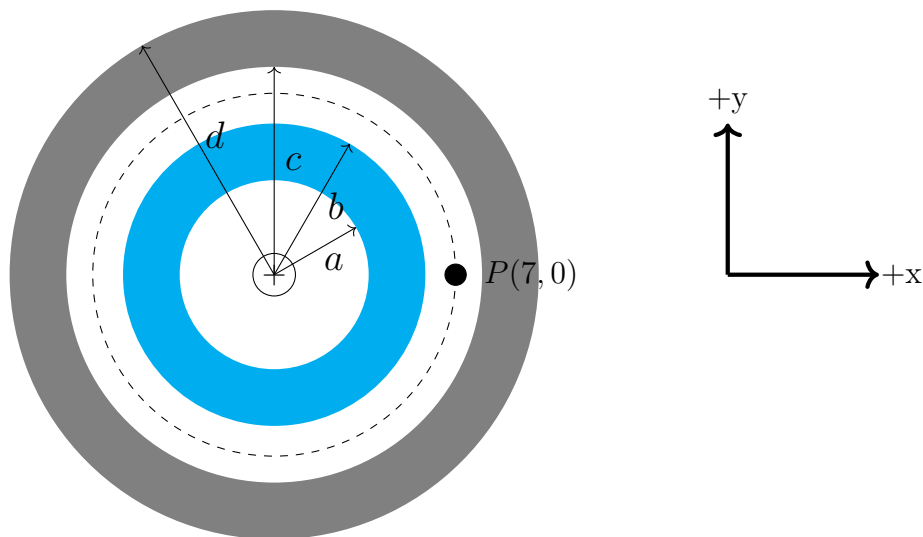
Good luck with your exam!

1. Three charges with charges  $q_1 = 10 \mu\text{C}$ ,  $q_2 = -20 \mu\text{C}$ , and  $q_3 = -30 \mu\text{C}$  exist in the x-y plane. Their positions are as shown below. The coordinate is in units of meters.



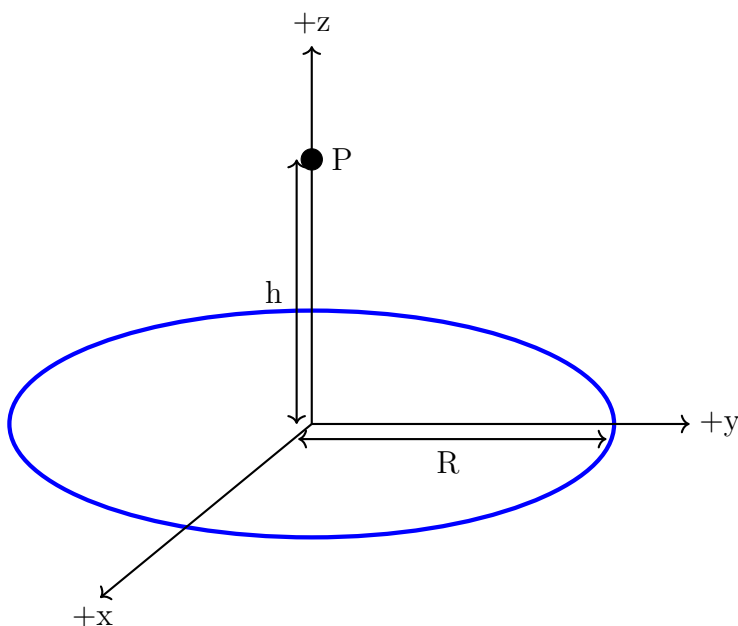
- (i) Find the electric field at the origin. Express the answer as a vector.  
 (ii) If a negative charge of  $q = -2\text{C}$  is placed at the origin, what is the force on the negative charge? Express the answer as a vector.

2. A positively charged particle with charge  $Q_0 = 5 \mu\text{C}$  is surrounded by two shells. The inner shell is made out of a conductor and the outer shell is made out of an insulator. The conductor shell is electrically neutral and has an inner radius of  $a = 3 \text{ m}$  and an outer radius of  $b = 5 \text{ m}$ . The insulator shell carries a charge  $Q_I = -10 \mu\text{C}$  spread uniformly throughout and has an inner radius of  $c = 9 \text{ m}$  and an outer radius of  $d = 13 \text{ m}$ .



- (i) Find the strength of the electric field at point P.
- (ii) Find  $Q_{inner}$ , the charge on the inner surface of the conductor shell.
- (iii) Find the location(s) on the positive x-axis where the electric field is 0. Assume the positive charge sits at the origin.

3. Consider a circular ring with radius  $R$  in the x-y plane centered at the origin carrying a charge of  $Q$  uniformly distributed in the ring. Point P lies on the z-axis and is a distance  $h$  from the x-y plane.



- (i) Write out an integral that gives the z-component of the electric field at point P. The answer should be algebraic.
- (ii) What is the electric field at point P? How is this electric field different from what you got in the first part?
- (iii) Let  $h \gg R$ , what does your answer in part (i) approximate to? Does the result resemble anything?

4. All four charges below have the same magnitude  $Q$ . The only difference is the sign for each charge. Given the charges and the Gaussian surfaces below, compare the electric flux of the three Gaussian surfaces.

