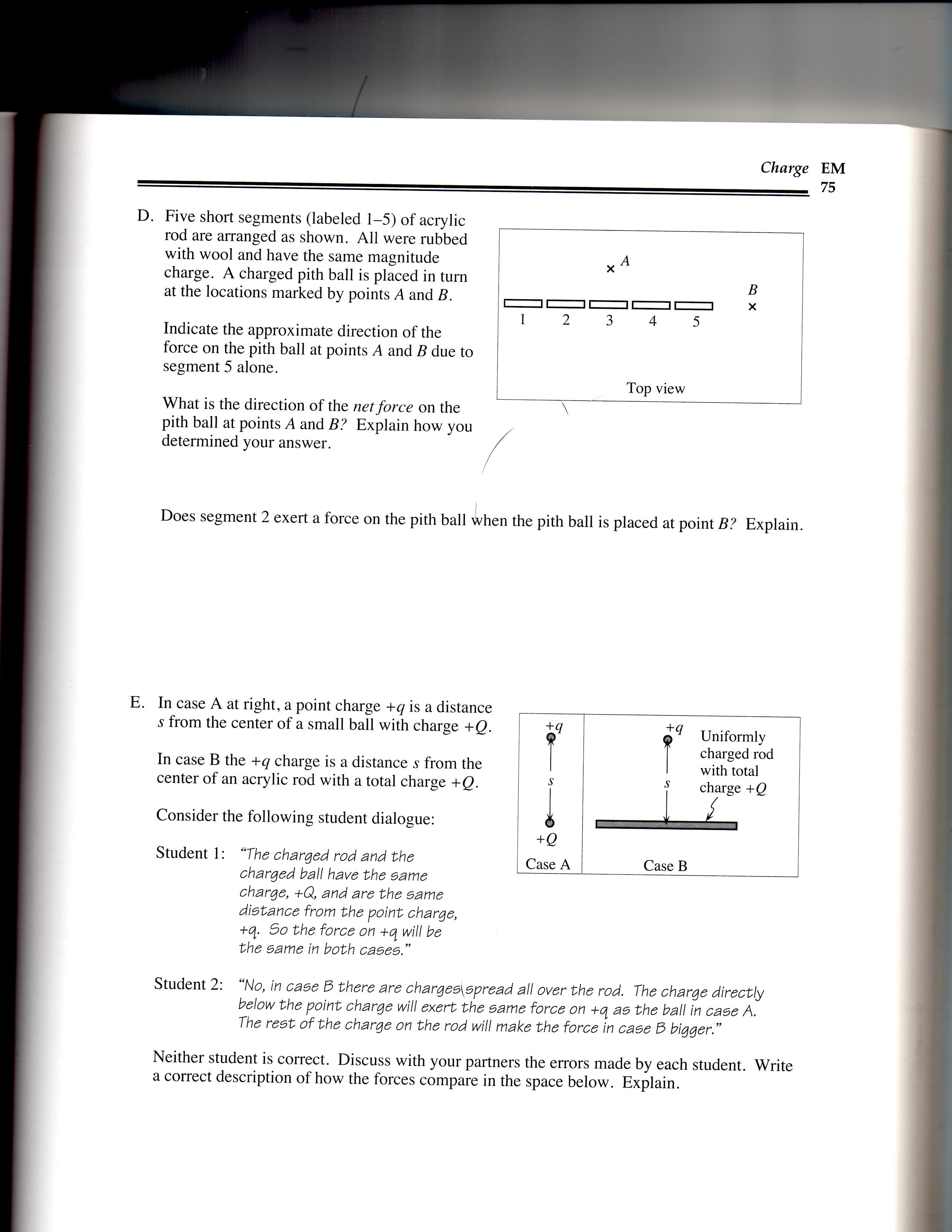
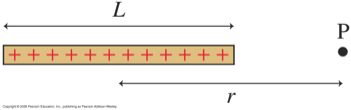
PY212 – Spring 2012

**Discussion 1 Worksheet**

Please begin working immediately with your partners on this first page of tutorials.

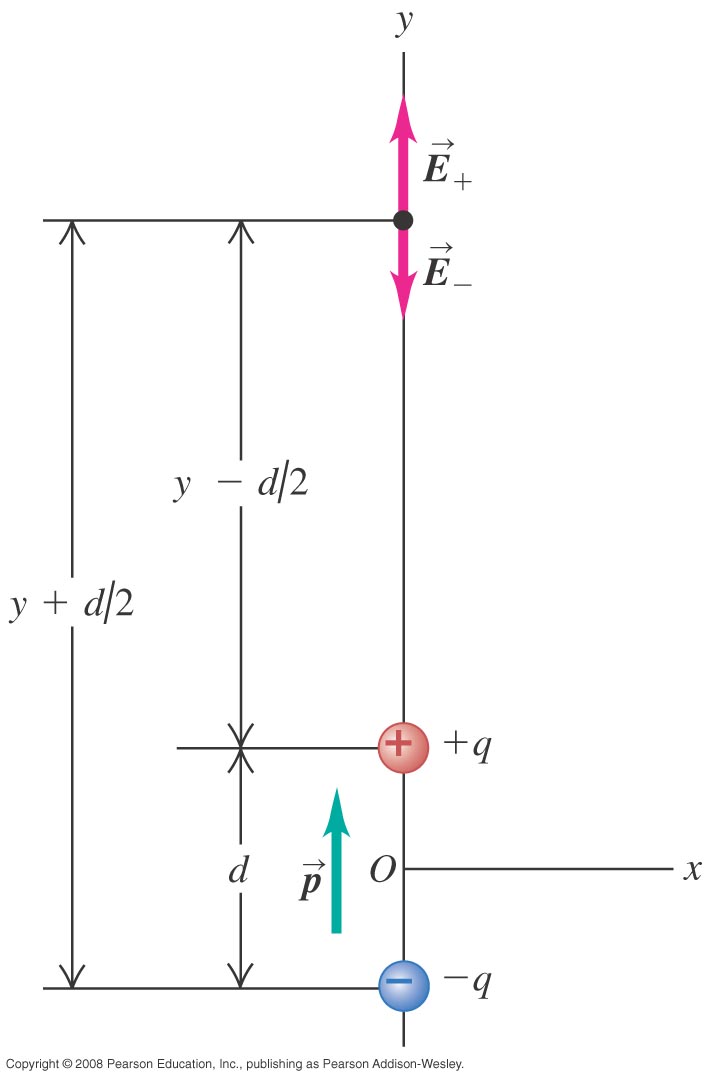
Please continue to work with your partners on the following exercises.



D

1. The figure shows a thin rod with total charge *Q* uniformly distributed along its length *L*. Find an expression for the electric field strength at point P, on the axis of the rod at distance *D* from the center.
2. Just by looking at the charge configuration, can you say which direction the net field points in? Please explain how you can tell.
3. Please discuss with your partners where you want to set the origin of your coordinate system. What factors should you consider?
4. Will you need to sum or integrate to find the electric field? Which formula is this? Please write down a formula without evaluating it (yet).
5. What is the linear charge density l? What is dq in terms of the coordinates given?
6. The electric field at point P depends on the (inverse square of the) distance from dq. How should we express this distance in terms of the coordinate system you chose above? Would this expression change if the origin of the coordinate system were different?
7. What is the variable of integration? What are the limits of integration for this variable, given your coordinate system? Would the limits of integration change if the origin of the coordinate system were different?
8. Evaluate the integral and simplify your expression. What would you expect for *r >> L*.
9. In the hw problem, the distance to point P is given by the variable r, not D as shown here. Does calling this distance D rather than r help clarify the problem? Why or why not?
10. A thin rod with total charge *Q* uniformly distributed along its length *L* is bent into a semicircle. Find an expression for the electric field at the center of the semicircle.



1. Please draw a picture of this on the right.
2. Do you see any symmetry in the problem that allows you to look at only one component of the electric field? Please explain.
3. Please discuss with your partners where you want to set the origin and what coordinate system makes sense for this problem. (Please think carefully!)
4. You will need to compute an integral to find the electric field. Are there any variables that you want to introduce in this problem to simplify your calculation? Please write down a formula for the net electric field without evaluating it (yet).
5. Write an expression for the linear charge density.
6. Write an expression for the charge element dq. On what variable does this depend?
7. What is the variable of integration? What are the limits of integration for this variable?
8. Find an expression relating the variable in part f) to the variable in part g) above.
9. Evaluate the integral and simplify your expression. What is the radius *r* of the semicircle in terms of *L*? How else can you write your answer?
10. In Example 21.14 in the textbook (shown on the right), the electric field of a dipole (a positive and negative charge separated by a distance d) is calculated at a point along its axis, i.e. along the *y*-axis. Please calculate the electric field in the plane that bisects the dipole, i.e. along the *x*-axis.
11. Please discuss with your partners what the problem is asking for. On the figure, please identify the point at which you want to calculate the field.
12. Draw the different electric field vectors at this point. What do you think the resultant vector would look like?
13. Will you need to sum or integrate to find the electric field? Which formula is this? Please write down a formula without evaluating it (yet).
14. Find the components of the field from each individual charge. Can anything cancel?
15. What is the distance from the point to each charge, in terms of the given coordinates?
16. Evaluate and simplify your expression.
17. We usually consider electric dipoles in the limit where the distance from the dipole is much bigger than the dipole separation, i.e.  for this problem. Please evaluate your expression for the electric field in this limit.

Hint: recall the binomial expansion .