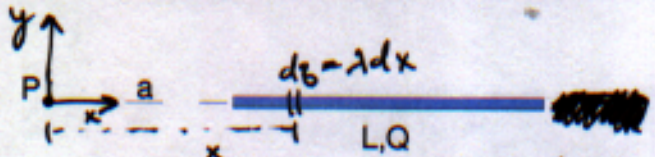
PHYS 142, EXAM 1 NAME:_____ SECTION:_____

(p)

2. (a) Calculate the electric potential at point P (which is at the origin), due to the charged rod with legth **L** and the total charge **Q**; the rod is a distance **a** from the origin (see picture). (b) If I put a charge **q** at point P, what will be its electric potential energy (with respect to the rod)? (c) What is the direction of the electric field at point P, assuming that the charge Q is negative? (d) How would you set up the calculation of its magnitude? (you don't actually have to calculate it)



labeling things: (1)

a) (2) $V = k\int_0^Q \frac{dq}{x}$ $\quad dq = \lambda \cdot dx$

add (1) $V = k\int_a^{a+L} \frac{\lambda dx}{x}$

$V = k\lambda \ln(x)\Big|_a^{a+L}$

$V = k\frac{Q}{L}\ln\left(\frac{a+L}{a}\right)$

add (1) $\boxed{V = k\frac{Q}{L}\ln\left(1+\frac{L}{a}\right)}$

b) $\boxed{U = qV}$ (1) either or

$\boxed{U = kq\frac{Q}{L}\ln\left(1+\frac{L}{a}\right)}$

c) $\boxed{\vec{E} = E_x\hat{x}}$ – in positive x-direction (toward the rod) (2)

d) either: $\boxed{E_x = \frac{-dV}{dx}}$ (2) ← either or

or: $\vec{E} = k\int_0^Q \frac{dq}{x^2} = \boxed{k\lambda\int_a^{a+L}\frac{dx}{x^2}}$ (3) (1pt extra credit)

$\varepsilon_o = 8.85\times10^{-12}\ C^2/(Nm^2)$ $\quad e = 1.6\times10^{-19}\ C$ $\quad m_e = 9.1\times10^{-31}\ kg$