## Physics 10164 - Spring 2020 Exam 1D

1) (30 pts) Three charges are fixed in place along the x-axis as shown below.
a) Find the magnitude and direction of the electric field at the location marked $x$.
b) If a $1.25-\mathrm{kg}$ mass with a charge of $-6.10 \mu \mathrm{C}$ were located at x , what would be the magnitude and direction of its acceleration?

2) ( 35 pts) A $3.50-\mathrm{kg}$ model rocket's engines provide a constant upward (+y) applied force of 122 N . The rocket is also moving through a uniform electric field of $7850 \mathrm{~N} / \mathrm{C}$ pointing in the -y direction. Assume only gravity, the applied force and the electric force are relevant in this problem. Starting from rest, the rocket moves upwards a total distance of 338 meters in 4.68 seconds, and the rocket has some charge $q$.
a) Find the value of $q$ for the rocket, and be sure to indicate clearly whether it is positive or negative.
b) How much work is done by the electric force during this motion?
3) ( 35 pts) Three charges are arranged in a line as shown below. Assume only the electric force does any work in this problem. Charges $q_{2}$ and $q_{4}$ remain fixed in place throughout this problem. Charge $q_{5}$ has a mass of 35.0 grams and is initially at rest, but it accelerates in response to the electric force acting upon it, moving 23.0 cm in the +x direction to a final location marked by $x$ in the diagram below. What is the speed of charge $q_{5}$ when it reaches that final location?

$$
\begin{aligned}
& \bigcirc \stackrel{23.0 \mathrm{~cm}}{\longrightarrow} \mathrm{O} \stackrel{23.0 \mathrm{~cm}}{\longleftrightarrow} \stackrel{23.0 \mathrm{~cm}}{\longleftrightarrow} \mathrm{x} \\
& \mathrm{q}_{4}=+4.05 \mu \mathrm{C} \quad \mathrm{q}_{2}=-2.92 \mu \mathrm{C} \quad \mathrm{q}_{5}=-5.28 \mu \mathrm{C}
\end{aligned}
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