Date: 14 April 2002

Name: Key   Id: Sect:

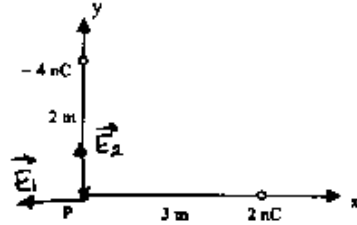Two point charges are located as shown in the figure.

(a)   What is the magnitude and direction of the net electric field at point P due to the two charges?

$$E_1 = \frac{k\,q_1}{r_1^2} = \frac{9\times10^9 \times 2\times10^{-9}}{(3)^2}$$

$$= 2 \ N/c$$

$$E_2 = \frac{k\,q_2}{r_2^2} = \frac{9\times10^9 \times 4\times10^{-9}}{(2)^2}$$

$$= 9 \ N/c$$
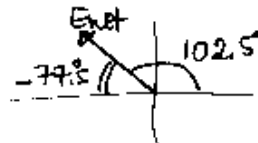
$$\vec{E}_{net} = -E_1\,\hat{\imath} + E_2\,\hat{\jmath} = -2\,\hat{\imath} + 9\,\hat{\jmath} \ \ N/c$$

$$|\vec{E}_{net}| = \sqrt{4+81} = \sqrt{85} = \boxed{9.22 \ N/c}$$

direction: $\theta = \tan^{-1}\left(\frac{9}{-2}\right) = -77.5°$ or $\theta = 102.5°$ from positive x-axis.

(b)   What is the magnitude and direction of the net electric force on a proton placed at point P.

$$|\vec{F}_{net}| = q\,|\vec{E}_{net}| = 1.6\times10^{-19} \times 9.22 = 1.5\times10^{-18} \ N$$

direction: $\vec{F}_{net}$ has same direction as $\vec{E}_{net}$

$$\theta = -77.5° \ \ or \ \ \theta = 102.5° \ from \ positive \ x\text{-axis}.$$