1.

(a) Before split $-\left(\left(\frac{4}{9}\right)*\log_2\frac{4}{9}+\left(\frac{5}{9}\right)*\log_2\frac{5}{9}\right)\cong 0.991$

(b) Split by a_1

$$\frac{4*-\left(\left(\frac{3}{4}\right)*\log_2\frac{3}{4}+\left(\frac{1}{4}\right)*\log_2\frac{1}{4}\right)+5*-\left(\left(\frac{1}{5}\right)*\log_2\frac{1}{5}+\left(\frac{4}{5}\right)*\log_2\frac{4}{5}\right)}{9}\cong 0.761$$

Information gains: $0.991-0.761=0.23$

Split by a_2

$$\frac{5*-\left(\left(\frac{2}{5}\right)*\log_2\frac{2}{5}+\left(\frac{3}{5}\right)*\log_2\frac{3}{5}\right)+4*-\left(\left(\frac{2}{4}\right)*\log_2\frac{2}{4}+\left(\frac{2}{4}\right)*\log_2\frac{2}{4}\right)}{9}\cong 0.984$$

Information gains: $0.991-0.984=0.007$

According to the entropy index, split by a_1 is better.

(c) Before split: $\left(1-\left(\frac{4}{9}\right)^2-\left(\frac{5}{9}\right)^2\right)\cong 0.494$

Split by a_1: $\frac{4}{9}*\left(1-\left(\frac{3}{4}\right)^2-\left(\frac{1}{4}\right)^2\right)+\frac{5}{9}*\left(1-\left(\frac{1}{5}\right)^2-\left(\frac{4}{5}\right)^2\right)\cong 0.3444$

Split by a_2: $\frac{5}{9}*\left(1-\left(\frac{2}{5}\right)^2-\left(\frac{3}{5}\right)^2\right)+\frac{4}{9}*\left(1-\left(\frac{2}{4}\right)^2-\left(\frac{2}{4}\right)^2\right)\cong 0.4888$

According to the Gini Index, split by a_1 is better.