2.

e)

$H_0: \mu_S - \mu_H = 0 \quad H_A: \mu_S - \mu_H \neq 0$

Test statistic is $d = \dfrac{|\hat{\mu}_S - \hat{\mu}_H - 0|}{se(\tilde{\mu}_S - \tilde{\mu}_H)} = \dfrac{|\bar{y}_S - \bar{y}_H|}{s_p\sqrt{\frac{1}{n_S} + \frac{1}{n_H}}}$, where

$\hat{\mu}_S = \bar{y}_S = \dfrac{\sum_{i=1}^{n_S} y_{Si}}{n_S}$, $\hat{\mu}_H = \bar{y}_H = \dfrac{\sum_{i=1}^{n_H} y_{Hi}}{n_H}$,

$s_p = \sqrt{\dfrac{(n_S-1)s_S^2 + (n_H-1)s_H^2}{n_S+n_H-2}}$, $s_S^2 = \dfrac{\sum_{i=1}^{n_S}(y_{Si} - \bar{y}_S)^2}{n_S-1}$,

$s_H^2 = \dfrac{\sum_{i=1}^{n_H}(y_{Hi} - \bar{y}_H)^2}{n_H-1}$.

Because $\bar{y}_S = 46.8599$, $\bar{y}_H = 43.70695$, $n_S = 20$, $n_H = 20$, we have $s_p = 9.411988$ and so $d = 1.059341$.

Its distribution is $T \sim t(n_S+n_H-2)$, which is

$T \sim t(38)$

p-value $= P(|T| \geq d) = 2 \times P(T \geq d) = 2\times[1 - P(T \leq d)]$, where $T \sim t(38)$. p-value is 0.296132.

f) Professor Stringer's cars use the same amount of gas on average. Based on part c and part d, both two intervals contain 0. This means that whether we assume the standard deviation of gas consumption of car S equals to the standard deviation of gas consumption of car H or not, both confidence intervals we get contain 0, which means that the mean value of gas consumption of car S equals to the mean value of gas consumption of car H. Also, based on part e, we have p-value is 0.296132. Because 0.296132 > 0.1, there is no evidence that against null hypothesis based on the data. Thus, Professor Stringer's cars use the same amount of gas on average.