1) $$\frac{\partial Pr[resp_i = 1]}{\partial age_i} + \frac{\partial Pr[resp_i = 0]}{\partial age_i} = \frac{\partial Pr[resp_i = 1]}{\partial age_i} + \frac{\partial(1 - Pr[resp_i = 1])}{\partial age_i}$$

$$= \frac{\partial Pr[resp_i = 1]}{\partial age_i} - \frac{\partial Pr[resp_i = 1]}{\partial age_i}$$

$\partial 1 = 0$

$$= 0$$

2) $resp_i^{new} = -resp_i + 1$

i.e. +ve response is 0 and -ve response is now 1.

$$\frac{Pr[resp_i^{new} = 1]}{Pr[resp_i^{new} = 0]} = \frac{Pr[resp_i = 0]}{Pr[resp_i = 1]}$$

$$= \frac{1}{\exp(\beta_0 + \beta_1 male_i + \beta_2 active_i + \beta_3 age_i + \beta_4 (\frac{age_i}{10})^2)}$$

$\boxed{\frac{1}{\exp(x)} = \exp(-x)}$

$$= \exp(-\beta_0 - \beta_1 male_i - \beta_2 active_i - \beta_3 age_i - \beta_4 (\frac{age_i}{10})^2)$$

Hence, the transformation implies the sign of parameters change.

3) Expand the model to allow for different age of male & female.

we can modify the model to use combination of male and age variables. i.e. we can extend by 2 more parameters.

$$\frac{Pr[resp_i = 1]}{Pr[resp_i = 0]} = \exp\left[\beta_0 + \beta_1 male_i + \beta_2 active_i + \beta_3 age_i + \beta_4 \left(\frac{age_i}{10}\right)^2 + \underbrace{\beta_5 male_i age_i + \beta_6 male_i \left(\frac{age_i}{10}\right)^2}_{\text{new parameters}} \right]$$