Question 1

1. The estimated model is

$$a.\ \pi = \frac{1}{1+e^{-(6.07-0.0177x)}}$$

2. The null deviance of the model is 34.617 and the residual deviance is 20.364. The residual deviance shows an improvement over the null model. Using the Hosmer and Lemeshow model to check goodness of fit we get a chi-square of 4.8315 and a p-value of 0.5656 indicating a good fit.
3. The beta = -0.0177 and the odds ratio = 0.9824. Using the odds ratio we can surmise that for every one unit of increase in speed the odds of hitting the target goes down by 1.75% or 100x(0.9824-1).
4. To test the quadratic term we set up the test as
    a. H0 : β2 = 0 vs H1 : β2 != 0
    b. The p-value from the addition of the quadratic is 0.989 which is much higher then any acceptable significance. We cannot reject the null hypothesis and so the addition of the quadratic did not help.

Question 2

1. The estimated model is

$$a.\ \pi = \frac{1}{1+e^{-(-7.047-0.00007382\,x1+0.9879\,x2)}}$$

2. The null deviance is 27.726 while the residual deviance is 21.082 which does indicate an improvement in performance. Using the Hosmer and Lemeshow test we get a chi-square of 4.7136 and a p-value of 0.581 indicating a good fit of the data.
3. The b1 of the model = 0.00007382 and has an odds ratio of 1.000074. So for every 1 unit of increase income the odds of buying a car really doesnt increase.
    a. The b2 of the model is 0.9879 and has an odds ratio of 2.6855. For every 1 year increase in age the odds of buying a car goes up by 168.55% or 100x(2.69-1).
4. The estimated probability of a family with an income of 45k and a car that is 5 years old purchasing a new car is 0.771% within the next 6 months
5. To set up the test for the interaction between x1 and x2 we do the following.
    a. H0 : β3 = 0 vs H1 : β3 != 0
    b. The p-value of the above test is 0.107 which is much larger than a significance level of 0.05. We cannot reject the null hypothesis. So the addition of the new variable did not improve the model meaningfully.
6. If the income were to increase by 1000 dollars the odds of buying a car would go up 7.666% as $e^{1000\,X\,0.00007382} = 1.0766$
7. The 95% confidence interval for b1 is (-0.00005106, 0.0001987) and the confidence interval is (-2.683594, 4.659366)