1. The relevant coefficient is $\beta_2$, the coefficient on $roe$. The stated hypothesis is $H_0 : \beta_2 = 0$ with alternative $H_1 : \beta_2 \neq 0$. The t-ratio is $t = \hat{\beta}_2 / se(\hat{\beta}_2) = .011/.04 = .275$. Since $t$ is asymptotically $N(0,1)$, we reject $H_0$ if $|t| > c = 1.96$. In this case, since $.275 < 1.96$, we fail to reject $H_0$. There is insufficient statistical evidence to contradict the hypothesis that return on equity has no effect on CEO salary.

2. The relevant coefficient is $\beta_1$, the coefficient on $\log(sales)$, because this is the elasticity of salary with respect to sales (its a log-log specification). The hypothesis is $H_0 : \beta_1 = 1$, with alternative $H_1 : \beta_1 \neq 1$. The t-ratio is 
\[
t = \frac{\hat{\beta}_1 - 1}{se(\hat{\beta}_1)} = \frac{.257 - 1}{.32} = -2.32.
\]

We reject $H_0$ at the 5% level if $|t| > c = 1.96$. In this case, $|2.32| > 1.96$, so we reject $H_0$ in favor of $H_1$. There is sufficient statistical evidence to conclude that the elasticity is not unity.

3. The coefficient of interest is $\beta_1$, the coefficient on $\log(sales)$. A 95% confidence interval for $\beta_1$ is 
\[
\hat{\beta}_1 \pm c \cdot se(\hat{\beta}_1) = .257 \pm 1.96 \cdot .32 = [-.37, .88]
\]
where $c = 1.96$ is the 95% two-tailed critical value from the $N(0,1)$ distribution.

4. The stated hypothesis is $H_0 : \beta_3 = \beta_4 = \beta_5 = 0$ with alternative that at least one of $\beta_3, \beta_4, \beta_5$ is non-zero.

An appropriate test statistic is the Wald statistic
\[
W = \frac{SSR_0 - SSR_1}{SSR_1/(n - k - 1)} = \frac{47.91 - 42.91}{42.91/(209 - 5 - 1)} = 23.65
\]

Note that $k = 5$ as there are five regressors in the general model.

Alternatively, you could have calculated the Wald statistic as
\[
W = \frac{R_1^2 - R_0^2}{(1 - R_1^2)/(n - k - 1)} = \frac{.357 - .282}{(1 - .357)/(209 - 5 - 1)} = 22.96
\]
(These really should give the same answer; the difference is due to rounding error.)

We reject $H_0$ if $W > c$, where $c$ is a critical value from the $\chi^2_3$ distribution. We use the $\chi^2_3$ distribution because there are three restrictions being tested. The level of the test was not specific in the question, so you are free to pick.
At the 5% level, $c = 7.81$. At the 1%, $c = 11.34$. Since $W = 23.65 > c$ in either case, we are able to reject $H_0$ in favor of $H_1$. We conclude that industry groups have a statistical effect on CEO salary, conditional on sales and return on equity.

An alternative approach is to use the $F$ statistic, where $F = W/3 = 23.65/3 = 7.03$. The 5% critical value is 2.6 and the 1% is 3.78. Since $F$ is larger than these critical values, we reach the same conclusion. In fact, this is necessarily the case as $n > 120$, so the critical values of the $F$ are just those of the $\chi^2_3$ divided by 3.

5. We use the asymptotic normality of $\hat{\beta}$ to show that the t-ratio $t = (\hat{\beta} - \beta)/se(\hat{\beta})$ is asymptotically $N(0, 1)$, and this in turn is used for two purposes: hypothesis testing and confidence intervals. The $N(0, 1)$ distribution is used to obtain the critical values for hypothesis tests, and for the critical values used to obtain confidence intervals.

6. A correct answer is

$$price = \beta_0 + \beta_1 \text{sqrft} + \delta_0 \text{urban} + \delta_1 \text{sqrft} \cdot \text{urban} + u.$$ 

In this equation, the conditional mean for urban houses is $(\beta_0 + \delta_0) + (\beta_1 + \delta_1) \text{sqrft}$, and that for rural houses is $\beta_0 + \beta_1 \text{sqrft}$. This specification allows the effect of $\text{sqrft}$ on price to be different across urban and rural houses.

An alternative equivalent answer is

$$price = \beta_0 \text{rural} + \beta_1 \text{sqrft} \cdot \text{rural} + \alpha_0 \text{urban} + \alpha_1 \text{sqrft} \cdot \text{urban} + u.$$ 

Here, the conditional mean for urban houses is $\alpha_0 + \alpha_1 \text{sqrft}$, and that for rural houses is $\beta_0 + \beta_1 \text{sqrft}$.

Note: A common answer was

$$price = \beta_0 + \beta_1 \text{sqrft} + \delta_0 \text{urban} + u.$$ 

This is an intercept shift, and does not allow the dependence on $\text{sqrft}$ to differ across rural urban houses, and is thus incorrect.

Another common answer was

$$price = \beta_0 + \beta_1 \text{sqrft} + \delta_1 \text{sqrft} \cdot \text{urban} + u.$$ 

This does allow the dependence on $\text{sqrft}$ to differ across urban and rural houses, but in an unnatural way, forcing the two regression functions to have the same intercept. This is not an desirable model.
7. We have \( g(x) = \beta_0 + \beta_1 x + \beta_2 x^2 \). Since \( g'(x) = \beta_1 + 2\beta_2 x \), then \( 0 = g'(m) = \beta_1 + 2\beta_2 m \). Hence \( m = -\beta_1 / 2\beta_2 \). The hypothesis is thus

\[
H_0 : -\frac{\beta_1}{2\beta_2} = 100
\]

or equivalently

\[
H_0 : -\beta_1 = 200\beta_2
\]

or

\[
H_0 : \beta_1 + 200\beta_2 = 0.
\]

There are two ways to test this hypothesis.

(A) t-ratio approach. Let \( \theta = \beta_1 + 200\beta_2 \) so that \( H_0 : \theta = 0 \). Writing \( \beta_1 = \theta - 200\beta_2 \) and substituting, we find

\[
Y_i = \beta_0 + (\theta - 200\beta_2) X_i + \beta_2 X_i^2 + u_i
\]

This equation can be estimated by OLS by regression of \( Y_i \) on \( X_i \) and \( (-200X_i + X_i^2) \). The test is the t-ratio \( t \) on \( \theta \), and \( H_0 \) is rejected if \( |t| > 1.96 \), the 5% critical value from the \( N(0, 1) \) distribution.

(B) Wald statistic approach. \( H_0 \) implies that \( \beta_1 = -200\beta_2 \). Substituting into the regression equation we find

\[
Y_i = \beta_0 - 200\beta_2 X_i + \beta_2 X_i^2 + u_i
\]

This equation is estimated by OLS by regressing \( Y_i \) on \( (X_i^2 - 200X_i) \), obtaining the sum of squared residuals \( SSR_0 \). The unrestricted regression is that of \( Y_i \) on \( X_i \) and \( X_i^2 \), obtaining the sum of squared residuals \( SSR_1 \). The Wald statistic is

\[
W = \frac{SSR_0 - SSR_1}{SSR_1/(n - 3)}
\]

and \( H_0 \) is rejected if \( W \) exceeds 3.84, the 5% critical value from the \( \chi^2_1 \) distribution. The \( \chi^2_1 \) distribution is used because there is one restriction being tested.

Note: These two approaches will yield the same answer, as the restriction is linear in the parameters, so \( W = t^2 \).