Biostatistics in-class exercise week 11 on multiple regression

A researcher examines the influence of several possible explanatory variables to an enzyme which is essential for the survival of cricket eggs (Grilleneier) and which can be inhibited by insecticides. The data set `cricket` contains $n = 156$ observations, each corresponding to a measurement in one egg, of the following variables:

`activity`	Activity of the enzyme in the egg
`treated`	Age of the egg (in days) at the time of the insecticide treatment
`observed`	Age of the egg (in days) at the time of the enzyme activity measurement
`insecticide`	Type of insecticide: carbaryl (0) or propoxur (1)
`dosage`	Dosage of the insecticide: low (0.6 mg), medium (0.8 mg), high (1.0 mg)

R output from a multiple linear regression fit:

```
                    Estimate Std. Error t value Pr(>|t|)
(Intercept)          -0.7151     9.6816  -0.074    0.941
treated              -8.9302     1.6275  -5.487 1.73e-07 ***
dosage0.8           -18.8747    11.5106  -1.640    0.103
dosage1.0           -13.9843    11.5106  -1.215    0.226
observed             17.8840     0.9970  17.937  < 2e-16 ***
insecticidepropoxur   1.8077     2.8506   0.634    0.527
treated:dosage0.8     2.6620     2.2279   1.195    0.234
treated:dosage1.0     1.4265     2.2279   0.640    0.523
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Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 17.8 on 148 degrees of freedom
Multiple R-squared: 0.6892,        Adjusted R-squared: 0.6745
F-statistic: 46.88 on 7 and 148 DF,  p-value: < 2.2e-16
```

i) The activity of the enzyme increases by approximately 17.9 when the age of the egg at the time of observation increases by one day (and all other predictors stay constant).
☐ True ☐ False

ii) The activity of the enzyme after the treatment with propoxur is significantly higher than after the treatment with carbaryl.
☐ True ☐ False

iii) The age of the egg at the moment of the treatment (`treated`) has become a valuable predictor for the enzyme activity only after having included the other predictors into the model.
☐ True ☐ False

iv) A significant interaction between `treated` and `dosage` would mean that the influence of the dosage of the insecticide depends on age of the eggs at the time of the treatment.
☐ True ☐ False

v) The 156 cricket eggs in the study come from 15 different *egg masses* (Gelege), i.e., were laid by 15 different cricket mothers. Why could this be a problem for the fitted linear model above?
☐ Because there could be a different number of eggs in each mass.
☐ This constitutes a multiple testing problem. The number of masses should be considered to adjust the significance levels of the fitted parameters.☐ We could have too few degrees of freedom in this case.
☐ The mass an egg comes from could have an effect on enzyme activity; this effect would be neglected in the fitted model above.