1.

Write the null and alternative hypotheses you would use to test the following situation.

1) 3% of trucks of a certain model have needed new engines after being driven between 0 and 100 miles. The manufacturer hopes that the redesign of one of the engine's components has solved this problem.

A) $H_0: p < 0.03$
$H_A: p = 0.03$

B) $H_0: p = 0.03$
$H_A: p > 0.03$

C) $H_0: p < 0.03$
$H_A: p > 0.03$

D) $H_0: p = 0.03$
$H_A: p < 0.03$

E) $H_0: p > 0.03$
$H_A: p = 0.03$

2. Mr. Wilcox purchased a trick coin that is supposed to land heads up 75% of the time. One of his students volunteer to test this claim. The student performs a test of the following hypotheses with alpha = 0.10:

$$H_0: p = 0.75$$
$$H_a: p < 0.75$$

where p = the true proportion of tosses of this coin that would land heads-up.

a. Describe a Type I error in this setting.

Rejecting the null and accepting the alternative, concluding that the coin lands heads up less than 75% of the time, but in reality the null hypothesis is true - the coin lands heads up 75% of the time.

b. Describe a Type II error in this setting.

Failing to reject the null hypothesis that the coin lands heads up 75% of the time when actually the coin lands heads up less than 75% of the time.

OR COULD SAY:
coin lands heads up less than advertised but we fail to find convincing evidence to prove it.

c. Which type of error may result in Mr. Wilcox returning the coin and writing a negative review of the product?

Type I error

(because in that case the conclusion was that coin doesn't work as advertised)

d. The company that produces the trick coin is in fact very worried about customers writing negative reviews. Would the company rather that this student use an alpha = 0.10 or an alpha = 0.05 for this hypothesis test?

Company would prefer alpha = .05

(with lower alpha, will reject null less often, so less likely to conclude that coin doesn't work)

3. It is known that in the past, 58% of the country watched the NFL on a weekly basis (NFL fan demographics: Who are football's biggest fans? | SponsorPulse). Your friend wants to see if the true proportion of people who watch the NFL has increased since Taylor Swift started dating Travis Kelce. They decide to do a hypothesis test; since they believe the true proportion who watch has increased, they plan to make their null hypothesis that the *true p is greater than .54* and the alternative hypothesis that *p is less than or equal to .54*. Your friend hopes that they will find a p-value over .05 so that they can reject the alternative hypothesis and accept the null hypothesis.

   a. **Explain to your friend what is wrong with their plan.**

1. If 58% is the known proportion, that should be used as the null
2. The null hypothesis is always $p = \_\_$, not $<$ or $>$
3. The alternative hypothesis should be what they want to show, so $p > \_\_$ in this case
4. If you find a p-value $>$ alpha, you fail to reject the null, you do not accept the null.

   b. **If you did not already do so in part a, write the correct hypotheses you would use to test if the true proportion of people who watch the NFL has increased.**

$H_0: p = .58$
$H_a: p > .58$

4. Another one of your friends heard that an individual's friends have more friends than that individual according to the Friendship paradox - Wikipedia. They have decided that they want to know the true average number of friends people have. They think it is likely fewer than 10, so they decide to make their null hypothesis $H_0: \bar{x} = 10$ and their alternative hypothesis $H_A: \bar{x} < 10$. **What is incorrect about your friend's hypotheses? What should their hypotheses be?**

When making hypotheses you are talking about the true population mean or proportion, not a sample. So they need to use μ instead of $\bar{x}$.

$H_0: \mu = 10$
$H_a: \mu < 10$

5. A third friend is a day student and is interested in the average amount of time it takes them to drive to Choate each morning. Their parents think it takes an average of 40 minutes, but the friend thinks it should take less. After timing their morning commute for a few months, the friend ends up with an $\bar{x}$ of 32 minutes. When they run the hypothesis test they get a p-value of .00056 which is way under their alpha level of .05. They then reject the null hypothesis and conclude that the true mean amount of time it takes them to drive to Choate is 32 minutes. **What is incorrect about your friend's conclusion? What is the correct conclusion?**

$H_0: \mu = 40$
$H_a: \mu < 40$

32 is the sample mean.
They can only conclude that the true mean is less than 40 minutes.

You cannot conclude that the true mean is the sample mean.

6. You do a hypothesis test and end up with a p-value of .004. You know that you should have chosen your alpha level at the beginning of the hypothesis test when you made your initial hypotheses, but you didn't. Now, usually you are forced to go with the alpha level mandated by the journal you want to publish in, or the governmental regulation associated with your field, **but if you were allowed to choose any alpha level at all, what alpha would you choose to make your results seem as impressive as possible?**

I would choose as low of an alpha value as possible while still making sure that my p-value was less than this alpha. .005 would accomplish this, or .0040000001 if I wanted to be really tricky. The lower the alpha value, the more impressive the results seem, as the lower the alpha, the more difficult it is to reject the null.