1.

a. If the student doesn't have psychic powers the probability of them getting it right will be 0.5. Hence the null hypothesis can be written as H0: p = 0.5. If the student has psychic powers, then their probability to ensure it's true should be greater than 0.5. Because if the probability of them getting it right is not greater than 0.5, then alternate hypotheses will be rejected. Thus, the alternate hypotheses in terms of p can be written as H1: p > 0.5

b. Statement i will be correct. The problem with sticking to saying that the student got 13 out of 20 right is that it's hard to interpret whereas if we look at the probability of the student getting 13 or more right, we can say that the student is within the top x% of the people who get that many right. So when a student guesses 13 out of 20, we can say that their probability is within the probability of getting 13 or more right.

c. So we know that when we want to find the p-value of say when student gets 13 out of 20 right, we can calculate it by finding the pbinom for (X≥12):

````
```{r}
p <- 1- pbinom(12,20,0.5)
p
```

 [1] 0.131588
````

But 13 out of 20 is not intriguing evidence because the p-value for it is 13.15 which is technically not solid evidence for proving that the student has psychic powers. If we want to prove something is True, then ideally we want a probability less than 0.5.

d. The p-value of when student gets 13 out of 20 right, can be calculated by finding the pbinom for (X≥18):

````
# d.
```{r}
1-pbinom(19,20,0.5)
p
```

 [1] 9.536743e-07
````

Here we can see that the p-value is approximately 0.00000095 which is very low and does make for solid evidence that the student might have psychic powers and also for rejecting the null hypothesis.

2.

a. If the students were randomly guessing then the expected number they got right should be 1/4 of the total no.of questions because the probability of getting a question with 4 options right by randomly guessing will be 0.25. So for the given question that would be 720/4 = 180.

b. Here the second option will be right:

```
> 1 - pbinom(236, 720, 0.25)
[1] 1.157004e-06
```

Because we are looking at a right tailed test. And in a right tailed 1 - pbinom (x-1, 720, 0.25) will be correct.

c. The significance probability is (**very small**/small/not small). This means a number of correct answers this high would be (not surprising/somewhat surprising/**very surprising**) if the students were just randomly guessing. The data is thus (**highly incompatible**/somewhat incompatible/compatible) with the null hypothesis. We have (**strong evidence**/some evidence/no evidence) in favor of the alternative hypothesis that students are doing better than random guessing

3.

a. This will be a left tailed test. And we already know from the slides the p-value formula for this will be:

````
```{r}
pbinom(15, 100, 1/6)
```

[1] 0.3876576
````

b. Again this will be a left tailed test because the hypothesis that we are trying to prove is p < 32/663. Hence the p-value will be:

````
```{r}
pbinom(59, 1000, 32/663)
```

[1] 0.9477338
````

c. Let's assume here that X is the no.of times that the home team has won. Now because this is a two tailed test the procedure will be the minimum of the calculated left and right values multiplied by 2:

```
# c.

# Left tailed test
```{r}
pbinom(1150, 2215, 0.5)
```

 [1] 0.9661853

# Right tailed test
```{r}
1 - pbinom(1149, 2215, 0.5)
```

 [1] 0.03713402

# The minimum value between the two is for the right tailed one.
# Two tailed value
```{r}
(1 - pbinom(1149, 2215, 0.5)) * 2
```

 [1] 0.07426804
```

d. Let's calculate the p-value first:

```
# d.

```{r}
1-pbinom(236,720,0.25)
```

 [1] 1.157004e-06
```

The probability is very low. Therefore, the null hypothesis is false which means the students are not randomly guessing.

5.

a. Our variable of interest will be the change in test score. It will approximately have a normal distribution with a mean = 6.5; standard deviation = 12; n = 61; $mu_0$ = 0
The H(0) for change in score is not positive will be : mean <= 0 and H(1) for change in

score is positive will be mean > 0. Now lets calculate t-static for the sample:

```{r}
mean <- 6.5
sd <- 12
n<- 61
mu0 <- 0
t.stat <- (mean - mu0)/(sd/sqrt(n))
t.stat
```

```
[1] 4.230552
```

Right tailed p-value for n-1 degrees of freedom is:

```{r}
1-pt(t.stat,df = n-1)
```

```
[1] 4.04772e-05
```

The p value is small enough to reject the null hypotheses, we can conclude that indeed, there is a positive increase in the score after the students listened to reggae music.

Now, let's calculate the 95% confidence interval for the population.

```{r}
mean - qt(.975,df=n-1) * sd / sqrt(n)
```

```
[1] 3.426657
```

```{r}
mean + qt(.975, df = n-1) * sd / sqrt(n)
```

```
[1] 9.573343
```

Hence we are 95% sure that the mean increase in score is between 3.426 and 9.573

b. We can infer, at least in part, that students who listened to reggae music prior to their math exam scored higher because the p-value we found was 0.00004. However, what sort of research was this? Was the experiment a randomized control one? Was a control group present? Is it possible to conclude that there is cause and effect solely based on the p value? For what p-value should we account? A 0.05 or a 0.01? Has any presumption been made? Do we still have the data set's original distribution? Therefore, based only on the available data, we can conclude that, for a 95% confidence interval, the study does demonstrate that students' score improvements at 0.00004 p-value were aided by live reggae music. However, we would need more info on how the study was conducted to be 100% sure.

6.

a. We know that we wish to test the null hypotheses that Clinton and Trump have equal support. Therefore the probability that a random person gives a higher score to either Trump or Clinton is 0.5. Hence our hypotheses are: H(0) : p = 0.5 H(1) : p!= 0.5

b. If the null hypothesis is true, then X has a Binomial(n,p) distribution, n = 1163, p = 0.5

c.

```
# c

```{r}
print(paste("The number of people that gave Clinton higher score than Trump were",sum(ANESpilot$ClintonFT > ANESpilot$TrumpFT)))
```

[1] "The number of people that gave Clinton higher score than Trump were 623"

```{r}
print(paste("The number of people that gave Trump higher score than Clinton were",sum(ANESpilot$TrumpFT > ANESpilot$ClintonFT)))
```

[1] "The number of people that gave Trump higher score than Clinton were 540"

```{r}
right_tailed <- 1-pbinom(622,1163,0.5)
right_tailed
```

[1] 0.008079136

```{r}
left_tailed <- pbinom(540,1163,0.5)
left_tailed
```

[1] 0.008079136

```{r}
pvalue <- 2 * (min(right_tailed , left_tailed))
pvalue
```

[1] 0.01615827

so the data is not consisent.
```

So the data is not consistent with the null hypotheses, which means that we can to a certain extent be sure that Clinton has higher probability of getting a higher rating than Trump.

d.

e. If we assume that a p-value of less than 0.017 is significant, the available data does appear to be sufficient to support the notion that Clinton will score higher than Trump. Is this conclusive evidence? I don't think so; there is some evidence to suggest that people as a whole might give Clinton a higher rating, but once more, we need to know how the data was gathered. Despite the fact that the sample size of 1163 may seem large, the US population as a whole is 333.294 million. Therefore, more information would increase my confidence that Clinton will be ranked higher than Trump. If we were to base our decision only on the above test, Clinton would score marginally higher than Trump.