Question 1.

(a)

Ho: mu = 15; Ha: mu < 15

T = (13.3 – 15)/(3.58/√22) = -1.7/.763 = -2.23

Reject Ho if t < -1.72 (alpha= .05 and 21 d.f.)

Decision to reject Ho, conclude mean unit price is less than $15.

1 mark for each point above.

(b)

Confidence interval is "no more than" or upper bound of 13.3 + 1.72 * .763.

UB is 14.6

1 marks for above.

0.5 mark for 2-sided CI of 13.3 +/- 2.08 * .763

Zero marks for lower bound of 13.3 – 1.72 * .763

Zero marks for any interval based on 15 or that does not contain the value 13.3.

1 mark for indicating that since the CI contains the value 15, it is consistent with (a)

(c)

Ho: median unit price = 15; Ha: median unit price < 15

Since p-value = .01 < .05, we reject Ho and conclude median is less than $15.

-1 for hypotheses using median, 0.5 for hypotheses using mean

-1 for decision and conclusion

(d)

Since there is an outlier in the boxplot suggesting non-normally distributed data, it is safer to do the nonparametric test.

-1 mark

Question 2.

a) Two-Sample T-Test and CI: A_1, B_1

```
Two-sample T for A_1 vs B_1

       N   Mean  StDev  SE Mean
A_1  100  103.6   60.9      6.1
B_1  100  120.6   85.1      8.5

Difference = mu (A_1) - mu (B_1)
Estimate for difference:  -16.9
95% CI for difference:  (-37.6, 3.7)
T-Test of difference = 0 (vs not =): T-Value = -1.62  P-Value = 0.108  DF = 179
```

-1 mark for hypotheses Ho: mu1-mu2=0; Ha: mu1-mu2 not zero
-1 mark for t-statistic (103.6-120.6)/sqrt(60.9^2/100 + 85.1^2/100) = -1.62
-1 mark for decision rule to reject H if |t| > 1.96
-1 mark for decision not to reject H and conclusion there is no difference in mean surgery times. (Non-rejection due to large variation in surgery times for different operations.)

Boxplot(s) A-1 and B-1 show(s) that this large sample(s) t-test is valid because it is reasonable to assume the population data are not extremely skewed. (With large samples, we do not need the data to be normally distributed.) (2 marks for correct answers)

(b) Paired T-Test and CI: A_2, B_2

```
Paired T for A_2 - B_2

              N    Mean  StDev  SE Mean
A_2         100  103.43  60.64     6.06
B_2         100  119.87  65.34     6.53
Difference  100  -16.44  30.23     3.02


95% CI for mean difference: (-22.44, -10.44)
T-Test of mean difference = 0 (vs not = 0): T-Value = -5.44  P-Value = 0.000
```

```
-1 mark for hypotheses Ho: mu(diff)=0; Ha: mu(diff) not zero
-1 mark for t-statistic = -16.44 / 3.02 = - 5.44
-1 mark for decision rule to reject H if |t| > 1.96
-1 mark for decision to reject H and conclusion there is a difference in mean
surgery times, if the mix of surgery times were the same.
```

Boxplot(s) Difference_2 show(s) that this large sample(s) t-test is valid because it is reasonable to assume the population (difference) data are not extremely skewed. (With a large sample, we do not need the differences to be normally distributed.) (2 marks)

(c) 2 marks:

Clearly this is more appropriately a paired t-test due to the large variations in surgical times. (Pairing the samples and taking differences allows the student to subtract out the effects of the different types of surgeries and isolate the effect of the two campuses).

Question 3.

Question a was changed from "more than 75%" to "less than 75%".
Also, "most important" was changed to "very important".

(a) `Test of p = 0.75 vs p < 0.75  (many had Ho: p1 – p2 < .75)`

```
                                  95%
                                Upper
Sample    X    N  Sample p     Bound  Z-Value  P-Value
1       280  400  0.700000  0.737688    -2.31    0.010
```

-1 for hypotheses
-1 for z-statistic = (.70 - .75)/sqrt(.75*.25/400) = -2.31
(deduct .5 for standard error sqrt(.7*.3/400)
-1 for decision rule to reject Ho if z < -1.645
-1 for decision to reject Ho and conclusion that less than 75% …

(b)
N = Z^2 *pq/(.01)^2 = 1.96^2 * .7*.3/(.01)^2 = 8067
2 marks, only 1 mark if p=q=.5 used for N = 9604, since this is used if there is no info on p and q.
Or 1 mark if p=.75, q=.25 used since we rejected that null H in (a).

(c) With two sample proportions are greater than 50% for "most important" may have been slightly contradictory depending on how the survey questions were asked, but changing "most important" to "very important" solves this problem.

Test and CI for Two Proportions

```
Sample    X    N  Sample p
1       280  400  0.700000
2       300  500  0.600000

Difference = p (1) – p (2)
Estimate for difference:  0.1
95% lower bound for difference:  0.0478553
Test for difference = 0.05 (vs > 0.05):  Z = 1.58  P-Value = 0.057
```

Ho: p1 – p2 = .05; Ha: p1-p2 > .05 or Ho: p2 – p1 = -.05; Ha: p2-p1 < -.05

CI has Lower Bound of (.7 - .6) - 1.645 *sqrt(.7*.3/400 + .6*.4/500)
or LB of 0.1 – 1.645 * 0.0317 = 0.1 - .052 = 0.048
For second set of hypotheses, CI has UB of -0.48

Since CI contains 0.050, we do not reject the null H.
Conclude they do not differ by more than 0.05.

-1 mark for hypotheses
-2 marks for appropriate 1-sided CI
only 1 mark for 2-sided CI : 0.1 +/- 1.96*.0317 or 0.1 +/- .062 or (0.038, 0.162)
-1 for observing CI does not contain 0.05 or -0.05
Same mark for observing 2-sided CI does contain 0.05
-1 for decision/conclusion.

Question 4.

```
Expected counts are printed below observed counts
Chi-Square contributions are printed below expected counts

           C1      C2      C3      C4  Total
    1     148     144      67      67    426
       170.74  132.42   69.12   53.72
        3.029   1.013   0.065   3.283
    2     351     243     135      90    819
       328.26  254.58  132.88  103.28
        1.576   0.527   0.034   1.707

Total     499     387     202     157   1245
Chi-Sq = 11.233, DF = 3, P-Value = 0.011
```

(a)

Ho: Poll and Support are independent, or The proportions supporting each candidate are equal
Ha: Poll and Support are associated or the proportions supporting each candidate are different.

Incorrect: Ho: The two polls are independent.

Chi-square statistic is 11.23

Critical value is 7.81 based on 3 d.f.
Since 11.2 > 7.81, we reject the null hypothesis at the .05 level
Conclude the two polls are different.
p-value approximately slightly greater than .01 (between .01 and .015)
(since critical value for .01 significance level is 11.34)
-1 for hypotheses
-2 for chi-square statistic (need to show some intermediate calculations)
-1 for decision rule and critical value based on 3 d.f.
-1 for decision and conclusion
-1 for approx. p-value
Total 6 marks
(b)

Ho: p(S) = pR) = .35; p(G) = p(P) = .15; Ha: one p is different

Observed #	351	243	135	90	**819**
Expected #	286.65	286.65	122.85	122.85	**819**
:Probabilities	0.35	0.35	0.15	0.15	**1**
Contribtions	14.44592	6.64686	1.201648	8.784066	**31.07849**

The chi-square statistic is 31.1. With 3 d.f., the critical value is 7.81
Therefore we reject the null H, and conclude the pundit is incorrect.

-1 mark for hypotheses
-2 for chi-square statistic (1 for intermediate calculations and 1 for final calculation)
-1 for decision rule and critical value based on 3 d.f.
-1 for decision and conclusion
Total 5 marks