Question 1.

THE 6 STEPS

Step 1: Set up H_0 and H_1.

We are conducting a one-tail test to the claim that the intrinsic group has a higher mean creativity score than the extrinsic group. Therefore, we will construct our null hypothesis to assume u_E is greater than or equal to u_I.

H_0: $u_E >= u_I$
H_A: $u_E < u_I$

Step 2: Identify alpha and the critical value.

The critical value has to be found from t-distribution calculator or lookup table, it's not part of the SAS output.

Our hypothesis test is with a significance level (alpha) of **.01**.

We are conducting a one-tail test, therefore we do not need to divide the alpha in 2 when calculation our t-score. We are only concerned about the area under the distribution curve on the left side:

DF = (23 + 24) - 2 = 45
Critical value = $t_{45}(.01)$ = **-2.412**

Step 3: Identify the test Statistic.

The test statistic is outputted by SAS. Also did manual calculation to verify.

X_E = 15.74
X_I = 19.88
N_E = 23
N_I = 24
S_E = 5.25
S_I = 4.44

X_E-X_I / sqrt((S_E^2/N_E) + (S_I^2/N_I)) = -4.14 / 1.421 = **-2.913**

Step 4: Find P-Value

The p-value is outputted by SAS. Also did manual calculation to verify.

DF = (N_E + N_I) – 2 = (23 + 24) - 2 = 45
T-score = -2.913
p-value = **0.0028**

Step 5: Reject H_0 if the P-value is less than the significance level (alpha). Fail to reject if H_0 if it is not.

Reject H_0 since 0.0028 < .01.

Step 6: Conclusion

There is strong evidence at alpha = .01 to support the claim that the intrinsic group has a higher mean creativity score than the extrinsic group.

SAS Code and Output:

```
data creativity;
input score group $;
datalines;
5 Extrinsic
5.4 Extrinsic
6.1 Extrinsic
10.9 Extrinsic
11.8 Extrinsic
12 Extrinsic
12.3 Extrinsic
14.8 Extrinsic
15 Extrinsic
16.8 Extrinsic
17.2 Extrinsic
17.2 Extrinsic
17.4 Extrinsic
17.5 Extrinsic
18.5 Extrinsic
18.7 Extrinsic
18.7 Extrinsic
19.2 Extrinsic
19.5 Extrinsic
20.7 Extrinsic
21.2 Extrinsic
22.1 Extrinsic
24 Extrinsic
12 Intrinsic
12 Intrinsic
12.9 Intrinsic
13.6 Intrinsic
16.6 Intrinsic
17.2 Intrinsic
17.5 Intrinsic
18.2 Intrinsic
19.1 Intrinsic
19.3 Intrinsic
```

```
19.8 Intrinsic
20.3 Intrinsic
20.5 Intrinsic
20.6 Intrinsic
21.3 Intrinsic
21.6 Intrinsic
22.1 Intrinsic
22.2 Intrinsic
22.6 Intrinsic
23.1 Intrinsic
24 Intrinsic
24.3 Intrinsic
26.7 Intrinsic
29.7 Intrinsic
;

proc ttest data = creativity alpha = .01 sides = lower;
   class group;
   var score;
run;
```

The SAS System

The TTEST Procedure

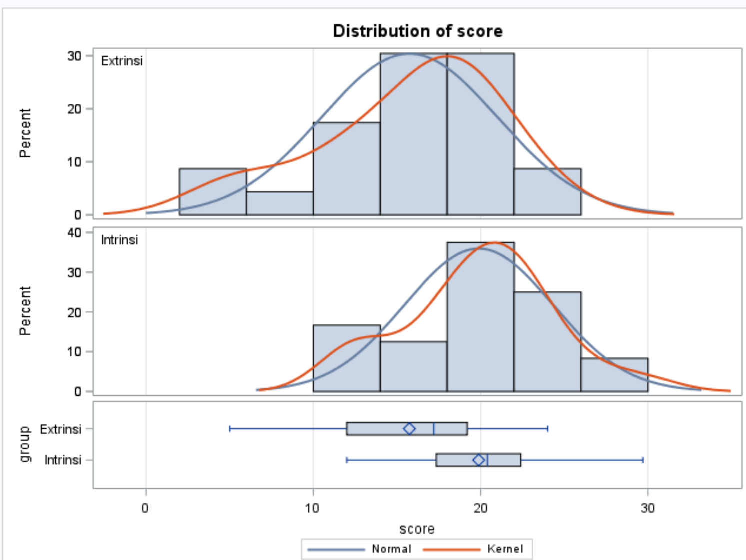
Variable: score

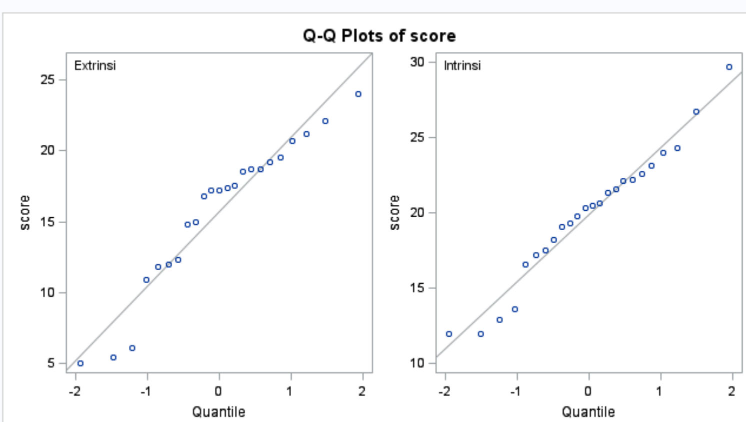
group	N	Mean	Std Dev	Std Err	Minimum	Maximum
Extrinsi	23	15.7391	5.2526	1.0952	5.0000	24.0000
Intrinsi	24	19.8833	4.4395	0.9062	12.0000	29.7000
Diff (1-2)		-4.1442	4.8541	1.4164		

group	Method	Mean	99% CL Mean		Std Dev	99% CL Std Dev	
Extrinsi		15.7391	12.6519	18.8264	5.2526	3.7660	8.3803
Intrinsi		19.8833	17.3393	22.4274	4.4395	3.2032	6.9965
Diff (1-2)	Pooled	-4.1442	-Infty	-0.7277	4.8541	3.8068	6.6041
Diff (1-2)	Satterthwaite	-4.1442	-Infty	-0.7097			

Method	Variances	DF	t Value	Pr < t
Pooled	Equal	45	-2.93	0.0027
Satterthwaite	Unequal	43.108	-2.92	0.0028

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	22	23	1.40	0.4289





We do not have to divide the p-value in half because we are performing a one-tail test. We are only interested in the area under the left tail of the distribution curve.

Question 2.

Key Statistics
Mean Difference = X_E-X_I = -4.14
Standard Error = SE(X_E-X_I) = 1.421
DF = 45
T-Score = t_{45}(.01) = -2.412

Confidence Limits
Half-width = (-2.412)(1.421) = **-**3.427
Upper 99% confidence limit = -4.14 + 3.427 = -0.713

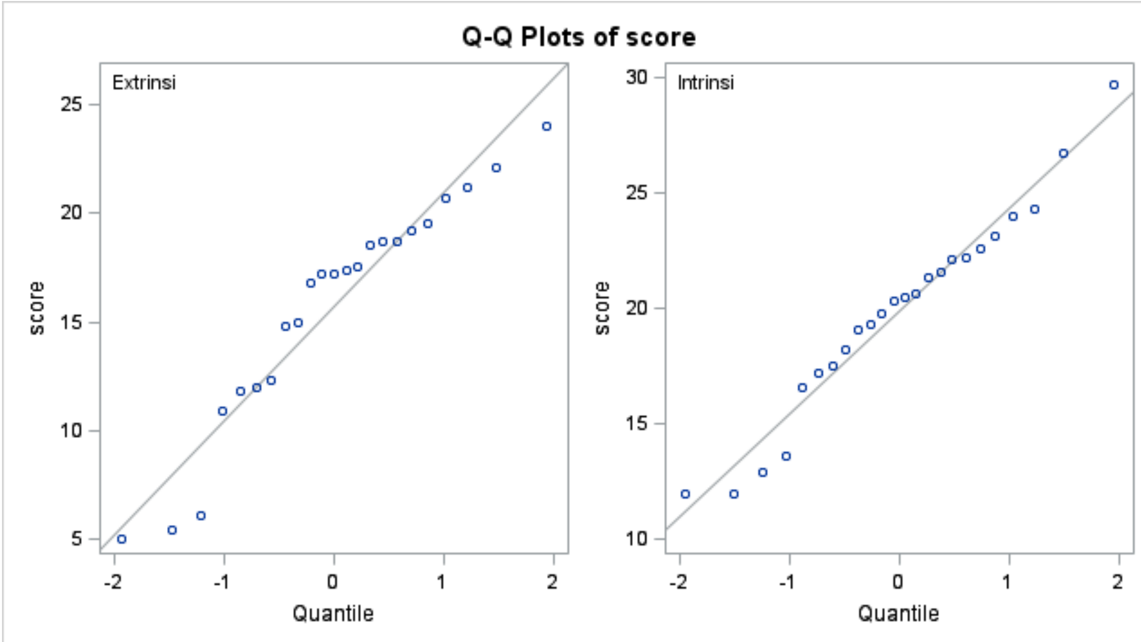
Confidence Interval
[-∞, -0.713]

Interpretation
We have a 99% confidence level that the true mean difference in the population (u_E - u_I) is equal to or less than -0.713. Since the upper limit of the confidence level is negative, it gives us further confirmation that the rejection of the null hypothesis (H_0: u_E >= u_I) is likely correct.

Question 3.

The 3 assumptions made in Question 1 so that we could use the two-sample t-test are:

a) **Normality –** Each of the two samples in these groups should follow a normal distribution. Presence of outliers, for example, would increase the sample variance and lead to inaccurate t-values. As indicated by the Q-Q plot, it shows that the data closely follows the line, which indicates that the groups follow a normal distribution.



b) **Equal SD** – The standard deviation of these two groups should be equal to each other. The standard deviations are relatively close in value and the two sample sizes are almost equal.

group	N	Mean	Std Dev	Std Err	Minimum	Maximum
Extrinsi	23	15.7391	5.2526	1.0952	5.0000	24.0000
Intrinsi	24	19.8833	4.4395	0.9062	12.0000	29.7000
Diff (1-2)		-4.1442	4.8541	1.4164		

c) **Independent** –Each of the observations should be independent of the others. This assumption was made during the data collection. The judges did not know if they were looking at a paper from the intrinsic or extrinsic group when they assigned the creativity scores.

Bonus Question.

Computed Power		
Index	Mean Diff	Power
1	0.5	0.023
2	1.0	0.050
3	1.5	0.095
4	2.0	0.166
5	2.5	0.264
6	3.0	0.386
7	3.5	0.519
8	4.0	0.651

The POWER Procedure
Two-Sample t Test for Mean Difference