Statics with Pulleys

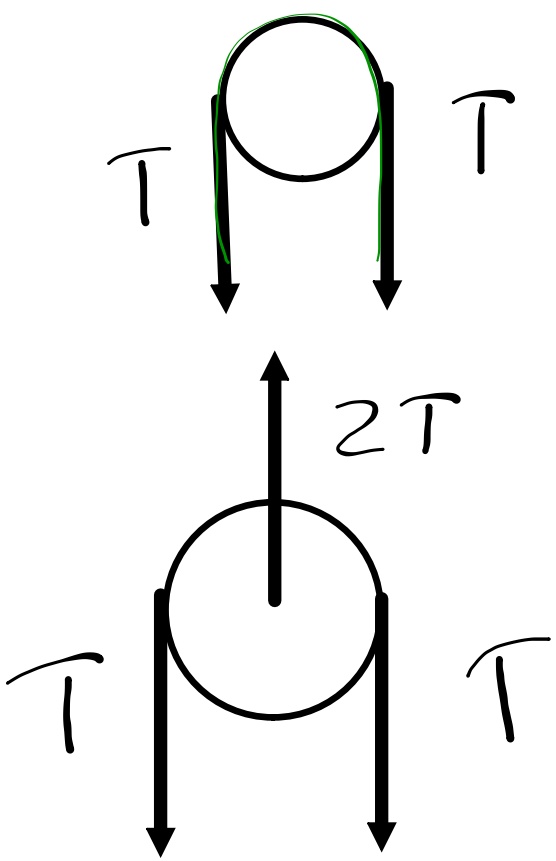
Assumption:

- Pulleys are massless and frictionless

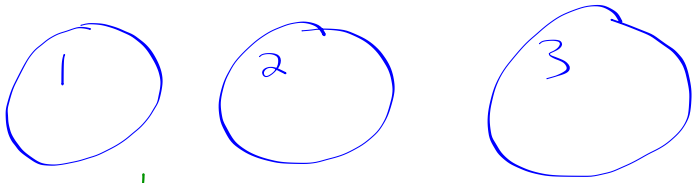
Two things to know:

- The tension in a string or rope is ALWAYS the same and acts as a pulling force in both directions (this means that the tension along one side of a pulley is always the same as the tension along the other side)

- The rules of statics apply (this means that the total of the upwards forces will always equal the total of the downwards forces on any pulley)



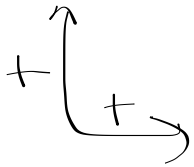
Number the pulleys ...



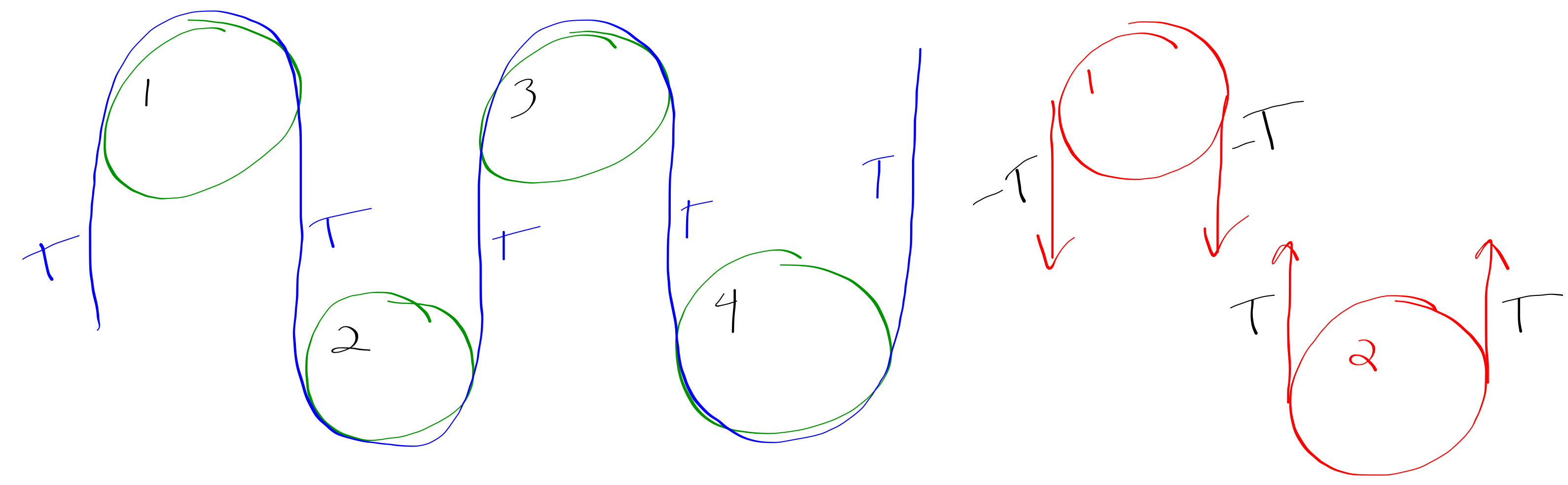
START W/UNKNOWN → FOLLOW THE CONNECTIONS

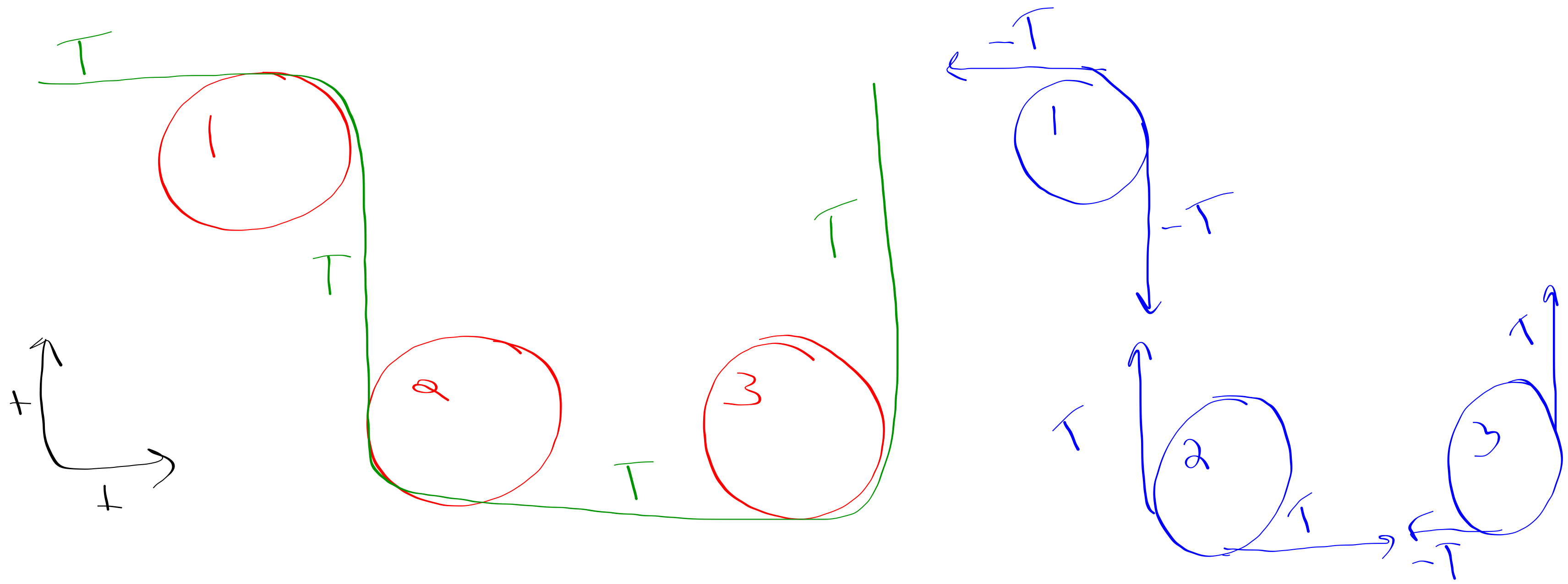
Follow the signs ...

Draw FBD's:

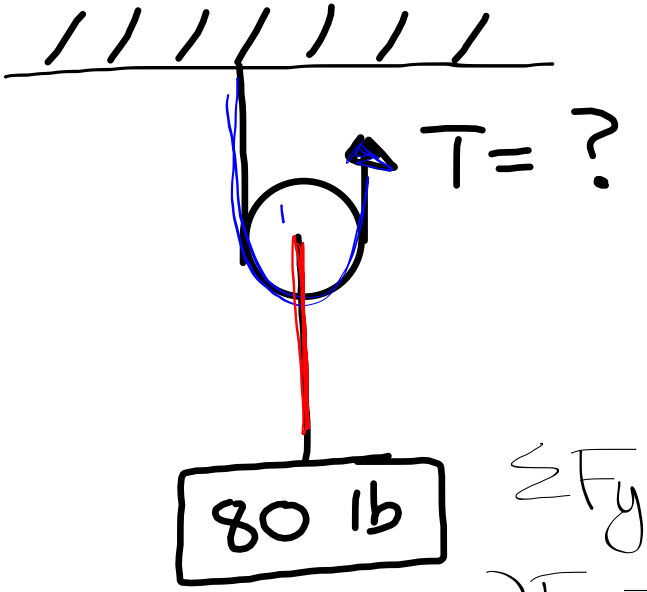


T is always positive... but the force on another object from a string with tension can be in any direction: Forces should be modified with the appropriate sign!


1
2
3
4
T
-T


T
1
2
3
+
-T

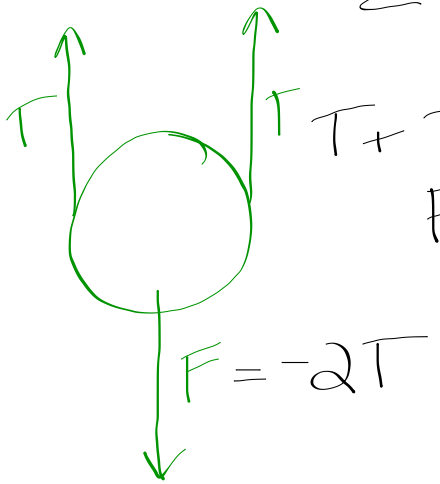
Example 1

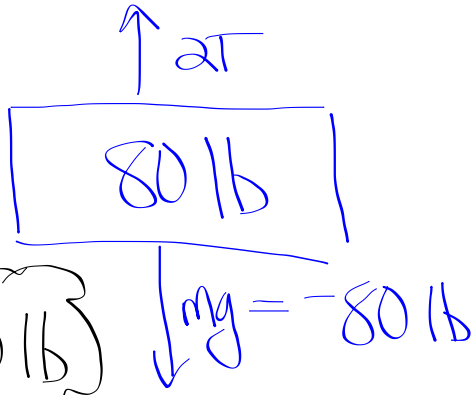


$\Sigma F_y = 0$

$T + T + F = 0$

$F = -2T$



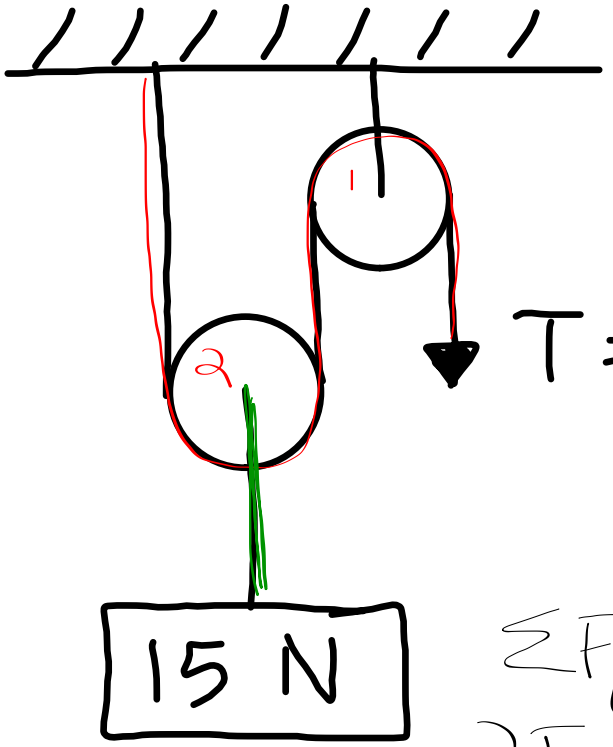


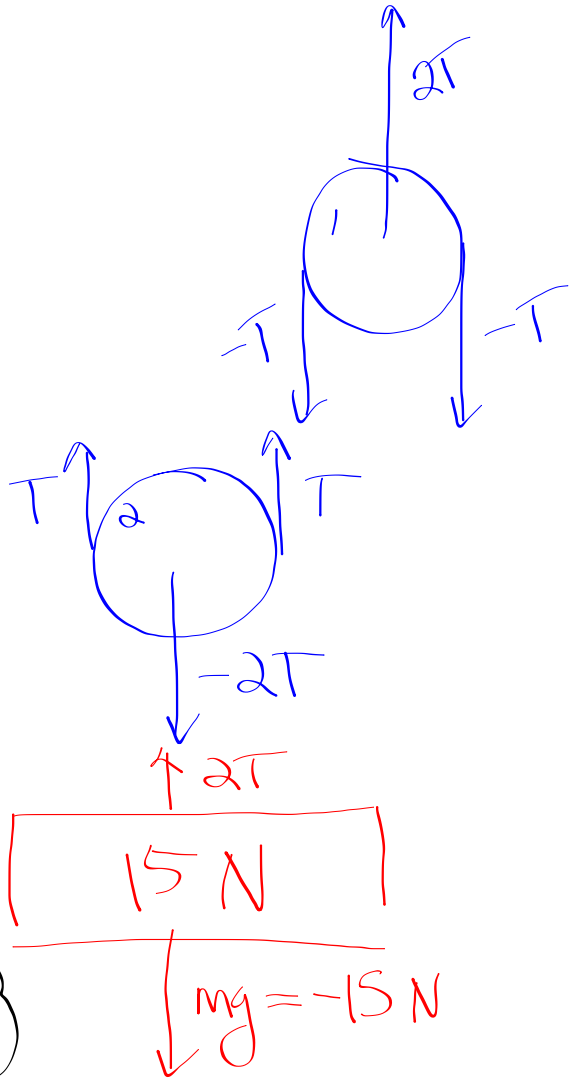
$\Sigma F_y = 0$

$2T + -80\,lb = 0$

$2T = 80\,lb$; $T = 40\,lb$

Example 2



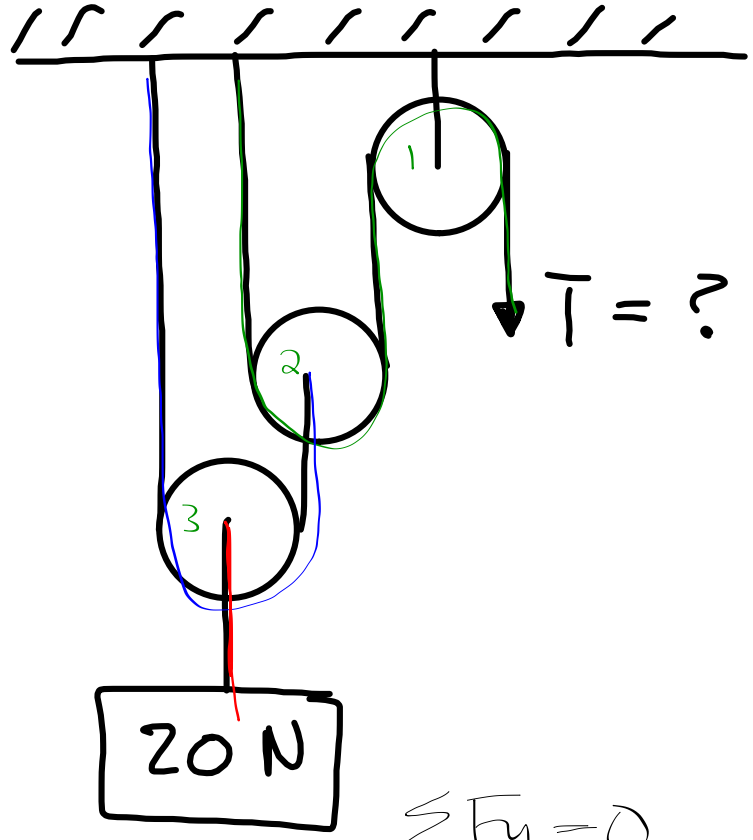


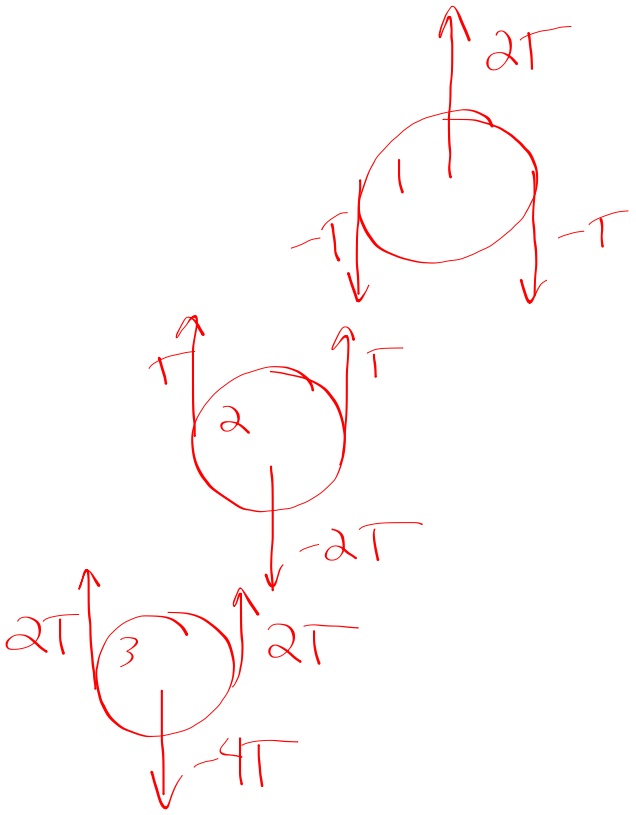
$\Sigma F_y = 0$

$2T + -15N = 0$

$2T = 15;$ $T = 7.5N$

Example 3

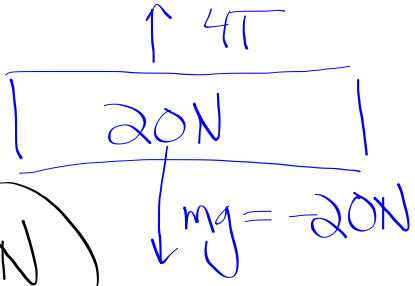




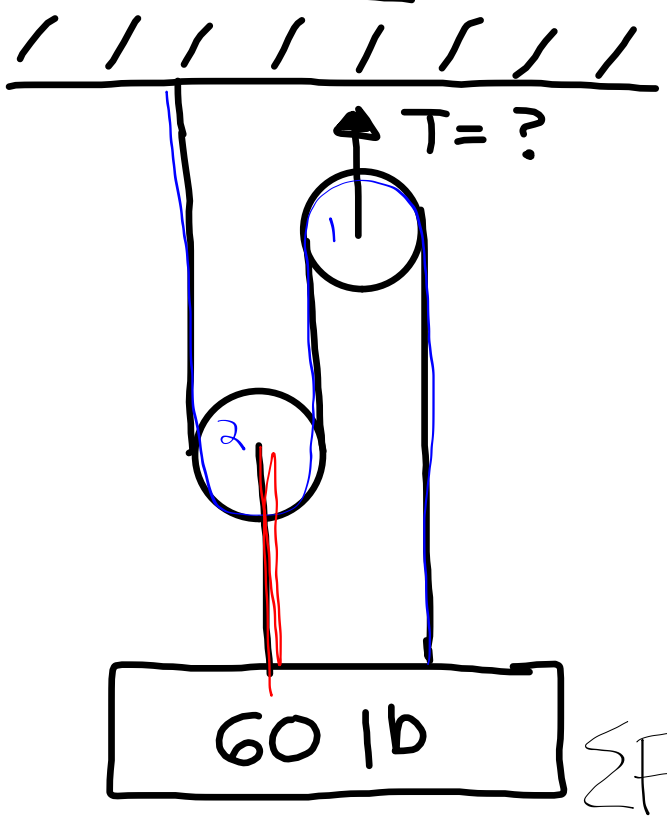
$\Sigma F_y = 0$

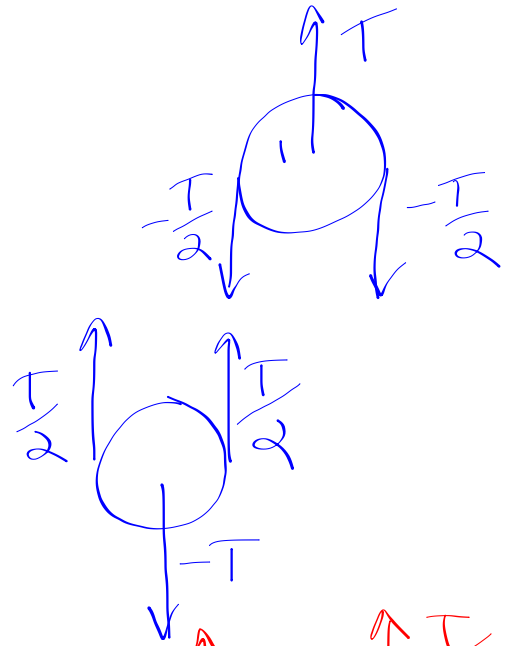
$4T + -20N = 0$

$4T = 20; \quad T = 5N$



EXAMPLE 4



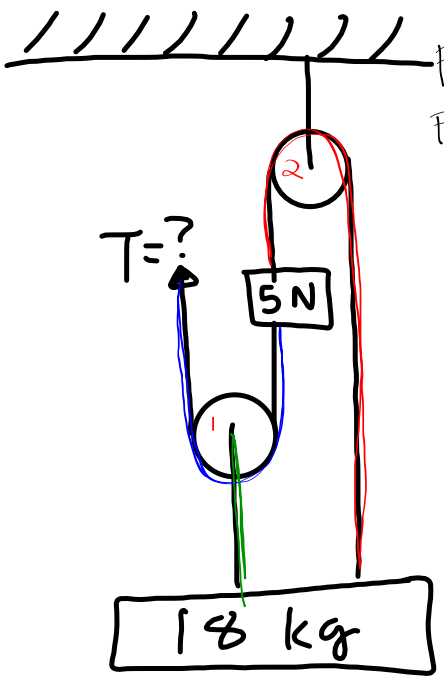


$\Sigma F_y = 0$

$T + \frac{T}{2} + -60^{lb} = 0$

$\frac{3}{2}T = 60$; $T = 40\,lb$

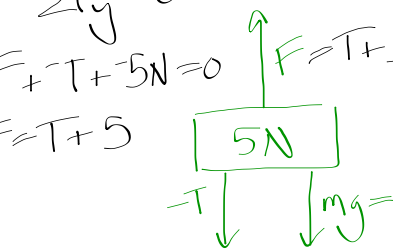
EXAMPLE 5

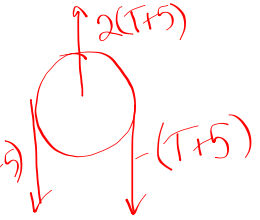


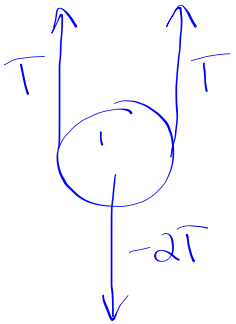
$\Sigma F_y = 0$

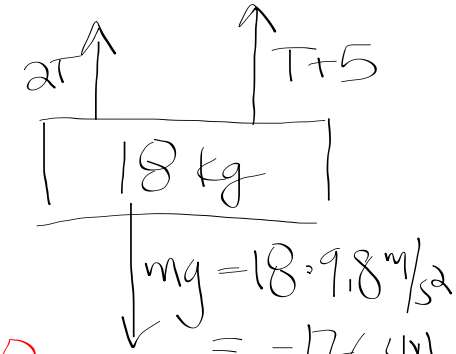
$F + -T + -5N = 0$

$F = T + 5$









$\Sigma F_y = 0$

$2T + T + 5 + -176.4N = 0$

$3T = 171.4N$

$T = 57.13N$