CE 3372 – Water Systems Design
ID-10-T-SI Circular

Purpose:	Compute discharge in a circular section using Manning's equation assuming normal (uniform) flow
Required Tools:	Calculator/Slide-Rule, or Logarithmic and Trigonometric Tables
Input Data:	Manning's n; Conduit Slope, S_0, (dimensionless); Flow Depth, d, (in meters); and Conduit Diameter, D, (in meters)
Output Values:	Discharge, Q, (in cubic meters per second)
Use:	When on-line tools or spreadsheet tools are unavailable.

1. Manning's $n =$ _____
2. Flow Depth $d =$ _____ meters.
3. Conduit Diameter $D =$ _____ meters.
4. Conduit Slope $S_0 =$ _____
5. Compute ratio of flow depth to diameter; $\frac{d}{D} =$ _____
6. Compute $cos(\alpha) = 1 - 2 \times \frac{d}{D} =$ _____
7. Compute the inverse cosine of the result in line [6] in **radians**. Enter the result below.

   $cos^{-1}(1 - 2 \times \frac{d}{D}) = \alpha =$ _____
8. Compute the flow area using

   $A = \frac{D^2}{4} \times (\alpha - sin(\alpha)cos(\alpha)) =$ _____ meters^2.
9. Compute the wetted perimeter

   $P_w = \alpha \times D =$ _____ meters.
10. Compute the hydraulic radius, $R_h = \frac{A}{P_w} =$ _____ meters.

11. Copy the value from Line [1], $n =$ _____

12. Copy the result from Line [8], $A =$ _____ meters^2.

13. Copy the result from Line [10], $R_h =$ _____ meters.

14. Copy the result from Line [4], $S_0 =$ _____

15. Compute square root of Line [14],

    $\sqrt{S_0} =$ _____

16. Compute Line[13] raised to the 2/3-rds power;

    $R_h^{2/3} =$ _____

17. Multiply Line [16],Line [15], and Line [12];

    $R_h^{2/3} \times \sqrt{S_0} \times A =$ _____

18. Multiply Line [17] by 1.0;

    $1.0 \times R_h^{2/3} \times \sqrt{S_0} \times A =$ _____

19. Divide Line [18] by Line [11], result is discharge,Q.

    $Q = \frac{1.0}{n} \times R_h^{2/3} \times \sqrt{S_0} \times A =$ _____ cubic meters per second.