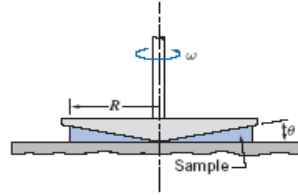


Problem 2.70

[Difficulty: 3]

2.70 A viscometer is used to measure the viscosity of a patient's blood. The deformation rate (shear rate)—shear stress data is shown below. Plot the apparent viscosity versus deformation rate. Find the value of k and n in Eq. 2.17, and from this examine the aphorism "Blood is thicker than water."

$du/dy \text{ (s}^{-1}\text{)}$	5	10	25	50	100	200	300	400
$\tau \text{ (Pa)}$	0.0457	0.119	0.241	0.375	0.634	1.06	1.46	1.78



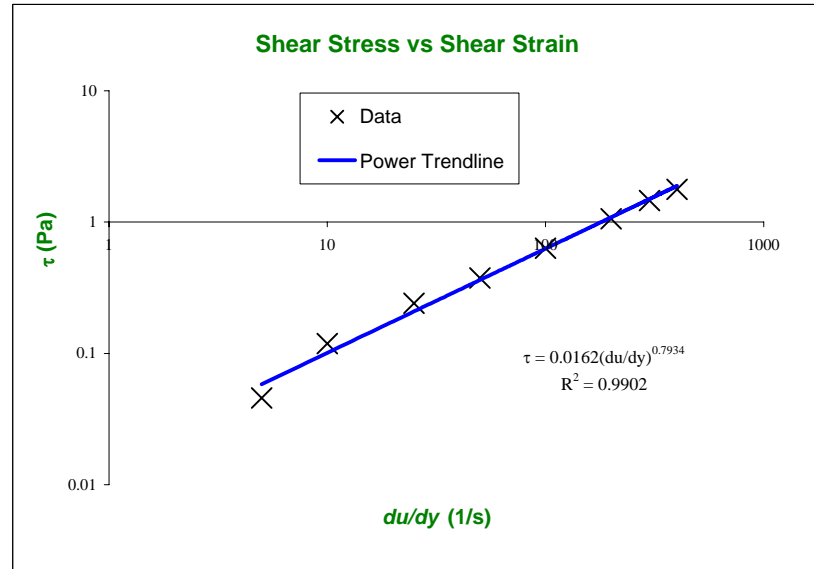
Given: Viscometer data

Find: Value of k and n in Eq. 2.17

Solution:

The data is

$\tau \text{ (Pa)}$	$du/dy \text{ (s}^{-1}\text{)}$
0.0457	5
0.119	10
0.241	25
0.375	50
0.634	100
1.06	200
1.46	300
1.78	400



Hence we have

$$k = 0.0162$$

$$n = 0.7934$$

Blood is pseudoplastic (shear thinning)

The apparent viscosity from

$$\eta = k (du/dy)^{n-1}$$

$du/dy \text{ (s}^{-1}\text{)}$	$\eta \text{ (N}\cdot\text{s/m}^2\text{)}$
5	0.0116
10	0.0101
25	0.0083
50	0.0072
100	0.0063
200	0.0054
300	0.0050
400	0.0047

$$\mu_{\text{water}} = 0.001 \text{ N}\cdot\text{s/m}^2 \text{ at } 20^\circ\text{C}$$

Hence, blood is "thicker" than water!