PROBLEM # 1

Several core plugs (same size: 2.54 cm diameter x 3.81 cm long) were cut from the core samples from a reservoir. Each was cleaned and porosity measured using a gas expansion porosimeter. Then, all were saturated with brine having a resistivity of 7.5 ohm-cm. Each was placed in a resistivity apparatus to measure the voltage drop under 0.01 ampere current. The porosity and voltage drop measured are listed below:

Sample Number	Porosity	Voltage (volts)
1	0.178	1.60
2	0.188	1.46
3	0.165	1.96
4	0.220	1.09
5	0.155	2.14
6	0.145	2.41

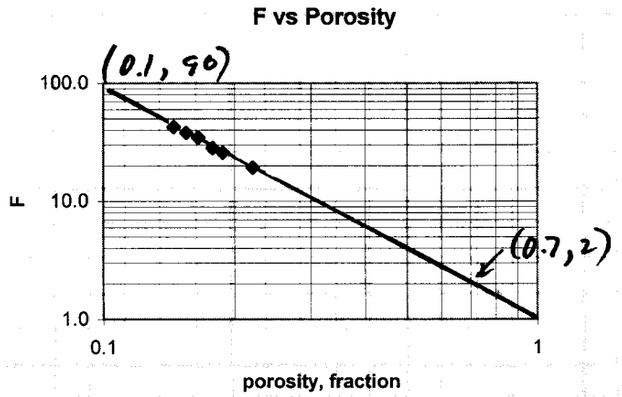
Calculate F and determine the parameters a and m

THEORY

$$F = \frac{R_o}{R_w} = a\phi^{-m}$$

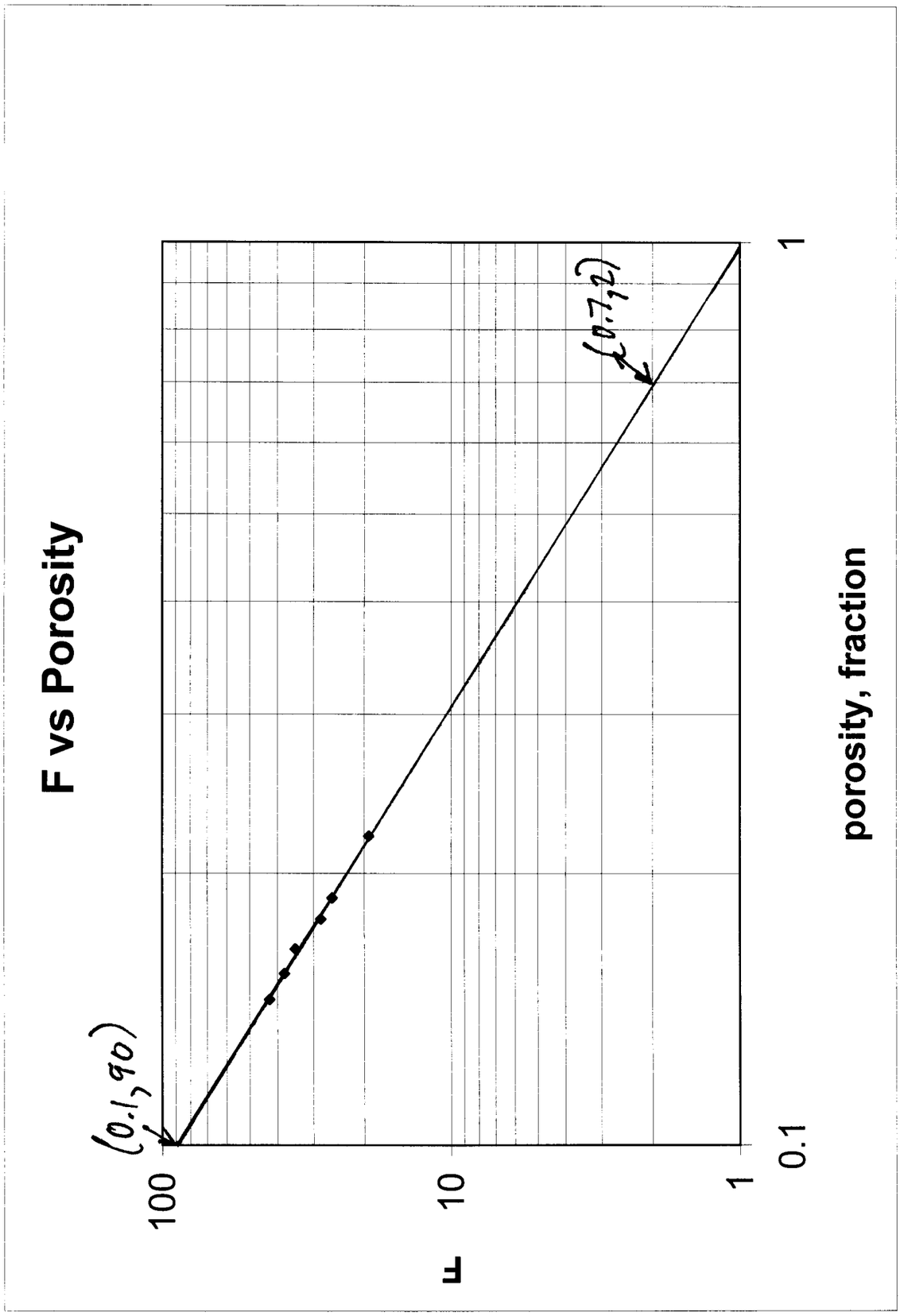
SOLUTION

S_w	E (volt)	r (ohm)	R_o (ohm-cm)	F
0.178	1.60	160	212.8	28.4
0.188	1.46	146	194.2	25.9
0.165	1.96	196	260.7	34.8
0.220	1.09	109	145.0	19.3
0.155	2.14	214	284.6	37.9
0.145	2.41	241	320.5	42.7



Slope = -1.956 = -m ⇒ m = 1.956

Intercept = 0.995 = a


F vs Porosity
(0.1, 90)
(0.7, 2)
100
10
1
F
1
0.1
porosity, fraction

PROBLEM # 2

The laboratory procedure was continued using Sample No. 1 of Problem 1. The brine saturation was reduced step-by-step by displacing with oil and the voltage drop measured.

Water Saturation	Voltage (volts)
1.00	1.60
0.70	3.06
0.52	4.86
0.43	7.30
0.35	10.63

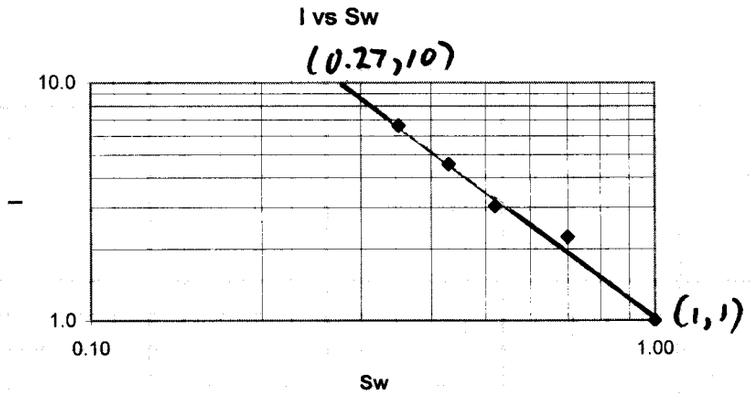
Calculate the formation resistivity, R_t as a function of S_w, and determine n.

THEORY

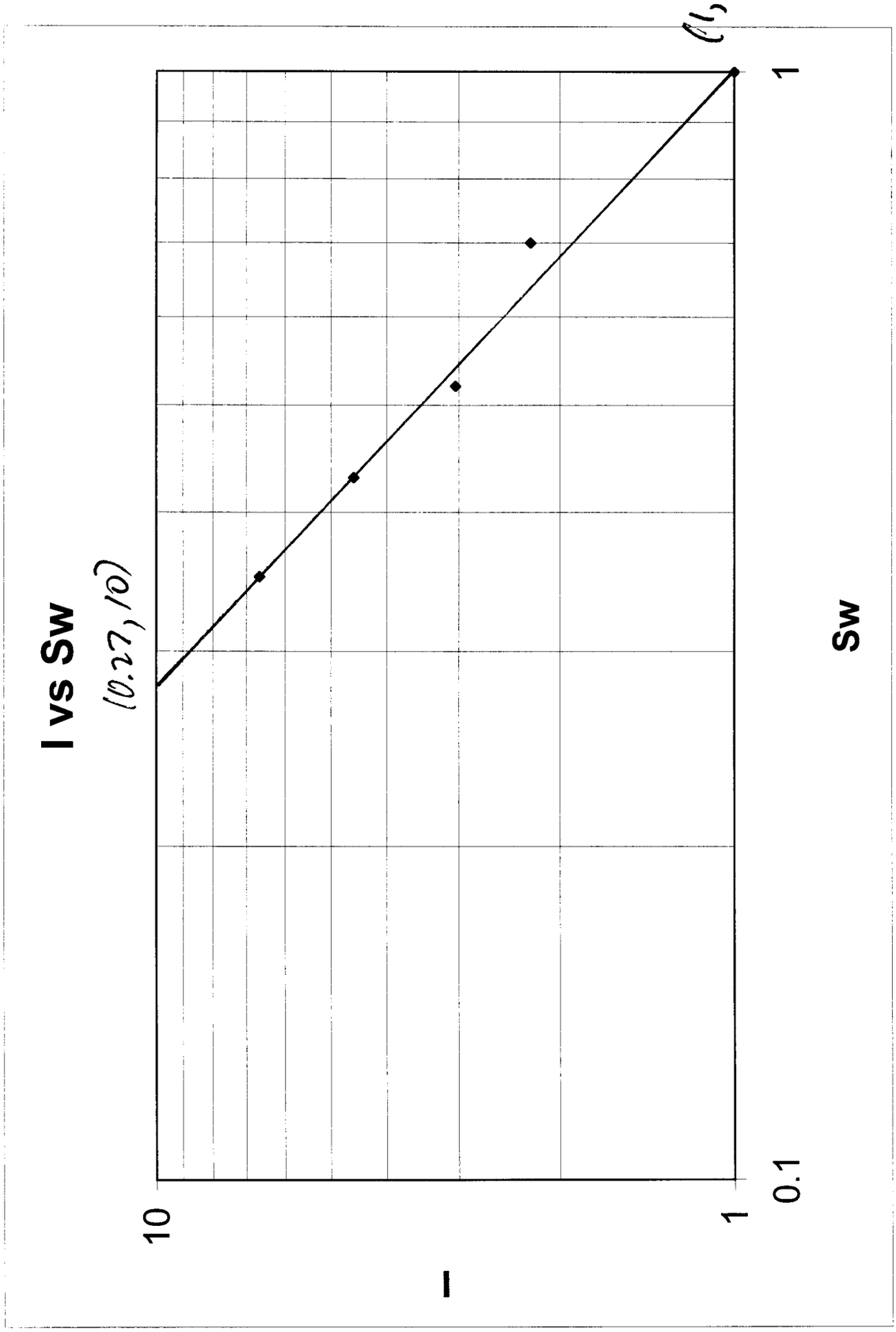
$$I = \frac{R_t}{R_o} = S_w^{-n}$$

SOLUTION

S_w	E (volt)	r (ohm)	R_t (ohm-cm)	I
1.00	1.60	160	212.8	1.0
0.70	3.60	360	478.8	2.3
0.52	4.86	486	646.4	3.0
0.43	7.30	730	970.9	4.6
0.35	10.63	1063	1413.7	6.6



Slope = $-1.759 = -n \Rightarrow n = 1.759$


I vs Sw
(0.27, 10)
(1, 1)
10
1
I
1
0.1
Sw

PROBLEM # 3

Use the information in Problems 1 and 2 to calculate the water saturation when the porosity is 0.17 and the formation resistivity is 537 ohm-cm.

THEORY

$$S_w^n = \frac{aR_w\phi^{-m}}{R_t}$$

SOLUTION

$$S_w^{1.759} = \frac{(0.995)(7.5\ \Omega cm)(0.17)^{-1.956}}{537\ \Omega cm}$$

$$Sw = 0.63$$