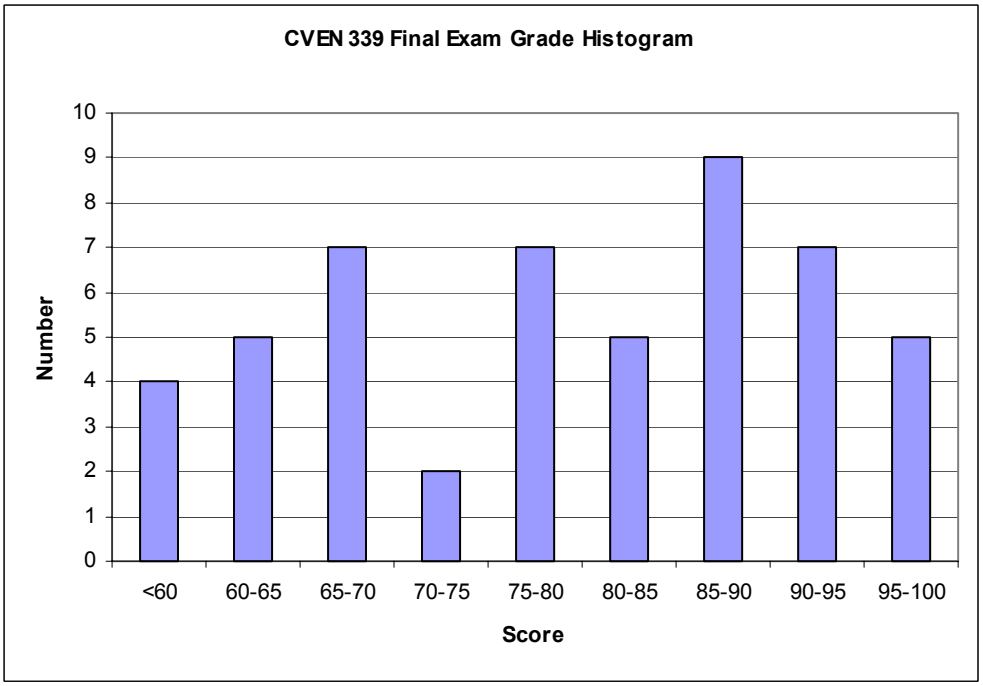
CVEN 339 – Final Exam – Spring 2004

Grade Statistics

Median	80.5
Mean	78.9
Std. Dev.	14.2
Maximum	99.8
Minimum	38.0



Name: _____

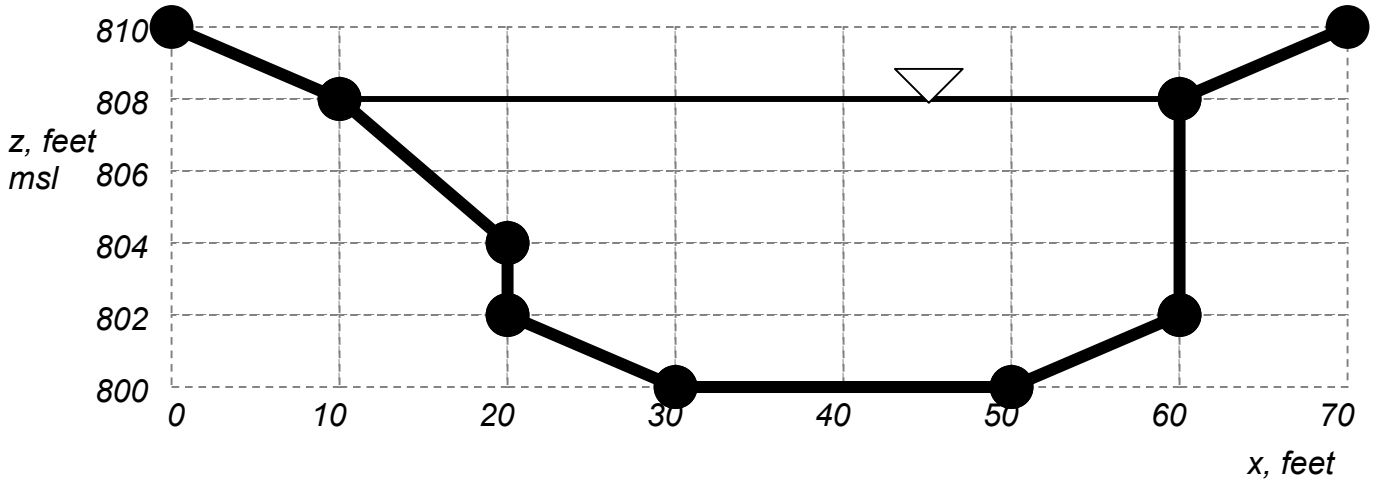
CVEN 339 – Water Resources Engineering
Spring Semester 2004
Dr. Kelly Brumbelow, Texas A&M University

Final Exam

Open-book, Open-notes (10 pages, 4 questions)

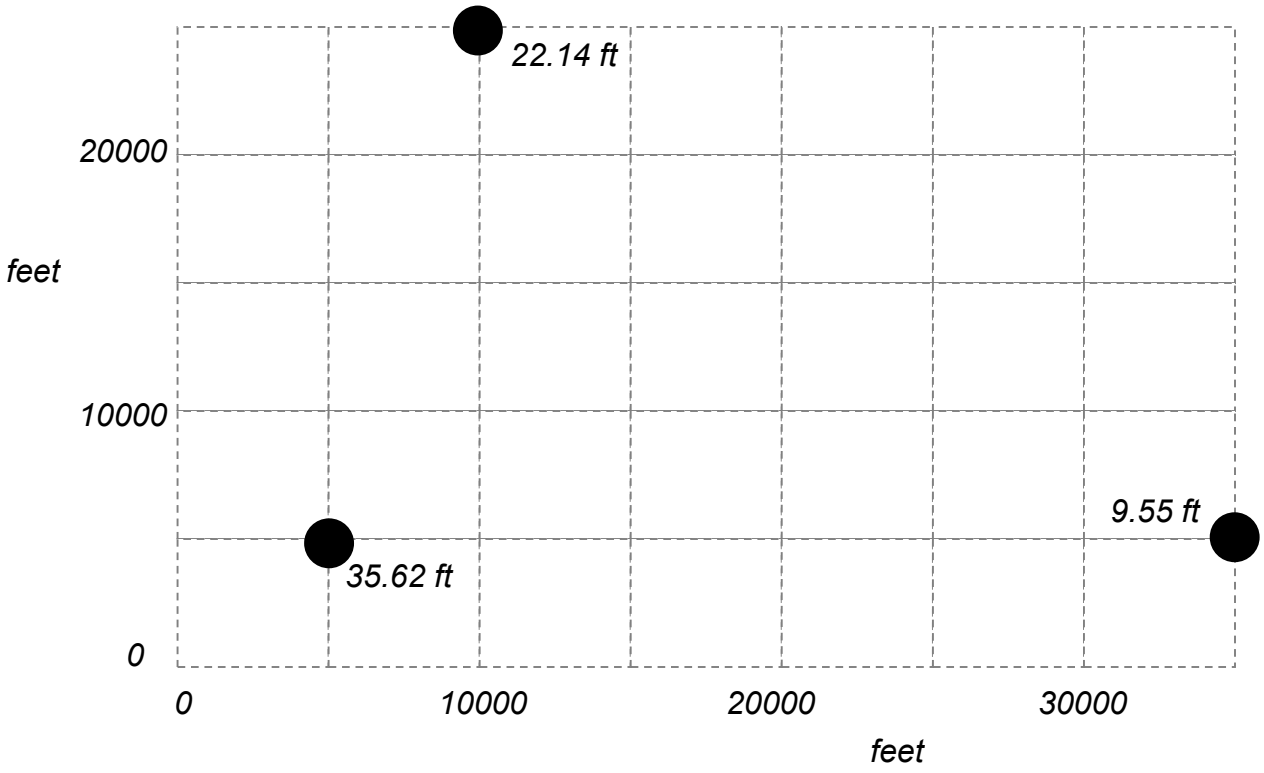
1. Drawn below to scale is the surveyed cross-section of a stream (note that horizontal and vertical scales are different). Also shown is the water surface and points in the cross-section where point measurements of velocity were taken on a particular day. The velocity values are given in the accompanying table.

(a) Determine the volumetric flowrate Q at this location. (15 points)
(b) Calculate the Froude number of this flow and state whether it is sub- or super-critical. (10 points)



x, feet	15	25	35	45	55
V, ft/sec					
at 0.2 depth	–	2.15	3.00	3.45	2.90
at 0.6 depth	1.80	–	–	–	–
at 0.8 depth	–	1.80	2.25	2.35	2.10

2. Mapped below are the locations of three monitoring wells drilled into a confined aquifer with value of piezometric head indicated at each well. If the aquifer transmissivity is 710 m^2/day and the aquifer is 115 ft thick, what will be the average flow velocity of water through this aquifer. Express your answer in units of ft/day. (20 points)

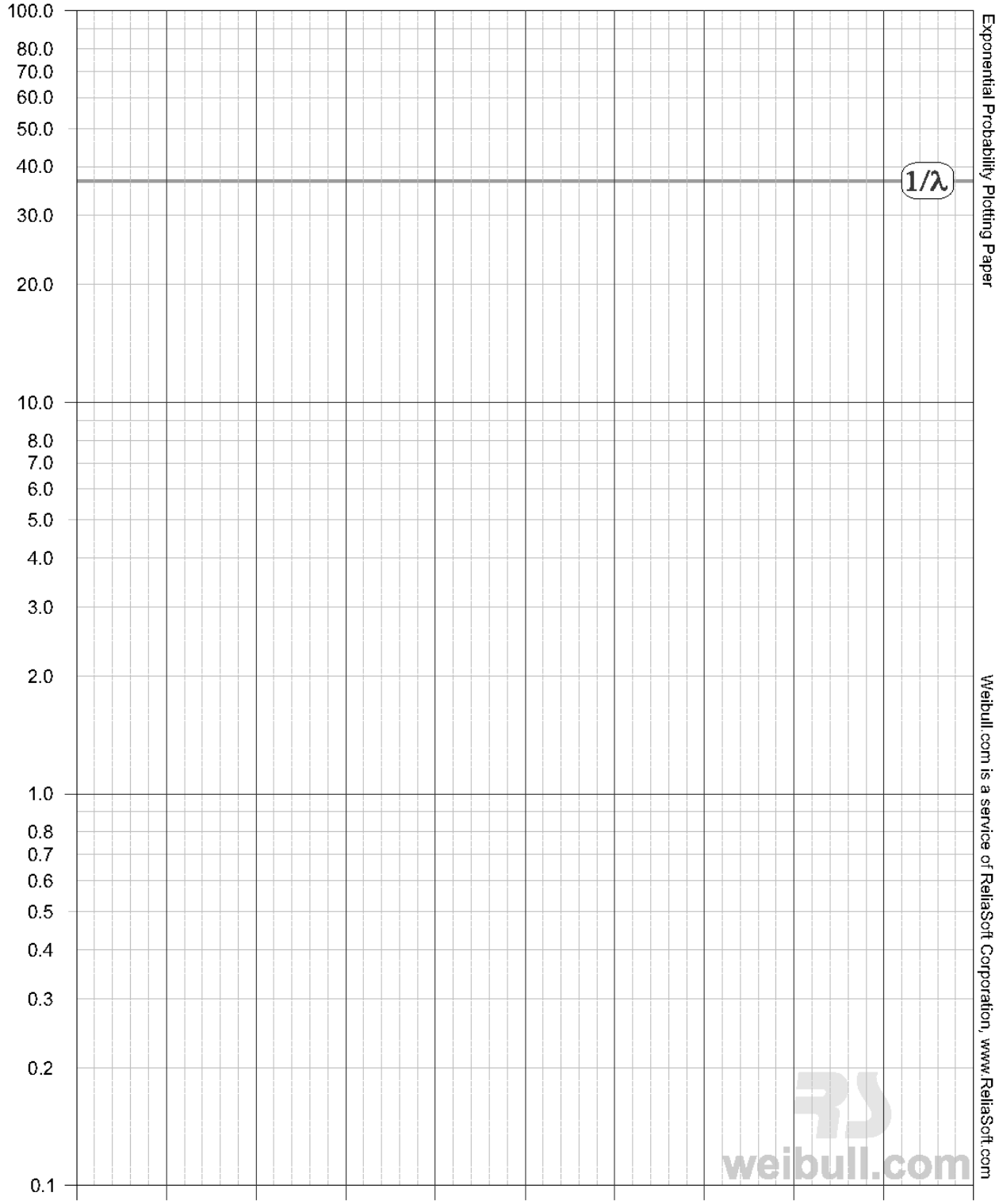


3. A bridge is being constructed across a wide desert wash (a natural channel that is usually dry but can contain significant flows after storms). For various reasons the contractor has decided on a policy whereby all work is suspended at the first sight of rain and equipment is moved away from the middle of the channel. However, there is some question as to how far the equipment needs to be moved, and you are consulted to assist in this question. Rainfall-runoff and hydraulic analysis can translate any precipitation amount into flowrate and then the extent of the channel that is wet, but no one knows what precipitation amount should be used. Listed below are the rainfall amounts for 24-hour rainfall previously recorded for the season in which construction will occur.

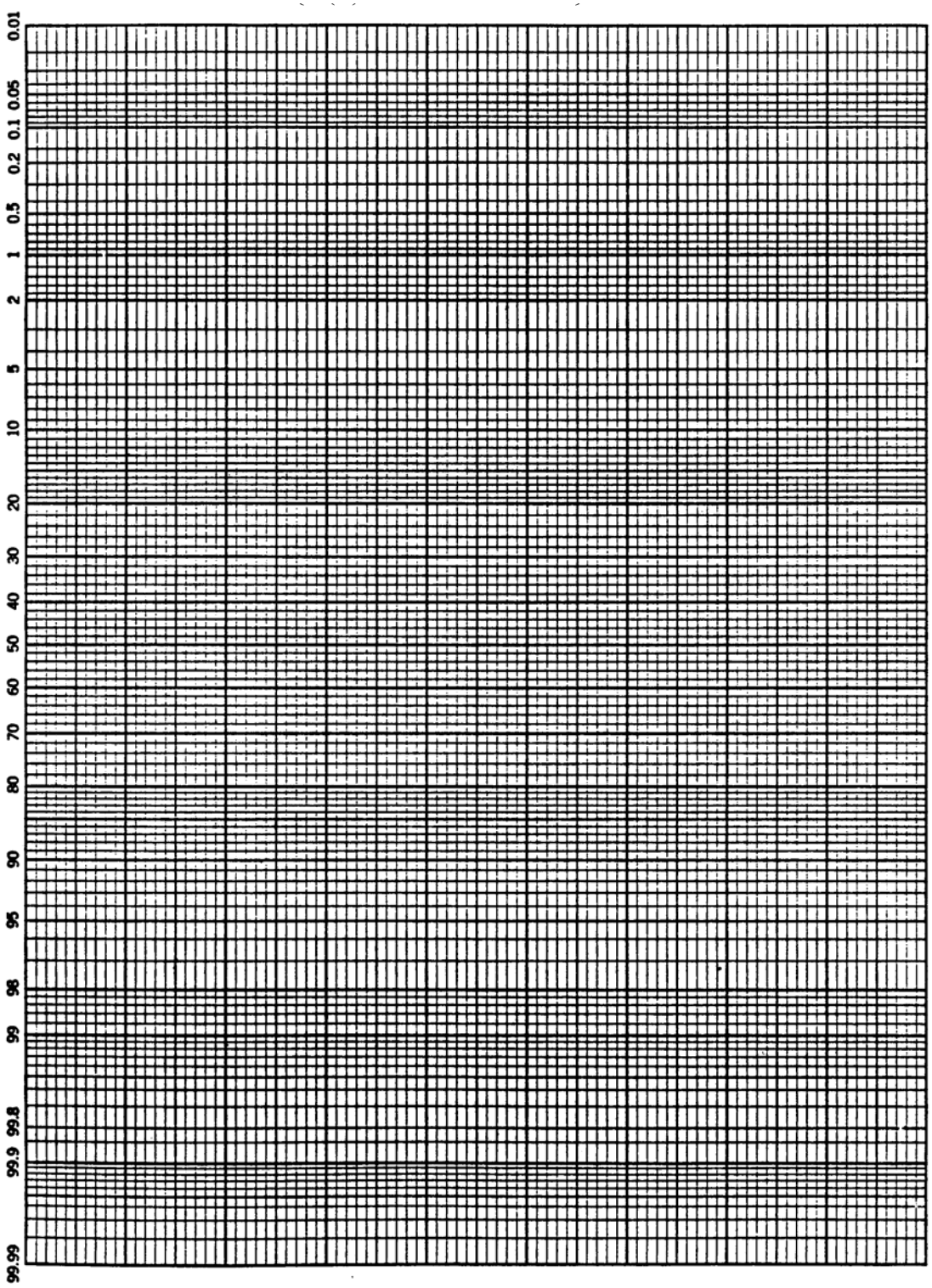
(a) Using the attached probability papers, determine whether the Normal or Exponential probability distribution function is applicable to this data. (15 points)
(b) Once you have decided on a distribution function, determine the precipitation amount that would be equaled or exceeded with a probability of 0.01. (5 points)

Precipitation (in)
0.70
2.10
1.00
0.25
0.35
1.40
0.55
0.60
1.10

Exponential Distribution Probability Paper: vertical axis is *1-F(x)* in percent



Normal Probability Paper: left-side vertical axis is *1-F(x)* in percent



4. A long pipeline transmits water from one reservoir to another. The first reservoir elevation is 1200 feet msl, and the second reservoir elevation is 1325 feet msl. The pipeline is 35,000 feet long, 24 inches in diameter, and constructed of welded steel. It can be assumed to be hydraulically long. A single-stage centrifugal pump drives the flow, and the pump's characteristic and efficiency curves are given below. Based on past experience the pump is turned on for only 12 hours each day to provide the needed volume of water per day at the downstream reservoir. That is, at the pumped flowrate it takes 12 hours to pump the amount of water needed each day at the end of the pipeline.

After some time in service, the pipeline develops a leak at a point 5,000 feet from the first reservoir and pump station. The pipeline elevation at this point is 1215 ft msl. The leak is a circular orifice 2.0 inches in diameter. Leakage can be modeled using the orifice discharge equation $Q = 0.62A\sqrt{2gH}$.

(a) Determine the volume of water lost each day at the leak if 12 hr/day operation is maintained. (20 points)

(b) Once the leak is found, several alternatives are considered to respond to the situation (the leak is in an inaccessible location and cannot be repaired): (i) Add a second pump stage and operate 12 hrs/day, (ii) Leave the pump unmodified and pump for a longer period each day, (iii) Increase the motor speed used to drive the pump and operate 12 hrs/day. Which of these alternatives would succeed in providing needed daily water delivery at the second reservoir and which alternatives would not succeed? (5 points)

(c) It is decided to leave the pump unmodified and operate for a longer period each day so that the needed volume of water is delivered daily. What will then be the cost of this leak in terms of energy used to drive the pump? Answer in units of kilowatt-hours. (1 kWh = $2.655 \cdot 10^6$ ft·lb) (10 points)