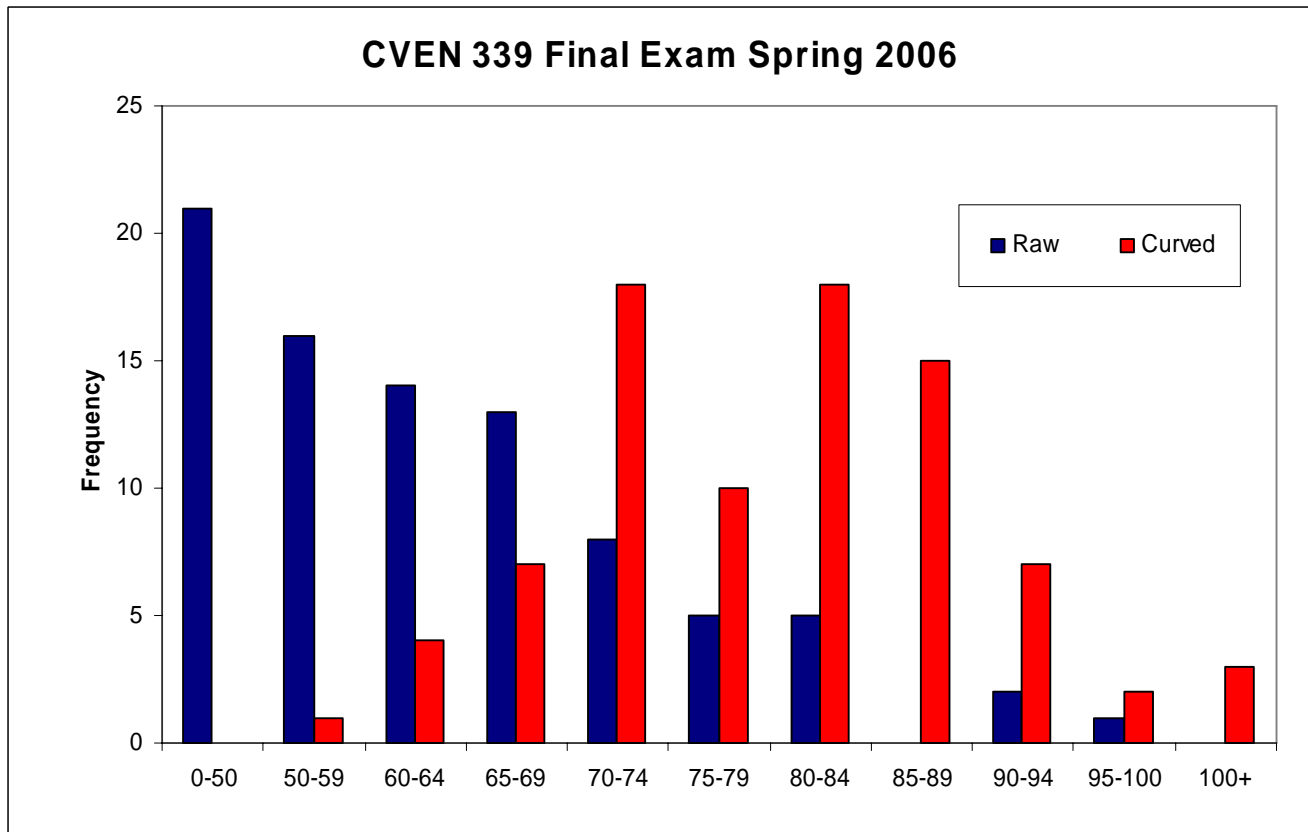


CVEN 339 – Spring 2006
Final Exam

	<u>Raw</u>	<u>Curved</u>
Median	62.8	81.2
Mean	61.1	80.0
St. Dev.	14.0	10.0
High	97	105.0
Low	24	54.0



Name: _____

CVEN 339 – Water Resources Engineering
Spring Semester 2006
Dr. Kelly Brumbelow, Texas A&M University

Final Exam

Open-book, Open-notes (10 pages, front & back, not including reference sheets; 25 questions)

An excerpt from the NCEES *Fundamentals of Engineering Supplied-Reference Handbook* is attached to this exam. This excerpt is only for the use of students during this exam and must be returned at the conclusion of the exam. Failure to return the excerpted pages attached to the exam paper will result in a grade of zero.

Questions 1 to 15 are written in the format of the F.E. Exam Morning Section and should require on average 2 minutes per question to complete. Each question is worth 1.7 points. **Clearly write the letter corresponding to the best answer in the blank provided.**

1. Two monitoring wells for an unconfined aquifer are 1000 ft apart. The elevation of the water table at Well 1 is 784.3 ft, and the elevation of the water table at Well 2 is 785.1 ft. The saturated hydraulic conductivity of the aquifer is 0.032 cm/day. Assuming the path between the wells is perpendicular to the aquifer's equipotential lines, what will be the average velocity and direction of flow in the aquifer?
- (A) 2.56×10^{-5} ft/day; from Well 1 to Well 2
(B) 8.40×10^{-7} ft/day; from Well 2 to Well 1
(C) 2.56×10^{-5} ft/day; from Well 2 to Well 1
(D) 7.80×10^{-4} ft/day; from Well 2 to Well 1

Answer #1: _____

2. A broad-crested weir is located in a rectangular open channel of width 7.90 m. If the depth of flow over the weir is 0.63 m, what is the flowrate in the channel?
- (A) 19.6 m³/s
(B) 153.8 m³/s
(C) 22.4 m³/s
(D) 12.4 m³/s

Answer #2: _____

3. A trapezoidal open channel has bottom width 15.2 ft, bed slope 0.0038 ft/ft, horizontal component of sideslope 3.0, and Manning's roughness coefficient 0.028. When the flowrate in the channel is $870 \text{ ft}^3/\text{sec}$, the flow depth is 4.5 ft, and flow velocity is 6.74 ft/sec. If the roughness coefficient is decreased to 0.012 while all other channel characteristics and the flowrate are held constant, which of the following would be true?

- (A) Flow depth = 4.5 ft; Flow velocity > 6.74 ft/sec
- (B) Flow depth < 4.5 ft; Flow velocity > 6.74 ft/sec
- (C) Flow depth > 4.5 ft; Flow velocity < 6.74 ft/sec
- (D) Flow depth < 4.5 ft; Flow velocity = 6.74 ft/sec

Answer #3: _____

4. In question 3 above, what is the value of the Froude number when the roughness coefficient is 0.028?

- (A) 0.68
- (B) 0.56
- (C) 1.23
- (D) 1.01

Answer #4: _____

5. A confined aquifer is 17.9 m thick. If its saturated hydraulic conductivity is $3.47 \times 10^{-6} \text{ ft/sec}$, what is its transmissivity?

- (A) $5.37 \text{ m}^2/\text{day}$
- (B) $1.89 \times 10^{-5} \text{ m}^2/\text{day}$
- (C) $1.64 \text{ m}^2/\text{day}$
- (D) $17.6 \text{ m}^2/\text{day}$

Answer #5: _____

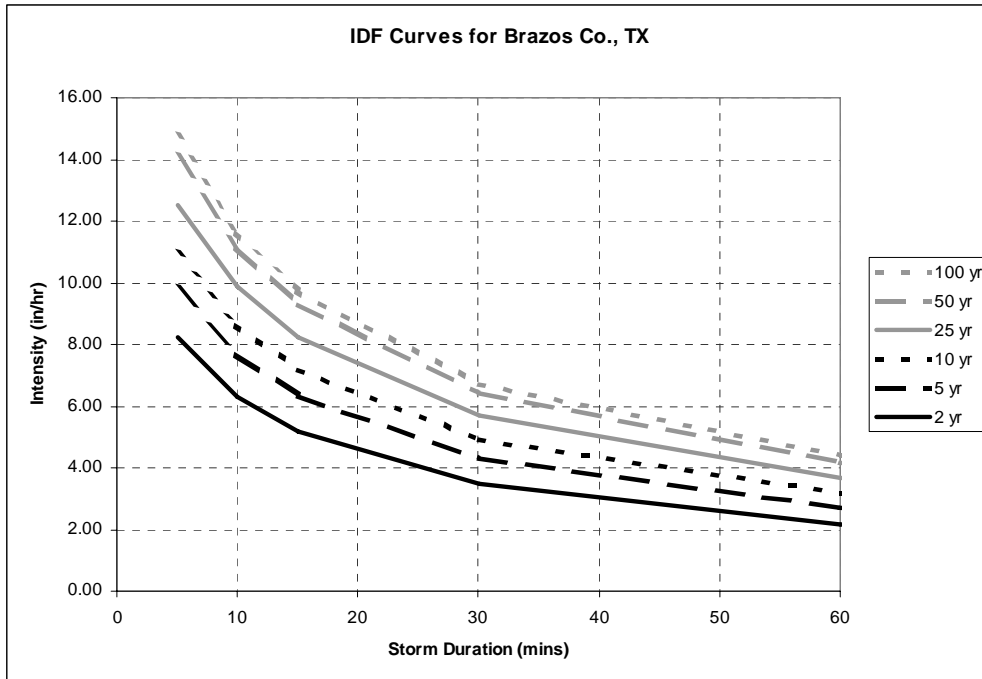
6. In the year 2004, a particular streamgage recorded a 50 year flood. In 2005, the same gage recorded another 50 year flood. What is the probability that a 50 year flood will be recorded in 2006?

- (A) 0.000 008
- (B) 0.000 4
- (C) 0.02
- (D) 0.000 2

Answer #6: _____

7. Peak runoff of $144 \text{ ft}^3/\text{sec}$ is computed for a specific watershed using the Rational Method, the IDF curves given below, and a 10 year storm. If the watershed has time of concentration 20 minutes, what would be the expected peak runoff from a 100 year storm?

- (A) $216 \text{ ft}^3/\text{sec}$
- (B) $1440 \text{ ft}^3/\text{sec}$
- (C) $108 \text{ ft}^3/\text{sec}$
- (D) $193 \text{ ft}^3/\text{sec}$



Answer #7: _____

8. A pump station has 3 centrifugal pumps in parallel. The pump characteristic curve for a single pump is defined below:

$$\text{Head (ft)} = 75 - 0.075 Q^2 - 0.75 Q \quad (Q \text{ in cfs})$$

What is the effective characteristic curve for the 3 pumps working together?

- (A) $\text{Head (ft)} = 225 - 0.225 Q^2 - 2.25 Q$
- (B) $\text{Head (ft)} = 75 - 0.025 Q^2 - 0.25 Q$
- (C) $\text{Head (ft)} = 75 - 0.0083 Q^2 - 0.25 Q$
- (D) $\text{Head (ft)} = 225 - 0.025 Q^2 - 0.75 Q$

Answer #8: _____

9. Flow entering a hydraulic jump has velocity 3.20 m/s and depth 0.30 m. If energy loss in the jump is 6.3% of the entering energy and depth after the jump is 0.66 m, what will be the flow velocity after the hydraulic jump?
- (A) 1.47 m/s
 - (B) 2.01 m/s
 - (C) 2.66 m/s
 - (D) 3.00 m/s

Answer #9: _____

10. If a stormwater detention reservoir is built immediately upstream of the outlet of a watershed, which of the following would be true?
- I. The watershed's runoff coefficient will decrease.
 - II. The peak runoff flowrate from the watershed will decrease.
 - III. The watershed time of concentration will increase.
- (A) III only
 - (B) I only
 - (C) I, II, and III
 - (D) II and III only

Answer #10: _____

11. A pipe flow entering a throttling valve has velocity 4.2 ft/sec and static pressure 85.0 psi. The valve has a minor loss coefficient of 121.3. If the pipe diameter remains constant before and after the valve, what will be the static pressure in the flow after the valve?
- (A) 99.3 psi
 - (B) 70.5 psi
 - (C) -1988.6 psi
 - (D) 37.7 psi

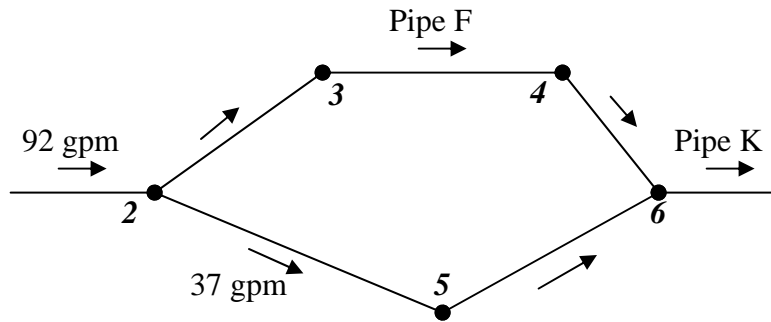
Answer #11: _____

12. Which answer below includes a set of parameters which are all used to calculate net positive suction head?
- (A) Pump characteristic function, Vapor pressure, and Pump efficiency
 - (B) Pump elevation, Ending reservoir elevation, and Vapor pressure
 - (C) Atmospheric pressure, Pump elevation, and Pump characteristic function
 - (D) Pump intake pipe length, Vapor pressure, and Pump elevation

Answer #12: _____

13. A small section of a pipe network is shown below. What are the flows in Pipes F and K?

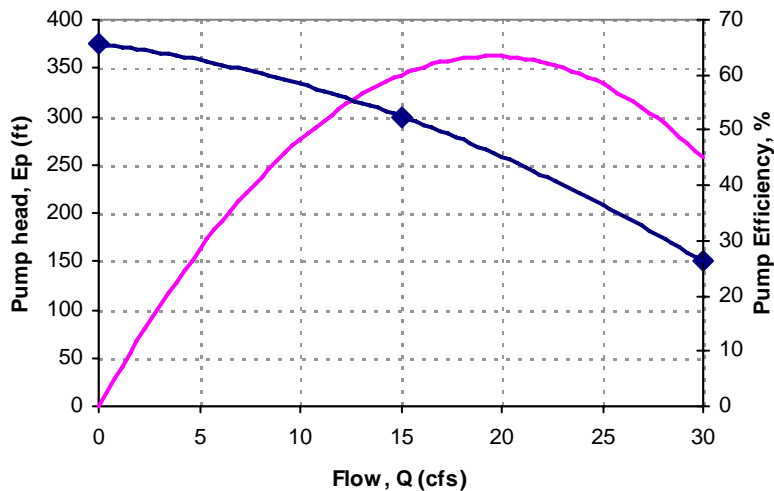
Node	Demand (gpm)
2	5
3	4
4	10
5	3
6	23



- (A) Pipe F, 51 gpm; Pipe K, 76 gpm
- (B) Pipe F, 46 gpm; Pipe K, 53 gpm
- (C) Pipe F, 51 gpm; Pipe K, 53 gpm
- (D) Pipe F, 46 gpm; Pipe K, 76 gpm

Answer #13: _____

14. The characteristic and efficiency curves for a specific pump are given in the figure below. What will be the shaft power consumed by the pump if it operates at a flowrate of 17.0 ft³/sec? (1 hp = 550 ft•lb/sec)



- (A) 329 hp
- (B) 540 hp
- (C) 885 hp
- (D) 1369 hp

Answer #14: _____

15. If the pump in question 14 above is operating at 17.0 cfs and pumping water from a reservoir at elevation 784 ft to a reservoir at elevation 988 ft, what is the head loss due to friction and minor losses in the pipeline between the two reservoirs?

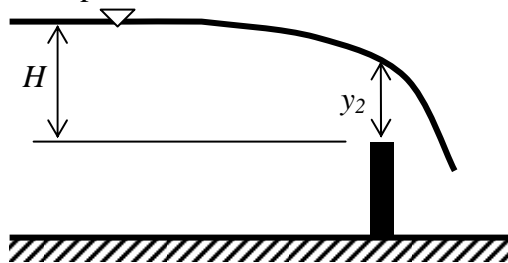
- (A) 0 ft
- (B) 76 ft
- (C) 280 ft
- (D) 375 ft

Answer #15: _____

Questions 16 to 23 are written in the format of the F.E. Exam Afternoon Section and should require on average 4 minutes per question to complete. Each question is worth 3.4 points. **Clearly write the letter corresponding to the best answer in the blank provided.**

16. Water flowing in a 3.0 m wide rectangular open channel must flow over a sharp-crested weir as shown in the figure below. At the weir crest, the depth of water above the crest y_2 is 0.20 m. What is the correct value of the dimension H measured far upstream of the weir?

- (A) 0.20 m
- (B) 0.25 m
- (C) 0.29 m
- (D) 0.42 m



Answer #16: _____

17. Three monitoring wells have been drilled into a confined aquifer. The coordinates and piezometric head at each well are:

Well 1: (15 000 m, 40 000 m), head = 236.2 m

Well 2: (20 000 m, 45 000 m), head = 234.4 m

Well 3: (25 000 m, 40 000 m), head = 236.2 m

The aquifer's thickness and transmissivity are 20 m and $0.06 \text{ m}^2/\text{day}$, respectively. The average velocity of flow in this aquifer is:

- (A) $2.16 \times 10^{-5} \text{ m/day}$
- (B) $1.53 \times 10^{-5} \text{ m/day}$
- (C) $1.08 \times 10^{-6} \text{ m/day}$
- (D) $7.64 \times 10^{-7} \text{ m/day}$

Answer #17: _____

18. Two open tanks are connected by a single pipe. The water surface elevations of the upstream and downstream tank are 218.55 ft and 208.32 ft, respectively. The pipe is cast iron, 403.5 ft long, and 4 inches in diameter. The pipe is connected to the tanks with a rounded entrance and exit. There are no other fittings. The expected flow rate in the pipe is most nearly:

- (A) 0.40 cfs
- (B) 0.53 cfs
- (C) 1.35 cfs
- (D) 1.78 cfs

Answer #18: _____

19. A 6-inch-diameter pipe in a water distribution system has a Hazen-Williams coefficient of 100. The flow in the pipe is 1.2 cfs. The pressure drop in a 500-foot length of pipe is:

- (A) 3.72 psi
- (B) 31.2 psi
- (C) 0.41 psi
- (D) 8.34 psi

Answer #19: _____

20. If a second pump is placed in series with an existing pump that inputs water to a long pipeline, which of the following would always be true?

- I. Flow through the pipeline will exactly double.
- II. The head loss in the pipeline will exactly double.

- (A) I only
- (B) II only
- (C) Both I and II
- (D) Neither I nor II

Answer #20: _____

21. A watershed has a curve number of 87. What percentage of gross rainfall will become runoff from a storm of 2.7 inches falling in 45 minutes?

- (A) 0.5%
- (B) 23%
- (C) 55%
- (D) 87%

Answer #21: _____

22. A pumping station includes a single pump that has the pump characteristic curve defined below:

$$\text{Head (ft)} = 60 - 0.0005 Q^2 - 0.05 Q \quad (Q \text{ in gpm})$$

The pipe network has a static head of 25 ft. The friction loss is defined by the following equation:

$$\text{Friction loss (ft)} = 0.0003 Q^2 \quad (Q \text{ in gpm})$$

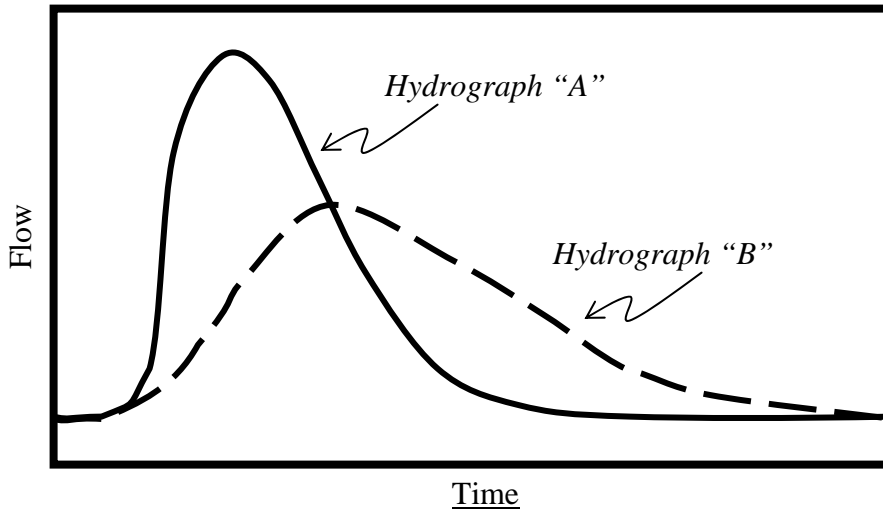
The flow rate delivered by the pump in operation is most nearly:

- (A) 180 gpm
- (B) 244 gpm
- (C) 296 gpm
- (D) 311 gpm

Answer #22: _____

23. A pair of hydrographs is shown in the figure below. Which of the statements below are plausible?

- I. The hydrographs are the inflow and outflow hydrographs for a reservoir.
- II. The hydrographs are runoff hydrographs before and after the conversion of a forested watershed to a fully urbanized one.
- III. The hydrographs are inflow and outflow hydrographs for a channel routing analysis.



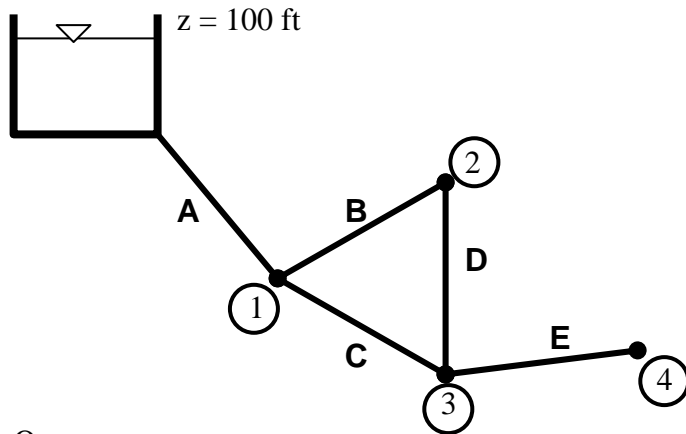
- (A) I only
- (B) II only
- (C) I and III only
- (D) I, II, and III

Answer #23: _____

Questions 24 and 25 are “long-form” free response questions. Partial credit will be awarded on these problems. Please attach all work for these problems to the exam paper.

24. A small pipe network is shown below. Nodal demands are given in the table. All pipes are 1000 ft long, 12 inches in diameter, friction factor f equal to 0.018. Solve for the flow in the 5 pipes. (20 points)

Node	Demand (cfs)
1	0.5
2	0
3	2.1
4	0.5



Answers:

$Q_A =$ _____

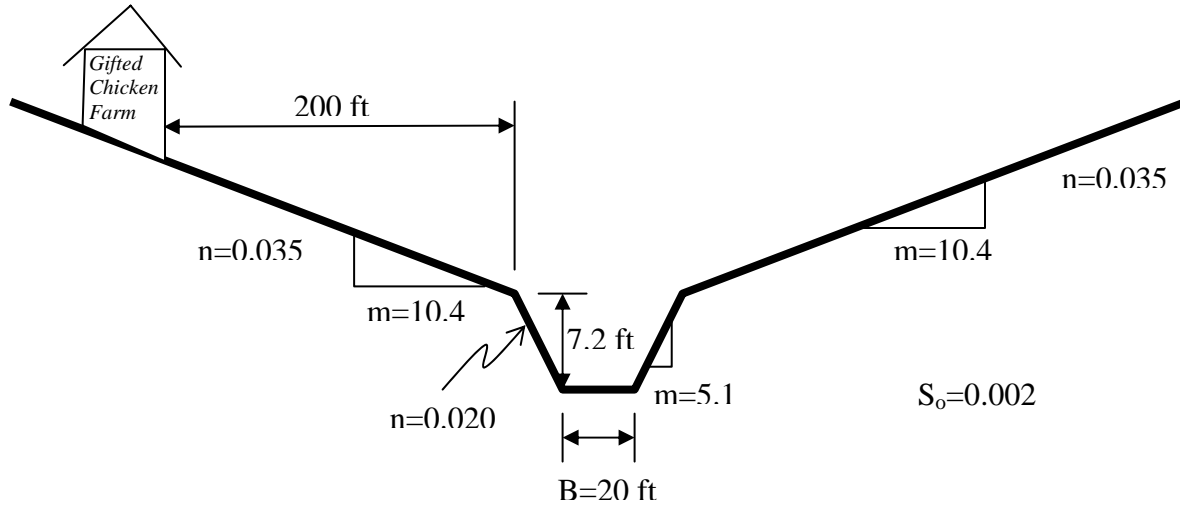
$Q_B =$ _____

$Q_D =$ _____

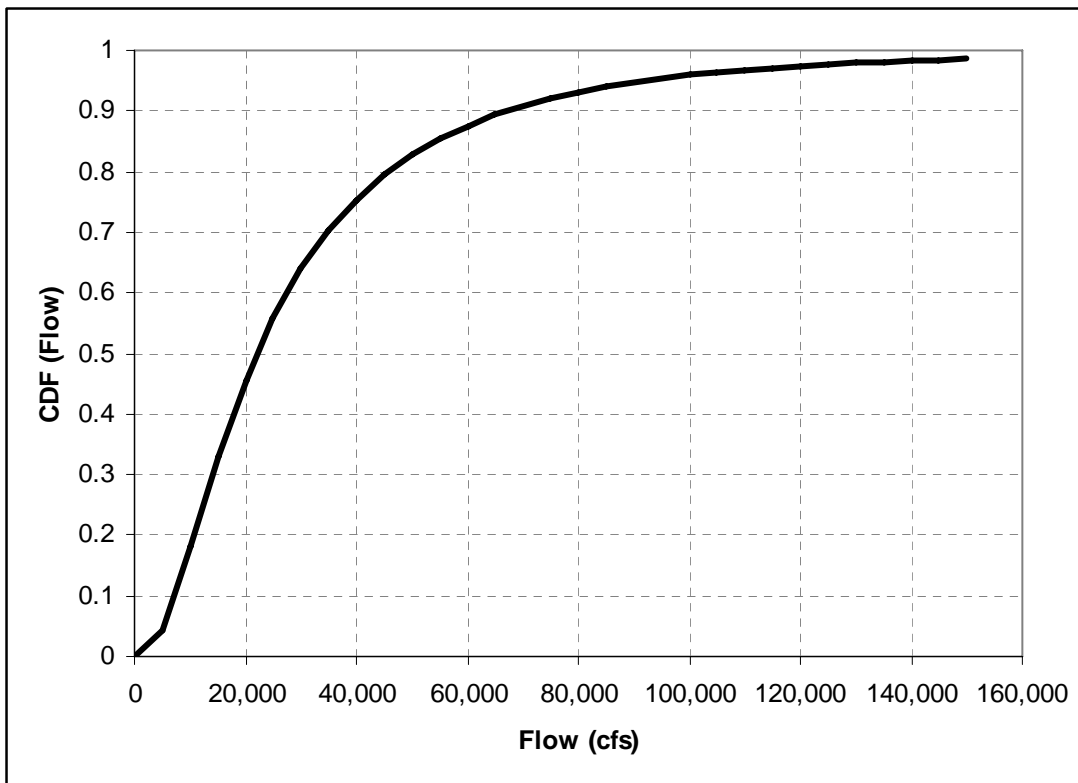
$Q_C =$ _____

$Q_E =$ _____

25. A river channel and its floodplain are drawn in cross-section below. A chicken farm for gifted chickens (our poultry future!) has been built at the location specified. Also shown below is a cumulative probability function for streamflow at the gifted chicken farm location. What return period flood event will drown the chickens (or at least require them to quickly fabricate a raft out of common barnyard materials in hope of saving their lives)? (27.3 points)



*Drawing not to scale.
The channel is symmetric about its center.*



Answer: _____ year flood