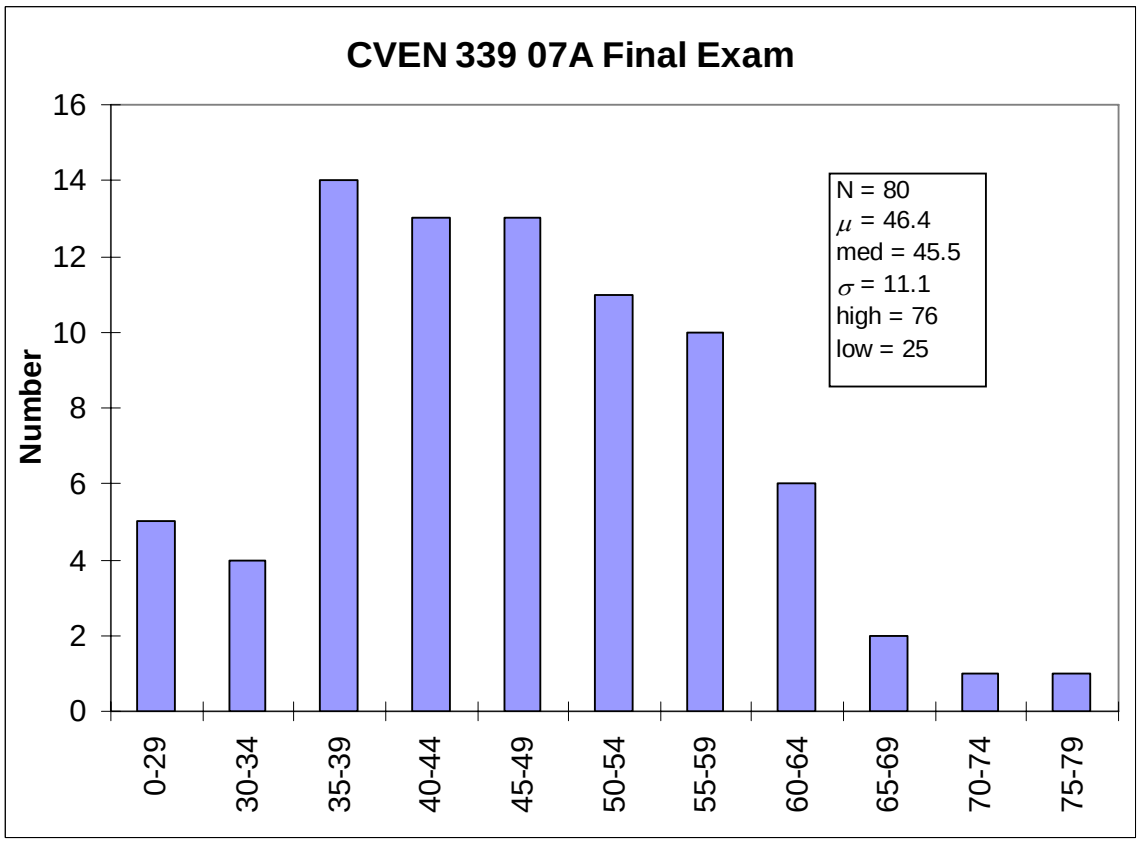
CVEN 339 – Final Exam – Spring 2007

80 Students

Median	45.5
Mean	46.4
St. Dev.	11.1
High	76
Low	25

Histogram:



Name: _____

CVEN 339 – Water Resources Engineering
Spring Semester 2007
Drs. Kelly Brumbelow and Anthony Cahill, Texas A&M University

Final Exam

Open-book, Open-notes (13 pages, front & back, not including reference sheets; 31 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 20 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 2 points. ***Clearly* write the letter corresponding to the best answer in the blank provided.**

1. A rectangular open channel has bottom width 7.2 ft, Manning's roughness coefficient 0.020, and a total constructed depth of 5.0 ft. If water flows in the channel at flow velocity 4.6 ft/sec and Froude number equal to 1.8, what is the volumetric flowrate in the channel?

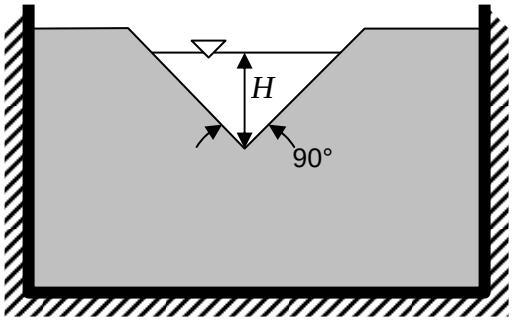
   (A) 2.63 ft^3/sec
   (B) 6.72 ft^3/sec
   (C) 22.1 ft^3/sec
   (D) 166 ft^3/sec

   Answer #1: _____

2. Flow in an open channel passes over a v-notch weir as shown in the figure below. If the flowrate in the channel is 2.04 m^3/s, what is the correct value of the dimension *H*?

   (A) 1.46 m
   (B) 0.92 m
   (C) 1.04 m
   (D) 1.16 m

   Answer #2: _____



3. A galvanized iron pipe is 3000 feet long and 12 inches in diameter. Water flows through the pipe at a flowrate of 2.40 ft^3/sec. The elevations of the pipe at its beginning and end are 90.0 ft and 70.0 ft, respectively. If the static pressure in the flow at the beginning of the pipe is 75.0 psi, what will be the static pressure in the flow at the end of the pipe (psi)?

   (A) 110.9
   (B) 80.6
   (C) 71.9
   (D) 52.5

   Answer #3: _____

4. In question 3 above, if the galvanized iron pipe were replaced with a cast iron pipe of the same length and diameter and the flowrate and static pressure at the beginning of the pipe were unchanged, which of the following would be true?

   I. The static pressure at the end of the pipe will decrease.
   II. The Reynolds number of the pipe flow will decrease.
   III. The flow velocity will decrease.

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

   Answer #4: _____

5. The piezometric head at monitoring well "A" is measured to be 437.2 m, and the piezometric head at monitoring well "B" is measured to be 445.2 m. The distance between the two wells is 1500 m. If the saturated hydraulic conductivity of the aquifer is 0.018 m/hr, what is the bulk velocity and direction of flow in the aquifer?

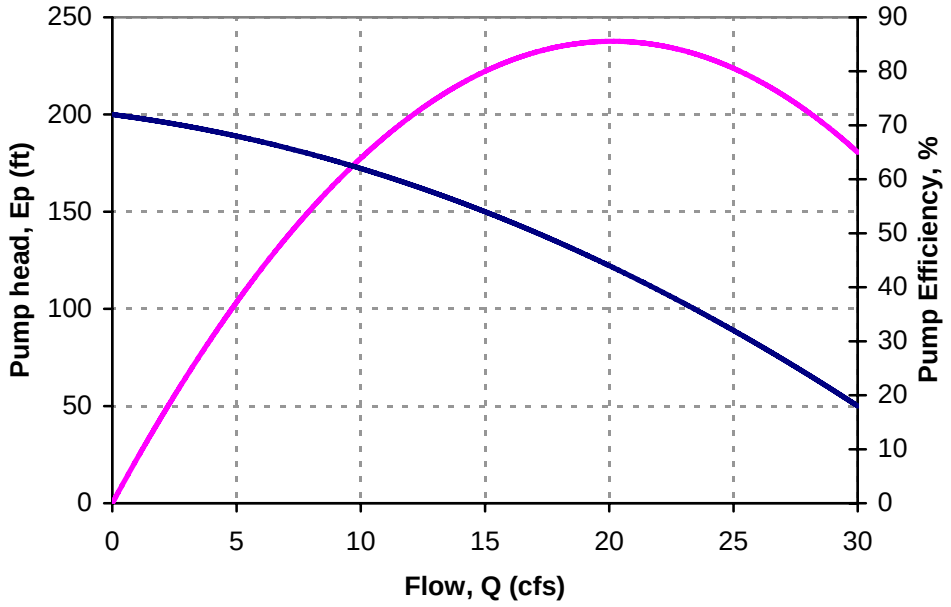
   (A) 9.59×10^{-5} m/day from B to A
   (B) 2.30×10^{-3} m/day from B to A
   (C) 9.59×10^{-5} m/day from A to B
   (D) 2.30×10^{-3} m/day from A to B

   Answer #5 _____

6. The characteristic and efficiency curves for a pump are given in the figure below. The pump will be installed at the beginning of a pipeline connecting two reservoirs. The friction loss for the pipeline is defined by the following equation:

   Friction loss (ft) = 0.30 Q^2 (cfs) for 2 cfs < Q < 19 cfs

   What is the maximum possible elevation difference (ft) between the two reservoirs for which flowrate in the pipeline will be at least 13 cfs?



   (A) 160
   (B) 156
   (C) 200
   (D) 89

   Answer #6: _____

7. On a specific date, piezometric head is measured at two monitoring wells, and the groundwater flow between the wells is also measured. Some time later the flow is measured again and is found to have increased significantly. Which of the statements below is the <u>least likely</u> explanation for the increase in groundwater flow?

   (A) Saturated hydraulic conductivity in the aquifer has increased
   (B) Head at the upstream well has increased
   (C) Head at the downstream well has decreased
   (D) Head at the upstream well has increased and head at the downstream well has decreased

   Answer #7: _____

8. A triangular open channel has Manning's roughness coefficient 0.015, longitudinal slope 0.001, and sideslopes 3H:1V. If the flowrate in the channel is 17.4 m^3/s, what is the Froude number of the flow?

   (A) 0.64
   (B) 0.92
   (C) 0.51
   (D) 28.7

   Answer #8: _____

9. The flowrate in a rectangular open channel is 20.6 ft^3/sec. The channel is 11.2 feet wide and has Manning's roughness coefficient 0.012 and longitudinal slope 0.003. If normal depth in the channel at this flowrate is equal to critical depth, what is the mean shear stress on the channel bed (lb/ft^2)?

   (A) 0.088
   (B) 12.8
   (C) 0.081
   (D) 0.311

   Answer #9: _____

10. The probability of at least one 20 year storm occurring in a 10-year period is:

   (A) 0.05
   (B) 0.32
   (C) 0.40
   (D) 0.88

   Answer #10: _____

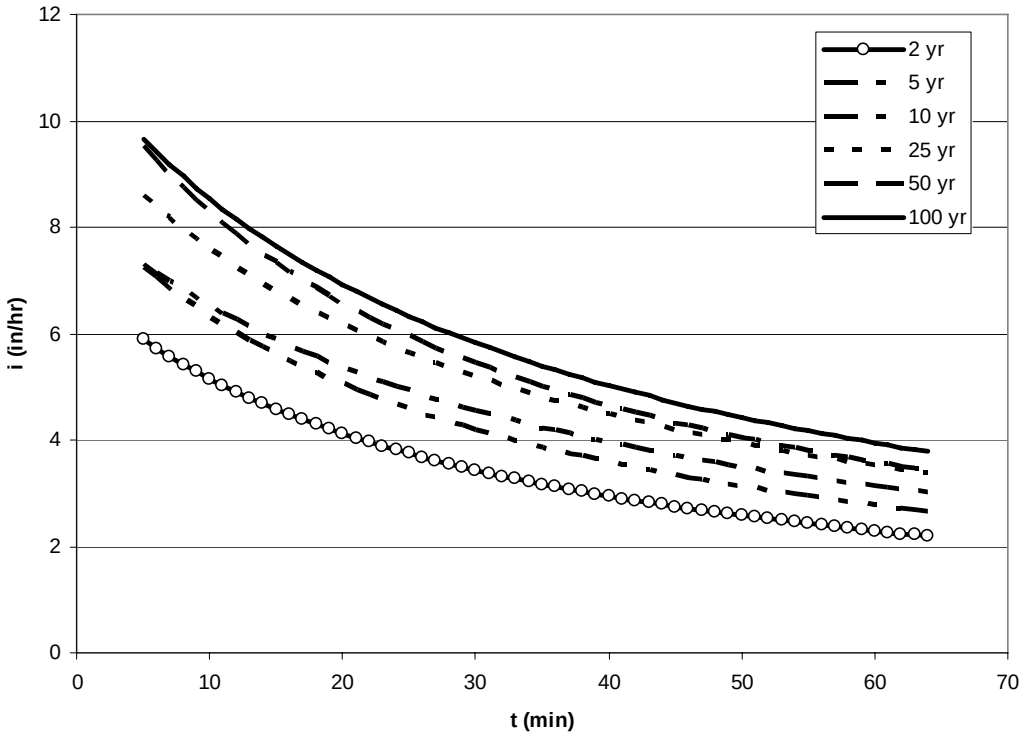
11. Which of the following statements are true?

   An IDF curve and a DDF curve:
   I. Contain the same information
   II. Curve the same way
   III. Are both derived from flood frequency curves

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

   Answer #11: _____

Please use the following intensity duration-frequency curves for questions 12 and 13.



12. A storm produced 4 inches in 30 minutes. The exceedence probability is most nearly:

    (A) 0.01
    (B) 0.05
    (C) 0.20
    (D) 0.50

    Answer #12: _____

13. A three acre watershed with a time of concentration of 15 minutes has a runoff coefficient of 0.4. Given the IDF curves above, what is the peak flow from a 25 year storm?

    (A) 6 ft^3/sec
    (B) 7.2 ft^3/sec
    (C) 8.4 ft^3/sec
    (D) 9.1 ft^3/sec

    Answer #13: _____

14. Which of the following statements are true?

Bulletin 17B is the preferred method for flood frequency analysis in civil engineering practice in the United States because:

I. It always provides the most accurate answer.
II. The government has recommended this method.
III. It is the easiest method.
IV. It yields highly conservative estimates, and is therefore the safest method for design.

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

Answer #14: _____

15. What percentage of a storm of 3.1 inches, of duration 80 minutes, becomes runoff if the watershed curve number is 66?

(A) 1 %
(B) 9 %
(C) 19%
(D) 76%

Answer #15: _____

16. Which of the following statements are true?

Puls and Muskingum routing are the same except:

I. one is for rivers, the other is for streams.
II. in one the outflow depends on storage and inflow, in the other it depends on storage only.
III. one was invented by Mr. Puls, the other by Mr. Muskingum.

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

Answer #16: _____

17. The Muskingum coefficients for a stretch of river are K = 2 hr and x = 0.1, with a delta t of 1 hr. C0, C1 and C2 (or C1, C2 and C3 in your book's notation) are:

(A) C0 = 0.05, C1 = 0.43, C2 = 0.52
(B) C0 = 0.13, C1 = 0.30, C2 = 0.57
(C) C0 = 0.23, C1 = 0.54, C2 = 0.23
(D) C0 = 0.29, C1 = 0.42, C2 = 0.29

Answer #17: _____

18. For a watershed with the 1 hour unit hydrograph below and a baseflow of 50 cfs, what is the peak flow (cfs) for a 2 hour storm in which 2 inches of rain fall?

t (hr)	1 hr UH (cfs)
0	0
1	100
2	300
3	500
4	400
5	300
6	200
7	100
8	0
9	0

(A) 1800
(B) 1050
(C) 950
(D) 500

Answer #18: _____

19. In the Bulletin 17B method, the log Pearson type III frequency factors depend on:

I. return period
II. skewness
III. geographic location of the watershed

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

Answer #19: _____

20. Which of the following statements are true?

For a given watershed the 2-hour unit hydrograph will:

I. have a longer time base than the 1-hour unit hydrograph
II. have a higher peak flow than the 1-hour unit hydrograph
III. be equal to the sum of 2 unit-hydrographs

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

Answer #20: _____

Questions 21 to 30 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 4 points. ***Clearly* write the letter corresponding to the best answer in the blank provided.**

21. A direct runoff hydrograph from a 10 mi2 watershed is given below. What is the peak flow (per inch of rain) of the unit hydrograph derived from this data?

t (hr)	DRH (cfs)
0	0
1	100
2	300
3	500
4	400
5	300
6	200
7	100
8	0
9	0

(A) 2.6 cfs/in
(B) 170 cfs/in
(C) 300 cfs/in
(D) 500 cfs/in

Answer #21: _____

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

Well 1: (– 1050 ft, 3975 ft), head = 365.2 ft
Well 2: (12020 ft, 10760 ft), head = 355.4 ft
Well 3: (5520 ft, – 2020 ft), head = 323.2 ft

The aquifer's thickness and transmissivity are 150 ft and 6.0 ft^2/day, respectively. The average velocity of flow (ft/day) in this aquifer is:

(A) 3.99×10^{-4}
(B) 2.90×10^{-2}
(C) 1.35×10^{-3}
(D) 1.93×10^{-4}

Answer #22: _____

23. A potential design for a trapezoidal open channel has been found to exceed allowable bed shear stress at the design flow. Which of the following design changes would likely decrease the bed shear stress?

I. Decreased longitudinal slope
II. Increased bottom width
III. Decreased side slope

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

Answer #23 _____

24. A pump has the pump characteristic curve defined below:

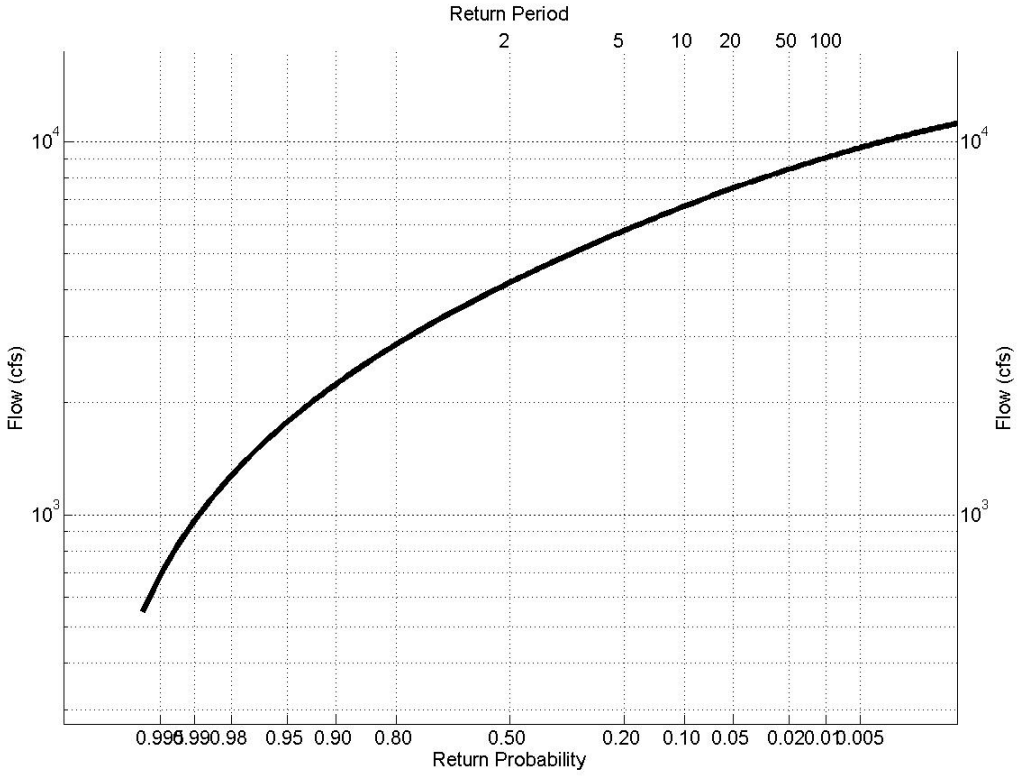
Head (ft) = $100 - 0.002\ Q^2$ (Q in gpm)

When the pump inputs water to a pipeline that has static head of 15 ft, the flowrate in the pipeline is 168 gpm. If a second identical pump is placed in parallel with the first pump, what will be the new flowrate (gpm) in the pipeline?

(A) 192
(B) 336
(C) 238
(D) 206

Answer #24 _____

25. A flood frequency curve is given below. What is the probability that the annual maximum flow will be over 6000 cfs in three consecutive years?



(A) 0.008
(B) 0.2
(C) 0.5
(D) 0.6

Answer #25: _____

26. A storm hyetograph is given below. The watershed has a curve number of 70. Derive the **total** runoff in inches over time.

time (hr)	rainfall (in/hr)
1	2
2	3
3	1

(Continued on next page)

(A)

time (hr)	V (in)
1	0.240602
2	0.714286
3	0.004608

(B)

time (hr)	V (in)
1	0.210526
2	0.491525
3	0.545455

(C)

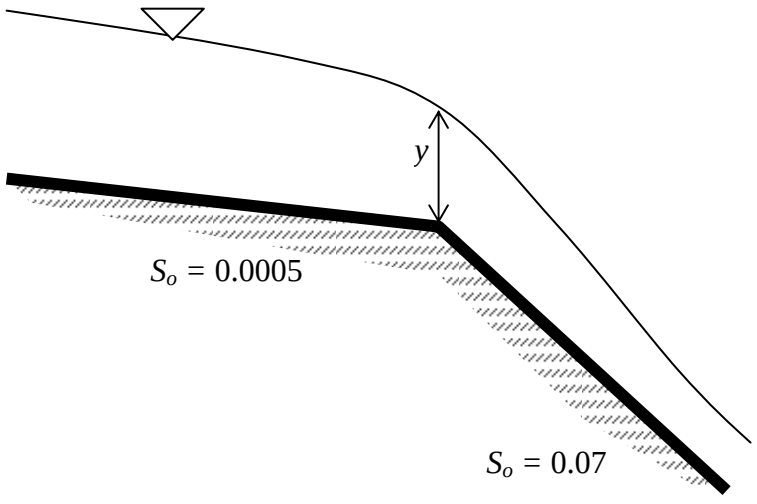
time (hr)	V (in)
1	0.414474
2	2.402542
3	3.208333

(D)

time (hr)	V (in)
1	0.240602
2	2.03632
3	2.805195

Answer #26: _____

27. A rectangular open channel includes a change in slope as shown in the figure below. The channel has width 15.4 m and Manning's roughness coefficient 0.018. If the dimension *y* is 2.50 m, what will be the flow depth (m) far downstream of the change in slope?



(A) 0.55
(B) 0.71
(C) 1.38
(D) 3.51

Answer #27:_____

28. For the channel in question 27 above, what is the minimum possible value of specific energy (m) for a flowrate of 75.0 m^3/s?

(A) 2.01
(B) 3.00
(C) 1.35
(D) 2.50

Answer #28 _____

29. Using Muskingum routing with K = 5 hr and x = 0.25 with delta t = 3 hr (C0 = 0.05, C1 = 0.52, C2 = 0.43), find the peak outflow for the given inflow.

t	I	O
0	500	500
3	800	
6	1100	
9	900	
12	700	
15	500	

(A) 800 cfs
(B) 915 cfs
(C) 1010 cfs
(D) 2200 cfs

Answer #29 _____

30. Given the 5 annual maximum flows and a log-Pearson type III 100-year return period frequency factor K_{100} = 1.880, what is the estimated 100 year flow?

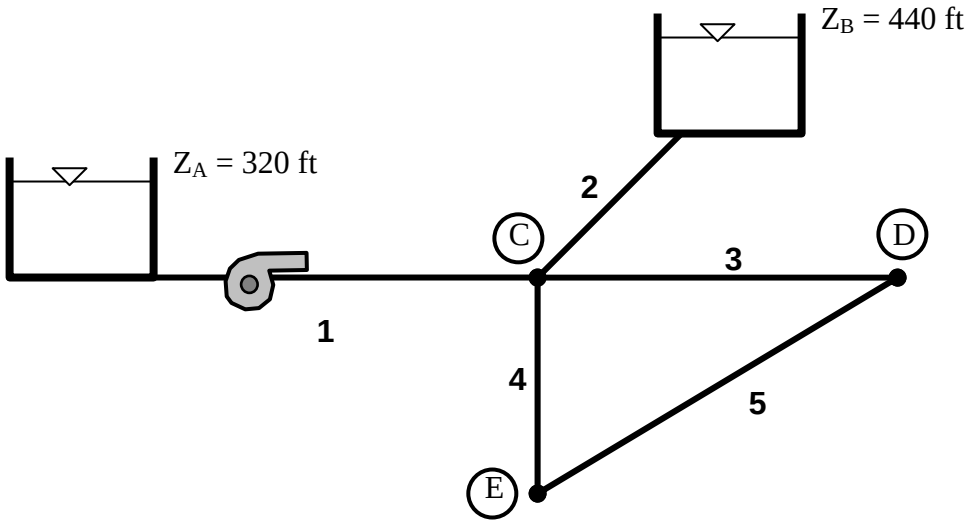
yr	Q (cfs)
2002	1100
2003	2100
2004	2400
2005	3700
2006	970

(A) 4140 cfs
(B) 5200 cfs
(C) 6000 cfs
(D) There is too little data to answer the question.

Answer #30 _____

Question 31 is a "long-form" free response question. Partial credit will be awarded on this problem. Please attach all work for this problem to the exam paper.

31. A small pipe network is shown below. Nodal demands and elevations and pipe lengths are given in the tables. All pipes are 24 inches in diameter and have friction factor *f* equal to 0.014. The pump's characteristic equation is $E_p = -0.15Q^2 - 1.5Q + 180$ ($[E_p]$ = ft, $[Q]$ = cfs). Solve for the flow in the 5 pipes (in cfs) and pressures at nodes *C*, *D*, and *E* (in psi). (20 points)



Node	Demand (cfs)	Elevation (ft)
C	4.5	330
D	3.2	350
E	0.5	360

Pipe	Length (ft)
1	5000
2	3000
3	2000
4	2000
5	5000

Answers:

Q_1 = _____cfs

Q_2 = _____cfs

Q_3 = _____cfs

Q_4 = _____cfs

Q_5 = _____cfs

P_C = _____psi

P_D = _____psi

P_E = _____psi