Name: _____

CVEN 339 – Water Resources Engineering
Summer Semester 2007
Dr. Kelly Brumbelow Texas A&M University

Final Exam

Open-book, Open-notes (9 pages, front & back, not including reference sheets; 19 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.

Questions 1 to 12 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 3 points. ***Clearly* write the letter corresponding to the best answer in the blank provided.**

1. A trapezoidal open channel has bottom width 4.0 ft, Manning's roughness coefficient 0.020, 1H:1V sideslopes, and longitudinal bed slope 0.041. If the flow in the channel 172 ft^3/sec, what is the depth of flow (ft)?

   (A) 4.15
   (B) 3.19
   (C) 2.62
   (D) 1.80

   Answer #1: _____

2. The value of the Froude number for the flow in problem 1 is:

   (A) 4.48
   (B) 2.48
   (C) 2.16
   (D) 0.37

   Answer #2: _____

3. A preliminary design for a triangular open channel is found to be wider than is allowable. Which of the following design changes could be made to make the channel narrower and still accommodate the same flowrate?

I. Decrease longitudinal bed slope
II. Decrease Manning's roughness
III. Decrease horizontal component of sideslope

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

Answer #3: _____

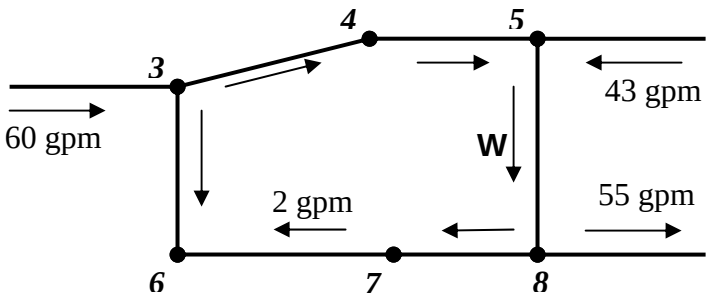
4. In the year 2007, a 50 year flood occurs at a particular streamgage. What will be the probability of a 5 year flood occurring at the same streamgage in the year 2008?

(A) 20%
(B) 10%
(C) 5%
(D) 0.4%

Answer #4: _____

5. A small section of a pipe network is shown below. What is the flow in Pipe W (gpm)?

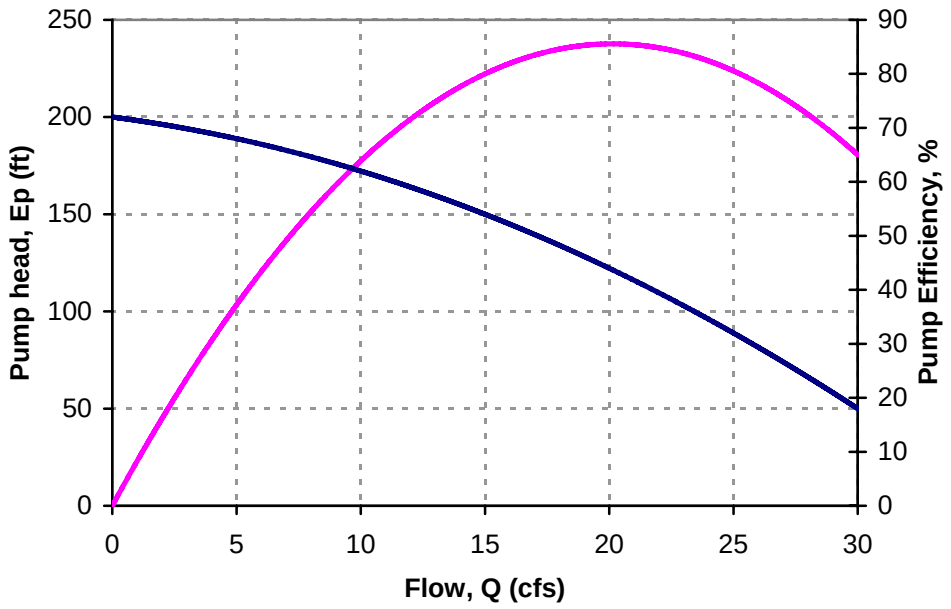
Node	Demand (gpm)
3	10
4	4
5	15
6	6
7	13
8	0



(A) 70
(B) 28
(C) 40
(D) 74

Answer #5 _____

6. The characteristic and efficiency curves for a pump are given in the figure below. What is the pump's shaft power (hp) at its best efficiency point? (1 hp = 550 ft•lb/sec)



(A) 1210
(B) 640
(C) 334
(D) 284

Answer #6: _____

7. A series of identical pumps will be installed at the beginning of a pipeline connecting two reservoirs. Each pump has the data given in problem 6. The ending reservoir is 120 ft higher then the starting reservoir. The friction loss for the pipeline is defined by the following equation:

Friction loss (ft) = $0.72\ Q^2$ (cfs) for 5 cfs < Q < 25 cfs

What is the minimum number of pumps in series that is required so that flowrate in the pipeline will be at least 18 cfs?

(A) 4
(B) 3
(C) 2
(D) 1

Answer #7: _____

8. A watershed has a NRCS curve number of 52. What will be the depth of runoff (in) resulting from a 4 hour storm with total rainfall 1.30 in?

   (A) 0
   (B) 0.68
   (C) 1.30
   (D) 9.23

   Answer #8: _____

9. Which of the following parameters is/are <u>not</u> required to derive a reservoir routing curve?

   I. Reservoir storage as a function of depth
   II. Length of culverts used as reservoir outflow structures
   III. Length of time step to be used in reservoir routing calculations

   (A) I and III
   (B) II and III
   (C) II only
   (D) None of the above

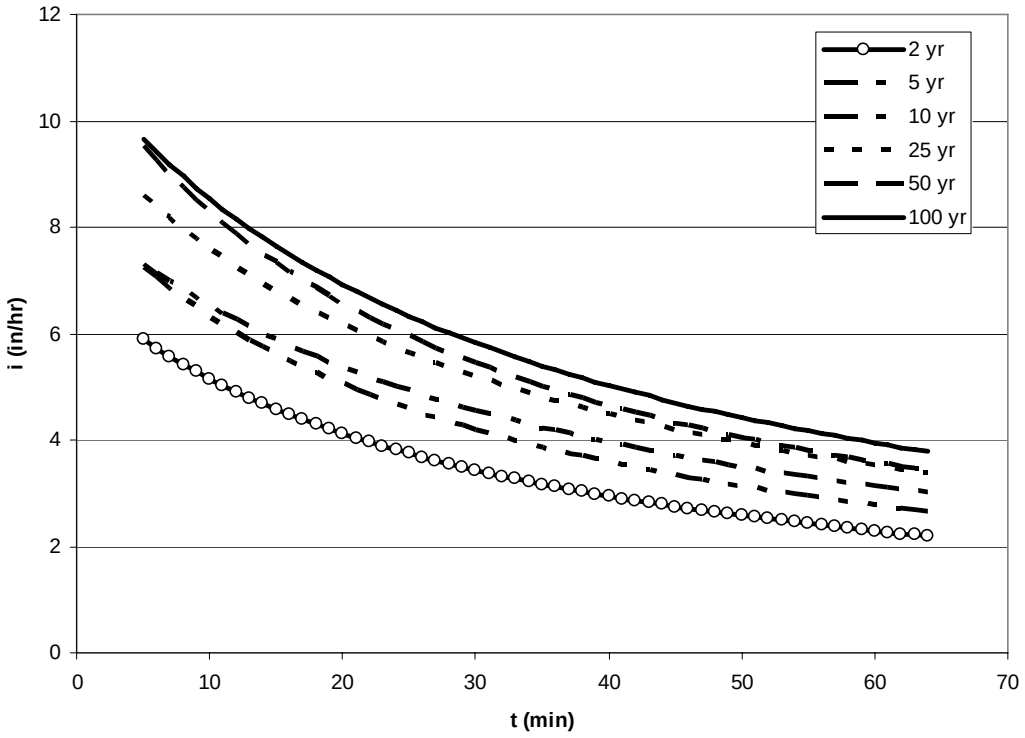
   Answer #9: _____

10. In a confined aquifer the piezometric head at monitoring well "X" is measured to be 114.2 m, and the piezometric head at monitoring well "Y" is measured to be 110.3 m. The distance between the two wells is 1200 m. If the transmissivity of the aquifer is 20.2 m^2/day and the thickness of the aquifer is 120 m, what is the bulk velocity of flow (m/day) in the aquifer:

    (A) 6.55×10^{-1}
    (B) 6.57×10^{-2}
    (C) 5.46×10^{-3}
    (D) 5.46×10^{-4}

    Answer #10: _____

Please use the following intensity-duration-frequency (IDF) curves for questions 11 and 12.



11. The depth of rainfall (inches) expected for the 10 year, 25 minute storm is:

    (A) 1.3
    (B) 2.1
    (C) 5.0
    (D) 7.8

    Answer #11: _____

12. According to the Rational Method and the given IDF curves, the magnitude of the 5 year design flood for a watershed having area 0.4 mi^2, runoff coefficient 0.45, and time of concentration 60 minutes is:

    (A) 403 ft^3/sec
    (B) 640 ft^3/sec
    (C) 207 ft^3/sec
    (D) 288 ft^3/sec

    Answer #12: _____

Questions 13 to 18 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 6 points. ***Clearly* write the letter corresponding to the best answer in the blank provided.**

13. The flow in a rectangular open channel is 3 ft^3/sec and is subcritical. The channel is 2 ft wide and has Manning's roughness coefficient 0.015 and longitudinal slope 0.002. Which of the following statements would be true for the supercritical flow in this channel having the same specific energy?

    I. The depth of the supercritical flow would be 0.28 ft.
    II. The slope required for the supercritical flow would be 0.147.
    III. The specific energy for both the subcritical and supercritical flows would be 0.72 ft.

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

    Answer #13: _____

14. Three monitoring wells have been drilled into an unconfined aquifer. The coordinates and piezometric head at each well are:

    Well 1: (2500 m, 1000 m), head = 473.1 m
    Well 2: (3500 m, 500 m), head = 492.8 m
    Well 3: (500 m, -1200 m), head = 480.9 m

    The aquifer's saturated hydraulic conductivity is 0.17 m/day. The average velocity of flow in this aquifer is:

    (A) 6.28×10^{-5} m/day
    (B) 3.27×10^{-3} m/day
    (C) 9.63×10^{-4} m/day
    (D) 1.02×10^{-2} m/day

    Answer #14: _____

15. The 2 hr unit hydrograph for a watershed is given below. If a storm of duration 4 hrs and 6.2 in runoff depth falls on this watershed, the peak of the runoff hydrograph resulting from the storm is most nearly:

Time (hrs)	2 hr Unit Hydrograph (cfs/in)
0	0
1	150
2	420
3	320
4	160
5	70
6	0

(A) 1800 cfs
(B) 2300 cfs
(C) 2600 cfs
(D) 840 cfs

Answer #15: _____

16. The flow in a 6 m wide rectangular open channel is 12 m^3/s. If the flow starts as a supercritical flow of depth 0.2 m and goes through a hydraulic jump, what will be the depth of flow (m) after the hydraulic jump?

(A) 3.84
(B) 1.02
(C) 5.30
(D) 1.92

Answer #16:_____

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

Head (ft) = $75 - 0.002\ Q^2 - 0.2\ Q$ (Q in gpm)

The pipe network has a static head of 40 ft. The friction loss is defined by the following equation:

Friction loss (ft) = $0.005\ Q^2$ (Q in gpm)

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

(A) 90
(B) 58
(C) 13
(D) 75

Answer #17 _____

18. The 1 hr unit hydrograph given below was calculated from the rainfall-streamflow data for a 25 year flood. Which of the following statements can be shown to be true with the given data?

Time (hrs)	1 hr Unit Hydrograph (cfs/in)
0	0
1	1300
2	850
3	120
4	0

I. If the unit hydrograph had been calculated from data for the 100 year flood, its peak would be greater than 1300 cfs/in.
II. The watershed's peak runoff flow for the 5 year flood would be less than 1300.
III. The unit hydrograph has a 4% probability of being applicable in any given year.

(A) III only
(B) I and III
(C) I, II, and III
(D) None of the above

Answer #18: _____

Question 19 is a "work-out" question. Partial credit will be awarded on this problem. Please attach all work for this problem to the exam paper.

19. A rectangular open channel approaches a culvert as shown in the sketch below. The channel is 15.2 ft wide, has Manning's roughness 0.023, and has longitudinal slope 0.005. The flowrate in the channel and through the culvert is 95 cfs, the system is in steady-state, and the culvert flow is inlet controlled. The invert elevation of the culvert inlet is 800.00 ft, and the culvert diameter is 4.0 ft.

    (A) *Determine the depth of water and the elevation of the water surface at the culvert entrance*.

    (B) The flow in the open channel follows an M-1 profile as it nears the backwater created by the culvert entrance. Using the Direct Step method and the known water depth found in part (A), *determine the depth of water and the elevation of the water surface at the point 700 ft upstream of the culvert entrance*. To save time, you may wish to use a large value of Δy in your calculations and then linear interpolate between stations as necessary to the point 700 ft upstream.

    (28 points)

Not to scale