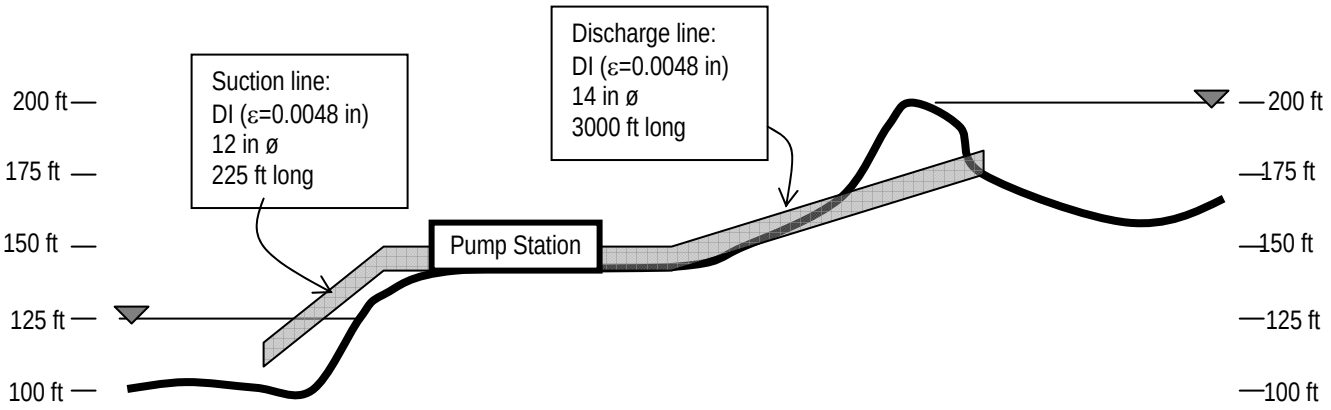
Name: _____

CVEN 458 – Hydraulic Engineering of WDS
Spring Semester 2009
Dr. Kelly Brumbelow, Texas A&M University

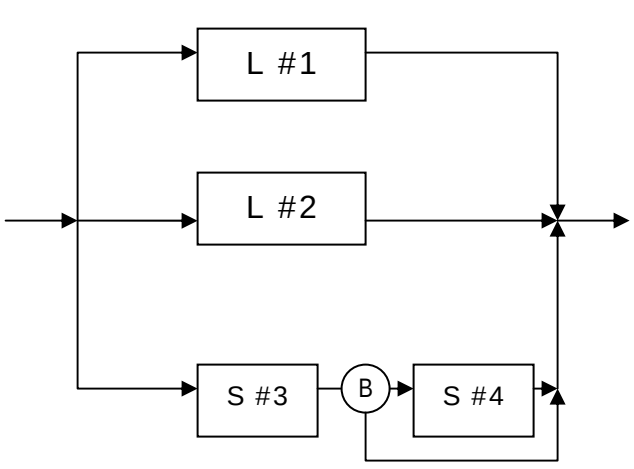
Exam #2

Open-book, Open-notes (8 pages {double-sided}, 3 questions); Time allowed: 90 minutes

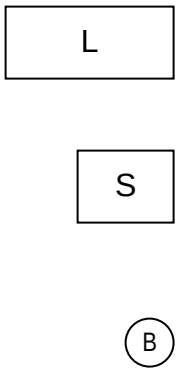
Questions 1-2 refer to the pump station/reservoir/pipeline system diagrammed below.



E L E V A T I O N



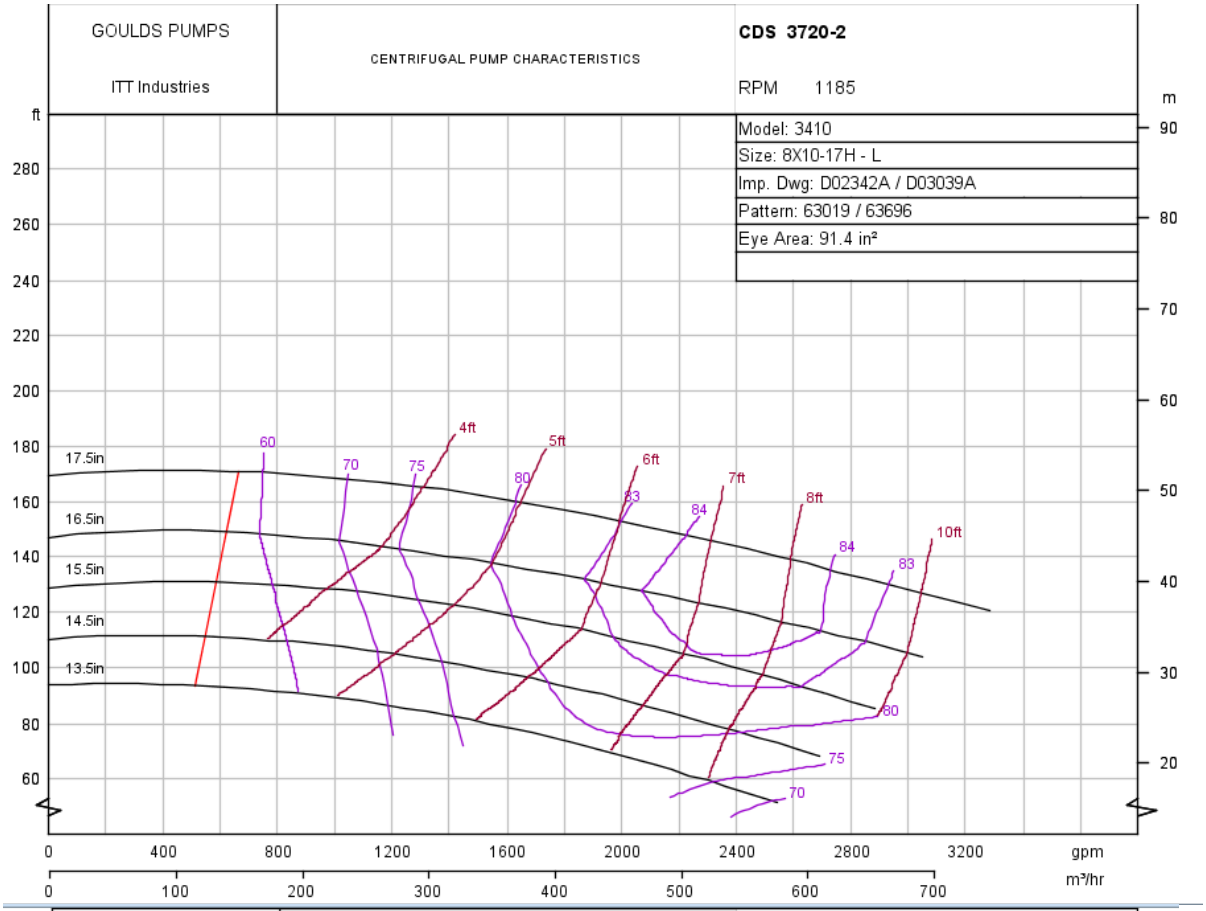
Pump Station Flow Schematic

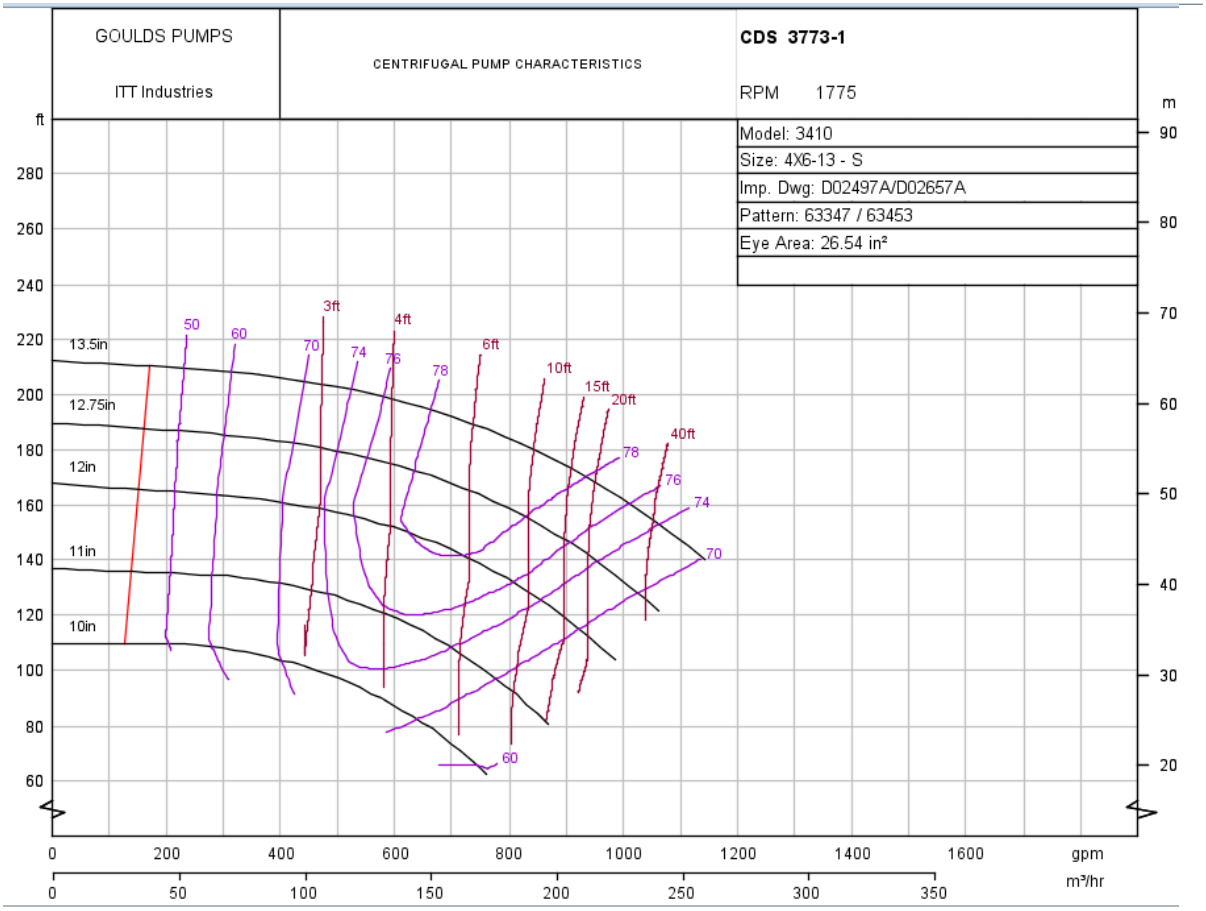


Goulds 3410 8x10-17-H-L, 1185 rpm, 16.5 in impellor

Goulds 3410 4x6-13-S, 1775 rpm, 11 in impellor

Bypass valve


GOULDS PUMPS
ITT Industries
CENTRIFUGAL PUMP CHARACTERISTICS
CDS 3720-2
RPM 1185
Model: 3410
Size: 8X10-17H - L
Imp. Dwg: D02342A / D03039A
Pattern: 63019 / 63696
Eye Area: 91.4 in²
ft
m
17.5in
16.5in
15.5in
14.5in
13.5in
4ft
5ft
6ft
7ft
8ft
10ft
gpm
m³/hr

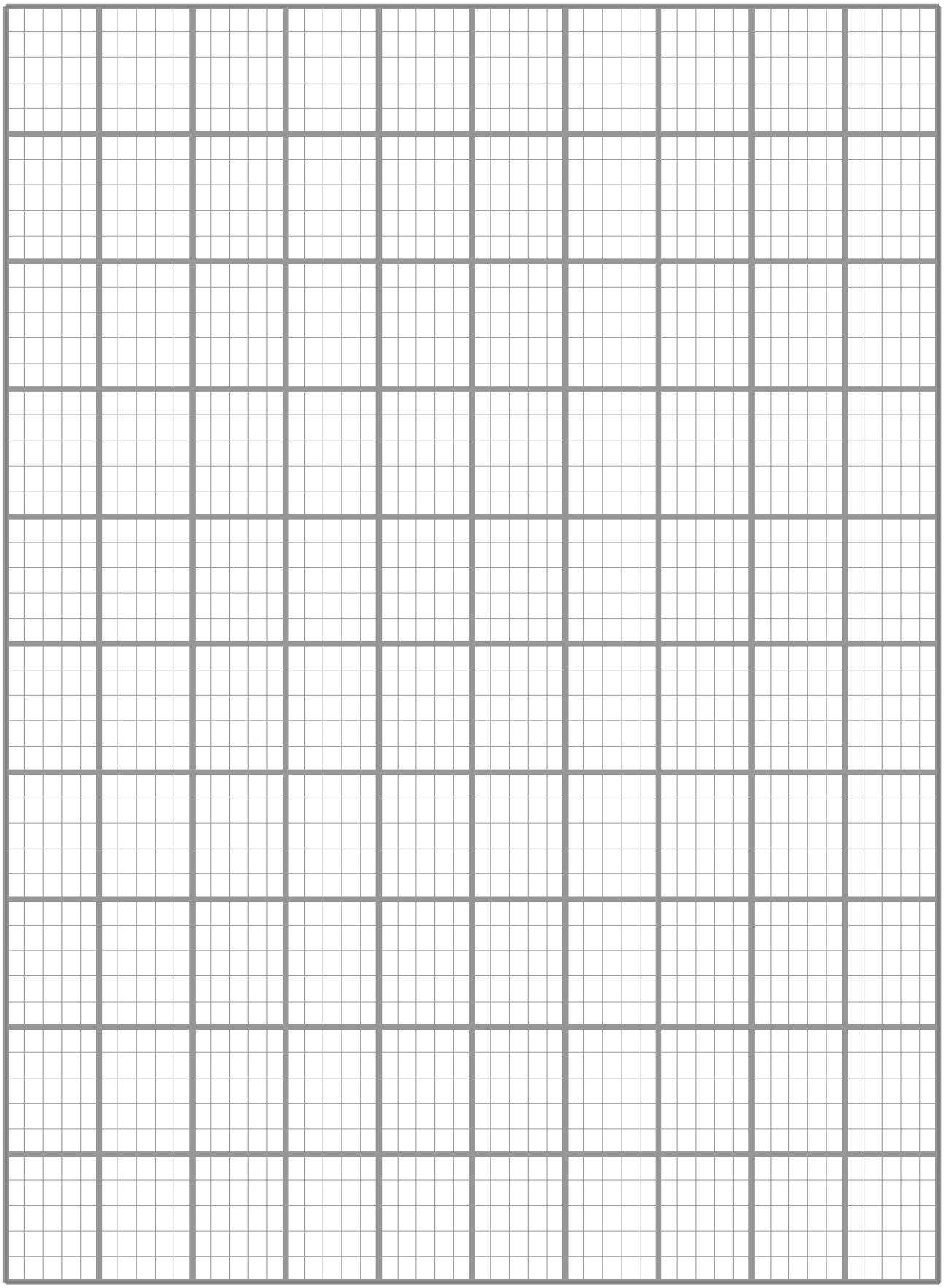

GOULDS PUMPS
ITT Industries
CENTRIFUGAL PUMP CHARACTERISTICS
CDS 3773-1
RPM 1775
Model: 3410
Size: 4X6-13 - S
Imp. Dwg: D02497A/D02657A
Pattern: 63347 / 63453
Eye Area: 26.54 in²
ft
m
13.5in
12.75in
12in
11in
10in
3ft
4ft
6ft
10ft
15ft
20ft
40ft
gpm
m³/hr

1. Determine the flowrate in the pipeline (gpm) and total shaft power consumption (kW) for the operating scenarios listed below. A sheet of blank graph paper is attached. (45 points)

{1 kW = 737.6 ft·lb/sec} {1 cfs = 448.8 gpm}

Scenario	Pumps Operating	Flow (gpm)	Shaft Power (kW)
A	All		
B	L #1, L #2, S #3		
C	L#1, S #3		

(Work space for #1)

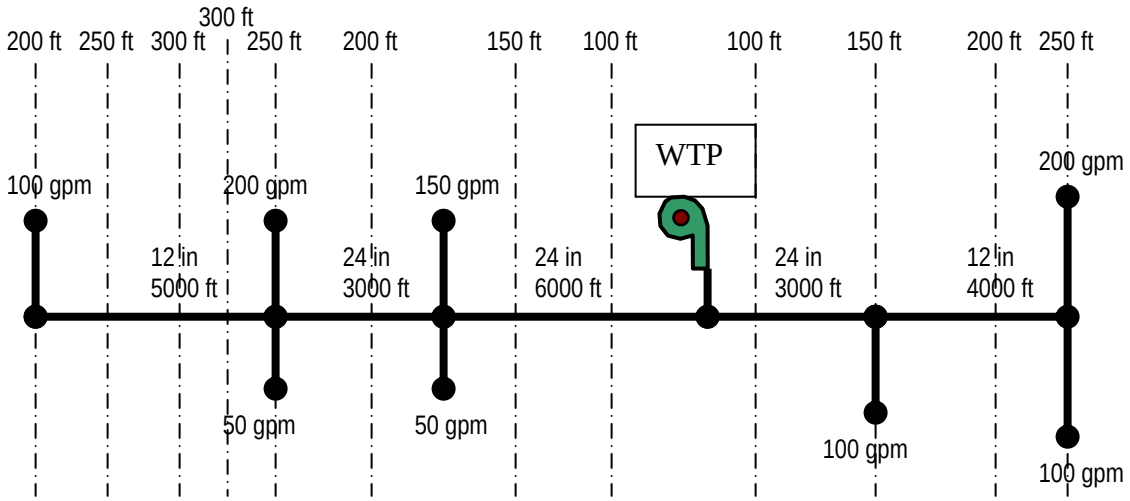


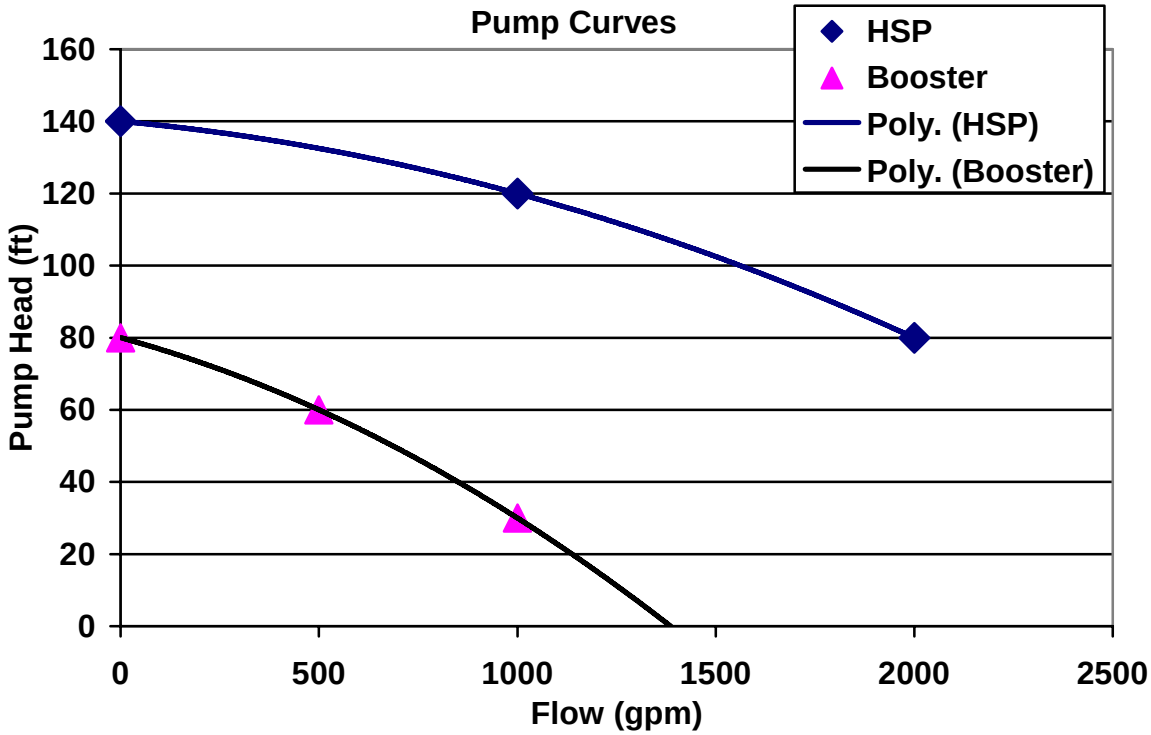
2. Will the pump station operate with sufficient NPSH? (25 points)

3. Diagrammed below is a simple WDS and the topography (dash-dot lines) of the area. Assume all pipes have Hazen-Williams C = 130; pipe diameters are given in inches and lengths in feet next to each pipe. The numbers next to nodes indicate nodal demand in gpm. Applicable codes state that pressure in the WDS must be maintained in the range 35-80 psi. Characteristic curves for the system's high service pump and the available model of booster pump are given below. You may assume that available pressure reducing valves decrease pressure by 25 psi. *Indicate on the diagram the necessary locations for booster pumps and pressure reducing valves.*

(30 points)

Hazen-Williams Eqn: $Q = 0.285\, C\, D^{2.63} \left(\frac{H_f}{L} \right)^{0.54}$, for [$Q$] = gpm, [$D$] = in, [$H_f$, L] = ft





{Work space for #3}