PROBLEM #1 - 25 points   <u>USE UNITS of METERS SECONDS and GRAMS</u>

Prepare a water budget for the year 2009 for the unconfined sedimentary aquifer that constitutes the basin illustrated below. The basin is surrounded by a topographic divide that coincides with the water table divide. Delineate each item of the water budget and show your calculations on the following page.

The unconfined aquifer has a Transmissivity of 120m^2/day and a Specific Yield of 0.12

The climate is such that evapotranspiration is about 90% of precipitation.

The basin is residential with approximately 5000 homes obtaining water from domestic wells.

Precipitation Stations Annual Precipitation for 2009 was the same as the average annual precipitation for the past century	
A	830 mm
B	620 mm

Water Level in meters Measured at the precipitation stations Contoured Water Levels are July 1, 2009		
Location	Jan 1, 2009	Dec 31, 2009
C	850.8 m	849.3 m
D	800.3 m	798.8 m
E	751.1 m	749.6 m

Stream Gage X 2009 Average Annual Discharge 26 meters^3/sec

DRAWN TO SCALE

Stream

Hydraulic head contour
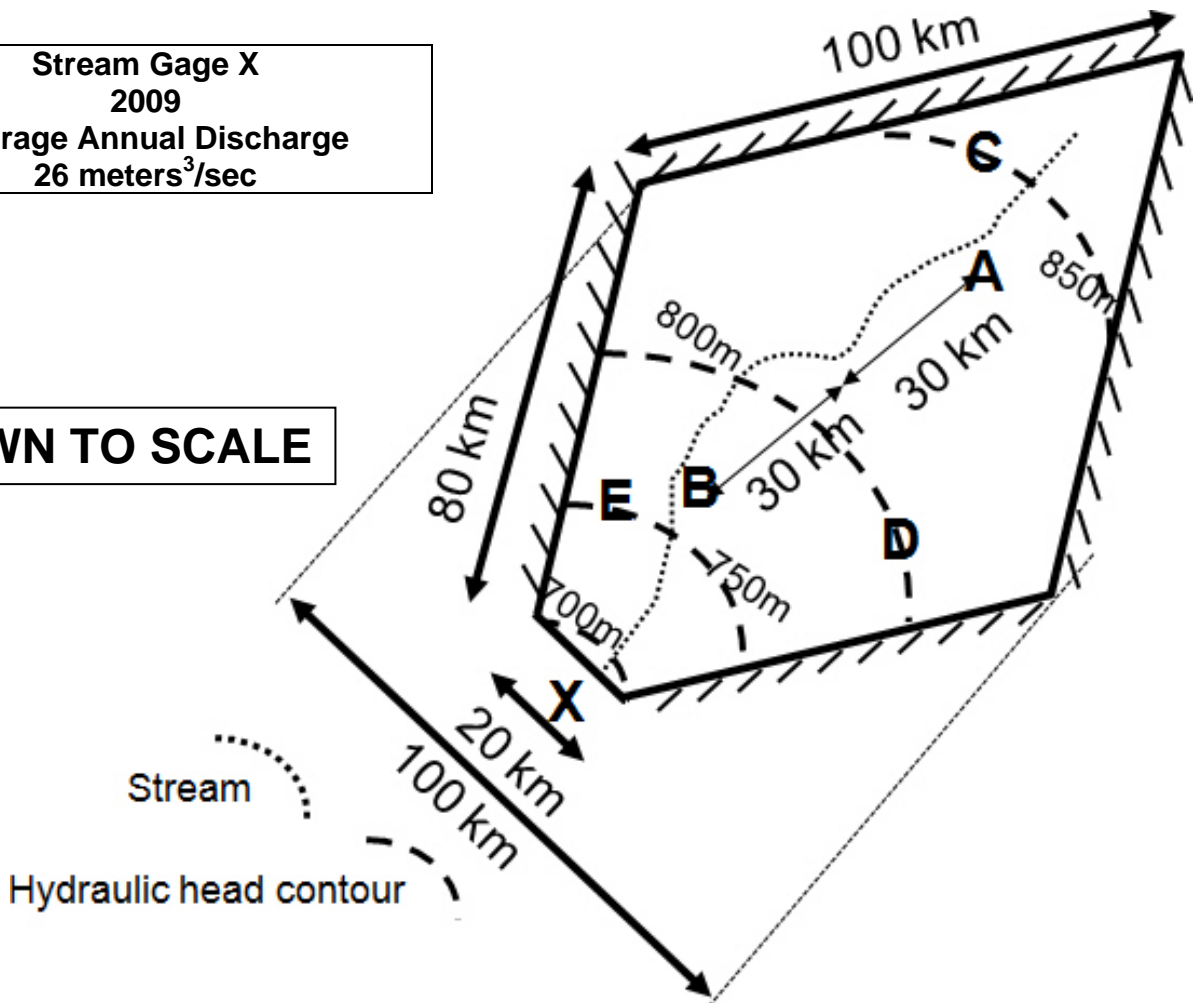
PROVIDE <u>CALCULATIONS AND ANSWERS TO PROBLEM 1</u> HERE

<u>USE UNITS of METERS SECONDS and GRAMS</u>

Delineate each item of the budget, show your calculations for each, and present the budget.

PROBLEM #2 – 25 points <u>USE UNITS of CENTIMETERS SECONDS and GRAMS</u>

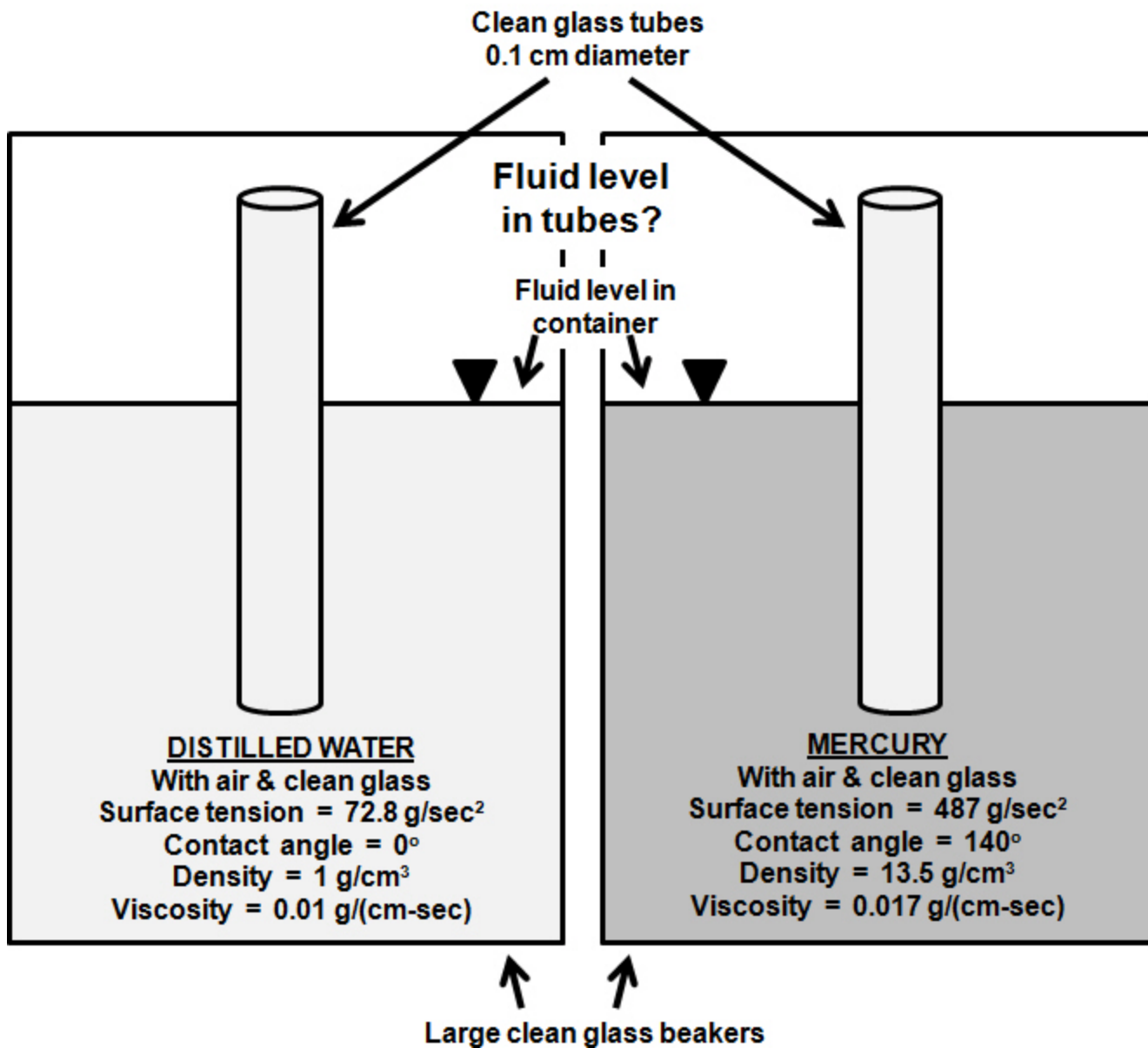Two identical clean glass beakers hold the same volume of fluid.

One contains distilled water and the other mercury.

A 0.1cm diameter glass tube is placed vertically in each beaker with the bottom of the tube suspended 10cm above the bottom of the beaker.

The properties of the fluids are indicated in the illustration below

ANSWER THE QUESTIONS ON THE FOLLOWING PAGE, SHOW YOUR WORK

NOT DRAWN TO SCALE

Clean glass tubes
0.1 cm diameter

Fluid level
in tubes?

Fluid level in
container

DISTILLED WATER
With air & clean glass
Surface tension = 72.8 g/sec²
Contact angle = 0°
Density = 1 g/cm³
Viscosity = 0.01 g/(cm-sec)

MERCURY
With air & clean glass
Surface tension = 487 g/sec²
Contact angle = 140°
Density = 13.5 g/cm³
Viscosity = 0.017 g/(cm-sec)

Large clean glass beakers

PROVIDE <u>CALCULATIONS AND ANSWERS TO PROBLEM 2 HERE</u>

<u>USE UNITS of CENTIMETERS SECONDS and GRAMS</u>

2a) On the diagrams of the precious page, draw a schematic of the fluid within each tube.

2b) What is the capillary rise of each fluid in the 0.1 cm diameter tubes?

2c) If the hydraulic conductivity for water in a porous medium is 3×10^{-2} cm/sec. What would the fluid conductivity be for mercury?
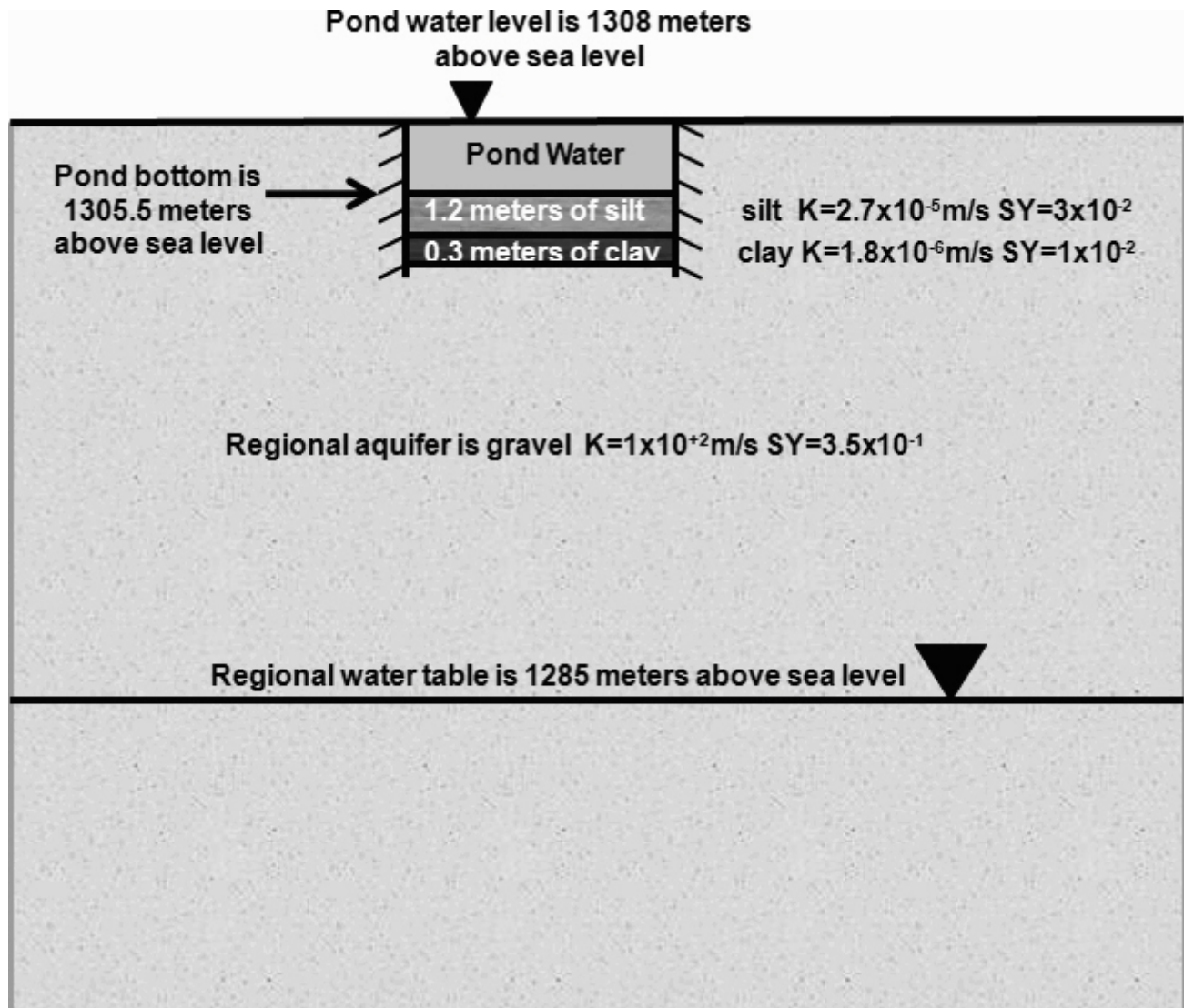
PROBLEM #3 – 25 points <u>USE UNITS of METERS SECONDS and GRAMS</u>

A 40 meter long by 36 meter wide man-made pond has impermeable steel walls to the bottom of the silt and clay lining as illustrated in the cross-sectional view below.

The system is at a steady state.

The regional water table is 23 meters below the pond surface.

ANSWER THE QUESTIONS ON THE FOLLOWING PAGE, SHOW YOUR WORK

Pond water level is 1308 meters above sea level

Pond Water

Pond bottom is 1305.5 meters above sea level

1.2 meters of silt

0.3 meters of clav

silt K=2.7×10^{-5}m/s SY=3×10^{-2}

clay K=1.8×10^{-6}m/s SY=1×10^{-2}

Regional aquifer is gravel K=$1 \times 10^{+2}$m/s SY=3.5×10^{-1}

Regional water table is 1285 meters above sea level

PROVIDE <u>CALCULATIONS AND ANSWERS TO PROBLEM 3 HERE</u>

 <u>USE UNITS of METERS SECONDS and GRAMS</u>

3a) What is the volumetric discharge from the base of the pond?

3b) What percentage of the pond volume is seeping through the bottom each day?

3c) Using sea level as your datum, what is the head at the contact between the silt and clay?

3d) What is the pressure at the same location that you calculated head for in b above?

3e) If we pumped the pond out and then allowed the silt and clay to drain completely, how much water would drain from the silt and clay?

PROBLEM #4 - 30 points   <u>USE UNITS of METERS SECONDS and GRAMS</u>
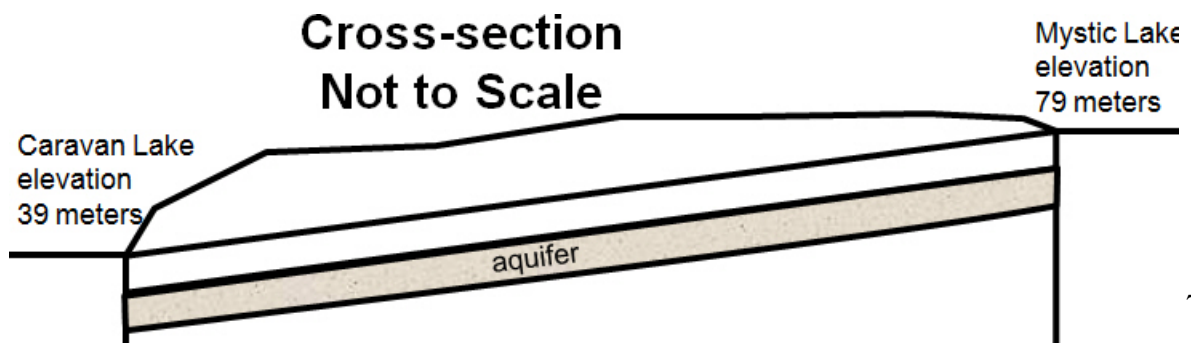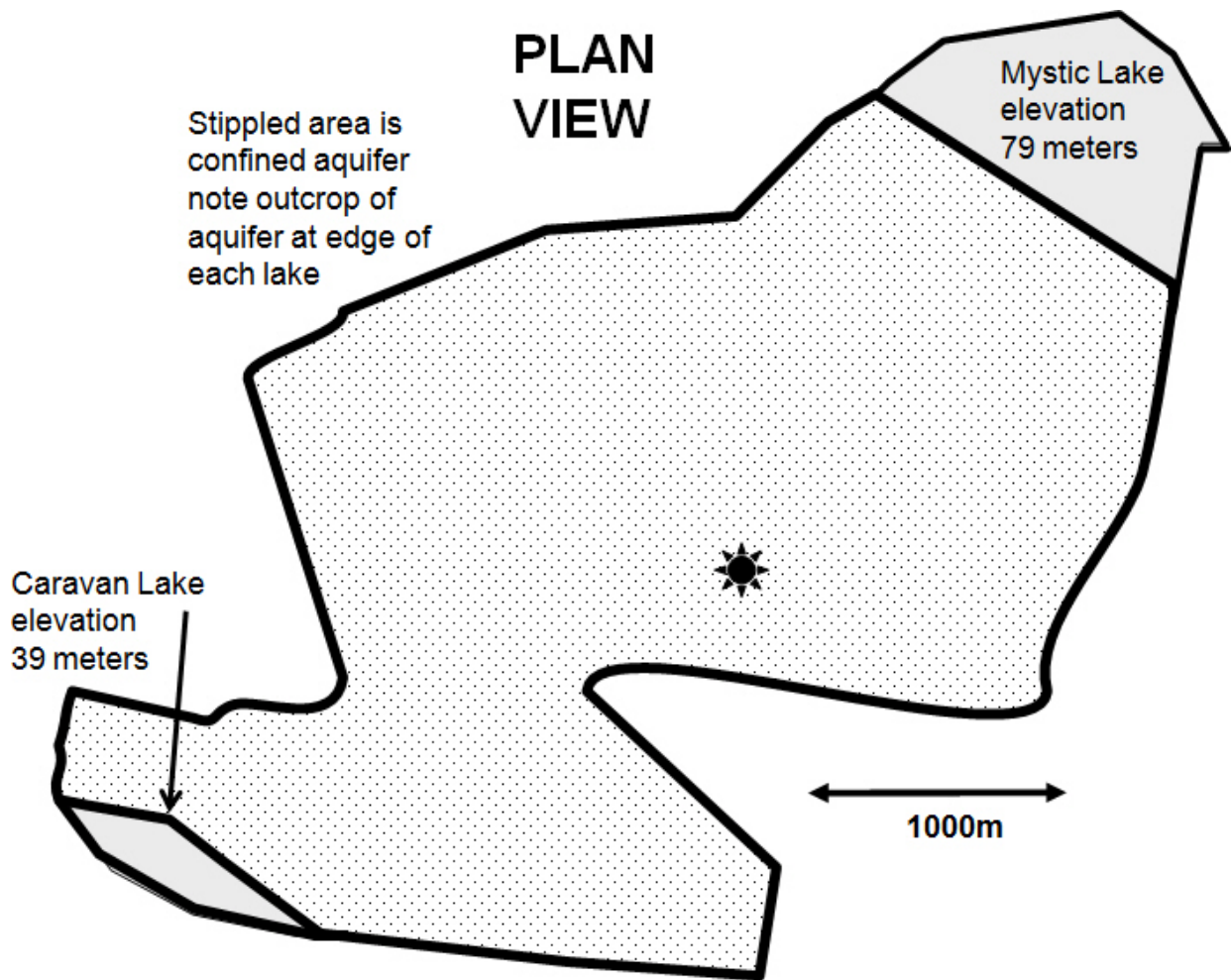
The confined aquifer illustrated in PLAN VIEW below is a uniform thickness of 13 meters.

It is underlain by low permeability bedrock and overlain by low permeability clay.

Both Mystic and Caravan lakes fully penetrate the thickness of the aquifer which has a vertical outcrop on the side of each lake (see cross-section view).

Hydraulic Conductivity of the aquifer is 5.3 cm/sec and its specific yield is 0.23.

ANSWER THE QUESTIONS ON THE FOLLOWING PAGE, SHOW YOUR WORK

PLAN VIEW

Mystic Lake elevation 79 meters

Stippled area is confined aquifer note outcrop of aquifer at edge of each lake

Caravan Lake elevation 39 meters

1000m

Cross-section Not to Scale

Mystic Lake elevation 79 meters

Caravan Lake elevation 39 meters

aquifer

PROVIDE CALCULATIONS AND <u>ANSWERS TO PROBLEM 4 HERE</u>

<u>**USE UNITS of METERS SECONDS and GRAMS**</u>

4a) Draw a PLAN VIEW flow net ON THE PLAN VIEW ON THE PREVIOUS PAGE and label the equipotential lines

4b) The ground elevation at the ☀ is 83m. What is the depth to water in the confined aquifer?

4c) The well at the ☀ detected the bottom of the aquifer at 50m below ground surface. What is the pressure at the bottom of the aquifer?

4d) Consider a drop of water in the confined aquifer that passes through the x,y location of the ☀ . How many <u>DAYS</u> does it take that drop to travel from Mystic Lake to Caravan lake?

4e) What is the volumetric flow rate from the confined aquifer to Caravan Lake?