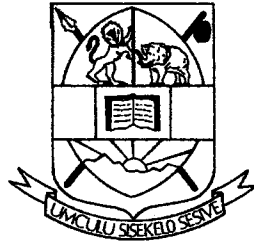


**2<sup>nd</sup> SEM. 2011/2012**

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**UNIVERSITY OF SWAZILAND  
FINAL EXAMINATION PAPER**

**PROGRAMME: BSC ABE III**

**COURSE CODE: ABE 304**

**TITLE OF PAPER: RURAL WATER SUPPLY AND HYDROLOGY**

**TIME ALLOWED: TWO (2) HOURS**

**INSTRUCTIONS: ANSWER QUESTION ONE AND ANY TWO  
OTHER QUESTIONS.**

**DO NOT OPEN THIS PAPER UNTIL PERMISSION HAS BEEN  
GRANTED BY THE CHIEF INVIGILATOR**

## SECTION I: COMPULSORY

## QUESTION 1

- A) Briefly explain the following terminology as used in groundwater analysis:
- i) An aquifer. (2 marks)
  - ii) Confined aquifer. (2 marks)
  - iii) An artesian aquifer. (2 marks)
  - iv) Perennial yield. (2 marks)
  - v) Transmissivity. (2 marks)
- B) A volume of water equal to  $40 \times 10^6 \text{ m}^3$  is pumped from an unconfined aquifer through wells uniformly distributed over an area of the aquifer equal to  $100 \text{ km}^2$ . The specific yield of the aquifer as determined by pump tests is  $S_y = 20\%$ . Determine the average draw down of the water table in meters assuming it is uniformly distributed over the area of the aquifer. (10 marks)
- C) A well penetrates a confined aquifer of coarse gravel 7.0 m thick and is screened throughout the thickness of the aquifer. Hydraulic conductivity measurements made in a well in the same region yield a value of 180 m/d. Two observation wells are installed at radial distances of 20 m and 120 m from the pumped well. The well is to be tested by pumping at a constant discharge of  $2725 \text{ m}^3/\text{d}$ . If the draw down in the observation well at 120 m distance is 1.26 m under steady state conditions, compute the expected drawdown in the well at 20 m distance. (10 marks)
- D) Given that a well test data from a constant rate test in a confined aquifer shows;  $t_0 = 0.42$  minutes and  $\Delta s = 0.60 \text{ m}$  with an observation well located 60 m from the pumped well. The discharge from the pumped well was held constant at  $2500 \text{ m}^3/\text{d}$ . compute the transmissivity and storativity of the aquifer. (10 marks)

[40 marks]

## SECTION II: ANSWER ANY TWO QUESTIONS

## QUESTION 2

- A) i. State the “continuity principle” in hydraulics and explain briefly its relevance in rural water supplies. **(10 marks)**
- ii. Water flows from a tank into a pipe at a rate of 1000.0 mL/s. Calculate the velocity of entrance into the pipe if the internal diameter of the inlet is 45 mm. **(5 marks)**
- B) i. What are the **two** major categories of water conveyance for rural water supplies? **(2 marks)**
- ii. Describe with the aid of a diagram the three categories of small community water distribution. **(13 marks)**
- [30 marks]**

## QUESTION 3

Figure 1 shows a pumping system to pump water to an elevated tank using a centrifugal pump (performance curve attached). The loss factors at the inlet and outlet are 0.5 and 1.5 respectively while the loss factor associated with the bend is 1.5. The diameter of the pipe is 0.050 m while the total pipe length is 400 m. In order to simplify the calculation you can assume that the friction factor is  $f = 0.036$ .

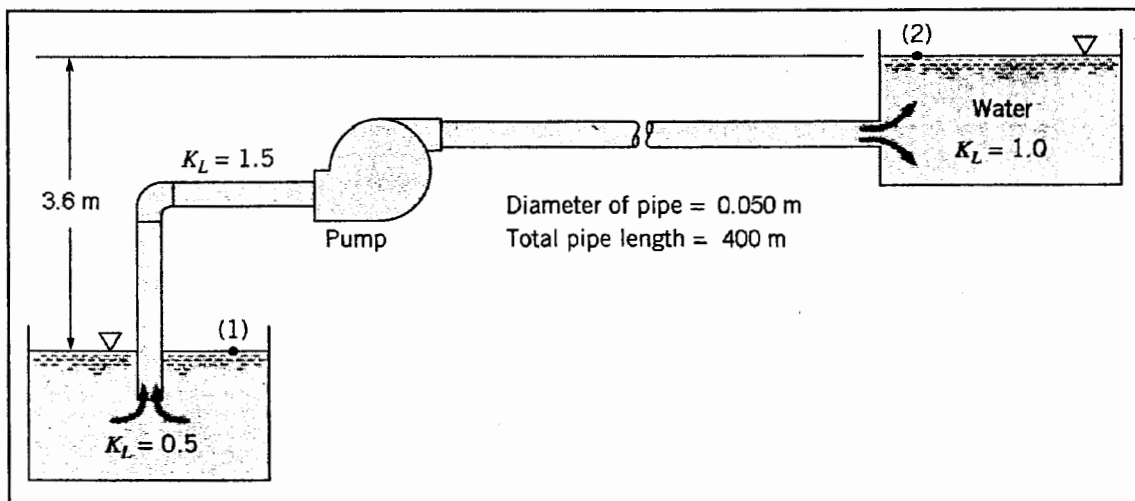


Figure 1. Water pumping system layout

- A) Determine the duty point of this pumping system and thus determine the flow rate of the pump for an impeller diameter of 140 mm? (10 marks)
- B) Also determine the shaft power of the pump and give an estimate of the pumps efficiency at the duty point. (10 marks)
- C) Given that the pump is located 1.80 m above the water surface (1), and the pipe length from inlet to pump is 6.0 m, determine the  $NPSH_A$  at the pump and state whether cavitation is likely to occur. (10 marks)

[30 marks]

#### QUESTION 4

- A) Briefly discuss the following concepts as used in rural water supply.
- i. Rooftop rainwater harvesting. (5 marks)
  - ii. Water collected from streams. (5 marks)
  - iii. Ground water extraction. (5 marks)
- B) The Water Services Corporation is responsible for **metered water supply** in Swaziland's urban areas. **Discuss** the major **challenges** of extending this social responsibility to provide such in rural areas? (15 marks)

[30 marks]

APPENDIX A: PUMP CURVE SELECTION

