MEBS6000 Utility Services

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Assignment 01 – Water Supply Systems, Drainage and Sewage Disposal (2025-2026)

1. Cold and Hot Water Supply Systems

1.1 Explain the typical process of planning and designing utility connections in urban cities. Comment on the pros and cons of using urban utility tunnels.

(10 marks)

1.2 Briefly describe the different types of surface and underground water sources in the world. Explain the general outlook of the future water resources in Hong Kong and list out the five main water resources.

(10 marks)

1.3 Explain why a balanced flue gas water heater is considered a better design arrangement than the conventional flue gas water heater. Discuss the important factors to consider when determining acceptable locations for the gas water heaters in residential buildings. Illustrate with diagram(s).

(10 marks)

1.4 A cold water tank is connected to a discharge pipe to give a water flow rate of 3 litre per second at the discharge point. If the static pressure head is 5 m and the effective length of pipe is 25 m, determine the appropriate pipe size using Thomas Box formula.

Thomas Box formula: $$q = \sqrt{\frac{d^5 \times H}{25 \times L \times 10^5}}$$

Explain the meaning and harmful effects of water hammer. Suggest measures to prevent its occurrence in water supply systems.

(10 marks)

1.5 An electric immersion heater is required to heat a 40 L tank of water. The initial water temperature is 20 °C and the final temperature required is 38 °C. Water must be brought up to final temperature in 1 hour and no additional water is added to the system. Assume the system has no heat loss, the density of the water is 997 $kg.m^{-3}$ and the specific heat of water is 4.2 $kJ.kg^{-1}.K^{-1}$, calculate the heater wattage required to heat the water. If an electric heater of 1.2 kW is applied, calculate the recovery period of the system.

Given: Formula to calculate recovery period:-

M = V T / (14.3 x P)

where M = time to heat the water (min.)

V = volume of water heated (litres)

T = temperature rise (°C)

P = rate of heat input to the water (kW)

Briefly describe the pipe jointing methods applied to different types of pipe materials commonly used in water supply systems.

(10 marks)

1.6 Briefly explain the design requirements in Hong Kong for centralised hot water systems. Discuss the major considerations when designing hot water systems for high-rise buildings.

(10 marks)

2. Sanitation and Drainage

2.1 A vertical drainage stack pipe of diameter 100 mm has a water discharge from a branch pipe with a flow rate of 1.7 $L.s^{-1}$. Calculate the terminal velocity of the downward discharge flow and the terminal length below point of discharge entry. Discuss how the air pressure fluctuations in the drainage stack may affect the loss of water seal and the escape of the foul air. Illustrate with diagrams.

Given: Terminal velocity equations:

$V_T = 10.073\ (Q/D)^{0.4}$, $L_T = 0.1706 \times V_T^2$

where V_T is terminal velocity ($m.s^{-1}$)

Q is discharge rate ($L.s^{-1}$)

D is diameter of stack (mm)

L_T is terminal length below point of entry (m)

(10 marks)

2.2 The sanitary drainage system could be a risk for the spread of COVID-19 and SARS disease in high-rise residential buildings. Briefly explain the possible disease transmission paths and discuss the possible methods to prevent this.

(10 marks)

3. Sewage Disposal

3.1 Discuss and compare the three system types of sewage disposal for drainage below ground arrangement. Illustrate with diagrams.

(10 marks)

3.2 Explain the three common acceptance tests of drainage systems. Illustrate with diagram(s). Discuss the safety precautions for doing testing and maintenance in underground manholes.

(10 marks)