

ORDRE DES INGÉNIEURS DU QUÉBEC
MAY 2013 SESSION

Open book examination
Non-programmable calculators: only authorized models
Duration : 3 hours

Water Supply and Wastewater Treatment

98-Civ-B5

QUESTION 1 FIRE PROTECTION (4 POINTS)

Compute the flow and volume of water required to fight the fire of a paint shop knowing the following data :

The building is a fire resistive construction
The surface of the first and only floor is 750 m^2
Height of the building : 8 m (equivalent of 2 storeys)
Occupancies : rapid burning (high hazard occupancies)
Automatic sprinklers : 50 % flow reduction
Exposed neighbouring structures :
 2 at 25 m
 1 at 40 m

QUESTION 2 ALKALINITY (2 POINTS)

The carbonate (CO_3^{2-}) concentration of a water sample at 25°C is 120 mg/L. Its pH is 10,3. Compute

- the carbonate (CO_3^{2-}) concentration in moles/L, in mg/L and in mg/L CaCO_3 . (0,5 point)
- the bicarbonate (HCO_3^-) concentration in mole/L and in mg/L CaCO_3 . (0,5 point)
- the OH^- concentration in moles/L and in mg/L CaCO_3 . (0,5 point)
- total alkalinity in mg/L CaCO_3/L . (0,5 point)

N.B. pK_1 and pK_2 of H_2CO_3 are respectively 6,3 and 10,3

QUESTION 3 CHEMICAL ANALYSIS OF WATER (3 POINTS)

On the bottle label of an imported italian water one reads the following concentrations of various soluble chemicals :

Concentration (mg/L)	Élément
445	SO_4^{2-}
239	HCO_3^{-1}
179	Ca^{2+}
55	Cl^-
52	Mg^{2+}
34	Na^+
3,0	$\text{NO}_3^- \text{-N}$
2,5	K^+
< 0,1	Cu^{2+}
< 0,02	Zn^{2+}
0,5	F^-
0	As
0	Pb

Show that this analysis is complete.

QUESTION 4 FIRE HYDRANTS (2 POINTS)

The horizontal section of a plywood warehouse is a rectangle 80 m by 40 m minus a smaller rectangle 40 m by 20 m which has been removed from one of its corners. The front of the building, the longest side (80 m), faces the street with which it is parallel. It is also located 5 m away from the street line property. The fire flow that you have computed is 22 000 L/min and the protected surface by each fire hydrant is 8 000 m². Fire hydrants are on the same side of the street as the warehouse, on the street line property, 5 m away from the building. Is one fire hydrant enough ? If not how many are required ? Explain your answer.

QUESTION 5 pH OF SURFACE WATER (1 POINT)

While a surface water sample was in transit from the sampling site to the laboratory its pH increased by 0,7 units from 6,8 to 7,5. Explain this phenomenon knowing that the sample was transported in an open sampling bottle.

QUESTION 6 NORMAL SOLUTION (2 POINTS)

How many liters of pure water must be added to half a liter of N/1 solution to prepare a N/50 solution.

QUESTION 7 SANITARY FLOWS (2 POINTS)

Write the equation of the maximum sanitary flow at the outlet of a sanitary sewer network. (1 point)

Write the equation of the minimum sanitary flow at the outlet of a sanitary sewer network. (point)

QUESTION 8 WATER INTAKE (2 POINTS)

Each fall the raw water quality at the water intake of your city located on the outskirts of a lake decreases. Suspended solids and soluble iron increase. Can you explain this phenomenon ?

QUESTION 9 WATER PRESSURE (2 POINTS)

Water is elevated in buildings using 25 mm copper pipes. The Hazen-Williams coefficient of copper is 135 compute the loss of pressure of the water if its velocity is 2 meters /s and each storey 4 meter high. Give your answer in kPa

GOOD LUCK

22 février 2013