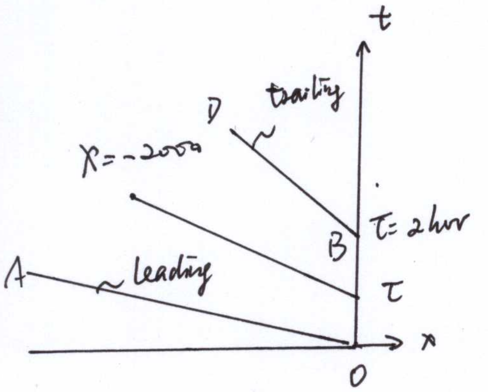
Q1:

(a): $h = 0.9m$ at $x = 0$ when $\tau = 1$ hour:



$$\frac{x}{t-\tau} = \frac{dx}{dt} = u_0 + 2c_0 - 3c$$

$u_0 = 1 m/s$

$c_0 = \sqrt{gh_0} = \sqrt{9.8 \times 1} = 3.13 m/s.$

$c = \sqrt{gh} = \sqrt{9.8\ 0.9} = 2.97 m/s$

$$\text{so } \frac{dx}{dt} = 1 + 2\times3.13 - 3\times2.97 = -1.65 m/s.$$

$$\cancel{t} - \tau = \frac{x}{dx/dt} = \frac{-2000}{-1.65} = 1212s \approx 0.34 \text{ hour}$$

so $t = \tau + 0.34hr = \underline{\underline{1.34 \text{ hour}}}.$

(b) Leading edge is represented by OA:

$$\left.\frac{dx}{dt}\right|_{OA} = u_0 - c_0 = 1 - 3.13 = -2.13 m/s.$$

trailing edge is represented by BD:

$$\left.\frac{dx}{dt}\right|_{BD} = u_0 + 2c_0 - 3c = 1 + 2\times3.13 - 3\sqrt{9.8\cdot0.8} = -1.14 m/s.$$

So Rate of lengthing:

$$r = \left| \left.\frac{dx}{dt}\right|_{OA} - \left.\frac{dx}{dt}\right|_{BD} \right| = 0.99 m/s.$$

(c) This is a positive surge with:

$$h_0 = 0.8\,m \Rightarrow C_0 = \sqrt{9.8 \cdot 0.8} = 2.8\,m/s.$$

$$U_0 + 2C_0 = (\underset{\substack{\uparrow \\ U_{0A}}}{1} + 2 \cdot \underset{\substack{\uparrow \\ C_{0A}}}{3.13}) \Rightarrow U_0 = 1 + 2 \cdot 3.13 - 2 \times 2.8 = 1.66\,m/s.$$

$$\partial h / \partial t = 0.2\,m/hr = \frac{1}{5 \cdot 3600}\,m/s.$$

$$X_0 = \frac{-(U_0 - C_0)^2}{\frac{3}{2}\sqrt{\frac{g}{h_0}}\left.\frac{\partial h}{\partial t}\right|_{t=0}} = \underline{\underline{-4.46\,km}} \ \#. \quad (\text{upstream}).$$

In the lecture note this minus sign is missing.

$$\cancel{t_1} \quad t_0 = \frac{+X_0}{U_0 - C_0} = \frac{-4460}{1.66 - 2.8} = +3912\,s = +1.09\,hr$$

~~Thus~~ This is to after $t = 10\,hr$, so the actual time is

$$t = 11.09\,hr.$$

Q2.

(a) See lecture note. This is a simple dam-break problem.

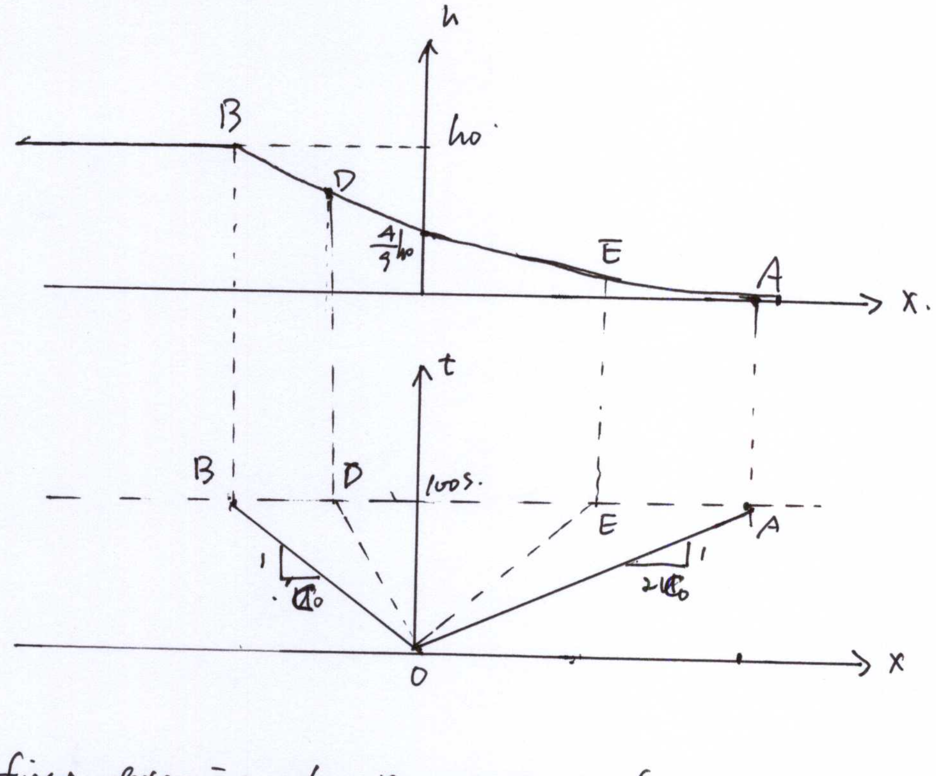
At $x = 0$,

$$U = C = \frac{2}{3} C_0 = \frac{2}{3}\sqrt{98.5} = \frac{14}{3} = 4.67\ m/s$$

$$h = \frac{4}{9} h_0 = \frac{20}{9} = 2.22\ m.$$

$$q = U \cdot h = 10.4\ m^2/s.$$

(b)



You first determine the x-coordinate of the ~~tail~~ leading and trailing edge:

$$X_A = t \cdot \left.\frac{dx}{dt}\right|_{OA} = 2C_0 \cdot t = 2\times 7 \times 100 = 1400\ m.$$

$$X_B = t \cdot \left.\frac{dx}{dt}\right|_{OB} = -C_0 \cdot t = -7 \times 100 = 700\ m.$$

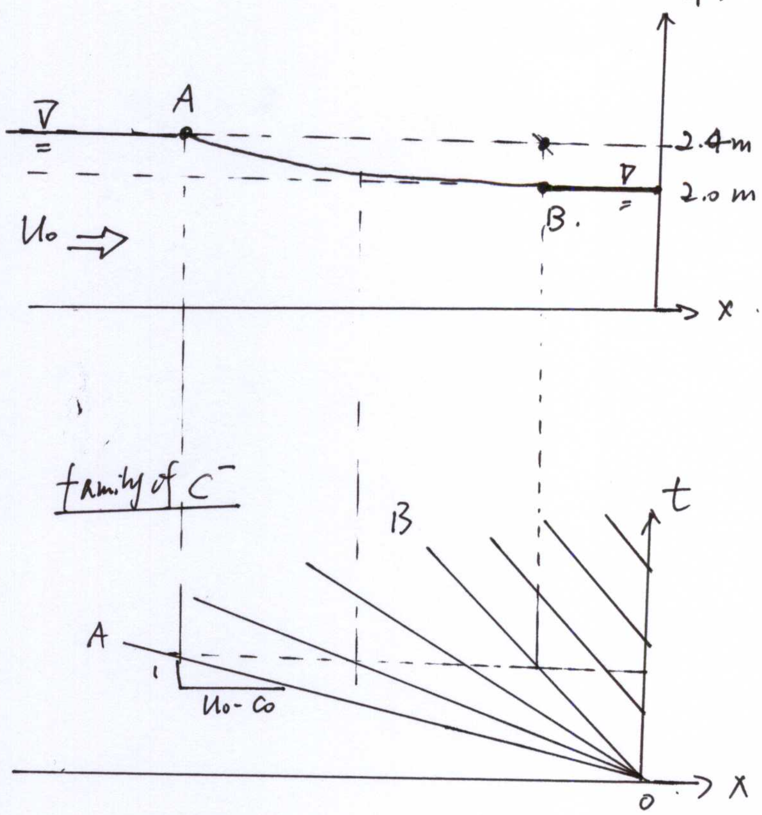
The first point within AB is the critical flow at $X=0$, where $h = \frac{4}{9} h_0$

To ~~get two more points, e.g. OB. For fi for example Point D where~~ $h = $ ~~$\frac{1}{2} h_0$ You get $\frac{dx}{dt}$~~ Other point use parabolic profile

$$h = \frac{1}{9g}\left(\frac{x}{t} - 2\sqrt{g h_0}\right)^2.$$

Q3

④



(a) Very similar to the "sudden closure of ~~sth~~ sluice gate" problem in homework. See the above for C^- characteristics.

Go through usually practice to prove:

① all C^- are straight lines

② For all C^- initiated at origin, they diverge.

③ OB corresponds to $h = 2.4 - 0.4 = 2m$ after the sudden drop.

④ Any C^- initiated on t-axis later will be parallel to OB.

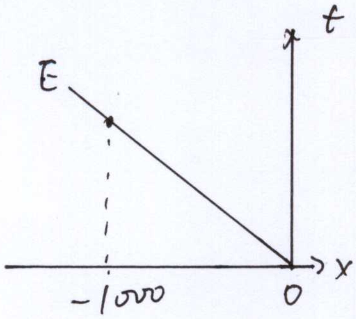
The region between OA and OB is non-uniform.

$$dx/dt\,|_{OA} = u_0 - c_0 = 1.5 - \sqrt{2.4 \times 9.8} = -3.35 m/s.$$

$$dx/dt\,|_{OB} = u_0 + 2c_0 - 3c = 1.5 + 2\sqrt{2.4 \times 9.8} - 3 \cdot \sqrt{2 \cdot 9.8} = -2.08 m/s$$

5

(b):



$$\frac{x}{t} = \frac{dx}{dt} = u_0 + 2c_0 - 3c$$

$$= 1.5 + 2\sqrt{9.8 \cdot 2.4} - 3 \cdot \sqrt{9.8 \cdot (2.4 - 0.2)}$$

$$= -2.73 \text{ m/s}$$

$$t = \frac{-1000}{-2.73} = 366 \text{ (s)}$$

#