Solution to Problem 1.5

A) TO ANSWER THIS QUESTION YOUR MUST DEFINE THE EDGE OF THE DIFFUSING PATCH OF FUEL. BY CONVENTION THIS IS TYPICALLY TAKEN AS $\pm 2\sigma$ FROM THE CENTER OF THE PATCH. BY THIS DEFINIT THE EDGE OF THE FUEL PATCH WILL REACH YOUR HOU WHEN $2\sigma = 50\text{-m}$

OR $2\sqrt{2Dt} = 50\text{-m}$

SOLVING FOR $t = \underline{31{,}250\,s} = 8.7\,hr$

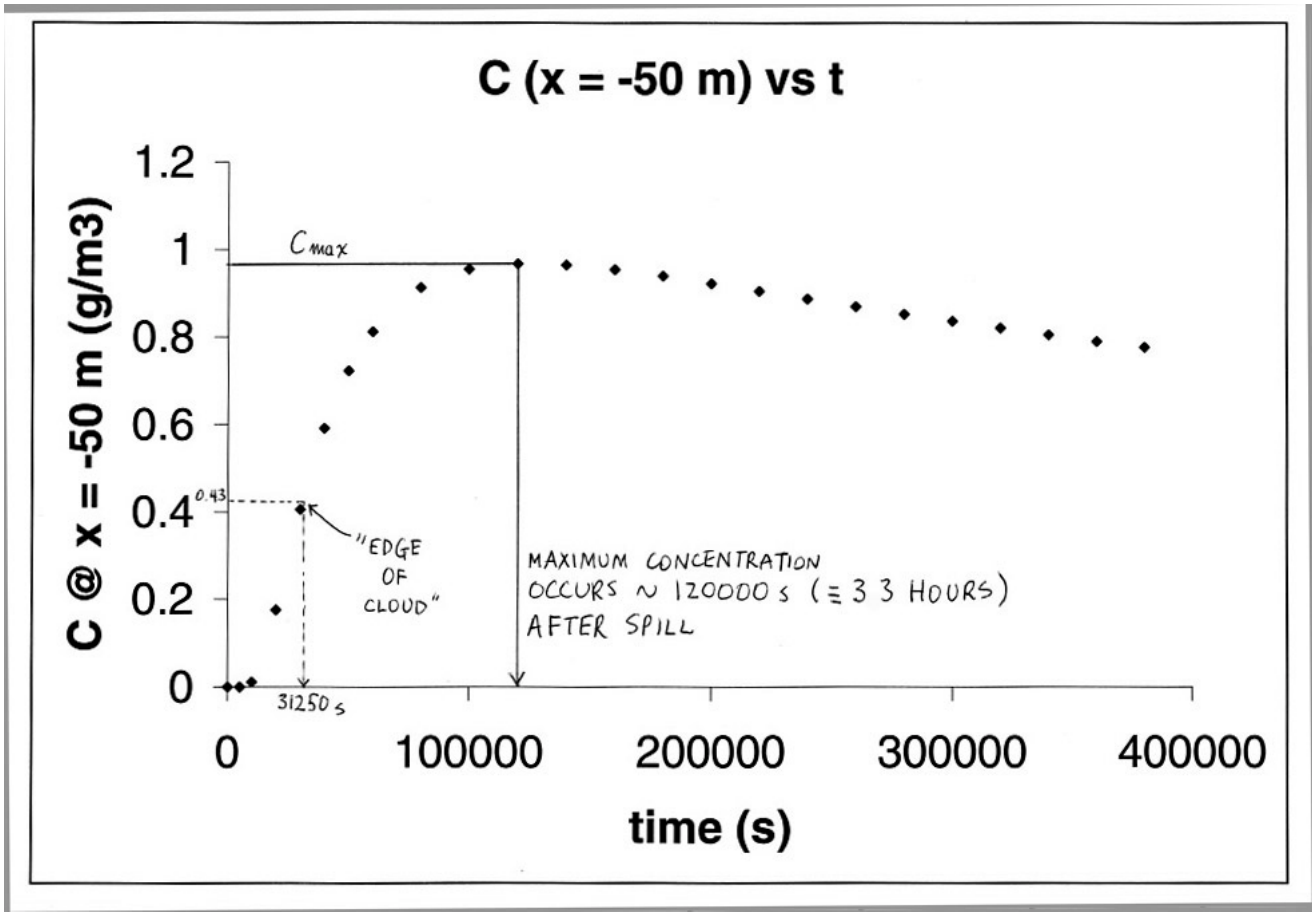
B) AT THE ABOVE TIME, THE CONCENTRATION AT YOUR IS, FROM EQ. 7

$$C(x=-2\sigma, t=31250s) = \frac{M}{A\sqrt{4\pi Dt}} \,\mathrm{EXP}\left\{-\frac{(-2\sigma)^2}{2\sigma^2}\right\}$$

$$= \frac{1\,kg}{(5m \cdot 1m)\sqrt{4\pi(0.01\,m^2/s)(31250s)}} \,\mathrm{EXP}\left\{-2\right\}$$

$$= 4.3\times10^{-4}\,kg\,m^{-3} = 0.43\,g\,m^{-3}$$

C) THE MAXIMUM CONCENTRATION AT $X = -50m$ CAN BE FOUND BY SETTING $\frac{d}{dt}\left[C(x=-50m, t)\right] = 0$. AS THIS IS A DIFFICULT DERIVATIVE, A GRAPHICAL SOLUTION IS EASIER AND MO INS


C (x = -50 m) vs t
C @ x = -50 m (g/m3)
1.2
1
0.8
0.6
0.4
0.2
0
0
100000
200000
300000
400000
time (s)
Cmax
0.43
"EDGE OF CLOUD"
31250 s
MAXIMUM CONCENTRATION OCCURS ~ 120000 s (≡ 33 HOURS) AFTER SPILL