HW6

① In all instances I still expect incomplete mixing to kick in and result in a late time scaling of $t^{-1/4}$.

What changes is when this happens

(i) Incomplete mixing happens earlier.
(ii) " " " even earlier than in (i)
(iii) " " " earlier (diffusion is less efficient)
(iv) " " " later (" " more ")
(v) " " " earlier (reaction is more efficient than mixing)
(vi) " " " later (reaction is less efficient than mixing)

② This problem is analogous to

$$\frac{\partial c_A}{\partial t} = D \frac{\partial^2 c_A}{\partial x^2} - r$$

$$\frac{\partial c_B}{\partial t} = D \frac{\partial^2 c_B}{\partial x^2} - r \qquad c_A c_B = 0$$

$$\frac{\partial c_C}{\partial t} = D \frac{\partial^2 c_C}{\partial x^2} + r$$

$$u_A = c_A + c_C \Rightarrow \frac{\partial u_A}{\partial t} = D \frac{\partial^2 u_A}{\partial x^2} \qquad u_A(t=0) = \delta(x-5)$$

$$u_B = c_B + c_C \Rightarrow \frac{\partial u_B}{\partial t} = D \frac{\partial^2 u_B}{\partial x^2} \qquad u_B(t=0) = \delta(x+5)$$

$$c_C = \min(u_A, u_B)$$

$$M_A = 1 - M_C = 1 - 2\int^{\infty} u_B \, dx \quad \text{(see HW4)}$$

Due to incomplete mixing your code should predict $M_{A\ particles} > M_A$.

(3) In class we said $\frac{d\langle c_A \rangle}{dt} = -k\langle c_A \rangle^2 - k\langle c_A' c_B' \rangle$

and argued $\langle c_A' c_B' \rangle$ scales like the peak of the conservative Greens function or $\frac{1}{E}$

where E is dilution index

For pure shear $E \sim t\sqrt{4 + \frac{\alpha^2 t^2}{3}} \sim t^2$ at late times

$\therefore$ Dominant balance of $k\langle c_A \rangle^2$ and $k\langle c_A' c_B' \rangle$

suggests $\langle c_A \rangle^2 \sim \frac{1}{E} \sim t^{-2}$

$\Rightarrow \langle c_A \rangle \sim t^{-1}$

↓

as if well mixed even if it is <u>not</u>!