# HW3_2

February 10, 2022

# 1 Problem 2

## 1.1 Problem 2.1

Describe expected profile for $x_A(z)$ ### Problem2.1.a

When $J_A$ is a negative constant, ficks law can be written as

$$J_A = -k = -cD_{AB}\frac{dx_A}{dz} \tag{1}$$

rearranging gives

$$\frac{dx_A}{dz} = \frac{k}{cD_{AB}}$$

which shows that with a negative constant for $J_A$, $\frac{dx_A}{dz}$ is positive which would mean that $x_A(z)$ has a positive slope

### 1.1.1 Proplem 2.1.b

When $J_A$ is linear with a positive slope the following relationship can be used

$$N_A = x_A N + J_A \tag{2}$$

which can be rearranged to give

$$J_A = -Nx_A + N_A$$

which is a linear expression for $J_A$ but it has a negative slope. In order to make the slope positive, $x_A(z)$ would need to be decreasing. so $x_A(z)$ would have a negative slope.

## 1.2 Problem 2.2

Describe expected profile for $J_A$ ### Problem 2.2.a When $x_A(z)$ is linear with a negative slope, $\frac{dx_A}{dz} = -k$ ∴

$$J_A = -cD_{AB}(-k) = kcD_{AB} \tag{3}$$

where $k$ is a constant. (3) shows that $J_A$ would be a positive constant if c is constant, or have a positive slope if c is variable.

### 1.2.1 Problem 2.2.b

When $x_A(z)$ is a gaussian function centered at $z = -2$ there are three scenarios: a.) $z < -2$ b.) $z = -2$ c.) $z > -2$

when $z < -2$, $\frac{dx_A}{dz} > 0$. Using Fick's law,

$$J_A = -cD_{AB}\frac{dx_A}{dz}$$

which means $J_A < 0$

when $z = -2$, $\frac{dx_A}{dz} = 0$ so $J_A = 0$

when $z > -2$, $\frac{dx_A}{dz} < 0$ so

$$J_A = cD_AB\frac{dx_A}{dz}$$

$\therefore J_A > 0$