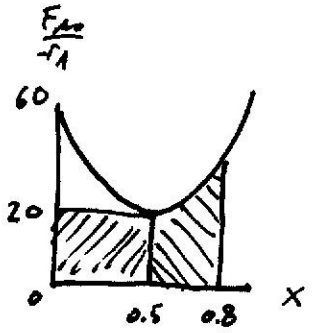
P2-10

(a) CSTR → PBR

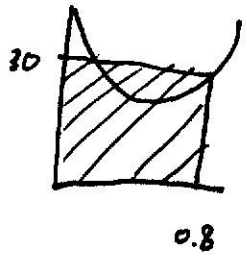


$F_{A0} = 2 \frac{mol}{s}$

$W_{PBR} = W_{CSTR} \approx 20\ kg$

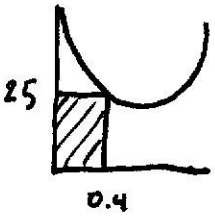
$W_{total} \approx 40\ kg$

(b)



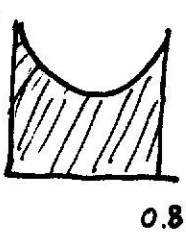
$W_{CSTR} \approx 48\ kg$

(c)



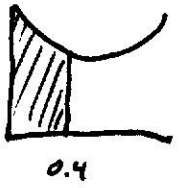
$W_{CSTR} \approx 20\ kg$

(d)



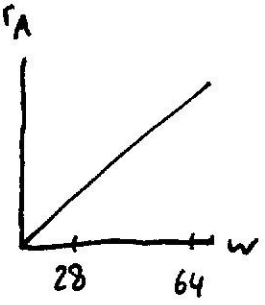
$W_{PBR} \approx 64\ kg$

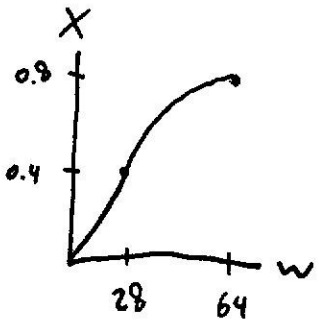
(e)



$W_{PBR} \approx 28\ kg$

(f)





Problem 3-10

Packages:

```
using DataFrames   , CairoMakie
```

Data:

`df =`

	rate	temperature
1	0.002	300.0
2	0.046	320.0
3	0.72	340.0
4	8.33	360.0

```
df = DataFrame(rate=[0.002, 0.046, 0.720, 8.33], temperature=[300., 320., 340., 360.])
```

`R = 1.987`

```
R = 1.987
```

Reaction:

$$2A + B \rightarrow 4C$$

Rate law:

$$-r_A = kC_A^2 C_B$$

Arrhenius equation:

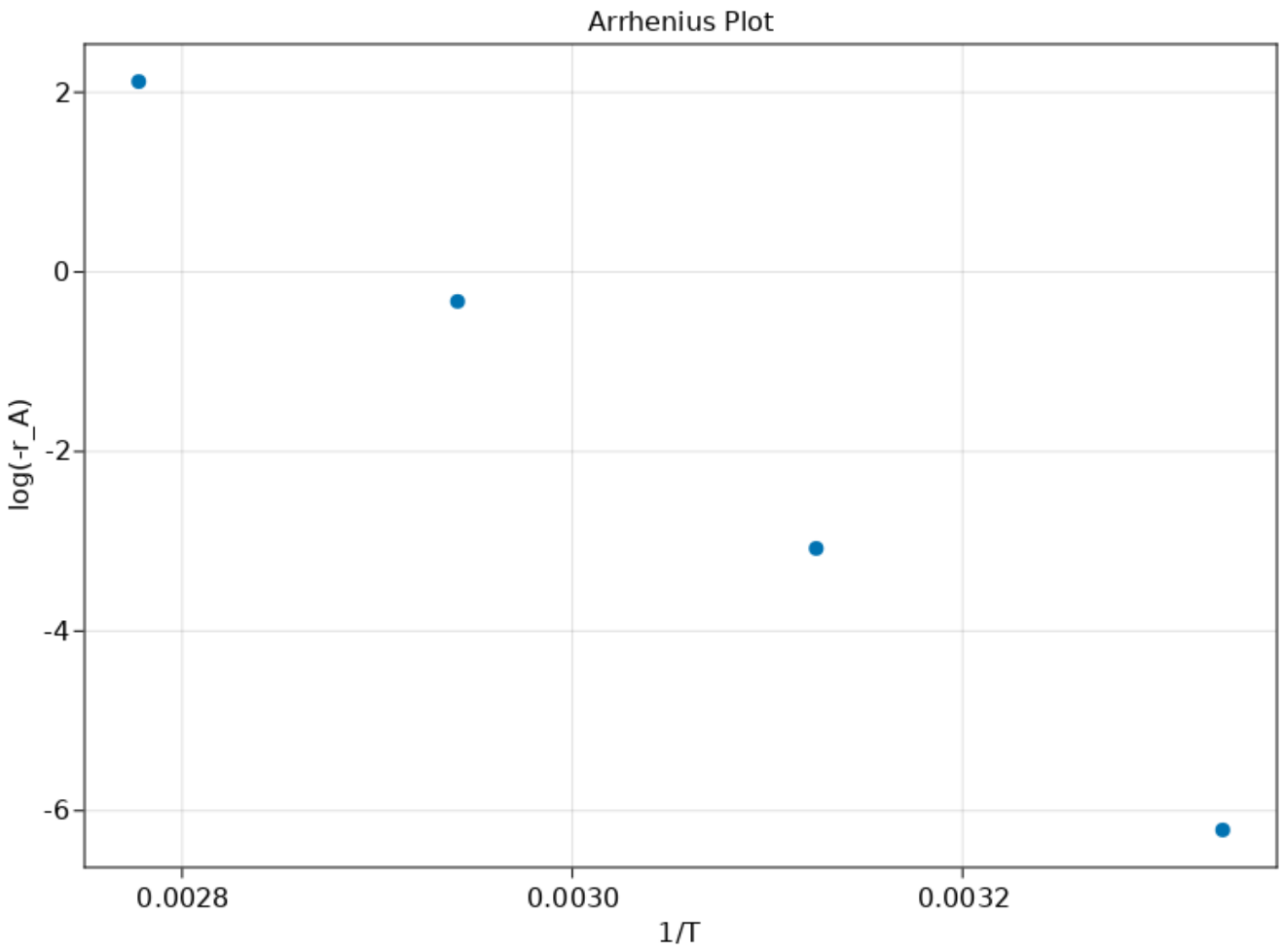
$$k = Ae^{-E_a/RT}$$

$$\ln(-r_A) = \frac{-E_a}{R} * \frac{1}{T} + \ln(6A)$$

Transform variables:

```
begin
    plot_x = 1 ./ df.temperature
    plot_y = log.(df.rate)
end;
```

Plot:



Solve linear system to get slope:

```
m = -682.4117882880058
```

```
m = plot_x \ plot_y
```

Calculate activation energy from slope:

$$m = \frac{-E_a}{R}$$

```
Ea = 1355.9522233282676
```

- `Ea = -m * R`

Use slope and a data point to solve for intercept:

```
(0.00333333, -6.21461)
```

- `plot_x[1], plot_y[1]`

$$-6.215 = \frac{-1356}{1.987} * 0.00333 + \ln(6A)$$

$$b = \ln(6A) = 2.735$$

Calculate frequency factor from intercept:

```
A = 2.5682905726548864
```

- `A = exp(2.735)/6`

P3-13

(a) 1: $-r_A = k C_A C_B^2$

2: $-r_A = k C_B$

3: $-r_A = k$

4: $-r_A = k C_A C_B^{-1}$

(b) 1: $-r_{H_2} = k C_{H_2}^{1/2} C_{Br_2}^{1/2}$

2: $-r_{H_2} = k C_{H_2} C_{I_2}$