```
clear
% U5.12
% A is benzene
% B is inert gas
% C is inert oil

yin = 0.127; % molA/mol-gas
yout = 0.015; % molA/mol-gas (maximum)
xin = 0.01; % molA/mol-liquid
t = 30+273.15; % K
p = 0.6e5; % Pa
nGin = 28.5e3; % mol-gas/h
nLin = 13e3; % mol-liquid/h

% convert to relative mole fractions
Yin = yin/(1-yin) % mol-A/mol-B
```

```
Yin = 0.1455
```

```
Yout = yout/(1-yout) % mol-A/mol-B
```

```
Yout = 0.0152
```

```
Xin = xin/(1-xin) % mol-A/mol-C
```

```
Xin = 0.0101
```

```
% mole flux of inerts
nB = nGin*(1-yin) % mol-B/h
```

```
nB = 2.4881e+04
```

```
nC = nLin*(1-xin) % mol-C/h
```

```
nC = 12870
```

```

% mole balance to get Xout
Xout = Xin + nB*(Yin-Yout)/nC
```

```
Xout = 0.2619
```

equilibrium

```
psat = 15909; % Pa [saturated pressure benzene at 30 degC]
psi = psat/p  % yA = psi * xA
```

```
psi = 0.2652
```

```
phi = @(X) psi./(1+X*(1-psi)); % YA = phi(XA) * XA
```

number of transfer units NY

```
Yin_star = phi(Xout)*Xout
```

```
Yin_star = 0.0582
```

```
Yout_star = phi(Xin)*Xin
```

```
Yout_star = 0.0027
```

```

```

Because the equilibrium curve in X_A | Y_A plane is not linear, the formulas derived using the linearity assumption should not be used.

Let us use these equations anyway, just to get an approximative solution:

```
p1 = phi(Xin)
```

```
p1 = 0.2632
```

```
p2 = phi(Xout)
```

```
p2 = 0.2224
```

```
phi_mean=sqrt(phi(Xin)*phi(Xout)) % geometric mean for "phi"
```

```
phi_mean = 0.2419
```

```
xi_mean = nC/(phi_mean*nB) % absorption factor (a mean value)
```

```
xi_mean = 2.1382
```

```

NY_approx = xi_mean/(xi_mean-1)*log((Yin-Yin_star)/(Yout-Yout_star)) % [expected 3.52]
```

```
NY_approx = 3.6395
```

However, the correct procedure is to go back to the "number of transfer units" (NY) definition and solve the integral numerically

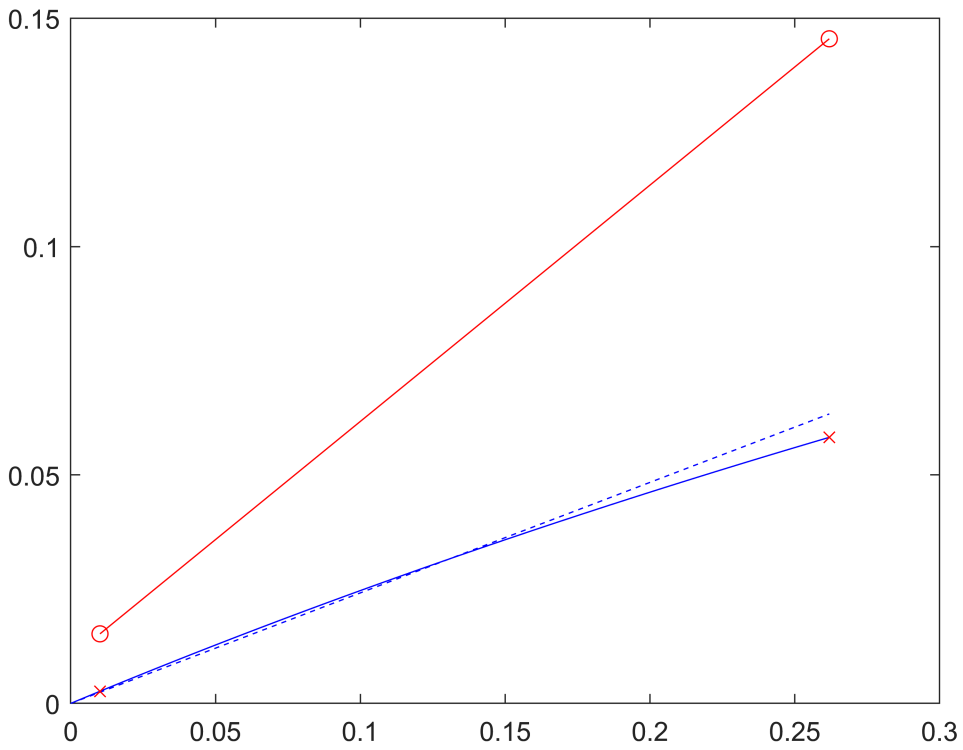
```
X = @(Y) Xin+nB/nC*(Y-Yout) % from mole balance
```

```
X = function_handle with value:
    @(Y)Xin+nB/nC*(Y-Yout)
```

```
NY = integral(@(Y) 1./( Y - phi(X(Y)).*X(Y)), Yout, Yin) % [expected 3.52]
```

```
NY = 3.5189
```

```
% Here we just plot the real equilibrium curve, linearized equlibrium and the working line
Xeq = linspace(0,Xout,100); %
Yeq1 = phi(Xeq).*Xeq;       % equilibrium
Yeq2 = phi_mean*Xeq;        % equilibrium linearized
plot(Xeq,Yeq1,'b-', Xeq,Yeq2, 'b--', ... % equilibria curves blue
```




```
    [Xin Xout], [Yout Yin],  'r-o', ... % working line red
    [Xin Xout], [Yout_star,Yin_star], 'rx') % just show where Y_star are
```