U-channel heat sink

```
{properties}
T_1=(Tin+Tsurface)/2
P_1=101
rho_1=Density(Air,T=T_1,P=P_1)
mu_1=Viscosity(Air,T=T_1)
cp_1=Cp(Air,T=T_1)
cv_1=Cv(Air,T=T_1)
Pr_1=Prandtl(Air,T=T_1)
k_1=Conductivity(Air,T=T_1)

V=1
Tin=300
channelwidth=0.007
channelheight=0.03
channellength=0.03
numberchannels=4
finthickness=0.001
Tsurface=320

{now find Rconv}
Dh=4*Ac/P
Ac=channelheight*channelwidth
P=2*channelheight+2*channelwidth
Re=V*Dh*rho_1/mu_1

hydroentrylength=0.075*Re*Dh
thermalentrylength=0.054*Re*Dh*Pr_1

{developing both thermally and hydrodynamically}
Gzinverse=channellength/Dh/Re/Pr_1
{look at figure from handout}
Nu=15 {just a rough number}   <- Or use Nu=3.66 + .... equation
Nu=h*Dh/k_1
Rconv=1/h/Asurface
Asurface=channelheight*channellength*2*numberchannels+channellength*channelwidth*numberchannels
```

SOLUTION
Unit Settings: [J]/[K]/[kPa]/[kg]/[degrees]

Ac = 0.00021 [-]	Asurface = 0.00804 [-]
channelheight = 0.03	channellength = 0.03
channelwidth = 0.007	cp_1 = 1005 [J/kg-K]
cv_1 = 718.2 [J/kg-K]	Dh = 0.01135 [m]
~~finthickness = 0.001~~	Gzinverse = 0.005384 [ ]
h = 34.87 W/m²K	hydroentrylength = 0.5762 [m]
k_1 = 0.02639 [W/m-K]	μ_1 = 0.00001904 [kg/m-s]
v = 15 [m²-K/W]	numberchannels = 4
P = 0.074 [-]	Pr_1 = 0.7252 [-]
P_1 = 101	Rconv = 3.567 [-] °C/W
Re = 676.8 [ ]	ρ_1 = 1.135 [kg/m³]
thermalentrylength = 0.3009 [m]	Tin = 300
Tsurface = 320	T_1 = 310 [-]

```
{pin fin homework problem}

{knowns}
Tin=300
Patm=101
V=1
St=0.01
Sl=0.01
D=0.0015
height=0.03
numbertubes=23
Ts=320

{properties}
rho=Density(Air,T=Tin,P=Patm)  {only a small change in temp from inlet to outlet, so OK to use Tin}
mu=Viscosity(Air,T=Tin)
Pr=Prandtl(Air,T=Tin)
Prs=Prandtl(Air,T=Ts)
k=Conductivity(Air,T=Tin)

{equations}
Re=rho*Vmax*D/mu
Vmax=St/2/(Sd-D)*V
Sd=(Sl^2+(St/2)^2)^0.5
Nu=F*1.04*Re^0.4*Pr^0.36*(Pr/Prs)^0.25
F=0.93 {correction factor because we have fewer than 16 columns}
Nu=h*D/k
Rconv=1/h/Asurface
Asurface=Atubes+Abase  {here we're using an estimate that h for the base is the same as h for the tubes. it probably will
 actually be somewhat less}
Atubes=pi*D*height*numbertubes
Abase=width*length
width=length
width=4*st+D+0.01 {calculate from fin pitch plus how far the base extends past the last fin on each side}
```

other correlations possible

SOLUTION

Unit Settings: [kJ]/[K]/[kPa]/[kg]/[degrees]

Abase = 0.002652 [-]	Asurface = 0.005904 [-]	Atubes = 0.003252 [-]
D = 0.0015	F = 0.93	h = 70.03 W/m²K
height = 0.03	k = 0.02565 [W/m-K]	length = 0.0515
μ = 0.00001857 [kg/m-s]	ν = 4.096 [m-K/W]	numbertubes = 23
Patm = 101	Pr = 0.7276 [-]	Prs = 0.7229 [-]
Rconv = 2.419 [-] °C/W	Re = 48.93 [s/m²]	ρ = 1.173 [kg/m³]
Sd = 0.01118	Sl = 0.01	St = 0.01
Tin = 300	Ts = 320	V = 1
Vmax = 0.5165 [-]	width = 0.0515 [-]	

1 potential unit problem was detected.

Purple units were automatically set. Right click on the variable to confirm or change the units.