



















```

d0 = 0.005
Z = 0.005
dr = d / 2# / 8#
dz = Z / 2#
'aluminum type 6061-T6
ro = 2700#
c = 902#
k = 167#
'
'copper
'ro = 8960#
'c = 385#
'k = 401#
'iron
'r = 7874#
'c = 449#
'k = 80.4

alfa = k / ro / c

dt = 0.5 / alfa / (1# / dr ^ 2 + 1# / dz ^ 2)
'result-check dt=0.036, take dt/10 for accuracy.
'pick dt=0.004 (250 time steps = 1 sec)

dt = 0.004
p = 2#
pdis = p * 4# / d0 ^ 2 / Pi
nz = 2
nr = 8
dtr = alfa * dt / dr ^ 2
dtz = alfa * dt / dz ^ 2

Ta = 300#
'initial state
For iz = -1 To nz + 1
For ir = -1 To nr + 1
tre(ir, iz) = Ta
Next ir
Next iz
'reset heat transfer
q1 = 0#
q2 = 0#
q3 = 0#
q = 0#
Timee = 0#

'loop over time
For it = 0 To 1000000
Timee = it * dt
'print state every second
If ((it Mod 250) = 0) Then
Cells(2 + it / 250, 14) = Timee / 60#
Cells(2 + it / 250, 15) = q
Cells(1, 3) = it
For iz = -1 To nz + 1
For ir = -1 To nr + 1
Cells(3 + iz, 4 + ir) = tre(ir, iz)
Next ir
Next iz
End If
'reset heat transfer

q1 = 0#
q2 = 0#
q3 = 0#
q = 0#
'r=0, z=0
tre(0, -1) = tre(0, 1) + 2# * dz / k * (pdis - h * (tre(0, 0) - Ta)
- sig * (tre(0, 0) ^ 4 - Ta ^ 4))
'r=0, z=0.005
tre(0, nz + 1) = tre(0, nz - 1) + 2# * dz / k * (0# * pdis - h *
(tre(0, nz) - Ta) - sig * (tre(0, nz) ^ 4 - Ta ^ 4))
'bc at r=0, all z
For iz = 0 To nz
tre(-1, iz) = tre(1, iz)
Next iz
'bc at r=R, all z
For iz = 0 To nz
tre(nr + 1, iz) = tre(nr - 1, iz) + 2# * dr / k * (0# * pdis - h *
(tre(nr, iz) - Ta) - sig * (tre(nr, iz) ^ 4 - Ta ^ 4))
Next iz
'z=0, all r
For ir = 1 To nr
tre(ir, -1) = tre(ir, 1) + 2# * dz / k * (0# * pdis - h * (tre(ir,
0) - Ta) - sig * (tre(ir, 0) ^ 4 - Ta ^ 4))
Next ir
'z=h, all r
For ir = 1 To nr
tre(ir, nz + 1) = tre(ir, nz - 1) + 2# * dz / k * (0# * pdis - h *
(tre(ir, nz) - Ta) - sig * (tre(ir, nz) ^ 4 - Ta ^ 4))
Next ir
'pde at r=0, all z
For iz = 0 To nz
tre(0, iz) = tre(0, iz) * (1# - 4# * dtr - 2# * dtz) + 4# * tre(1,
iz) * dtr + dtz * (tre(0, iz + 1) + tre(0, iz - 1))
Next iz
'pde elsewhere
For iz = 0 To nz
For ir = 1 To nr
tre(ir, iz) = tre(ir, iz) * (1# - 2# * dtr - 2# * dtz) + dtr * (tre(ir
+ 1, iz) + tre(ir - 1, iz)) + dtr / 2# / ir * (tre(ir + 1, iz) - tre(ir
- 1, iz)) + dtz * (tre(ir, iz + 1) + tre(ir, iz - 1))

Next ir
Next iz
For ir = 0 To nr - 1
tav0 = (tre(ir, 0) + tre(ir + 1, 0)) / 2#
q1 = q1 + (h * (tav0 - Ta) + sig * (tav0 ^ 4 - Ta ^ 4)) * 2# *
Pi * (ir + ir + 1) * dr / 2# * dr
tav1 = (tre(ir, nz) + tre(ir + 1, nz)) / 2#
q2 = q2 + (h * (tav0 - Ta) + sig * (tav0 ^ 4 - Ta ^ 4)) * 2# *
Pi * (ir + ir + 1) * dr / 2# * dr
Next ir
For iz = 0 To nz - 1
tavz = (tre(nr, iz) + tre(nr, iz + 1)) / 2#
q3 = q3 + (h * (tavz - Ta) + sig * (tavz ^ 4 - Ta ^ 4)) * 2# *
Pi * nr * dr * dz
Next iz
q = q1 + q2 + q3
Next it

End Sub.

```