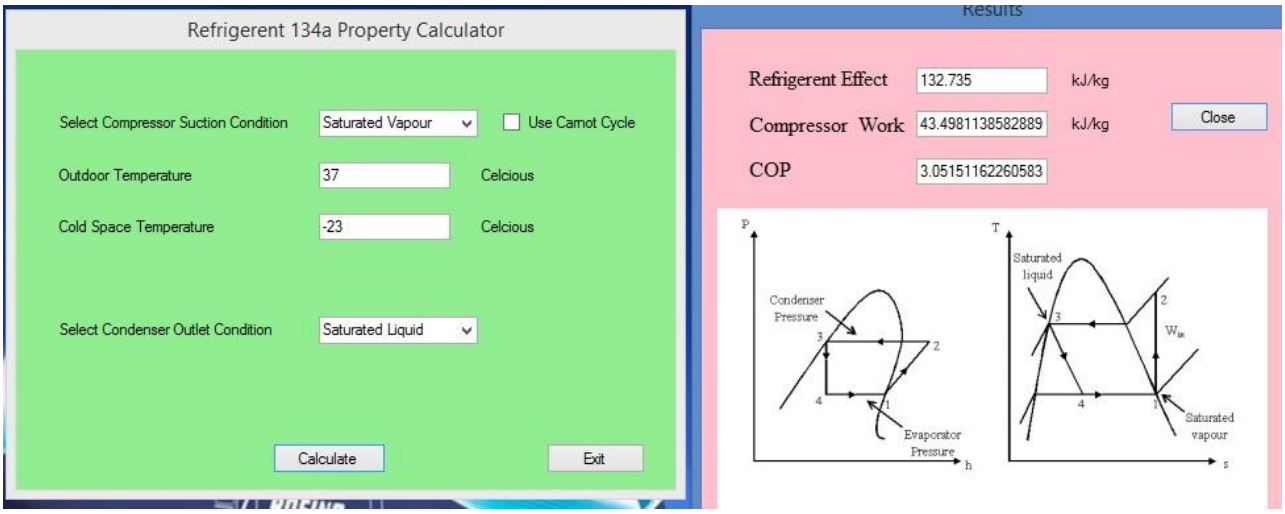
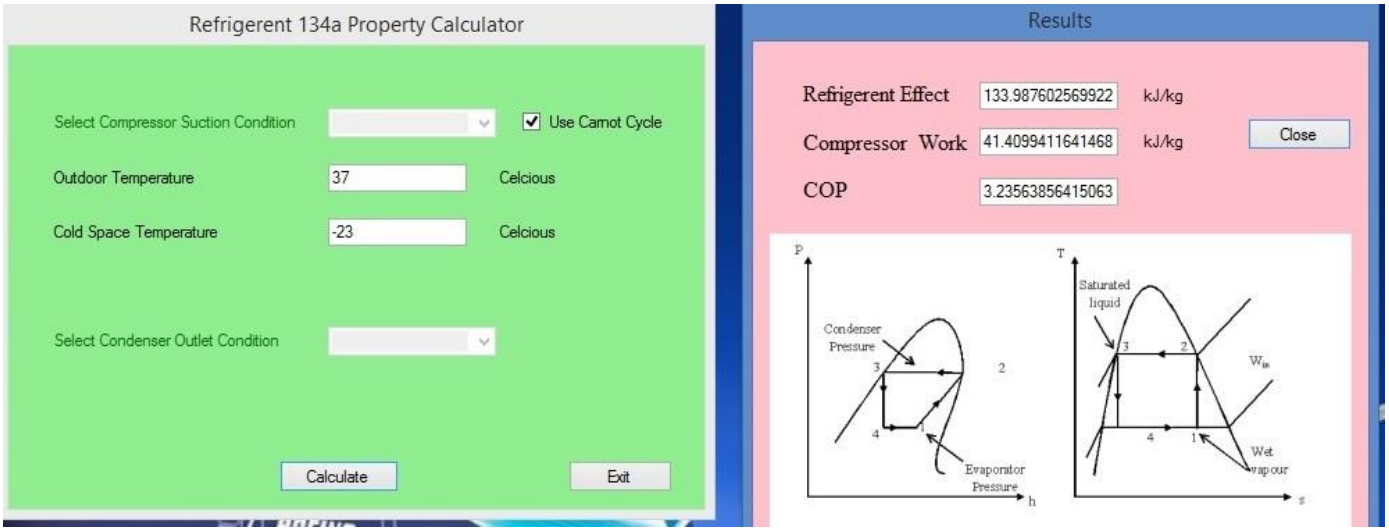
**Refrigeration and Air Condition – Assignment 100427P**

**Q1)**



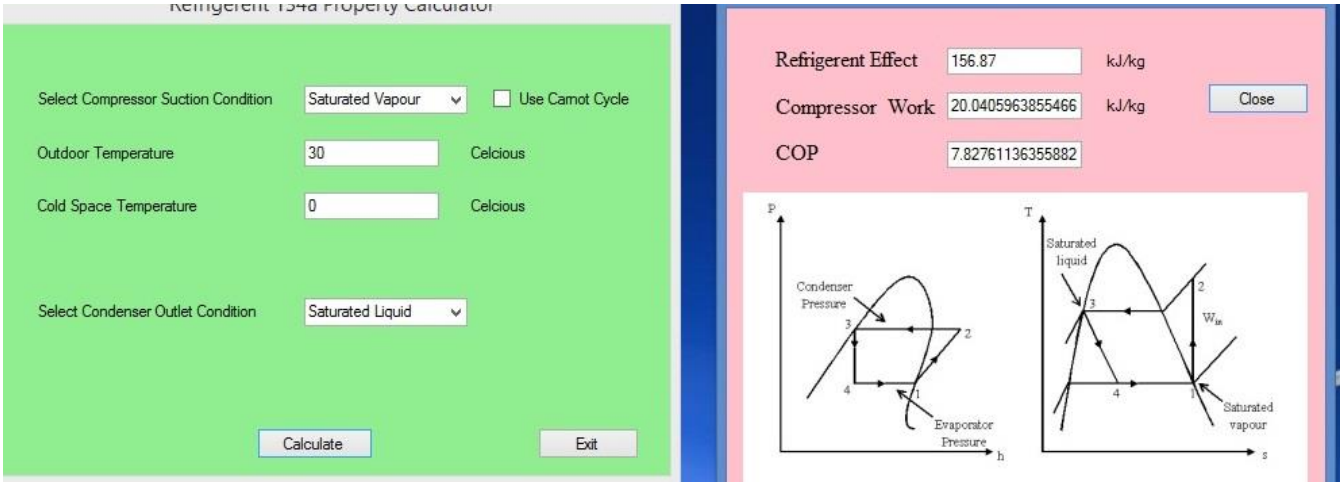




Tonnage =0.284 x 132.735 = 37.696 ton

Power Requirement = 43.498 kW

Ratio of COP of this cycle to Carnot cycle = 3.05/3.23 = 0.944

**Q2)**

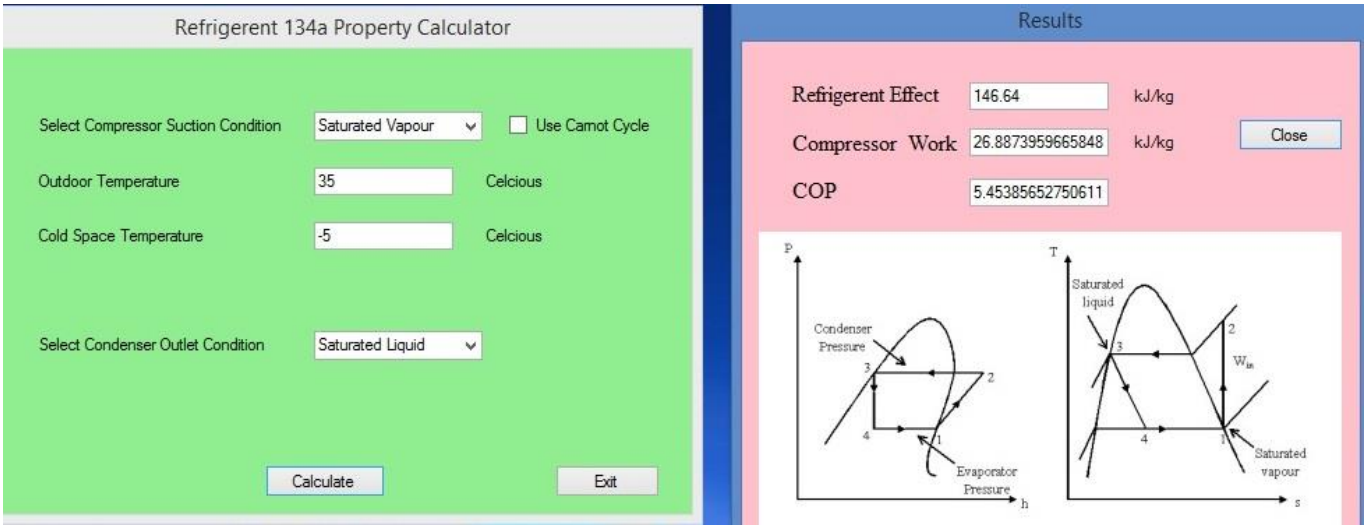



Mass flow rate = 10/ (3.5 x 156.87) = 0.018kg/s

Power Requirement = 0.018 x 20.0405 = 0.3607KW

COP = 7.8276

**Q3)**




Refrigerant Capacity of plant = (3.34 x$10^6$ + 4200x 35)x10x1000 /(24 x3600) = 17.185 kW

Mass flow rate = 2.8571/146.64 =0.1948 kg/s

Compression Work = 0.1948 x 26.887 = 5.23 kW

COP = 5.43

**Program Script**

```
Public Class frmInterface

    Dim Coldtemp, Condentemp, Dryness, Superheat, Subcooling, ps, hv, sv, hl, sl, h1, h2, h3 As
Double
    Dim Drynesslocation As Integer
    Dim superheatpressure() As Integer = {60, 100, 140, 180, 200, 240, 280, 320, 400, 500, 600,
700, 800, 900, 1000, 1200, 1400, 1600}

    Private Sub chbCarnot_CheckedChanged(ByVal sender As Object, ByVal e As
System.EventArgs) Handles chbCarnot.CheckedChanged
        If chbCarnot.Checked = True Then
            disabling()
            cboCompressorselection.Text = ""
            cboOutletCondenser.Text = ""
        Else
            enabling()

        End If
    End Sub
    Public Function showdryness() As Integer
        lblDryness.Show()
        txtDryness.Show()
        cboDryness.Show()
        Return 0
    End Function
    Public Function hidedryness() As Integer
        lblDryness.Hide()
        txtDryness.Hide()
        cboDryness.Hide()
        Return 0
    End Function
    Public Function hideoutletcondenser() As Integer
        lblOutletcondenser.Hide()
        cboOutletCondenser.Hide()
        Return 0
    End Function
    Public Function showoutletcondenser() As Integer
        lblOutletcondenser.Show()
        cboOutletCondenser.Show()
        Return 0
    End Function
    Public Function hidesubcooling() As Integer
        lblSubcooling.Hide()
        txtSubcooling.Hide()
        lblSubcoolcelcious.Hide()
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        Return 0
    End Function
    Public Function showsubcooling() As Integer
        lblSubcooling.Show()
        txtSubcooling.Show()
        lblSubcoolcelcious.Show()
        Return 0
    End Function
    Public Function disabling() As Integer
        cboCompressorselection.Enabled = False
        lblCompressorselection.Enabled = False
        lblOutletcondenser.Enabled = False
        cboOutletCondenser.Enabled = False
        Return 0
    End Function
    Public Function enabling() As Integer
        cboCompressorselection.Enabled = True
        lblCompressorselection.Enabled = True
        lblOutletcondenser.Enabled = True
        cboOutletCondenser.Enabled = True
        Return 0
    End Function

    Private Sub cboCompressorselection_TextChanged(ByVal sender As Object, ByVal e As
System.EventArgs) Handles cboCompressorselection.TextChanged
        If cboCompressorselection.Text = "Wet Vapour" Then
            txtDryness.Text = ""
            showdryness()
            lblDryness.Text = "Dryness Fraction"
            lblDrynesscelcious.Hide()
        ElseIf cboCompressorselection.Text = "Superheated Vapour" Then
            txtDryness.Text = ""
            showdryness()
            cboDryness.Hide()
            lblDryness.Text = "Degree of Superheat"
            lblDrynesscelcious.Show()
        Else
            hidedryness()
            lblDrynesscelcious.Hide()
        End If
    End Sub

    Private Sub cboOutletCondenser_TextChanged(ByVal sender As Object, ByVal e As
System.EventArgs) Handles cboOutletCondenser.TextChanged
        If cboOutletCondenser.Text = "Liquid with Sub Cooling" Then
            showsubcooling()
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        Else
            hidesubcooling()
        End If
    End Sub

    Private Sub btnExit_Click(ByVal sender As System.Object, ByVal e As System.EventArgs)
Handles btnExit.Click
        Application.Exit()
    End Sub

    Private Sub btnCalculate_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles btnCalculate.Click
        If txtCondenserTemperature.Text = "" Or txtEvaporatorTemperature.Text = "" Then
            MessageBox.Show("Please select the Outdoor or Cold space Temperatures")
        ElseIf txtCondenserTemperature.Text > 100 Or txtCondenserTemperature.Text < -40 Or
txtEvaporatorTemperature.Text > 100 Or txtEvaporatorTemperature.Text < -40 Then
            MessageBox.Show("Please enter temperature values between -40 and 100")
        Else
            Condentemp = txtCondenserTemperature.Text
            Coldtemp = txtEvaporatorTemperature.Text
            If chbCarnot.Checked = True Then
                saturatedvapour(Condentemp)
                h2 = hv
                Dim newentro, newt As Double
                newentro = sv
                newt = sl
                saturatedvapour(Coldtemp)
                h1 = (newentro - sl) * (hv - hl) / (sv - sl) + hl
                h3 = (newt - sl) * (hv - hl) / (sv - sl) + hl
                Form2.PictureBox9.Show()
            ElseIf cboCompressorselection.Text = "" Or cboOutletCondenser.Text = "" Then
                MessageBox.Show("Please select the compressor inlet or condenser outlet conditions")
            Else
                If cboOutletCondenser.Text = "Saturated Liquid" Then
                    If cboCompressorselection.Text = "Wet Vapour" Then
                        wetvapour()
                        saturatedvapour(Condentemp)
                        h3 = hl
                        If Drynesslocation = 2 And txtDryness.Text = 1 Then
                            Form2.PictureBox2.Show()
                        Else
                            Form2.PictureBox3.Show()
                        End If

                    ElseIf cboCompressorselection.Text = "Saturated Vapour" Then
                        saturatedvapour(Coldtemp)
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                h1 = hv
                deliverysuperheat(sv, Condentemp)
                h2 = hv
                saturatedvapour(Condentemp)
                h3 = hl
                Form2.PictureBox1.Show()
            Else
                superheatvapour()
                saturatedvapour(Condentemp)
                h3 = hl
                Form2.PictureBox4.Show()
            End If
        Else
            If txtSubcooling.Text = "" Then
                MessageBox.Show("Please enter degree of sub cooling")
            Else
                Subcooling = txtSubcooling.Text
                If cboCompressorselection.Text = "Wet Vapour" Then
                    wetvapour()
                    saturatedvapour(Condentemp - Subcooling)
                    h3 = hl
                    If Drynesslocation = 2 And txtDryness.Text = 1 Then
                        Form2.PictureBox7.Show()
                    Else
                        Form2.PictureBox8.Show()
                    End If
                ElseIf cboCompressorselection.Text = "Saturated Vapour" Then
                    saturatedvapour(Coldtemp)
                    h1 = hv
                    deliverysuperheat(sv, Condentemp)
                    h2 = hv
                    saturatedvapour(Condentemp - Subcooling)
                    h3 = hl
                    Form2.PictureBox6.Show()
                Else
                    superheatvapour()
                    saturatedvapour(Condentemp - Subcooling)
                    h3 = hl
                    Form2.PictureBox5.Show()
                End If
            End If
        End If
    End If
End If
results()
End Sub
```

```
    Public Function wetvapour() As Integer
        If txtDryness.Text = "" Or cboDryness.Text = "" Then
            MessageBox.Show("Please select dryness fraction or location of your entered dryness
fraction")
        ElseIf txtDryness.Text > 1 Or txtDryness.Text < 0 Then
            MessageBox.Show("Select the dryness fraction between 0 and 1")
        Else
            Dryness = txtDryness.Text
            If cboDryness.Text = "Suction" Then
                Drynesslocation = 1
                saturatedvapour(Coldtemp)
                h1 = Dryness * hv + (1 - Dryness) * hl
                Dim newentro As Double
                newentro = Dryness * sv + (1 - Dryness) * sl
                saturatedvapour(Condentemp)
                h2 = (newentro - sl) * (hv - hl) / (sv - sl) + hl
            Else
                Drynesslocation = 2
                saturatedvapour(Condentemp)
                h2 = Dryness * hv + (1 - Dryness) * hl
                Dim newentro As Double
                newentro = Dryness * sv + (1 - Dryness) * sl
                saturatedvapour(Coldtemp)
                h1 = (newentro - sl) * (hv - hl) / (sv - sl) + hl
            End If
        End If
        Return 0
    End Function

    Public Function superheatvapour() As Integer
        If txtDryness.Text = "" Then
            MessageBox.Show("Please select degree of superheat")
        Else
            Superheat = txtDryness.Text
            inletsuperheat(Coldtemp, Superheat)
            h1 = hv
            deliverysuperheat(sv, Condentemp)
            h2 = hv
        End If
        Return 0
    End Function

    Function saturatedvapour(ByVal temp As Double) As Double
        Dim a, b As Double
        Dim connection As OleDb.OleDbConnection
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        Dim mystr As String
        Dim da As OleDb.OleDbDataAdapter
        Dim ds, dm As New DataSet
        mystr = ("Provider=Microsoft.jet.oledb.4.0;Data Source=D:\Ref n Air
Assignment\PropertyTable.mdb")
        connection = New OleDb.OleDbConnection(mystr)
        connection.Open()
        da = New OleDb.OleDbDataAdapter("SELECT temperature FROM
saturated_temperature", connection)
        da.Fill(ds, "saturated_temperature")
        For i As Integer = 1 To 56
            a = ds.Tables("saturated_temperature").Rows(i - 1).Item(0)
            If a >= temp Then
                Exit For
            Else
                b = a
            End If
        Next
        da = New OleDb.OleDbDataAdapter("SELECT * FROM saturated_temperature WHERE
temperature = " & b & " OR temperature =" & a, connection)
        da.Fill(dm, "saturated_temperature")
        connection.Close()
        ps = (dm.Tables("saturated_temperature").Rows(1).Item(1) -
dm.Tables("saturated_temperature").Rows(0).Item(1)) * (temp - b) / (a - b) +
dm.Tables("saturated_temperature").Rows(0).Item(1)
        hl = (dm.Tables("saturated_temperature").Rows(1).Item(2) -
dm.Tables("saturated_temperature").Rows(0).Item(2)) * (temp - b) / (a - b) +
dm.Tables("saturated_temperature").Rows(0).Item(2)
        hv = (dm.Tables("saturated_temperature").Rows(1).Item(3) -
dm.Tables("saturated_temperature").Rows(0).Item(3)) * (temp - b) / (a - b) +
dm.Tables("saturated_temperature").Rows(0).Item(3)
        sl = (dm.Tables("saturated_temperature").Rows(1).Item(4) -
dm.Tables("saturated_temperature").Rows(0).Item(4)) * (temp - b) / (a - b) +
dm.Tables("saturated_temperature").Rows(0).Item(4)
        sv = (dm.Tables("saturated_temperature").Rows(1).Item(5) -
dm.Tables("saturated_temperature").Rows(0).Item(5)) * (temp - b) / (a - b) +
dm.Tables("saturated_temperature").Rows(0).Item(5)
        Return 0
    End Function

    Function inletsuperheat(ByVal temp As Double, ByVal degreesuperheat As Double) As
Double
        Dim h, s, p, plow, phigh As Double
        saturatedvapour(temp)
        p = ps
        saturatedvapour(temp + degreesuperheat)
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```
        phigh = ps
        For i As Integer = 0 To 17
            If superheatpressure(i) > p Then
                plow = superheatpressure(i - 1)
                Exit For
            End If
        Next
        Dim a, b As Double
        Dim connection As OleDb.OleDbConnection
        Dim mystr As String
        Dim da As OleDb.OleDbDataAdapter
        Dim ds, dm As New DataSet
        mystr = ("Provider=Microsoft.jet.oledb.4.0;Data Source=D:\Ref n Air
Assignment\PropertyTable.mdb")
        connection = New OleDb.OleDbConnection(mystr)
        connection.Open()
        da = New OleDb.OleDbDataAdapter("SELECT temperature FROM " & plow & "kpa",
connection)
        da.Fill(ds, plow & "kpa")
        b = ds.Tables(plow & "kpa").Rows(0).Item(0)
        For i As Integer = 1 To 15
            a = ds.Tables(plow & "kpa").Rows(i).Item(0)
            If a > temp Then
                Exit For
            Else
                b = a
            End If
        Next
        da = New OleDb.OleDbDataAdapter("SELECT * FROM " & plow & "kpa WHERE
temperature = " & b & " OR temperature =" & a, connection)
        da.Fill(dm, plow & "kpa")
        connection.Close()
        h = (dm.Tables(plow & "kpa").Rows(1).Item(1) - dm.Tables(plow &
"kpa").Rows(0).Item(1)) * (temp - b) / (a - b) + dm.Tables(plow & "kpa").Rows(0).Item(1)
        s = (dm.Tables(plow & "kpa").Rows(1).Item(2) - dm.Tables(plow &
"kpa").Rows(0).Item(2)) * (temp - b) / (a - b) + dm.Tables(plow & "kpa").Rows(0).Item(2)
        hv = (h - hv) * (p - plow) / (plow - phigh) + hv
        sv = (s - sv) * (p - plow) / (plow - phigh) + sv
        Return 0
    End Function

    Function deliverysuperheat(ByVal entropy As Double, ByVal temp As Double) As Double
        Dim hhigh, hlow, p, phigh, plow As Double
        saturatedvapour(temp)
        p = ps
        For i As Integer = 0 To 17
```

```
            If superheatpressure(i) > p Then
                phigh = superheatpressure(i)
                plow = superheatpressure(i - 1)
                Exit For
            End If
        Next
        Dim a, b As Double
        Dim connection As OleDb.OleDbConnection
        Dim mystr As String
        Dim da As OleDb.OleDbDataAdapter
        Dim ds, dm, dt, dn As New DataSet
        mystr = ("Provider=Microsoft.jet.oledb.4.0;Data Source=D:\Ref n Air
Assignment\PropertyTable.mdb")
        connection = New OleDb.OleDbConnection(mystr)
        connection.Open()
        da = New OleDb.OleDbDataAdapter("SELECT entropy FROM " & phigh & "kpa",
connection)
        da.Fill(ds, phigh & "kpa")
        b = ds.Tables(phigh & "kpa").Rows(0).Item(0)
        For i As Integer = 1 To 15
            a = ds.Tables(phigh & "kpa").Rows(i).Item(0)
            If a > entropy Then
                Exit For
            Else
                b = a
            End If
        Next
        da = New OleDb.OleDbDataAdapter("SELECT * FROM " & phigh & "kpa WHERE
entropy = " & b & " OR entropy =" & a, connection)
        da.Fill(dm, phigh & "kpa")
        hhigh = (dm.Tables(phigh & "kpa").Rows(1).Item(1) - dm.Tables(phigh &
"kpa").Rows(0).Item(1)) * (entropy - b) / (a - b) + dm.Tables(phigh & "kpa").Rows(0).Item(1)

        da = New OleDb.OleDbDataAdapter("SELECT * FROM " & plow & "kpa", connection)
        da.Fill(dt, plow & "kpa")
        b = dt.Tables(plow & "kpa").Rows(0).Item(2)
        If entropy > dt.Tables(plow & "kpa").Rows(0).Item(2) Then
            For i As Integer = 1 To 15
                a = dt.Tables(plow & "kpa").Rows(i).Item(2)
                If a > entropy Then
                    Exit For
                Else
                    b = a
                End If
            Next
```

```
            da = New OleDb.OleDbDataAdapter("SELECT * FROM " & plow & "kpa WHERE
entropy = " & b & " OR entropy =" & a, connection)
            da.Fill(dn, plow & "kpa")
            hlow = (dn.Tables(plow & "kpa").Rows(1).Item(1) - dn.Tables(plow &
"kpa").Rows(0).Item(1)) * (entropy - b) / (a - b) + dn.Tables(plow & "kpa").Rows(0).Item(1)
        Else
            saturatedvapour(dt.Tables(plow & "kpa").Rows(0).Item(0))
            hlow = (entropy - sl) * (hv - hl) / (sv - sl) + hl
        End If
        hv = (hhigh - hlow) * (p - plow) / (phigh - plow) + hlow
        connection.Close()
        Return 0
    End Function

    Public Function results() As Integer
        If h1 = 0 Or h2 = 0 Or h3 = 0 Then
            Dim abc As Integer
            abc = h1
        Else
            Form2.txtRefeffect.Text = h1 - h3
            Form2.txtComwork.Text = h2 - h1
            Form2.txtCOP.Text = (h1 - h3) / (h2 - h1)
            Form2.ShowDialog()
        End If
        Return 0
    End Function
End Class
```