```
function arda_numerical()

c_p = 0.718;         % Specific heat of air at constant volume
R = 287.058;         % J/(kg*K), Specific Gas Constant, dry air
%R = 461.495;        % J/(kg*K), Specific Gas Constant, water vapor

C_g = 1800;          % J/(kg*K), Specific heat capacity of humid air
 (60% relative
C_h = 4660;           % J/(kg*K), Specific heat capacity of the heater
m = 1.3;               % kg, Mass of the control volume
R_go = 0.028;        % K/W, Thermal resistance of the gas mixture to
 outside interface
R_hg = 0.028;        % K/W, Therman resistance of the heater to gax
 mixture interface

x_0 = [20 + 273;          % K, initial T_g
       50 + 273;          % K, Initial heater temp, T_h
       25 + 273;          % K, Initial outside / ambient temp, T_o
       101.325;    % Pa, Initial pressure of the control volume
       1];          % m^3, Initial volume of the control volume

if x_0(2) < x_0(1)
    % Throw this error because I didn't work an absolute value term
 into my
    % equations.
    error('Heater must be warmer than air.')
end

dt = 0.01;
t_final = 100;

[t, y] = euler_solver(x_0, dt, t_final);
figure

% Gas Temperature
subplot(3,1,1)
plot(t, real(y(:,1) - 273), '--b')
hold on

% Heater Temperature
plot(t, real(y(:,2) - 273), '--r')

% Ambient Temperature
plot(t, y(:,3) - 273, '--k')
ylabel 'Temp (C)'
hold off
grid on
legend({'T_g', 'T_h', 'T_o'},'Location','best')
axis([0 t_final 0 max(real([y(:,1); y(:,2); y(:,3)]) - 273)])

% Pressure
subplot(3,1,2)
```

```
plot(t, real(y(:,4)) / 1000, '--k')
ylabel('Pressure (kPa)')
grid on
axis([0 t_final 0 max(real(y(:,4)/1000))])

subplot(3,1,3)
plot(t, real(y(:,5)), '--m')
ylabel('Volume (m^3)')
grid on
axis([0 t_final 0 max(real(y(:,5)))])



    function [t, data] = euler_solver(x, dt, t_final)
        % Initialization
        time = 0;
        Nsteps = round(t_final/dt);
        t = zeros(Nsteps, 1);
        data = zeros(Nsteps, length(x));
        t(1) = time;
        data(1:2,:) = [x'; x'];

        for i = 2:Nsteps+1
            % Capture current values
            T_h = x(2);
            T_o = x(3);

            % Calculate rate of change of pressure
            p = x(4);
            p_dot = (p - data(i-1, 4))/dt;

            % Calculate rate of change of volume
            V = x(5);
            V_dot = (V - data(i-1, 5))/dt;

            % Calculate a few terms to reduce the complexity within
 derivs
            d = -(T_h/(C_g*R_hg) + T_o/(C_g*R_go));
            g = 1/(C_g*R_hg) + 1/(C_g*R_go);
            f = (c_p * p_dot * V_dot)/(C_g * R);

            % Calculate the increments
            delta = derivs(x);

            % Increment the variables
            x = x + delta*dt;
            time = time + dt;

            % Record data
            t(i+1) = time;
            data(i+1,:) = x';
        end

        function delta = derivs(x)
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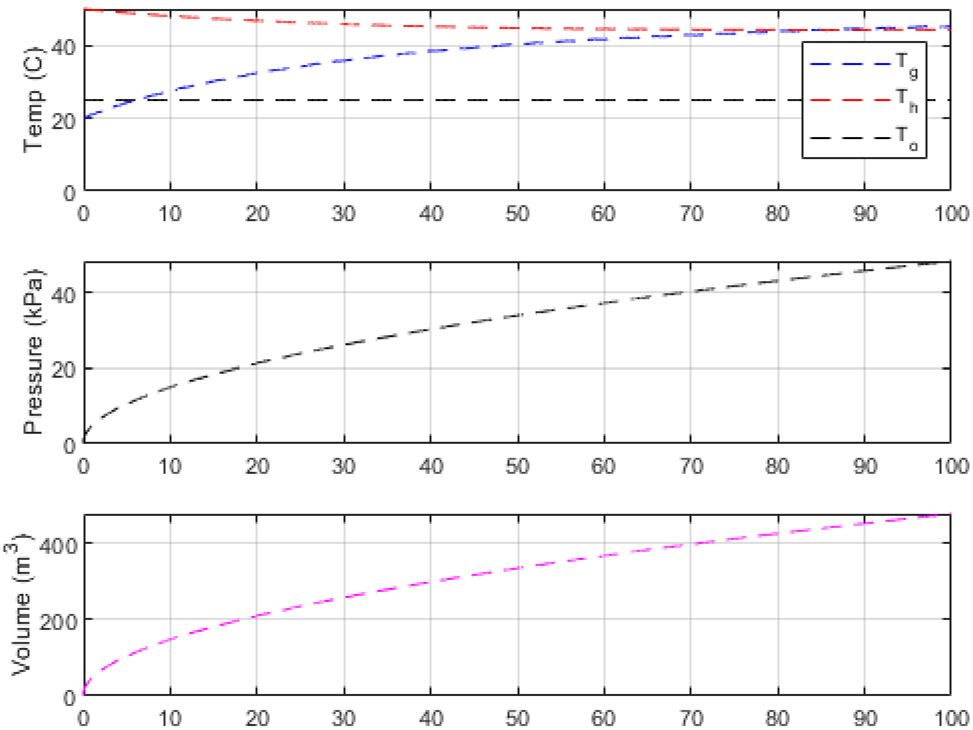
```
            delta = zeros(length(x), 1);
            delta(1) = (-(d + g*x(1)) + sqrt((d + g*x(1))^2 - (4 * (f)
* x(1) ) ) )/2;
            delta(2) = x(1)/(C_h*R_hg) - x(2)/(C_h * R_hg);
            delta(3) = 0;  % Constant ambient temperature outside the
system
            delta(4) = (m*R*x(1))/x(5);
            delta(5) = (m*R*x(1))/x(4);
        end
    end
end
```



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