Exercise 7

Part 1

$$\frac{dn_g}{dt} = F - L \qquad (1)$$

$$n_g C_p \frac{dT}{dt} = F C_p (T_0 - T) + \lambda L - h A_t (T - T_c) \qquad (2)$$

$$PV = n_g = RT \qquad (3)$$

$$P = A \exp\left(\frac{-B}{T}\right) \qquad (4)$$

1) We have four unknown P, L, n_g, T and four linearly independant equations

=> DOF satisfied

Incidence matrix

			Differential variable	
Eq	P	L	n_g	T
1		X	X	
2		X	X	X
3	X		X	X
4	X			X

3)

eq 4. $P = A \exp\left(-\frac{B}{T}\right)$

using chain rule

$$\Rightarrow \frac{dP}{dt} = \frac{dA \exp\left(-\frac{B}{T}\right)}{dT} \cdot \frac{dT}{dt} = \frac{AB}{T^2} \exp\left(-\frac{B}{T}\right) \frac{dT}{dt} \quad (5)$$

eq 5.

$$PV = n_s RT$$

$$\Rightarrow \frac{d(PV)}{dt} = \frac{d(n_s RT)}{dt} \Rightarrow P\frac{dV}{dt} + V\frac{dP}{dt} = n_s \frac{d(RT)}{dt} + RT\frac{dn_s}{dt}$$

Part 2

Theory

1) We make a polynomial to solve our IVP by using a set of orthogonal algebraic equations

2) The placement of points can improve accuracy as placing points where there is many points could improve the accuracy.
the amount of points makes it more likely that the points capture areas of rapid change
We can see this by seeing that more points is more accurate than less points of the same type (in the supplied plots)
We can also see that the Radau points are more accurate than uniform. They placement matters

3) Using adaptive methods. that ajust number of points and location based on behaviour.
We could also use higher order polynomials to increase accuracy

4) We should use implicit methods for solving stiff systems. Therefor orthogonal collocation probably is not the best method

5)