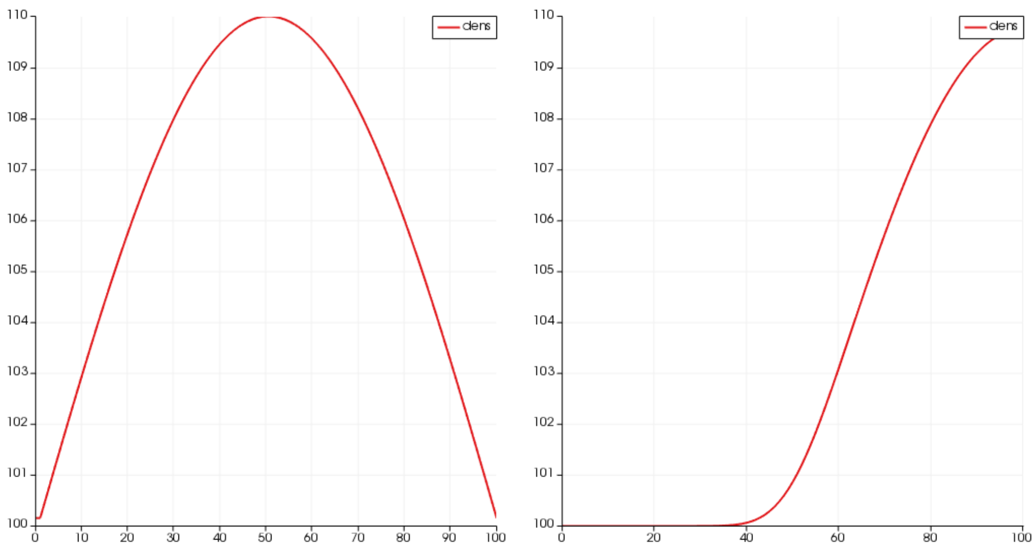
1 Advection

1.1 advec1-t

- *advec1-t.i*
- 1D generated mesh with libmesh
- Uses DG Kernels
- InflowBC and OutflowBC
- Transient problem

Figure 1 shows the results. Advects BC. It seems like the variable has to be a CONSTANT MONOMIAL.

$$\frac{\partial}{\partial t}\rho + v\frac{\partial}{\partial x}\rho = 0 \tag{1}$$



(a) t=0.

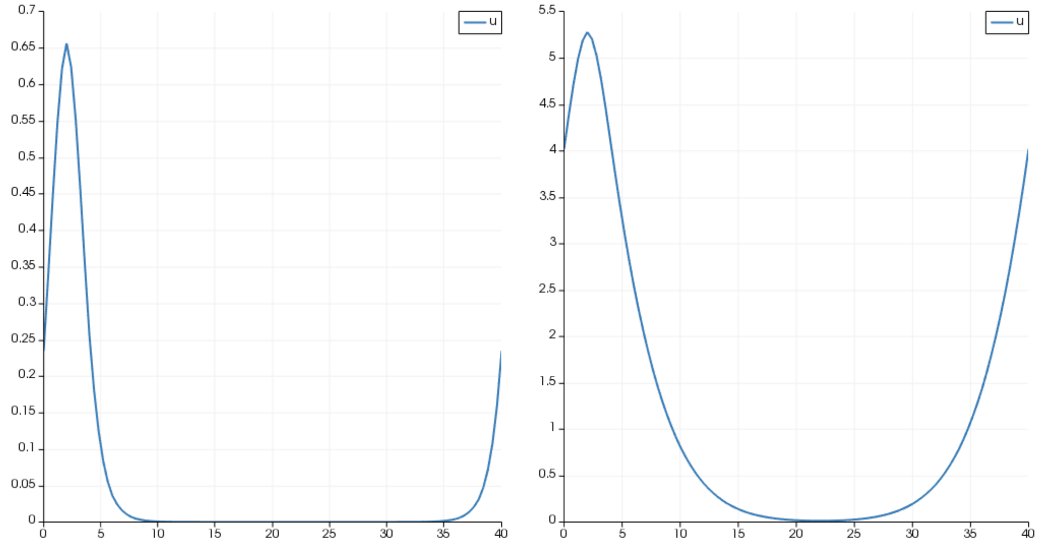
(b) t=100.

Figure 1: Advected density.

1.2 periodic_bc2

- *moose/examples/ex04_bcs/periodic_bc2.i*
- 1D generated mesh with libmesh
- Periodic BCs
- Transient problem

In *advec1-t-bc.i* I tried to add periodicBCs to the previous problem and it does not work. Here I tried to isolate the problem. Figure 2 shows the results. It does not work if the valiable is a CONSTANT MONOMIAL. It works if the variable is FIRST order (either MONOMIAL or LAGRANGE).



(a) t=0.

(b) t=20.

Figure 2: Periodic BCs.

1.3 advec2-t

- *advec2-t.i*
- 1D generated mesh with libmesh
- Uses DG Kernels
- TemperatureInflowBC and TemperatureOutflowBC
- Transient problem

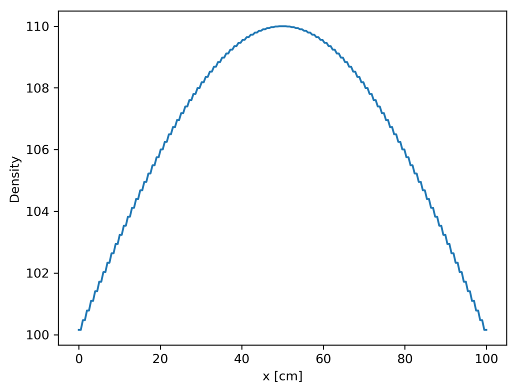
Very similar to *advec1-t.i*. Adds volumetric source. Figure 3 shows the results. It is correct. $\rho(L, t \to \infty) - \rho(0, t) = q/v * L = 200$

$$\frac{\partial}{\partial t}\rho + v\frac{\partial}{\partial x}\rho = \dot{q} \tag{2}$$

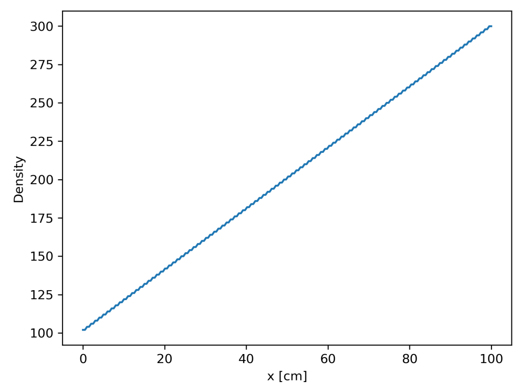
- IC: $\rho(x, 0) = 100 + 10sin(\frac{\pi}{L}x)$
- BC: $\rho(0, t) = 100$
- $v = 0.5$
- $L = 100$
- $q = 1$

1.4 advec2-ss

- *advec2-ss.i*
- 1D generated mesh with libmesh



(a) t=0.



(b) t=250.

Figure 3: Advected density with volumentric source.

- Uses DG Kernels
- Inflow and OutflowBC
- Steady problem

Same as *advec2-t* but steady state. Figure 4 shows the results. It is correct. $\rho(L) - \rho(0) = q/v * L = 200$

$$v \frac{\partial}{\partial x} \rho = \dot{q} \tag{3}$$

- BC: $\rho(0, t) = 100$
- $v = 0.5$
- $L = 100$
- $q = 1$

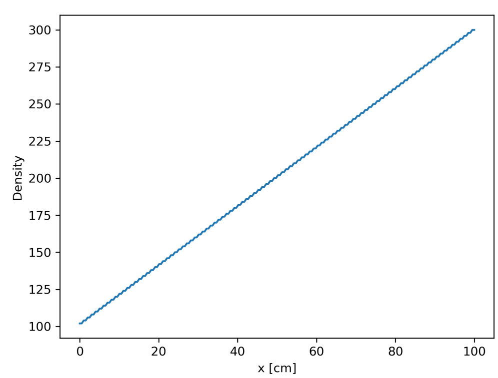


Figure 4: Steady state solution.

1.5 advec3-t

- *advec3-t.i*
- 1D generated mesh with libmesh
- Uses DG Kernels
- TemperatureInflowBC and TemperatureOutflowBC
- Transient problem

Very similar to *advec1-t.i*. Solves for the temperature advection equation. Advects BC. Figure 5 shows the results.

$$\rho c_p \frac{\partial}{\partial t} T + \rho c_p v \frac{\partial}{\partial x} T = 0 \tag{4}$$

- BC: $T(0,t) = 930$
- IC: $T(x,0) = 930$
- $\rho = 1e-2$
- $c_p = 2e3$
- $v = 0.5$
- $L = 100$

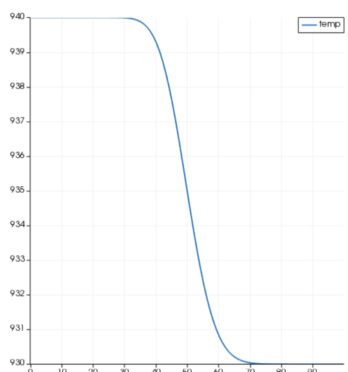


Figure 5: Advects BC.

1.6 advec4-t

- *advec4-t.i*
- 1D generated mesh with libmesh
- Uses DG Kernels
- TemperatureInflowBC and TemperatureOutflowBC
- Transient problem

Similar to *advec4-t.i* Adds a point source and solves for temperature. Figure 6 shows the results. It is correct. $T(L) - T(0) = q/(\rho c_p v) * L = 10$

$$\rho c_p \frac{\partial}{\partial t} T + \rho c_p v \frac{\partial}{\partial x} T = \dot{q} \tag{5}$$

- BC: $T(0, t) = 930$
- IC: $T(x, 0) = 930$
- $\rho = 1e - 2$
- $c_p = 2e3$
- $v = 0.5$
- $L = 100$
- $q = 1$

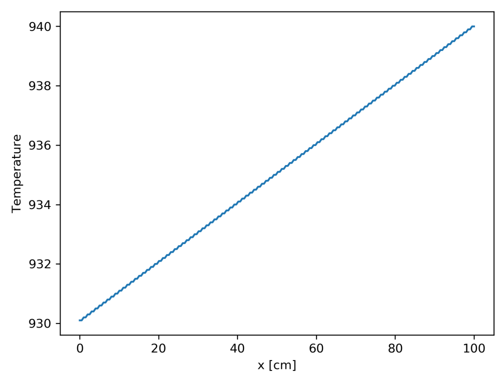


Figure 6: t=250.

1.7 advec5-t

- *advec5-t.i*
- pseudo-1D: GeneratedMesh
- Uses DG Kernels
- TemperatureInflowBC and TemperatureOutflowBC
- Transient problem

Similar to *advec4-t.i* but has a q'' on the wall. Figure 7 shows the results.

$$\rho c_p \frac{\partial}{\partial t} T + \rho c_p v \frac{\partial}{\partial x} T = 0 \tag{6}$$

This is not the real equation. When using the Galerkin method, a new term appears due to the neumann BC.

- IC: $T(x, y, 0) = 930$

- BC: $T(x, 0, t) = 930$
- BC: $q''(0, y, t) = 10sin(\pi/Ly)$
- $\rho = 1e - 2$
- $c_p = 2e3$
- $v = 0.5$
- $L = 100$
- $\Delta_x = 2$

$$T(L) - T(0) = \frac{1}{\rho c_p v} \frac{1}{\Delta_x} \int_0^L q'' dx = \frac{1}{10} \frac{1}{2} \frac{10 \times 2 \times L}{\pi} \tag{7}$$

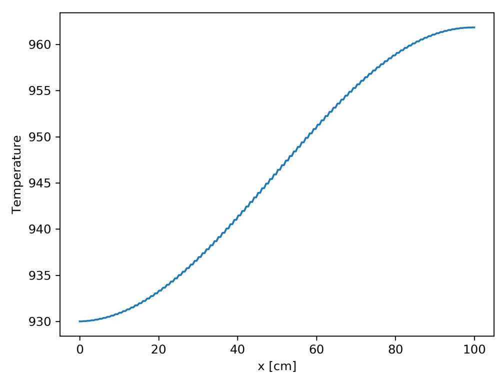


Figure 7: Advects temperature while wall is been heated.

1.8 advec5-ss

- *advec5-ss.i*
- pseudo-1D: GeneratedMesh
- Uses DG Kernels
- TemperatureInflowBC and TemperatureOutflowBC
- Steady state problem

Steady state version of *advec5-t.i*. Figure 8 shows the results.

$$\rho c_p v \frac{\partial}{\partial x} T = 0 \tag{8}$$

This is not the real equation. When using the Galerkin method, a new term appears due to the neumann BC.

- BC: $T(x, 0) = 930$
- BC: $q''(0, y) = 10sin(\pi/Ly)$

- $\rho = 1e - 2$
- $c_p = 2e3$
- $v = 0.5$
- $L = 100$
- $\Delta_x = 2$

$$T(L) - T(0) = \frac{1}{\rho c_p v} \frac{1}{\Delta_x} \int_0^L q'' dx = \frac{1}{10} \frac{1}{2} \frac{10 \times 2 \times L}{\pi} \tag{9}$$

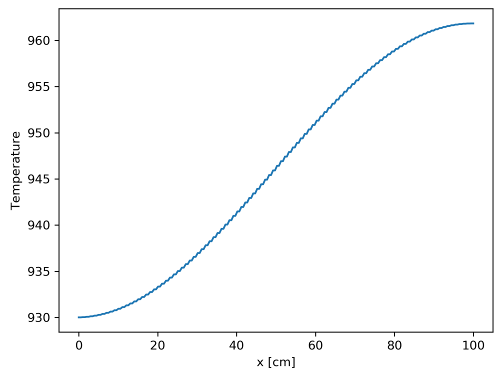


Figure 8: Advects temperature while wall is been heated.