1. For $u(x,t) = x^2 e^t - \sqrt{t}e^{-x}$, find $u_{xt}(\ln 2, 9)$.

2. Use the geometric method to find the general solution of $xu_x + t^2 u_t = x$.

3. Solve $u_{xx} - 2u_{xt} + u_{tt} = x + t$, $u(x,0) = \phi(x)$, $u_t(x,0) = \psi(x)$ by "factoring the operator".

4. Prove: If ϕ is a periodic function with period p, then the solution of the diffusion equation $u_t = ku_{xx}$ (on the whole real line) together with $u(x,0) = \phi(x)$ is also periodic in x with period p.

5. Separate the variables for $u_{xx} + 2u_x + u_t = 0$, $u(0,t) = u(1,t) = 0$ and find all eigenvalues and eigenfunctions of the resulting eigenvalue problem.

6. Let $f(x) = a$ for $-\pi \leq x < 0$, $f(0) = 0$, and $f(x) = b$ for $0 < x \leq \pi$. Find the Fourier series of f in $[-\pi, \pi]$. Does it converge pointwise to f?

7. Perform separation of variables to solve $u(m+1,n) - u(m,n+1) + u(m,n) = 0$, $u(m,0) = 2^m$.

8. Solve $u_t = u_{xx}$ in $[0,4]$ with $u = 0$ at both ends and $u(x,0) = x(5-x)$, using the forward differenece scheme with $\Delta x = 1$ and $\Delta t = 0.25$ to find the approximate value of $u(2,1)$.