For all the following multiple-choice questions, circle your answers clearly. No partial credit will be awarded; any scratch work will be ignored.

1. Which of the following is a physical principle used in class to derive the heat equation?

(a) Conservation of momentum

(b) Principle of least action

(c) Conservation of (heat) energy

(d) Second law of thermodynamics

(e) Maxwell's equations

2. Which of the following PDEs is the heat equation?

(a) $u = u_x$

(b) $u_t = u$

(c) $u_t = u_x$

(d) $u_{tt} = u_{xx}$

(e) $u_t = u_{xx}$

3. Why are <u>initial</u> conditions needed for the heat equation?

(a) The starting state of the system must be known to predict future heat flow.

(b) The PDE has no solutions without initial conditions.

(c) The PDE requires extra conditions at the boundary of the spatial domain.

(d) Without initial conditions, the PDE models wave propagation instead of heat flow.

(e) Without initial conditions, the PDE models chaotic dynamics instead of heat flow.