**Instructions:** This is a closed-book closed-notes test. You may use *one side* of a single 8 1/2 x 11 paper as a crib sheet. You may use a calculator, but you must show all your work to get credit. **You have exactly 50 minutes.**

1. (25 points) A system has a transfer function \( G(s) = \frac{s+3}{s(s^2-4)} \). Find its step response.

2. (25 points) Consider the unit-step response of a unity feedback control system whose *open loop* transfer function is \( G(s) = \frac{1}{s(s+2)} \). Determine
   
   (a) Rise time
   (b) Peak time
   (c) Maximum overshoot
   (d) Settling time (2% criterion)
   (e) Steady-state error

3. (25 points) Given the control system:

![Control System Diagram](image)

Design a feedback controller \( K(s) \) that meets the following requirements:

(a) Stabilizes the feedback system.
(b) Rejects step disturbances \( d(t) \) in the steady-state.
(c) Tracks step reference inputs \( r(t) \) in the steady-state.

For your design, compute the steady-state error to a step ramp input.
4. **(25 points)** Consider the following system:

![System Diagram](image)

Design the rate feedback constant $K_d$ and the feedback gain $K_p$ so that the control system achieves the following:

(a) Zero steady-state tracking error to unit step input.
(b) Step response overshoot less than 15%.
(c) Step response rise time less than 0.1 sec.