1. (25%) The variable $y:\Re\to\Re$ is governed by $\dot{y}+y=\dot{u}$, $y(0)=0$, with the input $u:\Re\to\Re$.
(a) (10%) Please solve the impulse response of y, that is, $u(t)=\delta(t)$;
(b) (7%) Based on the impulse response obtained in (a), find the step response of y;
(c) (8%) Solve the frequency response of y, i.e. the forcing response of y as $u(t)=\cos\omega t$.

2. (15%) Consider the following feedback system shown in Figure1.

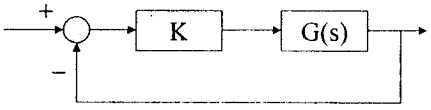

Figure 1.

Use the root locus method to discuss the correctness (true or false) of the following statements. **No point will be given to discussions that do not use the root locus method.**
(a) (5%) If G(s) is a stable first order system, the closed loop system is stable for all K > 0.
(b) (5%) When G(s) is a stable second order system with a zero in the right half plane, the closed loop system will eventually become unstable as K goes to +∞.
(c) (5%) Express G(s) = N(s)/D(s) where N(s) and D(s) are polynomials. If the degree of D(s) is greater than that of N(s) by at least 3, the closed loop system will eventually become unstable as K goes to +∞.

3. (15%) Consider the following two closed-loop systems (02) where

$$G_1(s)=\frac{1}{s(s+1)(s+100)} \quad \text{and} \quad G_2(s)=\frac{1}{100s(s+1)}$$

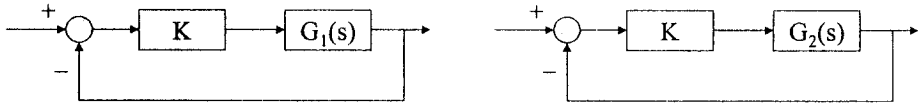

Figure 2.

(a) (5%) Identify the segments on the real axis which are parts of the root locuses of $G_1(s)$ and $G_2(s)$, respectively.
(b) (10%) Explain why the behaviors of the root locuses around the breakaway point of these two closed-loop systems are similar.