ANSWERS

1 (a) $H(\omega) = m[-m\omega^2 + i\omega b + k + \lambda^2 i\omega/(Ci\omega + 1/R)]^{-1}$, $S_{\dot{x}\dot{x}}(\omega) = \omega^2 \left|H(\omega)\right|^2 S_0$.

(b) $\sigma_x^2 = \pi S_0 m^2/[k(b+\lambda^2 R)]$, $\sigma_{\dot{x}}^2 = \pi S_0 m/(b+\lambda^2 R)$, $P = \pi S_0 m$.

(c) $P_{\text{fail}} = 0.011$.

2 (a) $\nu_b^+ = (1/2)Ca^2 \exp[-(b/d)^4]$.

(b) $p(b) = (4b^3/d^4)\exp[-(b/d)^4]$.

(d) $T = 4\alpha/(\sqrt{\pi}C\beta^2 d^2 a^2)$.

3 (b) $DF = (4b/A\pi)\sqrt{1-(a/A)^2}$ for $A > a$; $DF = 0$ for $A < a$.

(c) $f = -\omega^2 mA + (4b/\pi)\sqrt{1-(a/A)^2}$ for $A > a$; $f = -\omega^2 mA$ for $A < a$.

4 (a) $(0,0)$, $(-1/\alpha, 1)$, $(-1/\alpha, -1)$.

(b) First point: α<0 saddle point, $\alpha > 0$ centre

Second point: $\alpha < -0.5$ stable focus, $-0.5 < \alpha < 0$ stable node, $\alpha > 0$ saddle point

Third point: $\alpha < -0.5$ unstable focus, $-0.5 < \alpha < 0$ unstable node, $\alpha > 0$ saddle point