1 Question 1

1.1 Part a

We know that the energy varies as the amplitude squared all other things equal, so we have

$$E \propto A^2 \implies E \to \frac{E}{e^2} \implies A \to \frac{A}{e}$$

Since the decay is exponential, the decary to $\frac{1}{e^2}$ will take twice as long as the decay to $\frac{1}{e}$, so we have

$$t = 2\tau = 2 \times 50 = 100 \text{ s}$$

1.2 Part b

Let the damping coefficient be β, then we have

$$\beta t = 1 \implies \beta = 1/t = 1/100 = 10^{-2} \text{ s}^{-1}$$

and we know r is given by

$$r = 2m\beta = 2 \times 0.2 \times 10^{-2} = 4 \times 10^{-3} \text{ kg/s}$$

1.3 Part c

We know that the quality factor is given by $Q = \frac{\omega}{2\beta} = \frac{\sqrt{\omega_0^2 - \beta^2}}{2\beta}$