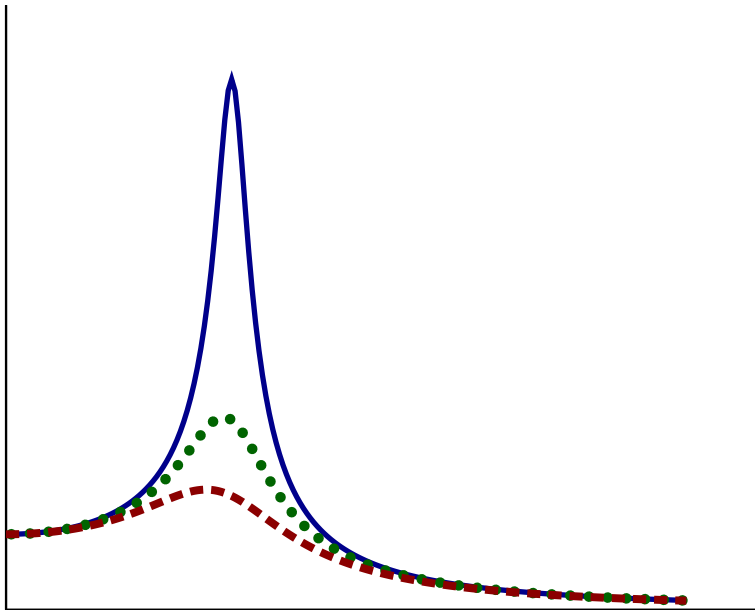# Question 1

Plots for the amplitude as a function of driving frequency for several oscillators, which have the same natural frequency, are as illustrated.

Which of the following is the ranking of the damping coefficients?

1. The coefficients of damping are the same.

2. Dashed red largest, dotted green middle, solid blue smallest.

3. Dashed red smallest, dotted green middle, solid blue largest.

4. Dotted green smallest, dashed red middle, solid blue largest.

Question 2

The power delivered by an external driving force is

$$P = -\frac{F_0^2}{m\omega_0} \, B \, \cos\left(\omega t\right) \sin\left(\omega t - \delta\right)$$

where $B = 1/\sqrt{(u - 1/u)^2 + 1/Q^2}$.

Which of the following is true when $w \ll \omega_0$?

1. P fluctuates between positive and negative.

2. P is always positive.

3. P is always negative.

Question 3

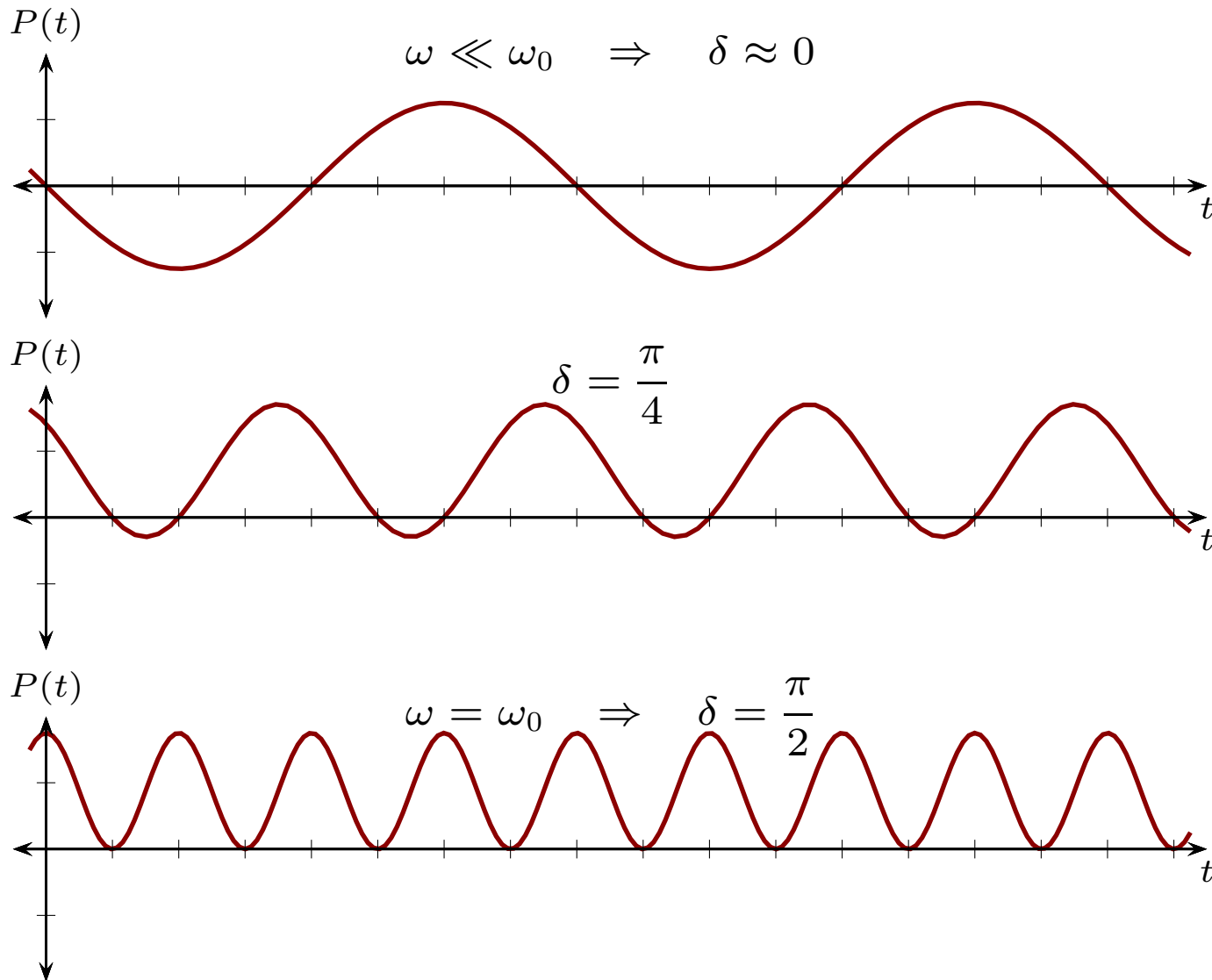The power delivered by an external driving force is

$$P = -\frac{F_0^2}{m\omega_0}\, B\, \cos\left(\omega t\right)\sin\left(\omega t - \delta\right)$$

where $B = 1/\sqrt{(u - 1/u)^2 + 1/Q^2}$.

Which of the following is true when $w = \omega_0$?

1. P fluctuates between positive and negative.

2. P is always positive.

3. P is always negative.

Power Delivered to a Damped Oscillator

$P(t)$

$$\omega \ll \omega_0 \quad \Rightarrow \quad \delta \approx 0$$

t

$P(t)$

$$\delta = \frac{\pi}{4}$$

t

$P(t)$

$$\omega = \omega_0 \quad \Rightarrow \quad \delta = \frac{\pi}{2}$$

t

Question 4

The average power absorbed from an external driving force is

$$\overline{P} = \frac{F_0^2}{2m\omega_0 Q} \frac{1}{\left(\dfrac{1}{u} - u\right)^2 + \frac{1}{Q^2}}$$

Which of the following is true?

1. The exact maximum power absorbed occurs when $\omega = \omega_0$.

2. The exact maximum power absorbed occurs when $\omega > \omega_0$.

3. The exact maximum power absorbed occurs when $\omega < \omega_0$.