

Score:

Name:

Solutions

Period (circle one): 1 2 3 4 5 6

Team (circle one): a b c d e f

### SM286 – Quiz 8 – Section 5.1 Mass Spring Systems

1. Express  $x = -\sin(2t) + \cos(2t)$  in the form  $x = A \sin(\omega t + \phi)$

$$A = \sqrt{(-1)^2 + (1)^2} = \sqrt{2}$$

$$\omega = 2$$

$$\phi = \tan^{-1}\left(\frac{1}{-1}\right) + \pi = -\frac{\pi}{4} + \pi = \frac{3\pi}{4}$$

$$\therefore x = \sqrt{2} \sin\left(2t + \frac{3\pi}{4}\right)$$

2. A damped mass-spring system with a mass  $m = 1$  and spring constant  $k = 4$  is described by the following equation of motion  $x'' + bx' + 4x = 0$ . For what values of  $b$  is the system under damped? Critically damped? Over damped?

$$\frac{-b \pm \sqrt{b^2 - 16}}{2} \Rightarrow$$

NOTE: In our Universe  $b > 0$

under damped:

$$b^2 - 16 < 0 \Rightarrow b^2 < 16$$

$$b < 4$$

critically damped:

$$b^2 - 16 = 0 \Rightarrow$$

$$b = 4$$

overdamped:

$$b > 4$$