

Show all your work if you want to receive credit.

- (1) Write $-3\cos(t) + 2\sin(t)$ as a function $C\cos(t - \alpha)$
- (2) For what value(s) of c will the equation $mx'' + cx' + kx = 3\cos 2t$ be in resonance?
- (3) Make the appropriate guess for the particular solution of the following. Do not solve.
- (a) $x'' + 4x' + 4x = t^2e^{-2t}$ (b) $y''' - y' = t$
- (4) Set up the differential equation for the figure below. Do not solve. Your answer should be in the form $ax'' + bx' + cx = f(t)$. You may want the following formulas
 $KE = \frac{1}{2}mv^2$, $KE = \frac{1}{2}I\omega^2$, $I = \frac{mr^2}{2}$, $PE = \frac{1}{2}kx^2$, $PE = mgh$
- (5) Set up the differential equation for the figure below. Do not solve. Your answer should be in the form $ax'' + bx' + cx = f(t)$. A 100 pound weight is attached to the end of a spring that is stretched 1 inch by a force of 100 pounds. A force $F_o \cos(\omega t)$ acts on the weight. A damping force with magnitude one-tenth the velocity also acts on the system. The weight is released from 6 inches above the equilibrium point with a downward velocity of 0.2 ft/sec.
- (6) The position of a mass in a spring system is given by $x = 2\cos\left(12t - \frac{\pi}{6}\right)$. Use algebra and trig to find the 3rd time that the mass is passing through the equilibrium position, heading upward. Answers should not include decimals.
- (7) The position of a mass in a spring system is given by $x = 2e^{-0.1t} \cos(2t + 0.02) - 4\cos(3t + 0.05)$. Use a calculator to draw a sketch on $0 \leq t \leq 2\pi$. Identify the second time that the mass is passing through the equilibrium position, heading upward. Answers should be accurate to three decimal places.
- (8) Completely solve $y'' + \lambda^2 y = 0$, $y(-2) = 0$, $y'(2) = 0$
- (9) Completely solve $x'' + 4x' + 8x = 2\sin t$, $x(0) = 0$, $x'(0) = 1$

