Honor Statement

I affirm that my work upholds the highest standards of honesty and integrity, and that I have neither given nor received any unauthorized assistance on this exam.

Signature _____

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total	

Instructions:

– Show all your work, and box your final answer.

– You may use one handwritten, double-sided $8\frac{1}{2}$" by 11" sheet of notes.

– No calculators, cell phones, headphones, or other electronics are allowed. You can include square roots and trigonometric functions in your answers.

– The value of g (acceleration due to gravity) is 9.8 m/s^2, or 32 ft/s^2.

– Your test should have 5 problems on 4 pages (not including this cover page)—double-check that it does!

– Raise your hand if you have any questions.

Give it your best shot!

1. A 32-lb object is attached to a (giant) spring, stretching it by 8 ft. Assume that when the object is traveling at 3 ft/s, it experiences a damping force of 15 lb. There is also an external force of $F(t) = 10 \cos 2t + 10 \sin 2t$ ft/s acting on the object.

At time $t = 0$, you pull the object 1 ft downward, and release it with initial velocity 1 ft/s downward.

(a) Find the amplitude and phase of the steady-state solution. (You may include square roots and trigonometric functions in your answer.)

(b) Find the position of the object as a function of time.

2. A 1kg mass is attached to a spring. The spring constant is $k = 25\text{kg/s}^2$, but you don't know the damping coefficient γ. If the quasiperiod is $2\pi/3$, find γ.

3. All critically damped systems have the same Q factor. Find this Q factor.

4. Find the general solution to the ODE

$$y'' - 6y' + 9y = te^{3t} + e^{-t}.$$

5. Given that $y_1(t) = t$ is a solution, find another solution to the ODE

$$t^2 y'' - t(t+2)y' + (t+2)y = 0$$

that is not a multiple of t. What is the general solution?