Physics 2110 - Quiz 2   **Name** _____

The position of a spaceship follows the function

$$x = A \sin Bt + Ct^3$$

where,

        A = 3500 m/s (There is an error in this unit. It should be m.)

        B = 0.00800 rad/s

        C = 0.00250 m/s³

(Note: All numbers are good to 3 significant digits.)

   a) What is the velocity function of this spaceship?

$$v = \frac{dx}{dt} = \frac{d}{dt}(A \sin Bt + Ct^3) = AB \cos Bt + 3Ct^2$$

$$v = (3500 \ m)(0.00800 \frac{rad}{s}) \cos\left(0.00800 \frac{rad}{s} t\right) + 3(0.00250 \frac{m}{s^3})t^2$$

$$v = (28.0 \frac{m}{s}) \cos\left(0.00800 \frac{rad}{s} t\right) + (0.00750 \frac{m}{s^3})t^2$$

   b) What is the acceleration function of this spaceship?

$$a = \frac{dv}{dt} = \frac{d}{dt}(AB \cos Bt + 3Ct^2) = -AB^2 \sin Bt + 6Ct$$

$$a = -(3500 \ m)\left(0.00800 \frac{rad}{s}\right)^2 \sin\left(0.00800 \frac{rad}{s} t\right) + 6(0.00250 \frac{m}{s^3})t$$

$$a = -\left(0.224 \frac{m}{s^2}\right) \sin\left(0.00800 \frac{rad}{s} t\right) + (0.0150 \frac{m}{s^3})t$$

   c) What is the instantaneous velocity of this spaceship at t = 90.0 s?

$$v = (28.0 \frac{m}{s}) \cos\left(0.00800 \frac{rad}{s} (90.0 \ s)\right) + (0.00750 \frac{m}{s^3})(90.0 \ s)^2$$

$$v = \left(21.1 \frac{m}{s}\right) + \left(60.8 \frac{m}{s}\right) = 81.9 \frac{m}{s}$$

   d) What is the instantaneous acceleration of this spaceship at t = 90.0 s?

$$a = -\left(0.224 \frac{m}{s^2}\right) \sin\left(0.00800 \frac{rad}{s} (90.0 \ s)\right) + (0.0150 \frac{m}{s^3})(90.0 \ s)$$

$$a = -\left(0.148 \frac{m}{s^2}\right) + \left(1.350 \frac{m}{s^2}\right) = 1.20 \ m$$