Name Period Date

# Quiz: Linear Motion {Calculations}

- Show equations and steps for credit.
- Include units for numerical answers for full credit
- Use 9.8 m/s² for the acceleration of gravity

1. A cart is given a push up a very long ramp. When it is 0.60 m from the motion sensor is it moving with an initial, instantaneous velocity of 2.0 m/s. It slows with a uniform acceleration of 0.40 m/s².

a. 4.8 m Calculate its position at t=3.0 seconds. $x_{(3)} = -.2(3^2) + 2(3) + .6 = 4.8m$

b. 1.2 m/s Calculate the ball's instantaneous velocity when its position, relative to the motion sensor, is 3.8 meters.

$x = -\frac{1}{2}(.4)t^2 + 2t + .6$

$= -.2t^2 + 2t + .6$

$v^2 = v_0^2 + 2a\Delta x$

$v^2 = 2^2 + 2(-.4)(3.8)$

c. 5.0 m Calculate the largest position reached by the cart.

$v = 0$ at $x_{max}$ $\quad 0^2 = 2^2 + 2(-.4)(\Delta x)$

$5.0 = \Delta x$

d. 10 sec Calculate the time required for the cart to return to its initial position.

$v = v_0 + at$

$-2\frac{m}{s} = +2\frac{m}{s}(-.4)\cdot t$

4. A spaceship moves with an acceleration of $v = 4.0t^2 - 800$. Times are in seconds, and velocities are in m/s.

a. −700 m/s Calculate the instantaneous velocity at t=5.0 seconds.

$v = 4(5^2) - 800$

b. 40 m/s² Calculate the instantaneous acceleration at t=5.0 seconds.

$\frac{dv}{dt} = 8t^1 \qquad 8(5)$

c. 8 m/s³ Calculate the jerk at t=5.0 seconds.

$\frac{da}{dt} = 8 = j$

d. 14 sec Calculate the time when the instantaneous velocity will be zero (not including t=0).

$0 = 4t^2 - 800 = 0$

5. A speeding car passes a motionless police car. The speeding car is moving at a constant velocity of 30.0 m/s. When it is 100.0 meters from the police car, the police cart starts to accelerate uniformly at a rate of 8.0 m/s²

a. 10 sec (and 2.5 sec before chase started!) Calculate the time when the police car will catch the speeder. $x = x$

$x_p = \frac{1}{2}(8)t^2 = 4t^2$ ?

$x_s = 30t + 100$

$4t^2 = 30t + 100$

$4t^2 - 30t - 100 = 0$

$(4t + 10)(t - 10) = 0$

b. 50 m/s Calculate the relative speed of the cars when the police car catches the speeder.

$v_s = 30\frac{m}{s}$

$v_p = 8t, \quad 8 \cdot 10 = 80\frac{m}{s}$