Name KEY

Test Prep Worksheet
Unit 2: Kinematics

1. A toy car riding around on the floor has its location described by the two functions $x(t) = (20\ cm/s^2)t^2 - (8.0\ cm/s)t$ and $y(t) = (4.0\ cm/s2)t^2 + (2.0\ cm/s)t - 8.8\ cm$, taken simultaneously. Determine the magnitude of the acceleration. Take second derivatives

$x'(t) = 40t + 8$ $\quad y'(t) = 8t + 2$

$x''(t) = 40$ $\quad y''(t) = 8$

$\sqrt{40^2 + 8^2} = \boxed{6.387\ m/s^2}$

2. Suppose acceleration is a function of x, where $a(t) = (4m/s^3)t$.
   a. If the velocity at t = 1s is zero, what is the velocity at t = 3 s?

$\int 4t = 2t^2 + C$

$v(1) = 0$

$2t = 0$

$C = -2$

$v(t) = 2t^2 - 2$

$v(3) = \boxed{16\ m/s}$

Ambiguous Question

   b. How long does it take to travel from x = 1 m to x = 3 m? Assuming it starts at origin.

$\int 2t^2 - 2 = \frac{2t^3}{3} - 2t + C$ $\quad \frac{2t^3}{3} - 2t = 3$

$C = 0$

3. The range of a projectile launched at a 30 degree angle is the same as a projectile launched at a 60 degree angle, but they won't be in the air for the same amount of time. Suppose a projectile launched at a 30 degree angle is in the air for 2.0 seconds. How long will the projectile be in the air if it is launched with the same speed at a 60 degree angle?

Time of flight Equation:

$t = \frac{2v_0 \sin\theta}{g}$

$\sin 30 = \frac{1}{2}$

$\sin 60 = \frac{\sqrt{3}}{2}$

$(2)(\sqrt{3}) = \boxed{3.464\ seconds}$

$\frac{d}{t} = s$ $\quad t = \frac{d}{s}$

4. A river flows with a steady speed *v*. A student swims upstream a distance *d* and then back to the starting point. The student can swim at speed *c* in still water.
   a. -In terms of *d*, *v*, and *c*, what time interval is required for the round trip?
   b. -What time interval would be required if the water were still?
   c. -Which time interval is larger? Explain if it is *always* larger

a. $\frac{d}{c-v} + \frac{d}{c+v}$

b. $\frac{2d}{c}$

c.

5. The velocity as a function of time for a car is given by

$$v(t) = 5\ m/s + (22\ m/s^2)t - (14\ m/s^3)t^2$$

a. What is this car's maximum velocity?

Graph it: 13.643

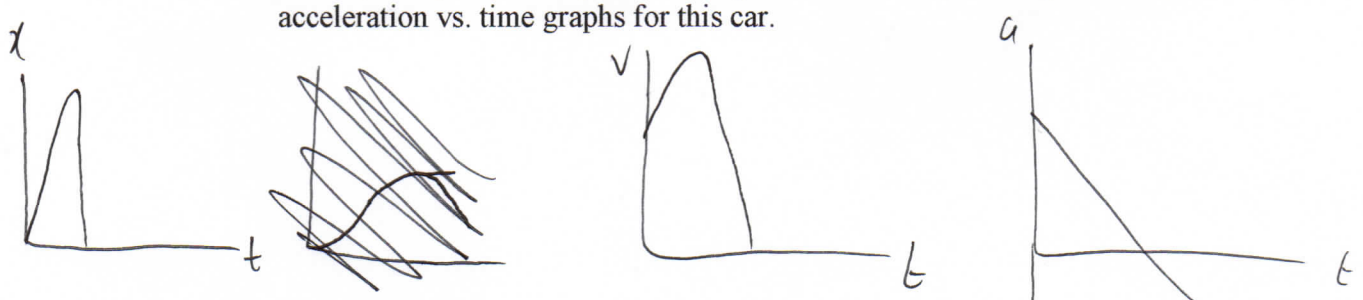
b. Calculate the car's displacement from t = 4 seconds to t = 7 seconds.

$\int_4^7 v(t) =$ −924m

c. At what time(s) does the car return to its original position ~~of x = 0 m~~?

$\int_0^x v(t) = 5t + 11t^2 - \frac{14t^3}{3} + C \quad C=0$ t = 2.747

d. Below, neatly and clearly sketch the position vs. time, velocity vs. time, and acceleration vs. time graphs for this car.

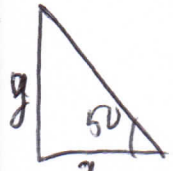


6. A skier leaves the ramp of a ski jump with a velocity of $v = 10\ m/s$ at $\Theta = 15°$ above the horizontal as shown below. The slope where she will land is inclined downward at $\Theta = 50°$, and air resistance is negligible.

-Find the distance from the end of the ramp to where the jump lands

-Find her velocity components just before landing

-Explain how you think the results might be affected if air resistance were included



$\tan 50 = \frac{y}{x}$

$x \tan 50 = y$

Δx

$-(\underbrace{(10\cos 15)(t)}_{x\ speed})(\tan 50) = \frac{1}{2}(-9.8)(t^2) + (10\sin 15)(t)$

Δy

t = 2.877 s

$(10\cos 15)(2.877\ s) = 27.794\ m$

$v^2 = (10\sin 15)^2 + 2(-9.8)(-10\cos 15)(2.877)(\tan 50) = 25.609$