PS#3 Name_____Graded on ***COMMUNICATION*** of physics

#1 - #3 constitute Midterm #1 from Spring quarter. The link to the spring quarter class is at the top of our class webpage. Feel free to scroll down to find a copy of the midterm, the midterm answers and the midterm solutions. Note that question 2 and 3 are in reversed order. I suggest that you check out your practice midterm and see the answers. Then you should try again to get it right and work with friends. Only at the very end should you look at solutions. But I leave this to you.

4) An object starts at 10 m with a speed of 5 m/s and has an acceleration of $-4\ m/s^2 + 2\ m/s^3(t)$. Find the velocity and position after 3 seconds. This is straight up kinematics because we have motion as an explicit function of time. And it's calculus at its best. We have acceleration which is the time derivative of velocity, and the second time derivative of position. We could make the graphs and take the area under the curves, but we would probably be best of just integrating the accelerating and putting in the initial conditions of 5 m/s and 10 m. We know that

$$v = v_o + \Delta v = v_o + \int a * dt = -\frac{5m}{s} - \frac{4m}{s^2}(t) + 1m/s^3 t^2, \text{ and}$$

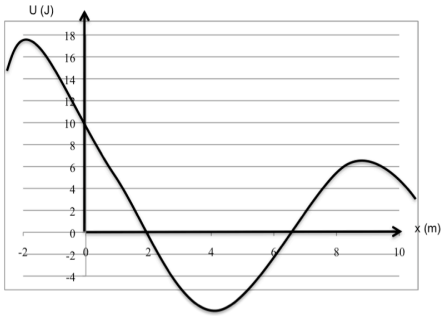
$$x = x_o + \Delta x = x_o + \int v * dt = 10m - \frac{5m}{s}(t) - \frac{2m}{s^2}(t^2) + \frac{1}{3}m/s^3 t^3, \text{ and at } t=3s, \text{ being}$$

meticulously careful of units, I evaluate:

x = 14 m, and *v = -6 m/s*.

5) This problem is a shorter version of the second question in last fall quarter's PS#3, please see the answers to this problem. Again, available on the website as described above. You see below a potential energy diagram for a **2 kg mass**, as a function of displacement. (positive *x* is to the right). The mass **starts out at *x* = 0 moving at 2 m/s** to the left. *There may be more than one correct answer. In this case, list all correct answers.*

a) Label stable equilibria with "S"
b) Label unstable equilibria with "U"
c) Label any turning points with "T"
d) what is its speed at *x* = 6m?
e) What is the approximate acceleration of the mass at *x* = 6m? (What two concepts are necessary for this?)
Include direction in your answer, with a unit vector or an arrow.



Recognize that the cart is not *moving* up and down on the y axis. The movement is in the x direction only. The *y* component on the graph is the energy, which could be the result of some electric field, magnets, springs, rubber bands, etc.

6) This question is the subject of a video assigned for Thursday. Using an energy lens, please show that if you drop a 5 kg box from 60 m, it hits the ground at ~35 m/s. But then, you *throw* the box *downward* from 60 meters height with an initial speed of 35 m/s.

a) Find the speed that it has when it hits the ground.
b) What if I throw it *upwards* at 35 m/s, what is the speed when it hits the ground?
c) What if I throw it straight off the cliff at 35 m/s horizontally, what speed does it have when it hits the ground now?
d) *Can* I throw a 5 kg box at 35 m/s? Please back up your answer.