Ph1a Homework Solution 5

Fall 2009

Each homework problem is worth 5 points. Please disregard the point values listed on the problem itself. Use these instead.

5.1 Frautschi 10.11 (5 points)

5.1.a (5 point)

Use conservation of energy

$$\frac{1}{2}mv^2 = mgh,$$

we get

$$h = \frac{v^2}{2g} \approx 5m$$

5.2 Frautschi 10.25 (5 points)

5.2.a (5 point)

Let K_r and U_r be the kinetic energy and potential energy when the mass is at the surface of the earth, respectively. Let escape velocity be v_e and we use conservation of energy

$$K_r + U_r = 0$$
$$\frac{mv_e^2}{2r} - G\frac{mM}{r^2} = 0$$
$$v_e = \sqrt{2GM/r}$$

where M is the mass of the earth.

for the speed necessary for an object to orbit the earth at its surface v_s,

$$G\frac{mM}{r^2} = m\frac{v_0^2}{r}$$
$$v_0 = \sqrt{GM/r}$$

So the ratio is $\sqrt{2}$.

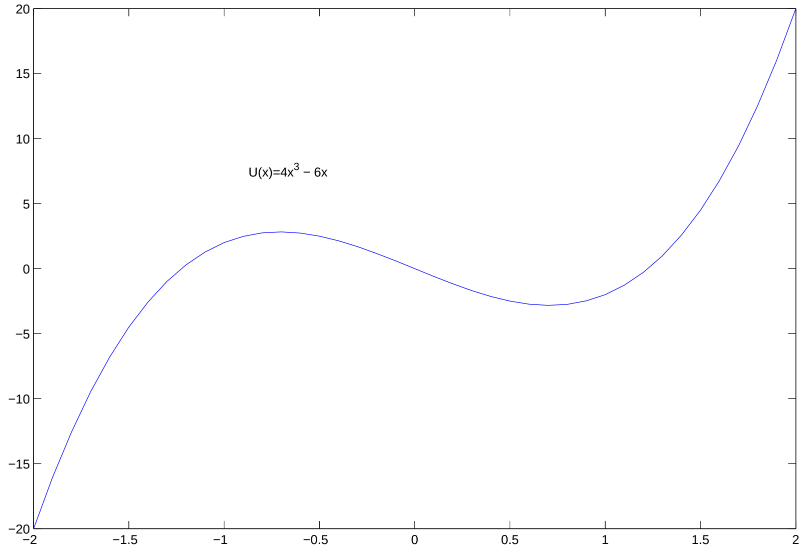
5.3 Frautschi 10.28 (5 points)

5.3.a (5 point)

From the graph, we see that it is the right point when the slope is zero.

$$U(x) = 4x^3 - 6x$$
$$U'(x) = 12x^2 - 6 = 0$$
$$x = \pm\sqrt{1/2}$$

We see that when $x = \sqrt{1/2}$ meter is the stable equilibrium.



5.4 Frautschi 10.32 (5 points)

5.4.a (5 point)

Let the intial and final total energy be E_i and E_f respectively, and $m = 0.03$ kg, $v = 1.4$ m/s, then

$$E_i = mgh$$

$$E_f = \frac{1}{2}mv^2$$

The fraction of dissipation is

$$\frac{E_i - E_f}{E_i} = 1 - \frac{v^2}{2gh} = \frac{1}{3}$$

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