Classical Mechanics (PG), Autumn 2013 CMI

Problem set 2

Due at the beginning of lecture on Monday August 12, 2013

Central force problem, 1D potentials

1. $\langle \mathbf{8} \rangle$ Look for a scaling symmetry of the equations of motion of a particle moving in 3D in a $V(r) = -\frac{\alpha}{r^n}$ potential for $n > 0$. What we mean is that if $\mathbf{r}(t)$ is a solution, then so must $\mathbf{s}(t) = \lambda^\gamma \mathbf{r}(\lambda t)$ for some γ and for any $\lambda > 0$. Can you find a γ that does the job? Hint: Unit vectors remain unit vectors under rescaling.

2. $\langle \mathbf{5} \rangle$ For $W > V > 0$, evaluate the integral

$$\Pi = \int_V^W \frac{dE}{\sqrt{(E-V)(W-E)}} \tag{1}$$

Hint: Try the substitution $x = \sqrt{\frac{E-V}{W-E}}$.