Physics 321 – Review #2

Things to Remember

1. Be able to write the kinetic and potential energies of a system in terms of $q_i$ and $\dot{q}_i$ or $q_i$ and $p_i$.
2. Know the definition of generalized coordinates and momenta. Be able to find the generalized momentum conjugate to a given coordinate.
3. Know Lagrange’s Equations of Motion.
4. Know Hamilton’s Equations of Motion.
5. Know how to apply Lagrange multipliers to simple systems. Be able to find solutions to problems and to find the generalized forces of constraint.
6. Use, but not memorize, the rotation matrices $R_x$, $R_y$, and $R_z$.
   \[ R_z = \begin{bmatrix} \cos \omega \omega & -\sin \omega \omega & 0 \\ \sin \omega \omega & \cos \omega \omega & 0 \\ 0 & 0 & 1 \end{bmatrix} \]
7. Use, but not memorize,
   \[ \ddot{v} = \dot{v}' + \ddot{\omega}' \times \dot{r}' \quad \ddot{v}' = \ddot{v} - \ddot{\omega} \times \dot{r} \]
   \[ \ddot{a} = \ddot{a}' + \dddot{\omega}' \times \dot{r}' + 2\dddot{\omega}' \times \dot{r}' + \dddot{\omega}' \times (\dddot{\omega}' \times \dot{r}') \]
   \[ \dddot{a}' = \dddot{a} - \dddot{\omega} \times \dot{r} - 2\dddot{\omega} \times \dot{r} + \dddot{\omega} \times (\dddot{\omega} \times \dot{r}) \]
   \[ \dddot{F}'_{eff} = \dddot{F}'_{real} + m\dddot{\omega}' \times \dddot{\omega}' + 2m\dddot{\omega}' \times \dddot{\omega}' + m(\dddot{\omega}' \times \dddot{\omega}') \times \dddot{\omega}' \]
8. Find the equations of motion for a planetary orbit in terms of the relative coordinate $r$ and the angle $\phi$. Show that angular momentum is conserved. Be able to discuss the solutions:
   \[ r = \frac{c}{1 + \varepsilon \cos \phi} \]
9. Know the different conic sections and the eccentricities associated with each.