HW Jan 23, Johannes Byle

1.39 $F = ma$ stays the same. The position of the ball is $(v_0 cos\theta t - \frac{1}{2} g sin\phi t^2, (v_0 sin\theta t - \frac{1}{2} g cos\phi t^2, 0)$. Time it takes for the ball to reach the final position is where $0 = t(2v_0 sin\theta - g sin\phi t)$ or $t = \frac{2v_0 sin\theta}{g sin\phi}$. Thus the ball is a distance of $\frac{2v_0^2 cos\phi sin\theta}{g sin\phi} = \frac{2v_0^2 cos(\phi+\theta) sin\theta}{g cos^2\phi}$ away from the origin. The maximum upward range is where $x = v_0 \frac{v_0}{g sin\phi} - \frac{1}{2} g sin\phi (\frac{v_0}{g sin\phi})^2$ or $x = \frac{v_0^2}{g(1+sin\phi)}$.

1.41 Equation 1.48 is $F_r = m(\ddot{r} - r\dot{\phi}^2), F_\phi = m(r\ddot{\phi} + 2\dot{r}\dot{\phi})$ Since R is constant $T = mR\omega^2$.

1.43 (a) $\hat{r} = \frac{x\hat{x} + y\hat{y}}{\sqrt{x^2+y^2}}$, and $\sqrt{x^2+y^2} = \sqrt{(r sin\theta cos\phi)^2 + (r sin\theta sin\phi)^2}$, or $\sqrt{x^2+y^2} = \sqrt{r^2 sin^2\theta(cos^2\phi + sin^2\phi)} = r sin\theta$. Thus $\hat{r} = \frac{r sin\theta cos\phi\hat{x} + r sin\theta sin\phi\hat{y}}{r sin\theta} = \hat{x} cos\phi + \hat{y} sin\phi$. We know $\hat{\phi} = -sin\phi\hat{x} + cos\phi\hat{y}$.

(b) $\dot{\hat{r}} = -sin\phi\dot{\phi}\hat{x} + cos\phi\dot{\phi}\hat{y}$ and $\dot{\hat{\phi}} = -cos\phi\dot{\phi}\hat{x} - sin\phi\dot{\phi}\hat{y}$