AEEM5063 HW#3

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09.23.24

2.12

$$\vec{V} = -4\hat{i} + 3\hat{j} - 5\hat{k}$$
$$\hat{u_r} = 0.26726\hat{i} + 0.53452\hat{j} + 0.80178\hat{k}$$

(a)

$$v_r = \vec{V} \cdot \hat{u_r} = -4 * 0.26726 + 3 * 0.53452 - 5 * 0.80178$$
$$\boxed{v_r = -3.474\text{km/s}}$$

(b)

$$v = \sqrt{v_r^2 + v_\perp^2} \rightarrow v_\perp = \sqrt{v^2 - v_r^2}$$
$$v = \sqrt{(-4)^2 + 3^2 + (-5)^2} = 50$$
$$v_\perp = \sqrt{50^2 - (-3.474)^2} = \boxed{6.159 \text{ km/s}}$$

(c)

$$\tan\gamma = \frac{v_r}{v_\perp} = \frac{-3.474}{6.159}$$
$$\boxed{\gamma = -29.43^\circ}$$

2.14

$$\vec{V} = 2\hat{i} + 3\hat{j} + 4\hat{k}$$

$$v = \sqrt{2^2 + 3^2 + 4^2} = 5.3852$$

$$u_V = \frac{\vec{V}}{v} = 0.37139\hat{i} + 0.55709\hat{j} + 0.74278\hat{k}$$

$$\epsilon = \frac{v^2}{2} - \frac{\mu}{r} = \frac{5.3852^2}{2} - \frac{398600}{10000} = -25.36$$

$$-25.36 = \frac{0^2}{2} - \frac{398600}{r} \rightarrow r = 15718$$

$$\vec{r} = ru_V = 15718(0.37139\hat{i} + 0.55709\hat{j} + 0.74278\hat{k})$$

$$\boxed{\vec{r} = 5837.4\hat{i} + 8756.1\hat{j} + 11675\hat{k} \text{ km}}$$

2.16

$$\mu = 42828\text{km}^3/\text{s}^2; \quad R = 3396\text{km}$$

$$v = \frac{\mu}{r} = \frac{42828}{3396} = \boxed{3.4511 \text{ km/s}}$$

$$T = \frac{2\pi}{\sqrt{\mu}} r^{3/2} = \frac{2\pi}{\sqrt{42828}}(3396 + 200)^{3/2} = 6547\text{s}$$

$$\boxed{\text{T=1 hr, 49 min, 7s}}$$

2.5