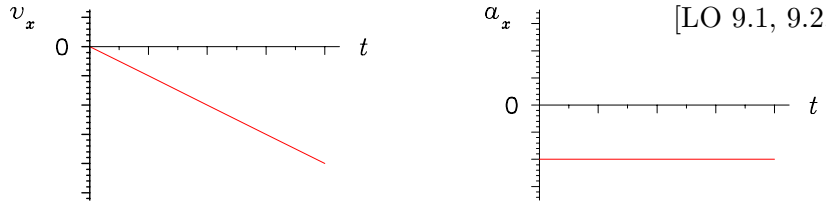
# Phys 218 – Spring 2018

## All *University Physics* Sections

## Comprehensive Exam

**Short Answers:**

A) (a) [LO 9.1, 9.2, 12.1, 12.2]




(b) $\vec{v}$ and $\vec{a}$ are both negative/to the left [LO 13.1, 13.2]

B) (a) i. Point $A$ [LO 44.1]

ii. Point $F$ [LO 44.2]

iii. Point $A$ [LO 44.3]

(b) $B$ and $E$ are stable, $C$ is unstable, and the rest ($A$, $D$ and $F$) are not in equilibrium [LO 42.1, 42.2, 42.3, 42.4, 42.5, 42.6]

(c) i. $3 \leq x \leq 5$ [LO 43.1]

ii. $7 \leq x \leq 9$ [LO 43.2]

iii. $1 \leq x \leq 11$ [LO 43.3]

C) (a) $\omega = 2$ rad/s and $T = \pi$ s [LO 3.1, 21.1, 25.1, 66.1, 66.2]

(b) $A = 5$ cm [LO 3.2, 40.1, 66.3]

(c) $v_{x,\text{max}} = 10$ cm/s [LO 66.4]

(d) $a_{x,\text{max}} = 20$ cm/s$^2$ [LO 66.5]

D) (a) $\vec{v}_1 = -12\hat{i}$ m/s [LO 48.1]

(b) $\vec{v}_{2/1} = +20\hat{i}$ m/s [LO 20.1]

(c) $\vec{v}_{1/s} = -22\hat{i}$ m/s [LO 20.2]

(d) $\vec{v}_{2/s} = -2\hat{i}$ m/s [LO 20.3]

E) $\omega_f = \frac{1}{2}\omega_i$ [LO 51.1, 51.2, 52.1, 53.1, 57.1, 57.2, 59.1]

**Problem 1:**

(a) Any valid coordinate system accepted [LO 9.3]

(b) $v_0 = \frac{\sqrt{2gh}}{\sin\theta}$ [LO 1.1, 3.3, 14.1, 15.1]

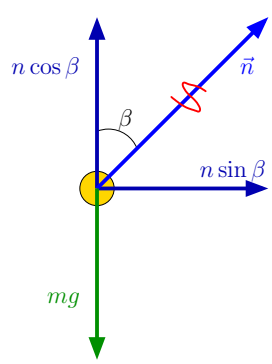
(c) $t = \frac{D\tan\theta}{\sqrt{2gh}}$ [LO 1.2, 3.4, 6.1, 14.2, 15.2]

(d) $H = D\tan\theta\left(\frac{D\tan\theta}{4h} - 1\right)$ [LO 6.2, 14.3]

**Problem 2:**

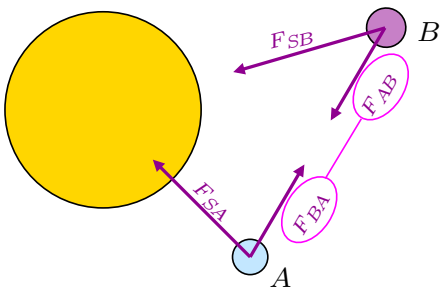
(a) $a_{\text{rad}} = -\omega^2 R\sin\beta\,\hat{r}$, or $\omega^2 R\sin\beta$ radially inward [LO 16.1, 18.1, 18.2]

(b) [LO 1.3, 23.1, 26.1]




(c) $\beta = \cos^{-1}\left(\frac{g}{\omega^2 R}\right)$ [LO 4.1, 21.2, 21.3]

**Problem 3:** (a) [LO 22.1, 60.1, 60.2, 60.3, 60.4]




(b) Doesn't change since $U_{\text{grav}}$ doesn't depend on radius of the star [LO 61.1]

(c) $U_{SA} = 100\, U_{BA}$ [LO 61.2]

(d) $F_{SA} = ma_A = mv_A^2/R_{SA}$, which, with $F_{SA} = G\frac{Mm_A}{R_{SA}^2}$ [LO 18.3, 21.4, 60.5]

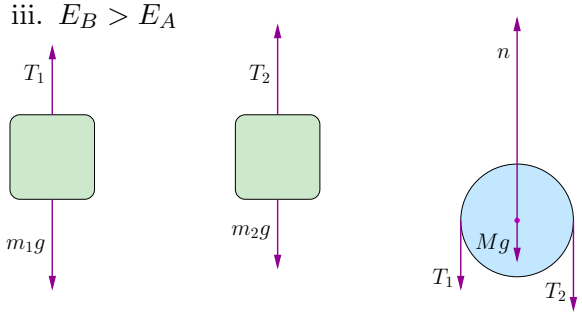
$\Rightarrow\ v_A = \sqrt{GM/R_{SA}}$

(e) i. $K_A > K_B$ [LO 34.1]

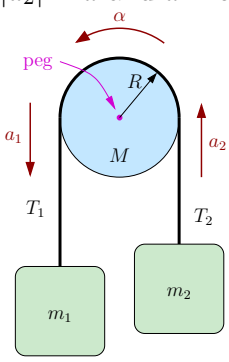
ii. $U_B > U_A$ [LO 61.3]

iii. $E_B > E_A$ [LO 40.2]

**Problem 4:** (a) [LO 23.2, 23.3, 23.4, 24.1, 24.2, 24.3, 24.4, 26.2]




(b) $|\vec{a}_1| = |\vec{a}_2| = a$ and $a = \alpha R$ [LO 6.3, 6.4, 6.5]




(c) ① $m_1 g - T_1 = m_1 a$ [LO 21.5, 21.6, 51.3, 54.1, 54.2, 55.1]

② $T_2 - m_2 g = m_2 a$

③ $T_1 - T_2 = \frac{1}{2} M a$

(d) $a = \dfrac{(m_1 - m_2)g}{m_1 + m_2 + \frac{1}{2}M}$ [LO 4.2]

**Problem 5:** (a) $T = Mg\left(\dfrac{L}{2h\tan\theta}\right)$ [LO 2.1, 2.2, 3.5, 23.5, 24.5, 54.3, 54.4, 55.2]

(b) $\alpha = \dfrac{3g\cos\theta}{2L}$ [LO 51.4, 55.3]

(c) $\omega = \sqrt{3g\sin\theta/L}$ [LO 3.6, 35.1, 38.1, 40.3]