

物理学基礎 問題集2019

～力学～

略解 例題24 - 43

例題-24

$$1. \quad x(t) = \frac{v_0}{\omega} \sin \omega t$$

$$2. \quad x(t) = x_0 \cos \omega t$$

3.

$$x(t) = \sqrt{x_0^2 + \left(\frac{v_0}{\omega}\right)^2} \sin \left(\omega t + \tan^{-1} \frac{\omega x_0}{v_0} \right)$$

$$4. \quad x(t) = x_0 \cos [\omega(t - t_1)]$$

例題-25

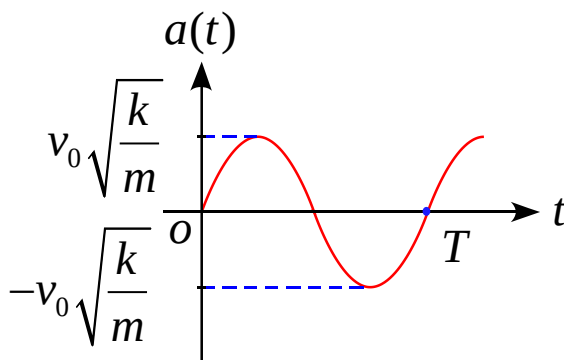
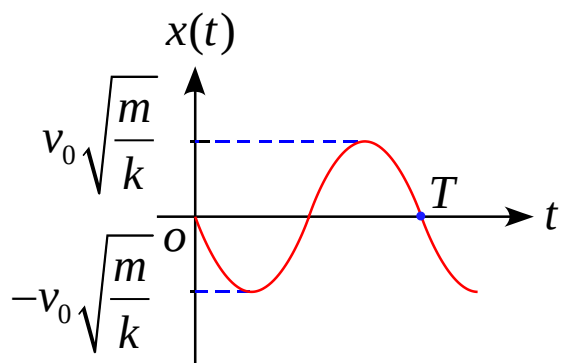
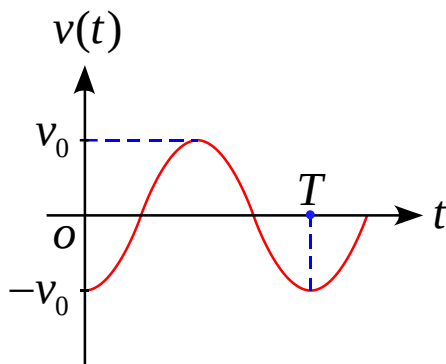
$$1. \quad ma = -kx$$

$$2. \quad v(t) = -v_0 \cos \sqrt{\frac{k}{m}} t$$

$$3. \quad x(t) = -v_0 \sqrt{\frac{m}{k}} \sin \sqrt{\frac{k}{m}} t$$

$$4. \quad a(t) = v_0 \sqrt{\frac{k}{m}} \sin \sqrt{\frac{k}{m}} t$$

5.



例題-26

$$1. \quad ma = mg - kx$$

$$2. \quad v(t) = (x_0 - x_1) \sqrt{\frac{k}{m}} \sin \sqrt{\frac{k}{m}} t$$

3.

$$x(t) = (x_1 - x_0) \cos \sqrt{\frac{k}{m}} t + \frac{mg}{k}$$

例題-27

$$1. \quad ma_r = T - mg \cos \theta$$

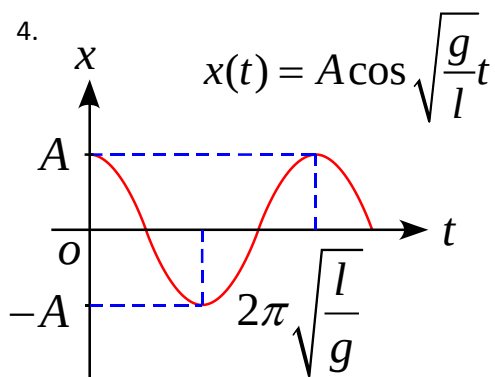
$$ma_\theta = -mg \sin \theta$$

$$2. \quad \text{周期: } T = 2\pi \sqrt{\frac{l}{g}}$$

振幅: A

$$3. \quad t_1 = \frac{\pi}{2} \sqrt{\frac{l}{g}}$$

例題-27



例題-28

レポート課題につき省略

Hint

実際に計算してみると

$$\bar{U}(t) = \frac{1}{T} \int_0^T U(t) dt = \frac{1}{4} m A^2 \omega^2$$

$$\bar{K}(t) = \frac{1}{T} \int_0^T K(t) dt = \frac{1}{4} m A^2 \omega^2$$

となり、等しくなります。

例題-29

1. $ma_r = mg \cos \theta - S$

$$ma_\theta = -mg \sin \theta$$

2. $T = 2\pi \sqrt{\frac{l}{g}}$

3. $\theta(t) = \theta_0 \cos \sqrt{\frac{g}{l}} t$

$$S = mg$$

例題-30

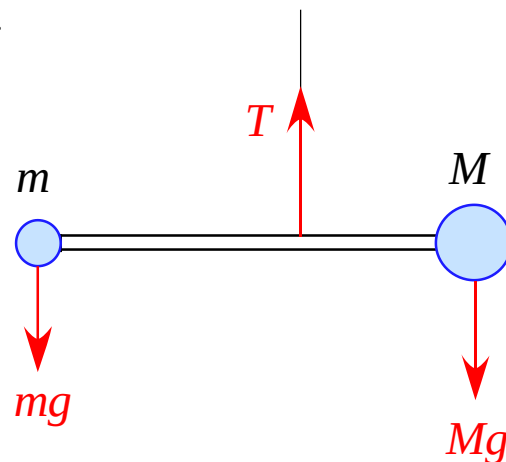
1. $N = |\vec{N}| = xF$

2. $N = |\vec{N}| = xF \sin \theta$

3. $N = |\vec{N}| = xF_y - yF_x$

例題-31

1.



2. $0 = T - mg - Mg$

3. $\frac{d\vec{L}}{dt} = \begin{pmatrix} 0 \\ 0 \\ r_1 mg - r_2 Mg \end{pmatrix}$

4. $\frac{r_1}{r_2} = \frac{M}{m}$

例題-32

1.

$$\frac{d\vec{L}}{dt} = \begin{pmatrix} 0 \\ 0 \\ xmg - (L-x)Mg \end{pmatrix}$$

$$2. \quad x = \frac{M}{m+M}L$$

3.

$$\frac{d\vec{L}}{dt} = \begin{pmatrix} 0 \\ 0 \\ xmg - (L-x)Mg + \left(x - \frac{1}{2}\right)mg \end{pmatrix}$$

4.

$$x = \frac{m+2M}{2(M+2m)}L$$

例題-33

$$\tan \theta_0 = \frac{1}{2\mu}$$

例題-34

$$1. \quad 0 = f - N' \sin \theta$$

$$0 = N + N' \cos \theta - mg$$

2.

$$\frac{d\vec{L}}{dt} = \begin{pmatrix} 0 \\ 0 \\ -Lmg \cos \theta + dN' \sin \theta + dN' \frac{\cos \theta}{\tan \theta} \end{pmatrix}$$

$$3. \quad \frac{f}{N} = \frac{L \sin^2 \theta \cos \theta}{d - L \sin \theta \cos^2 \theta}$$

例題-35

1.

$$\vec{p} = (p_x, p_y)$$

$$= (-mr_0 \omega \sin \omega t, mr_0 \omega \cos \omega t)$$

例題-35

$$2. \quad \vec{L} = \begin{pmatrix} 0 \\ 0 \\ mr_0^2 \omega \end{pmatrix}$$

例題-36

$$1. \quad \vec{L} = \begin{pmatrix} 0 \\ 0 \\ lmv \end{pmatrix}$$

$$2. \quad \vec{N} = \begin{pmatrix} 0 \\ 0 \\ -mgl \sin \theta \end{pmatrix}$$

$$3. \quad \begin{pmatrix} 0 \\ 0 \\ \frac{d}{dt}(lmv) \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ -mgl \sin \theta \end{pmatrix}$$

4. 略

例題-37

$$1. \quad 0 = S \cos \theta - mg$$

$$2. \quad ma_r = -S \sin \theta$$

$$ma_\theta = 0$$

$$3. \quad S = \frac{mg}{\cos \theta}$$

$$v = v_\theta = \sqrt{\frac{gl}{\cos \theta}} \sin \theta$$

$$T = 2\pi \sqrt{\frac{l \cos \theta}{g}}$$

例題-38

$$1. \quad 0 = N + S \cos \theta - mg$$

$$2. \quad ma_r = -S \sin \theta$$

$$ma_\theta = 0$$

例題-38

$$3. \quad S = ml\omega^2$$

$$N = m(g - h\omega^2)$$

$$4. \quad \omega_0 = \sqrt{\frac{g}{h}}$$

例題-39

$$1. \quad ma_r = mg \cos \theta - T$$

$$ma_\theta = -mg \sin \theta$$

$$2. \quad T_B = 3mg$$

$$3. \quad T_C = 3mg \cos \theta$$

例題-40

$$1. \quad ma_r = mg \cos \theta - T$$

$$ma_\theta = -mg \sin \theta$$

$$2. \quad v_0 \geq \sqrt{5gr}$$

例題-41

$$1. \quad v_1 = \sqrt{\frac{GM}{R}}$$

$$2. \quad v_2 = \sqrt{\frac{2GM}{R}}$$

例題-42

略

例題-43

$$1. \quad r_1 v_1 = r_2 v_2$$

$$2. \quad r_1 v_1 = r_2 v_2$$

3.

$$\frac{1}{2}mv_1^2 + \left(-G \frac{Mm}{r_1}\right) = \frac{1}{2}mv_1^2 + \left(-G \frac{Mm}{r_1}\right)$$