物理学基礎　問題集2019

～力学～

略解 例題24 - 43

例題-24

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

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

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. $x(t)=x_0\cos\left[\omega\left(t-t_1\right)\right]$

例題-25

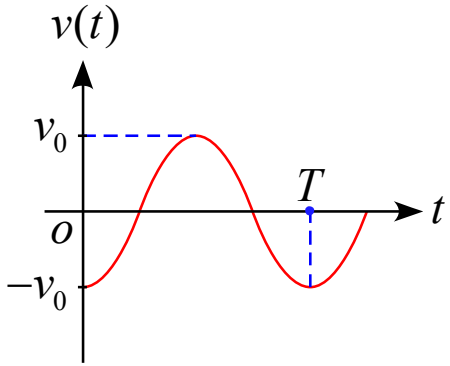
1. $ma=-kx$

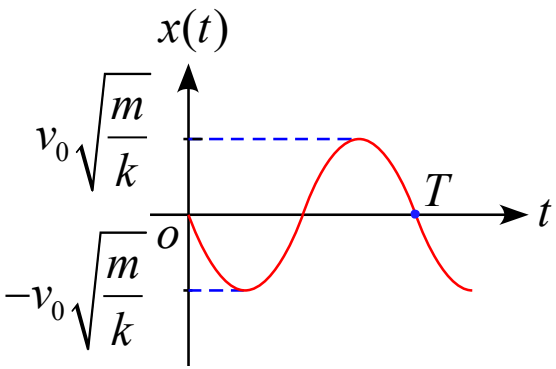
2. $v(t)=-v_0\cos\sqrt{\dfrac{k}{m}}t$

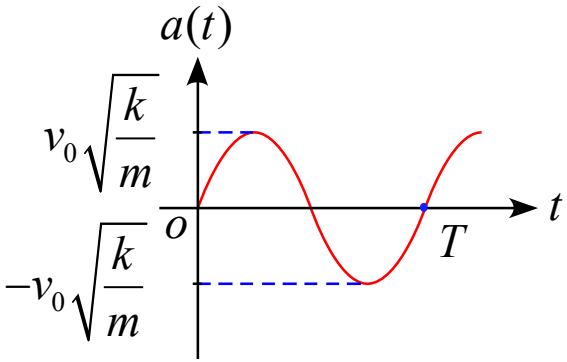
3. $x(t)=-v_0\sqrt{\dfrac{m}{k}}\sin\sqrt{\dfrac{k}{m}}t$

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

5.







例題-26

1. $ma=mg-kx$

2. $v(t)=\left(x_0-x_1\right)\sqrt{\dfrac{k}{m}}\sin\sqrt{\dfrac{k}{m}}t$

3.

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

例題-27

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

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

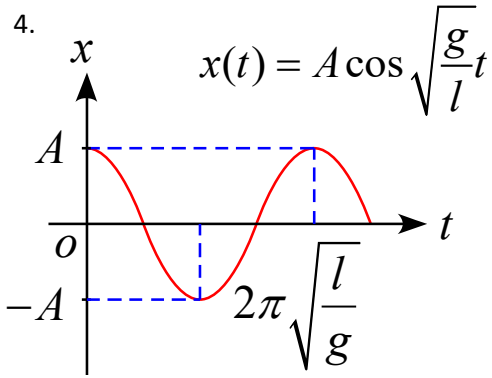
2. 周期： $T=2\pi\sqrt{\dfrac{l}{g}}$

振幅： A

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

例題-27

4.



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

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

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

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

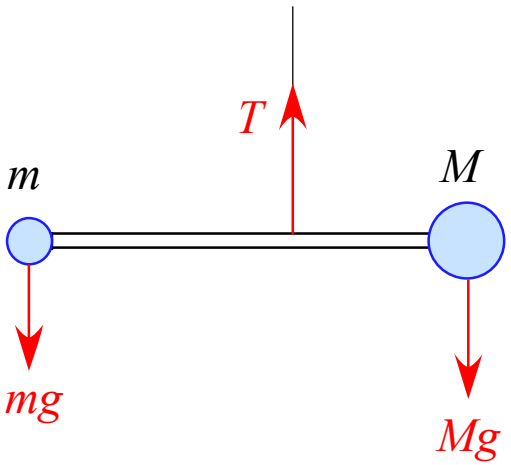
1. $N = |\vec{N}| = xF$

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

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. $$0=f-N'\sin\theta$$
$$0=N+N'\cos\theta-mg$$

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

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

例題-36

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

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

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

4. 略

例題-37

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

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

$ma_\theta = 0$

3. $S = \dfrac{mg}{\cos\theta}$

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

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

例題-38

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

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

$ma_\theta = 0$

例題-38

3. $S = ml\omega^2$

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

4. $\omega_0 = \sqrt{\dfrac{g}{h}}$

例題-39

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

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

2. $T_B = 3mg$

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

例題-40

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

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

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

例題-41

1. $v_1 = \sqrt{\dfrac{GM}{R}}$

2. $v_2 = \sqrt{\dfrac{2GM}{R}}$

例題-42

略

例題-43

1. $r_1 v_1 = r_2 v_2$

2. $r_1 v_1 = r_2 v_2$

3.

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