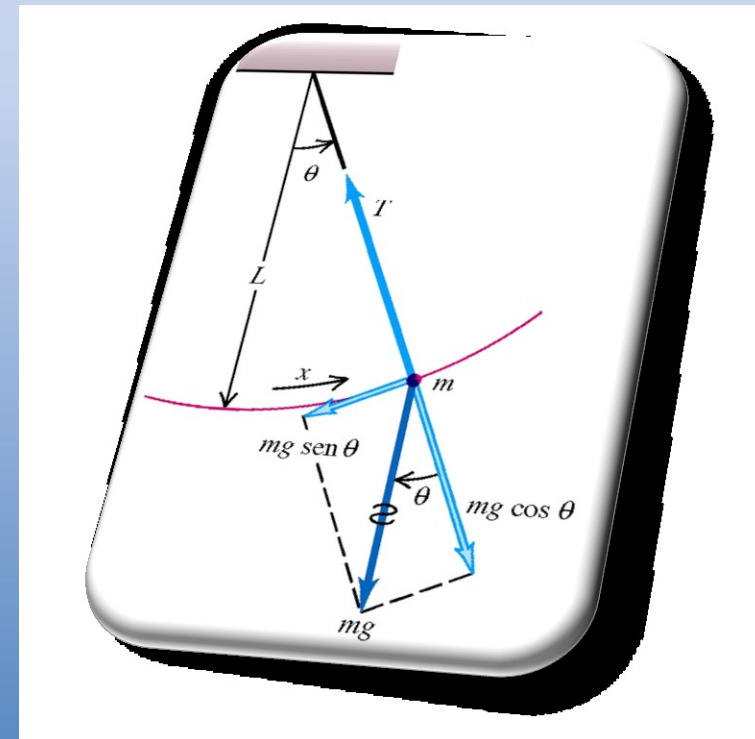
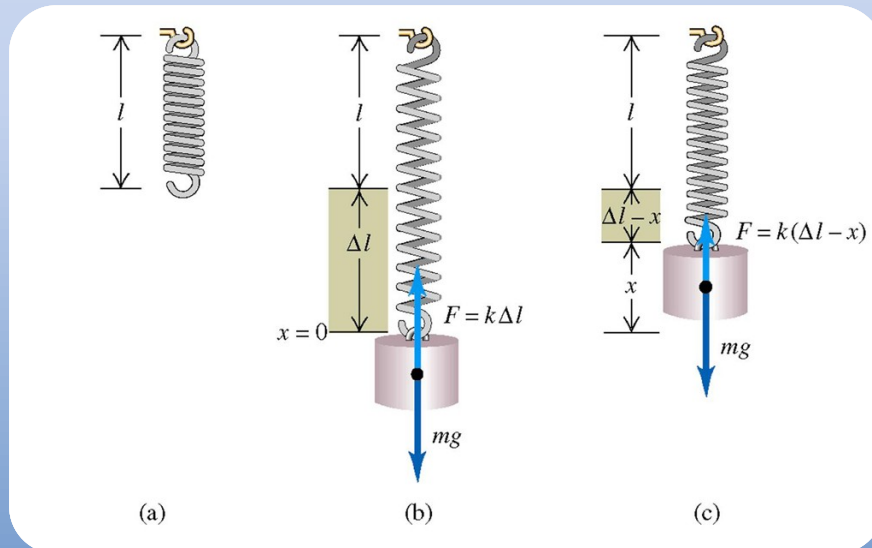


Oscilador Harmônico

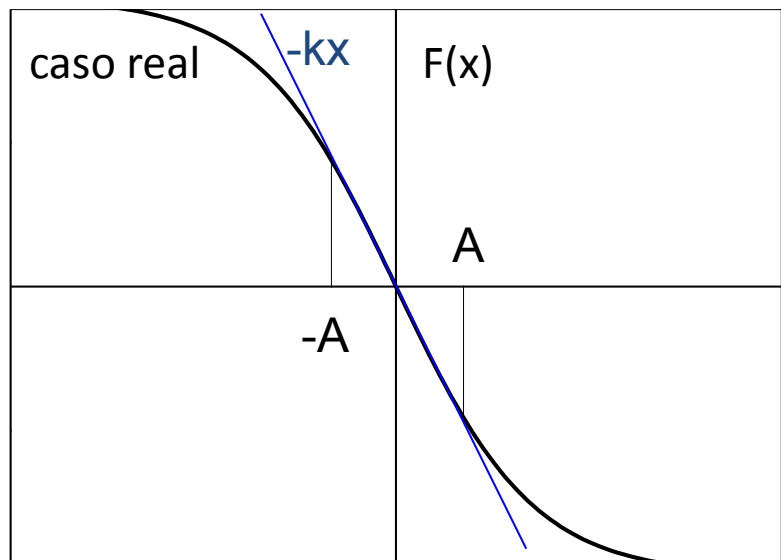
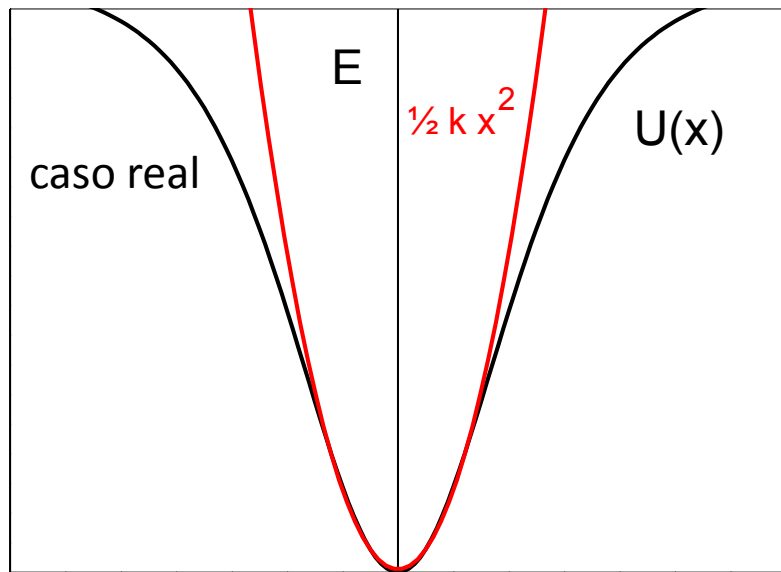
Oscilações: Vibrações localizadas

Ondas: propagação de energia

Ex: -posição de um bloco de massa m preso a uma mola
 -ângulo de desvio da vertical de um pêndulo



Próximo da posição de equilíbrio temos um poço de potencial



$$F(x) = -dU(x)/dx$$

$$dU(x) = F(x) dx$$

$$U(x) = \frac{1}{2} k x^2$$

Força restauradora:

$$F(x) = -kx$$

Simulação de uma mola que sofre deformação na compressão e no estiramento

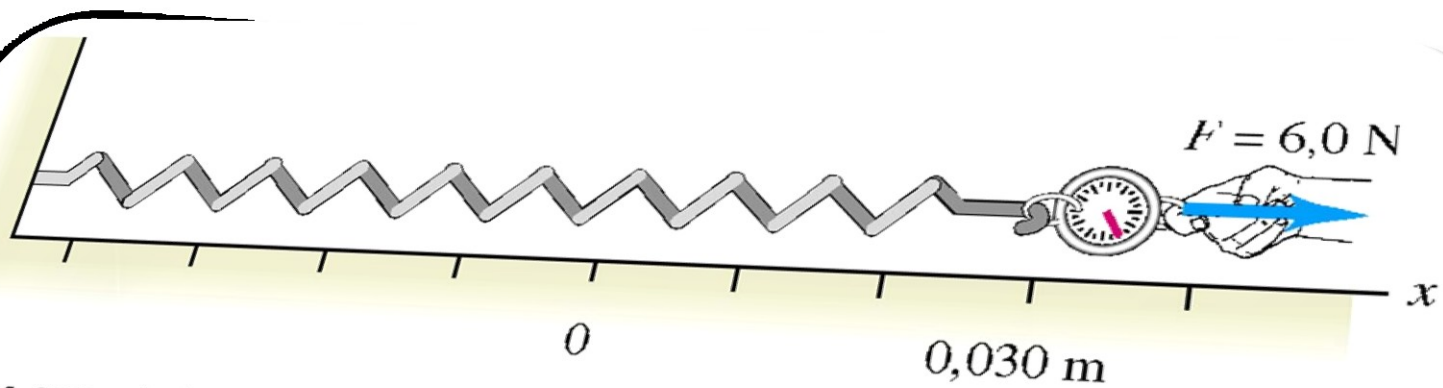
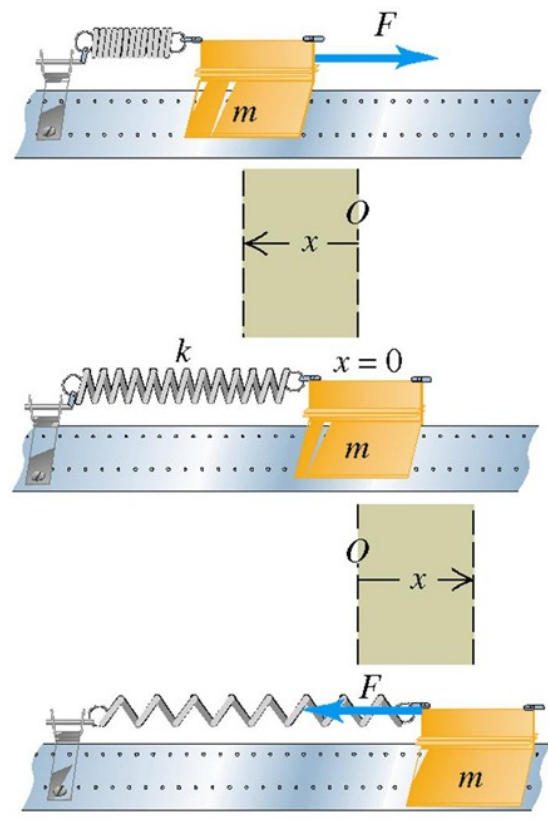
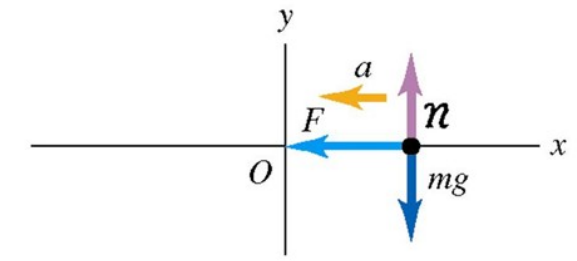
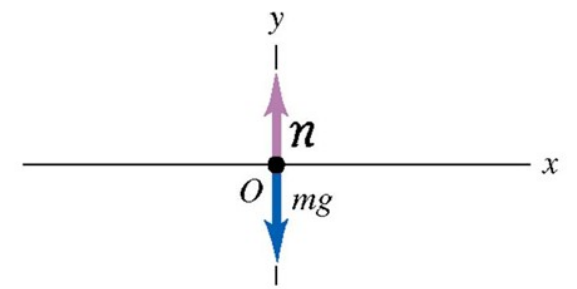
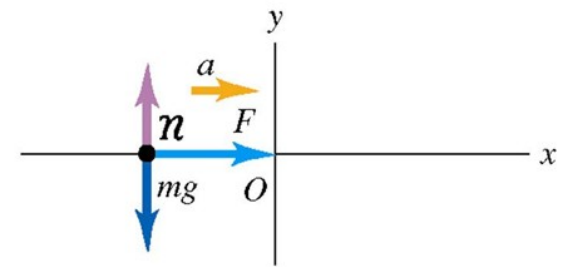


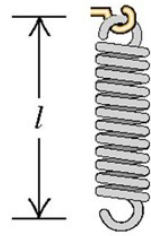
FIGURA 13.5 A força exercida sobre a mola é igual a $6,0 \text{ N}$. A força exercida pela mola é igual a $-6,0 \text{ N}$.



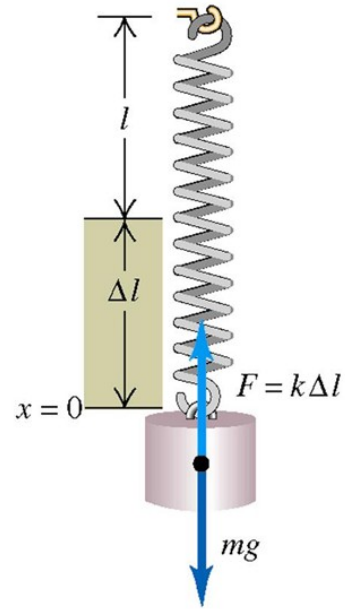
(a)



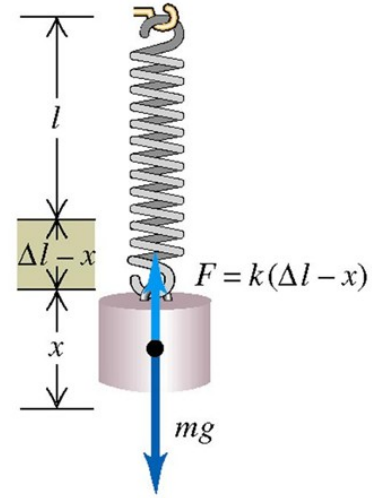
(b)



(a)



(b)



(c)

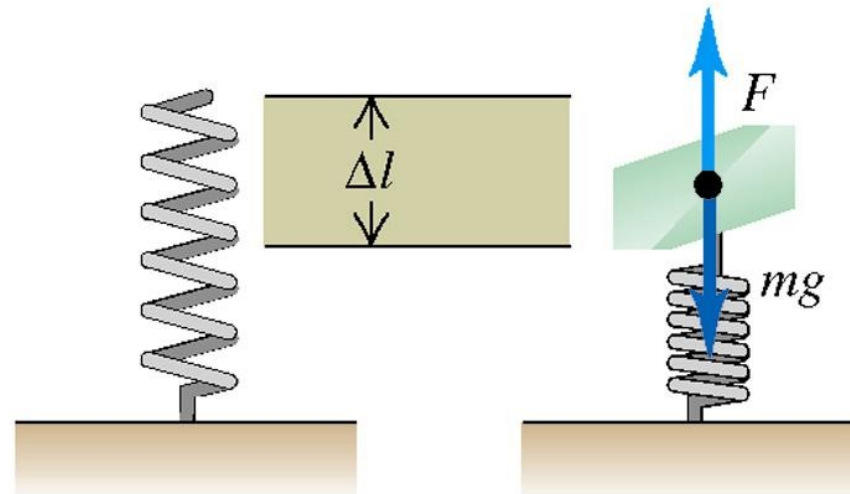
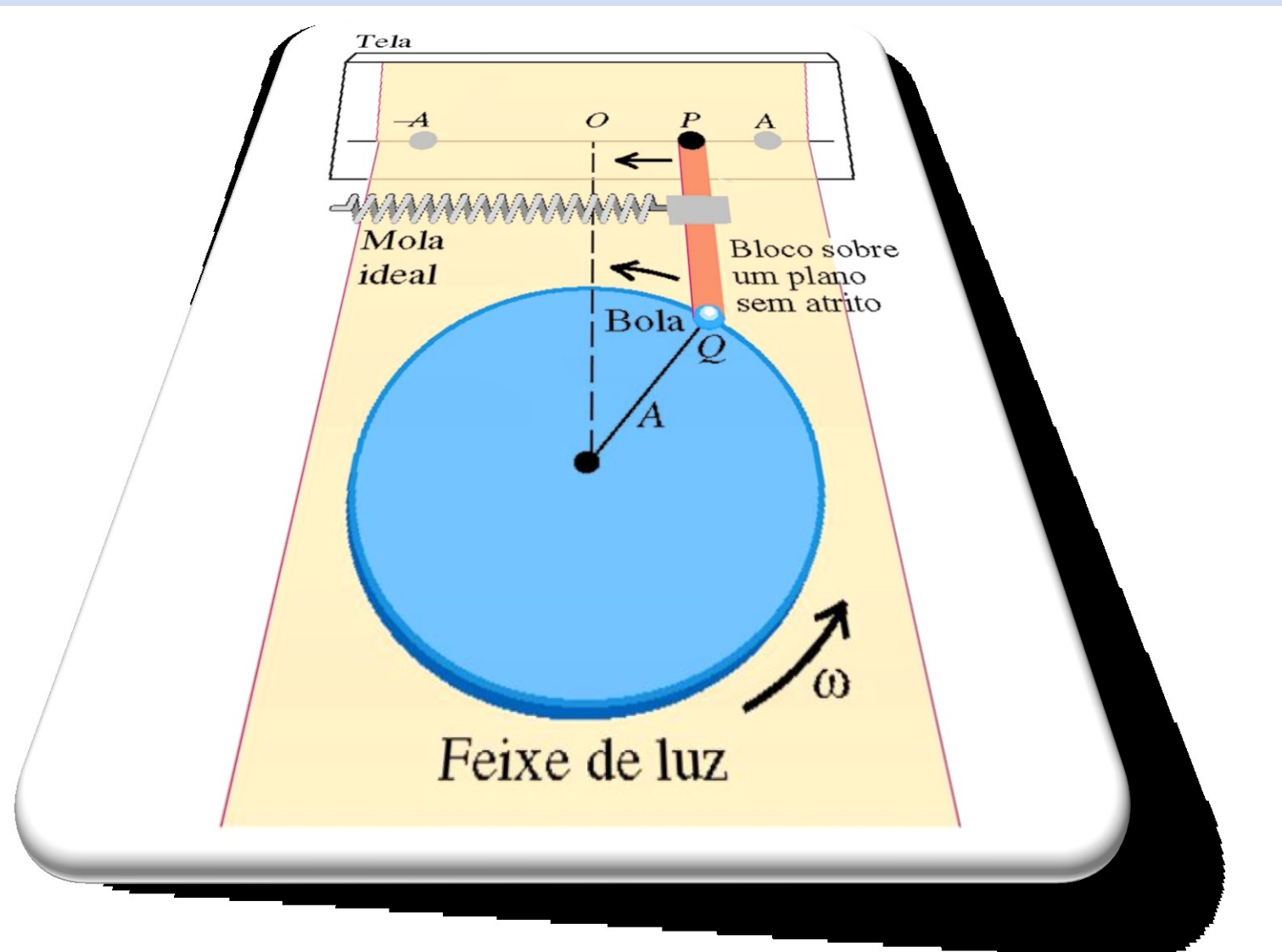
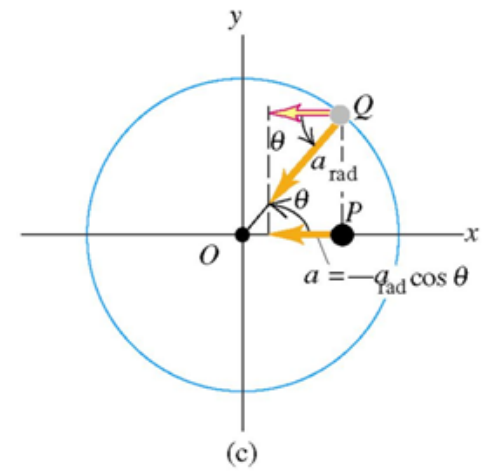
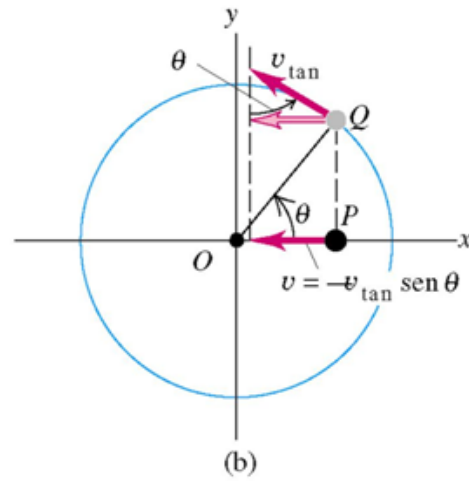
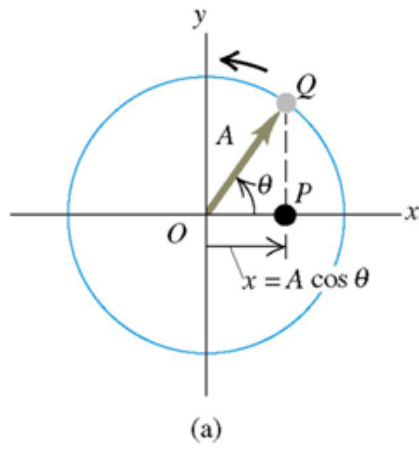


FIGURA 13.15 Quando o peso mg comprime a mola até uma distância Δl , a constante da mola é dada por $k = mg/\Delta l$ e a frequência angular do MHS vertical é dada por $\omega = \sqrt{k/m}$.





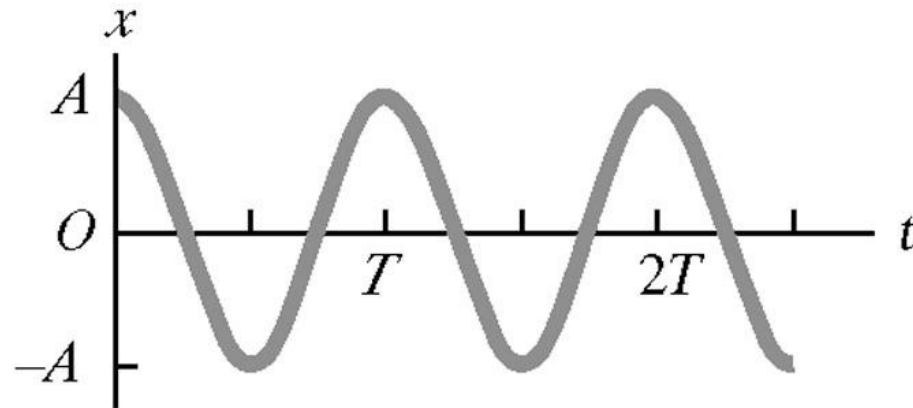
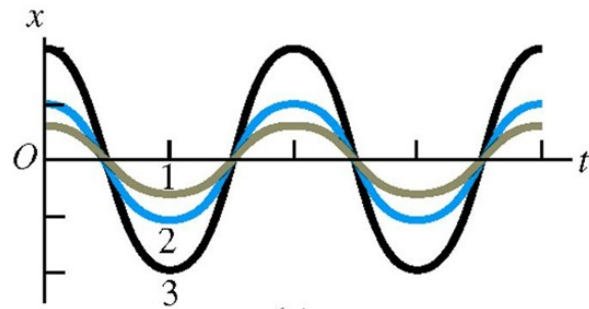


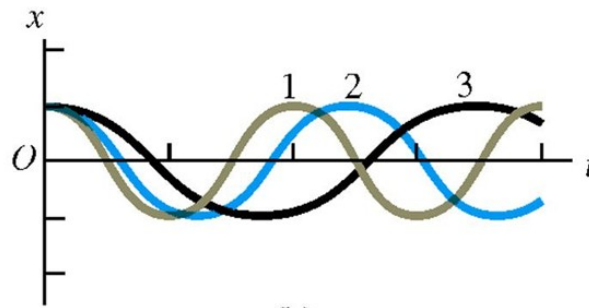
FIGURA 13.6 Gráfico de x contra t (Equação (13.13)) em um movimento harmônico simples. No caso indicado $\phi = 0$.

$$x(t) = A \cos(\omega t + \varphi)$$



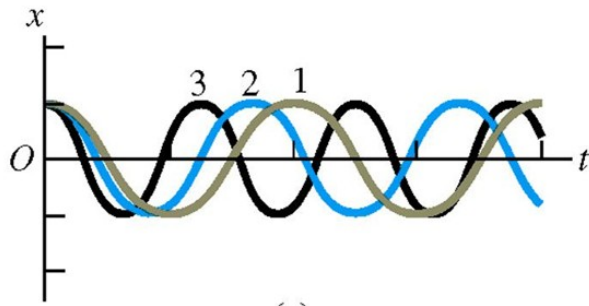
(a)

Amplitude ($1 < 2 < 3$)



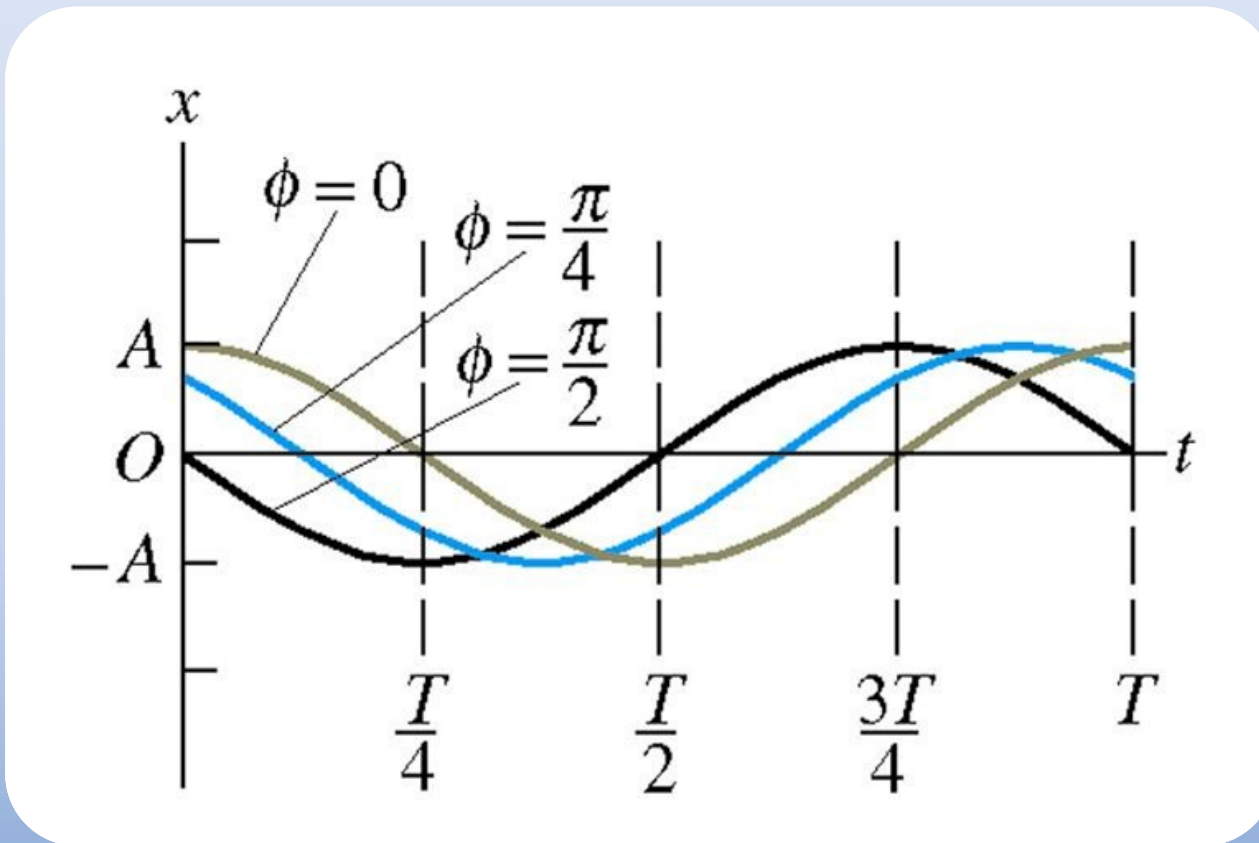
(b)

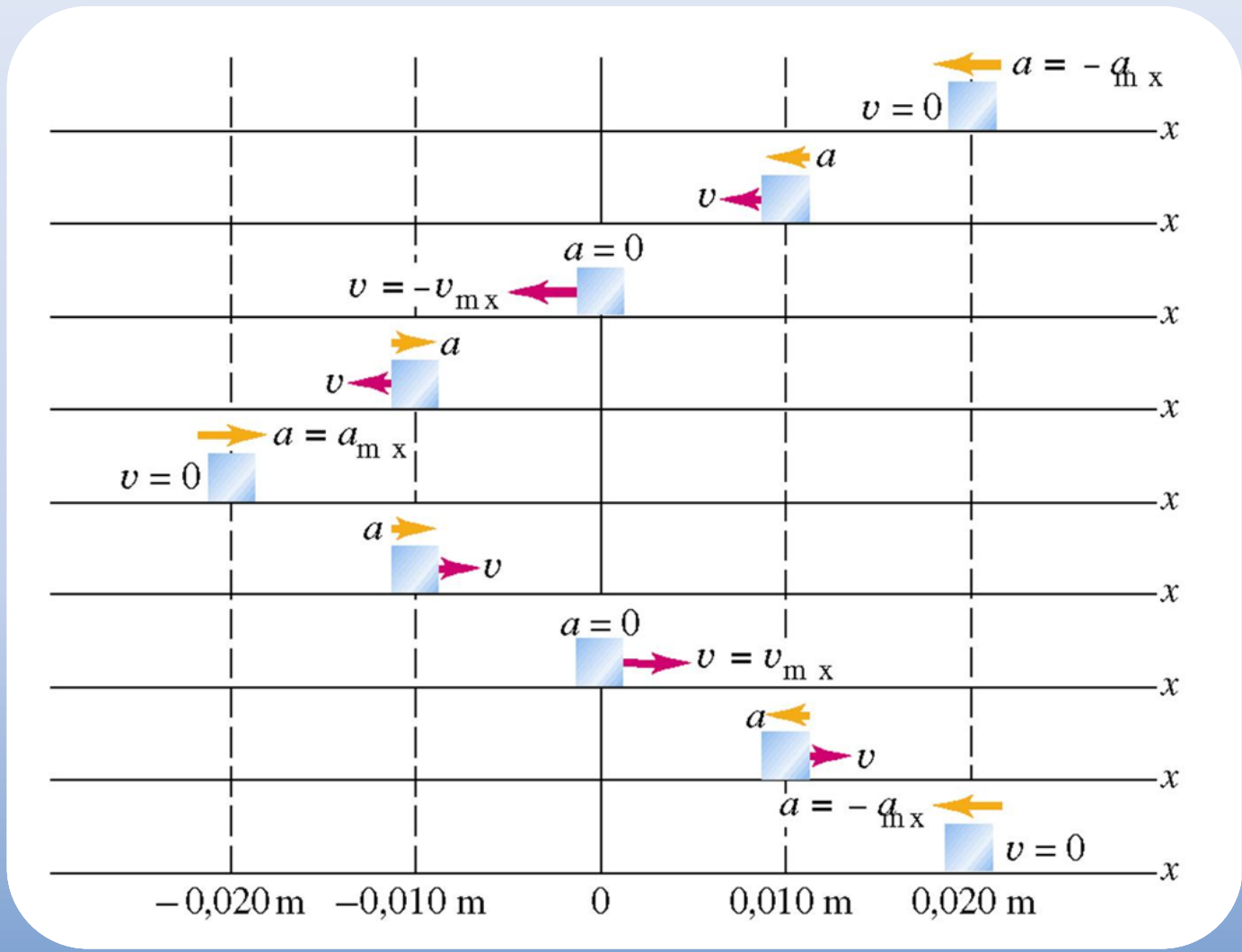
massa ($1 < 2 < 3$)

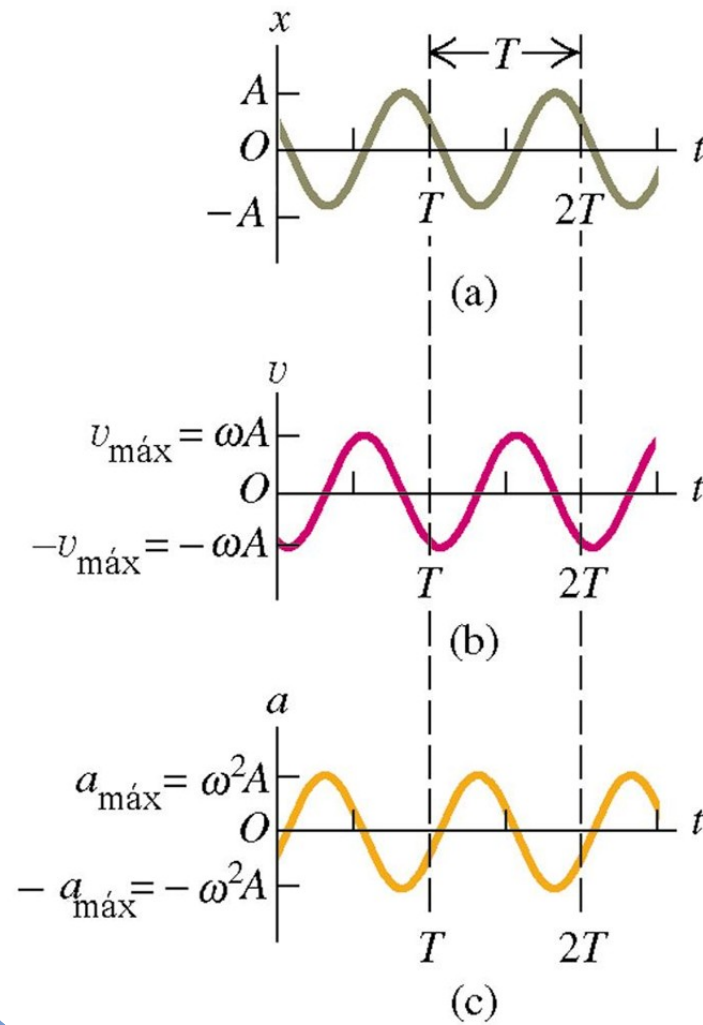


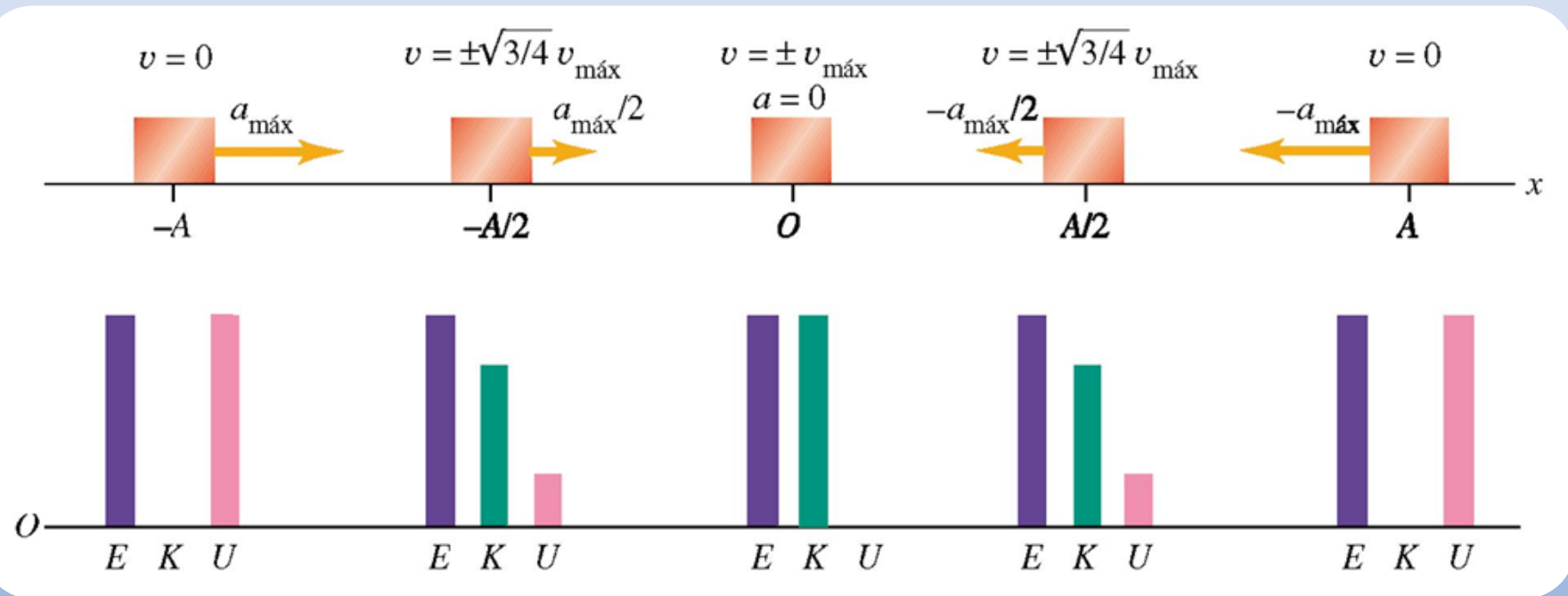
(c)

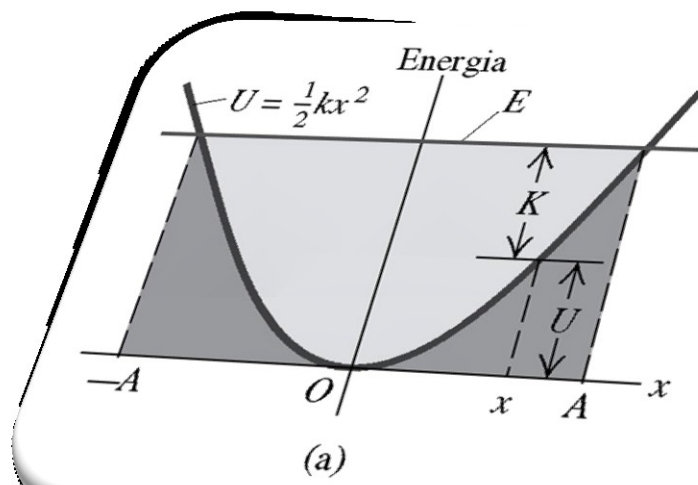
k ($1 < 2 < 3$)



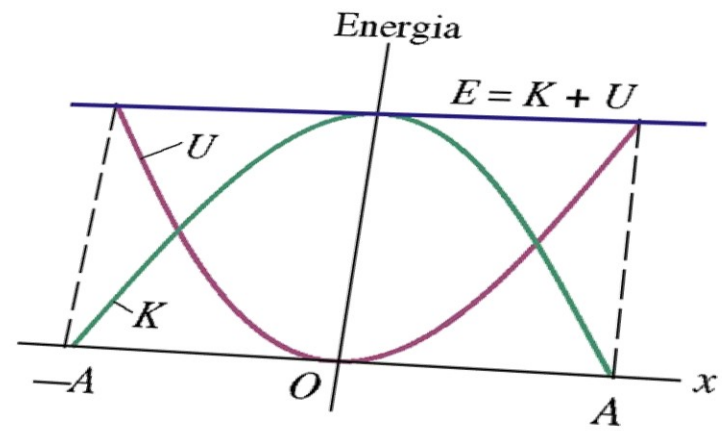








(a)



(b)

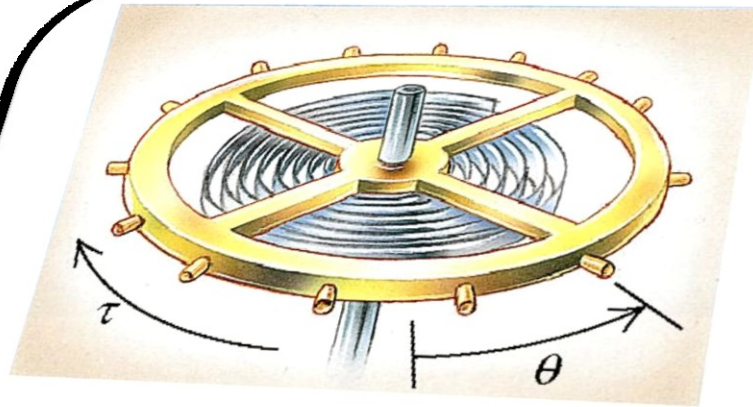


FIGURA 13.16 A roda catarina de um relógio mecânico. A mola helicoidal exerce um torque restaurador proporcional ao deslocamento angular a partir da posição de equilíbrio. Logo, o movimento é um MHS.

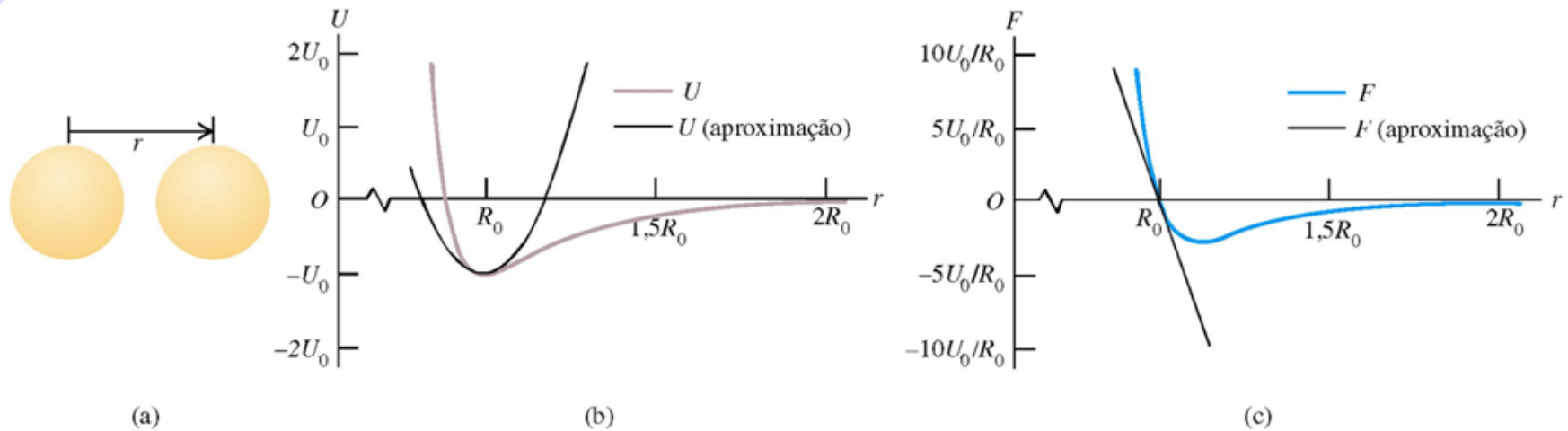


FIGURA 13.17 (a) Dois átomos separados por uma distância r . (b) Energia potencial U da interação de van der Waals em função de r . O valor de U é mínimo para a distância de equilíbrio $r = R_0$. Nas vizinhanças de $r = R_0$, U pode ser aproximada por uma parábola. (c) A força F sobre o átomo do lado direito em função de r . Para a distância de equilíbrio $r = R_0$, F é igual a zero. Nas vizinhanças de $r = R_0$, F pode ser aproximada por uma linha reta.

