

## Tome 1, Mécanique

### Chapitre 2

$$\begin{aligned}2.1 \quad A_x &= A \cos \theta_A \\ A_y &= A \sin \theta_A\end{aligned}$$

$$2.2 \quad A = \sqrt{A_x^2 + A_y^2}$$

$$2.3 \quad \tan \theta_A = \frac{A_y}{A_x}$$

$$2.8 \quad A = \sqrt{A_x^2 + A_y^2 + A_z^2}$$

$$2.9 \quad \vec{\mathbf{A}} \cdot \vec{\mathbf{B}} = AB \cos(\theta)$$

$$2.11 \quad \vec{\mathbf{A}} \cdot \vec{\mathbf{B}} = A_x B_x + A_y B_y + A_z B_z$$

$$2.12 \quad \vec{\mathbf{A}} \times \vec{\mathbf{B}} = AB \sin(\theta) \vec{\mathbf{u}}_n$$

$$\begin{aligned}2.13 \quad \vec{\mathbf{A}} \times \vec{\mathbf{B}} &= C_x \vec{\mathbf{i}} + C_y \vec{\mathbf{j}} + C_z \vec{\mathbf{k}} \\ &= (A_y B_z - A_z B_y) \vec{\mathbf{i}} + \\ &\quad (A_z B_x - A_x B_z) \vec{\mathbf{j}} + \\ &\quad (A_x B_y - A_y B_x) \vec{\mathbf{k}}\end{aligned}$$

### Chapitre 3

$$3.2 \quad \text{vitesse scalaire moyenne} = \frac{\text{distance parcourue}}{\text{intervalle de temps}}$$

$$3.3 \quad v_{x_{\text{moy}}} = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i}$$

$$3.5 \quad v_x = \frac{dx}{dt}$$

$$3.6 \quad a_{x_{\text{moy}}} = \frac{\Delta v_x}{\Delta t}$$

$$3.7 \quad a_x = \frac{dv_x}{dt}$$

$$3.9 \quad v_x = v_{x0} + a_x t$$

$$3.10 \quad x = x_0 + \frac{1}{2}(v_{x0} + v_x)t$$

$$3.11 \quad x = x_0 + v_{x0}t + \frac{1}{2}a_x t^2$$

$$3.12 \quad v_x^2 = v_{x0}^2 + 2a_x(x - x_0)$$

$$3.13 \quad v_y = v_{y0} - gt$$

$$3.14 \quad y = y_0 + \frac{1}{2}(v_{y0} + v_y)t$$

$$3.15 \quad y = y_0 + v_{y0}t - \frac{1}{2}gt^2$$

$$3.16 \quad v_y^2 = v_{y0}^2 - 2g(y - y_0)$$

### Chapitre 4

$$4.3 \quad \vec{\mathbf{v}}_{\text{moy}} = \frac{\Delta \vec{\mathbf{r}}}{\Delta t} = \frac{\Delta x}{\Delta t} \vec{\mathbf{i}} + \frac{\Delta y}{\Delta t} \vec{\mathbf{j}} + \frac{\Delta z}{\Delta t} \vec{\mathbf{k}}$$

$$4.9 \quad x = v_{x0}t$$

$$4.10 \quad v_y = v_{y0} - gt$$

$$4.11 \quad y = y_0 + v_{y0}t - \frac{1}{2}gt^2$$

$$4.12 \quad v_y^2 = v_{y0}^2 - 2g(y - y_0)$$

$$4.13 \quad a_r = \frac{v^2}{r}$$

$$4.14 \quad T = \frac{2\pi r}{v}$$

$$4.16 \quad \vec{\mathbf{v}}_{\text{PA}} = \vec{\mathbf{v}}_{\text{PB}} + \vec{\mathbf{v}}_{\text{BA}}$$

### Chapitre 5

$$5.1 \quad F_{\text{res}} = k\Delta\ell$$

$$5.2 \quad \sum \vec{\mathbf{F}} = m\vec{\mathbf{a}}$$

$$5.3 \quad \sum F_x = ma_x \quad \sum F_y = ma_y \quad \sum F_z = ma_z$$

$$5.4 \quad F_g = \frac{GMm}{r^2}$$

### Chapitre 6

$$6.1 \quad f_c = \mu_c N$$

$$6.2 \quad f_{s(\text{max})} = \mu_s N$$

$$6.3 \quad \sum F_x = \frac{mv^2}{r}$$

### Chapitre 7

$$7.1a \quad W = FS \cos(\theta)$$

$$7.1c \quad W = F_x \Delta x + F_y \Delta y + F_z \Delta z$$

$$7.7 \quad W_{\text{res}} = -\frac{k}{2}(x_f^2 - x_i^2)$$

$$7.11 \quad K = \frac{1}{2}mv^2$$

$$7.12 \quad \sum W = \Delta K$$

$$7.13 \quad P_{\text{moy}} = \frac{\Delta W}{\Delta t}$$

$$7.15a \quad P = \vec{\mathbf{F}} \cdot \vec{\mathbf{v}}$$

### Chapitre 8

$$8.6a \quad U_g = mgy$$

$$8.7a \quad U_{\text{res}} = \frac{1}{2}kx^2$$

$$8.8a \quad K_f + U_f = K_i + U_i$$

$$8.9 \quad E = K + U$$

$$8.10 \quad E_i = E_f \quad \Delta E = 0$$

$$8.16b \quad \Delta K + \Delta U = W_{\text{nc}}$$

$$8.16c \quad \Delta E = E_f - E_i = W_{\text{nc}}$$

$$8.19 \quad U_g = -\frac{GmM}{r}$$

$$8.20 \quad E = \frac{1}{2}mv^2 - \frac{GmM}{r}$$

$$8.21 \quad E = -\frac{GmM}{2r}$$

$$8.22 \quad v_{\text{lib}} = \sqrt{\frac{2GM_{\text{T}}}{R_{\text{T}}}}$$

### Chapitre 9

$$9.1 \quad \vec{\mathbf{p}} = m\vec{\mathbf{v}}$$

$$9.6a \quad m_1 \vec{\mathbf{u}}_1 + m_2 \vec{\mathbf{u}}_2 = m_1 \vec{\mathbf{v}}_1 + m_2 \vec{\mathbf{v}}_2$$

$$9.6b \quad \begin{aligned}m_1 u_{1x} + m_2 u_{2x} &= m_1 v_{1x} + m_2 v_{2x} \\ m_1 u_{1y} + m_2 u_{2y} &= m_1 v_{1y} + m_2 v_{2y} \\ m_1 u_{1z} + m_2 u_{2z} &= m_1 v_{1z} + m_2 v_{2z}\end{aligned}$$

$$9.7 \quad \frac{1}{2}m_1 u_1^2 + \frac{1}{2}m_2 u_2^2 = \frac{1}{2}m_1 v_1^2 + \frac{1}{2}m_2 v_2^2$$

$$9.10 \quad v_{2x} - v_{1x} = -(u_{2x} - u_{1x})$$

$$9.14 \quad \vec{\mathbf{I}} = \Delta \vec{\mathbf{p}} = \vec{\mathbf{p}}_f - \vec{\mathbf{p}}_i$$

$$9.15 \quad \vec{\mathbf{I}} = \Delta \vec{\mathbf{p}} = \vec{\mathbf{F}}_{\text{moy}} \Delta t$$

### Chapitre 10

$$10.1 \quad \vec{\mathbf{r}}_{\text{CM}} = \frac{\sum m_i \vec{\mathbf{r}}_i}{M}$$

$$10.2 \quad x_{\text{CM}} = \frac{\sum m_i x_i}{M}; \quad y_{\text{CM}} = \frac{\sum m_i y_i}{M}; \quad z_{\text{CM}} = \frac{\sum m_i z_i}{M}$$

$$10.4 \quad \vec{\mathbf{v}}_{\text{CM}} = \frac{\sum m_i \vec{\mathbf{v}}_i}{M}$$

$$10.5a \quad \vec{\mathbf{P}} = M\vec{\mathbf{v}}_{\text{CM}}$$

$$10.6 \quad \sum \vec{\mathbf{F}}_{\text{EXT}} = M\vec{\mathbf{a}}_{\text{CM}}$$

### Chapitre 11

$$11.1 \quad \Delta\theta = \frac{s}{r}$$

$$11.2 \quad \omega_{\text{moy}} = \frac{\Delta\theta}{\Delta t} = \frac{\theta_f - \theta_i}{t_f - t_i}$$

$$11.3 \quad \omega = \lim_{\Delta t \rightarrow 0} \frac{\Delta\theta}{\Delta t} = \frac{d\theta}{dt}$$

$$11.4 \quad \omega = \frac{2\pi}{T} = 2\pi f$$

$$11.6 \quad \omega = \omega_0 + \alpha t$$

$$11.7 \quad \theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$$

$$11.8 \quad \omega^2 = \omega_0^2 + 2\alpha(\theta - \theta_0)$$

$$11.9 \quad v_t = \omega r$$

$$11.10 \quad a_r = \frac{v_t^2}{r} = \omega^2 r$$

$$11.11 \quad a_t = \alpha r$$

$$11.22 \quad \tau = \pm r_{\perp} F = \pm r F_{\perp}$$

$$11.23 \quad \tau = \pm r F \sin \theta$$

$$11.24 \quad \sum \tau = I\alpha$$

$$11.25 \quad P = \tau\omega$$

### Chapitre 12

$$12.1 \quad \sum \vec{\mathbf{F}} = 0$$

$$12.2 \quad \sum F_x = 0; \quad \sum F_y = 0$$

$$12.3 \quad \sum \tau = 0$$

$$12.10 \quad \vec{\ell} = \vec{\mathbf{r}} \times \vec{\mathbf{p}}$$

### Chapitre 13

$$13.2 \quad F_g = \frac{Gm_1 m_2}{r^2}$$

$$13.8 \quad E = -\frac{GmM}{2a}$$

### Chapitre 14

$$14.1 \quad \rho = \frac{m}{V}$$

$$14.3 \quad \text{contrainte de traction } \sigma = \frac{F_0}{A}$$

$$14.4 \quad \text{déformation } \varepsilon = \frac{\Delta L}{L_0}$$

$$14.5 \quad E = \frac{\sigma}{\varepsilon}$$

$$14.8 \quad P = P_0 + \rho gh$$

$$14.9 \quad F_p = \rho_f V g$$

$$14.11 \quad A_1 v_1 = A_2 v_2$$

$$14.12 \quad P + \rho gy + \frac{1}{2}\rho v^2 = \text{constante}$$

### Chapitre 15

$$15.1 \quad \omega = \frac{2\pi}{T} = 2\pi f$$

$$15.2 \quad x(t) = A \sin(\omega t + \phi)$$

$$15.3 \quad v_x(t) = \frac{dx}{dt} = \omega A \cos(\omega t + \phi)$$

$$15.4 \quad a_x(t) = \frac{dv_x}{dt} = \frac{d^2 x}{dt^2} = -\omega^2 A \sin(\omega t + \phi)$$

$$15.5b \quad a_x = -\omega^2 x$$

$$15.9 \quad \omega = \sqrt{\frac{k}{m}}$$

$$15.11 \quad U = \frac{1}{2}kx^2 = \frac{1}{2}kA^2 \sin^2(\omega t + \phi)$$

$$\begin{aligned}15.12 \quad K &= \frac{1}{2}mv_x^2 = \frac{1}{2}m\omega^2 A^2 \cos^2(\omega t + \phi) \\ &= \frac{1}{2}kA^2 \cos^2(\omega t + \phi)\end{aligned}$$

$$15.13 \quad E = \frac{1}{2}mv^2 + \frac{1}{2}kx^2 = \frac{1}{2}kA^2$$

$$15.15a \quad \omega = \sqrt{\frac{g}{L}}$$

$$15.16 \quad \theta = \theta_0 \sin(\omega t + \phi)$$

### Chapitre 16

$$16.2 \quad PV = nRT$$

$$16.5 \quad \Delta L = \alpha L_0 \Delta T$$

$$16.7 \quad \Delta V = \beta V_0 \Delta T$$

### Chapitre 17

$$17.1 \quad \Delta Q = mc\Delta T$$

$$17.4 \quad C = Mc$$

$$17.6 \quad m_1 c_1 \Delta T_1 + m_2 c_2 \Delta T_2 = 0$$

$$17.7 \quad \Delta Q = mL$$

$$17.9 \quad \Delta U = Q - W$$

$$17.11 \quad Q_{\nu} = nC_{\nu} \Delta T$$

$$17.20 \quad \frac{dQ}{dt} = \kappa A \frac{T_C - T_F}{L}$$

$$17.22 \quad \frac{dQ_{\text{émis}}}{dt} = e\sigma A T^4$$

### Chapitre 18

$$18.5 \quad K_{\text{moy}} = \frac{1}{2}mv_{\text{qm}}^2 = \frac{3}{2}kT$$

$$18.6a \quad v_{\text{qm}} = \sqrt{\frac{3kT}{m}}$$

$$18.8 \quad \Delta U = nC_{\nu} \Delta T$$

$$18.9 \quad C_{\nu} = \frac{3}{2}R$$

$$18.10 \quad C_p = \frac{5}{2}R$$

$$18.16 \quad f(v) = Av^2 e^{-mv^2/2kT}$$

$$18.18 \quad \lambda = \frac{1}{\sqrt{2n_p} \pi d^2}$$

### Chapitre 19

$$19.1 \quad W = Q = |Q_C| - |Q_F|$$

$$19.2 \quad \varepsilon = \frac{W}{|Q_C|} = 1 - \frac{|Q_F|}{|Q_C|}$$

$$19.3 \quad |Q_C| = W + |Q_F|$$

$$19.6 \quad \varepsilon_C = 1 - \frac{T_F}{T_C}$$

$$19.9 \quad \Delta S = S_f - S_i = \int_i^f \frac{dQ_R}{T}$$

$$19.11 \quad \Delta S = nC_{\nu} \ln \frac{T_f}{T_i} + nR \ln \frac{V_f}{V_i}$$