The background features several mathematical elements: a green integral formula  $\int_a^b f(x) dx$  on the left; a partial derivative  $\frac{\partial}{\partial y} f(x, y, z)$  at the top center; a vector diagram with  $\vec{a}$  and  $\vec{b}$  at the top right; a hyperbolic identity  $\cosh^2 \phi - \sinh^2 \phi = 1$  on the right; a volume formula  $V_A = \frac{4}{3} \pi r^3$  on the right; a complex number formula  $= |z| \cos \varphi + |z/i| \sin \varphi$  at the bottom right; and a black triangle on the bottom left.

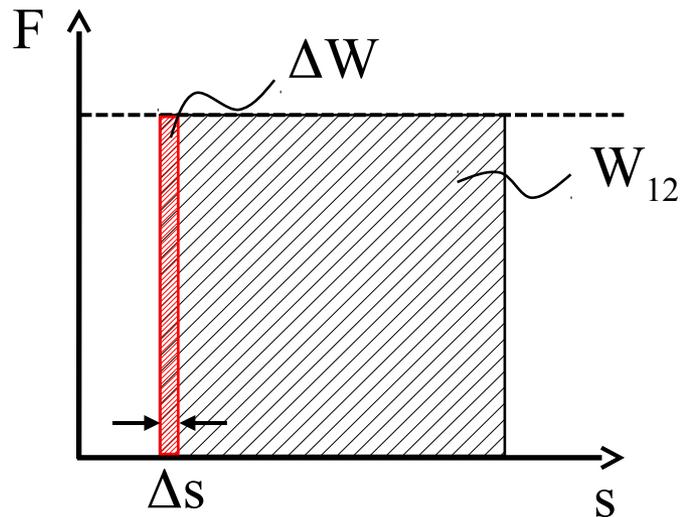
# Mathematischer Vorkurs zu den Vorlesungen Physik A+B

Dr. Hans-Günter Ludwig  
Wintersemester 2019/20

Kapitel 3:  
Integralrechnung

# Kraft-Weg-Diagramme

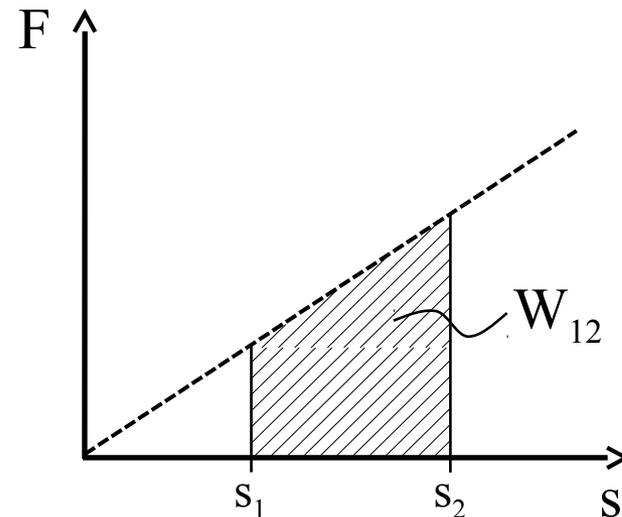
- Ortsunabhängige Kräfte:



$$\Delta W = F \cdot \Delta s$$

$$W = F \cdot s$$

- Ortsabhängige Kräfte:



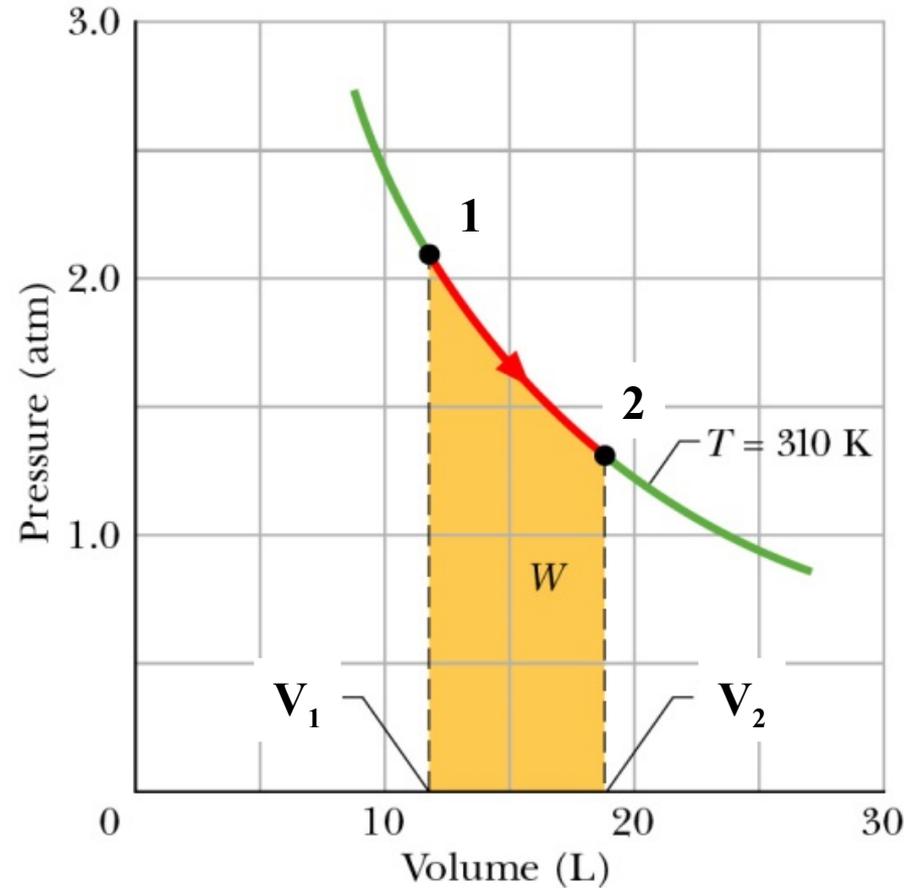
$$dW = F ds$$

$$W_{12} = \int_{s_1}^{s_2} F ds$$

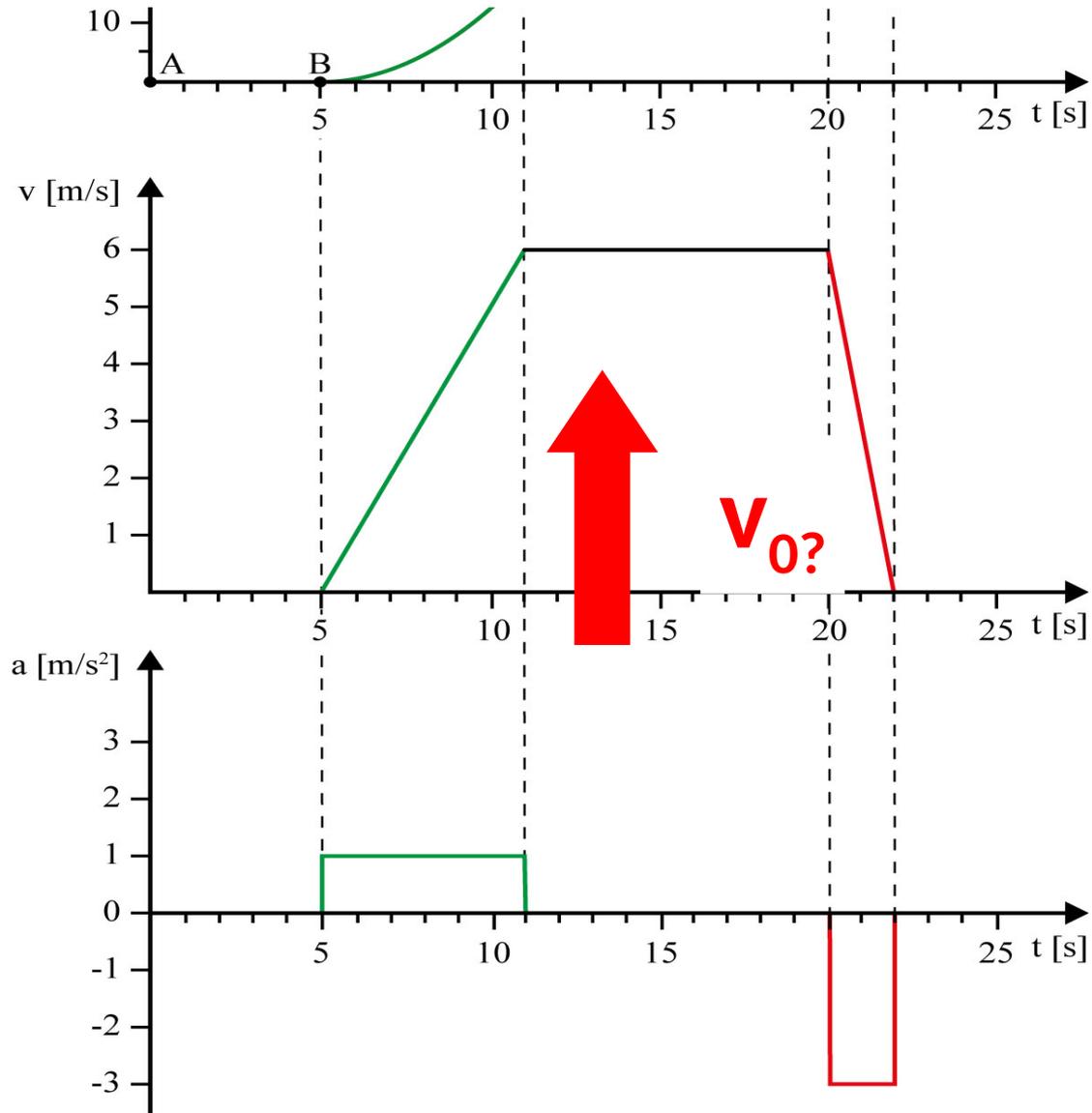
# Zustandsänderungen und Arbeit

$$W_{12} = \int dW = \int_{V_1}^{V_2} p dV$$

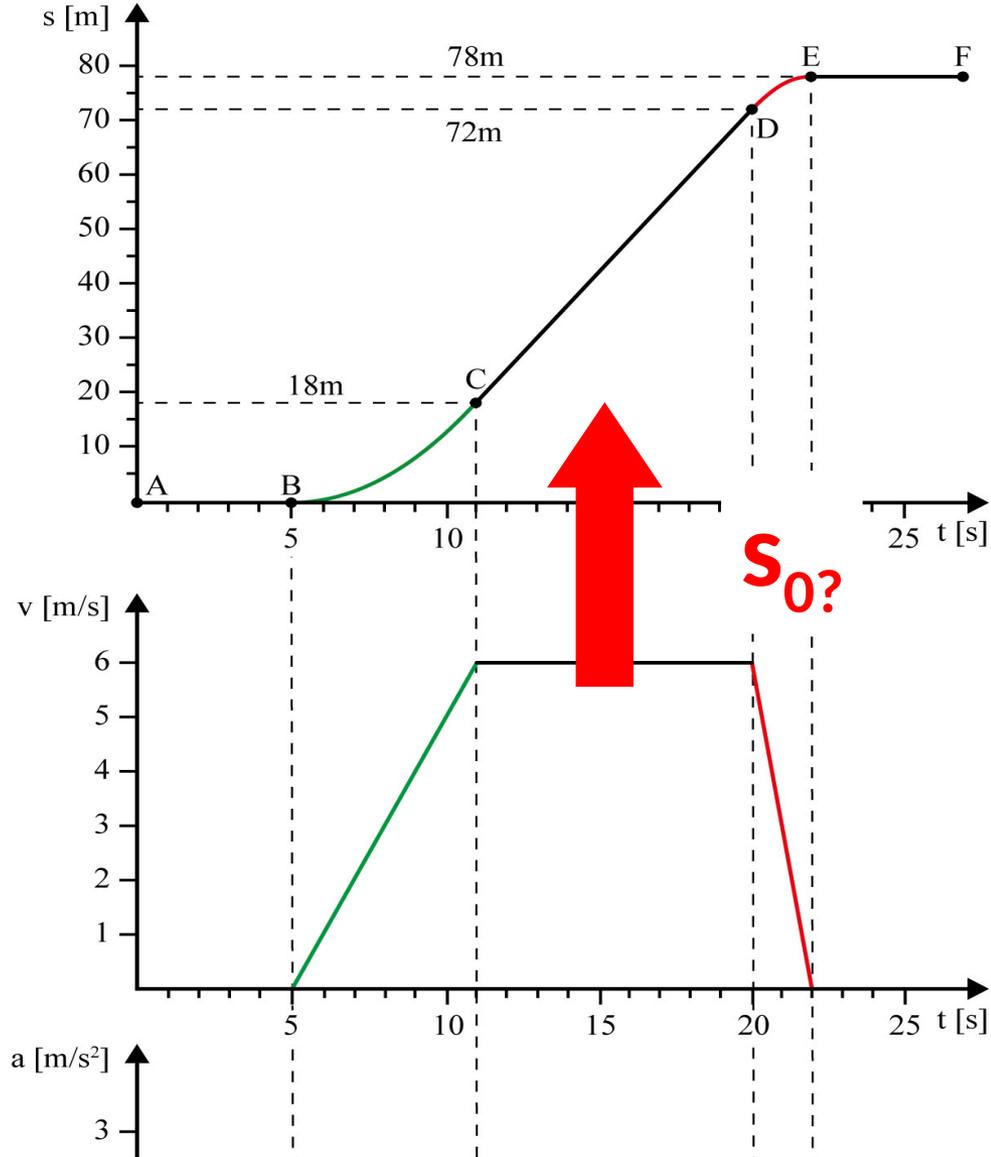
- D.h. die Arbeit  $W_{12}$  entspricht der Fläche unter der Kurve der Zustandsänderung im p,V-Diagramm.



# Beschleunigungs-Zeit-Diagramm



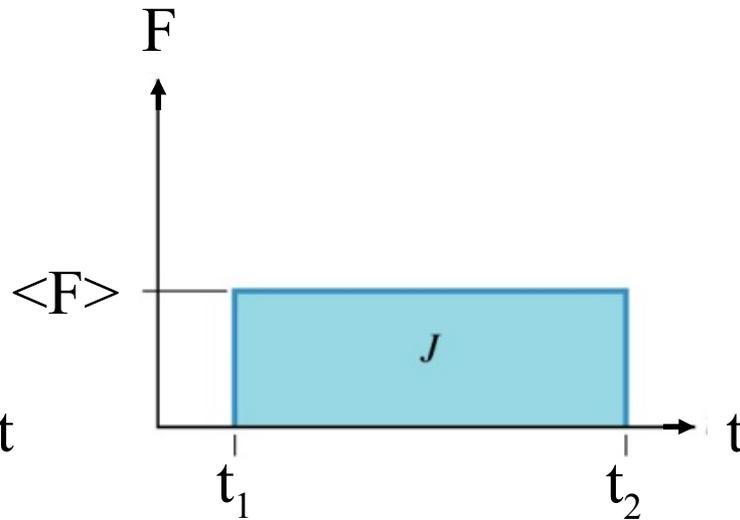
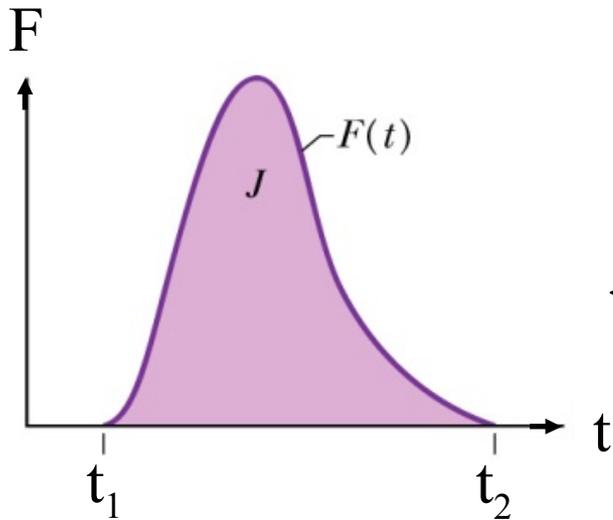
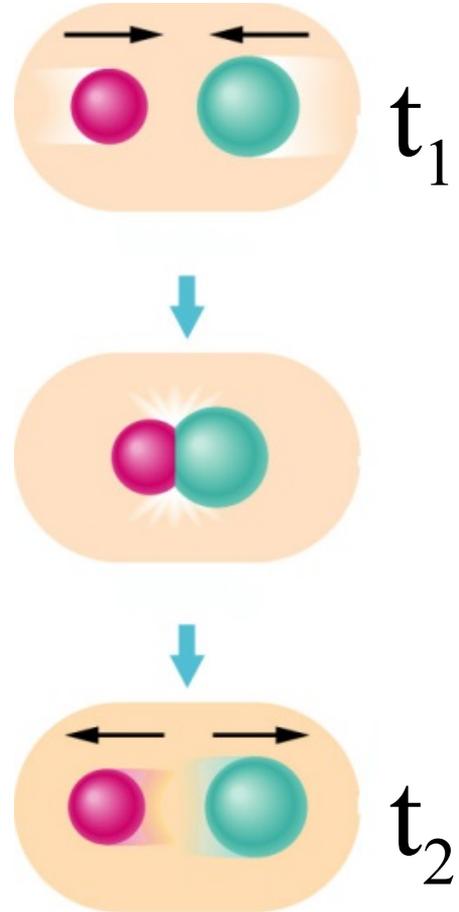
# Geschwindigkeits-Zeit-Diagramm



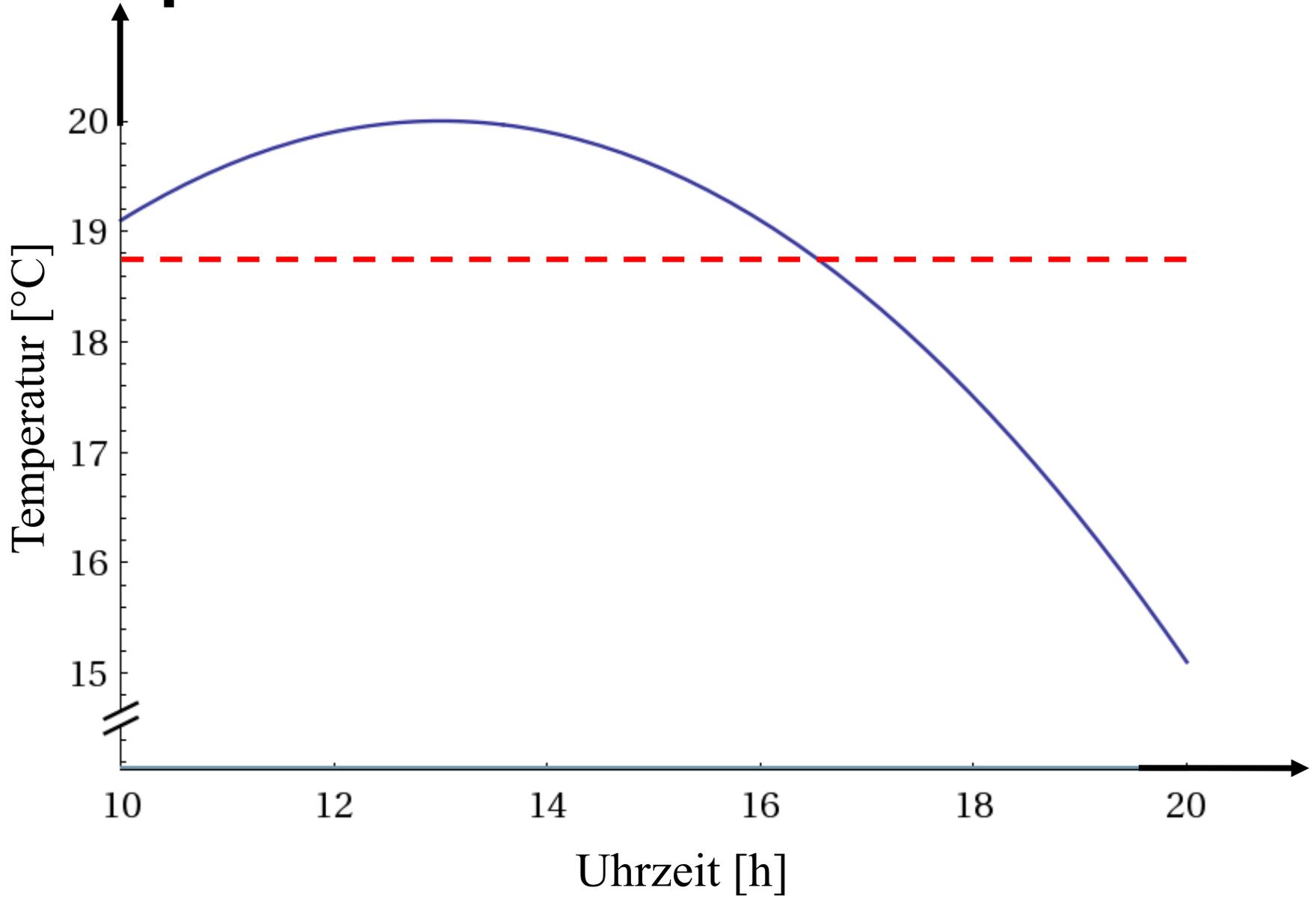


# Kraftstoß

$$\Delta \vec{p} = \vec{J} := \int_{t_1}^{t_2} \vec{F}(t) dt = \langle \vec{F} \rangle \Delta t$$



# Temperatur-Mittelwert



A large brown bear is lying down on a grey, textured rock surface. The bear's head is resting on the left side of the rock, and its body extends towards the right. The bear's fur is thick and brown. A semi-transparent dark grey rectangular box is overlaid on the bear's midsection, containing the text "15 Minuten Pause!".

**15 Minuten Pause!**