

Work and Energy Chapter IV Work and Energy The objective of this chapter is to introduce the energy tools used in mechanics to solve problems. Kinetic Energy Dr IACHACHENE FARIDA FHC-UMBB-2024-2025 9 Work and Energy Chapter IV The Kinetic Energy Theorem $E_k B - E_k A = ?$ WAB F ?ext Demonstration Consider a particle moving under the action of a resultant force $F \rightarrow$ between A and B. The work done by $F \rightarrow$ for an elemental displacement $dr \rightarrow$ is : $dW = F \rightarrow \cdot dr$ Dr IACHACHENE FARIDA FHC-UMBB-2024-2025 18 Work and Energy Chapter IV Dr IACHACHENE FARIDA FHC-UMBB-2024-2025 19 Work and Energy Chapter IV Dr IACHACHENE FARIDA FHC-UMBB-2024-2025 20 Work and Energy Chapter IV Solution Calculation of the total mechanical energy at equilibrium: We know that : $E_T = E_k + E_p$ At equilibrium: – the velocity of the system is zero $V = 0 \Rightarrow E_k = 0$ – and the potential energy of the system $E_p = E_p(\text{elastic}) + E_p(\text{gravitational})$ So: $E_p = \frac{1}{2} kx^2 + mgh$ NA: $E_p = \frac{1}{2} 200(0.02)^2 + 0.1 \times 10 \times 0.5 = 1.54 \text{ J}$ Hence, the total mechanical energy at equilibrium: $E_T = E_p = 1.54 \text{ J}$ Dr IACHACHENE FARIDA FHC-UMBB-2024-2025 5 Work and Energy Chapter IV B- Work of a variable force When force is variable, the calculation of work for this variable force involves first defining the increment of work, denoted as dW , done by a force F ?No Work Done Dr IACHACHENE FARIDA FHC-UMBB-2024-2025 4 Work and Energy Chapter IV Exercise 1 A body weighing 4 kg ascends a ramp inclined at 30° over a distance of 15 m. The driving force is $F = 30 \text{ N}$. Calculate the work done by each force acting on this body. Dr IACHACHENE FARIDA FHC-UMBB-2024-2025 15 Work and Energy Chapter IV Examples of potential energy a) Gravitational potential energy $E_p = mgh + C_{st}$ If we set $E_p = 0$ for $h=0$, then the constant (C_{st}) is equal to 0 Gravitational potential energy $m h$ It is the energy that a body possesses due to its position in a gravitational field Work and Energy Chapter IV b- Elastic Potential Energy It is potential energy stored as a result of deformation of an elastic object such as spring. Dr IACHACHENE FARIDA FHC-UMBB-2024-2025 12 Work and Energy Chapter IV Dr IACHACHENE FARIDA FHC-UMBB-2024-2025 13 Work and Energy Chapter IV Exercise 4 : A particle of mass m moving along a straight trajectory is subjected to a force $F(x)$, the variations of which with respect to x are depicted in figure below. Dr IACHACHENE FARIDA FHC-UMBB-2024-2025 1 Work and Energy Chapter IV A- Work done by a constant force work done by a constant force $F \rightarrow$ during a rectilinear displacement AB , is defined as the scalar product of the force $F \rightarrow$ and the displacement AB . $W_{AB}(F) = F \cdot AB$ 5 10 15 20 25 30 0,0 0,5 1,0 $x(m)$ $F(N)$ Dr IACHACHENE FARIDA FHC-UMBB-2024-2025 14 Work and Energy Chapter IV 4. Potential energy The kinetic energy E_k of a particle is associated with its motion. $dr \rightarrow$ Dr IACHACHENE FARIDA FHC-UMBB-2024-2025 6 Work and Energy Chapter IV Exercise 2: A body m is subjected to a force $F \rightarrow$, moving along the trajectory $OABCO$, as shown in figure opposite. Dr IACHACHENE FARIDA FHC-UMBB-2024-2025 8 Work and Energy Chapter IV Kinetic energy E_k , is the energy possessed by an object due to its motion. $= m \frac{dV}{dt}$ Dr IACHACHENE FARIDA FHC-UMBB-2024-2025 10 Work and Energy Chapter IV We substitute the expression for $F \rightarrow$ into equation (*): (*) $\Rightarrow dW = m \frac{dV}{dt} dt$?< 0 negative work Dr IACHACHENE FARIDA FHC-UMBB-2024-2025 3 Work and Energy Chapter IV ?acting through an infinitesimal displacement dr ?Introduction 2.1. ?0