

Useful Physics Formulae

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1 Energy

1.1 Conservation of energy

Explanation: The final total energy of a system (the sum of all kinetic (K_f) and potential (U_f) energy terms) will be exactly the same as the initial total energy plus the work (W) done on the system by an external force.

$$\Sigma U_i + \Sigma K_i + W = \Sigma U_f + \Sigma K_f$$

1.2 Work done by a force

Explanation: If a force acts on an object while the object is moving, then the work done on the object is just the product of the force F , the total distance traveled d , and the cosine of the angle between the displacement and the force (θ). This is true even if the motion was not in a straight line; d is just the total change in position.

$$W = Fd\cos(\theta)$$

1.3 Relationship between work and potential energy

Explanation: The work done by a conservative force is simply the change in **potential energy**, albeit with a negative sign in front (since the energy *lost* by the potential is *gained* by the system, or vice versa).

$$W = -\Delta U = -(U_f - U_i)$$

2 Springs

2.1 Force (Hooke's Law)

Explanation: The force due to a spring is proportional to the spring constant k and the displacement from equilibrium x . The negative sign comes from the fact that springs always want to return to their equilibrium length when disturbed; a positive displacement x will therefore result in a force F_s in the negative direction. A stiffer spring will have a larger spring constant k .

$$F_s = -kx$$

2.2 Potential Energy

Explanation: Again, k is the spring constant and x is the displacement from equilibrium.

$$U_s = kx^2$$