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1. Kinematics

运动学

1.1 Scalars and Vectors

标量与矢量

☐☐☐ Describe a scalar or vector quantity using magnitude and direction, as appropriate.

1.2 Displacement, Velocity, and Acceleration

位移、速度与加速度

- ☐☐☐ Describe a change in an object’s position.
- ☐☐☐ Describe the average velocity and acceleration of an object.
- ☐☐☐ Describe the instantaneous position, velocity, and acceleration of an object as a function of time.

1.3 Representing Motion

运动的表示

☐☐☐ Describe the position, velocity, and acceleration of an object using representations of that object’s motion.

1.4 Reference Frames and Relative Motion

参考系与相对运动

- ☐☐☐ Describe the reference frame of a given observer.
- ☐☐☐ Describe the motion of objects as measured by observers in different inertial reference frames.

1.5 Motion in Two or Three Dimensions

二维或三维运动

☐☐☐ Describe the motion of an object moving in two or three dimensions.

2. Force and Translational Dynamics

力与平动动力学

2.1 Systems and Center of Mass

系统与质心

- ☐☐☐ Describe the properties and interactions of a system.
- ☐☐☐ Describe the location of a system’s center of mass with respect to the system’s constituent parts.

2.2 Forces and Free-Body Diagrams

力与受力图

- ☐☐☐ Describe a force as an interaction between two objects or systems
- ☐☐☐ Describe the forces exerted on an object or system using a free-body diagram.

2.3 Newton’s Third Law

牛顿第三定律

☐☐☐ Describe the interaction of two objects or systems using Newton’s third law and a representation of paired forces exerted on each object or system.

2.4 Newton’s First Law

牛顿第一定律

☐☐☐ Describe the conditions under which a system’s velocity remains constant.

2.5 Newton’s Second Law

牛顿第二定律

☐☐☐ Describe the conditions under which a system’s velocity changes.

2.6 Gravitational Force

万有引力

- ☐☐☐ Describe the gravitational interaction between two objects or systems with mass.
- ☐☐☐ Describe situations in which the gravitational force can be considered constant.
- ☐☐☐ Describe the conditions under which the magnitude of a system’s apparent weight is different from the magnitude of the gravitational force exerted on that system.
- ☐☐☐ Describe inertial and gravitational mass.
- ☐☐☐ Describe the gravitational force exerted on an object by a uniform spherical distribution of mass.

2.7 Kinetic and Static Friction

动摩擦与静摩擦

- ☐☐☐ Describe kinetic friction between two surfaces.
- ☐☐☐ Describe static friction between two surfaces.

2.8 Spring Forces

弹簧力

- ☐☐☐ Describe the force exerted on an object by an ideal spring.
- ☐☐☐ Describe the equivalent spring constant of a combination of springs exerting forces on an object.

2.9 Resistive Forces

阻力

☐☐☐ Describe the motion of an object subject to a resistive force.

2.10 Circular Motion

圆周运动

- ☐☐☐ Describe the motion of an object traveling in a circular path.
- ☐☐☐ Describe circular orbits using Kepler’s third law.

3. Work, Energy, and Power

功、能与功率

3.1 Translational Kinetic Energy

平动动能

☐☐☐ Describe the translational kinetic energy of an object in terms of the object’s mass and velocity.

3.2 Work

功

☐☐☐ Describe the work done on an object or system by a given force or collection of forces.

3.3 Potential Energy

势能

☐☐☐ Describe the potential energy of a system.

3.4 Conservation of Energy

能量守恒

- ☐☐☐ Describe the energies present in a system.
- ☐☐☐ Describe the behavior of a system using conservation of mechanical energy principles.
- ☐☐☐ Describe how the selection of a system determines whether the energy of that system changes.

3.5 Power

功率

☐☐☐ Describe the transfer of energy into, out of, or within a system in terms of power.

4. Linear Momentum

线动量

4.1 Linear Momentum 线动量

☐☐☐ Describe the linear momentum of an object or system.

4.2 Change in Momentum and Impulse 动量变化与冲量

- ☐☐☐ Describe the impulse delivered to an object or system.
- ☐☐☐ Describe the relationship between the impulse exerted on an object or system and the change in momentum of the object or system.

4.3 Conservation of Linear Momentum 线动量守恒

- ☐☐☐ Describe the behavior of a system using conservation of linear momentum.
- ☐☐☐ Describe how the selection of a system determines whether the momentum of that system changes.

4.4 Elastic and Inelastic Collisions 弹性碰撞与非弹性碰撞

☐☐☐ Describe whether an interaction between objects is elastic or inelastic.

5. Torque and Rotational Dynamics

力矩与转动动力学

5.1 Rotational Kinematics 转动运动学

☐☐☐ Describe the rotation of a system with respect to time using angular displacement, angular velocity, and angular acceleration.

5.2 Connecting Linear and Rotational Motion 联系线运动与转动

☐☐☐ Describe the linear motion of a point on a rotating rigid system that corresponds to the rotational motion of that point, and vice versa.

5.3 Torque 力矩

- ☐☐☐ Identify the torques exerted on a rigid system.
- ☐☐☐ Describe the torques exerted on a rigid system.

5.4 Rotational Inertia 转动惯量

- ☐☐☐ Describe the rotational inertia of a rigid system relative to a given axis of rotation.
- ☐☐☐ Describe the rotational inertia of a rigid system rotating about an axis that does not pass through the system's center of mass.

5.5 Rotational Equilibrium and Newton's First Law in Rotational Form 转动平衡与转动形式的牛顿第一定律

☐☐☐ Describe the conditions under which a system's angular velocity remains constant.

5.6 Newton's Second Law in Rotational Form 转动形式的牛顿第二定律

☐☐☐ Describe the conditions under which a system's angular velocity changes.

6. Energy and Momentum of Rotating Systems

转动系统的能量与动量

6.1 Rotational Kinetic Energy 转动动能

☐☐☐ Describe the rotational kinetic energy of a rigid system in terms of the rotational inertia and angular velocity of that rigid system.

6.2 Torque and Work 力矩与功

☐☐☐ Describe the work done on a rigid system by a given torque or collection of torques.

6.3 Angular Momentum and Angular Impulse 角动量与角冲量

- ☐☐☐ Describe the angular momentum of an object or rigid system.
- ☐☐☐ Describe the angular impulse delivered to an object or rigid system by a torque.
- ☐☐☐ Relate the change in angular momentum of an object or rigid system to the angular impulse given to that object or rigid system.

6.4 Conservation of Angular Momentum 角动量守恒

- ☐☐☐ Describe the behavior of a system using conservation of angular momentum.
- ☐☐☐ Describe how the selection of a system determines whether the angular momentum of that system changes.

6.5 Rolling 滚动

- ☐☐☐ Describe the kinetic energy of a system that has translational and rotational motion.
- ☐☐☐ Describe the motion of a system that is rolling without slipping.
- ☐☐☐ Describe the motion of a system that is rolling while slipping.

6.6 Motion of Orbiting Satellites 轨道卫星的运动

☐☐☐ Describe the motions of a system consisting of two objects or systems interacting only via gravitational forces.

7. Oscillations

振动

7.1 Defining Simple Harmonic Motion (SHM) 简谐运动的定义

☐☐☐ Describe simple harmonic motion.

7.2 Frequency and Period of SHM 简谐运动的频率与周期

☐☐☐ Describe the frequency and period of an object exhibiting SHM.

7.3 Representing and Analyzing SHM 简谐运动的表示与分析

☐☐☐ Describe the displacement, velocity, and acceleration of an object exhibiting SHM.

7.4 Energy of Simple Harmonic Oscillators 简谐振子的能量

☐☐☐ Describe the mechanical energy of a system exhibiting SHM.

7.5 Simple and Physical Pendulums 单摆与物理摆

☐☐☐ Describe the properties of a physical pendulum.