1. Average velocity equals the algebraic mean of the initial and final velocities.
2. The radius of curvature of the trajectory of a particle is entirely determined by the *speed* and the *centripetal acceleration* of the particle.
3. In a simple pendulum the net force acting on the particle always points tangentially to the circular path of the particle.
4. For conservative forces the work done by the force around any closed loop is zero.
5. The direction of the force of kinetic friction is always opposite that of the acceleration.
6. Potential energy can have negative values.
7. Due to the Coriolis force, a bullet fired vertically from the Equator is deflected towards the west.
8. The Euler force is always zero when the object is not moving in a rotating coordinate system.
9. The kinetic energy of a system of particles is independent of the work done by internal forces.
10. The torque vector is perpendicular to the force vector.
11. The angular momentum of a body is constant if the vectorial sum of the forces acting on the body is zero.
12. If an ice-skater pulls his arms in close to his body, while performing a spin, his angular momentum will increase.
13. The amplitude of harmonic oscillations depends on the initial displacement and the initial velocity.
14. In damped oscillations the sum of the kinetic and potential energies is constant in time.
15. Forced oscillation: in case of resonance, the driving force and the body's velocity are in phase.
16. The wave function $Y(x,t) = 3\cdot\sin(-5t-6x)$ describes a wave propagating in the $(-x)$ direction.
17. When we pluck a string on a violin, we generate longitudinal waves in the string.
18. The Doppler effect has the same mathematical formula for sound and electromagnetic waves.
19. In an ideal gas, temperature is proportional to volume.
20. Temperature is an extensive state variable.
21. The efficiency of a Carnot-engine depends on the type of gas used.
22. A heat pump can expel much larger useful energy than the amount of invested work.
23. Heat never flows from a substance of low temperature to a substance of high temperature.
24. If a block of hot iron is placed into cold water, the entropy of the block of iron decreases.
25. Electric field lines originate on negative charges.
26. The flux of the electric field over a closed surface is proportional to the net charge enclosed by the surface.
27. Electric flux is a scalar quantity.
28. In electrostatics the charge density is constant on the surface of a metal.
29. In electrostatics the surface of a metal is an equipotential surface.
30. In electrostatics the electric potential is constant inside a sphere.

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1. A stone is thrown with an initial speed of 10m/s, at an angle of 30° with respect to the horizontal. Find the radius of curvature of at the initial point of its parabolic path.
(a) 6.4m (b) 8.2m (c) 11.5m (d) none

2. A particle is moving along a straight line with an acceleration of $a(t) = 10 - 3t$ [m/s^2]. At $t = 0$ the particle is at rest. Find the displacement of the particle during the first 2 seconds.
(a) 4.5m (b) 9m (c) 16m (d) none

3. The position vector of a particle is $\mathbf{r}(t) = 3t^3\mathbf{e_x} + 2t^2\mathbf{e_y} - 5t\mathbf{e_z}$ [m]. Find the magnitude of its velocity at t = 2s.
(a) 37.2m/s (b) 56.3m/s (c) 73.1m/s (d) none

4. A person is lifting a 2kg mass vertically with constant force. During a displacement of 2m, the work done by the person is 100J. Find the acceleration of the mass.
(a) 10m/s^2 (b) 15m/s^2 (c) 20m/s^2 (d) none

5. How long does it take the 50kW engine of a car to accelerate the vehicle from 54km/h to 90km/h on a horizontal road, neglecting air resistance? The mass of the car is 1000kg.
(a) 3s (b) 4s (c) 8s (d) none

6. A ball with mass 0.1kg falls from a height of 1.25m. After colliding with the ground it bounces back to a height of 0.8m. Find the average force exerted by the ground on the ball, if the collision lasted 0.1s.
(a) 10N (b) 17N (c) 23N (d) none

7. A mass of 1kg is attached to a 1m long string and is released from rest when the string is horizontal. Find the angle between the string and the vertical when the tension in the string is 20N.
(a) 42° (b) 48° (c) 60° (d) none

8. A particle of mass m at a latitude of 30°N is moving towards the North with a velocity v. Find the magnitude and direction of the Coriolis force acting on the particle.
(a) $2mv\omega$, West (b) $mv\omega$, North (c) $mv\omega$, East (d) none

9. A solid cylinder is rolling down a slope with an inclination angle of 30°. Find the acceleration of the center of mass of the cylinder.
(a) g/6 (b) g/3 (c) g/2 (d) none

10. Find the instantaneous power of the torque $\tau = 2\mathbf{e_x} + 7\mathbf{e_y} - 5\mathbf{e_z}$ at the angular velocity $\omega = 3\mathbf{e_x} - 4\mathbf{e_z}$.
(a) 9W (b) 26W (c) 33 W (d) none

11. Find the period of a 33.6cm long rod, if it is swaying around an axis that is at a distance of 8.4cm from the top end of the rod.
(a) 0.23s (b) 0.5s (c) 0.88s (d) none

12. A 0.1kg particle is attached to a spring having a spring constant of 2.5N/m. At t=0 the displacement of the particle is −0.15m and its velocity is 3m/s. Find the amplitude of the oscillation.
(a) 0.2m (b) 0.25m (c) 0.3m (d) none

13. Two particles, both having a mass of 1kg, are hung vertically on a spring having a spring constant of 500N/m. One of the particles is suddenly cut off from the spring. Find the amplitude of the oscillations of the second particle.
(a) 1cm (b) 2cm (c) 4cm (d) none

14. A 1kg particle is attached to a spring with a spring constant of 5N/m. The particle is submerged in a liquid. Find the period of oscillation if in every 3 periods the amplitude decreases by a factor of e^6.
(a) 2.95s (b) 3.76s (c) 7.68s (d) none

15. A sound wave having a frequency 1000Hz propagates with a speed of 330m/s. Find the phase difference between the oscillation of an air molecule 1m from the source at t = 2s, and another air molecule 10m from the source at t = 2.028s.
(a) 0.044 (b) 0.45 (c) 4.57 (d) none

16. A tube of length 30cm is closed at one end. Find the frequency of the 2nd harmonic that can be generated, if the speed of sound in air is 340m/s.
(a) 550Hz (b) 700Hz (c) 850Hz (d) none

17. Two waves having the same amplitude are added coherently. The resultant intensity is the same as the intensity of each component wave. Find the phase difference between the two component waves.
(a) 45° (b) 90° (c)120° (d) none

18. A vehicle which emits a sound of constant frequency passes an observer with a speed v. The ratio between the highest and lowest observed frequencies (corresponding to the approaching and receding vehicle, respectively) is 1.2. Find the speed of the vehicle. (The speed of sound in air is 330m/s.)
(a) 20m/s (b) 30m/s (c) 40m/s (d) none

19. The side of a cube is 80cm. When the temperature of the cube is raised from 20°C to 30°C, its volume increases by 307cm^3. Find the linear coefficient of thermal expansion.
(a) 10^{-6}/°C (b) 10^{-5}/°C (c) $2\cdot10^{-5}$/°C (d) none

20. There is 0.8kg hydrogen (M=2g) and 1.6kg oxygen (M=32g) in a 1000 liter balloon at 300K. Find the pressure of the gas mixture.
(a) 1123kPa (b) 846kPa (c) 324kPa (d) none

21. A work of 258J is applied to compress 2 moles of He gas adiabatically. Find the change in its temperature.
(a) 0°C (b) 10°C (c) 20°C (d) none

22. The pressure of 1 liter of O_2 gas (f = 5) is increased isovolumetrically from 100kPa to 300kPa. Find the increase in internal energy.
(a) 150J (b) 370J (c) 500J (d) none

23. A Carnot engine operates between two heat reservoirs, with temperatures of 300K and 400K, respectively. The engine absorbes a heat of 600J from the hot heat reservoir. Find the work done by the engine.
(a) 130J (b) 150J (c) 180J (d) none

24. A Carnot engine operates between two heat reservoirs, with temperatures of 0°C and 100°C, respectively. The engine does a work of 1000J in one cycle. Find the heat given up to the cold heat reservoir in one cycle.
(a) 2730J (b) 1350J (c) 870J (d) none

25. One mole of ideal gas undergoes isothermal expansion from a pressure of 10^4Pa to a pressure of 10Pa. Find the change in entropy.
(a) 57J/K (b) 606J/K (c) 723J/K (d) none

26. A system consists of 10 particles. Find the thermodynamic probability that belongs to the macrostate 0 2 1 0 2 5.
(a) 0.73 (b) 7560 (c) 12840 (d) none

27. An uncharged plastic sphere has a radius of 10cm. We place a point charge of –1mC at a distance of 1m from the center of the sphere. Find the total flux of the electric field over the surface of the plastic sphere.
(a) 1Vm (b) 0 (c) –2Vm (d) none

28. A charged particle of 16nC is placed to the North of point P, at a distance of 2m. Another charged particle, of –45nC, is placed to the East of P, at a distance of 3m. Find the electric field at point P.
(a) 58V/m (b) 16.4V/m (c) 8.8V/m (d) none

29. A long cylinder has a radius of 10cm. Find the surface charge density on the surface of the cylinder, if the electric field at a distance of 1m from the cylinder's axis is 10kV/m.
(a) 44.3nC/m^2 (b) 886nC/m^2 (c) 4.43μC/m^2 (d) none

30. A cube whose edges are 7cm long is uniformly charged with a volume charge density of 60nC/m^3. Calculate the flux of the electric field over *one side* of the cube.
(a) 1523Nm^2/C (b) 0.387Nm^2/C (c) 3.42Nm^2/C (d) none

31. Charge is distributed uniformly over the length of a circular metallic loop. The loop has a radius of 10cm. Find the charge on the loop, if the electric potential at the center of the loop is 900V relative to a point at infinity.
(a) 5nC (b) 10nC (c) 1mC (d) none

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1. Write Newton's laws.

2. What is the work-energy theorem? Derive the work-energy theorem in 1D using Newton's laws.

3. Derive the expressions for the 1st and 2nd cosmic speeds at the surface of Earth.

4. Describe the precessional motion of a gyroscope, and calculate its angular speed.

5. What are the effects of damping in an oscillatory motion?

6. Write the linear wave equation in 1D and show that it is satisfied by a sinusoidal plane wave.

7. Derive the formula for acoustic Doppler effect using a spacetime diagram.
theoretically?

8. Draw F(v) Maxwell-Boltzmann velocity distribution curves belonging to different temperature values. What is the physical meaning of F(v)? Draw the most probable speed, the average speed and the root-mean-square speed in the diagram.

9. What does the „equipartition of energy” say?

10. What is Dulong-Petit’s empirical law for the molar heat of solids and how can it be justified theoretically?

11. What is latent heat? What is its SI unit?

12. Write at least two forms of the 2nd law of thermodynamics.

13. Using Coulomb’s law, derive the expression for the electric field of a uniformly charged thin circular ring, along its symmetry axis at a distance d from its center. (The ring has a radius r.)

14. Using Gauss’s law, derive the expression for the electric field of a uniformly charged infinite straight line, at a distance d from the line.