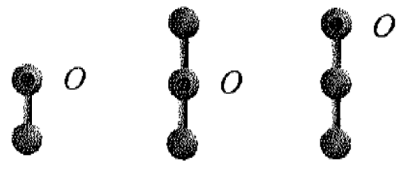
選擇題 (50 分)

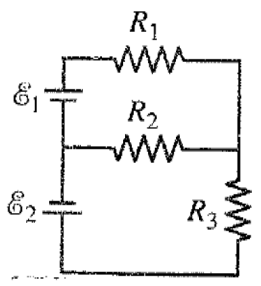
1. (5 points) A certain particle has a weight of 22 N at a point where the free-fall acceleration is 9.8 m/s^2. What is the weight of the particle where the free-fall acceleration is 4.9 m/s^2? (a) 5.5 N (b) 11 N (c) 22 N (d) 44 N (e) 88 N.
2. (5 points) A 5.0 g marble is fired vertically upward using a spring gun. The spring must be compressed 8.0 cm if the marble is to just reach a target 20 m above the marble's position on the compressed spring. What is the spring constant of the spring? (a) 0.31 N/cm (b) 0.62 N/cm (c) 3.1 N/cm (d) 5.0 N/cm (e) 7.2 N/cm.
3. (5 points) An automobile traveling 80.0 km/h has tires of 75.0 cm diameter. If the car is brought to stop uniformly in 30.0 turns of the tires (without skidding), what is the angular acceleration of the wheels? (a) -2.31 rad/s^2 (b) -3.31 rad/s^2 (c) -5.31 rad/s^2 (d) -7.31 rad/s^2 (e) -9.31 rad/s^2.
4. (5 points) A body of radius R and mass m is rolling smoothly with velocity v on a horizontal surface. It then rolls up a hill to a maximum height $h = 3v^2/4g$, where g is the gravitational acceleration. What is the body's rotational inertia about the rotational axis through its center of mass? (a) $2mR^2$ (b) mR^2 (c) $mR^2/2$ (d) $mR^2/3$ (e) $mR^2/4$.
5. (5 points) The following figure shows three physical pendulums consisting of identical uniform spheres of the same mass that are rigidly connected by identical rods of negligible mass. Each pendulum is vertical and can pivot about suspension point O. Rank the pendulums according to the period of oscillation, **greatest first**.
(a) (*1*) (*3*) (*2*) (b) (*2*) (*3*) (*1*) (c) (*3*) (*2*) (*1*) (d) (*1*) (*2*) (*3*) (e) (*2*) (*1*) (*3*).



6. (5 points) A circular loop (radius = 0.50 m) carries a current of 3.0 A and has unit normal vector of $(2\mathbf{i} - \mathbf{j} + 2\mathbf{k})/3$. What is the x component of the torque on this loop when it is placed in a uniform magnetic field of $(2\mathbf{i} - 6\mathbf{j})$T? (a) 4.7 N · m (b) 3.1 N · m (c) 19 N · m (d) 9.4 N · m (e) 12 N · m.

7. (5 points) A parallel plate capacitor of capacitance C_0 has plates of area A with separation d between them. When it is connected to a battery of voltage V_0, it has charge of magnitude Q_0 on its plates. The plates are pulled apart to a separation $2d$ while the capacitor remains connected to the battery. After the plates are $2d$ apart, the magnitude of the charge on the plates and the potential difference between them are (a) $\frac{1}{2}Q_0$, $\frac{1}{2}V_0$ (b) $\frac{1}{2}Q_0$, V_0 (c) Q_0, V_0 (d) $2Q_0$, V_0 (e) $2Q_0$, $2V_0$.

8. (5 points) What is the magnitude of the current in the 20-Ω resistor? $\varepsilon_1 = 10$V, $\varepsilon_2 = 15$V, $R_1 = 10\Omega$, $R_2 = 20\Omega$ and $R_3 = 10\Omega$.



(a) 0.75 A (b) 0.00 A (c) 0.25 A (d) 0.50 A (e) 1.00 A.

9. (5 points) A 60-Hz ac generator with a peak voltage of 110 V drives a series RC circuit with $R = 10.0\Omega$ and C = 300 μF. The impedance is (a) 4.68 Ω (b) 8.84 Ω (c) 10.0 Ω (d) 13.4 Ω (e) 18.8 Ω.

10. (5 points) A charge of 20 nC is distributed uniformly along the y axis from $y = 0$ to $y = 4$ m. Which of the following integrals is correct for the electric potential (relative to zero at infinity) at the point $x = +3$ m on the x axis? (a) $\int_0^4 \frac{45dy}{(y^2+9)^{1/2}}$ (b) $\int_0^4 \frac{180dy}{(y^2+9)^{1/2}}$ (c) $\int_0^4 \frac{45dy}{y^2+9}$ (d) $\int_0^4 \frac{180dy}{y^2+9}$ (e) $\int_0^4 \frac{45dy}{(y^2+9)^{3/2}}$.

計算與簡答題 (50分)

1. (10 points) An object undergoing simple harmonic motion takes 0.25 s travel from one point of zero velocity to the next such point. The distance between those points is 36 cm. Calculate (a) the period, and (b) the amplitude of the motion.

2. (15 points) One mole of a monatomic ideal gas initially at a volume of 10 L and a temperature of 300 K is heated at constant volume to a temperature of 600 K, allowed to expand isothermally to its initial pressure, and finally compressed at a constant pressure to its original volume, pressure, and temperature. (a) During the cycle, how much heat enters the system (the gas)? (b) What is the net work done by the gas?

3. (10 points) What is the energy dissipated as a function of time in a circular loop of 10 turns of wire having a radius of 10.0 cm and a resistance of $2.0\,\Omega$ if the plane of the loop is perpendicular to a magnetic field given by

$$\mathbf{B(t) = B_0 e^{2t/\tau}}$$

with $B_0 = 1.00$ T and $\tau = 0.10$ s ?

4. (15 points) A very large thin plane has uniform surface charge density σ. Touching it on the right, as shown in the following figure, is a long wide slab of thickness d with uniform volume charge density ρ_E. Determine the electric field (a) to the left of the plane, (b) to the right of the slab, and (c) everywhere inside the slab.