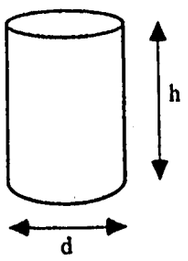
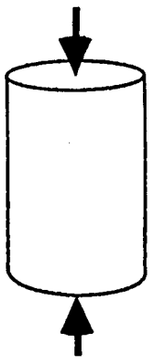
**** Show all steps if there are calculations. ****
**** If equations are used in the answers, clearly define all parameters in them. ****

1. **(5%)** The height of a right circular bar is measured as h = 5.00 ± 0.01 cm, and the diameter d = 2.00 ± 0.01 cm. The bar weights w = 100 ± 2 g. What is the density of the bar and how accurately is it known?



2. **(18%)** Use the example of bicycle riding to explain the followings in detail
   (a) Newton's first law of motion
   (b) Newton's second law of motion
   (c) Newton's third law of motion
   (d) Newton's universal law of gravity
   (e) the forces of friction
   (f) the law of conservation of energy

3. **(10%)** A rock of cylindrical shape is 4.0000 cm in diameter and 8.0000 cm long. When a load of 10000 kg (compression) is applied along the cylindrical axis, the diameter becomes 4.0005 cm and the length becomes 7.9950 cm. Calculate
   (a) compressive stress (in Pascal),
   (b) compressive strain,
   (c) elastic modulus (Young's modulus, in Pascal),
   (d) Poisson's ratio.
   When the load is 15000 kg in compression, what would be
   (e) the diameter and the length of the rock.



4. (10%) When a spring is stretched by a force of 200 g, it elongates 20 cm. A mass of 400 g is attached to this spring and oscillates on a horizontal, frictionless surface with an amplitude of 4 cm.
   (a) Find the period of the motion.
   (b) Determine the maximum speed and the maximum acceleration of the mass
   (c) Calculate the total energy of the system.
   (d) What is the velocity of the mass when the displacement is 3 cm.
   (e) Calculate the kinetic energy and the potential energy of the system when the displacement is 3 cm.

5. (30%) Define and/or describe the followings.
   (a) a volt
   (b) an electron volt
   (c) capacitance
   (d) dielectric constant
   (e) electric current
   (f) Ohm's law
   (g) resistivity
   (h) electric power
   (i) Kirchhoff's rules
   (j) magnetic field and magnetic force

6. (15%) Define and/or describe the followings.
   (a) Snell's law of refraction
   (b) index of refraction
   (c) constructive and destructive interference of light waves
   (d) diffraction of light
   (e) polarization of light

7. (12%) Define and/or describe the followings.
   (a) photoelectric effect
   (b) Heisenberg's uncertainty principle
   (c) the four quantum numbers
   (d) Pauli's exclusion principle