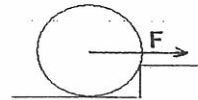


I. 填充題 (作答填寫在答案紙指定格子內，每格 5%)※ 本大題請於答案卷內之「非選擇題作答區」標明格號依序作答。

- A ball is thrown horizontally from the height of 20 m and hits the ground with a speed that is three times its initial speed. The initial speed of the ball is (1) m/s.
- A 1000 kg boat is traveling at 60 km/h when its engine is shut off. The magnitude of the frictional force f_k between the boat and water is proportional to the speed v of the boat: $f_k = 70v$, where v is in meters per second and f_k is in newtons. The time required for the boat to slow down to 30 km/h is (2) seconds.
- A 4.0 kg bundle starts up a 30° incline with 128 J of kinetic energy. How far will it slide up the incline if the coefficient of kinetic friction between the bundle and the incline is 0.30? (3) m.
- A block of mass $m_1 = 1.60$ kg is moving to the right with a speed of 4.00 m/s on a frictionless horizontal track, collides with a mass-less spring attached to a second block of mass $m_2 = 2.10$ kg, moving to the left with a speed of 2.50 m/s on the same track. Determine the maximum distance by which the spring is compressed during the collision. (4) m. (The spring has a spring constant of 600 N/m)
- A uniform ball, of mass $M = 5.00$ kg and radius R , rolls smoothly from rest down a ramp at angle $\theta = 30.0^\circ$. The ball descends a vertical height $h = 1.20$ m to reach the bottom of the ramp. The speed of the ball at the bottom is (5) m/s.
- One mole of the monotonic gas argon expand isothermally at 300 K, from an initial volume of $V_i = 0.030$ m³ to a final volume of $V_f = 0.060$ m³. Assuming that argon is an ideal gas, find (a) the work done by the gas: (6) J and (b) entropy change $\Delta S =$ (7) J/K of the system during the expansion.
- You are trying to raise a bicycle wheel of mass m and radius R up over a curb of height h . To do this, you apply a horizontal force F . What is the smallest magnitude of the force F that will succeed in raising the wheel onto the curb when the force is applied to the center of the wheel. (8)



- What are the electric fields of an isolated sphere of radius R , with uniform volume charge density ρ , at a point outside the sphere? (9)
- An air-filled parallel plate capacitor is connected to a battery of voltage V_o . There is charge Q_o on each plate, energy U_o stored between the plates and an electric field of E_o between the plates. The capacitor remains connected to the battery and a dielectric material with a dielectric constant of K is then placed between the plates of the capacitor. What are the new values of V , Q , U , and E ? (10)
- A solid cylindrical conductor of radius a and charge Q is coaxial with a cylindrical shell of radius b ($b > a$) and charge $-Q$. Find the capacitance of this cylindrical capacitor if its length is L . (11)
- In a coaxial cable, the solid inner conductor carries a current of I . The shield, which also carries a current of I but in the opposite direction, has an inner radius of a and an outer radius of b . The current density is equally distributed over each conductor. What is the magnitude of B if $a = 1$ mm, $b = 1.1$ mm, $r = 1.05$ mm, and $I = 10$ mA? (12)
- In an RLC series circuits, $v_R(t)$, $v_L(t)$ are the potential difference across a resistor an inductor. What are the relation of $v_R(t)$ with $i(t)$ and $v_L(t)$ with $i(t)$. (13) (Hint: in phase; leads by 90° ; lags by 90°)
- Two slits, separated by $d = 0.45$ mm, are illuminated with light of wavelength 560 nm. The pattern is viewed on a screen 2.5 m from the slits. What is the intensity at a point 2 mm from the central bright fringe? (Assume that I_0 is the intensity be produced by a single slit.) (14)
- X-rays (wavelength of 1.0 nm) are scattered from two small tumors in human body. If the two tumors are a distance of 5.0 cm away from the x-ray detector, and the detector has an aperture of 0.5 mm. What is minimum separation between two tumors that allow x-ray detector to tell from that there are two tumors instead of one? (15)
- Briefly describe the physical significance of Frank-Hertz Experiments. (16)

II. 計算與問答題 (作答書寫在答案紙上；必須詳述而非簡答)

- What are: (a) the Carnot cycle and the efficient of a Carnot engine, and (b) the Bernoulli's equation. (10%)
- (a) Write down Maxwell equations of Electromagnetic theorem and describe their physical significance. (b) According to Quantum Mechanics, draw the atomic structure of a neutral atom with five electrons. (10%)