

國立中山大學九十二學年度轉學生招生考試試題

科目：微積分【物理系二年級、電機系二年級、海工系二年級】

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Full marks are 100; the marks are indicated within questions.

I. (15) Give the definition of the indefinite integral, and describe the relation between it and the definite integral (i.e., the fundamental theorem of Calculus).

II. (15) Find the limit

$$\lim_{x \rightarrow \infty} (\sqrt{x + \sqrt{x}} - \sqrt{x}).$$

III. (15) Let the function

$$f(x) = \frac{(1+x)(2+x) \cdots (9+x)}{(1-x)(2-x) \cdots (9-x)}.$$

Find the derivative $f'(0)$.

IV. (15) Find the limit

$$\lim_{h \rightarrow 0} \frac{1}{h} \int_x^{x+h} \frac{du}{u + \sqrt{u^2 + 1}}.$$

V. (20) Let S be the closed domain by rotating two curves: $y = x^2$ and $y = 2 - x^2$. Find the volume of S .

VI. (20) Prove that the functions $r^n \cos n\theta$ and $r^n \sin n\theta$ satisfy the Laplace equation,

$$\Delta u = \frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0,$$

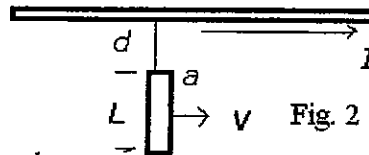
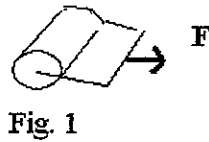
where (r, θ) are the polar coordinates, $x = r \cos \theta$ and $y = r \sin \theta$.

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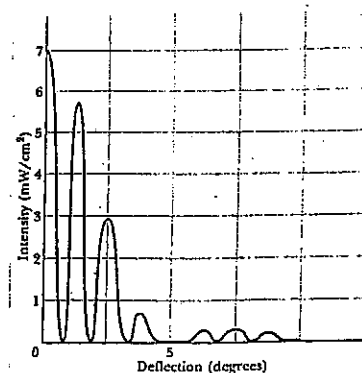
科目：普通物理【物理系二年級、電機系二年級】

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1. A cylindrically symmetric object with rotational inertial $I = kMR^2$ is pulled by a yoke connected to its axle as shown in Fig.1. Find the acceleration of the object. (12%)

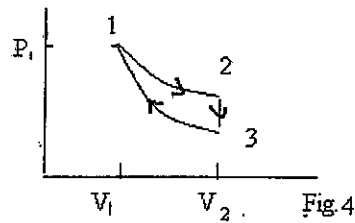


2. A 30.0 kg projectile is fired at an angle of 60.0 degree above the horizontal and with a velocity of magnitude 200m/s. At the highest point of its trajectory the projectile explodes into two fragments with equal mass, one of which falls vertically with 1.0m/s speed. How far from the point of firing does the other fragment strike the ground? (12%)
3. A 3.0g bullet is fired horizontally to two blocks on a frictionless table. The bullet penetrates the first 1.5kg block and leaves with speed 0.6m/s. And then it strikes the second 2.1kg block and stays in the block. The final speed of the second block is 1.3m/s. Find the initial speed of the bullet. (13%)
4. The long, straight wire in Fig.2 carries constant current I . A metal rod with length L is moving at constant velocity V . Point a is a distance d from the wire. Find the *emf* induced in the rod. (12%)
5. Light of wavelength 440 nm passes through a double slit, yielding a diffraction pattern whose graph of intensity I versus deflection angle θ is shown Fig.3. Calculate a) the slit width and b) the slit separation. (12%)



6. In an LR circuit, the current rises to 40% of its final value in 40ms. a) How long does it take to reach 80% of the final value? b) If $R = 12$ ohms, what is L . (12%)

7. One mole of mono-atomic ideal gas under the processes in Fig.4 where $V_2 = 3.0V_1$ and 1- \rightarrow 2 isothermal, 2- \rightarrow 3 constant volume, and 3- \rightarrow 1 adiabatic. Find
 a) $P_2, P_3,$ and T_3 b) $W, Q,$ and ΔS in three processes respectively. All quantities are written in terms of $P_1, V_1,$ and gas constant R . (15%)



8. What is the probability of finding a particle in a one-dimensional box of length L in the region between $x = L/4$ and $x = 3L/4$ when the particle is in the first excited state? (12%)