

國立交通大學 107 學年度碩士班考試入學招生試題

科目：普通物理(6062)

考試日期：107年2月1日 第2節

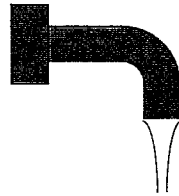
系所班別：教育研究所 組別：教育所丙A組

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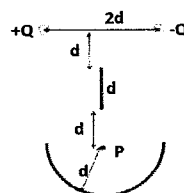
【不可使用計算機】\*作答前請先核對試題、答案卷(試卷)與准考證之所組別與考科是否相符!!

- (1) (Total 10%) A rope with non-negligible mass is suspended vertically. Assuming that transverse pulses generated at the free end of the rope satisfy the linear wave equation, does the wave speed of the pulses increase, decrease, or stay the same as they propagate upward along the rope? (5%) Please explain your answers. (5%)

- (2) (Total 6%) A water stream gets narrower after it comes out of a faucet as shown below. Please explain why.



- (3) (Total 10%) Suppose you have two engines with efficiencies  $e_1$  and  $e_2$  and you let them run in series. What is the overall efficiency?
- (4) (Total 12%) Suppose a loop of flexible rope with total weight  $W$  is resting on a smooth circular cone with base radius  $R$  and height  $H$ . Determine the tension in the rope.
- (5) (Total 12%) (a) Please find moment of inertia for a uniform solid sphere with mass  $M$  and radius  $R$  with respect to its central axis. (6%) (b) Please find moment of inertia for a hollow thin uniform spherical shell with mass  $M$  and radius  $R$  with respect to its central axis. (6%)
- (6) (Total 16%) A smiling face is composed of 2 charge points, a line of metallic wire and a half circle metallic line. Please calculate the total electric field at the point P by following the 3 steps. (a) E field of P from the 2 charges. (2%) (b) E field of P from the straight line. (5%) (c) E field of P from the half circle. (6%) (d) Total E field of P. (3%)



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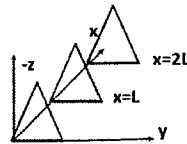
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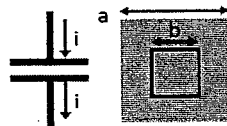
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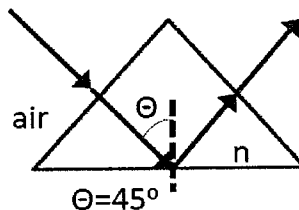
- (7) (Total 12%) A non-uniform magnetic field is expressed as  $B(x)=ax$  (Tesla) along the x-axis. Three loops of triangle (with equal edges of  $b$ ) are placed in the field at  $x=0$ ,  $x=L$ ,  $x=2L$  meters with current flowing clockwise. (a) Please calculate the total magnetic flux of the loops due to  $B(x)$ . (4%) (b) If there are  $(N+1)$  turns of same triangle loops per meter in a triangular solenoid, please calculate the total magnetic flux in the solenoid with a total length of  $2L$  meter. (5%) (c) What is the Emf in the system. (3%)



- (8) (Total 12%) Below, the left figure is from side view and the right figure is from top view of a capacitor. (a) If a current  $i=4$  A charges the square capacitor here, what is the displacement current? (2%) (b) What is the  $dE/dt$  in the square region of length  $a=2$  meter. (3%) (c) What is the displacement current in the inner square region of length  $b=1$  meter? (2%) (d) Please draw the B field direction at a distance  $d$  away from square center (current  $i$  going into page). (2%) (e) What is the  $\oint \vec{B} \cdot d\vec{s}$  around the inner square? (3%) Please provide numerical answers if applicable. Permittivity  $\epsilon_0=8.85 \times 10^{-12}$  (C<sup>2</sup>/N/m<sup>2</sup>), permeability  $\mu_0= 1.3 \times 10^{-6}$  (T · m/A)



- (9) (Total 4%) In the following figure, the normal incident light enters the prism, and it has a total internal reflection so that it exits the prism at the right angle from the other side. What is the condition for the refractive index  $n$  in this prism?



- (10) (Total 6%) Please sketch the incident, reflected and refracted beam at the Brewster's angle  $\theta_B$  in detail and calculate this angle for an air/medium interface where the refractive index of the medium is 1.5.