

國立中正大學九十八學年度學士班二年級轉學生招生考試試題

學系別：數學系、地球與環境科學系、物理學系、  
機械工程學系、化學工程學系

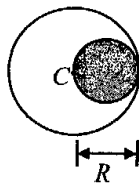
科目：普通物理

第 2 節

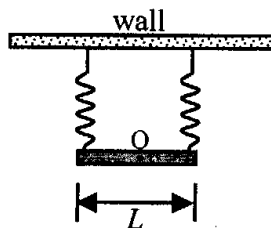
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Multiple Choice (60 points)

1. (5 points) A ball is thrown straight down, from an unknown height and hits the floor with a speed that is 5 m/s greater than its release speed. How long does it take to hit the ground? (a) 0.51 sec (b) 0.71 sec (c) 1 sec (d) 1.1 sec (e) 1.21 sec.
2. (5 points) A flywheel requires 3 sec to rotate through 234 radian. Its angular velocity at the end of this time is 108 rad/sec. Find its constant angular acceleration (in rad/sec<sup>2</sup>). (a) 45 (b) 20 (c) 10 (d) -10 (e) -20.
3. (5 points) A uniform disc of radius  $R$  has a hole of diameter  $R$  cut out as shown. The resulting object has a mass  $M$ . Calculate its moment of inertia about a perpendicular axis through the disc center  $C$ . (a)  $(1/8)MR^2$  (b)  $(3/16)MR^2$  (c)  $(1/4)MR^2$  (d)  $(13/24)MR^2$  (e)  $(1/2)MR^2$ .



4. (5 points) If a satellite in an elliptical orbit about the earth has a perigee distance (closest distance of approach) of 300 km above the surface of the earth, an apogee distance (farthest distance from the earth) of 2000 km above the surface of the earth, then what is the ratio of the orbital speed at perigee to that at apogee. Assume the earth radius is 6400 km. (a) 1.11 (b) 1.25 (c) 1.49 (d) 2.03 (e) 3.15.
5. (5 points) A long thin uniform rod of length  $L$  and mass  $m$  is free to rotate in a horizontal plane about a fixed vertical axis through its center  $O$ . Two identical springs with force constant  $k$  are connected horizontally between the ends of the rod and a fixed wall (see diagram). What is the period of small oscillations when the rod is pushed slightly to one side and released? (a)  $T=2\pi(2m/3k)^{1/2}$  (b)  $T=2\pi(3k/m)^{1/2}$  (c)  $T=2\pi(m/6k)^{1/2}$  (d)  $T=2\pi(4k/3m)^{1/2}$  (e)  $T=2\pi(m/4k)^{1/2}$



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6. (5 points) The maximum theoretical efficiency of a heat engine operating between reservoirs at the steam point and at room temperature is about: (a) 10% (b) 20% (c) 50% (d) 80% (e) 99%.
7. (5 points) A uniform linear charge of 2.0 nC/m is distributed along the  $x$  axis from  $x = 0$  to  $x = 3$  m. Which of the following integrals is correct for the  $y$  component of the electric field at  $y = 4$  m on the  $y$  axis?
- a.  $\int_0^3 \frac{72dx}{(16+x^2)^{3/2}}$
  - b.  $\int_0^3 \frac{18dx}{(16+x^2)^{3/2}}$
  - c.  $\int_0^3 \frac{72dx}{16+x^2}$
  - d.  $\int_3^0 \frac{18dx}{16+x^2}$
  - e. none of these
8. (5 points) Two large parallel conducting plates are 8.0 cm apart and carry equal but opposite charges on their facing surfaces. The magnitude of the surface charge density on either of the facing surfaces is  $2.0 \text{ nC/m}^2$ . Determine the magnitude of the electric potential difference between the plates.
- a. 36 V
  - b. 27 V
  - c. 18 V
  - d. 45 V
  - e. 16 V
9. (5 points) When a capacitor is fully charged, the current through the capacitor is
- a. zero.
  - b. at its maximum value.
  - c. equal to the current in a resistive circuit in parallel with the capacitor circuit.
  - d. greater than the current in a resistor that is farther from the battery than the capacitor.
  - e. zero if it is the only capacitor, but maximum if there is another capacitor in series with it.

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10. (5 points) A rectangular wire loop (length = 60 cm, width = 40 cm) lies completely within a perpendicular and uniform magnetic field of magnitude of 0.5 T. If the length of the loop starts increasing at a rate of 20 mm/s at time  $t = 0$ , while the width is decreasing at the same rate, what is the magnitude of the induced emf at time  $t = 4.0$  s?
- a. 6.8 mV
  - b. 5.2 mV
  - c. 3.6 mV
  - d. 8.4 mV
  - e. 10 mV
11. (5 points) If the maximum  $E$ -component of an electromagnetic wave is 600 V/m, what is the maximum  $B$ -component?
- a. 1.4 T
  - b.  $1.8 \times 10^{-5}$  T
  - c.  $2.0 \times 10^{-6}$  T
  - d.  $1.0 \times 10^{-3}$  T
  - e.  $1.6 \times 10^{-10}$  T
12. (5 points) Light is incident on a double-slit. The fourth bright band has an angular distance of  $7.0^\circ$  from the central maximum. What is the distance between the slits (in  $\mu\text{m}$ )? (Assume the frequency of the light is  $5.4 \times 10^{14}$  Hz.)
- a. 27
  - b. 21
  - c. 24
  - d. 18
  - e. 14

**Problems (40 points)**

1. (10 points)  $n$  moles of an ideal gas are initially at a pressure  $P_i$ . The gas is compressed isothermally at an absolute temperature  $T$  to a pressure  $P_f$ . Find the work done by the gas.
2. (10 points) A turntable of mass 2 kg and radius 15 cm rotates freely at 2 rad/s. A ball of putty of mass 500 g lands 10 cm from the center and is stuck on the turntable.  
(a) What is the new angular speed? (b) What is the change in kinetic energy? You can treat the turntable as a disk.
3. (10 points) Consider a long cylindrical charge distribution of radius  $R$  with a uniform charge density  $\rho$ . Find the electric field at distance  $r$  from the axis where  $r < R$ .
4. (10 points) Consider the current-carrying loop shown in the following figure, formed of radial lines and segments of circles whose centers are at point  $P$ . Find the magnitude and direction of  $\mathbf{B}$  at  $P$ .

