Physics 1BA3 **Test #1** **1 hour**
Feb 2003

Name:
Section:
Number:

This paper consists of 5 questions. Show your work for each question in the space provided (it will be marked). Circle the correct answer and transfer your choice to the last page.

gravitational field at earth's surface	$g = 9.81\ m/s^2$
speed of light in vacuum	$c = 3.00 \times 10^8\ m/s$
Planck's constant	$h = 6.63 \times 10^{-34}\ J\text{-}s$
charge of electron	$-e = -1.602 \times 10^{-19}\ C$
mass of the electron	$m_e = 9.109 \times 10^{-31}\ kg$
mass of the hydrogen atom	$m_H = 1.67353 \times 10^{-27}\ kg$
mass of the neutron	$m_n = 1.67492 \times 10^{-27}\ kg$
Coulomb's law constant	$k_e = [4\pi\varepsilon_0]^{-1} = 9 \times 10^9\ Nm^2/C^2$
Bohr radius	$a_0 = 0.0529\ nm$
$\int \sin(ax)\,dx = -(\cos(ax))/a$	$amu = 931.494013\ MeV/c^2$
$\int \sin^2(ax)\,dx = x/2 - (\sin(2ax))/(4a)$	
$\int \cos^2(ax)\,dx = x/2 + (\sin(2ax))/(4a)$	

Moment of inertia of a long thin uniform stick about its middle = $M L^2 / 12$
Moment of inertia of a disk about its axis = $M R^2 / 2$
Moment of inertia of a ring about its axis = $M R^2$

$\mathbf{I} = \mathbf{I}_{cm} + \mathbf{m}\,\mathbf{d}^2$
$\mathbf{I} = \int \mathbf{r}^2\,\mathbf{dm}$
$(m_e c)$
$V = k_e\, q / r$
$r_n = n^2\, a_0$
$\mathbf{F} = k_e\, q_1 q_2 / r^2$
$\mathbf{F} = q\,\mathbf{v} \times \mathbf{B}$
$\mathbf{F} = q\,\mathbf{E}$
$\mathbf{F} = m\,\mathbf{a}$ $\quad E = h f$
$L = I\,\omega$
$\tau = I\,\alpha$
$N = N_0\, e^{-\lambda t}$

$\Delta x\, \Delta p_x >= h / 4\pi$
$\lambda' - \lambda_0 = h\,(1 - \cos\theta)\,/$

$E_n = -13.6 / n^2\ eV$
$E_n = n^2\, h^2 / (8\, m\, L^2)$

$\lambda = h / p$
$c = f\,\lambda$

$hf = \Phi + K_e^{max}$
$E_b = (Z\, m_H + N\, m_n - M_A)\, c^2$
$\lambda\, T_{1/2} = 0.693$

1. A mass m is attached to a string and rotates in a vertical circle of radius R. In this particular case when the mass is at the top of the circle the tension in the string is 3mg. What is the speed of the mass?

a) $\sqrt{2gR}$

b) $\sqrt{gR}$

c) $\sqrt{3gR}$

(d) $2\sqrt{gR}$

e) None of the above

2. A disk is initially at rest. It begins to rotate with an angular acceleration given by $(0.6 \pi t + \pi)$ rad / s^2 where t is the time in seconds. Integrate twice to obtain the angle that the disk has rotated through after 2 seconds.

a) 1.6π radians
b) 2.8π radians
c) 3.2π radians
d) 4.4π radians
e) none of the above

3. Three charges Q, Q and 2Q are placed on the points of an equilateral triangle with side L. Find the magnitude of the total electric force on the charge 2Q.

a) $2k_e Q^2 / L^2$

b) $2\sqrt{3}\, k_e Q^2 / L^2$

c) $3\sqrt{3}\, k_e Q^2 / L^2$

d) $k_e Q^2 / L^2$

e) none of the above

4. Suppose a rod of length L_1 , with constant linear mass density, λ kg / m, has a thin massless stick L_2 long joined on its end as shown in the figure. Calculate the moment of inertia for rotation about the origin (the left hand end). (To do this you might choose a small typical part of the rod with length dx and mass λ dx, find its contribution to the moment of inertia and integrate.)

a) $1/3\ \lambda\ L_1^3$

b) $1/3\ \lambda\ (L_1^3 + L_2^3)$

c) $1/3\ \lambda\ L_1\ (L_1^2 + 3\ L_1\ L_2 + 3\ L_2^2)$

d) $1/3\ \lambda\ L_1^2$

e) something else

5. A disk and a ring both with radius R and mass M.
Suppose the ring is rotating about a vertical axis and the disk which is not rotating is gently placed on top of it. Consider what will be conserved when this happens. Find the ratio of the final kinetic energy to the initial kinetic energy.

a) 0.5 times bigger than before
b) 1.5 times smaller than before
c) 3.5 times smaller than before
d) unchanged
e) none of the above

Transfer your answers here

1.	a)	b)	c)	d)	e)
2.	a)	b)	c)	d)	e)
3.	a)	b)	c)	d)	e)
4.	a)	b)	c)	d)	e)
5.	a)	b)	c)	d)	e)