PHYSICS 149 TEST 2 11 November, 2003

This 12-question test is worth 100 points, each question is weighted equally (~8.33 points). Please fill out the answer sheet with soft lead pencil. Be sure to give your name, student ID # [THIS IS STILL YOUR SS#], date, Course #, Test 2, and SIGN the answer sheet. Be prepared to present your Student picture ID card when handing in your answer sheet. You may keep the sheets with the questions and your work.

Pick the nearest value for your answer (there may be slight round off errors).

Don't get hung up too long over any one question until you have tried all of them.

You are expected to bring your own sheet of equations and words explaining the equations. Here are a few possibly useful equations. You will need to know when they are valid and when they are not.

$g = 9.8\ m/s^2$ $G = 6.67 \times 10^{-11} Nm^2/kg^2$ $F_G = GMm/r^2$ $g = G M_E/r_E^2$

The Earth's mass and radius are $M_E = 5.98 \times 10^{24}$ kg and $r_E = 6.38 \times 10^6$, respectively

$v = v_o + a t$ for each vector component of **v** and **a**

$x = x_o + v_o t + \frac{1}{2} a t^2$ and ditto for y and z components

$v_x^2 - v_{ox}^2 = 2a(x - x_o)$ etc. average $v_x = \Delta x/\Delta t$ etc.

$x = x_o + \frac{1}{2}(v_o + v)t$ etc. average $\mathbf{a} = \Delta v/\Delta t$ and etc. for each component

$x = r\cos(\theta)$ $y = r\sin(\theta)$ $\tan(\theta) = y/x$

$F = ma$ F of A on B = -F of B on A $f_k = \mu_k N$ $f_s^{MAX} = \mu_s N$

$a_c = \omega^2 r = \omega v = v^2/r$ $f = 1/T$ $\omega = 2\pi f = 2\pi/T = v/r$ = angular frequency

$v = 2\pi r/T$

1.) What is the gravitational force between two asteroids each of which have masses of 40 MegaTons and whose centers of mass are separated from each other by 375m? [Note, one metric Ton is 10^3 kg.]

a .) 759 kN
b.) 144 kN
c.) 108 kN
d.) 296 kN
e.) 485 kN

2.) These two asteroids are moved 4 times closer together. Their mutual gravitational attraction changes by what factor?

a.) increase, x 4

b.) increase, x 16

c.) decrease, x 64

d.) decrease, x 1/4

e.) decrease, x 1/16

3.) You pull a 45 kg suitcase along a level floor by pulling on its "leash" with a force of 190 N directed 40° upwards (relative to horizontal.) What is the normal force N, of the floor on the box?

a.) 196 N

b.) 200 N

c.) 286 N

d.) 319 N

e.) 506 N

4.) You later pull the same suitcase, which is at rest, directly sideways [purely horizontally] with the same force. What is the smallest coefficent of static friction, μ_s, so that the box will not slip?

a.) 0.92

b.) 0.58

c.) 0.43

d.) 1.27

e.) 1.85

5.) Same suitcase, same horizontal pull on the leash, but the suitcase is moving. It slides with kinetic coefficient of friction $\mu_k = 0.25$. What is the box's acceleration?

a.) 1.27 m/s^2

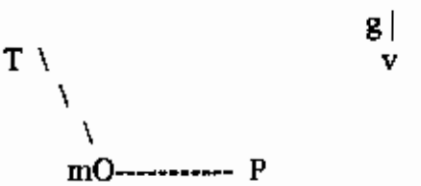
b.) 1.77 m/s^2

c.) 2.92 m/s^2

d.) 6.55 m/s^2

e.) 8.90 m/s^2

6.) A mass m = 45 kg is suspended in static equilibrium from two ropes. One rope pulls directly sideways (horizontally) with tension P. The other rope has a tension T on the opposite side and directed upwards at an angle 45° from the horizontal. What is the tension T, in Newtons?



a.) 624 N

b.) 783 N

c.) 1203 N

d.) 1537 N

e.) 1822 N

7.) A 45 kg mass on a frictionless 45° inclined plane is attached to a 45 kg hanging mass by a string passing over a frictionless pulley. What is the magnitude of the acceleration of either (or both) masses, in terms of g, the acceleration of gravity? [the word processor doesn't let me line up the 45° string properly – assume it is parallel to the ramp!]

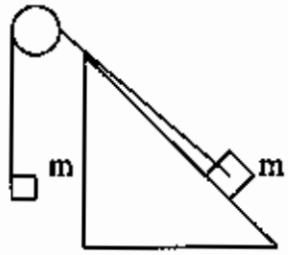
a.) 1.032 x g

b.) 0.927 x g

c.) 0.673 x g

d.) 0.504 x g

e) 0.146 x g



8.) A cat on a merry go round which is turning at an angular speed of 0.5 rad/s will slip off if it experiences more than 0.3 gees of horizontal acceleration (i.e. 0.3 times g). What is the farthest that the cat can stand from the axis of rotation?

a.) 3.6 m
b.) 5.0 m
c.) 11.8 m
d.) 14.3 m
e.) 9.8 m

9.) What is the coefficient of static friction between the cat and the merry go round? (the coefficient is assumed to be independent of where the cat stands) ? μ_s = ?

a.) 0.18
b.) 0.27
c.) 0.30
d.) 0.49
e.) 0.63

10.) At what angle must a circular track with radius 35 m be banked so that a bicycle going 7 m/s will not slip (up OR down) even if there is zero static friction?

a.) 8°
b.) 19°
c.) 28°
d.) 33°
e.) 45°

11.) A 2 kg hockey puck slides (without friction) inside a vertical-loop circular track of radius = 1.5m. At the bottom its speed is 6 m/s. When the puck is at the bottom, what is the normal force of the track on it? [Hint: what two forces contribute, (and in what directions) to the required centripetal force on the puck at the bottom of the track?]

a.) 9 N

b.) 22 N

c.) 45 N

d.) 68 N

e.) 89 N

12.) What is the orbital period , T, of an astronaut orbiting in a circle of radius 150 m around a space ship whose mass is 10 Metric Tons? [Note: use 1 year $\cong \pi \times 10^7$ s.]

a) 0.45 yr (years)

b) 0.82 yr

c) 1.13 yr

d) 1.52 yr

e) 2.13 yr