PHYSICS 149 TEST 2 7 November, 2001

This 15-question test is worth 100 points, each question is weighted equally. Please fill out the answer sheet with soft lead pencil. Be sure to give your name, student ID #, 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 roundoff 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

$v = v_0 + a t$ for each vector component of $v$ and $a$

$x = x_0 + v_0 t + \frac{1}{2} a t^2$ and ditto for y and z components

$v_x^2 - v_{0x}^2 = 2a(x - x_0)$ etc. average $v_x = \Delta x/\Delta t$ etc.

$x = x_0 + \frac{1}{2}(v_0 + v)t$ etc. average $a = \Delta v/\Delta t$ 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 $f_k = \mu_k N$ $f_s^{MAX} = \mu_s N$

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

$v = 2\pi r/T$

1. A block sliding with a speed of 60 m/s on a level floor with kinetic coefficient of friction $\mu_k = 0.7$ will come to rest in what length of time?

a) 2.17 s
b) 4.85 s
c) 6.38 s
d) 8.75 s
e) 11.38 s

2. A mass of 190 kg is hung on a Y-shaped cable truss where both top branches of the Y make an angle of 6° to the horizontal. What is the tension, T, in each of the upper cables?

a) 0.83 kN
b) 1.29 kN
c) 7.66 kN
d) 8.91 kN
e) 12.35 kN

3. Two masses, of 35 kg and 45 kg, are hung at the two ends of a very light rope which passes over a very low-mass low-friction pulley. How big is the 45 kg mass's downward acceleration?

a) (1/35)g
b) (1/45)g
c) (1/8)g
d) (1/80)g
e) (1/10)g

4. A 78 kg box is dropped from rest off of a tower. A strong side-wind exerts a 55 N CONSTANT force sideways on the box. How far downward (y-component only) does the box drop in 5 seconds?

a) 176.4 m
b) 98.0 m
c) 122.5 m
d) 19.6 m
e) 108.4 m

5. A box lies on a plank, which is slowly tilted until the box just begins to slip when the plank surface is tilted at 70 degrees above horizontal. What is the coefficient of static friction $\mu_s$ between the box and the plank?

a) 0.97
b) 0.22
c) 1.23
d) 1.95
e) 2.75

6. $\mathbf{r}$ = (-50m, 70m); $\mathbf{R}$ = (80m, 87m). What is the direction of $\mathbf{C} = \mathbf{r} + \mathbf{R}$, relative to the x-axis ?

a) 17°
b) 29°
c) 45°
d) 63°
e) 79°

7. A ball is launched from ground level in a direction 70 degrees above the ground. It takes the ball 11 seconds to reach maximum height. What was the ball's initial (vertical) y-component of velocity?

a) 98 m/s
b) 54 m/s
c) 108 m/s
d) 216 m/s
e) 490 m/s

8. A dog races THREE TIMES around a circular track in a time of 270 s with a speed of 8 m/s. What is the radius of the track?

a) 115m
b) 215m
c) 315m
d) 415m
e) 515m

9. A centrifuge develops $5.00 \times 10^{4}$ g of centripetal acceleration at a radius of 5 cm from the axis of revolution ( g = 9.8 m/s). What is the angular frequency, $\omega$, of this centrifuge?

a) 990 rad/s

b) 548 rad/s

c) 256 rad/s

d) 2540 rad/s

e) 3220 rad/s

10. A car travels on a $10^{\circ}$ "banked curve" with a radius of 30 m. What steady speed must the car have to experience zero NET force on the tires in any direction PARALLEL to the pavement? (Hint: vertical component of N balances the car's weight, horizontal component of N is the required centripetal force, and N points $10^{\circ}$ away from the vertical direction.)

a) 7.20 m/s
b) 9.32 m/s
c) 6.51 m/s
d) 4.80 m/s
e) 3.27 m/s

11. A fighter pilot loops his airplane in a large vertical circle, and goes over the top upside down at 120 m/s speed. The seat and floor push downward on him with a normal force, N, the same size as his gravitational weight $F_g$. What is the radius of the circle? (Hint: more than one force contributes to the total centripetal force on him.)

a) 0.735 km
b) 1.15 km
c) 2.25 km
d) 4.13 km
e) 6.25 km

12. Two masses are connected by a stretched spring and released on a frictionless surface. The 3 kg mass accelerates at a rate of $+10\ m/s^2$ *towards* the 8 kg mass. What is the vector acceleration of the 8 kg mass, in the same one-dimensional coordinate system?

a) $-2.75\ m/s^2$
b) $+2.75\ m/s^2$
c) $-3.75\ m/s^2$
d) $+3.75\ m/s^2$
e) $-4.75\ m/s^2$

13. A sky diver of mass 90 kg experiences a 550 N force of air resistance when he spreads his arms and legs. What is the magnitude of his acceleration in terms of $g = 9.8\ m/s^2$, the acceleration of gravity?

a) 0.08 g
b) 0.18 g
c) 0.28 g
d) 0.38 g
e) 0.48 g

14. A rock is two earth-radii above the earth's surface, so that it is three earth-radii from the center of the earth. With what acceleration does it fall towards the earth? (Try not to use the mass and radius of the Earth explicitly, just scale Earth's gravity appropriately.)

a) $0.57\ m/s^2$
b) $0.89\ m/s^2$
c) $1.09\ m/s^2$
d) $2.62\ m/s^2$
e) $3.98\ m/s^2$

15. A boat takes 2 minutes to cross a river which is 450 m wide and flowing at 3.8 m/s. The boat aims directly across the river, that is, its velocity RELATIVE TO THE WATER is directed purely ACROSS the river. How far is the boat from its starting point (DIAGONAL distance) when it reaches the opposite bank?

a) 0.46 km
b) 0.64 km
c) 1.31 km
d) 1.79 km
e) 2.01 km