Physics 2305   9 February, 2000
Practice for Exam 1

The exam consists of 10 multiple choice questions, each worth 7 points, and 3 free-form questions, each worth 10 points. Give yourself 75 minutes to take the exam, and use either the equation sheet or the study guide. Then score yourself to see how you might do.

1.   What is the angle between the vectors **a** and **b**, where **a** = 3 **i** − 2 **j** + 1 **k** and **b** = 2 **i** − 2 **k**?

        A)   41°
        B)   58°
        C)   68°
        D)   71°
        E)   None of the above   Answer: _____

2.   An acre is 4840 square yards. How many square meters are there in an acre? 1 yard = 36 inches, and 1 inch = 2.54 cm.

        A)   4047 m^2
        B)   4426 m^2
        C)   5293 m^2
        D)   5789 m^2
        E)   None of the above   Answer: _____

3.   A highway engineer banks a road with a radius of curvature of 85 m at an angle of 18°. If there were no friction, at what speed could a driver complete the curve?

        A)   37 mi/h
        B)   59 mi/h
        C)   63 mi/h
        D)   65 mi/h
        E)   None of the above   Answer: _____

4.   John is walking across an elevator at 0.5 m/s while the elevator descends at a constant velocity of 1.6 m/s. What is the magnitude of his total velocity (with respect to the ground)?

        A)   0.5 m/s
        B)   1.6 m/s
        C)   1.7 m/s
        D)   2.2 m/s
        E)   None of the above   Answer: _____

5. A car parked on a 15° hill pops out of gear and begins rolling down the hill. How fast is the car travelling after rolling 20 m? Ignore the effects of friction.

    A) 7 m/s
    B) 10 m/s
    C) 14 m/s
    D) 20 m/s
    E) None of the above   Answer: _____

6. The one-minute averaged velocity of the winds from a hurricane is reported to be 153 ± 4 knots. What is the percentage error?

    A) ± 0.4 %
    B) ± 2.6 %
    C) ± 4.0 %
    D) ± 5.2 %
    E) None of the above   Answer: _____

7. A massless frictionless pulley has two masses connected to a massless string suspended so one of the masses is on each side of the pulley. What is the acceleration of either mass?

    A) $\pm\, g$
    B) $\pm\, T / (m_1+m_2)$
    C) $\pm\, g\,(m_1+m_2) / (m_1-m_2)$
    D) $\pm\, g\,(m_1-m_2) / (m_1+m_2)$
    E) None of the above   Answer: _____

8. Sylvia is designing a new coffee-cup with a non-slip bottom so that it won't slide around people's dashboards when they are driving. If it's to remain in place on a level road with a radius of curvature of 40 m when they are driving at 30 miles per hour, what is the minimum value needed for the coefficient of static friction?

    A) 0.18
    B) 0.46
    C) 0.75
    D) > 1.0, which is impossible
    E) None of the above   Answer: _____

For 9. and 10.: A carnival ride drops a car and its riders 25 m in free-fall, then slows them to rest so that they experience a uniform deceleration of 8.0 g's.

9.   How fast are the riders moving at the end of the initial drop?

A)   16 m/s
B)   22 m/s
C)   250 m/s
D)   490 m/s
E)   None of the above   Answer: _____

10.   Over what vertical distance do they decelerate?

A)   3.1 m
B)   6.3 m
C)   13 m
D)   25 m
E)   None of the above   Answer: _____

Questions 11 through 13 are *free-form* questions, which require *clear and logical* work showing that you understand the problem and know how to get the answer. Think of it as an essay question. If deriving a formula, don't forget to state clearly what assumptions you are making. If solving a problem, write out and circle your algebraic solution, then work out the numerical answer.

11.   For projectile motion, assume that $x_o = y_o = 0$, and derive the range equation for the distance travelled by an object fired with initial velocity v_o at an angle θ_o before landing a distance R downrange with $y = 0$: $R = (v_o^2/g) \sin (2 \theta_o)$

12.   Two masses are connected by a massless cable over a frictionless, massless pulley at the top of an inclined plane which makes an angle of 50° from the horizontal. Mass m_1 rests on the incline, and the coefficient of static friction between it and the plane is 0.62. Mass m_2 hangs from the pulley off of the high end of the incline. If the two masses are stationary and $m_1 = 4.0$ kg, what is the range of possible values for m_2?

13.   Starting with the differential definitions of acceleration and velocity, derive the following:

$$x = x_o + v_o t + \tfrac{1}{2} at^2 \qquad v = v_o + at \qquad v^2 = v_o^2 + 2a\,(x - x_o)$$

Answers: 1. C; 2. A; 3. A; 4. C; 5. B; 6. B; 7. D; 8. B; 9. B; 10. A; 11. See sec. 4-6; 12. $m_2 = m_1 (\sin \theta \pm \mu_s \cos \theta)$, so 1.5 kg $< m_2 <$ 4.7 kg; 13. See sec. 2-7.