Physics 2414  
Midterm #1 – Fall 2005 Afternoon  
Version A

Multiple Choice (7 pts each)

1. A space traveler lands on one of the inner bodies of our solar system. To measure the acceleration of gravity, the traveler drops a golf ball from his spaceship to the ground, 12.0 m below. The traveler observes that the golf ball hits the ground after 1.64 s. Where is the space traveler?
   A. Sun (g = 270 m/s²).
   B. Mercury (g = 3.6 m/s²).
   C. Venus (g = 8.9 m/s²).
   D. Earth (g = 9.8 m/s²).
   E. Moon (g = 1.6 m/s²).

   \[ x = \frac{1}{2} gt^2 \]
   \[ 12 \text{ m} = \frac{1}{2} g (1.64 \text{ s})^2 \]
   \[ g = 8.92 \text{ m/s}^2 \]

2. Safe drivers do not tail gate. A convenient method to estimate the minimum safe following distance is the “two second rule.” This is the distance where your car reaches a point on the road 2 seconds after the car in front of you. If you are traveling at 150 km/h, what is the minimum safe distance between cars according to this rule?

   A. 10 m.
   B. 20 m.
   C. 60 m.
   D. 80 m.
   E. 200 m.

   \[ \frac{150 \text{ km}}{1000 \text{ m}} \frac{1 \text{ km}}{3600 \text{ s}} = 41.7 \text{ m/s} \]
   \[ 2.5 \times 41.7 \text{ m/s} = 83.3 \text{ m} \]

3. The starship Enterprise is suddenly attacked by the Dominion battleship Founder-1. Initially, both ships are side-by-side and at rest. The Enterprise can accelerate at twice the rate as Founder-1. After a certain time, how much farther has the Enterprise traveled compared to Founder-1?

   A) \( \sqrt{2} \) times farther.  
   B) 2 times farther.  
   C) 4 times farther.  
   D) 6 times farther.  
   E) Can only be determined if we know the actual time and acceleration.

   \[ x_D = \frac{1}{2} a_0 t^2 \]
   \[ a_E = 2 a_0 \]
   \[ x_E = \frac{1}{2} a_0 t^2 \]

   \[ t = \sqrt{\frac{2 x_E}{a_0}} \]
   \[ x_E = 2 x_D \]

\[ t = \sqrt{\frac{x_E}{a_0}} \]
4. Consider a car at rest. We can conclude that the downward gravitational pull of Earth on the car and the upward normal force of Earth on it are equal and opposite because
   A. the car is very heavy.  
   B. the net force on the car is zero.  
   C. the two forces form an action-reaction pair.  
   D. the upward gravitational pull of the car on the Earth is equal to the downward gravitational pull of Earth on the car.  
   E. none of the above.

5. In the 17th century, Otto von Guericke fitted two hollow bronze hemispheres together and removed the air from the resulting sphere with a pump. Two eight horse teams could not pull the halves apart even though the hemispheres fell apart when air was readmitted. Suppose von Guericke had tied both teams of horses to one side and bolted the other side to a heavy tree trunk. In this case, the tension on the hemispheres would be
   A. four times  
   B. two times  
   C. the same as  
   D. one half  
   E. one quarter

   what it was before.

6) Two bricks are released from the top of a building. Brick A weighs twice as much brick B. Brick A is dropped and the brick B is thrown straight up into the air. Which statement is true regarding this situation.
   A) Brick A accelerates faster than the brick B.  
   B) Brick B accelerates faster than the brick A.  
   C) The bricks have the same magnitude of acceleration but the accelerations are in opposite directions.  
   D) The two bricks accelerate at the same rate during the entire time they are in the air.  
   E) The two bricks have the same acceleration except for the instant when the brick B reaches its maximum height.

7) The radius of a sphere is increased by 6%; the percentage increase of the surface area of the sphere is.
   a) 5%  
   b) 10%  
   c) 12%  
   d) 16%  
   e) 18%

   \[
   \frac{SA_{new}}{SA} = \frac{4\pi (1.06r)^2}{4\pi r^2} = \left(\frac{1.06}{1}\right)^2 = 1.12 \approx 12\%.
   \]
8) The length 3.76 mm is multiplied by 0.05 mm. The appropriately rounded product is, in mm²
   a) 0.18
   b) 1.8
   c) 0.19
   d) 0.1881
   e) 0.188

   \[ 3.76 \times 0.05 \text{ mm} = 0.188 \text{ mm} \]

   1 sig digit => 0.2

9) To be dimensionally consistent, distance [L], velocity [L/T], and acceleration [L/T²] must be related as follows:
   a) Distance ~ velocity² / acceleration
   b) Distance ~ velocity / acceleration
   c) Distance ~ velocity² x acceleration
   d) Distance ~ velocity x acceleration²
   e) Distance ~ velocity⁵ / acceleration

   \[ \frac{m^2}{s^2} = \frac{m^2 \cdot s^3}{m} = m \]

10) Consider the plot of X vs t at the right.
    At which point is the object turning around?

   a) A
   b) B
   c) C
   d) D
   e) F
11) Two masses are connected by a cord that passes over a pulley as shown in the figure. The pulley and the cord have negligible mass. Mass 2 moves on a horizontal surface without friction and mass 1 is suspended vertically. The cord has negligible mass. Mass 1 is equal to 4.0 kg and mass 2 is equal to 8.0 kg. What is the tension in the cord that connects the two masses?

a) 15.2 N  
b) 21.2 N  
c) 26.1 N  
d) 32.7 N  
e) 37.7 N

\[ \alpha = \frac{m_1 g}{m_1 + m_2} \]

\[ \alpha = 3.27 \text{ m/s}^2 \]

\[ T = m_2 \alpha = 26.1 \text{ N} \]

12) A 4.0 kg mass has a velocity of 12 m/s to the WEST. The 4.0 kg mass undergoes an acceleration of 2.0 m/s² to the WEST for 3.0 sec. What is the velocity of the 4.0 kg mass at the end of the 3.0 sec interval?

a) 18 m/s to the WEST  
b) 6 m/s to the WEST  
c) 0 m/s  
d) 6 m/s to the EAST  
e) 18 m/s to the EAST

\[ v = v_0 + at \]

\[ 12 \text{ m/s} + 2 \text{m/s}^2 \cdot 3 \text{ sec} = 18 \text{ m/s} \text{ West} \]

13) A 3.0 kg ball is thrown vertically into the air with an initial velocity of 15 m/s. The maximum height of the ball is,

a) 12.0 m  
b) 11.5 m  
c) 10.0 m  
d) 9.5 m  
e) 9.0 m

\[ v_f^2 = v_i^2 + 2a \Delta x \]

\[ \Delta x = \frac{v_i^2}{2g} = 11.5 \text{ m} \]

14) Spring A has a length of 3.5 cm. When a force of 5.2 N is applied, the length of spring A is 7.0 cm. Spring B has the same spring constant as spring A but has a length of 5.0 cm. When a 5.2 N force applied to spring B, what is its length in cm?

a) 7.0  
b) 5.0  
c) 8.1  
d) 8.5  
e) 10.0

spring A stretches by 3.5 cm

spring B will also stretch by 3.5 cm

35 cm + 5.0 cm = 40 cm