Name: \\

Section: \\

Physics 218 
Summer 2008 
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Examination #1 
Time 90 minutes

Part I. Multiple Choice Questions:

1. What are the units of the following quantities:
   (5)
   \[ \begin{align*}
   p &= \text{power} = [\frac{\text{J}}{\text{s}}] \\
   g &= \text{gravitational acceleration} = [\frac{\text{m}}{\text{s}^2}] \\
   a_R &= \text{radial acceleration} = [\frac{\text{rad}}{\text{s}^2}] \text{ m/s}^2 \\
   k &= \text{spring constant} = [\frac{\text{N}}{\text{m}}] \\
   \mu_k &= \text{coefficient of kinetic friction} = [\text{no dimension}]
   \end{align*} \]

2. The number 5.43 x 10^{-4} is equivalent to:
   (2)
   a. 0.0000543  \[\boxed{\text{d. 0.000543}}\]

3. How long would it take a car starting from rest and accelerating at 5 m/s^2 to cover a distance of 100m?
   (4)
   a. 4.5 s  \[\boxed{\text{b. 6.3 s}}\]
   c. 10.0 s  
   d. 40 s
4. A box slides down an incline making an angle of 30° with the horizontal. The block moves at constant speed of 5 m/s. The coefficient of kinetic friction is
   a. 0.6
   b. 0.5
   c. 0.4
   d. 0.2

5. A package is dropped from a helicopter that is 30 m above ground moving with constant horizontal velocity of 15 m/s. At what horizontal distance relative to the initial position of the helicopter will the package hit the ground?

   a. 18.6 m
   b. 37 m
   c. 15.1 m
   d. 0 m

6. Which of the following statements is true for a projectile launched at 30° with the horizontal:

   a. Its speed is constant
   b. Its horizontal speed decreases
   c. The acceleration and velocity vectors are antiparallel
   d. The vertical component of velocity changes sign
7. Two balls are projected off a cliff. One is thrown horizontally, the other is released from rest and falls vertically. Which of the following statements is true?

a. The ball that falls vertically hits the ground first.
b. The ball that is projected horizontally hits the ground first.
c. Both balls hit the ground at the same time.
d. We cannot determine which ball hits the ground first unless we know the speed at which the first ball was projected horizontally.

8. Calculate the energy produced by operating an exercise bike at an average power of 100 watts for two hours.

\[ E = p \cdot t = 100 \cdot 2 \cdot 60 \cdot 60 = 7.2 \cdot 10^5 \text{ J} \]
9. One 3.5 kg paint bucket is hanging by a massless cord from another 3.5 kg paint bucket, also hanging by a massless cord.

(a) If the buckets are at rest, what is the tension in each cord?

(b) If the two buckets are pulled upward with an acceleration of 1.30 m/s\(^2\) by the upper cord, calculate the tension in each cord.

\[ T_2 = w_2 = m_2 g = 34.3 \text{ N} \]

\[ T_1 = w_1 + w_2 = m_1 g + m_2 g = 68.6 \text{ N} \]

\[ T_2 = w_2 + m_2 a_2 = 38.85 \text{ N} \]

\[ T_1 = w_1 + m_1 a_1 + w_2 + m_2 a_2 = 77.6 \text{ N} \]

\[ a_1 = a_2 = a \]
10. A quarterback throws a football with an initial upward velocity component of 10 m/s and a horizontal velocity component of 20 m/s. Air resistance may be ignored.

a) Make a sketch of the situation.
b) How much time is required for the football to reach the highest point of the trajectory?
c) How high is this point?
d) How much time (after being thrown) is required for the football to return to its original level? How does this compare with the time calculated in part (a)?
e) How far has the ball traveled horizontally during this time or what is its horizontal range?
f) What is the speed of the ball when it hits the ground?

\[
\begin{align*}
\upsilon_y &= 10 \text{ m/s} \\
\upsilon_x &= 20 \text{ m/s}
\end{align*}
\]

\[b) \quad t = \frac{\upsilon_{y0}}{g} = 1.02 \text{ s}\]

\[c) \quad y = \upsilon_{y0} \cdot t - \frac{g \cdot t^2}{2} = 5.1 \text{ m}\]

\[d) \quad h = 0 = \upsilon_{y0} \cdot t' - \frac{g \cdot t'^2}{2} \Rightarrow t' = 2.04 \text{ s} \quad t' = \frac{1}{2} t\]

\[e) \quad S = \upsilon_{x0} \cdot t' = 70.8 \text{ m}\]

\[f) \quad \upsilon = \sqrt{\upsilon_{y0}^2 + \upsilon_{x0}^2} = 22.4 \text{ m/s}\]
11. A flat (unbaked) curve on a highway has a radius of 240 m. A light car rounds the curve at a speed of 32.0 m/s.
   a. What is the minimum coefficient of friction that will prevent sliding?
   b. Will a heavier car start sliding at a higher speed?

   \[ \mu = \frac{v^2}{R} \]

   \[ \mu > \frac{v^2}{SR} = 0.435 \]

   b) no mass dependence

12. Block A has a mass of 4.00 kg, and block B has a mass of 25.0 kg. The coefficient of kinetic friction between block B and the horizontal surface is 0.20.

   a) Assign positive forces to the right and draw free body diagrams for A, B, C.
   b) What is the mass of block C if block B is moving to the right with an acceleration 3.00 m/s²?
   c) What is the tension in each chord when the block B has this acceleration?

   b) \[ a \left( m_A + m_B + m_C \right) = g \left( m_C - m_A - \mu m_B \right) \]

   \[ m_C = \frac{m_A (g+a) + m_B (g+\mu g)}{g-a} = 25.8 \text{ kg} \]

   c) \[ T_A = m_A (g+a) = 51.2 \text{ N} \]

   \[ T_C = m_C (g-a) = 175 \text{ N} \]