Physics 105 Exam 2 Sec. 1,2
Hess (2-2108) Winter 2012

3-digit CID#______ If you don’t remember it, write the last 3 digits of your BYUID#.
You are also free to write your name somewhere, but we don’t require that.

You are allowed pencils and a testing center calculator (should be provided without charge). No scratch paper is allowed. If you need more paper, you may separate the exam and use backs of paper then restaple exam. A foreign language dictionary is allowed if English is not your native language.

Do all your work on the exam itself. When you are confident you have found the correct answer, fill in the appropriate bubble on the scantron sheet. Check your work. No partial credit given.

Carry three significant figures throughout your calculations; for example 2 m means 2.00 m, and don’t round 431 to 430.

\[
\begin{align*}
\Delta x &= \frac{\Delta x}{\Delta t} \\
\Delta v &= \frac{\Delta v}{\Delta t} \\
v_{av} &= \frac{v_f + v_i}{2} \\
a &= \frac{v_f - v_i}{t} \\
\Delta x &= vt + \frac{1}{2}at^2 \\
v_f^2 &= v_i^2 + 2a\Delta x
\end{align*}
\]

If \( ax^2 + bx + c = 0 \), \( x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \)

\[
\begin{align*}
\sum \vec{F} &= m\vec{a} \\
W &= mg \\
f_s &\leq \mu_s N \\
f_k &= \mu_k N \\
W &= F\Delta x \cos \theta \\
KE &= \frac{1}{2}mv^2 \\
PE_G &= mgy \\
PE_S &= \frac{1}{2}kx^2 \\
F_s &= -kx \\
\Delta KE &= W_{\text{total}} \\
\Delta KE + \Delta PE &= W_{\text{nonconservative}} \\
(KE_f + PE_f) &= (KE_i + PE_i) + W_{\text{nonconservative}} \\
P &= \frac{W}{\Delta t} = Fv \cos \theta \\
p &= mv \\
\vec{p}_i &= \vec{p}_f \\
F &= \frac{\Delta p}{\Delta t} \\
x_{cm} &= \frac{\sum x_i m_i}{m_{\text{total}}} \\
v_{cm} &= \frac{\sum v_i m_i}{m_{\text{total}}} \\
\sum \vec{F}_{\text{ext}} &= m\vec{a}_{cm}
\end{align*}
\]

Constants
\( g = 9.80 \text{ m/s}^2 \)

Things that will not be given on formula sheets:
common math identities such as area, circumference of a circle (in terms of radius or diameter), rectangle, triangle
definitions of cosine, sine, tangent.
1. Two objects at rest of mass M and 2M are each subject to a constant net force F over a distance d. At the end of the motion mass _________ moves the fastest
   a) M  b) 2M  c) neither they move the same

2. (continued) At the end of the motion _________ has the most kinetic energy.
   a) M  b) 2M  c) neither they have the same KE

3. The masses accelerate as mass B (mB) falls. There is no friction. Which is true about the string tension? _______
   a) T > mBg
   b) T = mBg
   c) T < mBg
   d) the above statements can’t be determined without knowing mass A.

4. The following forces (each of the same magnitude) all act on an object.

   Which of the following is closest to the direction of the resulting force R?
   a)  
   b)  
   c)  
   d)  

5. (continued) If the magnitude of each force above if 17 N and \theta is 37°, then the magnitude of the resulting for R is _________ N.
   a) 0 to 15  
   b) 15 to 16  
   c) 16 to 17  
   d) 17 to 18  
   e) 18 to 19  
   f) 19 to 20  
   g) 20 to 21  
   h) More than 21

6. The block is pushed with force P. For the block to not slide, the minimum required coefficient of static friction is ___________. P = 50 N and m = 10 kg
   a) 0.000 to 0.125  
   b) 0.125 to 0.250  
   c) 0.250 to 0.375  
   d) 0.375 to 0.500  
   e) 0.500 to 0.625  
   f) 0.625 to 0.750  
   g) 0.750 to 0.875  
   h) 0.875 to 1.000
7. A 2000 kg elevator has a cable attached to its top to accelerate or decelerate it. The elevator accelerates from 0 to 5 m/s in 3.2 seconds. The tension in the cable while it accelerates is __________ kN.
   a) 0 to 20 
   b) 20 to 21 
   c) 21 to 22 
   d) 22 to 23 
   e) 23 to 24 
   f) 24 to 25 
   g) 25 to 26 
   h) more than 26 

8. (continued) After the 3.2 seconds as the elevator moves up at constant speed, The tension in the cable is __________. (Same choices)

9. Several battleships shoot bullets with the same initial speed at an airplane above them. Some are right under the plane and some are farther away and shoot at an angle. When the bullets reach the plane, the bullets with the greatest speed are _______. Ignore air friction.
   a) the closest ships 
   b) the farthest ships 
   c) neither; same speed 

10. In the train, the locomotive pushes backwards on the track with a constant force of 80 kN. \( M_1 = 2000 \) kg, \( M_2 = 5000 \) kg, \( M_3 = M_4 = 2500 \) kg. The train’s acceleration is _______ m/s^2.
   a) 0 to 5 
   b) 5 to 6 
   c) 6 to 7 
   d) 7 to 8 
   e) 8 to 9 
   f) 9 to 10 
   g) more than 10 

11. (continued) The force between \( M_2 \) and \( M_3 \) while the train accelerates is __________ kN.
   a) 0 to 20 
   b) 20 to 24 
   c) 24 to 38 
   d) 28 to 32 
   e) 32 to 36 
   f) 36 to 40 
   g) more than 40 

12. A child pushes a block across a table. Newton’s third law states that forces always come in pairs. Consider the force of gravity (weight) on the block. The other force in the pair with the weight force is ______
   a) friction 
   b) the block pulling up on the earth 
   c) the normal force on the block 
   d) the acceleration 
   e) the force of the child pushing on the block.
13. A horizontal constant force of 45 N pushes a 50 kg block along a horizontal frictionless surface. After being pushed for a distance of 20 meters from rest, the block’s KE is _____________ J.

a) 0 to 200  
b) 200 to 300  
c) 300 to 400  
d) 400 to 500  
e) 500 to 600  
f) 600 to 700  
g) 700 to 800  
h) more than 800

14 (continued) After the push ends, the block slides up a frictionless incline of 30° above horizontal. The block will slide ________ m along the incline before it stops.

a) 0 to 0.75  
b) 0.75 to 1.50  
c) 1.50 to 2.25  
d) 2.25 to 3.00  
e) 3.00 to 3.75  
f) 3.75 to 4.50  
g) more than 4.50

15. A skydiver opens his parachute and slows while he falls. During this time which is true?

a) The force of the parachute on the skydiver is greater than the force of gravity on the skydiver.  
b) The force of the parachute on the skydiver is greater than the force of skydiver on the parachute.  
c) The force of gravity on the skydiver is greater than the force of parachute on the skydiver.  
d) The force of gravity on the skydiver is equal to the force of the parachute on the skydiver.

16. Two blocks of mass M and 2M are on a frictionless inclined plane. If both are released from rest at the same height, which block has the greatest speed at the bottom?

a) M    b) 2M    c) same

17. (continued) Now suppose that the two blocks are released from the same height on a inclined plane with a coefficient of kinetic friction \( \mu_k \). Which block has the greatest speed at the bottom?

a) M    b) 2M    c) same

18. The pulley shown is mass less and frictionless. \( M_1 \) is moving ________ m/s after falling 0.5 m. \( M_1 = 5 \) kg and \( M_2 = 3 \) kg.

a) 0 to 1.60  
b) 1.6 to 1.7  
c) 1.7 to 1.8  
d) 1.8 to 1.9  
e) 1.9 to 2.0  
f) 2.0 to 2.1  
g) 2.1 to 2.2  
h) more than 2.22
19. While you sit in a car, you take a circular left turn at constant speed, and see that your physics book on the seat slides to your right. Which is true? _____
   a. a force pulls the book to the right
   b. the coefficient of friction isn’t strong enough to keep it turning it in a circle
   c. the book puts a smaller force on the car than the car puts on the book
   d. you are observing motion in an inertial (nonaccelerating) reference frame

20. A 50 kg woman slides down a frictionless slide of height 8 m and then compresses a large spring (or springy matt) with $k = 3000 \, \text{N/m}$. When she comes to a stop, the spring is compressed a distance of ________ m.
   a) 0 to 0.75
   b) 0.75 to 1.50
   c) 1.50 to 2.25
   d) 2.25 to 3.00
   e) 3.00 to 3.75
   f) 3.75 to 4.50
   g) more than 4.50

1. Janet (80 kg) is standing at rest in the middle of a frozen lake of radius 50 m. She holds a 1 kg snowball and throws it horizontally at 10 m/s. It takes her ________ min to slide to the shore on frictionless ice______.
   a) 0 to 2
   b) 2 to 3
   c) 3 to 4
   d) 4 to 5
   e) 5 to 6
   f) 6 to 7
   g) more than 7

2. Later she is moving very fast at 16 m/s on ice and collides with her 40 kg brother who was at rest and they start to slide holding on to each other. Their velocity after the collision is ________ m/s.
   a) 0 to 5
   b) 5 to 7
   c) 7 to 9
   d) 9 to 11
   e) 11 to 13
   f) 13 to 15
   g) more than 15

3. A bullet of mass $M$ is moving with a velocity $V$. A ball has a mass $5M$ and a velocity of $V/5$. Which has more KE?____  a) bullet  b) ball  c) same

4. (continued) Which has more momentum?_____  a) bullet  b) ball  c) same

10. Two pool balls of equal mass undergo a collision. Initially the first ball is moving at 2 m/s at an angle of $30^\circ$ above the horizontal and the second ball is at rest. After the collision the second ball is moving 1 m/s to the right. The final velocity of the first ball is __________ m/s.
   a) 0 to 0.55
   b) 0.55 to 0.80
   c) 0.80 to 1.05
   d) 1.05 to 1.30
   e) more than 1.30
   38 good
11. During the collision, if outside forces can be neglected, you can be sure that, _______ (mark ALL that are true)
   a) total kinetic energy was conserved
   b) total momentum was conserved
   c) center of mass velocity was conserved

14. You shoot horizontally at pieces of wood on ice with two rubber bullets: One is elastic and bounces back at you. The other is inelastic and doesn’t bounce much at all. If they have the same mass, and strike pieces of wood of the same mass, which one causes the wood to move the fastest over the ice? _______ a) the elastic one  b) the inelastic one  c) the same for both