

EXAM 3

Name: \_\_\_\_\_ Student ID #: \_\_\_\_\_

TA (circle one): Beetle Flitcroft McKain Pokrovski

A. [5 pts.] When an actor in a movie, usually a stunt person, leaps out a second floor window to avoid a raging fire in the building, the actor normally lands on an off-camera soft mat that protects the actor from injury. Explain how the mat protects the actor from injury using physics principles. Be specific. WHEN THE ACTOR JUMPS OUT OF THE WINDOW AT THE BOTTOM OF THE FALL WHERE SHE STOPS  $E = \Delta p$  NO MATTER HOW SHE STOPS. IN ADDITION  $I = F \Delta t$  WHEN THE MAT STOPS THE FALL  $\Delta t$  IS MUCH GREATER THAN IF THE FALL WERE STOPPED BY THE SIDEWALK. THE LONGER  $\Delta t$  IS THE SMALLER  $F$  IS, AND THE LESS LIKELY AN INJURY WILL RESULT.

B. [9 pts.] For items a and b below identify which of the events (numbered 1, 2, 3, 4 and/or 5 below) fit.

3, 5  
5

- a. The events for which the momentum of the stated system is conserved.  
b. The events for which the KE of the stated system is conserved.

1. A basketball bouncing off the floor. The basketball is the system of interest. The ball does not rise to the same height it fell from.
2. A lump of clay hitting a stationary wooden block inelastically on a frictionless surface. The lump of clay is the system of interest.



3. Same as #2 but the lump of clay and the block make up the system of interest
4. Two blocks of equal mass, one moving and one stationary, colliding elastically on a frictionless surface. The system of interest is the block that is initially moving.



5. Same as #4 but the system of interest is the pair of blocks.

C. [15 pts.] Three circular objects of the same mass and radius, a uniform disk ( $I = \frac{1}{2} MR^2$ ), a hoop ( $I = MR^2$ ), and a spherical shell ( $I = \frac{2}{3} MR^2$ ) are allowed to roll without slipping down an incline through the same vertical height. In the space below, write disk, hoop, shell, same or none to best fit the statement.

- DISK 1. The object that reaches the bottom of the incline most quickly.  
DISK 2. The object that has the largest  $KE_{trans}$  at bottom.  
HOOP 3. The object that has the largest  $KE_{rot}$  at bottom.  
DISK 4. The object with the largest angular speed about an axis through the center of mass at the bottom.  
SAME 5. The object with the largest mechanical energy at the bottom.