Physics 1145 Fall 2021 Test 3 (4 pages)

Name:__________________ November 19, 2021 Total Score:_________/120__

$\sum F_x = ma_x$ $f_S \le \mu_S N$ $f_k = \mu_k N$ $a_c = \frac{v^2}{R}$ $F_{Sx} = -kx$

$\tau = rF\sin\theta$ $\sum\tau = I\alpha$ $v = \omega r$ $a = \alpha r$ $I = \sum_i m_i r_i^2$ $L = I\omega$

$\vec{p} = m\vec{v}$ $\vec{J} = \vec{F}_{avg}\Delta t$ $\vec{P}_f - \vec{P}_i = \vec{J}_{ext}$ $W = Fd\cos\theta$ $\Delta E = W$

$K = \frac{1}{2}mv^2$ $U_{grav} = mgy$ $U_{spring} = \frac{1}{2}kx^2$ $\Delta E_{th} = f_k \Delta x$ $P = W/\Delta t = Fv$

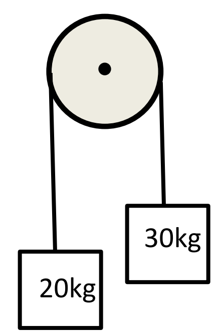
____1. (5) A spring gun shoots out a ball with a certain speed. When the spring is compressed twice the distance it was on the first shot, the launch speed is
A) reduced by factor of 4 B) halved C) doubled D) quadrupled

____2. (5) A soccer ball of mass M is traveling with a speed V in the negative x-direction. After being kicked by a player's foot, the ball travels in the opposite direction with a speed of V. What was the x-component of the impulse delivered to the ball by the foot?
A) zero B) MV C) $-2MV$ D) $2MV$

_____3. (5) A constant force T acts on an object perpendicular to the direction in which it is moving. The work done by the force on the object
A) depends on the mass of the object B) is zero
C) depends on the acceleration of the object D) depends on the speed of the object

_____4. (5) You try to put a merry-go-round into rotation by applying a force of fixed magnitude at the rim. Two children sit on the merry-go round. You will achieve the largest angular acceleration if
A) the kids sit close to the center B) the kids sit at the rim on opposite sides
C) the kids sit at the rim, next to each other D) it does not matter where the kids sit

______5. (5) A 20kg box and a 30kg crate are attached to the two ends of a massless string that passes over a disk shaped pulley, as shown in the figure. The system is released from rest. Which is true about the tensions on the left and right side of the pulley?



A) The tension on the left is equal to the tension on the right.
B) The tension on the left is less than the tension on the right.
C) The tension on the left is larger than the tension on the right.
D) Each tension equals the weight of the object on its side.

_____6.(5) You push an object with force F over a certain distance. If you push the object with the same force over the same distance, but need twice the time, your power output is
A) halved B) unchanged C) doubled D) quadrupled

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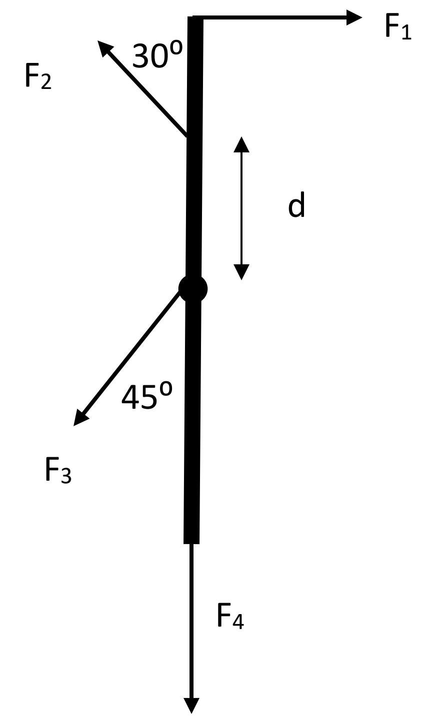
7. (30) A uniform beam of mass 5.0 kg and length 2.0 m can rotate about an axle through its center. Four forces are acting on it as shown in the figure. Their magnitudes are F_1=4.0N, F_2=4.0N, F_3=6N and F_4=8.0N.
The moment of inertia of a uniform beam of mass *m* and length *L* about its center of mass is $\frac{1}{12} mL^2$.



a) (20) Calculate the torques due to each of the forces.

b) (10) Calculate the angular acceleration of the beam. Is it clockwise or counter-clockwise?

8.(10) You are using a spring scale with an initial length of 20 cm to weigh a 4.0 kg pumpkin. The spring stretches to 30 cm.
Calculate the force constant of the spring and the potential energy of the stretched spring.

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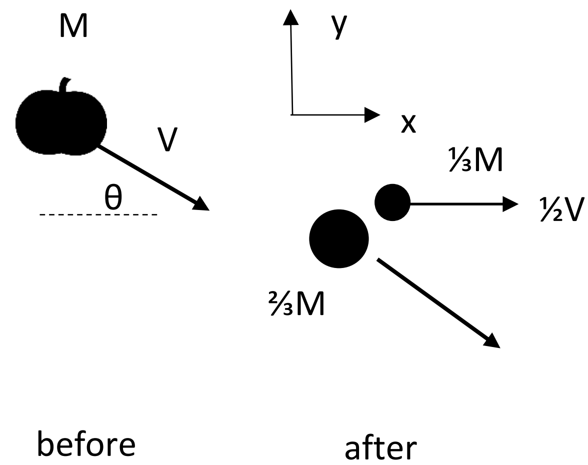
9.(25) Students are experimenting with an explosives-filled pumpkin. The pumpkin of total mass M moves with speed V on a frictionless horizontal table in a straight line that makes an angle θ with the x-direction, as shown in the diagram. It explodes and breaks up into two fragments of unequal masses. Fragment A of mass ⅓M moves with speed ½V in the positive x-direction.

Because of their excitement over the successful explosion, the students failed to record any information about the movement of the other fragment, B. The figure shows a top view of the table.

Find the x-and y-components of the velocity of fragment B.



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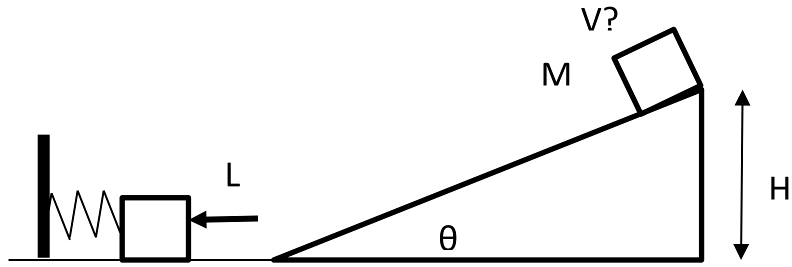
10. (25) A box containing a Thanksgiving turkey of mass M is pushed against a spring of spring constant k, compressing it a distance L. It is released from rest and slides along a **frictionless horizontal** surface and up a **rough incline** (coefficient of kinetic friction μ) that makes an angle θ above the horizontal, until it arrives with some unknown speed at a vertical height H above the starting position.



Use energy methods to derive an expression for the final speed with which the box arrives a height H, in terms of system parameters.

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