Name:

Your code is: AAAAAA

Put your name here:

Keep this exam **CLOSED** until advised by the instructor.

60 minute long closed book exam.

Fill out the bubble sheet: last name, first initial, student number, section number and **code**.

A two-sided 8.5 by 11 handwritten help sheet is allowed.

When done, hand in your **test** and your **bubble sheet**.

Thank you and good luck!

Possibly useful constants:

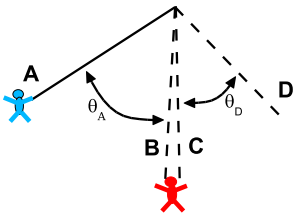
- g = 9.81 m/s^2
- G = 6.67$\times$10^{-11} Nm^2/kg^2
- σ = 5.67 $\times$ 10^{-8} W/(m^{2}K^4)
- R= 0.0821 L*atm/(mol*K) = 8.31 J/(mol*K)

Possibly useful Moments of Inertia:

- Solid homogeneous sphere: $I_{CM} = (2/5)MR^2$
- Thin spherical shell: $I_{CM} = (2/3)MR^2$
- Thin uniform rod, axis perpendicular to length: $I_{CM} = (1/12)ML^2$
- Solid homogeneous cylinder, axis through center of mass and parallel to length: $I_{CM} = (1/2)MR^2$

Useful information for Geometry:

- Volume of a sphere: $V = (4/3)\pi r^3$
- Volume of a cylinder: $V = \pi r^2 h$



10 pt

Jane, who has mass M_{jane}, swings down from a tree, starting from rest, using a vine which has a starting angle θ_A (see the figure). When the rope is vertical, she rescues Tarzan, who has mass $M_{\text{tarzan}} > M_{\text{jane}}$, from the river where he was teasing the crocodiles. Jane and Tarzan then swing together to a tree branch on the other side of the river which has final angle θ_D. In the figure, position B is just before Jane picks up Tarzan, while position C is just after she picks up her irresponsible boyfriend.

▷ The mechanical energy (kinetic+potential) of Jane at "A" is _____ the mechanical energy of Jane and Tarzan together at "D".

1. **A**◯ greater than **B**◯ less than **C**◯ equal to

▷ Janes's momentum at "B" is _____ the momentum of Jane and Tarzan together at "C".

2. **A**◯ greater than **B**◯ less than **C**◯ equal to

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8 pt A cylindrical space station located in distant space, rotates with constant angular velocity about its axis. Astronaut Andy rotates with the station and is located at the perimeter, a distance R from the axis.

▷ Andy's acceleration is not zero.

3. **A**◯ True **B**◯ False

▷ Andy has constant velocity.

4. **A**◯ True **B**◯ False

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8 pt A cantaloupe orbits a planet with a speed of 5500 m/s. At the radius of the orbit the acceleration of gravity is measured to be 3.1 m/s^2. What is the radius of the orbit? *(in* `m`*)*

5. **A**◯ 5.21×10^6 **B**◯ 6.09×10^6 **C**◯ 7.13×10^6
D◯ 8.34×10^6 **E**◯ 9.76×10^6 **F**◯ 1.14×10^7
G◯ 1.34×10^7 **H**◯ 1.56×10^7

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8 pt The work done in accelerating a flywheel from rest to an angular speed of 11.6 revolutions per second is 16.3 kJ. What is the moment of inertia of the flywheel? *(in* `kg*m^2`*)*

6. **A**◯ 3.14 **B**◯ 3.93 **C**◯ 4.91 **D**◯ 6.14
E◯ 7.67 **F**◯ 9.59 **G**◯ 11.99 **H**◯ 14.98

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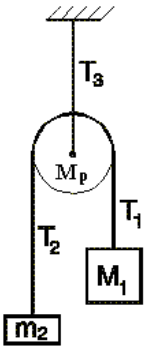
10 pt A uniform frictionless pulley is attached to the ceiling, in a gravity field of 9.81 m/s^2. The mass of the pulley is M_p.



Mass M_1 is greater than mass m_2. The quantities T_1, T_2, T_3 and g are magnitudes. Select greater than, less than or equal to.

▷ If counterclockwise is defined as the positive direction for rotational motion, then the angular acceleration of the pulley will be _____ zero.

7. **A**◯ Greater than **B**◯ Less than **C**◯ Equal to

▷ T_2 is _____ T_1.

8. **A**◯ Greater than **B**◯ Less than **C**◯ Equal to

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8 pt Some curious students hold a rolling race by rolling four items down a steep hill. The four items are a solid homogeneous sphere, a thin spherical shell, a solid homogeneous cylinder and a hoop with all its mass concentrated on the hoop's perimeter. All of the objects have the same mass and start from rest. Assume that the objects roll without slipping and that air resistance and rolling resistance are negligible. For each statement below, select True or False.

▷ The hoop reaches the bottom of the hill last.

9. **A**◯ True **B**◯ False

▷ Upon reaching the bottom of the hill, the homogeneous sphere will have a larger rotational kinetic energy than any of the other objects will when they reach the bottom of the hill.

10. **A**◯ True **B**◯ False

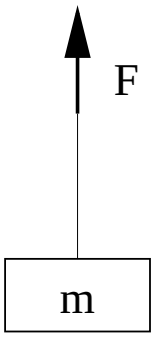
A billiard ball moving at 5.57 m/s strikes a stationary ball of the same mass. After the collision, the first ball moves at 3.20 m/s at an angle of -54.94° with respect to the original line of motion.

8 pt What is the speed of the second ball after the collision?
(in `m/s`*)*

11.**A**◯ 2.19 **B**◯ 2.47 **C**◯ 2.80 **D**◯ 3.16
E◯ 3.57 **F**◯ 4.03 **G**◯ 4.56 **H**◯ 5.15

8 pt At what angle did the second ball move relative to the original line of motion of the first ball? (Give answer in degrees)

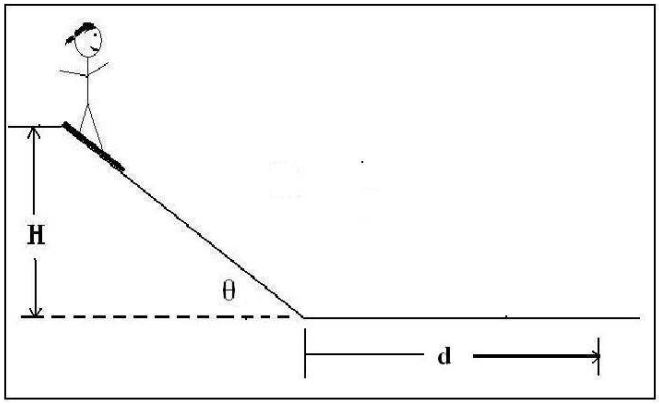
12.**A**◯ 4.8 **B**◯ 6.3 **C**◯ 8.4 **D**◯ 11.2
E◯ 14.9 **F**◯ 19.8 **G**◯ 26.4 **H**◯ 35.1



8 pt
An m = 6.25 kg mass is suspended on a string which is pulled upward by a force of F = 67.1 N. (See figure.) If the upward velocity of the mass is 4.25 m/s right now, then what is the velocity 2.50 s later?
(in `m/s`*)*

13.**A**◯ 2.69 **B**◯ 3.36 **C**◯ 4.20
D◯ 5.26 **E**◯ 6.57 **F**◯ 8.21
G◯ 1.03×10^1 **H**◯ 1.28×10^1

A 62.4 kg snowboarder starts from rest at the top of a 13.6 m high hill. The hill is inclined at an angle of 25 degrees relative to the horizontal. The hill is frictionless, but the horizontal surface at the bottom of the hill is rough. The coefficient of kinetic friction between the snowboard and the horizontal surface is 0.21. The incline makes an angle of 25 degrees with the horizontal.



8 pt What is the snowboarder's speed when she reaches the bottom of the hill?
(in `m/s`*)*

14.**A**◯ 2.2 **B**◯ 3.0 **C**◯ 3.9 **D**◯ 5.2
E◯ 6.9 **F**◯ 9.2 **G**◯ 12.3 **H**◯ 16.3

8 pt How far does the snowboarder travel (d) after reaching the bottom of the hill before she comes to rest?
(in `m`*)*

15.**A**◯ 21.58 **B**◯ 25.25 **C**◯ 29.54 **D**◯ 34.56
E◯ 40.44 **F**◯ 47.31 **G**◯ 55.35 **H**◯ 64.76

8 pt Identify each of the statements as being either TRUE or FALSE.

▷ The unit of work, the joule is dimensionally the same as newton×meter.
16. **A**◯ True **B**◯ False

▷ The unit of power, the watt is dimensionally the same as joule/second.
17. **A**◯ True **B**◯ False