General Physics
Physics 101
Test #2 – Spring 2017
Wednesday 3/1/17
Prof. Bob Ekey

Name (print):_____

I hereby declare upon my word of honor that I have neither given nor received unauthorized help on this work.

Signature:_____

Part I. Multiple Choice (3 pts each)

Instructions:

Please clearly circle one and only one answer for each of the following.
Show all of your work. Partial credit may be given if you include your work.

Questions:

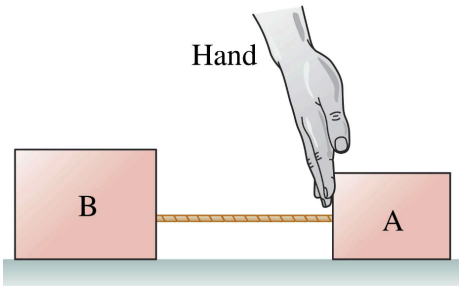
1. Hannah was pulling her pet rabbit on a sled across a level bit of ground that was covered with snow using a rope at an angle above the ground. They were accelerating at 3.00 m/s^2. The mass of the rabbit and the sled was 50 kg. The rope pulled the sled with components of 100.0 N upward & 250.0 N to the right. What is the magnitude of the force of friction acting on the sled?

(a) 250 N
(b) 100 N
(c) 400 N
(d) Need more information

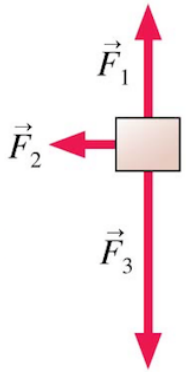
2. A standard clock, like the one hanging on the wall in this room, is running out of batteries. As the second hand slows to a stop what are the signs of ω and α?

(a) ω is positive and α is positive.
(b) ω is positive and α is negative.
(c) ω is negative and α is positive.
(d) ω is negative and α is negative.

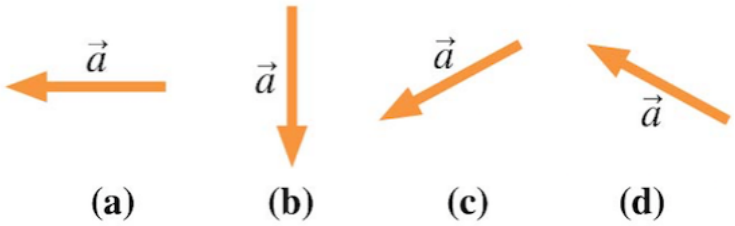
3. Block A and B, with masses 1 kg and 2 kg respectively, are connected via a massless string. If the hand exerts a 9 N force on block A, what is the net force on mass A?

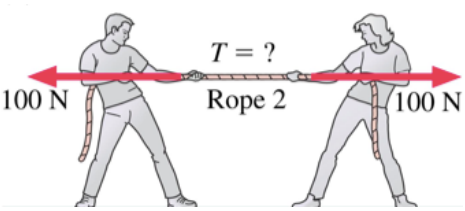


(a) 12 N
(b) 9 N
(c) 6 N
(d) 3 N



4. In which direction does the object shown accelerate?





5. Two people are playing tug-of-war, and are presently at a stand-still. What is the tension in the rope? Ignore the mass of the rope, and assume it is equally stretched.

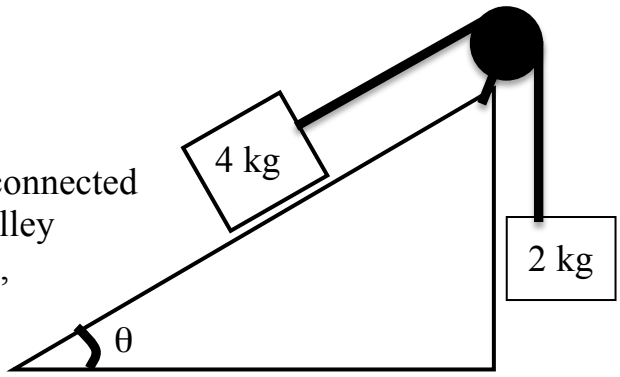
(a) 200 N
(b) 100 N
(c) -200 N
(d) 0 N

6. A 50 g rock is attached to a 50 cm long string. If it is spun in uniform circular motion and has an acceleration of 2.0 m/s^2, what is the angular speed of the rock?

(a) 2.0 rad/s
(b) 1.0 m/s
(c) 4.0 rad/s
(d) 1.0 rad/s

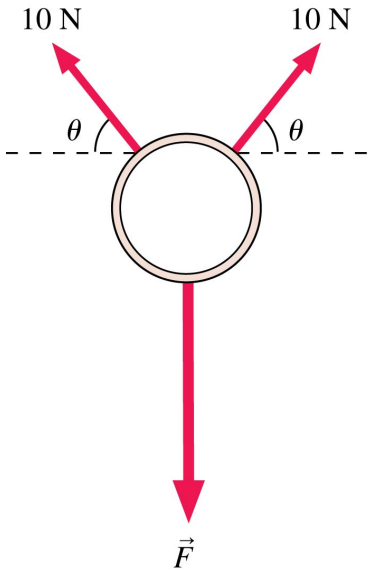
7. A constant force applied to A causes A to accelerate at 3 m/s^2. The same force applied to B causes B to accelerate at 5 m/s^2. What is the ratio of m_A /m_B of the masses of A to the mass of B?

(a) 5/3
(b) 3/5
(c) 15/1
(d) 1/15



8. A 4.0 kg box is on a frictionless 35º ramp and is connected via a massless string over a massless, frictionless pulley to a hanging 2.0 kg mass. If you hold the 2 kg mass, what is the tension in the string?

(a) 20 kg m/s
(b) 22 N
(c) 39 kg m/s^2
(d) 2 N



9. A mass-less ring, seen from above, is pulled on by three forces with theta equal to 30º. The ring is not moving. How big is the force *F*?

(a) 10 N
(b) 17 N
(c) 8.7 N
(d) 20 N

10. A spool has a thin, negligible-mass cable attached to it, which is pulled with an acceleration of 1.5 m/s^2. The diameter of the spool is 6.0 cm and it rotates on a frictionless bearing from rest. After 1.0 m of the cable has been unwound, what is the angular speed of the spool? Assume the cable is pulled at an angle that allows for the maximum speed to be obtained.

(a) 5.5 x 10^2 rad/s
(b) 28 rad/s
(c) 57 rad/s
(d) 5.0 rad/s

11. Which of the following statements is true?

(a) If two different massed objects sitting on a frictionless surface explode apart, it is possible for them to have the same velocity post explosion.

(b) An object in uniform circular motion has zero acceleration.

(c) The force of gravity and the normal force are Newton 3rd law pairs.

(d) For a motionless wooden block on a wooden ramp, it is possible for static friction force to be less than the kinetic friction force (if it was moving).

12. The wheel has a radius of 0.25 m and undergoes 10 revolutions without slipping as it accelerates from rest in 2.0 seconds. What is the value of the angular acceleration of the wheel during this time?

(a) 64 rad/s^2
(b) 10 rad/s^2
(c) 5.0 rad/s^2
(d) 31 rad/s^2

Part II. Short answer problems (12 pts each)

Instructions:

Solve three of the following four problems. If you try to solve all four problems, please clearly indicate which problems you wish to have graded. If you do not indicate this, I will assume you want me to grade problems one, two and three.

Please show all of your work, including equations without numbers.
Please provide units with all answers.
Partial credit may be given if you include your work.

Question 1. Grade this problem? Yes or No (circle one)

This question inspired by: http://nerdist.com/how-hard-would-it-be-to-push-a-star-destroyer/

In Rogue One, a Hammerhead Corvette (spaceship) pushes a non-operational Star Destroyer (spaceship) from rest, over a distance of 4.00×10^2 m for 10.0 seconds. The mass of the Star Destroyer is approximately 3.62×10^{10} kg and the Hammerhead is 2.20×10^8 kg. We'll assume this is 1D and a constant acceleration.

(a) What is the acceleration of the system (Hammerhead Corvette+ Star Destroyer)?

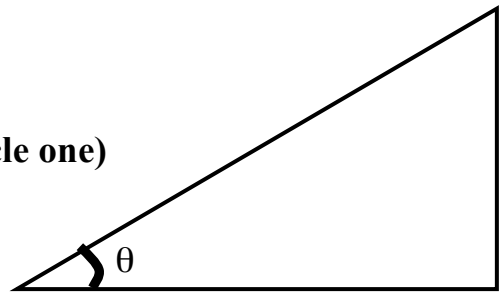
(b) What is the force (mag + dir) of the Star Destroyer on the Hammerhead Corvette?

(c) What thrust force (mag + dir) is the Hammerhead Corvette providing to push the system?

(d) The non-operational Star Destroyer then crashes into an operational Star Destroyer ripping through it, while remaining fairly intact. Which experiences a bigger force from the collision, the operational or non-operational Star Destroyer? Explain.

Question 2. **Grade this problem? Yes or No (circle one)**

A 2.0 kg steel disc is launched up a dry steel ramp that is inclined at a 40º angle. The block's initial speed is 10 m/s. Be sure to show your sum of all forces equations.



(a) Calculate the normal force acting on the disc while on the ramp.

(b) Calculate the friction force. Explicitly state the direction (up or down the ramp).

(c) Calculate the net acceleration on the disc parallel to the ramp. Explicitly state the direction (up or down the ramp).

(d) As the disc slides back down the ramp, how will its speed compare to the launch speed when it arrives at the launch location? Is it the same, greater or less in magnitude? No calculations are necessary, but you must discuss the acceleration of the disc as it slides down the ramp. A force diagram may help.

Question 3. **Grade this problem? Yes or No (circle one)**

A 5.0-m-diameter merry-go-round is initially turning with a 4.0 s period counter-clockwise. It slows down and stops in 20 s.

(a) Before slowing, what is the tangential speed of a child on the rim? Assume it is rotating counter-clockwise.

(b) What is the angular acceleration of the merry-go-round as it stops?

(c) How many revolutions does the merry-go-round make as it stops?

(d) Explain whether the magnitude of the tangential acceleration of the child is constant or changing during the motion. Words are required in your explanation, but calculations are not.

Question 4. **Grade this problem? Yes or No (circle one)**

While at the AAPT conference, I stayed on the 26th floor and would take the elevator daily to the lobby. Once traveling at a constant speed (2.0 m/s), it would take 60 seconds to travel the 120 m to the lobby. To achieve the constant speed, I determined the elevator traveled one floor from rest, which is a -3.0 m displacement.

(a) At the start, what is the acceleration of the elevator as it descends from rest?

(b) If during the acceleration I determined during that the normal force that I experience is 1.0 kN, what is my mass?

(c) What normal force do I experience while I am traveling at the constant speed?

(d) At what point during the ride, do I feel the lightest (experience the smallest normal force)? Start, constant speed or stop? Assume the elevator does not stop at any other floors. Explain.