General Physics
Physics 101
Test #2 – Fall 2020
Friday 10/16/20
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.

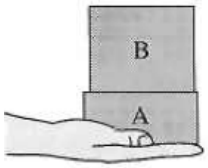
Signature:_____

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. Block A and B are 5.0 kg and 10.0 kg respectively. As shown, these blocks are lifted with a uniform acceleration of +2.0 m/s^2. What is the magnitude of the force of block A on block B?

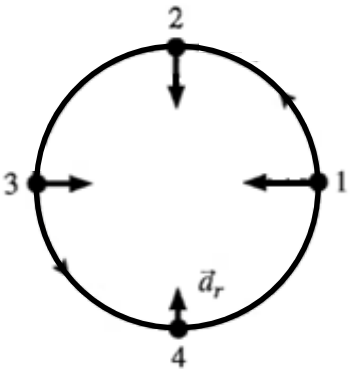
(a) 1.2 x 10^2 N
(b) 20 N
(c) 78 N
(d) 59 N

2. A space station is constructed as a rotating cylinder that rotates about its axis. The space station spins up for 300 seconds from rest to create artificial gravity with the outer deck of the space station rotates at 70 m/s, with a rotational period of 45 s. What is the radial distance from the axis of rotation to the outer deck?

(a) 4.9 km
(b) 5.0 x 10^2 m
(c) 3.3 km
(d) 1.0 x 10^3 m

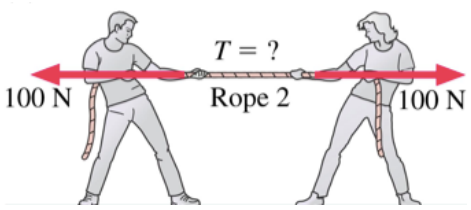
3. A rifle with a barrel length of 60 cm fires a 10 g bullet with a horizontal speed of 400 m/s. The bullet strikes a block of wood and penetrates to a depth of 12 cm. What resistive force (assumed to be constant) does the wood exert on the bullet?

(a) 6.7 x 10^3 N
(b) 1.3 x 10^3 N
(c) 670 kN
(d) Need more information



4. The following figure shows the radial acceleration vector at four successive points on the trajectory of a particle rotating counter-clockwise. What is the sign of the angular acceleration?

(a) Postive
(b) Zero
(c) Negative
(d) Imposible to determine



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.

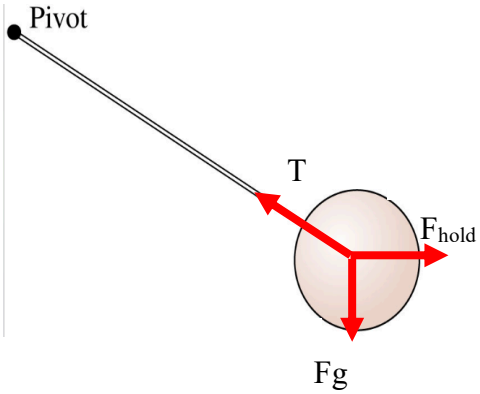
(a) 200 N
(b) 100 N
(c) -200 N
(d) 0 N

6. A block of mass, m, is pushed along the floor with velocity, *v*, slides a distance, d, after the pushing force is removed. What is the distance traveled if initial velocity of the block is $\sqrt{2}v$?

(a) $4d$
(b) $\frac{1}{2}d$
(c) $\sqrt{2}d$
(d) $2d$

7. A top is spinning counter-clockwise at 10 rev/s slows as it experiences a 2.0 rad/s^2 magnitude acceleration. After 10 seconds, through what angle has the top turned through?

(a) 7.3 x 10^2 rev
(b) 5.3 x 10^2 rad
(c) 1.0 x 10^2 rad
(d) 200 rotations

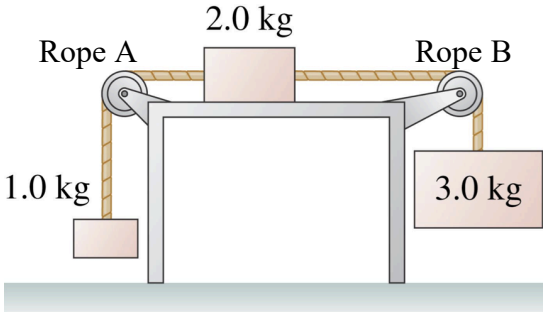


8. A 2.0 kg mass is attached to a string and held in equilibrium with the horizontal force as shown. If the hold force is 10 N, what is the tension in the string?

(a) 12 kg m/s
(b) 30 N
(c) 22 N
(d) 5.5 kg m/s^2

9. A block floats on a cushion of air. It is pushed to the right with a force that remains constant as the block moves from 0 to 1 and from 1 to 2 the size of the force steadily decreases until it reaches half of its initial value. For the block which of the following is true?

(a) Slows down from 1 to 2
(b) Moves at a constant speed from 0 to 1
(c) Speeds up from 1 to 2
(d) From 0 to 1, speeds up at first and then has a constant speed



10. Three masses are connected by massless strings over massless-frictionless pulleys as shown. The tabletop is very slippery, thus you can ignore friction. What is the acceleration of the system?

(a) 2.3 m/s^2
(b) 9.8 m/s
(c) 4.9 m/s^2
(d) 3.3 m/s^2

11. Which of the following statements is true?

(a) While standing on a scale in an accelerating elevator, the scale cannot read zero.

(b) The "lb" is a unit of mass.

(c) A box in the back of a car that doesn't slide when it stops is in equilibrium.

(d) In uniform circular motion the acceleration is non-zero.

12. A wooden block of 2.0 kg slides up a wooden ramp angled at 30º above the horizontal. As the block slides back down the ramp, what is the magnitude of the net force acting on the block? Please include friction.

(a) 6.4 kg m/s^2
(b) 5.9 N
(c) 9.8 kg m/s
(d) 13 N

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)**

The end sheets of a 12 cm diameter roll of toilet paper are pulled with an angular acceleration of 10 rad/s^2 from rest unwinding nearly 1.0 m of paper (don't judge). Assume the diameter of the roll is constant during this unwinding (lies!).

(a) After 0.30 m of the toilet paper has been unwound, how many revolutions has the roll completed?

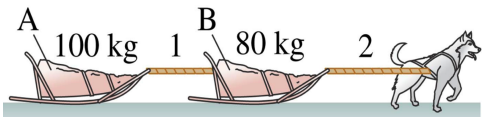
(b) What is its angular speed in rad/s when 0.30 m of paper has been unwound?

(c) What is the centripetal acceleration of the spool at this instance?
Be sure to explicitly state the direction in words.

(d) Explain/show the direction of the total acceleration vector at this instance, and what acceleration(s) are composed of the total acceleration. Words and possibly equations or a diagram are necessary in your answer, but no additional calculations are required.

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

A sled dog drags sled A and B across the snow. There is friction, but the coefficient is unknown.



(a) Draw a force diagram showing all forces acting on sleds A and B. Be sure to use proper labels for each force. If unsure, please name each force appropriately.

(b) If the net force acting on the system is 93.6 N, what is the acceleration of the system?

(c) If the tension in rope 1 is 150 N, what is the magnitude of the friction force acting on sled A?

(d) If the magnitude of the friction force acting upon sled B is 78 N, what is the tension in rope 2?

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

A 10 kg chair is pushed over a level floor at constant velocity with a force of 100 N at an angle of 30º below the horizontal, which has components of (87 N, -50 N). Friction cannot be ignored as the rug is quite thick (it really ties the room together).

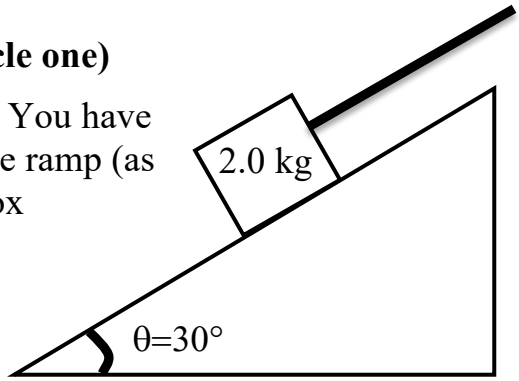
(a) What is the normal force exerted on the chair by the floor?

(b) What is the friction force acting on the chair? Be sure to include a magnitude and state the direction in words.

(c) What is the coefficient of friction between the floor and chair?

(d) If the chair is stopped and pushed again with 100 N at the same angle, it now does not move. Please explain with words and theory. A force diagram may help, but is not required.

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



Moving, you decide to use a ramp to make your life easier. You have a box connected to a rope that you are pulling parallel to the ramp (as shown) and the ramp is frictionless (which is nice). The box accelerates at 1.0 m/s^2 down the ramp.

(a) What is the net force acting upon the box? Be sure to provide a statement of direction in words along with your numerical force answer.

(b) What is the magnitude of the force that you are pulling up the ramp?

(c) After 200 ms, what is the velocity of the box?
Be sure to state a direction in words along with your numerical answer.

(d) Unfortunately, you let go of the box and it slides down the ramp colliding with a mirror sitting at the bottom of the ramp (bad luck?). The mirror is destroyed, but the box is intact. From this result, explain which experiences a larger force the box or the mirror? Please justify and explain your answer with words.