General Physics
Physics 101
Test #2 – Spring 2018
Wednesday 2/28/18
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:

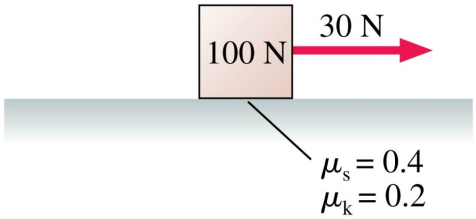
1. Blocks of mass 1.0 kg, 2.0 kg and 3.0 kg are lined up in a row on a frictionless table. All three are pushed forward by an 18 N force applied to the 1.0 kg block. What is the force of the 1.0 kg block on 2.0 kg block?

(a) 10 N
(b) 9.0 kg m/s
(c) 6.0 N
(d) 15 kg m/s^2

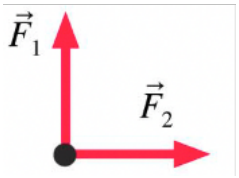
2. In the Quarter Quell arena, Katniss and company are on a small island in the middle of a lake that starts to spin from rest. The top speed of the island is one rotation every 3.0 seconds. Katniss is hanging near the edge of the island at 6.0 m from its axis of rotation and the island takes 15 s to reach top speed. During startup what is the angular acceleration of Katniss?

(a) 0.14 rad/s^2
(b) 0.022 rad/s^2
(c) 1.256 rad/s^2
(d) 0.20 rad/s^2

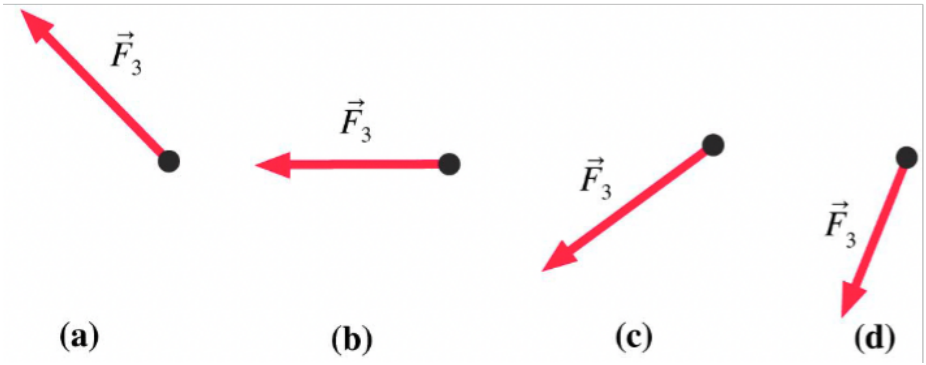
3. A box with a weight of 100 N is at rest. It is then pulled by a 30 N horizontal force. Does the box move?



(a) Yes
(b) No
(c) Too close to call
(d) Need more information



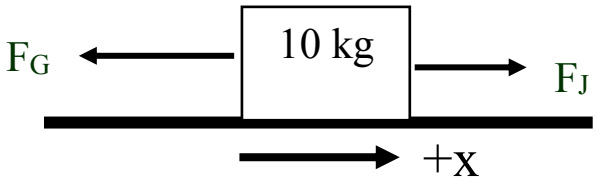
4. Three forces are acting on the same point and the net force of the system points to the right. Which vector could represent the third force?



5. Biff (75 kg) and Jesup (150 kg) are wrestling on an icy pond, which we can assume to be friction free. They are at a standstill and Biff unexpectedly pushes Jesup with a force of 1.5 kN. If the push takes 0.10 second, what is the magnitude of the acceleration of Biff?

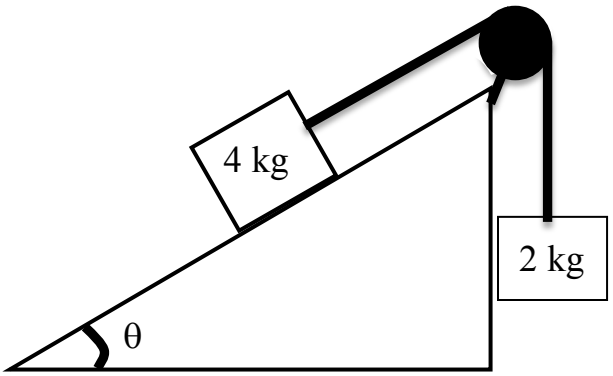
(a) 20 m/s^2
(b) 10 m/s^2
(c) 0.0 m/s^2
(d) Need more information

6. George and Jill are getting a divorce and are fighting over a 10 kg trunk (as shown). George "knows everything", so he is pulling with a force of 5.0 N magnitude, and knows the trunk is accelerating at 1.0 m/s^2 to the right. What force must Jill be pulling with for this to be the case? Pretend friction doesn't exist.



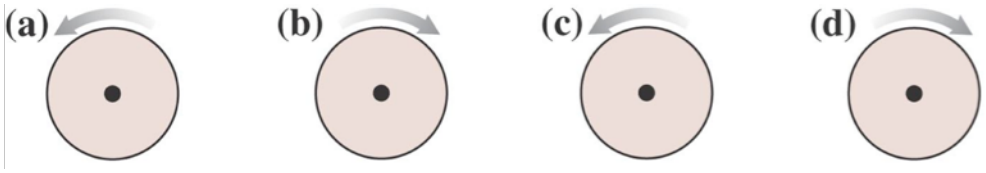
(a) 10 N
(b) 15 N
(c) 5.0 N
(d) -10 N

7. A 4.0 kg box is on a frictionless 20º ramp and is connected via a massless string over a massless, frictionless pulley to a hanging 2.0 kg weight. If you gently release the box, which way will it move on the ramp?



(a) Up
(b) Down
(c) It will not move
(d) Need more information

8. Which of the following has a negative angular acceleration?



Speeding up | Slowing down | Slowing down | Constant speed

9. A block pushed along the floor with velocity, *v*, slides a distance, d, after the pushing force is removed. What initial velocity is necessary, if you want the block to travel a distance of 4d before stopping?

(a) $8v$
(b) $4v$
(c) $2v$
(d) $\sqrt{2}v$

10. A 31.4 cm diameter pie plate rotates in uniform circular motion with an acceleration of 3.14 m/s^2. After 3.14 s, what is the angular speed of the plate?

(a) 20 rad/s
(b) 62.8 rad/s
(c) 3.16 rad/s
(d) 4.47 rad/s

11. Which of the following statements is false?

(a) Two points on a rigid wheel undergoing an angular acceleration always have the same angular velocity at a given time.

(b) Friction does not always point in the opposite direction of motion.

(c) The tangential acceleration of a point on the rim of a wheel is not constant if its angular velocity is constantly increasing.

(d) When punching through a wall with your hand, the force the hand exerts on the wall is the same as the force the wall exerts on the hand.

12. A block sliding on a friction free surface is being pushed with a small constant force to the right, causing the block's speed to increase. At a later time in the motion a second force is applied to the block in addition to the first force. This second force is the same magnitude as the first force but in the opposite direction. What happens to the block's speed after the second force is applied?

(a) Increases
(b) Stays the same
(c) Decreases
(d) Need more information

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)

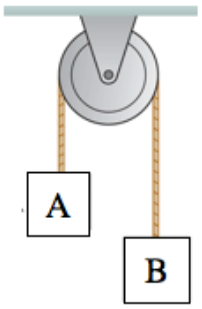
Astronauts use a centrifuge to simulate the acceleration of a rocket launch. The centrifuge has a top speed of 5.0 rad/s in the counter-clockwise direction and the astronaut is strapped into a seat 6.0 m from the axis of rotation. The centrifuge takes 5.0 seconds to travel from rest before to its top speed.

(a) What is the astronaut's tangential acceleration when speeding up to the top speed?

(b) How many revolutions did the astronaut make while speeding up to the top speed?

(c) Once at top speed, the centrifuge is moving in uniform circular motion, what is the direction of the acceleration on the astronaut? Be sure to justify your answer with words, theory and possibly equations.

(d) As the astronaut stops, if the centrifuge spins for 50 radians before it stops, what is the angular acceleration of the astronaut as she stops?



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

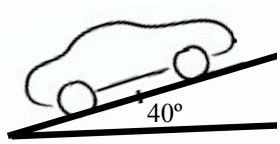
For the Atwood's machine shown, it takes Mass B 200 ms to fall 10 cm from rest. Note: $m_B > m_A$ and $m_A = 0.50$ kg.

(a) What is the acceleration (mag.) of the system?

(b) What is the tension in the string?

(c) What is the mass of block B?

(d) Please explain which block has a larger net force acting on it. Be sure to explain/justify your choice with words and theory.



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

A 2.0×10^3 kg car with rubber tires is parked on a concrete hill that has a 40º slope.

(a) What is the magnitude and direction of the normal force acting on the car? Please state the direction in words.

(b) What is the magnitude and direction of the friction force acting on the car? Please state the direction in words.

(c) If the car parks on a similar patch of concrete but the angle of the slope is larger, the car would still be stationary. Explain how this is possible in terms of your answer to (b) and the concept(s) of friction. No new calculations are necessary, but words are required.

(d) After a winter storm, the owner of the car attempted to park on the original 40º sloped hill, but unfortunately the car begins to slide. If the coefficient of kinetic friction between the tires and the road are 0.10, what is the acceleration (mag + dir) of the car?

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

A 500 g model rocket is launched vertically. The rocket engine, when it is fired exerts an 8.0 N thrust on the rocket. Your goal is to have the rocket pass through a small horizontal hoop that is 20 m above the launch point. Ignore mass loss.

(a) What is the acceleration of the rocket as the engine fires?

(b) How fast is the rocket traveling when it reaches the hoop?

(c) Part of the total mass of the rocket is a 5.0 mg ant, what net force does it experience while the rocket is fired?

(d) Once through the hoop, the rocket runs out of fuel, and it continues to travel upwards. Is the normal force experienced by the ant greater than or less than the force of gravity acting upon it. Please explain your answer with words and possibly a diagram.