

General Physics
Physics 101
Test #3 – Spring 2022
Wednesday 4/13/22
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: _____

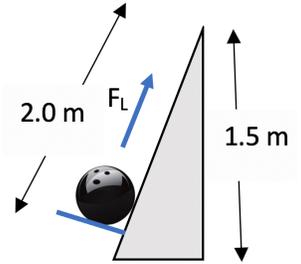
Part I. Multiple Choice (3 pts each)

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. A 5.0 kg bowlingball is lifted with a simple machine. If it travels 2.0 m during the lift, what force is required to lift the ball 1.5 m vertically? Assume it travels at a constant 1.5 m/s.



- (a) 37 N
- (b) 65 N
- (c) 2.8 N
- (d) 40 N

2. Which of the following statements is true?

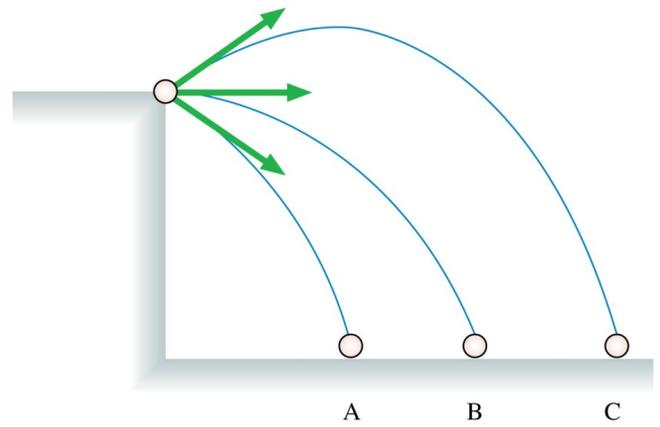
- (a) If the total momentum of a system is zero, the system is motionless.
- (b) An object in free-fall can have a non-zero kinetic energy at its max height.
- (c) In a conservative system, the total mechanical energy can change.
- (d) The net force acting on an object in uniform circular motion is zero.

3. A baseball player swings his 1.0 kg bat with a speed of 10 m/s, and hits a 60 g baseball that was approaching him at a speed of 20 m/s. If the ball rebounds at 40 m/s, what is the velocity of the bat immediately after the hit?

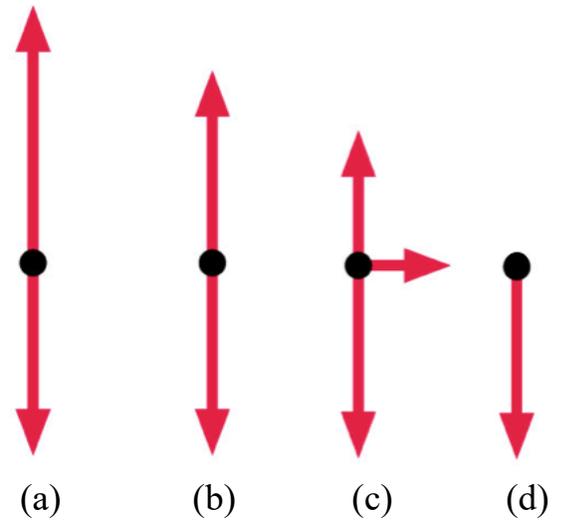
- (a) 0.0 m/s
- (b) 8.8 m/s
- (c) 6.4 m/s
- (d) 11 m/s

4. Three balls are thrown from a cliff with the same speed but at different angles. Which ball has the greatest speed just before it hits the ground?

- (a) Ball C
- (b) Ball B
- (c) Ball A
- (d) All balls have the same speed.

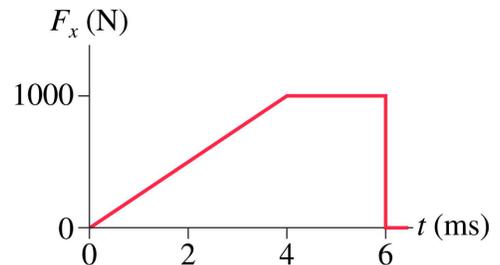


5. A car coasts over the top of a hill that has a radius of 50 m. If the car barely stays on the road at the top, which of the following force diagrams shows what is happening?



6. You throw your 1.0 kg book onto the table with a velocity of -1.0 m/s, and it experiences the force shown. What impulse does the book experience?

- (a) -1.0 Ns
- (b) 6.0 kg m/s
- (c) 4.0 Ns
- (d) 6.6 Nm



7. A 2.0 kg mass on the end of a 1.5 m long string is spun in a vertical circle. If at the bottom of the motion tension in the string is 3.0 times the gravitational force, what is the magnitude of the centripetal force acting on the mass at this point in the motion?

- (a) 20 N
- (b) 39 N
- (c) 59 N
- (d) 78 N

8. A process occurs in which a system's kinetic energy increase while the environment does work on the system. Does the system's potential energy... Ignore Thermal Energy.

- (a) Increase
- (b) Decrease
- (c) Stay the same
- (d) Not enough information to tell

9. A 5.0 kg block is launched up ramp with a 50 N/m spring. The block has a velocity of 5.0 m/s when it is climbed a vertical distance of 5.0 m from the launch point, what is the spring potential energy before launch?

- (a) 3.1×10^2 J
- (b) 62 Nm
- (c) 6.3×10^2 J
- (d) Need more information

10. Dan (50 kg) is gliding on his 5.0 kg skateboard at 4.0 m/s. He suddenly jumps backward off the skateboard, kicking it forward at 8.0 m/s. How fast is Dan going as his feet hit the ground?

- (a) 5.2 m/s
- (b) 3.6 m/s
- (c) 3.3 m/s
- (d) 36 m/s

11. Two 100 N/m springs are horizontally connected to a 2.0 kg block one on the left and one on the right (both springs are secured on the end not connected to the block). If the net force acting on the block is +10 N, when the right spring is compressed by 10 cm, by how much is the left spring compressed or stretched?



- (a) 20 cm
- (b) 10 cm
- (c) 0.0 cm
- (d) 40 cm

12. A cart on an air track is moving at 0.5 m/s when the air is suddenly turned off. The cart comes to rest after traveling 0.50 m. The experiment is repeated, but now the same cart is moving at 1 m/s when the air is turned off. How far does the cart travel before coming to rest?

- (a) 1 m
- (b) 2 m
- (c) 4 m
- (d) 8 m

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.

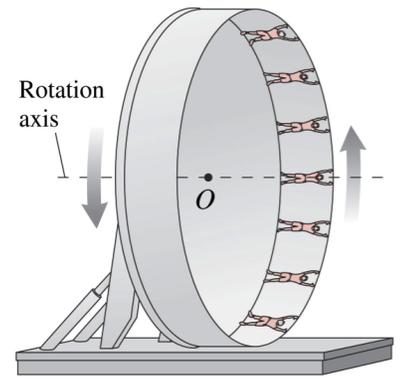
Please show all of your work, including equations without numbers.

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)

In an amusement park ride called “The Roundup”, passengers stand inside a 16-m diameter rotating ring. After the ring has acquired sufficient speed, it tilts into a vertical plane.



(a) Suppose the rider’s mass is 55 kg and they rotate at a constant speed of 11 m/s. What is the magnitude and direction of the net force when the rider is at the top of the ride? Please explicitly state direction.

(b) With how much force does the ring push on her at the bottom of the ride?

(c) As the ride spins, explain whether or not the magnitude of the net force, normal force and gravity acting on the passenger changes. Words and possibly force diagrams are necessary in your explanation to justify your answers.

(d) If the ride operates at the critical speed, what is the period of rotation?

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

A 1.0 kg, 2.0 kg and 3.0 kg ball approach each other for a collision. The 1.0 kg ball is traveling at 2.0 m/s to the east and the 3.0 kg ball is traveling at 5.0 m/s to the north-west, with components of 3.0 m/s to the west and 4.0 m/s to the north. After the collision, the balls stick together and are at rest.

(a) What is the velocity in the y-direction for the 2.0 kg ball pre-collision?

(b) What is the momentum in the x-direction for the 2.0 kg ball pre-collision?

(c) In this collision are momentum and/or kinetic energy conserved? Explain your answer using words, and be sure to address both momentum and kinetic energy.

(d) At what angle is the 2.0 kg ball traveling pre-collision?

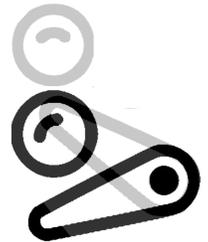
Question 3. Grade this problem? Yes or No (circle one)

Playing pinball at your local establishment, you launch the 80g ball using the spring loaded launcher. The spring is compressed 10 cm and it climbs a vertical distance of 50 cm until it turns around. We are ignoring the effects of the ball's rotation (sad, really)

(a) What is the spring constant of the launcher?

(b) What is the velocity of the ball after it has climbed 25 cm vertically?

(c) Using the concept of Work-Energy, explain how the force from the flipper can change the direction of the pinball. Be sure to include words and equations/theory in your explanation.



(d) In a multi-ball mode, two balls of equal mass collide elastically. The velocity of the first ball pre-collision is 1.0 m/s, and the velocity of the second ball pre-collision is -2.0 m/s. What is the velocity of the second ball post collision?

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

A 1000 kg steel beam is raised by a cable attached to a large crane. Starting from rest the beam travels 10 meters upwards while experiencing a total work of 10 kJ.

(a) What is the net force applied to the beam? Be sure to state the direction in words.

(b) What is the work done by tension?

(c) What is the velocity of the beam after traveling 10 m?

(d) Suddenly, the cable breaks and the beam crashes to the ground. Explain how momentum can be conserved in the beam's collision with the ground if post collision the beam is at rest.