Quiz 1: Newton's First Law and Third Law

1. Inertia is proportional to what quantity?
a) Velocity
b) Speed
c) Mass
d) None of the above

2. In the vacuum of space, is it ever possible to stop an object that is already moving?
a) No, an object in motion stays in motion
b) Yes, but only if an outside force acts on it
c) No, the vacuum prevents a change in velocity
d) None of the above

3. Whenever a change in motion is observed, what is always the cause?
a) Momentum
b) Force
c) Mass
d) Inertia
e) None of the above

4. If Newton's Third Law states that for every action there is an equal and opposite reaction, how is acceleration and motion possible?

5. If I stomp on the floor with 500 N of force, what is the force the floor pushes on me?
a) 250 N
b) 1000 N
c) 500 N
d) None of the above

6. If two objects of different masses collide, which of the two objects would accelerate in the direction opposite their original line of travel faster?

7. If a tractor-trailer truck is traveling down a road and is carrying cargo with k times the mass of the tractor, m, if the tractor accelerates forward, the force the tractor exerts on the trailer is
a) Greater than the force the trailer exerts on the tractor since the object is accelerating forward

b) Less than the force the trailer exerts on the tractor since the trailer is more massive
c) Equal to the force the trailer exerts on the tractor

8. If I throw a basketball with a force of magnitude F, the basketball exerts a force on me equal to what?

a) F/2
b) F
c) 2F
d) None of the above

9. Why is it that if I drop a bouncy ball against the floor, it returns to the height it was dropped from?

10. Why is it that objects in space tend to maintain their speed?

Quiz 2: Newton's Second Law

1. An object is dropped from a helicopter at time t
    a. Draw the free body diagram of the object before time t
    b. What is the acceleration of the object before time t
    c. Draw the free body diagram of the object at time t
    d. What is the acceleration of the object at time t
2. An object is being pulled by two strongmen, Angelo and Joe, Joe pulls on the object with a force of magnitude F, Angelo pulls on the object in the opposite direction with a force of magnitude F/2, if the object has a mass of magnitude m, what is the acceleration, what is the net force?
3. If a box is sliding down an incline with an angle θ at a constant velocity, which of the following is (are) true:
    a. It is in static equilibrium
    b. It's acceleration is 0 $\frac{m}{s^2}$
    c. The net force is 0 N
    d. All of the above
4. If a box is being pushed at a constant velocity, what is necessarily true about the friction force and the force applied to the box?
5. Which is always bigger in magnitude, μ_s or μ_k
6. If a box has mass, m, and a coefficient of static friction, μ_s, will the force of static friction always be equal to $\mu_s F_{normal}$ for any force applied on the box? (assume that it is not on an incline)
7. Why is it that objects on a table don't accelerate downwards towards the center of the Earth?
8. When is the friction force equal to $\mu_s F_{normal}$?
9. When is the friction force equal to $\mu_k mg$?
10. When is the friction force equal to $\mu_k mgsin(\theta)$?
11. Assume that a snowboarder rides down a course at a constant velocity, what is the coefficient of kinetic friction in terms of the degree of incline of the course (θ), the mass of the snowboarded, m, the gravitational field strength of Earth, g, and any other fundamental constants or trigonometric functions as needed?
12. Assume a box slides down a ramp at an angle θ with respect to the horizontal, the box has a mass of m and a coefficient of friction of μ.
    a. Draw a free-body diagram showing all forces (not components) that act on the box

b. Draw an expanded free-body diagram showing all forces and components that act on the box
c. What is an expression of the component of the gravitational force that acts perpendicular to the incline?
d. What is an expression of the component of the gravitational force that acts parallel to the incline?
e. What is an expression of the force of kinetic friction in terms of m, fundamental constants, θ, and trig functions as necessary?

13. Assume a box has a velocity, v and hits a section of rough terrain that has a coefficient of kinetic friction, μ_k, if the box has a mass of m, answer the following (assume air resistance is negligible) :
    a. Draw a free-body diagram of the box
    b. What is the acceleration of the box?
    c. How long will it take the box to come to a complete stop?
    d. How far will the box travel from its initial position when it comes to a complete stop?
    e. If the box started with a velocity of 2v, answer the following:
        i. What would its acceleration be when it hits the rough terrain?
        ii. How long will it take the box to come to a complete stop?
        iii. How far will the box travel from its initial position when it comes to a complete stop?
    f. If the box started with a velocity of kv, answer the following:
        i. What would its acceleration be when it hits the rough terrain?
        ii. How long will it take the box to come to a complete stop?
        iii. How far will the box travel from its initial position when it comes to a complete stop?
    g. If the box had a mass of 2m, answer the following:
        i. What would its acceleration be when it hits the rough terrain?
        ii. How long will it take the box to come to a complete stop?
        iii. How far will the box travel from its initial position when it comes to a complete stop?
    h. If the box had a mass of km, answer the following:
        i. What would its acceleration be when it hits the rough terrain?
        ii. How long will it take the box to come to a complete stop?
        iii. How far will the box travel from its initial position when it comes to a complete stop?
    i. If the coefficient of kinetic friction between the box and the rough terrain were changed to be $2\,\mu_k$ answer the following:
        i. What would its acceleration be when it hits the rough terrain?

ii. How long will it take the box to come to a complete stop?
iii. How far will the box travel from its initial position when it comes to a complete stop?

j. If the coefficient of kinetic friction between the box and the rough terrain were changed to be k μ_k answer the following:
i. What would its acceleration be when it hits the rough terrain?
ii. How long will it take the box to come to a complete stop?
iii. How far will the box travel from its initial position when it comes to a complete stop?

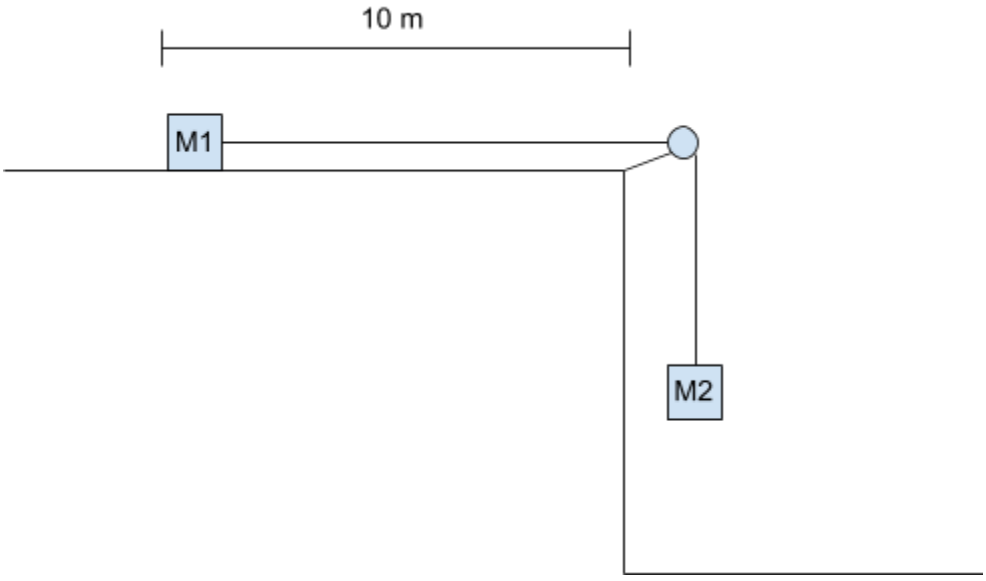
14. True or False: Newton's second law can be used to find the acceleration of an object which can be then used to solve kinematics problems?
15. Suppose a box is dropped off a cliff at an extreme height, what is true about the magnitude of the drag force the box experiences on its way down?

a) It increases as a function of time
b) It decreases as a function of time
c) It stays the same
d) It increases at first and then decreases
e) It decreases at first and then increases
f) None of the above

16. True or False: All objects, regardless of mass, accelerate towards the Earth at the same rate due to gravity (assume air resistance is negligible)
17. Assume a box slides down a ramp at an angle of 30 degrees with respect to the horizontal, the box has a mass of 50 kg and a coefficient of friction of .5 .
    a. Draw a free-body diagram showing all forces (not components) that act on the box
    b. Draw an expanded free-body diagram showing all forces and components that act on the box
    c. What is the magnitude of the component of the gravitational force that acts perpendicular to the incline?
    d. What is the magnitude of the component of the gravitational force that acts parallel to the incline?
    e. What is the magnitude of the force of kinetic friction?
18. Assume a box has a velocity, 50 $\frac{m}{s}$ and hits a section of rough terrain that has a coefficient of kinetic friction, .6 , if the box has a mass of 100 kg, answer the following (assume air resistance is negligible) :
    a. Draw a free-body diagram of the box
    b. What is the acceleration of the box?

c. How long will it take the box to come to a complete stop?
d. How far will the box travel from its initial position when it comes to a complete stop?

19. True or False: the static friction force will always match the force applied to it, until it reaches the maximum static friction force.
20. True or False: The kinetic friction force will always match the force applied to it, until it reaches the maximum kinetic friction force.
21. True or False: the greater the degree of incline, the greater the parallel component of the gravitational force
22. True or False: the greater the degree of incline, the greater the perpendicular component of the gravitational force
23. True or False: The normal force is always equal to the gravitational force
24. True or False: The velocity of an object is always constant when the net force is 0N
25. True or False: The drag force is proportional to velocity
26. True or False: The friction force is proportional to the normal force
27. True or False: If given a displacement vs time graph, one can find acceleration and use it along with the object's mass in newton's second law to get the net force.
28. Why do some objects fall at a slower rate than others?
29. Assume there are two boxes of masses, m_1 and m_2 respectively, $m_2 > m_1$ and the two are connected via a string and pulley system as shown below, the coefficient of friction between m_1 and the table is μ_k :

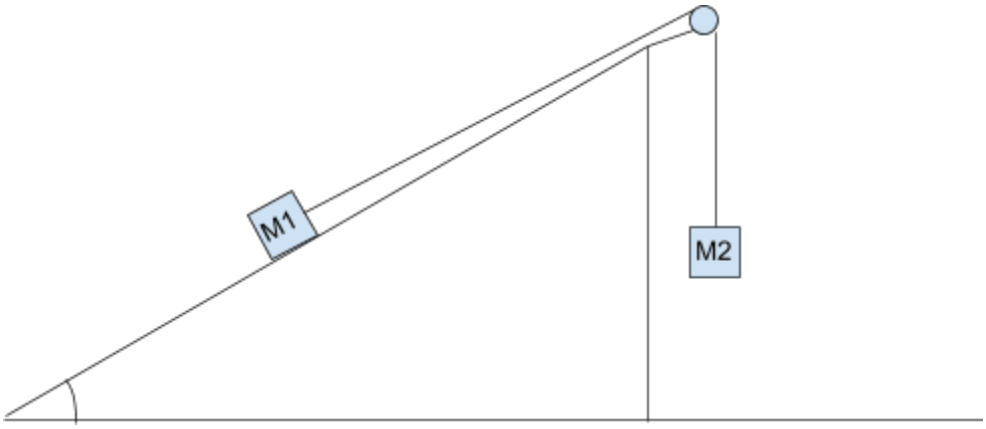


a. Draw a free-body diagram of m_1 and m_2 while m_1 is on the table

b. What is the net acceleration of the system down the table?
c. What is the tension force between m_1 and the rope?
d. What is the tension force between m_2 and the rope?
e. Draw a free-body diagram of m_1 while it is on its trajectory to the floor
f. What is the final velocity of m_1 as it reaches the end of the table?
g. Assuming the length of the rope is sufficiently long to not cause tension as m_1 lands on the floor, how far would it travel from the base of the table?
h. How long would it take m_1 to travel from the edge of the table to its final distance from the base of the table?
i. What is its acceleration as it is falling down?

30. True or False: Friction always acts in the direction that is opposite of how the object is sliding

31. Assume there are two boxes attached to a string pulley system as shown below, the boxes have different masses, such that $m_2 > m_1$, if the degree of the incline is θ and the coefficient of friction between m_1 and the incline is μ, answer the following (assume the ropes and pulley are massless and ideal).



a. Draw a free-body diagram for m_1
b. Draw a free-body diagram for m_2
c. What is the friction force for m_1
d. Is the acceleration of m_1 less than, equal to, or greater than m_2

e. What is the acceleration of m_1
f. What is the acceleration of m_2
g. Is the tension force of m_1 less than, equal to, or greater than m_2
h. What is the tension force of m_1
i. What is the tension force of m_2

32. True or False: the direction of the restoring force in a spring is always opposite that of the applied force?

33. An object of known mass, m, hangs on a spring with spring constant, k, how far down will the spring stretch in order to be in equilibrium?

34. True or False: The larger the spring constant, the stiffer the spring.