Gravity, Mass & Weight Questions and Notes Name:

1. What is the difference between mass and weight?  
   *Mass (scalar) is the amount of matter in an object and doesn’t change (kg), while weight (vector) is the downward for of gravity on an object (N). W=mg On a trip to the moon, your mass would not change, but your weight would.*
2. What is Newton’s Universal Law of Gravitation?  
   *All objects in the universe exert an attractive force on each other that depends on the mass of the objects and the distance between them. F = G x (m1m2/d2)*  
   1. Is gravity the same everywhere? <https://www.newscientist.com/article/dn24068-gravity-map-reveals-earths-extremes/>   
        
      <http://www.glencoe.com/sites/common_assets/science/virtual_labs/E25/E25.html>
3. Consider falling objects…
   1. How does a parachute keep a skydiver from plummeting to their death?  
      *Background knowledge: terminal velocity occurs when the downward force of gravity equals the upward force of air resistance. At this point, the object (or person) cannot travel any faster. When a skydiver opens the parachute, air resistance increases because of surface area. Air resistance also increases as the person picks up speed (they encounter more air particles). As soon as the air resistance is high enough to equal the downward force of gravity, the skydiver can no longer increase their speed and is said to have reached terminal velocity. The parachute lowers the terminal velocity by increasing air resistance, enabling the person to land safely.*
   2. Suppose you were to drop a bowling ball and a marble from bridge at the same time. Which would hit the water below first?  
      *Same time! The force of gravity would be greater on the bowling ball because of its larger mass, but it also has more inertia to overcome. The force of gravity would be less on the marble because of its smaller mass, but it also has less inertia.*

*Elephant: m = 1000 kg, F = 10,000 N, a = 10 m/s/s*

*Mouse = m = 1 kg, F = 10 N, a = 10 m/s/s*

* 1. If you shoot a gun and drop a bullet at the same time, which would hit the ground first?  
     *They would hit the ground at the same time.*

[*https://www.youtube.com/watch?v=YxRCyokN3g8&safety\_mode=true&persist\_safety\_mode=1*](https://www.youtube.com/watch?v=YxRCyokN3g8&safety_mode=true&persist_safety_mode=1)

1. Application of Newton’s Laws
   1. While driving down the road, an unfortunate bug strikes the windshield of a bus. The bug hit the windshield, and the windshield hit the bug. Which of the two forces is greater: the force on the bug or the force on the bus?  
      *The forces are EQUAL! The bug splatters, because with its smaller mass, it is less able to withstand the larger acceleration. F= mA (bug), F=Ma (bus)*

*2 N = (0.01 kg x 200 m/s2) for bug OR 2 N = (1000 kg x 0.002 m/s2) for bus*

* 1. A gun recoils when it is fired. The recoil is the result of action-reaction force pairs. As the gases from the gunpowder explosion expand, the gun pushes the bullet forward and the bullet pushes the gun backward. The acceleration of the recoiling gun is…
     1. greater than the acceleration of the bullet.
     2. **smaller than the acceleration of the bullet.**
     3. the same size as the acceleration of the bullet.

*The force on the gun equals the force on the bullet. However, the acceleration depends on both force and mass. Mass and acceleration are inversely proportional, so the bullet with the smaller mass has a greater acceleration, while the gun with the larger mass has a smaller acceleration.*

Can You Accelerate? Remember: F = ma and W = mg

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| --- | --- | --- | --- | --- | --- |
| Participant | Standing Force (N) | Max Force (N) | Change in Force (N) | Mass (kg) = Force/gravity | Accel (m/s2) = change in F/m |
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Scratch Paper for calculations: