Physics 200 Name: _____

Practice Test – Circular Motion, Gravity, and Energy

$G = 6.67 \times 10^{-11}\ Nm2/kg^2$

1. Calculate the gravitational force between a 1,200kg car and a 60kg person when their centers of mass are 5m apart.

2. A carnivalgoer who weighs 600N passes through a loop-the-loop at a constant speed of 20m/s. Even though they are upside-down, at the top of the loop they feel heavier than normal; they feel like they weigh 900N. What is the radius of the loop?

3. A 10,000kg bush elephant is floating in empty space, far from any other object. A tiny speck of dust is orbiting the elephant in a circular orbit at an orbital radius of 6m.

   a. What is the velocity of the dust speck?

   b. How many Earth days will it take the dust speck to orbit the elephant once?

4. Passengers on the Concorde (a retired supersonic passenger jet) flew at an altitude of nearly 20,000m, higher than any commercial jet flies today. At that altitude, its passengers were about 6.39 x 10^6m from the center of the Earth. What was the value of g that they experienced? Round to the nearest 0.01m/s^2. Earth's mass is 5.97 x 10^{24}kg.

5. A lazy curler uses their foot to accelerate a curling stone. They push the 20kg stone with a 15N force directed at a 50 degree downward angle (relative to horizontal). Ignoring friction, how much work do they do on the stone as they push it a horizontal distance of 2m?

6. Pat has a machine, and its purpose is to lift hay bales. The machine uses 1500W of power. The machine lifts a 25kg hay bale at a constant speed over a time interval of 11 seconds. In this time, the hay bale is lifted 12m.

   a. How much energy does the machine use during these 10 seconds?

   b. How much work does the machine do on the hay bale?

   c. What is the machine's % efficiency?

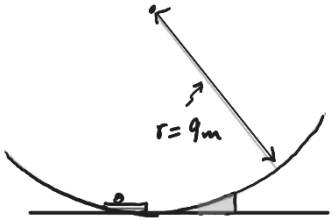
7. 16 students pull ropes, causing a sled to accelerate from rest on level ground. For every student pulling, a propulsive force of 24N gets applied to the sled. This force is applied to the sled over a distance of 17.4m. The total mass of the sled and the occupant is 83kg, and the coefficient of friction between the sled and the snow is 0.12.

a. How much total work do the students do on the sled?

b. How much work does friction do on the sled?

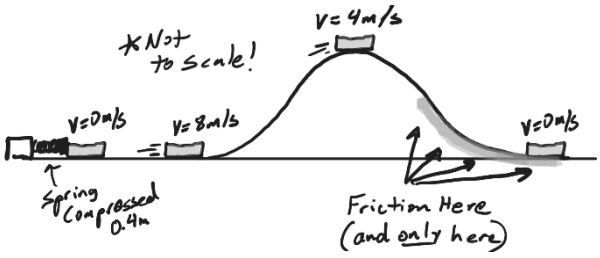
c. What is the sled's velocity after it accelerates for the full 17.4m?

8. Next the sled from the previous question begins to climb up a ramp. The entry to the ramp is an arc of a circle with a radius of **9m**. What value of g is felt by the sled and its occupant once they have entered this arc?



9. The same sled continues to travel up the ramp to a height of 0.8m before flying into the air. If we ignore friction and drag for this event, what is the sled's velocity when it reaches the top of the ramp?

10. A spring is **compressed a distance of 0.4m**, and it is placed next to a **0.15kg puck**. The puck and the spring are at a **height of 0m**. All of the energy stored in the spring is then used to launch the puck rightward, with no friction or drag. When the puck leaves the spring, it is traveling horizontally at a speed of **8m/s**. The puck slides frictionlessly up a hill until its speed has slowed to **4m/s**. It then slides down the other side of the hill and encounters a section of track where it experiences a constant friction force of **4N**. The puck continues to experience this friction until it returns to its original height of **0m**, where it comes to rest.



a. How much energy was stored in the spring before it pushed the puck?

b. What is the spring's constant, k?

c. What maximum force does the spring apply?

d. What is the height of the top of the hill?

e. How much work is done on the puck by friction?

f. How far does the puck slide while it experiences friction?