Mr. Renwick’s Physics 11 Name: _______________
Worksheet - Work, Energy, and Power Review

Questions

1. How much kinetic energy is there in a 1,300 kg car travelling at 65 km/h?
2. How much gravitational potential energy is there in a 150 g apple that is hanging from a tree 2.5 m in the air?
3. There is a 2.0 kg sled sliding down a hill.
    1. If the 73.5 kg rider wants to be going 120 km/h when the sled reaches the bottom of the hill, how high vertically up the hill should they start? Assume there is no drag or friction.
    2. The rider starts 56.6 m vertically up the hill, and rides down. However, the radar at the bottom records a final speed of only 96.6 km/h. How much energy was lost to friction and drag?
    3. The rider decides they want to go faster. They carry 75.5 kg of weights onto the sled, at a vertical height of 56.6 m up the hill. The energy lost to drag, 10,300 J, does not change. However, the energy lost to friction doubles to 8,880 J. How fast is will the rider be going at the bottom of the hill?
    4. Why does increasing the rider’s mass increase the rider’s final speed?
4. On Earth, an astronaut can crack a peanut by performing 110 J of work on it.
    1. They crack a peanut using a 1.0 kg mass. From what height must it be dropped, assuming no energy losses?
    2. Assuming that the transfer of energy from the 1.0 kg mass to the peanut is only 32% efficient, from what height must the mass be dropped?
    3. The astronaut now goes to the moon, where the force of gravity is 1.62 N/kg on the surface. Assuming 32% efficiency, from what height must the mass be dropped?
5. The astronaut goes to an asteroid with a radius of $95\underline{0}$ km and a mass of 9.39×10^{19} kg. What is the force of gravity on the surface of the asteroid?
6. A student with a mass of 32 kg runs up a 3.2 m tall set of stairs in 1.5 seconds. What is their power output, in horsepower? A horsepower (1 hp) is equal to 745.7 W.
7. In BC, electricity costs about 11.43 cents per kilowatt-hour.
    1. With $10.00, how long (in days) could you keep a $10\underline{0}$ W incandescent bulb lit?
    2. How much would it cost to keep the equivalent LED bulb lit for this long, considering the LED bulb only consumes 15.5 W?
8. A student wants to launch a 75 g ball to a height of 3.5 m. They have a spring with a constant of 92.5 N/m. If the process is 100% efficient, how far must they compress the spring to launch the ball?

9. An input gear with 4 teeth is attached to an output gear with 32 teeth.
    1. What is the mechanical advantage of the gear system?
    2. If the gear system is 92% efficient, what is the magnitude of the output force if an input force of 25 N is applied?
10. A force of 250 N is needed on the output arm of a 23 cm lever. The input arm has a length of 78 cm. What is the magnitude of the needed input force?
11. A pulley system with 8 ropes is being used to lift a mass of 1,200 kg.
    1. What is the magnitude of the force which which the operator must pull on the rope?
    2. How far must the operator pull the rope to move the mass to a height of 25 m?

Answers

1. E_k = 210,000 J = 210 kJ
2. Ep = 3.7 J
3. 1. h_i = 56.6 m
   2. E_{lost} = 14,700 J
   3. vf = 29.3 m/s = 105 km/h
   4. Because the energy lost due to drag is not proportional to the mass, so doubling the mass doubles the force of gravity and the force of friction, but not the drag force.
4. 1. h = 11 m
   2. h = 35 m
   3. h = 210 m
5. **g** = 6.94×10^{-3} N/kg [down]
6. P = 670 W = 0.90 hp
7. 1. t = 3.15×10^{6} s = 36.4 days
   2. $1.55
8. x = 0.24 m
9. 1. MA = 8
   2. F_{out} = 180 N
10. F_{in} = 74 N
11. 1. F_{in} = 1,500 N
    2. d_{in} = 200 m