Work, Energy, and Power **Name_____**

Honors Physics

Work

1. A child pulls her sled across the snow with a horizontal force of 50 N for 30 m at a constant velocity. How much work did she do on the sled?
2. An adult reaches down and pulls the sled with a force of 50 N at an angle of 30^o above the horizontal for 30 m at a constant velocity. How much work did the adult do on the sled?
3. How much work would an 80 kg person have to do in order to lift his/her own body weight up the entire flight of stairs of the Empire State building (FYI: 1576 stairs!) , which is 320 meters high?
4. How much work does a football player do in the weight room when he squats 150 kg up a distance of 1 meter? How much work does he do if he does 3 sets of 10 squats in a row?

Gravitational Potential Energy

5. How much potential energy does a 1500 kg roller coaster have when it is at the top of a 20 meter hill?
6. Calculate the potential energy of 4.3×10^6 kg of water at the top of Niagara Falls, which is 22 m high.
7. The energy content of 1 gallon of gasoline is 132,000,000 Joules per gallon and the Empire State building has a mass of 331,000,000 kg. If you could set the gallon of gasoline off, and transfer all of the energy to the building, how high could you lift the building into the air?
8. Calculate the height of stairs a 60 kg student would have to run in order to burn off 1 Calorie of food energy, which is the equivalent of 4190 Joules.
9. Consider the combined mass of the cyclist and bike to be 80 kg. How much energy does a cyclist use in climbing Mount Ventoux in the Tour de France, which has a height of 1912 meters?

Elastic Potential Energy (Springs)

10. A mass of 0.44 kg is placed on a spring and it stretches 0.051 m. Calculate the spring constant of the spring using Hooke's law (F =kx).
11. Calculate the energy stored in a spring with a spring constant of 12 N/m when it is stretched out 0.35 meters.
12. How far does a spring with a spring constant of 15 N/m need to be compressed in order to store 20 J of energy?

Kinetic Energy

13. Calculate the kinetic energy of a car that has a mass of 1950 kg that is traveling 27 m/s.
14. Calculate the kinetic energy of a 0.050 kg bullet that is traveling 400 m/s.
15. How fast would a 60 kg student have to run in order to have a kinetic energy of 2000 Joules?
16. Calculate the kinetic energy of a 1000 kg car is traveling at 10 m/s, and then calculate and compare that energy to the kinetic energy the same car would have if it were going 20 m/s. (Note: the velocity doubled. What happened to the KE? Look at the KE equation. Why does this happen?)

Power

17. Calculate the power output of a motor that is able to do 1500 Joules of work in 30 seconds. Then, calculate and compare that power rating to another motor that does 1500 Joules of work in 15 seconds.
18. If a lawn mower engine is rated as a 1 Horsepower motor, its power rating is 746 Watts. Calculate how long it would take a 746 Watt motor to do 2000 Joules of work.
19. If the same 746 Watt motor were hooked up to a winch, how long would it take the motor to lift a 60 kg student up to the top of the Empire State building, which is 443 meters high?
20. How many Joules of energy are used by a 1119 Watt motor that is left running for 30 minutes?

Answers

1. 1500 J
2. 1300 J
3. 251,000 J
4. 1470 J ; 44,100 J
5. 294,000 J
6. 9.3×10^8 J
7. 0.04 m (4 cm)
8. 7.1 m
9. 1.5×10^6 J
10. 84.5 n/m
11. 0.74 J
12. 1.6 m
13. 711,000 J
14. 4000 J
15. 8.2 m/s
16. 50,000 J ; 200,000 J
17. 50 W ; 100 W
18. 2.7 s
19. 350 s
20. 2,014,200 J