Physics 112 - Work, Energy and Power

1. How much work must be done to roll a safe of mass 90.0 kg a distance of 15.0 m across a level floor where the coefficient of friction is 0.0450? (596 J)

2. A force of 8.0 N is applied to a mass of 2.0 kg which is initially at rest. If the frictional force which opposes the motion of this mass is 3.0 N, how much work is done in 6.0 s? (360 J)

3. A lawn roller is pushed over a level surface, at a constant velocity, a distance of 0.500 km by a force of 250 N applied to the handle which makes an angle of 35° with the horizontal. How much work is done? $(1.03 \times 10^5$ J)

4. A 10 N object is pushed along a horizontal floor with a force of 5.0 N. If the coefficient of friction is 0.20 and if the object is pushed for a distance of 4.0 m, calculate
   (a) the total work done (20 J)
   (b) the acceleration (3.0 m/s^2)
   (c) the final velocity (4.0 m/s)
   (d) the final kinetic energy (12 J)
   (e) the energy lost to heat. (8 J)

5. A body weighing 400 N is pushed across the floor by a person who exerts a force of 96 N for 2.0 seconds. The object starts from rest and the coefficient of friction is 0.020.
   (a) how much work is done? (4.2×10^2 J)
   (b) How much energy is lost to heat? (35 J)
   (c) What is the final speed of the body? (4.4 m/s)

6. A 250 gram bullet is fired from a gun with a muzzle velocity of 300 m/s.
   (a) What is the kinetic energy of the bullet? (1.13×10^4 J)
   (b) What average force must be exerted by the powder gases to give the bullet this energy if the barrel of the gun is 50.0 cm long? (2.26×10^4 N)

7. A 1.00 kg balloon, full of water, is dropped from the top of a 100 m tall building. Just as the balloon strikes the ground its speed is 40 m/s. How much heat energy is transferred to the air? (180 J)

8. A bowling ball of mass 2.00 kg rolls off a table, which is 1.25 m high, with a speed of 1.00 m/s. What speed will it have when it hits the floor? (5.05 m/s)

9. A body weighing 30.0 N is pushed across a level floor by a force of 10.0 N parallel to the floor for a distance of 4.00 m. the coefficient of friction is 0.20.
   (a) How much work is done by the person? (40.0 J)
   (b) What is the kinetic energy of the body after being pushed? (16 J)
   (c) What is the final speed of the body? (3.2 m/s)
   (d) Why isn't the work done equal to the kinetic energy?

10. A 150 N body is allowed to slide down a frictionless inclined plane 2.00 m high and 10.0 m long.
   (a) How much kinetic energy will the body have when it reaches the bottom of the plane? (300 J)
   (b) What will its velocity be? (6.26 m/s)

11. A 100 N rock rolls down a hill that is 2.00 m high and 5.00 m long. The force of friction is 12 N.
   (a) What is the potential energy of the rock at the top of the hill? (200 J)

(b) How much energy is lost due to heat?   (60 J)

(c) What is the kinetic energy of the rock when it reaches the bottom?   (140 J)

(d) What is the velocity of the rock when it reaches the bottom of the hill?   (5.29 m/s)

12. A pendulum bob of mass 0.50 kg has a maximum velocity of 2.0 m/s. What is the greatest height to which it swings?   (0.20 m)

13. A 2.00 kg ball rolls across a level road and into a ditch. If the speed of the ball is 10.0 m/s and the ditch is 1.00 m deep, calculate, assuming no friction,

(a) the ball's speed when half way down the slope of the ditch.   (10.5 m/s)

(b) the ball's speed when it has reached the bottom   (11.0 m/s)

(c) the vertical height to which the ball will rise up the far slope before stopping.   (6.12 m)

14. A loaded elevator has a mass of 2.5×10^3 kg. If it is raised, at constant speed, to a height of 45 m in 8.5 s, what power is used?   (1.3×10^5 W)

15. An engine must exert a force of 3500 N to pull a railroad car along a horizontal track at the rate of 15 m/s. What power is being developed by this engine?   ($5.3x10^4$ W)

16. How long will it take a 10 kW motor to raise, at constant speed, a 150 kg object to a height of 40 m?   (5.9 s)

17. How many kilowatts will be required to move a car which weighs 15 000 N up a grade which rises 5.00 m for every 100 m of roadway at the rate of 30 km/h? The frictional force is 1800 N. (21 kW)

18. A motor is rated to deliver 10 kW of power. At what speed, in m/min, can this motor raise a mass of 2.75×10^4 kg?   (2.2 m/min)

19. A spring that can be stretched 10.0 cm by a force of 50.0 N is attached to a wall and pulled horizontally until it is stretched 30.0 cm.

(a) How much force is being applied when the spring is stretched this far?   (150 N)

(b) What is the average force used to stretch the spring this far?   (75 N)

(c) What is the amount of work done in stretching the spring?   (23 J)

(d) What is the potential energy stored in the spring while it is stretched this far?   (23 J)