Energy, Work, Power and Efficiency Worksheet

1. Calculate the work done by a 47 N force pushing a pencil 0.26 m.
2. Calculate the work done by a 47 N force pushing a 0.025 kg pencil 0.25 m against a force of 23 N.
3. Calculate the work done by a 2.4 N force pushing a 400 g sandwich across a table 0.75 m wide.
4. How far can a mother push a 20.0 kg baby carriage, using a force of 62 N, if she can only do 2920 J of work?
5. How much work is it to lift a 20 kg sack of potatoes vertically 6.5 m?
6. If a small motor does 520 J of work to move a toy car 260 m, what force does it exert?
7. A girl pushes her little brother on his sled with a force of 300 N for 750 m. How much work is this if the force of friction acting on the sled is (a) 200 N, (b) 300 N?
8. A 75.0 kg man pushes on a 500,000 ton wall for 250 s but it does not move. How much work does he do on the wall?
9. A boy on a bicycle drags a wagon full of newspapers at 0.80 m/s for 30 min using a force of 40 N. How much work has the boy done?
10. What is the gravitational potential energy of a 61.2 kg person standing on the roof of a 10-storey building relative to
    (a) the tenth floor,
    (b) the sixth floor,
    (c) the first floor. (Each storey is 2.50 m high.)
11. A 10 000 kg airplane lands, descending a vertical distance of 10 km while travelling 100 km measured along the ground. What is the plane’s loss of potential energy?
12. A coconut falls out of a tree 12.0 m above the ground and hits a bystander 3.00 m tall on the top of the head. It bounces back up 1.50 m before falling to the ground. If the mass of the coconut is 2.00 kg, calculate the potential energy of the coconut relative to the ground at each of the following sites:
    (a) while it is still in the tree,
    (b) when it hits the bystander on the head,
    (c) when it bounces up to its maximum height,
    (d) when it lands on the ground,
13. Calculate the kinetic energy of a 45 g golf ball travelling at:
    (a) 20 m/s, (b) 40 m/s, (c) 60 m/s.
14. When the speed of an object doubles, does its kinetic energy double? Explain your answer.
15. How fast must a 1000 kg car be moving to have a kinetic energy of:
    (a) 2.0 x 10^3 J, (b) 2.0 x 10^5 J, (c) 1.0 kW·h?
16. How high would you have to lift a 1000 kg car to give it a potential energy of:
   (a) $2.0 \times 10^3$ J,  
   (b) $2.00 \times 10^5$ J,  
   (c) 1.00 kW·h?

17. A 50 kg bicyclist on a 10 kg bicycle speeds up from 5.0 m/s to 10 m/s.
   (a) What was the total kinetic energy before accelerating?
   (b) What was the total kinetic energy after accelerating?
   (c) How much work was done to increase the kinetic energy of the bicyclist?
   (d) Is it more work to speed up from 0 to 5.0 m/s than from 5.0 to 10.0 m/s?

18. At the moment when a shotputter releases a 5.00 kg shot, the shot is 3.00 m above the ground and travelling at 15.0 m/s. It reaches a maximum height of 8.00 m above the ground and then falls to the ground. If air resistance is negligible,
   (a) What was the potential energy of the shot as it left the hand relative to the ground?
   (b) What was the kinetic energy of the shot as it left the hand?
   (c) What was the total energy of the shot as it left the hand?
   (d) What was the total energy of the shot as it reached its maximum height?
   (e) What was the potential energy of the shot at its maximum height?
   (f) What was the kinetic energy of the shot at its maximum height?
   (g) What was the kinetic energy of the shot just as it struck the ground?

19. A power mower does $9.00 \times 10^5$ J of work in 0.500 h. What power does it develop?

20. How long would it take a 500 W electric motor to do $1.50 \times 10^5$ J of work?

21. How much work can a 22 kW car engine do in 60 s if it is 100% efficient?

22. A force of 5.0 N moves a 6.0 kg object along a rough floor at a constant speed of 2.5 m/s.
   (a) How much work is done in 25 s.?
   (b) What power is being used?
   (c) What force of friction is acting on the object?

23. How much electrical energy (in kilowatt hours) would a 60.0 W light bulb use in 60.0 days if left on steadily?

24. A 6.0 kg metal ball moving at 4.0 m/s hits a 6.0 kg ball of putty at rest and sticks to it. The two go on at 2.0 m/s.
   (a) What is the kinetic energy of the metal ball before it hits?
   (b) What is the kinetic energy of the metal ball after it hits?
   (c) What is the kinetic energy of the putty ball after being hit?
   (d) How much energy does the metal ball lose in the collision?
   (e) How much kinetic energy does the putty ball gain in the collision?
   (f) What happened to the rest of the energy?
25. A 3.0 kg metal ball, at rest, is hit by a 1.0 kg metal ball moving at 4.0 m/s. The 3.0 kg ball moves forward at 2.0 m/s and the 1.0 kg ball bounces back at 2.0 m/s.
   (a) What is the total kinetic energy before the collision?
   (b) What is the total kinetic energy after the collision?
   (c) How much energy is transferred from the small ball to the large ball?

26. Two balls with the same mass, one of wood and the other a ping-pong ball partly filled with sand, are rolled along a desk. The wooden ball rolls along nicely, but the ping-pong ball stops in a few centimetres. What happened to its kinetic energy? Was the kinetic energy changed to heat energy by the force of friction between the ball and the desk? Explain your answer.

27. How much heat energy is needed to raise the temperature of 50 g of lead by 4.0°C?

28. By how much would 1500 J of heat energy raise the temperature of 0.50 kg of aluminum?

29. What is the specific heat capacity of a material if 2000 J of heat energy can raise the temperature of 10 g of it by 140°C?

30. Suppose that your car has a mass of 1000 kg and is made completely of steel. What temperature change would 1.0 kW·h of heat energy produce in it?

31. A large tank of water in the basement of a solar home measures 4.0 m by 4.0 m by 2.0 m. The density of water is 1000 kg/m³. The temperature of the water is 70°C.
   (a) What volume of water can be stored in the tank?
   (b) What is the mass of this water?
   (c) How much heat energy will be released by the water as it cools from 70°C to room temperature (20°C), in kilowatt hours?

32. A 12 V car battery is found to be capable of storing 2.0 kW·h of electrical energy. For a certain electric car, it is necessary to develop 10 kW of power to drive at 20 km/h.
   (a) Suppose that the car has 10 such batteries. How long (in hours) could it run if all 10 of them released all of their energy?
   (b) How far (in kilometres) can the car go on its 10 batteries if they are fully charged?