

**Physics 03-04 Power**

Name: \_\_\_\_\_

Rate that \_\_\_\_\_ is \_\_\_\_\_

$$P = \frac{W}{t}$$

Unit: joule/s = watt (W)

Power is the \_\_\_\_\_ that \_\_\_\_\_ is \_\_\_\_\_

A 1000 kg car accelerates from 0 to 100 km/h in 3.2 s on a level road. Find the average power of the car.

**Electrical Energy**Often measured in \_\_\_\_\_ because  $Pt = W$ 

If it costs \$0.10 per kWh, how much will it cost to run a 1000 W microwave for 2 minutes?

**Homework**

1. Is it correct to conclude that one engine is doing twice the work of another just because it is generating twice the power? Explain.
2. Explain, in terms of the definition of power, why energy consumption is sometimes listed in kilowatt-hours rather than joules.
3. A spark of static electricity, such as that you might receive from a doorknob on a cold dry day, may carry a few hundred watts of power. Explain why you are not injured by such a spark.
4. A person is making homemade ice cream. She exerts a force of magnitude 22 N on the free end of the crank handle, and this end moves in a circular path of radius 0.28 m. The force is always applied parallel to the motion of the handle. If the handle is turned once every 1.3 s, what is the average power being expended? (Cutnell 6.56) **30 W**
5. One kilowatt · hour (kWh) is the amount of work or energy generated when one kilowatt of power is supplied for a time of one hour. A kilowatt · hour is the unit of energy used by power companies when figuring your electric bill. Determine the number joules of energy in one kilowatt · hour. (Cutnell 6.57)  **$3.6 \times 10^6$  J**
6. A 300-kg piano is being lifted at a steady speed from ground level straight up to an apartment 10.0 m above the ground. The crane that is doing the lifting produces a steady power of 400 W. How much time does it take to lift the piano? (Cutnell 6.58) **73.5 s**
7. In 2.0 minutes, a ski lift raises four skiers at constant speed to a height of 140 m. The average mass of each skier is 65 kg. What is the average power provided by the tension in the cable pulling the lift? (Cutnell 6.59) **3000 W**
8. A person in good physical condition can put out 100 W of useful power for several hours at a stretch, perhaps by pedaling a mechanism that drives an electric generator. Neglecting any problems of generator efficiency and practical considerations such as resting time: (a) How many people would it take to run a 4.00-kW electric clothes dryer? (b) How many people would it take to replace a large electric power plant that generates 800 MW? (OpenStax 7.32) **40, 8 million**
9. What is the cost of operating a 3.00-W electric clock for a year if the cost of electricity is \$0.0900 per kWh? (OpenStax 7.33) **\$2.37**
10. A large household air conditioner may consume 15.0 kW of power. What is the cost of operating this air conditioner 3.00 h per day for 30.0 d if the cost of electricity is \$0.110 per kWh? (OpenStax 7.34) **\$149**
11. (a) What is the average power consumption in watts of an appliance that uses 5.00 kWh of energy per day? (b) How many joules of energy does this appliance consume in a year? (OpenStax 7.35) **208 W,  $6.57 \times 10^9$  J**
12. A 500-kg dragster accelerates from rest to a final speed of 110 m/s in 400 m (about a quarter of a mile) and encounters an average frictional force of 1200 N. What is its average power output in watts and horsepower if this takes 7.30 s (1 hp = 746 W)? (OpenStax 7.37)  **$4.80 \times 10^5$  W, 643 hp**
13. (a) How long will it take an 850-kg car with a useful power output of 40.0 hp (1 hp = 746 W) to reach a speed of 15.0 m/s, neglecting friction? (b) How long will this acceleration take if the car also climbs a 3.00-m-high hill in the process? (OpenStax 7.38) **3.20 s, 4.04 s**
14. (a) What is the available energy content, in joules, of a battery that operates a 2.00-W electric clock for 18 months? (b) How long can a battery that can supply  $8.00 \times 10^4$  J run a pocket calculator that consumes energy at the rate of  $1.00 \times 10^{-3}$  W? (OpenStax 7.40)  **$9.46 \times 10^7$  J, 2.54 yr**