Physics 2204
Unit 3: Work, Power and Energy
Worksheet 2: Power

Student Name:_____

Power refers to the rate at which work is done.

The formulae for calculating power is:

$$Power = \frac{Work}{\Delta time} = \frac{W}{\Delta t} \qquad Power = \frac{Energy}{\Delta Time} = \frac{E}{\Delta t}$$

Work (W) is measured in joules (J)

Time(t) is measured in seconds (s)

Power(P) is measured in J/s or Watts

The formula for the power of lifting is:

$$Power = \frac{mgd}{\Delta t}$$

Power is a scalar quantity

Example 1:

Calculate the power developed by a runner able to do 7.0 x 10^2 J of work in 2.0 s.

Example 2:

How much work is done by a crane in 1.7 s, if it has a power output of 3.9 x 10^4 W?

Example 3:

How long would it take a 1.00 kW electric motor on a conveyor belt to do 750 J of work?

Example 4:

A woman lifts a 125 N child a distance of 1.5 m in 0.75 s. What is her power output in lifting the child?

PART A: MULTIPLE CHOICE

Instructions: Shade the letter of the correct answer on the computer scorable answer sheet provided

1. Which represents the rate of work done?

(A) Efficiency
(B) Force
(C) Power
(D) Work

2. What is the definition of power?

(A) Force on an object divided by the time the force acts
(B) Force on an object times the distance the object moves
(C) Work done on an object divided by the time taken to do the work
(D) Work done times the time taken to do that work

3. What is the unit of measure for power?

(A) Joule
(B) Newton/kg
(C) Newton •second
(D) Watt

4. Which of the following is equivalent to a watt

(A) J
(B) J •s
(C) J/s
(D) J/s^2

5. Which of the following is not a formula for calculating power?

(A) $P = \frac{\vec{F}}{t}$

(B) $P = \frac{mgh}{t}$

(C) $P = \frac{E}{\Delta t}$

(D) $P = \frac{\vec{F} \bullet \vec{d}}{\Delta t}$

6. A student normally takes 40 s to climb a flight of stairs. Which is true if she climbs the same stairs in 20 s?

(A) She develops half her normal power
(B) She develops twice her normal power
(C) She does half as much work
(D) She does twice as much work

7. A teacher has twice the mass of a student. If they both run up the same flight of stairs in the same amount of time, which statement is true?

(A) The student generated greater power
(B) The student was faster
(C) The teacher did less work
(D) The teacher generated greater power

8. Two students with the same mass run up a flight of stairs. If student A runs twice as fast as student B, which statement is true?

(A) Student A did more work.
(B) Student A generated more power.
(C) Student B did more work.
(D) Student B generated more power

9. How much energy does a 100 W electric bulb transfer in 1 min?

(A) 100 J
(B) 600 J
(C) 3600 J
(D) 6000 J

10. What is the power used in doing 81J of work in 9.0 s?

(A) 0.11 watts
(B) 9.0 watts
(C) 90 watts
(D) 729 watts

11. How much power is required to do 40 J of work on an object in 5 s?

(A) 5 W
(B) 8 W
(C) 40 W
(D) 200 W

12. A 65 kg girl climbs a 4.0 m ladder in 5.0 s. How much power does she generate?

(A) 52 W
(B) 510 W
(C) 13 000 W
(D) 51 000 W

13. How much power is generated in lifting a 55 kg block 3.5 m in a time of 3.2 s?

(A) 36 W
(B) 490 W
(C) 590 W
(D) 1900 W

14. How much power is required to raise a 30. kg crate a vertical distance of 6.0 m in a time of 4.0 s?

(A) 45 W
(B) 290 W
(C) 440 W
(D) 1800 W

15. A construction worker uses 643 W of power in lifting a load of bricks to a support stand 1.50 m from the ground in a time of 0.70s. What was the mass of the bricks she lifted?

(A) 0.327 kg
(B) 3.06 kg
(C) 30.6 kg
(D) 68.9 kg

Power problems:

1. A toaster oven uses 67,500 joules of energy in 45 seconds to toast a piece of bread. What is the power of the oven?

2. A horse moves a sleigh 1.00 kilometer by applying a horizontal 2,000-newton force on its harness for 45 minutes. What is the power of the horse? (Hint: Convert time to seconds.)

3. A wagon is pulled at a speed of 0.40 meters/sec by a horse exerting an 1,800-newton horizontal force. What is the power of this horse?

4. Emily's vacuum cleaner has a power rating of 200 watts. If the vacuum cleaner does 360,000 joules of work, how long did Emily spend vacuuming?

5. Nicholas spends 20 minutes ironing shirts with his 1,800-watt iron. How many joules of energy were used by the iron? (Hint: convert time to seconds).

6. It take a clothes dryer 45 minutes to dry a load of towels. If the dryer uses 6,750,000 joules of energy to dry the towels, what is the power rating of the machine?

7. A 1000-watt microwave oven takes 90 seconds to heat a bowl of soup. How many joules of energy does it use?

8. A force of 100 newtons is used to move an object a distance of 15 meters with a power of 25 watts. Find the work done and the time it takes to do the work.

9. If a small machine does 2,500 joules of work on an object to move it a distance of 100 meters in 10 seconds, what is the force needed to do the work? What is the power of the machine doing the work?

10. A machine uses a force of 200 newtons to do 20,000 joules of work in 20 seconds. Find the distance the object moved and the power of the machine. (Hint: A joule is the same as a Newton-meter.)

11. A machine that uses 200 watts of power moves an object a distance of 15 meters in 25 seconds. Find the force needed and the work done by this machine.

12. A 2.0×10^3 W winch is used to raise a 1200 kg car vertically from a ditch. Calculate how high the car is raised if the winch operates for 72 s.

13. A crane with a power output of 3500 W is used to lift a mass of 250 kg. Calculate the time required to lift the mass from the second to the fifth floor if each floor is 4.50 m high.

14. A 605 kg race car accelerates from 20.0 m/s to 60.0 m/s.

    i) Calculate the work done during the acceleration.
    ii) If the car generates 582 kW of power, calculate the time it took to accelerate.